National ITS Architecture Service Packages

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1 Introduction

Service Packages provide an accessible, deployment oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. Service Packages collect together one or more Equipment Packages that must work together to deliver a given transportation service and the Architecture Flows that connect them and other important external systems. In other words, they identify the pieces of the Physical Architecture that are required to implement a particular transportation service. This section outlines the purpose and structure of the Service Package document and describes some of the guiding principles used in developing the Service Packages.

1.1 Document Purpose

This Service Packages document is one of a series of deliverables documenting the National Intelligent Transportation System (ITS) Architecture developed under contract to the U.S. Department of Transportation (DOT). This document defines the Service Packages, provides a series of analyses centered on the Service Packages, and includes a number of examples that illustrate ways Service Packages can be applied in regional and project architecture development activities. Through these definitions, analyses, and examples, the Service Packages document provides a comprehensive review of the Service Packages and how they can be used to plan and implement integrated transportation systems customized to local needs.

This document is intended to serve the transportation professional who is involved in ITS planning and/or implementation and wants to leverage the opportunities presented by the National ITS Architecture. The document, along with the other National ITS Architecture documents, will be of particular interest to those that are developing, or supporting the development of regional ITS systems. This group includes transportation planners, engineers, system integrators, and state and local implementers who are progressing towards integrated ITS implementations.

What does this Service Packages Document include?

- A summary of the National ITS Architecture and how Service Packages can be used to relate the Architecture to ITS implementations.
- A description of each of the Service Packages and general information on the problems addressed, potential benefits, and enabling technologies associated with their use.
- A description of the relationships and synergies between Service Packages that can be used to plan cost-effective, time phased deployment of ITS.
- Examples and illustrations of some of the ways that Service Packages can be applied to transportation system planning and project deployment.

What is not included in this Service Packages Document?

- A prescribed process for using the Service Packages. Different stakeholders must adapt the general processes identified herein to address prevailing local conditions and requirements.
- A prescription for ownership, financial, and operational responsibilities for each of the Service Package components. The identification of public sector and private sector roles will be dependent on the needs of each community.
- Evaluations of Service Packages. While the document details many of the likely benefits resulting from Service Package implementation and provides some guidance for pre-implementation assessment, the impact of implementing Service Packages will vary depending on local factors such as regional transportation supply and demand, technology choices, operational context, and intensity of deployment.

1.2 Guiding Principles

Wide spread implementation of ITS will depend on a multitude of individual deployment decisions by public agencies and the private sector. The National ITS Architecture preserves choice for each of these implementers by limiting its scope to include only those interfaces and functional descriptions that address key system interoperability issues. This conservative scope allows each implementer to make maximum use of existing assets and provides a variety of evolutionary paths for maturing ITS capabilities based on individual priorities. This conservative scope carries over into the Service Packages, which bundle together the elements of the architecture that apply to representative ITS implementations.

The National ITS Architecture was developed by a diverse group of private companies, public agencies, and technical specialists which represent a microcosm of the range of stakeholders who will ultimately influence the scope and character of future ITS deployments. The Architecture has benefited from participation by public agencies at the national, state, regional, and local levels. The issues that resonate from these organizations include preservation of local autonomy, effective utilization of existing systems as well as those in development, and flexibility to expand the system as local authorities deem appropriate.

These issues were echoed by the private sector with the additional recommendation that utilizing existing infrastructure enables rapid early deployment, reduces risk through utilization of known technologies and organizations, and allows more reliable cost estimation. Leveraging the existing and emerging national communications infrastructure (e.g., the Internet) was a unique idea when the architecture was originally conceived. Today, ITS, like the broader economy, is swept up in the adaptation and use of the Internet for its own business needs.

These considerations resulted in this Service Packages document which is based on several key principles:

- The Service Packages are not a prescription for every region, or even one region. They identify the key ingredients from the Architecture that support representative ITS deployments. The recipe for a particular region must be based on identified needs and available resources. As a result, tailoring a regional ITS architecture derived from the Service Packages is a mandatory step to ensure that the architecture supports specific regional needs.
- A set of basic Service Packages was identified that support the critical needs of public organizations to maintain and improve existing systems. Initial ITS implementations will build on these systems.
- Distinct Service Packages are identified that provide enabling infrastructure that is aimed at the most critical operational problems of today's transportation systems. Early implementations enhance management of the transportation network and form a basis for many of the value-added information services associated with ITS.
- Staged implementation can begin with these "islands" of basic ITS capability that are deployed in response to local needs. Increased travel demand, greater traveler expectations, and evolving needs encourages service expansion and eventual linking of these ITS islands. Geographic expansion will be paralleled by technology growth resulting in new capabilities, new products, and new features. Service Packages are defined to capture these progressions.
- ITS standards provide a unifying framework that will enhance the interoperability of these diverse, locally-responsive ITS implementations. The Service Packages are linked with, and supported by, ITS standards that are required to achieve the interoperability objectives of US DOT for ITS.

1.3 Document Structure

The Service Packages Document begins with a summary of the core physical architecture definition and builds outward to define Service Packages and their potential application in regional and project architecture development. The contents of each of the document sections are summarized in the following paragraphs.

Section 2. Relating Service Packages to the National ITS Architecture. This section provides a brief review of the National ITS Architecture and describes how the Service Packages fit in this context. Detailed definitions of all the Service Packages are presented and a discussion of the relationship between Service Packages and the Theory of Operations is provided.

Section 3. Relating Service Packages to the User Services. This section relates the Service Packages to the User Services that are the requirements basis for the National ITS Architecture. As might be expected, this is a many-to-many relationship since a single Service Package often includes capabilities that span more than one user service. Also, a single User Service sometimes includes a range of incremental capabilities that are segregated into separate Service Packages.

2 Relating Service Packages to the National ITS Architecture

The National ITS Architecture provides a framework for designing transportation systems that implement the ITS User Services. The User Services were developed as part of the National ITS Program Planning process and were the key source requirements for the Architecture development effort. The Architecture defines the functions that must be performed, the Subsystems that provide these functions, and the information that must be exchanged to support these User Services. The Service Packages are directly traceable to both the Architecture Framework and the User Services. This section describes each of the Service Packages and connects the Service Packages to the Architecture Framework and the User Services.

This section introduces the National ITS Architecture definition and relates this definition to the range of ITS services and implementation options that will be considered by implementers. This relationship between Architecture and implementation is presented using a defined set of *Service Packages*.

2.1 Relating Service Packages to the Architecture Definition

Service Packages represent particular groupings of entities defined in the Physical Architecture that correspond to specific transportation services. The Physical Architecture is comprised of transportation, communications, and institutional layers. The transportation layer includes the various transportation-related processing centers, distributed field equipment, vehicle equipment, and other equipment used by travelers to access ITS services. The transportation layer is fully documented in the separate Physical Architecture document. The communication layer provides for the transfer of information between the transportation layer elements. The institutional layer introduces the policies, funding incentives, working arrangements, and jurisdictional structure that support the technical layers of the Architecture.

The Transportation and Communication Layers together are the *Architecture Framework* that coordinates overall system operation by defining interfaces between equipment which may be deployed by different procuring and operating sectors. The Architecture Framework defines what each major transportation system element does and how they interact to provide all user services. This Framework of Subsystems and interfaces is specified in an implementation independent fashion to preserve maximum implementation flexibility.

Figure 2.1-1 provides a high-level view of the Architecture Framework. The figure includes both the transportation and communication layers of the Architecture since it depicts both the Subsystems (transportation layer elements) and the major communications interconnects (communication layer elements) required to support the user services.



Figure 2.1-1: National ITS Architecture Subsystems and Communications

2.1.1 Service Packages and Subsystems

The Transportation Layer includes the twenty-two interconnected Subsystems identified in Figure 2.1-1. The selected Subsystems align closely with existing jurisdictional and physical boundaries that underscore the operation and maintenance of current transportation systems. By mirroring the current transportation environment with the identified Subsystems, the Subsystem boundaries identify the likely candidates for interface standardization. The Architecture recognizes these boundaries to minimize the impact associated with adoption of the Architecture. Maximum commonality between existing transportation system boundaries and Architecture boundaries serves to minimize the number of artificial boundaries which are imposed (and constrained) by the Architecture. Complete definitions of the Subsystems and other Physical Architecture entities can be found in the Physical Architecture document.

Before describing how Subsystems combined for a particular Service Package application, an important distinction must be made between the "center" Subsystems and the transportation management "centers" that are familiar to most transportation professionals.

In simplest terms, the center Subsystems are not "brick and mortar". Each Subsystem is a cohesive set of functional definitions with required interfaces to other Subsystems. Subsystems are *functionally*, not physically, defined. A regional implementation may include a single physical center that collocates the capabilities from several of the center Subsystems. For instance, a single Transportation Management Center may include Traffic Management Subsystem, Transit Management Subsystem, Emergency Management Subsystem, and Information Service Provider Subsystem capabilities. Conversely, a single Subsystem may be replicated in many different physical centers in a complex metropolitan area system. For instance, multiple traffic management Subsystems may be implemented in a region reflecting distinct State freeway and local arterial management centers. Figure 2.1-2 provides an indication of the range of ways that center Subsystems may be implemented in physical centers.



Figure 2.1-2: Center Subsystems May Be Implemented In Various Regional Configurations

A Service Package is implemented with a combination of interrelated equipment; this equipment often resides in several different Subsystems within the Architecture Framework and may be operated by different stakeholders. For instance, the Transit Vehicle Tracking Service Package includes vehicle location equipment in the Transit Vehicle Subsystem and a base station element in the Transit Management Subsystem. In this example, all Service Package elements are owned and operated by the same transit stakeholder.

In other cases, the Service Package elements are owned and operated by different stakeholders. Many of the ATIS Service Packages require equipment in the Information Service Provider Subsystem that is owned and operated by a public or private information provider and equipment that is acquired and operated by the consumer as part of the Vehicle Subsystem or Personal Information Access Subsystem. Since equipment in different Subsystems may be purchased and operated by different end-users, these Subsystem-specific components may encounter varied deployment.

2.1.2 Service Packages and Equipment Packages

To understand and analyze these potential deployment variations, the defined Service Packages must be decomposed to their constituent elements. The portion of the Service Package capabilities that are allocated to each Subsystem are segregated and defined as Equipment Packages to support this additional resolution. An *Equipment Package* represents a set of capabilities that exist in a subsystem.

Since Equipment Packages are both the most detailed elements of the Physical Architecture and associated with specific Service Packages, there is clear traceability between the interface-oriented Architecture Framework and the deployment-oriented Service Packages. Figure 2.1-3 depicts the relationship between Architecture elements and Service Packages.

Service Packages



Figure 2.1-3: Architecture Element Relationships

Table 2.1-1 provides a complete listing of the Equipment Packages for each valid Service Package/Subsystem combination. In the table, the rows represent the defined Service Packages, the columns represent the Subsystems, and the center section of the table identifies the associated Equipment Packages. Related Service Packages are grouped along the left side so the reader can see the total set of Equipment Packages that make up a particular Service Package deployment. The Physical Architecture deliverable provides detailed specifications for each of the Equipment Packages identified in the table.

Table 2.1-1: Complete listing of the Equipment Packages for each valid Service Package/Subsystem Combination

Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
AD1	ITS Data Mart	Government Reporting Systems Support ITS Data Repository Traffic and Roadside Data Archival		CV Data Collection		Emergency Data Collection		Emissions Data Collection		ISP Data Collection	MCM Data Collection		Parking Data Collection	Toll Data Collection			Roadway Data Collection Roadway Probe Data Communications			Traffic Data Collection	Transit Data Collection		Vehicle Traffic Probe Support
AD2	ITS Data Warehouse	Government Reporting Systems Support ITS Data Repository On-Line Analysis and Mining Traffic and Roadside Data Archival		CV Data Collection		Emergency Data Collection		Emissions Data Collection		ISP Data Collection	MCM Data Collection		Parking Data Collection	Toll Data Collection			Roadway Data Collection Roadway Probe Data Communications			Traffic Data Collection	Transit Data Collection		Vehicle Traffic Probe Support
AD3	ITS Virtual Data Warehouse	ITS Data Repository Virtual Data Warehouse Services																					
APTS01	Transit Vehicle Tracking																				Transit Center Vehicle Tracking	On-board Transit Trip Monitoring	
APTS02	Transit Fixed- Route Operations																				Transit Center Fixed-Route Operations Transit Vehicle Operator Assignment	On-board Schedule Management	
APTS03	Demand Response Transit Operations																				Transit Center Paratransit Operations Transit Vehicle Operator Assignment	On-board Paratransit Operations	
APTS04	Transit Fare Collection Management															Remote Transit Fare Management					Transit Center Fare Management	On-board Transit Fare Management	
APTS05	Transit Security					Center Secure Area Alarm Support Center Secure Area Sensor Management Center Secure Area Surveillance Emergency Response Management										Remote Traveler Security Traveler Secure Area Sensor Monitoring Traveler Secure Area Surveillance			Field Secure Area Sensor Monitoring Field Secure Area Surveillance		Transit Center Security	On-board Transit Security	
APTS06	Transit Fleet Management																				Transit Garage Maintenance Transit Vehicle Assignment	On-board Maintenance On-board Schedule Management	
APTS07	Multi-modal Coordination																			I MC Multimodal Coordination	Transit Center Multi-Modal Coordination	Un-board Schedule Management	

Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
APTS08	Transit Traveler Information									Infrastructure Provided Trip Planning ISP Traveler Data Collection					Personal Interactive Information Reception	Remote Transit Information Services					Transit Center Information Services	On-board Transit Information Services	
APTS09	Transit Signal Priority																Roadway Signal Priority			TMC Multimodal Coordination	Transit Center Signal Priority	On-board Transit Signal Priority	
APTS10	Transit Passenger Counting																· · · · ·				Transit Center Passenger	On-board Passenger	
APTS11	Multimodal Connection Protection									Infrastructure Provided Trip Planning					Personal Trip Planning and Route Guidance	Remote Transit Information Services					Counting Transit Center Connection Protection	Counting On-board Connection Protection On-board Transit Fare Management	
ATIS01	Broadcast Traveler Information									Basic Information Broadcast ISP Traveler Data Collection					Personal Basic Information Reception	Remote Basic Information Reception							Basic Vehicle Reception
ATIS02	Interactive Traveler Information									Interactive Infrastructure Information ISP Traveler Data Collection ISP Traveler Information Alerts Traveler Telephone Information					Personal Interactive Information Reception	Remote Interactive Information Reception							Interactive Vehicle Reception
ATIS03	Autonomous Route Guidance														Personal Autonomous Route Guidance Personal Location Determination								Vehicle Autonomous Route Guidance Vehicle Location Determination
ATIS04	Dynamic Route Guidance									Basic Information Broadcast ISP Traveler Data Collection					Personal Autonomous Route Guidance Personal Basic Information Reception Personal Location Determination								Basic Vehicle Reception Vehicle Autonomous Route Guidance Vehicle Location Determination
ATIS05	ISP Based Trip Planning and Route Guidance						_			Infrastructure Provided Trip Planning ISP Traveler Data Collection	1				Personal Location Determination Personal Trip Planning and Route Guidance	Remote Interactive Information Reception							Vehicle Location Determination Vehicle Trip Planning and Route Guidance
ATIS06	Transportation Operations Data Sharing					Emergency Transportation Operations Data Collection				ISP Operational Data Repository ISP Traveler Data Collection	MCM Transportation Operations Data Collection	<u>n</u>					n			TMC Transportation Operations Data Collection	Transit Transportation Operations Data Collection		
ATIS07	Travel Services Information and Reservation									ISP Travel Services Information and Reservation ISP Traveler Data Collection					Personal Interactive Information Reception	Remote Interactive Information Reception							Interactive Vehicle Reception
ATIS08	Dynamic Ridesharing									Infrastructure Provided					Personal Interactive	Remote Interactive							Vehicle Trip Planning and

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Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
										Dynamic Ridesharing Infrastructure Provided Trip Planning ISP Traveler Data Collection					Information Reception	Information Reception							Route Guidance
ATIS09	In Vehicle Signin	3					On-board EV Incident Management Communication					MCV Vehicle Safety Monitoring	Parking Short Range Traveler Information Communications				Roadway Equipment Coordination Roadway Short Range Traveler Information Communications			TMC In-Vehicle Signing Management		On-board Transit In Vehicle Signing Communications	Vehicle Short Range Traveler Information Reception
ATIS10	Short Range Communications Traveler Information									ISP Short Range Communications Traveler Information Distribution ISP Traveler Data Collection							Roadway Short Range Traveler Information Communications						Vehicle Short Range Traveler Information Reception
ATMS01	1 Network Surveillance																Roadway Basic Surveillance Roadway Equipment Coordination			Collect Traffic Surveillance Traffic Equipment Maintenance			
ATMS02	2 Traffic Probe Surveillance									ISP Probe Information Collection ISP Traveler Data Collection							Roadway Probe Data Communications			TMC Probe Information Collection			Vehicle Location Determination Vehicle Traffic Probe Support
ATMS0	3 Traffic Signal Control																Field Management Stations Operation Roadway Basic Surveillance Roadway Equipment Coordination Roadway Signal Controls			Collect Traffic Surveillance TMC Signal Control Traffic Equipment Maintenance			
ATMS04	Traffic Metering																Roadway Basic Surveillance Roadway Equipment Coordination Roadway Traffic Information Dissemination Roadway Traffic Metering			Collect Traffic Surveillance TMC Traffic Information Dissemination TMC Traffic Metering Traffic Equipment Maintenance			
ATMSO	5 HOV Lane Management																Roadway Equipment Coordination Roadway HOV Control			Collect Traffic Surveillance TMC HOV Lane Management			Vehicle Traffic Probe Support
ATMSO	5 Traffic Information Dissemination																Roadway Equipment Coordination Roadway Traffic Information Dissemination			TMC Traffic Information Dissemination			
ATMS07	7 Regional Traffic Management								, 					n			*			TMC Regional Traffic Management TMC Signal Control TMC Traffic Metering			

Service Packag	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
ATMS0	8 Traffic Incident Management System					Emergency Response Management Incident Command	On-board EV Incident Management Communication				MCM Incident Management						Roadway Equipment Coordination Roadway Incident Detection			TMC Incident Detection TMC Incident Dispatch Coordination/Communication			
ATMS0	9 Transportation Decision Support and Demand Management	:																		TMC Demand Management Coordination TMC Traffic Management Decision Support TMC Traffic Network Performance Evaluation	Transit Center Multi-Modal Coordination		
ATMS1	D Electronic Toll Collection								Fleet Administration	Infrastructure Provided Trip Planning ISP Traveler Data Collection				Toll Administration				Toll Plaza Toll Collection					Vehicle Toll/Parking Interface
ATMS1	1 Emissions Monitoring and Management							Emissions Data Management									Roadway Emissions Monitoring Roadway Equipment Coordination						Vehicle On- board Diagnostics System
ATMS1	2 Roadside Lighting System Control	g															Roadside Lighting System Control			TMC Lighting System Control			
ATMS1	3 Standard Railroa Grade Crossing	d															Standard Rail Crossing			HRI Traffic Management			
ATMS1	4 Advanced Railroad Grade Crossing																Advanced Rail Crossing			HRI Traffic Management			
ATMS1	5 Railroad Operations Coordination																		1	Rail Operations Coordination			
ATMS1	6 Parking Facility Management												Parking Electronic Payment Parking Management										Vehicle Toll/Parking Interface
ATMS1	7 Regional Parking Management												Parking Coordination										
ATMS1	8 Reversible Lane Management																Roadway Equipment Coordination Roadway Reversible Lanes			TMC Reversible Lane Management			
ATMS1	9 Speed Warning and Enforcement	t									MCM Speed Monitoring and Warning						Roadway Equipment Coordination Roadway Speed Monitoring and Warning			TMC Speed Monitoring and Warning			
ATMS2	Drawbridge Management																Multimodal Crossing Control			TMC Multimodal Crossing Management			
ATMS2	1 Roadway Closure Management	3				Emergency Response Management	On-Board EV Barrier System Control				MCM Work Zone Management	MCV Barrier System Control					Field Barrier System Control Roadway Basic Surveillance Roadway Equipment Coordination Roadway Traffic Information Dissemination Roadway Work Zone Traffic Control			Barrier System Management Collect Traffic Surveillance TMC Traffic Information Dissemination			
ATMS2	2 Variable Speed																Roadway Basic			Collect Traffic Surveillance			

Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
	Limits																Surveillance Roadway Equipment Coordination Roadway Traffic Information Dissemination Roadway Variable Speed Limits			TMC Traffic Information Dissemination TMC Variable Speed Limits Traffic Equipment Maintenance			
ATMS23	Dynamic Lane Management and Shoulder Use																Roadway Basic Surveillance Roadway Dynamic Lane Management and Shoulder Use Roadway Equipment Coordination			Collect Traffic Surveillance TMC Dynamic Lane Management and Shoulder Use Traffic Equipment Maintenance			Vehicle Traffic Probe Support
ATMS24	Dynamic Roadway Warning																Roadway Basic Surveillance Roadway Equipment Coordination Roadway Warning			Collect Traffic Surveillance TMC Roadway Warning Traffic Equipment Maintenance			
ATMS25	VMT Road User Payment									ISP Traveler Data Collection				Center VMT Payment Administration	Personal Interactive Information Reception	Remote Interactive Information Reception		Roadway VMT Payment					Vehicle VMT Payment Collection
ATMS26	Mixed Use Warning Systems																Roadway Mixed Use Sensing Roadway Warning			TMC Roadway Warning TMC Signal Control			
AVSS01	Vehicle Safety Monitoring																						Vehicle Safety Monitoring
AVSS02	Driver Safety Monitoring																						Driver Safety Monitoring System
AVSS03	Longitudinal Safety Warning																						Vehicle Location Determination Vehicle Longitudinal Warning
AVSS04	Lateral Safety Warning																						Vehicle Lateral Warning System
AVSS05	Intersection Safety Warning																Roadway Equipment Coordination Roadway Intersection Safety Warning						Vehicle Intersection Safety Warning Vehicle Location Determination
AVSS06	Pre-Crash Restraint Deployment			·						<u>.</u>	<u>n</u>			<u></u>							<u>.</u>		Vehicle Pre- Crash Safety Systems Vehicle Warning System
AVSS07	Driver Visibility Improvement								<u> </u>	<u> </u>													Driver Visibility Improvement System
AVSS08	Advanced Vehicle																						Vehicle

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Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
	Longitudinal Control																						Location Determination Vehicle Longitudinal Control
AVSS09	Advanced Vehicle																						Vehicle Lateral
AVSS10	Intersection Collision Avoidance																Roadway Equipment Coordination Roadway Intersection			n			Vehicle Intersection Control Vehicle Location
AVSS11	Automated Vehicle Operations																Safety Warning Roadway Automated Vehicle Operations			TMC Automated Vehicle Operations			Vehicle Automated Operations
AVSS12	Cooperative Vehicle Safety Systems																Roadway Equipment Coordination Roadway Safety Warning System						Vehicle Warning System
CV001	Carrier Operations and Fleet Management		On-board Trip Monitoring						Fleet Administration														
CV002	Freight Administration		On-board Cargo Monitoring On-board CV Safety and Security On-board Trip Monitoring		Roadside Safety and Security Inspection				Commercial Vehicle and Freight Security Fleet Administration Freight Administration and Management														
CV003	Electronic Clearance		On-board CV Electronic Data	CV Information Exchange CV Safety and Security Administration	Citation and Accident Electronic Recording Roadside Electronic Screening															n 			
CV004	CV Administrative Processes			Credentials and Taxes Administration CV Information Exchange					Fleet Administration Fleet Credentials and Taxes Management and Reporting														
CV005	International Border Electronic Clearance		On-board CV Electronic Data	CV Information Exchange CV Safety and Security Administration International CV Administration	International Border Crossing Roadside Electronic Screening				Freight Administration and Management														
CVO06	Weigh-In-Motion		On-board CV Electronic Data		Roadside WIM																		
CV007	Roadside CVO Safety		On-board CV Electronic Data On-board CV Safety and Security	Credentials and Taxes Administration CV Information Exchange CV Safety and Security Administration	Citation and Accident Electronic Recording Roadside Electronic Screening Roadside				Fleet Administration Fleet Maintenance Management										1	n			

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Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
					Safety and Security Inspection																		
CVO08	On-board CVO Safety		On-board Cargo Monitoring On-board CV Safety and Security	CV Information Exchange CV Safety and Security Administration	Citation and Accident Electronic Recording Roadside Safety and Security Inspection				Fleet Administration Fleet Maintenance Management														
CV009	CVO Fleet Maintenance		On-board Trip Monitoring						Fleet Maintenance Management														
CVO10	HAZMAT Management		On-Board Cargo Monitoring			Emergency Commercial Vehicle Response Mayday Support			Commercial Vehicle and Freight Security Fleet HAZMAT Management														Vehicle Mayday I/F
CVO11	Roadside HAZMAT Security Detection and Mitigation			Credentials and Taxes Administration	Roadside HAZMAT detection	Emergency Commercial Vehicle Response																	
CVO12	CV Driver Security Authentication		On-board Driver Authentication		Roadside Safety and Security Inspection	Emergency Commercial Vehicle Response			Manage CV Driver Identification														
CVO13	Freight Assignment Tracking		On-board Cargo Monitoring On-board Driver Authentication On-board Trip Monitoring						Commercial Vehicle and Freight Security Fleet Administration Freight Administration and Management														
EM01	Emergency Call- Taking and Dispatch					Emergency Call-Taking Emergency Dispatch	On-board EV En Route Support																
EM02	Emergency Routing					Emergency Routing	On-board EV En Route Support										Roadway Signal Preemption			TMC Incident Dispatch Coordination/Communication TMC Signal Control			
EM03	Mayday and Alarms Support					Center Secure Area Alarm Support Center Secure Area Surveillance Mayday Support									Personal Location Determination Personal Mayday I/F	Remote Traveler Security Traveler Secure Area Surveillance							Vehicle Location Determination Vehicle Mayday I/F
EM04	Roadway Service Patrols					Service Patrol Management	On-board EV En Route Support On-board EV Incident Management Communication																
EM05	Transportation Infrastructure Protection					Center Secure Area Sensor Management Center Secure Area Surveillance	On-Board EV Barrier System Control									Traveler Secure Area Sensor Monitoring Traveler Secure Area Surveillance	Field Barrier System Control Field Safeguard System Control		Field Secure Area Sensor Monitoring Field Secure Area Surveillance	Barrier System Management Safeguard System Management TMC Incident Dispatch Coordination/Communication			Vehicle Secure Area Access System
EM06	Wide-Area Alert					Emergency				ISP Emergency	MCM Incident			Toll Operator	Personal Basic	Remote Basic	Roadway Traffic	Toll Plaza		TMC Incident Dispatch	Transit Center		Basic Vehicle

Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
						Early Warning System				Traveler Information ISP Traveler Data Collection Traveler Telephone Information	Management			Alert	Information Reception	Information Reception Remote Transit Information Services	Information Dissemination	Toll Collection		Coordination/Communication TMC Traffic Information Dissemination	Information Services Transit Center Security		Reception
EM07	Early Warning System					Center Secure Area Sensor Management Center Secure Area Surveillance Emergency Early Warning System Emergency Environmental Monitoring					MCM Incident Management								Field Secure Area Sensor Monitoring Field Secure Area Surveillance	TMC Incident Detection	Transit Center Security		
EM08	Disaster Response and Recovery					Emergency Response Management Incident Command					MCM Incident Management MCM Roadway Maintenance and Construction									TMC Incident Dispatch Coordination/Communication	Transit Center Security		
EM09	Evacuation and Reentry Management					Emergency Evacuation Support					MCM Incident Management									TMC Evacuation Support	Transit Evacuation Support		
EM10	Disaster Traveler Information					Emergency Evacuation Support Emergency Response Management				ISP Emergency Traveler Information ISP Traveler Data Collection Traveler Telephone Information					Personal Basic Information Reception Personal Interactive Information Reception	Remote Basic Information Reception Remote Interactive Information Reception							Basic Vehicle Reception Interactive Vehicle Reception
MC01	Maintenance and Construction Vehicle and Equipment Tracking						-				MCM Vehicle Tracking	MCV Vehicle Location Tracking					n						
MC02	Maintenance and Construction Vehicle Maintenance										MCM Vehicle and Equipment Maintenance Management	MCV Vehicle System Monitoring and Diagnostics											Vehicle Safety Monitoring System
MC03	Road Weather Data Collection										MCM Environmental Information Collection	MCV Environmental Monitoring					Roadway Environmental Monitoring			TMC Environmental Monitoring			
MC04	Weather Information Processing and Distribution					Emergency Environmental Monitoring				ISP Traveler Data Collection	MCM Environmental Information Processing									TMC Environmental Monitoring	Transit Environmental Monitoring		
MC05	Roadway Automated Treatment										MCM Automated Treatment System Control						Roadway Automated Treatment Roadway Equipment Coordination Roadway Traffic Information Dissemination						
MC06	Winter Maintenance										MCM Maintenance Decision Support	MCV Winter Maintenance								TMC Incident Dispatch Coordination/Communication			

Service Package	Service Package Name	Archived Data Management	Commercial Vehicle	Commercial Vehicle Administration	Commercial Vehicle Check	Emergency Management	Emergency Vehicle	Emissions Management	Fleet and Freight Management	Information Service Provider	Maintenance and Construction Management	Maintenance and Construction Vehicle	Parking Management	Payment Administration	Personal Information Access	Remote Traveler Support	Roadway	Roadway Payment	Security Monitoring	Traffic Management	Transit Management	Transit Vehicle	Vehicle
											MCM Winter Maintenance Management												
MC07	Roadway Maintenance and Construction										MCM Maintenance Decision Support MCM Roadway Maintenance and Construction	MCV Roadway Maintenance and Construction					Roadway Field Device Monitoring			Traffic Equipment Maintenance			
MC08	Work Zone Management										MCM Work Zone Management	MCV Barrier System Control MCV Work Zone Support					Roadway Work Zone Traffic Control			TMC Work Zone Traffic Management		·	
MC09	Work Zone Safety Monitoring										MCM Work Zone Safety Management	MCV Vehicle Safety Monitoring					Roadway Equipment Coordination Roadway Work Zone Safety						
MC10	Maintenance and Construction Activity Coordination					Emergency Response Management					MCM Work Activity Coordination									TMC Work Zone Traffic Management	Transit Center Multi-Modal Coordination	·	
MC11	Environmental Probe Surveillance									ISP Probe Information Collection	MCM Environmental Information Collection						Roadway Probe Data Communications						Vehicle Environmental Probe Support
MC12	Infrastructure Monitoring										MCM Infrastructure Monitoring	MCV Infrastructure Monitoring					Roadway Infrastructure Monitoring Roadway Probe Data Communications						Vehicle Environmental Probe Support

2.2 The National ITS Architecture Service Packages

The Architecture definition summarized in the previous section is intended to be extremely accommodating.

- Its breadth supports the complete range of ITS services from basic signal control improvements to automated highway systems.
- Its scalability supports implementations suitable for major metropolitan areas as well as remote rural areas.
- Its technological neutrality ensures that it will remain viable in the future and receptive to technology changes.

This high degree of flexibility is necessary since the Architecture must accommodate the range of possible ITS implementations across the United States over a twenty year timeframe. Unfortunately, this flexibility also complicates the task of determining which pieces of the Architecture are applicable and how they can best be applied in addressing a particular community's current and future transportation needs (see figure 2.2-1).



Figure 2.2-1: Translating Architecture to Implementation through Service Packages

To provide visibility into the service options that will be considered by ITS planners and implementers, a set of *Service Packages* have been defined. The Service Packages provide an accessible, deployment oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. They address the specific service requirements of traffic managers, transit operators, travelers, and other ITS stakeholders. The Service Packages were defined with enough granularity to support specific benefits analyses.

Several different Service Packages are defined in each major application area which provides a palette of service options at various costs. Service Packages are also structured to segregate services that are likely to encounter technical or nontechnical challenges from lower risk services. This approach allows the identification of a subset of the Service Packages that are likely early deployments. At the other end of the spectrum, several of the Service Packages represent advanced products or services that will not be available for some time. Many of the Service Packages are also incremental so that more advanced packages can be efficiently implemented by building on common elements that were deployed earlier with more basic packages.

The complete set of Service Packages are identified in Table 2.2-1. In order to more accurately specify Service Packages in tables, each is given an abbreviation indicating the general class of stakeholder and an index (e.g., ATMS01 is a Service Package primarily of interest to transportation managers). The following describes the acronyms used in Table 2.2-1.

- ATMS Advanced Traffic Management Systems
- APTS Advanced Public Transportation Systems
- ATIS Advanced Traveler Information Systems
- CVO Commercial Vehicle Operations
- EM Emergency Management
- AD Archived Data
- MCO Maintenance and Construction Management
- AVSS Advanced Vehicle Safety Systems

Service Package	Service Package Name
AD1	ITS Data Mart
AD2	ITS Data Warehouse
AD3	ITS Virtual Data Warehouse
APTS01	Transit Vehicle Tracking
APTS02	Transit Fixed-Route Operations
APTS03	Demand Response Transit Operations
APTS04	Transit Fare Collection Management
APTS05	Transit Security
APTS06	Transit Fleet Management

Table 2.2-1: Service Packages Summary

Service Package	Service Package Name
APTS07	Multi-modal Coordination
APTS08	Transit Traveler Information
APTS09	Transit Signal Priority
APTS10	Transit Passenger Counting
APTS11	Multimodal Connection Protection
ATIS01	Broadcast Traveler Information
ATIS02	Interactive Traveler Information
ATIS03	Autonomous Route Guidance
ATIS04	Dynamic Route Guidance
ATIS05	ISP Based Trip Planning and Route Guidance
ATIS06	Transportation Operations Data Sharing
ATIS07	Travel Services Information and Reservation
ATIS08	Dynamic Ridesharing
ATIS09	In Vehicle Signing
ATIS10	Short Range Communications Traveler Information
ATMS01	Network Surveillance
ATMS02	Traffic Probe Surveillance
ATMS03	Traffic Signal Control
ATMS04	Traffic Metering
ATMS05	HOV Lane Management
ATMS06	Traffic Information Dissemination
ATMS07	Regional Traffic Management
ATMS08	Traffic Incident Management System
ATMS09	Transportation Decision Support and Demand Management
ATMS10	Electronic Toll Collection
ATMS11	Emissions Monitoring and Management
ATMS12	Roadside Lighting System Control
ATMS13	Standard Railroad Grade Crossing
ATMS14	Advanced Railroad Grade Crossing
ATMS15	Railroad Operations Coordination
ATMS16	Parking Facility Management
ATMS17	Regional Parking Management
ATMS18	Reversible Lane Management
ATMS19	Speed Warning and Enforcement
ATMS20	Drawbridge Management
ATMS21	Roadway Closure Management
ATMS22	Variable Speed Limits
ATMS23	Dynamic Lane Management and Shoulder Use
ATMS24	Dynamic Roadway Warning
ATMS25	VMT Road User Payment
ATMS26	Mixed Use Warning Systems
AVSS01	Vehicle Safety Monitoring
AVSS02	Driver Safety Monitoring

Service Package	Service Package Name
AVSS03	Longitudinal Safety Warning
AVSS04	Lateral Safety Warning
AVSS05	Intersection Safety Warning
AVSS06	Pre-Crash Restraint Deployment
AVSS07	Driver Visibility Improvement
AVSS08	Advanced Vehicle Longitudinal Control
AVSS09	Advanced Vehicle Lateral Control
AVSS10	Intersection Collision Avoidance
AVSS11	Automated Vehicle Operations
AVSS12	Cooperative Vehicle Safety Systems
CVO01	Carrier Operations and Fleet Management
CVO02	Freight Administration
CVO03	Electronic Clearance
CVO04	CV Administrative Processes
CVO05	International Border Electronic Clearance
CVO06	Weigh-In-Motion
CVO07	Roadside CVO Safety
CVO08	On-board CVO Safety
CVO09	CVO Fleet Maintenance
CVO10	HAZMAT Management
CVO11	Roadside HAZMAT Security Detection and Mitigation
CVO12	CV Driver Security Authentication
CVO13	Freight Assignment Tracking
EM01	Emergency Call-Taking and Dispatch
EM02	Emergency Routing
EM03	Mayday and Alarms Support
EM04	Roadway Service Patrols
EM05	Transportation Infrastructure Protection
EM06	Wide-Area Alert
EM07	Early Warning System
EM08	Disaster Response and Recovery
EM09	Evacuation and Reentry Management
EM10	Disaster Traveler Information
MC01	Maintenance and Construction Vehicle and Equipment Tracking
MC02	Maintenance and Construction Vehicle Maintenance
MC03	Road Weather Data Collection
MC04	Weather Information Processing and Distribution
MC05	Roadway Automated Treatment
MC06	Winter Maintenance

The deployment oriented Service Packages are traceable to the interface-oriented Architecture definition. Once a particular Service Package is selected for implementation, the required Subsystems, Equipment Packages, and interface requirements are readily identified due to this traceability. This approach allows the planner or implementer to first consider service needs and later concentrate on those pieces of the Architecture necessary to provide the selected service.

It is important to note that the Service Packages are illustrative rather than prescriptive. The actual implementation variations that are possible across the country are myriad and cannot be enumerated through a finite set of packages. The Service Packages are tools that allow this document to discuss incremental deployment of ITS services in a manner that is relevant to the underlying Architecture definition.

The remainder of this section defines each of the Service Packages in more detail. A description of the service offered by each Service Package is provided. Tables provide the included Equipment Packages and Subsystems, the Associated Planning Factors and Goals and the Associated Objectives and Performance Measures, The Service Package graphic is provided that identifies how the Architecture Framework supports the Service Package. Where several major implementation options are supported by the Service Package, these are also identified and differentiated in the descriptions.



Figure 2.2-2 provides a legend to assist in interpretation of the Service Package

Figure 2.2-2: Service Package Diagram Elements

In addition to the information provided in this document, each Service Package is associated with the applicable ITS applications of the US DOT ITS Knowledge Resources. The Knowledge Resources are a collection of benefits, costs and lessons learned for over 170 ITS applications. On the National Architecture Website, for each Service Package links are provided to the ITS Knowledge Resources pages of the related applications on the Service Package page under the ITS Applications tab. These links allow users to readily determine the benefits, costs and lessons learned of Service Packages.

Also, the Theory of Operations of the National ITS Architecture describes the operation of each Service Package using transaction set diagrams that illustrate the sequence of information exchange (or an example of the sequence of information exchange) between architecture entities to implement the service. The Theory of Operations is available in the Theory of Operations document or on the National Architecture website on the Service Package pages under the Transaction Set tab.

2.2.1 Traffic Management Service Packages

Network Surveillance (ATMS01)

This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.

Equipment Package Name	Subsystem
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination	Roadway
Collect Traffic Surveillance	Traffic Management
Traffic Equipment Maintenance	Traffic Management

Table 2.2.1-1: ATMS01 Included Equipment Packages and Subsystems

Table 2.2.1-2: ATMS01 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility, convenience, and comfort for transportation system users
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-3: ATMS01 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Arterial	X percent of major and minor	Percent of major and minor
Management:	arterials are equipped and operating	arterials equipped and operating
Traffic Monitoring	with arterial link traffic data	with arterial link traffic data
and Data Collection	detection stations (appropriate	detection stations (appropriate
	technology) per Z distance by year Y.	technology) per Z distance.

Objective Category	Objective	Performance Measure
Arterial	X percent of major and minor	Percent of major and minor
Management:	arterials are equipped and operating	arterials equipped and operating
Traffic Monitoring	with closed circuit television (CCTV)	with closed circuit television
and Data Collection	cameras per Z distance by year Y.	(CCTV) cameras per Z distance.
Freeway	Increase the level of transportation	Total amount of TMC equipment.
Management:	management center (TMC) field	
Transportation	hardware (cameras, variable message	
Management	signs, electronic toll tag readers, ITS	
Centers	applications, etc.) by X percent by	
-	year Y.	
Freeway	Increase the percent of regional	Percent of regional transportation
Management:	transportation system monitored by	system monitored by the TMC for
Management	the two for real-time performance.	real-time performance.
Contors		
Centers Enocial Event	Increase the nercent of major special	Dereent of enocial events using
Management: Lice	avonts using ITS related assots (o.g.	ITS related assets to detect and
of Technology	roadside cameras dynamic message	manage incidents /bottlenecks at
or reciniology	signs vehicle sneed detectors) to	entry/exit routes of the events
	detect and manage special event	end y exit routes of the events.
	entry/exit bottlenecks and incidents	
	by X percent in Y years.	
Traveler	Increase the percent of modes in the	Percent of modes in the region
Information: Data	region that share their traveler	that share their traveler
Collection and	information with other modes in the	information with other modes.
Sharing on Travel	region to 100 percent by Y year.	
Conditions		
Traveler	Increase the percent of the	Percent of the transportation
Information: Data	transportation system in which travel	system in which travel conditions
Collection and	conditions can be detected remotely	can be detected remotely via
Sharing on Travel	via CCTV, speed detectors, etc. to X	CCTV, speed detectors, etc.
Conditions	percent by Y year.	
Traveler	Increase the percent of	Percent of transportation facilities
Information: Data	transportation facilities whose	whose owners share their traveler
Collection and	owners share their traveler	information with other agencies in
Sharing on Travel	information with other agencies in	the region.
Conditions	the region to X percent by Y year.	



ATMS01 – Network Surveillance

*Note: Graphic shows key service package elements. Some elements are omitted for clarity.

Traffic Probe Surveillance (ATMS02)

This service package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this service package: 1) wide-area wireless communications between the vehicle and center is used to communicate vehicle operational information and status directly to the center, and 2) dedicated short range communications between passing vehicles and the roadside is used to provide equivalent information to the center. The first approach leverages wide area communications equipment that may already be in the vehicle to support personal safety and advanced traveler information services. The second approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short range communications applications identified within the architecture. The service package enables transportation operators and traveler information providers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users and private information providers. It requires one of the communications options identified above, on-board equipment, data reduction software, and fixed-point to fixed-point links between centers to share the collected information. Both "Opt out" and "Opt in" strategies are available to ensure the user has the ability to turn off the probe functions to ensure individual privacy. Due to the large volume of data collected by probes, data reduction techniques are required, such as the ability to identify and filter out-of-bounds or extreme data reports.

Equipment Package Name	Subsystem
ISP Probe Information Collection	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Roadway Probe Data Communications	Roadway
TMC Probe Information Collection	Traffic Management
Vehicle Location Determination	Vehicle
Vehicle Traffic Probe Support	Vehicle

Table 2.2.1-4: ATMS02 Included Equipment Packages and Subsystems

Table 2.2.1-5: ATMS02 Associated Planning Factors and Goals

MetroFactor	Goal	
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system	
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development	
Objective Category	Objective	Performance Measure
---------------------	---	---------------------------------
Arterial	Field data collection is conducted either	Number of field data collection
Management: Traffic	through floating car studies or other	studies performed every Y and
Monitoring and Data	methods at least once every Y years on	X years on major and minor
Collection	major signalized arterials and X years on	signalized arterials,
	minor signalized arterials.	respectively.
Freeway	Increase the percent of regional	Percent of regional
Management:	transportation system monitored by the	transportation system
Transportation	TMC for real-time performance.	monitored by the TMC for
Management Centers		real-time performance.

Table 2.2.1-6: ATMS02 Associated Objectives and Performance Measures



ATMS02 – Traffic Probe Surveillance

Traffic Signal Control (ATMS03)

This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the ATMS07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.

Equipment Package Name	Subsystem
Field Management Stations Operation	Roadway
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination	Roadway
Roadway Signal Controls	Roadway
Collect Traffic Surveillance	Traffic Management
TMC Signal Control	Traffic Management
Traffic Equipment Maintenance	Traffic Management

Table 2.2.1-7: ATMS03 Included Equipment Packages and Subsystems

Table 2.2.1-8: ATMS03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Objective	Objective	Performance Measure
Category		
Arterial Management: Delay	Decrease the seconds of control delay per vehicles on arterial roads by X percent in Y years. (Control delay is defined as the portion of the total delay attributed to traffic signal operation for signalized intersections).	Control delay seconds per vehicle.
Arterial Management: Delay	Increase the miles of arterials in the region operating at level of service (LOS) Z by X percent in Y years.	Percent of arterial miles in region operating at LOS Z.
Arterial Management: Reliability	Reduce buffer index on arterials during peak and off- peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Arterial Management: Reliability	Reduce delay associated with incidents on arterials by X percent by year Y.	Hours of delay associated with incidents.
Arterial Management: Traffic Monitoring and Data Collection	X percent of intersections in the region are equipped and operating with traffic signals that enable real-time monitoring and management of traffic flows by year Y.	Percent of intersections in the region equipped and operating with traffic signals that enable real-time monitoring and management of traffic flows.
Arterial Management: Traffic Signal Management	Crash data for all arterials in the region is reviewed every X years to determine if signal adjustments can be made to address a safety issue.	Number of years between reviews of crash data on all arterials for possible signal timing impacts.
Arterial Management: Traffic Signal Management	Increase the number of intersections running in a coordinated, closed-loop, or adaptive system by X percent in Y years.	Number of intersections running in a coordinated, closed-loop, or adaptive system.
Arterial Management: Traffic Signal Management	Maintain a program of evaluating X percent of signals for retiming every Y years.	Number of traffic signals evaluated for retiming.

Objective	Objective	Performance Measure
Category		
Arterial Management: Traffic Signal Management	Special timing plans are available for use during freeway incidents, roadway construction activities, or other special events for X miles of arterials in the region by year Y.	Number of miles of arterials that have at least one special timing plan for incidents, construction, or events.
Special Event Management: Entry/Exit Travel Times	Reduce average time to clear event's exiting queue by X percent in Y years.	Average time to clear event's exiting queue by year per event.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time away from selected special events to a set of locations over a year.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time to selected special events from a set of locations in the area over a year.
Special Event Management: Entry/Exit Travel Times	Reduce buffer time index for travelers to multiple similar special events by X percent in Y years.	Buffer time index for travelers to multiple similar special events.
Special Event Management: Entry/Exit Travel Times	Reduce non-special event VMT in the event area during events by X percent in Y years.	Non-special event VMT in the event area during events over a year.
Special Event Management: Use of Technology	Implement special event traffic signal timing plans at X percent of major special events each year beginning in year Y.	Percent of major special events each year in which a special event traffic signal timing plan was implemented.
Special Event Management: Use of Technology	Increase the percent of major special events using ITS- related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) to detect and manage special event entry/exit bottlenecks and incidents by X percent in Y years.	Percent of special events using ITS-related assets to detect and manage incidents/bottlenecks at entry/exit routes of the events.
System Efficiency: Cost of Congestion	Reduce the annual monetary cost of congestion per capita for the next X years.	Cost (in dollars) of congestion or delay per capita.

Objective	Objective	Performance Measure
Category		
System	Reduce hours of delay per	Hours of delay (person-hours).
Efficiency: Delay	capita by X percent by year Y.	
System	Reduce hours of delay per	Hours of delay per capita.
Efficiency: Delay	capita by X percent by year Y.	
System	Reduce hours of delay per	Hours of delay (person-hours).
Efficiency: Delay	driver by X percent by year Y.	
System	Reduce hours of delay per	Hours of delay per driver.
Efficiency: Delay	driver by X percent by year Y.	
System	Reduce the number of hours	Hours per day at LOS F or V/C > 1.0 (or other
Efficiency:	per day that the top 20 most	threshold).
Duration of	congested roadways	
Congestion	experience recurring	
	congestion by X percent by	
	year Y.	
System	Reduce excess fuel consumed	Excess fuel consumed (total or per capita).
Efficiency:	due to congestion by X	
Energy	percent by year Y.	
Consumption		
System	Reduce total energy	Total energy consumed per capita for
Efficiency:	consumption per capita for	transportation.
Energy	transportation by X percent	
Consumption	by year Y.	
System	Reduce total fuel	Total fuel consumed per capita for
Efficiency:	consumption per capita for	transportation.
Energy	transportation by X percent	
Consumption	by year Y.	
System	Maintain the rate of growth in	Percent of lane-miles (or rail) operating at
Efficiency: Extent	facility miles experiencing	LOS F or V/C $>$ 1.0
of Congestion	recurring congestion as less	
	than the population growth	
	rate (or employment growth	
	rate).	
System	Reduce the percentage of	Percent of lane-miles (or rail) operating at
Efficiency: Extent	facility miles (highway,	LOS F or V/C > 1.0
of Congestion	arterial, rail, etc.)	
	experiencing recurring	
	congestion during the peak	
Guatana	period by x percent by year Y.	Demonstration and the state of
System	Reduce the share of major	Percent of intersections operating at LUS F
efficiency: Extent	Thersections operating at LOS	or v/c > 1.0
System Efficiency: Extent of Congestion	experiencing recurring congestion during the peak period by X percent by year Y. Reduce the share of major intersections operating at LOS Z by X percent by year Y.	Percent of intersections operating at LOS F or V/C > 1.0

Objective	Objective	Performance Measure
Category		
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).
System Reliability: Non- Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non- Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non- Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.

Objective	Objective	Performance Measure
Category		
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective	Objective	Performance Measure
Category		
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Transit Operations and Management: Transit Signal Priority	Decrease delay by X percent per year by increasing the use of queue jumping and automated vehicle location.	Travel time delay on routes with queue jumping and automated vehicle location in use.
Transit Operations and Management: Transit Signal Priority	Decrease system-wide signal delay on transit routes by X percent per year.	System-wide signalized stop delay on transit routes.
Travel Weather Management: Signal Timing Plans	Special timing plans are available for use during inclement weather conditions for X miles of arterials in the region by year Y.	Number of miles of arterials that have at least one special timing plan for inclement weather events.



ATMS03 – Traffic Signal Control

Traffic Metering (ATMS04)

This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the Network Surveillance service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.

Equipment Package Name	Subsystem
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination	Roadway
Roadway Traffic Information Dissemination	Roadway
Roadway Traffic Metering	Roadway
Collect Traffic Surveillance	Traffic Management
TMC Traffic Information Dissemination	Traffic Management
TMC Traffic Metering	Traffic Management
Traffic Equipment Maintenance	Traffic Management

Table 2.2.1-10: ATMS04 Included Equipment Packages and Subsystems

Table 2.2.1-11: ATMS04 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;	Reduce environmental impacts
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-12: ATMS04 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		

Objective	Objective	Performance Measure
Category		
Freeway	Reduce the number of	Hours of delay (vehicle-hours or person-
Management:	person hours (or vehicle	hours).
Efficiency	hours) of delay experienced	
	by travelers on the freeway	
	system.	
Freeway	Reduce the number of	Hours of delay per capita or driver.
Management:	person hours (or vehicle	
Efficiency	hours) of delay experienced	
	by travelers on the freeway	
	system.	
Freeway	Reduce the share of freeway	Miles at LOS X or V/C > 1.0 (or other
Management:	miles at Level of Service	threshold).
Efficiency	(LOS) X by Y by year Z.	
Freeway	Increase the number freeway	Total number of ramp meters (by year of
Management:	ramps currently metered by	installation).
Ramp	X percent by year Y.	
Management		
Freeway	Increase the percent of	Percent of interchanges operating at LOS Z
Management:	freeway interchanges	or above during peak periods (per year).
Ramp	operating at LOS Z or higher	
Management	during peak periods by X	
	percent by year Y.	
Freeway	Reduce the number of	Total number of congestion-inducing
Management:	congestion-inducing	incidents at freeway interchanges during
Ramp	incidents occurring at	peak period (per year).
Management	freeway ramps by X percent	
	by year Y.	
Freeway	Reduce buffer index on the	The buffer index (represents the extra time
Management:	freeway system during peak	(buffer) travelers add to their average travel
Reliability	and off-peak periods by X	time when planning trips in order to arrive
	percent in Y years.	on-time 95 percent of the time).
Freeway	Reduce delay associated with	Hours of delay associated with incidents.
Management:	incidents on the freeway	
Reliability	system by X percent by year	
	Υ.	
Freeway	Increase the level of	Total amount of TMC equipment.
Management:	transportation management	
Transportation	center (TMC) field hardware	
Management	(cameras, variable message	
Centers	signs, electronic toll tag	
	readers, ITS applications,	
	etc.) by X percent by year Y.	

Objective	Objective	Performance Measure
Category		
Special Event	Reduce non-special event	Non-special event VMT in the event area
Management:	VMT in the event area during	during events over a year.
Entry/Exit Travel	events by X percent in Y	
Times	years.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay per
Cost of Congestion	cost of congestion per capita	capita.
	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	recurring congestion on	threshold).
Congestion	major freeways from X to Y	
	by year Z.	
System Efficiency:	Reduce the number of hours	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	per day that the top 20 most	threshold).
Congestion	congested roadways	
	experience recurring	
	congestion by X percent by	
	year Y.	
System Efficiency:	Reduce excess fuel	Excess fuel consumed (total or per capita).
Energy	consumed due to congestion	
Consumption	by X percent by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent	
	by year Y.	
System Efficiency:	Reduce total fuel	Total fuel consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent	
	by year Y.	
System Efficiency:	Maintain the rate of growth	Percent of lane-miles (or rail) operating at
Extent of	in facility miles experiencing	LOS F or V/C > 1.0
Congestion	recurring congestion as less	
	than the population growth	
	rate (or employment growth	
	rate).	

Objective	Objective	Performance Measure
Category		
System Efficiency: Extent of Congestion	Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Intensity of Congestion (Travel	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel
Time Index)		time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	scheduled and/or unscheduled disruptions to travel.
System Reliability:	Reduce total person hours of	Travel time delay during scheduled and/or
Non-Recurring Delay	delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	unscheduled disruptions to travel.
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	scheduled and/or unscheduled disruptions to travel.

Objective	Objective	Performance Measure
Category		
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on- time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.



ATMS04 – Traffic Metering

HOV Lane Management (ATMS05)

This service package manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals. Preferential treatment is given to HOV lanes using special bypasses, reserved lanes, and exclusive rightsof-way that may vary by time of day. Vehicle occupancy detectors may be installed to verify HOV compliance and to notify enforcement agencies of violations.

Table 2.2.1-13: ATMS05 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway HOV Control	Roadway
Collect Traffic Surveillance	Traffic Management
TMC HOV Lane Management	Traffic Management
Vehicle Traffic Probe Support	Vehicle

Table 2.2.1-14: ATMS05 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.1-15: ATMS05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freeway	Ensure that all HOV lanes carry a	Vehicle volume and persons per hour
Management: HOV	throughput of at least Y persons	per lane.
Lanes	per hour.	
Freeway	Ensure that all HOV lanes operate	Minimum and Average speeds in
Management: HOV	at no less than 50 mph during their	HOV lanes.
Lanes	hours of operation.	
Freeway	Ensure that all HOV lanes operate	Vehicle volume and persons per hour
Management: HOV	with a volume of at least X vehicles	per lane.
Lanes	per hour.	

Objective Category	Objective	Performance Measure
Freeway	Increase the average vehicle	Vehicle volume and persons per hour
Management: HOV	occupancy rate in HOV lanes to X	per lane.
Lanes	by year Y.	
Freeway	Increase the compliance rate for	Number of vehicles violating HOV
Management: HOV	HOV lanes to X by year Y.	restrictions.
Lanes		
Freeway	Increase the number of HOV lane	Total number of HOV lane miles in a
Management: HOV	miles from X to Y by year Z.	region.
Lanes		
Freeway	Provide options for reliable travel	Share of freeway network with HOV
Management: HOV	times for carpools and transit on	lanes.
Lanes	at least X percent of the freeway	
	network by year Y.	
Freeway	Ensure that all managed lanes	Passenger volumes in managed
Management:	(e.g., HOV lanes, HOT lanes) carry	lanes.
Managed Lanes	a throughput of at least Y persons	
	per hour.	
Freeway	Ensure that all managed lanes	Average speeds in managed lanes.
Management:	(e.g., HOV lanes, HOT lanes)	
Managed Lanes	operate at no less than 50 mph	
	during their hours of operation.	
Freeway	Ensure that all managed lanes	Vehicle volumes in managed lanes.
Management:	(e.g., HOV lanes, HOT lanes)	
Managed Lanes	operate with a volume of at least X	
_	vehicles per hour.	
Freeway	Increase the miles of managed	Miles of managed lanes.
Management:	lanes in the region from X to Y by	
Managed Lanes	year Z.	
Freeway	Provide options for reliable travel	Share of freeway network with
Management:	times for certain types of travel	managed lanes (by class of traveler).
Manageo Lanes	(e.g., transit, carpools, trucks, etc.)	
	freeway notwork by year V	
System Efficiency:	Reduce the appual monotony cost	Cost (in dollars) of congestion or
Cost of Congostion	of congection per capita for the	delay per capita
Cost of Congestion	nove V voars	
System Efficiency:	Reduce hours of delay per capita	Hours of dolay (porson bours)
Delay	by X percent by year V	Hours of delay (person-hours).
System Efficiency:	By A percent by year 1.	Hours of dolay par capita
Dolay	by X percept by year V	Hours of delay per capita.
System Efficiency:	Boduce hours of delay par driver	Hours of delay (person hours)
Delay	by X percent by year V	
System Efficiency:	Beduce hours of delay per driver	Hours of delay per driver
Delay	by X percent by year V	rious of delay per driver.
Delay	by A percent by year 1.	

Service Packages

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0
Duration of	recurring congestion on major	(or other threshold).
Congestion	freeways from X to Y by year Z.	
System Efficiency:	Reduce the number of hours per	Hours per day at LOS F or V/C > 1.0
Duration of	day that the top 20 most	(or other threshold).
Congestion	congested roadways experience	
	recurring congestion by X percent	
	by year Y.	
System Efficiency:	Reduce excess fuel consumed due	Excess fuel consumed (total or per
Energy Consumption	to congestion by X percent by year	capita).
	Υ.	
System Efficiency:	Reduce total energy consumption	Total energy consumed per capita
Energy Consumption	per capita for transportation by X	for transportation.
	percent by year Y.	
System Efficiency:	Reduce total fuel consumption per	Total fuel consumed per capita for
Energy Consumption	capita for transportation by X	transportation.
	percent by year Y.	
System Efficiency:	Maintain the rate of growth in	Percent of lane-miles (or rail)
Extent of Congestion	facility miles experiencing	operating at LOS F or V/C > 1.0
	recurring congestion as less than	
	the population growth rate (or	
	employment growth rate).	
System Efficiency:	Reduce the percentage of facility	Percent of lane-miles (or rail)
Extent of Congestion	miles (highway, arterial, rail, etc.)	operating at LOS F or V/C > 1.0
	experiencing recurring congestion	
	during the peak period by X	
Custom Efficience	percent by year Y.	
System Efficiency:	Reduce the share of major	Percent of intersections operating at
Extent of Congestion	Intersections operating at LOS 2 by	LOS F Or V/C > 1.0
Custom Efficiency	X percent by year Y.	
System Efficiency:	Reduce the regional average travel	Travel time index (the average travel
Intensity of	time index by X percent per year.	time during the peak period, using
Time Index		congested speeds, divided by the off-
Time muex)		or from flow speeds)
System Efficiency:	Appual rate of change in regional	Average commute trip travel time
Travel Time	Annual rate of change in regional	(minutes)
navernine	not exceed regional rate of	(minutes).
	nonulation growth through the	
	vear Y	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X percent	periods (minutes).
	by year Y.	
System Efficiency:	Reduce vehicle miles traveled per	Average VMT per capita per day, per
Vehicle Miles	capita by X percent by year Y.	week, or per year.
Traveled	. , . , ,	



ATMS05 – HOV Lane Management

Traffic Information Dissemination (ATMS06)

This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated. The sharing of transportation operations data described in this service package also supports other services like ATMS09- Traffic Decision Support and Demand Management.

Table 2.2.1-16: ATMS06 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway Traffic Information Dissemination	Roadway
TMC Traffic Information Dissemination	Traffic Management

Table 2.2.1-17: ATMS06 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Increase the safety of the transportation system for motorized and	Improve the safety of the
nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Objective Category	Objective	Performance Measure
Arterial Management: Reliability	Reduce buffer index on arterials during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Arterial Management: Reliability	Reduce delay associated with incidents on arterials by X percent by year Y.	Hours of delay associated with incidents.
Emergency/Incident Management: Person Hours of Delay	Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y years.	Person hours (or vehicle hours) of delay associated with traffic incidents.
Emergency/Incident Management: Traveler Information	Reduce the time between recovery from incident and removal of traveler alerts for that incident.	Time between recovery from incident and removal of traveler alerts.
Emergency/Incident Management: Traveler Information	Reduce time between incident/emergency verification and posting a traveler alert to traveler information outlets (e.g., variable message signs, agency website, 511 system) by X minutes in Y years.	Time to alert motorists of an incident/emergency.
Emergency/Incident Management: Use of Technology	Increase number of ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident and emergency detection by X in Y years.	Number of ITS-related assets in use for incident detection.
Emergency/Incident Management: Use of Technology	Increase number of regional road miles covered by ITS- related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection by X percent in Y years.	Number of regional roadway miles covered by ITS-related assets in use for incident detection.
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay (vehicle-hours or person-hours).

Objective Category	Objective	Performance Measure
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay per capita or driver.
Freeway Management: Efficiency	Reduce the share of freeway miles at Level of Service (LOS) X by Y by year Z.	Miles at LOS X or V/C > 1.0 (or other threshold).
Freeway Management: Reliability	Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Freeway Management: Reliability	Reduce delay associated with incidents on the freeway system by X percent by year Y.	Hours of delay associated with incidents.
Freeway Management: Transportation Management Centers	Increase the level of transportation management center (TMC) field hardware (cameras, variable message signs, electronic toll tag readers, ITS applications, etc.) by X percent by year Y.	Total amount of TMC equipment.
Freight Management: Detours and Routing	Provide freight operators with traveler alerts and alternate routes in the case of incidents, special events, weather, construction, and severe congestion at choke points on X percent of freight-significant routes by year Y.	Percent of freight-significant routes where traveler alerts and alternate route information is provided in the case of incidents, special events, weather, construction, and severe congestion at choke points.
Freight Management: Travel Time Reliability	Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years.	Buffer Index on regional freight routes during peak and off-peak period.
Special Event Management: Traveler Information	Increase the methods of effectively disseminating special event information to travelers by X percent in Y years (e.g., media releases, highway advisory radio, dynamic message signs, commercial AM and FM radio).	Number of effective methods to disseminate special event information to travelers.

Objective Category	Objective	Performance Measure
Special Event	Increase the percentage of	Percent of special events with
Management:	planned special events (with	expected attendance over Z that
Traveler Information	attendance above Z) with	traveler information is disseminated
	information on anticipated and	at least X hours prior to the event.
	actual travel conditions being	
	disseminated to the traveling	
	public at least X hours prior to	
	the event.	
Special Event	Increase the percent of major	Percent of special events using ITS-
Management: Use of	special events using ITS-related	related assets to detect and manage
Technology	assets (e.g., roadside cameras,	incidents/bottlenecks at entry/exit
	dynamic message signs, vehicle	routes of the events.
	speed detectors) to detect and	
	manage special event entry/exit	
	bottlenecks and incidents by X	
	percent in Y years.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay
Cost of Congestion	cost of congestion per capita for	per capita.
	the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or $V/C > 1.0$ (or
Duration of	frequencies from X to X by year 7	other threshold).
Congestion	Reeways from X to Y by year 2.	
System Efficiency:	Reduce the number of hours	Hours per day at LOS F or $V/C > 1.0$ (or
Congestion	per day that the top 20 most	other threshold).
Congestion	recurring congestion by Y	
	nercent by year V	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	canita)
Energy consumption	by year Y	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	vear Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency:	Maintain the rate of growth in	Percent of lane-miles (or rail)
Extent of Congestion	facility miles experiencing	operating at LOS F or V/C > 1.0
	recurring congestion as less	
	than the population growth rate	
	(or employment growth rate).	
System Efficiency:	Reduce the percentage of	Percent of lane-miles (or rail)
Extent of Congestion	facility miles (highway, arterial,	operating at LOS F or V/C > 1.0
	rail, etc.) experiencing recurring	
	congestion during the peak	
Custom Efficiency	period by X percent by year Y.	Devee at of interventions on eventing at
System Efficiency:	Reduce the share of major	Percent of intersections operating at
Extent of Congestion	by X percept by year X	LOSFOFV/C > 1.0
System Efficiency:	By A percent by year 1.	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the neak period using
Congestion (Travel	per vear.	congested speeds, divided by the off-
Time Index)		peak period travel time, using posted
,		or free-flow speeds).
System Efficiency:	Annual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes).
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X	periods (minutes).
Sustan Daliability	percent by year Y.	Total parsan bours of dolay during
Non-Recurring Delay	delay (or travel-time delay per	scheduled and/or unscheduled
Non-Necurring Delay	capita) by time period (peak	disruptions to travel
	off-peak) caused by all transient	
	events such as traffic incidents.	
	special events, and work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled
Non-Recurring Delay	delay (or travel-time delay per	and/or unscheduled disruptions to
	capita) by time period (peak,	travel.
	off-peak) caused by scheduled	
	events, work zones, or system	
	maintenance by x hours in y	
	years.	
System Reliability:	Reduce total person hours of	I otal person hours of delay during
Non-Recurring Delay	uelay (or travel-time delay per	scheduled and/or unscheduled
	off-neak) caused by	uisi uptions to travel.
	unscheduled disruptions to	
	travel.	

Objective Category	Objective	Performance Measure
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min)

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off- peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Travel Weather Management: Disseminating Information	Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	Time from beginning of weather event to posting of traveler information on (variable message signs, 511, Road Weather Information Systems, public information broadcasts etc.).

Objective Category	Objective	Performance Measure
Travel Weather	Reduce time to alert travelers of	Time from beginning of weather event
Management:	travel weather impacts (using	to posting of traveler information on
Disseminating	variable message signs, 511,	agency website.
Information	road weather information	
	systems, public information	
	broadcasts, the agency's	
	website, Web 2.0 technologies,	
	etc.) by X (time period or	
	percent) in Y years.	
Traveler Information:	Increase the accuracy and	Number of complaints received from
Information	completeness of traveler	system users about inaccurate or
Dissemination	information posted (on variable	missing information.
	message signs, websites, and/or	
	web 2.0 technologies) by	
	reducing the number of	
	incomplete and inaccurate	
	reports by X percent in Y years.	
Work Zone	Provide traveler information	Percent of work zones on major
Management:	regarding work zones using	arterials, freeways, and transit routes
Traveler Information	variable message signs (VMS),	for which traveler information is
	511, traveler information	available via variable message signs
	websites, and/or Web 2.0	(VMS), 511, traveler information
	technologies for at least X	websites, and/or Web 2.0
	percent of work zones on major	technologies.
	arterials, freeways, and transit	
	routes over the next Y years.	



ATMS06 – Traffic Information Dissemination

Regional Traffic Management (ATMS07)

This service package provides for the sharing of traffic information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the ATMS03-Traffic Signal Control and ATMS04-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

Table 2.2.1-19: ATMS07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
TMC Regional Traffic Management	Traffic Management
TMC Signal Control	Traffic Management
TMC Traffic Metering	Traffic Management

Table 2.2.1-20: ATMS07 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the transportation	Enhance the integration
system, across and between modes, for people and freight;	and connectivity of the
	transportation system
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.1-21: ATMS07 Associated Objectives and Performance Measures

Objective Category Objective

Objective Category	Objective	Performance Measure
Arterial	Decrease the seconds of control delay	Control delay seconds per vehicle.
Management:	per vehicles on arterial roads by X	
Delav	percent in Y years. (Control delay is	
,	defined as the portion of the total	
	delay attributed to traffic signal	
	operation for signalized intersections).	
Arterial	Increase the miles of arterials in the	Percent of arterial miles in region
Management:	region operating at level of service	operating at LOS Z.
Delay	(LOS) Z by X percent in Y years.	
Integration:	Reduce door-to-door trip time by X	Average door-to-door trip time.
Connectivity	percent by year Y.	
Special Event	Reduce average time to clear event's	Average time to clear event's
Management:	exiting queue by X percent in Y years.	exiting queue by year per event.
Entry/Exit Travel		
Times		
Special Event	Reduce average travel time into and	Average travel time away from
Management:	out of the event by X percent in Y	selected special events to a set of
Entry/Exit Travel	years.	locations over a year.
Times		
Special Event	Reduce average travel time into and	Average travel time to selected
Management:	out of the event by X percent in Y	special events from a set of
Entry/Exit Travel	years.	locations in the area over a year.
Times		
Special Event	Reduce buffer time index for travelers	Buffer time index for travelers to
Management:	to multiple similar special events by X	multiple similar special events.
Entry/Exit Travel	percent in Y years.	
limes		
Special Event	Reduce non-special event VIVIT in the	Non-special event VMT in the
Management:	event area during events by X percent	event area during events over a
Times	in y years.	year.
System Efficiency:	Reduce the appual monotory cost of	Cost (in dollars) of congestion or
Cost of Congestion	connection per capita for the payt X	delay per capita
Cost of Congestion	vears	
System Efficiency:	Reduce hours of delay per capita by X	Hours of delay (person-bours)
Delav	percent by year Y.	
System Efficiency:	Reduce hours of delay per capita by X	Hours of delay per capita.
Delay	percent by year Y.	
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay (person-hours).
Delay	percent by year Y.	, , , , ,
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay per driver.
Delay	percent by year Y.	· · ·
System Efficiency:	Reduce the daily hours of recurring	Hours per day at LOS F or V/C >
Duration of	congestion on major freeways from X	1.0 (or other threshold).
Congestion	to Y by year Z.	

Objective Category	Obiective	Performance Measure
System Efficiency:	Reduce the number of hours per day	Hours per day at LOS F or V/C >
Duration of	that the top 20 most congested	1.0 (or other threshold).
Congestion	roadways experience recurring	
0	congestion by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed due to	Excess fuel consumed (total or
Energy	congestion by X percent by year Y.	per capita).
Consumption		
System Efficiency:	Reduce total energy consumption per	Total energy consumed per capita
Energy	capita for transportation by X percent	for transportation.
Consumption	by year Y.	
System Efficiency:	Reduce total fuel consumption per	Total fuel consumed per capita
Energy	capita for transportation by X percent	for transportation.
Consumption	by year Y.	
System Efficiency:	Maintain the rate of growth in facility	Percent of lane-miles (or rail)
Extent of	miles experiencing recurring	operating at LOS F or V/C > 1.0
Congestion	congestion as less than the population	
	growth rate (or employment growth	
	rate).	
System Efficiency:	Reduce the percentage of facility miles	Percent of lane-miles (or rail)
Extent of	(highway, arterial, rail, etc.)	operating at LOS F or V/C > 1.0
Congestion	experiencing recurring congestion	
	during the peak period by X percent by	
	year Y.	
System Efficiency:	Reduce the share of major	Percent of intersections operating
Extent of	intersections operating at LOS Z by X	at LOS F or V/C > 1.0
Congestion	percent by year Y.	
System Efficiency:	Reduce the regional average travel	Travel time index (the average
Intensity of	time index by X percent per year.	travel time during the peak
Congestion (Travel		period, using congested speeds,
Time Index)		divided by the off-peak period
		travel time, using posted or free-
		flow speeds).
System Efficiency:	Annual rate of change in regional	Average commute trip travel time
Travel Time	average commute travel time will not	(minutes).
	exceed regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time during	Average travel time during peak
Travel Time	peak periods by X percent by year Y.	periods (minutes).
System Efficiency:	Reduce door-to-door trip time by X	Average door-to-door trip time.
Trip Connectivity	percent by year Y.	
System Reliability:	Reduce total person hours of delay (or	Total person hours of delay
Non-Recurring	travel-time delay per capita) by time	during scheduled and/or
Delay	period (peak, off-peak) caused by all	unscheduled disruptions to
	transient events such as traffic	travel.
	incidents, special events, and work	
	zones.	

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y	Travel time delay during scheduled and/or unscheduled disruptions to travel.
	years.	
System Reliability:	Reduce total person hours of delay (or	Total person hours of delay
Non-Recurring	ravel-time delay per capita) by time	uuring scheduled diamentions to
Delay	unscheduled disruptions to travel.	travel.

ATMS07 – Regional Traffic Management



Traffic Incident Management System (ATMS08)

This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

Equipment Package Name	Subsystem
Emergency Response Management	Emergency Management
Incident Command	Emergency Management
On-board EV Incident Management Communication	Emergency Vehicle
MCM Incident Management	Maintenance and Construction
	Management
Roadway Equipment Coordination	Roadway
Roadway Incident Detection	Roadway
TMC Incident Detection	Traffic Management
TMC Incident Dispatch	Traffic Management
Coordination/Communication	

Table 2.2.1-22: ATMS08 Included Equipment Packages and Subsystems

Table 2.2.1-23: ATMS08 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system

MetroFactor	Goal
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

Table 2.2.1-24: ATMS08 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Arterial Management:	Reduce buffer index on	The buffer index (represents the extra
Reliability	arterials during peak and off-	time (buffer) travelers add to their
	peak periods by X percent in Y	average travel time when planning
	years.	trips in order to arrive on-time 95
		percent of the time).
Arterial Management:	Reduce delay associated with	Hours of delay associated with
Reliability	incidents on arterials by X	incidents.
	percent by year Y.	
Emergency/Incident	Increase customer satisfaction	Percentage of customers satisfied with
Management:	with the region's incident	region's incident management
Customer Satisfaction	management by X percent	practices.
	over Y years.	
Emergency/Incident	Reduce mean incident	Mean incident clearance time per
Management: Incident	clearance time per incident by	incident.
Duration	X percent over Y years.	
	(Defined as the time between	
	awareness of an incident and	
	the time the last responder has	
	left the scene.)	

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Incident Duration	Reduce mean incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies) by X percent over Y years (i.e., through "Motorist Assist" roving patrol programs, reduction of inaccurate verifications, etc.).	Average incident notification time of necessary response agencies.
Emergency/Incident Management: Incident Duration	Reduce mean roadway clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and restoration of lanes to full operational status.)	Mean roadway clearance time per incident.
Emergency/Incident Management: Incident Duration	Reduce mean time for needed responders to arrive on-scene after notification by X percent over Y years.	Mean time for needed responders to arrive on-scene after notification.
Emergency/Incident Management: Incident Duration	Reduce mean time of incident duration (from awareness of incident to resumed traffic flow) on transit services and arterial and expressway facilities by X percent in Y years.	Mean time of incident duration.
Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Number of agencies in the region with interoperable voice communications.
Objective Category	Objective	Performance Measure
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Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Number of participating agencies in a regional coordinated incident response team.
Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Percentage of incident management agencies in region participating in multi-modal information exchange network.
Emergency/Incident Management: Inter- Agency Coordination	Increase the number of corridors in the region covered by regional coordinated incident response teams by X percent in Y years.	Number of TIM corridors in the region covered by regional coordinated incident response teams.
Emergency/Incident Management: Person Hours of Delay	Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y years.	Person hours (or vehicle hours) of delay associated with traffic incidents.
Emergency/Incident Management: Training	By Y (year), X percent of staff in region with incident management responsibilities will have completed the National Incident Management System (NIMS) Training and at least X percent of transportation responders in the region are familiar with the incident command structure (ICS).	Percent of staff having completed NIMS training and percent of transportation responders familiar with ICS.

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Use of Technology	Increase number of ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident and emergency detection by X in Y years.	Number of ITS-related assets in use for incident detection.
Emergency/Incident Management: Use of Technology	Increase number of regional road miles covered by ITS- related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection by X percent in Y years.	Number of regional roadway miles covered by ITS-related assets in use for incident detection.
Freeway Management: Reliability	Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Freeway Management: Reliability	Reduce delay associated with incidents on the freeway system by X percent by year Y.	Hours of delay associated with incidents.
Freight Management: Detours and Routing	Provide freight operators with traveler alerts and alternate routes in the case of incidents, special events, weather, construction, and severe congestion at choke points on X percent of freight-significant routes by year Y.	Percent of freight-significant routes where traveler alerts and alternate route information is provided in the case of incidents, special events, weather, construction, and severe congestion at choke points.
Freight Management: Travel Time Reliability	Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years.	Buffer Index on regional freight routes during peak and off-peak period.
Special Event Management: Entry/Exit Travel Times	Reduce average time to clear event's exiting queue by X percent in Y years.	Average time to clear event's exiting queue by year per event.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time away from selected special events to a set of locations over a year.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time to selected special events from a set of locations in the area over a year.

Objective Category	Objective	Performance Measure
Special Event	Reduce buffer time index for	Buffer time index for travelers to
Management:	travelers to multiple similar	multiple similar special events.
Entry/Exit Travel	special events by X percent in Y	
Times	years.	
Special Event	Reduce non-special event VMT	Non-special event VMT in the event
Management:	in the event area during events	area during events over a year.
Entry/Exit Travel	by X percent in Y years.	
Times		
Special Event	Increase the number of	Number of agencies special event
Management: Multi-	agencies with special event	management responsibilities using
Agency Coordination	management responsibilities	interoperable communications.
and Training	that use interoperable	
	communications by X percent	
	in Y years.	
Special Event	Increase the percentage of	Percent of stakeholder agencies
Management: Multi-	special event stakeholder	participating agencies in a regional
Agency Coordination	agencies participating in a	special event management team.
and Training	regional event management	
	team to X percent by year Y.	
Special Event	Implement special event traffic	Percent of major special events each
Management: Use of	signal timing plans at X percent	year in which a special event traffic
Technology	of major special events each	signal timing plan was implemented.
	year beginning in year Y.	-
Special Event	Increase the percent of major	Percent of special events using ITS-
Management: Use of	special events using ITS-related	related assets to detect and manage
Technology	assets (e.g., roadside cameras,	incidents/bottlenecks at entry/exit
	dynamic message signs, vehicle	routes of the events.
	speed detectors) to detect and	
	manage special event	
	entry/exit bottlenecks and	
	incidents by X percent in Y	
	years.	
System Efficiency: Cost	Reduce the annual monetary	Cost (in dollars) of congestion or delay
of Congestion	cost of congestion per capita	per capita.
	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
	Capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
	Capita by X percent by year Y.	
System Efficiency:	Reduce nours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.

Objective Category	Obiective	Performance Measure
System Reliability:	Reduce the average planning	The planning time index represents
Planning Time Index	time index for (specific routes	the time that must be added to travel
	in region) by X (no units) over	time at free-flow speeds or the posted
	the next Y years.	speed limit to ensure on time arrivals
		for 95 percent of the trips. Planning
		time = 95th percentile travel time
		(minutes) – Travel time at free-flow
		speed or posted speed limit. Average
		planning time index or planning time
		can be computed using a weighted
		average over person miles traveled.
System Reliability:	Reduce the 90th (or 95th)	95th or 90th percentile travel times for
Travel Time 90th/95th	percentile travel times for each	selected routes.
Percentile	route selected by X percent	
	over Y years.	
System Reliability:	Reduce the average of the	95th or 90th percentile travel times for
Travel Time 90th/95th	90th (or 95th) percentile travel	selected routes.
Percentile	times for (a group of specific	
	travel routes or trips in the	
	region) by X minutes in Y years.	
System Reliability:	Decrease the average buffer	The buffer index represents the extra
Travel Time Buffer	index for (multiple routes or	time (buffer) most travelers add to
Index	trips) by X percent over Y	their average travel time when
	years.	planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Decrease the buffer index for	The buffer index represents the extra
Travel Time Buffer	(specific travel routes) by X	time (buffer) most travelers add to
Index	percent over the next Y years.	their average travel time when
		planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off- peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (interstates, freeways, expressways, all roads, main tracks, and main sidewalks) of weather-related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather- related debris after weather impact.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (mode, hierarchy of facilities, or subarea of region) of weather- related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather- related debris after weather impact.
Work Zone Management: Travel Time Reliability	Reduce vehicle-hours of total delay in work zones caused by incidents (e.g., traffic crashes within or near the work zone).	Vehicle-hours of delay due to incidents related to work zones.



ATMS08 – Traffic Incident Management System

Transportation Decision Support and Demand Management (ATMS09)

This service package recommends courses of action to traffic operations personnel based on an assessment of current and forecast road network performance. Recommendations may include predefined incident response plans and regional surface street and freeway control strategies that correct network imbalances. Where applicable, this service package also recommends transit, parking, and toll strategies to influence traveler route and mode choices to support travel demand management (TDM) programs and policies managing both traffic and the environment. TDM recommendations are coordinated with transit, parking, and toll administration centers to support regional implementation of TDM strategies. Incident response and congestion management recommendations are implemented by the local traffic management center and coordinated with other regional centers by other service packages (see ATMS07-Regional Traffic Management and ATMS08-Traffic Incident Management). All recommendations are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. Traffic data is collected from sensors and surveillance equipment as well as other transportation management centers (see ATIS06-Transportation Operations Data Sharing). Forecasted traffic loads are derived from historical data and route plans supplied by the Information Service Provider Subsystem. This service package also collects air quality, parking availability, transit usage, and vehicle occupancy data to support TDM, where applicable.

Equipment Package Name	Subsystem
TMC Demand Management Coordination	Traffic Management
TMC Traffic Management Decision Support	Traffic Management
TMC Traffic Network Performance Evaluation	Traffic Management
Transit Center Multi-Modal Coordination	Transit Management

Table 2.2.1-25: ATMS09 Included Equipment Packages and Subsystems

Table 2.2.1-26: ATMS09 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	for transportation system
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	

MetroFactor	Goal
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-27: ATMS09 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Special Event Management:	Reduce non-special event VMT in the event area during events by X	Non-special event VMT in the event
Entry/Exit Travel	percent in Y years.	
Times		
Special Event	Decrease the percent of special	Percent of special event attendees
Management:	event attendees traveling to the	using single-occupancy vehicles each
Mode Shift from	event in single-occupancy vehicles	year for selected events.
SOV	by X percent in Y years.	
Special Event	Increase the percent of special event	Percent of special event attendees
Management:	attendees using park & ride lots by X	utilizing park & ride lots each year
SOV	percent in Yyears.	for selected events.
Special Event	Increase the percent of special	Percent of special events with
Management:	events with dedicated shuttle	dedicated shuttle service for
Mode Shift from	service by X percent in Y years.	selected events during a 1-year
SOV		period.
System Efficiency:	Reduce the annual monetary cost of	Cost (in dollars) of congestion or
Cost of Congestion	congestion per capita for the next X years.	delay per capita.
System Efficiency:	Reduce hours of delay per capita by	Hours of delay (person-hours).
Delay	X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita by	Hours of delay per capita.
Delay	X percent by year Y.	
System Efficiency: Delay	Reduce hours of delay per driver by X percent by year Y.	Hours of delay (person-hours).
System Efficiency:	Reduce hours of delay per driver by	Hours of delay per driver.
Delay	X percent by year Y.	
System Efficiency:	Reduce the daily hours of recurring	Hours per day at LOS F or V/C > 1.0
Duration of	congestion on major freeways from	(or other threshold).
Congestion	X to Y by year Z.	
System Efficiency:	Reduce the number of hours per day	Hours per day at LOS F or V/C > 1.0
Duration of	that the top 20 most congested	(or other threshold).
Congestion	roadways experience recurring	
Suctor Efficiency:	Reduce excess fuel consumed due to	Evenes fuel consumed (total or per
Energy	neutre excess ruer consumed due to	Excess ruer consumed (coldi of per
	congestion by X percent by year V	canita)

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce total energy consumption	Total energy consumed per capita
Energy	per capita for transportation by X	for transportation.
Consumption	percent by year Y.	
System Efficiency:	Reduce total fuel consumption per	Total fuel consumed per capita for
Energy	capita for transportation by X	transportation.
Consumption	percent by year Y.	
System Efficiency:	Maintain the rate of growth in	Percent of lane-miles (or rail)
Extent of	facility miles experiencing recurring	operating at LOS F or V/C > 1.0
Congestion	congestion as less than the	
	population growth rate (or	
	employment growth rate).	
System Efficiency:	Reduce the percentage of facility	Percent of lane-miles (or rail)
Extent of	miles (highway, arterial, rail, etc.)	operating at LOS F or V/C > 1.0
Congestion	experiencing recurring congestion	
	during the peak period by X percent	
	by year Y.	
System Efficiency:	Reduce the share of major	Percent of intersections operating at
Extent of	intersections operating at LOS Z by X	LOS F or $V/C > 1.0$
Congestion	percent by year Y.	
System Efficiency:	Reduce the regional average travel	I ravel time index (the average travel
Intensity of	time index by X percent per year.	time during the peak period, using
Time Index)		off-neck period travel time, using
Time muex)		nosted or free-flow speeds)
System Efficiency:	Annual rate of change in regional	Average commute trip travel time
Travel Time	average commute travel time will	(minutes)
	not exceed regional rate of	
	population growth through the year	
	Y.	
System Efficiency:	Improve average travel time during	Average travel time during peak
Travel Time	peak periods by X percent by year Y.	periods (minutes).
System Efficiency:	Reduce vehicle miles traveled per	Average VMT per capita per day, per
Vehicle Miles	capita by X percent by year Y.	week, or per year.
Traveled		
System Options:	Achieve X percent alternative (non-	Percent of all trips made using
Mode Share	SOV) mode share in transit station	alternative modes in transit station
	communities (or other destinations)	communities.
	by year Y.	
System Options:	Increase active (bicycle/pedestrian)	Share of trips by each mode of
Mode Share	mode share by X percent by year Y.	travel.
System Options:	Increase alternative (non-SOV) mode	Share of trips by each mode of
Mode Share	share for all trips by X percent within	travel.
	the next Y years.	
System Options:	Reduce per capita SOV commute trip	SOV commute trips per capita.
Mode Share	rate by X percent in Y years.	

Objective Category	Objective	Performance Measure
System Options: Mode Share	Reduce SOV vehicle trips by X percent through travel demand management strategies (e.g., employer or residential rideshare) by year Y.	Share of employees walking, biking, telecommuting, carpooling/vanpooling, riding transit, driving alone.
System Options: Transit Use System Options: Transit Use	Increase average transit load factor by X percent by year Y. Increase passenger miles traveled per capita on transit by X percent by year Y.	Number of riders on various transit units per trip at peak travel times. Number of passenger miles traveled per capita.
System Options: Transit Use	Increase transit mode share by X percent by year Y during peak periods.	Percent of all peak-period trips made by transit.
System Options: Transit Use	Increase transit mode share by X percent by year Y.	Percent of all trips made by transit.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
Travel Demand Management: Auto Commuter Trip Reduction Programs	Reduce commuter vehicle miles traveled (VMT) per regional job by X percent in Y years.	Commuter VMT per regional employee.
Travel Demand Management: Parking Management	Biannually increase preferred parking spaces for carpool/vanpool participants within downtown, at special events, and among major employers by X percent within Y years.	Number of preferred parking spaces for carpool/vanpool participants.

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Travel Demand	Implement parking pricing for X	Number of communities with priced
Management:	communities every Y years.	parking stalls.
Parking		
Management		
Travel Demand	Implement shared parking for X	Number of communities with shared
Management:	communities every Y years.	parking.
Parking		
Management		
Travel Demand	Increase park-and-ride lot capacity	Capacity of park & ride lots.
Management:	by X percent over Y years.	
Parking		
Management		
Travel Demand	Increase the number of	Number of residents/commuters
Management:	residents/commuters receiving	receiving information on parking
Parking	information on parking pricing and	pricing and availability.
Management	availability within Y years.	

ATMS09 – Transportation Decision Support and Demand Management



Electronic Toll Collection (ATMS10)

This service package provides toll operators with the ability to collect tolls electronically and detect and process violations. The fees that are collected may be adjusted to implement demand management strategies. Field-Vehicle Communication between the roadway equipment and the vehicle is required as well as Fixed Point-Fixed Point interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Toll violations are identified and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional, and ultimately national interoperability for these services. Two other service packages, APTS04: Transit Fare Collection Management and ATMS16: Parking Facility Management also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services.

The vehicle equipment and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.

Table 2.2.1-28: ATMS10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Fleet Administration	Fleet and Freight Management
Infrastructure Provided Trip Planning	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Toll Administration	Payment Administration
Toll Plaza Toll Collection	Roadway Payment
Vehicle Toll/Parking Interface	Vehicle

Table 2.2.1-29: ATMS10 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.1-30: ATMS10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freeway	Increase the percentage of users	Percentage of drivers with ETC
Management: Pricing	carrying electronic toll collection	transponders.
and Tolling	(ETC) transponders by X percent	
	by year Y.	
Freeway	Increase the share of freeways	Lane miles that are priced.
Management: Pricing	that are priced to X percent by	
and Tolling	year Y.	
Freeway	Increase the share of toll	Share of toll roads and bridges using
Management: Pricing	roadways and bridges that are	variable pricing.
and Tolling	using variable pricing (e.g.,	
	congestion pricing) to X percent	
	by year Y.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay
Cost of Congestion	cost of congestion per capita for	per capita.
	the next X years.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay per capita.
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	
System Efficiency:	Reduce the regional average	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Congestion (Travel	per year.	congested speeds, divided by the off-
Time Index)		peak period travel time, using posted
		or free-flow speeds).
System Efficiency:	Annual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes).
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	

Objective Category Object	ctive	Performance Measure
System Efficiency: Impro Travel Time durin	ove average travel time ng peak periods by X percent par V	Average travel time during peak periods (minutes).

ATMS10 – Electronic Toll Collection



Emissions Monitoring and Management (ATMS11)

This service package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the emissions management subsystem for processing. Both area wide air quality monitoring and point emissions monitoring are supported by this service package. For area wide monitoring, this service package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this service package collects data from on-board diagnostic systems and measures tail pipe emissions to identify vehicles that exceed emissions tests, depending on policy and regulations. Summary emissions information or warnings can also be displayed to drivers. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

Table 2.2.1-31: ATMS11 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Emissions Data Management	Emissions Management
Roadway Emissions Monitoring	Roadway
Roadway Equipment Coordination	Roadway
Vehicle On-board Diagnostics System	Vehicle

Table 2.2.1-32: ATMS11 Associated Planning Factors and Goals

MetroFactor	Goal
Protect and enhance the environment, promote energy conservation,	Reduce
improve the quality of life, and promote consistency between	environmental
transportation improvements and State and local planned growth and	impacts
economic development patterns;	

Table 2.2.1-33: ATMS11 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Environment: Clean Air	Reduce carbon dioxide (CO2)	Carbon dioxide emissions -
and Climate Change	emissions to X percent below year Y	tons per day
	by year Z.	
Environment: Clean Air	Reduce emissions of coarse	Course particular (PM10) levels
and Climate Change	particulates (PM10) by X percent by	- micrograms per cubic meter
	year Y.	
Environment: Clean Air	Reduce emissions of coarse	Course particulate (PM10)
and Climate Change	particulates (PM10) by X percent by	emissions - tons per day
	year Y.	

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Environment: Clean Air and Climate Change	Reduce emissions of fine particulates (PM2.5) by X percent by year Y.	Fine particulate (PM2.5) emissions - tons per day
Environment: Clean Air and Climate Change	Reduce emissions of fine particulates (PM2.5) by X percent by year Y.	Fine particulate (PM2.5) levels - micrograms per cubic meter

ATMS11 – Emissions Monitoring and Management



Roadside Lighting System Control (ATMS12)

This service package includes systems that manage electrical lighting systems by monitoring operational conditions and using the lighting controls to vary the amount of light provided along the roadside. These systems allow a center to control lights based on traffic conditions, time-of-day, and the occurrence of incidents. Such systems can increase the safety of a roadway segment by increasing lighting and conserve energy at times when conditions warrant a reduction in the amount of lighting.

Table 2.2.1-34: ATMS12 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadside Lighting System Control	Roadway
TMC Lighting System Control	Traffic Management

Table 2.2.1-35: ATMS12 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for motorized and	Improve the safety of
nonmotorized users;	the transportation
	system
Protect and enhance the environment, promote energy conservation,	Reduce environmental
improve the quality of life, and promote consistency between	impacts
transportation improvements and State and local planned growth and	
economic development patterns;	

Table 2.2.1-36: ATMS12 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driving while intoxicated
Fatalities		

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unexpected	Number of crashes and fatalities
Crashes and	congestion	related to unexpected congestion
Fatalities		
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging
Safety: Vehicle	Reduce secondary crashes	Number of secondary crashes
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes per X VMT.
Crashes and	in the region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving pedestrians.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Worker	Enhance safety of workers	Number of crashes and fatalities in
Safety		work zones
Safety: Worker	Enhance safety of workers	Number of workers injured by vehicles
Safety		in work zones
Safety: Worker	Safeguard public safety personnel	Number of public safety personnel
Safety	while they are at roadway incidents	struck by vehicle at
	and emergencies	incident/emergency site
Safety: Worker	Safeguard public safety personnel	Number of public safety vehicles
Safety	while they are at roadway incidents	struck at incident/emergency site
	and emergencies	

ATMS12 – Roadside Lighting System Control



Standard Railroad Grade Crossing (ATMS13)

This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem.

Table 2.2.1-37: ATMS13 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Standard Rail Crossing	Roadway
HRI Traffic Management	Traffic Management

Table 2.2.1-38: ATMS13 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.1-39: ATMS13 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce crashes at railroad crossings	Number of crashes and fatalities at railroad crossings
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driver inattention and distraction
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driving while intoxicated
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes in the region by X percent by year Y.	Total crashes per X VMT.

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes involving bicyclists and pedestrians in the region by X percent by year Y.	Total crashes involving bicycles.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes involving bicyclists and pedestrians in the region by X percent by year Y.	Total crashes involving pedestrians.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.

ATMS13 – Standard Railroad Grade Crossing



Advanced Railroad Grade Crossing (ATMS14)

This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This service package includes all capabilities from the Standard Railroad Grade Crossing service package and augments these with additional safety features to mitigate the risks associated with higher rail speeds. The active warning systems supported by this service package include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this service package, the wayside equipment provides additional information about the arriving train so that the train's direction of travel, estimated time of arrival, and estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This service package also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

Table 2.2.1-40: ATMS14 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Advanced Rail Crossing	Roadway
HRI Traffic Management	Traffic Management

Table 2.2.1-41: ATMS14 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.1-42: ATMS14 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce crashes at railroad crossings	Number of crashes and fatalities at railroad crossings
Safety: Vehicle Crashes and	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes in the region by X percent by year Y.	Total crashes per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes involving bicyclists and pedestrians in the region by X percent by year Y.	Total crashes involving bicycles.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes involving bicyclists and pedestrians in the region by X percent by year Y.	Total crashes involving pedestrians.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.

ATMS14 – Advanced Railroad Grade Crossing



Railroad Operations Coordination (ATMS15)

This service package provides an additional level of strategic coordination between freight rail operations and traffic management centers. Rail operations provides train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.

Table 2.2.1-43: ATMS15 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Rail Operations Coordination	Traffic Management

Table 2.2.1-44: ATMS15 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.1-45: ATMS15 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the annual monetary cost	Cost (in dollars) of congestion or
Cost of Congestion	of congestion per capita for the	delay per capita.
	next X years.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay per capita.
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency: Duration of Congestion	Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion by X percent by year Y.	Hours per day at LOS F or V/C > 1.0 (or other threshold).
System Efficiency: Energy Consumption	Reduce excess fuel consumed due to congestion by X percent by year Y.	Excess fuel consumed (total or per capita).
System Efficiency: Energy Consumption	Reduce total energy consumption per capita for transportation by X percent by year Y.	Total energy consumed per capita for transportation.
System Efficiency: Energy Consumption	Reduce total fuel consumption per capita for transportation by X percent by year Y.	Total fuel consumed per capita for transportation.
System Efficiency: Extent of Congestion	Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate).	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the share of major intersections operating at LOS Z by X percent by year Y.	Percent of intersections operating at LOS F or V/C > 1.0
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off- peak period travel time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).



ATMS15 – Railroad Operations Coordination

Parking Facility Management (ATMS16)

This service package provides enhanced monitoring and management of parking facilities. It assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This service package collects current parking status, shares this data with Information Service Providers and Traffic Management, and collects parking fees using the same in-vehicle equipment utilized for electronic toll collection or contact or proximity traveler cards used for electronic payment. Two other service packages, APTS04: Transit Fare Collection Management and ATMS10: Electronic Toll Collection also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services.

Equipment Package Name	Subsystem
Parking Electronic Payment	Parking Management
Parking Management	Parking Management
Vehicle Toll/Parking Interface	Vehicle

Table 2.2.1-46: ATMS16 Included Equipment Packages and Subsystems

Table 2.2.1-47: ATMS16 Associated Planning Factors and Goals

MetroFactor	Goal	
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for	
people and for freight;	transportation system users	
Promote efficient system management and	Increase operational efficiency and reliability of the	
operation;	transportation system	

Table 2.2.1-48: ATMS16 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Special Event	Decrease the time spent clearing special	Percent decrease in time to
Management: Parking	event venue parking lots of vehicles by X	clear parking lots.
Management	percent in Y years following each event.	
Special Event	Enhance parking facility services and	Number of parking facilities
Management: Parking	management	with advanced parking
Management		information to customers
Special Event	Enhance parking facility services and	Number of parking facilities
Management: Parking	management	with automated occupancy
Management		counting and space
		management
Special Event	Enhance parking facility services and	Number of parking facilities
Management: Parking	management	with coordinated availability
Management		information

Objective Category	Objective	Performance Measure
Special Event	Enhance parking facility services and	Number of parking facilities
Management: Parking	management	with coordinated electronic
Management		payment systems
Special Event	Enhance parking facility services and	Number of parking facilities
Management: Parking	management	with electronic fee
Management		collection
Special Event	Enhance parking facility services and	Number parking facilities
Management: Parking	management	with electronic fee
Management		collection
Special Event	Increase the number of special events	Number of special events
Management: Parking	that use shared parking facilities (e.g.,	that use shared parking
Management	parking lots of nearby businesses or	facilities.
	organizations) by X percent in Y years.	
Special Event	Increase the use of flexible pricing	Percent of parking spaces
Management: Parking	mechanisms near special event locations	near special event locations
Management	on X percent of parking spaces in Y years.	that use flexible pricing
		mechanisms.
Transit Operations and	Increase the number of automobile and	Number of auto/bicycle
Management: Park-	bicycle spaces by X percent within Y	spaces at the park-and-ride
and-Ride Support	years for lots currently experiencing X	lots
	percent utilization.	
Transit Operations and	Increase traveler awareness of park-and-	Number of users aware of
Management: Park-	ride lots by X percent within Y years.	park-and-ride lots in their
and-Ride Support		region.



ATMS16 – Parking Facility Management

Regional Parking Management (ATMS17)

This service package supports communication and coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems. This service package also shares information with transit management systems and information service providers to support multimodal travel planning, including parking reservation capabilities. Information including current parking availability, system status, and operating strategies are shared to enable local parking facility management that supports regional transportation strategies.

Table 2.2.1-49: ATMS17 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
Parking Coordination	Parking Management	

Table 2.2.1-50: ATMS17 Associated Planning Factors and Goals

MetroFactor	Goal	
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for	
people and for freight;	transportation system users	
Promote efficient system management and	Increase operational efficiency and reliability of the	
operation;	transportation system	

Table 2.2.1-51: ATMS17 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Special Event	Reduce average time to clear event's	Average time to clear event's
Management:	exiting queue by X percent in Y years.	exiting queue by year per
Entry/Exit Travel		event.
Times		
Special Event	Reduce average travel time into and out	Average travel time away from
Management:	of the event by X percent in Y years.	selected special events to a set
Entry/Exit Travel		of locations over a year.
Times		
Special Event	Reduce average travel time into and out	Average travel time to selected
Management:	of the event by X percent in Y years.	special events from a set of
Entry/Exit Travel		locations in the area over a
Times		year.
Special Event	Reduce buffer time index for travelers to	Buffer time index for travelers
Management:	multiple similar special events by X	to multiple similar special
Entry/Exit Travel	percent in Y years.	events.
Times		

Objective Category	Objective	Performance Measure
Special Event	Increase the percent of special event	Percent of special event
Management:	attendees using park & ride lots by X	attendees utilizing park & ride
Mode Shift from	percent in Y years.	lots each year for selected
SOV		events.
Special Event	Increase the percent of special events	Percent of special events with
Management:	with dedicated shuttle service by X	dedicated shuttle service for
Mode Shift from	percent in Y years.	selected events during a 1-year
SOV		period.
Special Event	Decrease the time spent clearing special	Percent decrease in time to
Management:	event venue parking lots of vehicles by X	clear parking lots.
Parking	percent in Y years following each event.	
Management		
Special Event	Enhance parking facility services and	Number of parking facilities
Management:	management	with advanced parking
Parking		information to customers
Management		
Special Event	Enhance parking facility services and	Number of parking facilities
Management:	management	with automated occupancy
Parking		counting and space
Management		management
Special Event	Enhance parking facility services and	Number of parking facilities
Management:	management	with coordinated availability
Parking		information
Management		
Special Event	Enhance parking facility services and	Number of parking facilities
Management:	management	with coordinated electronic
Parking		payment systems
Management		
Special Event	Enhance parking facility services and	Number of parking facilities
Management:	management	with electronic fee collection
Parking		
Management		
Special Event	Enhance parking facility services and	Number parking facilities with
Management:	management	electronic fee collection
Parking		
Management		
Special Event	Increase on-street parking restrictions on	Percent of routes widely used
Management:	X percent of widely used routes during	during planned special events
Parking	special events in Y years.	with on-street parking
Management		restrictions.
Special Event	Increase the number of special events	Number of special events that
Management:	that use shared parking facilities (e.g.,	use shared parking facilities.
Parking	parking lots of nearby businesses or	
Management	organizations) by X percent in Y years.	

Objective Category	Objective	Performance Measure
Special Event	Increase the use of flexible pricing	Percent of parking spaces near
Management:	mechanisms near special event locations	special event locations that use
Parking	on X percent of parking spaces in Y years.	flexible pricing mechanisms.
Management		
System Efficiency:	Annual rate of change in regional average	Average commute trip travel
Travel Time	commute travel time will not exceed	time (minutes).
	regional rate of population growth	
	through the year Y.	
System Efficiency:	Improve average travel time during peak	Average travel time during peak
Travel Time	periods by X percent by year Y.	periods (minutes).
Travel Demand	Biannually increase preferred parking	Number of preferred parking
Management:	spaces for carpool/vanpool participants	spaces for carpool/vanpool
Parking	within downtown, at special events, and	participants.
Management	among major employers by X percent	
	within Y years.	
Travel Demand	Implement parking pricing for X	Number of communities with
Management:	communities every Y years.	priced parking stalls.
Parking		
Management		
Travel Demand	Implement shared parking for X	Number of communities with
Management:	communities every Y years.	shared parking.
Parking		
Management		
Travel Demand	Increase park-and-ride lot capacity by X	Capacity of park & ride lots.
Management:	percent over Y years.	
Parking		
Management		
Travel Demand	Increase the number of	Number of
Management:	residents/commuters receiving	residents/commuters receiving
Parking	information on parking pricing and	information on parking pricing
	avanability within Y years.	anu avallability.
I ravel Demand	Install parking meters along X corridors	Number of corridors in urban
ivianagement:	by year Y in the urban core/transit	core/transit supportive areas
rdrking	supportive areas.	with parking meters.
Management: Parking Management Travel Demand Management: Parking Management	residents/commuters receiving information on parking pricing and availability within Y years. Install parking meters along X corridors by year Y in the urban core/transit supportive areas.	residents/commuters receiving information on parking pricing and availability. Number of corridors in urban core/transit supportive areas with parking meters.



ATMS17 – Regional Parking Management

Reversible Lane Management (ATMS18)

This service package provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this service package includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This service package also includes the equipment used to electronically reconfigure intersections and manage right-of-way to address dynamic demand changes and special events.

Table 2.2.1-52: ATMS18 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway Reversible Lanes	Roadway
TMC Reversible Lane Management	Traffic Management

Table 2.2.1-53: ATMS18 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;	Reduce environmental impacts
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-54: ATMS18 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freeway	Reduce the number of person hours	Hours of delay (vehicle-hours or
Management:	(or vehicle hours) of delay	person-hours).
Efficiency	experienced by travelers on the	
	freeway system.	
Freeway	Reduce the number of person hours	Hours of delay per capita or driver.
Management:	(or vehicle hours) of delay	
Efficiency	experienced by travelers on the	
	freeway system.	

Objective Category	Objective	Performance Measure
Freeway	Reduce the share of freeway miles at	Miles at LOS X or $V/C > 1.0$ (or
Management:	Level of Service (LOS) X by Y by year	other threshold).
Efficiency	Ζ.	
Special Event	Reduce average time to clear event's	Average time to clear event's
Management:	exiting queue by X percent in Y years.	exiting queue by year per event.
Entry/Exit Travel		
Times		
Special Event	Reduce average travel time into and	Average travel time away from
Management:	out of the event by X percent in Y	selected special events to a set of
Entry/Exit Travel	years.	locations over a year.
Times		
Special Event	Reduce average travel time into and	Average travel time to selected
Management:	out of the event by X percent in Y	special events from a set of
Entry/Exit Travel	years.	locations in the area over a year.
Times		
Special Event	Reduce buffer time index for	Buffer time index for travelers to
Management:	travelers to multiple similar special	multiple similar special events.
Entry/Exit Travel	events by X percent in Y years.	
Times		
System Efficiency:	Reduce the annual monetary cost of	Cost (in dollars) of congestion or
Cost of Congestion	congestion per capita for the next X	delay per capita.
	years.	
System Efficiency:	Reduce hours of delay per capita by	Hours of delay (person-hours).
Delay	X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita by	Hours of delay per capita.
Delay	X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay (person-hours).
Delay	percent by year Y.	
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay per driver.
Delay	percent by year Y.	
System Efficiency:	Reduce the daily hours of recurring	Hours per day at LOS F or V/C > 1.0
Duration of	congestion on major freeways from	(or other threshold).
Congestion	X to Y by year Z.	
System Efficiency:	Reduce the number of hours per day	Hours per day at LOS F or $V/C > 1.0$
Duration of	that the top 20 most congested	(or other threshold).
Congestion	roadways experience recurring	
	congestion by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed due to	Excess fuel consumed (total or per
Energy	congestion by X percent by year Y.	capita).
Consumption		
System Efficiency:	Reduce total energy consumption	Total energy consumed per capita
Energy	per capita for transportation by X	for transportation.
Consumption	percent by year Y.	
System Efficiency:	Reduce total fuel consumption per	Total fuel consumed per capita for
Energy	capita for transportation by X	transportation.
Consumption	percent by year Y.	
Objective Category	Objective	Performance Measure
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System Efficiency: Extent of Congestion	Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate).	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the share of major intersections operating at LOS Z by X percent by year Y.	Percent of intersections operating at LOS F or V/C > 1.0
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y	Average travel time during peak
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.





Speed Warning and Enforcement (ATMS19)

This service package monitors vehicle speeds and supports warning drivers when their speed is excessive. Also the service includes notifications to an enforcement agency to enforce the speed limit of the roadway. Speed monitoring can be made via spot speed or average speed measurements. Roadside equipment can display the speed of passing vehicles and/or suggest a safe driving speed. Environmental conditions and vehicle characteristics may be monitored and factored into the safe speed advisories that are provided to the motorist. For example, warnings can be generated recognizing the limitations of a given vehicle for the geometry of the roadway such as rollover risk for tall vehicles.

This service focuses on monitoring of vehicle speeds and enforcement of the speed limit while the variable speed limits service (covered in ATMS22-Variable Speed Limits service package) focuses on varying the posted speed limits to create more uniform speeds along a roadway, to promote safer driving during adverse conditions (such as fog) and/or to reduce air pollution.

Table 2.2.1-55: ATMS19 Included	Equipment	Packages and	Subsystems
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Equipment Package Name	Subsystem	
MCM Speed Monitoring and Warning	Maintenance and Construction Management	
Roadway Equipment Coordination	Roadway	
Roadway Speed Monitoring and Warning	Roadway	
TMC Speed Monitoring and Warning	Traffic Management	

Table 2.2.1-56: ATMS19 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.1-57: ATMS19 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to unexpected	Number of crashes and fatalities
Crashes and	congestion	related to unexpected
Fatalities		congestion

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce speed differential	Number of crashes and fatalities
Crashes and		related to excessive speeding
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in the	
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving
Crashes and	involving bicyclists and pedestrians in the	pedestrians.
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	



ATMS19 – Speed Warning and Enforcement

Drawbridge Management (ATMS20)

This service package supports systems that manage drawbridges at rivers and canals and other multimodal crossings (other than railroad grade crossings which are specifically covered by other service packages). The equipment managed by this service package includes control devices (e.g., gates, warning lights, dynamic message signs) at the drawbridge as well as the information systems that are used to keep travelers apprised of current and forecasted drawbridge status.

Table 2.2.1-58: ATMS20 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Multimodal Crossing Control	Roadway
TMC Multimodal Crossing Management	Traffic Management

Table 2.2.1-59: ATMS20 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.1-60: ATMS20 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay
Cost of Congestion	cost of congestion per capita for	per capita.
	the next X years.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay per capita.
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
System Efficiency: Energy Consumption	Reduce total energy consumption per capita for transportation by X percent by year Y.	Total energy consumed per capita for transportation.
System Efficiency: Energy Consumption	Reduce total fuel consumption per capita for transportation by X percent by year Y.	Total fuel consumed per capita for transportation.
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off- peak period travel time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).



ATMS20 – Drawbridge Management

Roadway Closure Management (ATMS21)

This service package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The service package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this service package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This service package covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other ATMS service packages.

Equipment Package Name	Subsystem
Emergency Response Management	Emergency Management
On-Board EV Barrier System Control	Emergency Vehicle
MCM Work Zone Management	Maintenance and Construction Management
MCV Barrier System Control	Maintenance and Construction Vehicle
Field Barrier System Control	Roadway
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination	Roadway
Roadway Traffic Information Dissemination	Roadway
Roadway Work Zone Traffic Control	Roadway
Barrier System Management	Traffic Management
Collect Traffic Surveillance	Traffic Management
TMC Traffic Information Dissemination	Traffic Management

Table 2.2.1-61: ATMS21 Included Equipment Packages and Subsystems

Table 2.2.1-62: ATMS21 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system
Promote efficient system management and	Increase operational efficiency and
operation;	reliability of the transportation system

Table 2.2.1-63: ATMS21 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Travel Weather	Increase by X percent of significant	Percent of significant travel
Management: Detours for	travel routes covered by weather-	routes covered by weather-
Impacted Roadways	related diversion plans by year Y.	related diversion plans.

ATMS21 – Roadway Closure Management



Variable Speed Limits (ATMS22)

This service package sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog), and/or to reduce air pollution. Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits, usually by lane. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.

This service establishes variable speed limits and communicates the speed limits to drivers. Speed warnings and enforcement of speeds limits, including variable speed limits, is covered in the ATMS19-Automated Speed Warning and Enforcement service package.

Variable speed limits are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as ATMS23-Dynamic Lane Management and Shoulder Use and ATMS24-Dynamic Roadway Warning).

Equipment Package Name	Subsystem
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination	Roadway
Roadway Traffic Information Dissemination	Roadway
Roadway Variable Speed Limits	Roadway
Collect Traffic Surveillance	Traffic Management
TMC Traffic Information Dissemination	Traffic Management
TMC Variable Speed Limits	Traffic Management
Traffic Equipment Maintenance	Traffic Management

Table 2.2.1-64: ATMS22 Included Equipment Packages and Subsystems

Table 2.2.1-65: ATMS22 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-66: ATMS22 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay (vehicle-hours or person- hours).
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay per capita or driver.
Freeway Management: Efficiency	Reduce the share of freeway miles at Level of Service (LOS) X by Y by year Z.	Miles at LOS X or V/C > 1.0 (or other threshold).
Freeway Management: Reliability	Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Freeway Management: Reliability	Reduce delay associated with incidents on the freeway system by X percent by year Y.	Hours of delay associated with incidents.
Freight Management: Travel Time Reliability	Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years.	Buffer Index on regional freight routes during peak and off-peak period.
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to road weather conditions	Number of crashes and fatalities related to weather conditions
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to unexpected congestion	Number of crashes and fatalities related to unexpected congestion
Safety: Vehicle Crashes and Fatalities	Reduce lane departure crashes	Number of crashes and fatalities related to inappropriate lane departure, crossing or merging
Safety: Vehicle Crashes and Fatalities	Reduce secondary crashes	Number of secondary crashes
Safety: Vehicle Crashes and Fatalities	Reduce speed differential	Number of crashes and fatalities related to excessive speeding

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of	Total crashes per X VMT.
Crashes and	crashes in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of	Total fatalities per X VMT.
Crashes and	fatalities and severe injuries	·
Fatalities	in the region by X percent by	
	year Y.	
Safety: Vehicle	Reduce the total number of	Total severe injuries per X VMT.
Crashes and	fatalities and severe injuries	
Fatalities	in the region by X percent by	
	year Y.	
Special Event	Reduce average time to clear	Average time to clear event's exiting queue
Management:	event's exiting queue by X	by year per event.
Entry/Exit Travel	percent in Y years.	
Times		
Special Event	Reduce average travel time	Average travel time away from selected
Management:	into and out of the event by	special events to a set of locations over a
Entry/Exit Travel	X percent in Y years.	year.
Times		
Special Event	Reduce average travel time	Average travel time to selected special
Management:	into and out of the event by	events from a set of locations in the area
Entry/Exit Travel	X percent in Y years.	over a year.
Times		
Special Event	Reduce buffer time index for	Buffer time index for travelers to multiple
Management:	travelers to multiple similar	similar special events.
Entry/Exit Travel	special events by X percent	
Times	in Y years.	
Special Event	Reduce non-special event	Non-special event VMT in the event area
Management:	VMT in the event area during	during events over a year.
Entry/Exit Travel	events by X percent in Y	
Times	years.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay per
Cost of	cost of congestion per capita	capita.
Congestion	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year	
	Υ.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year	
	Υ.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delav	driver by X percent by year Y	

Service Packages

Objective	Objective	Performance Measure
Category		
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	recurring congestion on	threshold).
Congestion	major freeways from X to Y	
	by year Z.	
System Efficiency:	Reduce the number of hours	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	per day that the top 20 most	threshold).
Congestion	congested roadways	
	experience recurring	
	congestion by X percent by	
	year Y.	
System Efficiency:	Maintain the rate of growth	Percent of lane-miles (or rail) operating at
Extent of	in facility miles experiencing	LOS F or $V/C > 1.0$
Congestion	recurring congestion as less	
	than the population growth	
	rate (or employment growth	
	rate).	
System Efficiency:	Reduce the percentage of	Percent of lane-miles (or rail) operating at
Extent of	facility miles (highway,	LOS F or V/C > 1.0
Congestion	arterial, rail, etc.)	
	experiencing recurring	
	congestion during the peak	
	period by X percent by year	
Custom Efficiency	Y. Deduce the share of major	Demonstrations exercises at LOC F an
System Eniciency:	intersections operating at	Percent of intersections operating at LOS F of $V/C > 1.0$
Congestion	LOS 7 by X percent by year X	V/C > 1:0
System Efficiency:	Reduce the regional average	Travel time index (the average travel time
Intensity of	travel time index by X	during the neak period using congested
Congestion	nercent per vear	speeds divided by the off-neak period travel
(Travel Time	percent per year.	time using nosted or free-flow speeds)
Index)		time, using posted of nee now specus).
System Efficiency:	Annual rate of change in	Average commute trip travel time (minutes)
Travel Time	regional average commute	
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak periods
Travel Time	during peak periods by X	(minutes).
	percent by year Y.	. ,

Objective	Objective	Performance Measure
Category		
System Reliability:	Reduce total person hours of	Total person hours of delay during scheduled
Non-Recurring	delay (or travel-time delay	and/or unscheduled disruptions to travel.
Delay	per capita) by time period	
	(peak, off-peak) caused by all	
	transient events such as	
	traffic incidents, special	
	events, and work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled and/or
Non-Recurring	delay (or travel-time delay	unscheduled disruptions to travel.
Delay	per capita) by time period	
	(peak, off-peak) caused by	
	scheduled events, work	
	zones, of system	
	Maintenance by x hours in y	
System Reliability:	Reduce total person hours of	Total person hours of delay during scheduled
Non-Recurring	delay (or travel-time delay	and/or unscheduled disruptions to travel
Delay	per capita) by time period	and/or anscheduled disruptions to travel.
Delay	(peak, off-peak) caused by	
	unscheduled disruptions to	
	travel.	
System Reliability:	Reduce the average planning	The planning time index represents the time
Planning Time	time for (specific routes in	that must be added to travel time at free-
Index	region) by X minutes over	flow speeds or the posted speed limit to
	the next Y years.	ensure on time arrivals for 95 percent of the
		trips. Planning time = 95th percentile travel
		time (minutes) – Travel time at free-flow
		speed or posted speed limit. Average
		planning time index or planning time can be
		computed using a weighted average over
Sustam Baliability	Deduce the average planning	person miles traveled.
System Reliability:	time index for (specific	the planning time index represents the time
Pidning Time	routes in region) by X (no	flow speeds or the posted speed limit to
muex	units) over the next V years	ensure on time arrivals for 95 percent of the
	unitsy over the next 1 years.	trins Planning time = 95 th nercentile travel
		time (minutes) – Travel time at free-flow
		speed or posted speed limit. Average
		planning time index or planning time can be
		computed using a weighted average over
		person miles traveled.
System Reliability:	Reduce the 90th (or 95th)	95th or 90th percentile travel times for
Travel Time	percentile travel times for	selected routes.
90th/95th	each route selected by X	
Percentile	percent over Y years.	

Objective Category	Objective	Performance Measure
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on- time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.



ATMS22 – Variable Speed Limits

Dynamic Lane Management and Shoulder Use (ATMS23)

This service package provides for active management of travel lanes along a roadway. The package includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control specific lanes and/or the shoulders. This equipment can be used to change the lane configuration on the roadway according to traffic demand and lane destination along a typical roadway section or on approach to or access from a border crossing, multimodal crossing or intermodal freight depot. This package can be used to allow temporary or interim use of shoulders as travel lanes. The equipment can be used to electronically reconfigure intersections and interchanges and manage right-of-way dynamically including merges. Also, lanes can be designated for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. Prohibitions or restrictions of types of vehicles from using particular lanes can be implemented.

The lane management system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.

Dynamic lane management and shoulder use is an Active Traffic Management (ATM) strategy and is typically used in conjunction with other ATM strategies (such as ATMS22-Variable Speed Limits and ATMS24-Dynamic Roadway Warning).

Equipment Package Name	Subsystem
Roadway Basic Surveillance	Roadway
Roadway Dynamic Lane Management and Shoulder Use	Roadway
Roadway Equipment Coordination	Roadway
Collect Traffic Surveillance	Traffic Management
TMC Dynamic Lane Management and Shoulder Use	Traffic Management
Traffic Equipment Maintenance	Traffic Management
Vehicle Traffic Probe Support	Vehicle

Table 2.2.1-67: ATMS23 Included Equipment Packages and Subsystems

Table 2.2.1-68: ATMS23 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.1-69: ATMS23 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay (vehicle-hours or person- hours).
Freeway Management: Efficiency	Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.	Hours of delay per capita or driver.
Freeway Management: Efficiency	Reduce the share of freeway miles at Level of Service (LOS) X by Y by year Z.	Miles at LOS X or V/C > 1.0 (or other threshold).
Freeway Management: Managed Lanes	Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) carry a throughput of at least Y persons per hour.	Passenger volumes in managed lanes.
Freeway Management: Managed Lanes	Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate at no less than 50 mph during their hours of operation.	Average speeds in managed lanes.
Freeway Management: Managed Lanes	Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate with a volume of at least X vehicles per hour.	Vehicle volumes in managed lanes.
Freeway Management: Managed Lanes	Increase the miles of managed lanes in the region from X to Y by year Z.	Miles of managed lanes.
Freeway Management: Managed Lanes	Provide options for reliable travel times for certain types of travel (e.g., transit, carpools, trucks, etc.) on at least X percent of the freeway network by year Y.	Share of freeway network with managed lanes (by class of traveler).
Freeway Management: Reliability	Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).

Objective	Objective	Performance Measure
Category		
Freeway	Reduce delay associated with	Hours of delay associated with incidents.
Management:	incidents on the freeway	
Reliability	system by X percent by year	
	Υ.	
Freight	Reduce the average duration	Average duration of delays per month at
Management:	of delays per month at	intermodal facilities.
Intermodal	intermodal facilities by X	
Facilities	percent in Y years.	
Freight	Reduce the frequency of	Frequency of delays per month at
Management:	delays per month at	intermodal facilities where a delay is defined
Intermodal	intermodal facilities by X	as an addition of Z minutes to free flow
Facilities	percent in Y years.	conditions.
Freight	Reduce buffer index on	Buffer Index on regional freight routes
Management:	regional freight routes during	during peak and off-peak period.
Travel Time	peak and off-peak periods by	
Reliability	X percent in Y years.	
Special Event	Reduce average time to clear	Average time to clear event's exiting queue
Management:	event's exiting queue by X	by year per event.
Entry/Exit Travel	percent in Y years.	
Times		
Special Event	Reduce average travel time	Average travel time away from selected
Management:	into and out of the event by	special events to a set of locations over a
Entry/Exit Travel	X percent in Y years.	year.
Times		
Special Event	Reduce average travel time	Average travel time to selected special
Management:	Into and out of the event by	events from a set of locations in the area
Entry/Exit Travel	X percent in Y years.	over a year.
Consist Event	Doduce buffer time index for	Duffer time index for travelers to multiple
Special Event	travelars to multiple similar	similar special events
Entry/Exit Traval	charged avants by X parsont	similar special events.
Times	in V years	
Snecial Event	Beduce non-special event	Non-special event VMT in the event area
Management [.]	VMT in the event area during	during events over a year
Entry/Exit Travel	events by X percent in Y	during events over a year.
Times	vears	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay per
Cost of	cost of congestion per capita	capita.
Congestion	for the next X years.	
System Efficiency:	, Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	,
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	

Service Packages

Objective	Objective	Performance Measure
Category		
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	recurring congestion on	threshold).
Congestion	major freeways from X to Y	
	by year Z.	
System Efficiency:	Reduce the number of hours	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	per day that the top 20 most	threshold).
Congestion	congested roadways	
	experience recurring	
	congestion by X percent by	
	year Y.	
System Efficiency:	Maintain the rate of growth	Percent of lane-miles (or rail) operating at
Extent of	in facility miles experiencing	LOS F or V/C > 1.0
Congestion	recurring congestion as less	
	than the population growth	
	rate (or employment growth	
	rate).	
System Efficiency:	Reduce the percentage of	Percent of lane-miles (or rail) operating at
Extent of	facility miles (nighway,	LOS F or V/C > 1.0
Congestion	arterial, rail, etc.)	
	congestion during the peak	
	neriod by X percent by year	
System Efficiency:	Reduce the share of major	Percent of intersections operating at LOS F
Extent of	intersections operating at	or V/C > 1.0
Congestion	LOS Z by X percent by year Y.	
System Efficiency:	Reduce the regional average	Travel time index (the average travel time
Intensity of	travel time index by X	during the peak period, using congested
Congestion	percent per year.	speeds, divided by the off-peak period travel
(Travel Time		time, using posted or free-flow speeds).
Index)		
System Efficiency:	Annual rate of change in	Average commute trip travel time (minutes).
Travel Time	regional average commute	
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak periods
Travel Time	during peak periods by X	(minutes).
	percent by year Y.	

Objective	Objective	Performance Measure
Category		
System Reliability:	Reduce total person hours of	Total person hours of delay during scheduled
Non-Recurring	delay (or travel-time delay	and/or unscheduled disruptions to travel.
Delay	per capita) by time period	
	(peak, off-peak) caused by all	
	transient events such as	
	traffic incidents, special	
	events, and work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled and/or
Non-Recurring	delay (or travel-time delay	unscheduled disruptions to travel.
Delay	per capita) by time period	
	(peak, off-peak) caused by	
	scheduled events, work	
	zones, or system	
	maintenance by x hours in y	
	years.	
System Reliability:	Reduce total person hours of	Total person hours of delay during scheduled
Non-Recurring	delay (or travel-time delay	and/or unscheduled disruptions to travel.
Delay	per capita) by time period	
	(peak, off-peak) caused by	
	unscheduled disruptions to	
	travel.	
System Reliability:	Reduce the average planning	The planning time index represents the time
Planning Time	time for (specific routes in	that must be added to travel time at free-
Index	region) by X minutes over	flow speeds or the posted speed limit to
	the next Y years.	ensure on time arrivals for 95 percent of the
		trips. Planning time = 95th percentile travel
		time (minutes) – Travel time at free-flow
		speed or posted speed limit. Average
		planning time index or planning time can be
		computed using a weighted average over
		person miles traveled.
System Reliability:	Reduce the average planning	The planning time index represents the time
Planning Time	time index for (specific	that must be added to travel time at free-
Index	routes in region) by X (no	flow speeds or the posted speed limit to
	units) over the next Y years.	ensure on time arrivals for 95 percent of the
		trips. Planning time = 95th percentile travel
		time (minutes) – Travel time at free-flow
		speed or posted speed limit. Average
		planning time index or planning time can be
		computed using a weighted average over
		person miles traveled.
System Reliability:	Reduce the 90th (or 95th)	95th or 90th percentile travel times for
Travel Time	percentile travel times for	selected routes.
90th/95th	each route selected by X	
Percentile	percent over Y years.	

Objective Category	Objective	Performance Measure
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on- time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.





Dynamic Roadway Warning (ATMS24)

This service package includes systems that dynamically warn drivers approaching hazards on a roadway. Such hazards include roadway weather conditions, road surface conditions, traffic conditions including queues, obstacles or animals in the roadway and any other transient event that can be sensed. These dynamic roadway warning systems can alert approaching drivers via warning signs, flashing lights, in-vehicle messages, etc. Such systems can increase the safety of a roadway by reducing the occurrence of incidents. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous.

Speed warnings that consider the limitations of a given vehicle for the geometry of the roadway (e.g., rollover risk for tall vehicles) are not included in this service package but are covered by the ATMS19 – Speed Warning and Enforcement service package.

Roadway warning systems, especially queue warning systems are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as ATMS22-Variable Speed Limits and ATMS23-Dynamic Lane Management and Shoulder Use).

Equipment Package Name	Subsystem
Roadway Basic Surveillance	Roadway
Roadway Equipment Coordination Roadway	
Roadway Warning	Roadway
Collect Traffic Surveillance	Traffic Management
TMC Roadway Warning	Traffic Management
Traffic Equipment Maintenance	Traffic Management

Table 2.2.1-70: ATMS24 Included Equipment Packages and Subsystems

Table 2.2.1-71: ATMS24 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system
Promote efficient system management and	Increase operational efficiency and
operation;	reliability of the transportation system

Table 2.2.1-72: ATMS24 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driver inattention and distraction
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driving while intoxicated
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to road weather conditions	Number of crashes and fatalities related to weather conditions
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to unexpected congestion	Number of crashes and fatalities related to unexpected congestion
Safety: Vehicle Crashes and Fatalities	Reduce secondary crashes	Number of secondary crashes
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes in the region by X percent by year Y.	Total crashes per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).



ATMS24 – Dynamic Roadway Warning

VMT Road User Payment (ATMS25)

This service package facilitates charging fees to roadway vehicle owners for using specific roadways with potentially differential payment rates based on time-of-day, which specific roadway is used, and class of vehicle (a local policy decision by each roadway owner). Vehicle owners need only register with a single payment entity of their choice (a participating state, municipal, or regional DOT, an authority, or a private entity), and payments are reconciled by the entity receiving payment (and travel history) with all roadway owners that participate in the VMT payment scheme, which may also include the Federal government. Vehicle owners would pay nothing for distances traveled where there are no payments required (e.g. in jurisdictions that have not implemented a distance based payment or for roadway operators that collect payment using traditional tolls), although a Federal payment rate might cover some or all roadway operations (a Federal policy decision). Basic operation depends on the vehicle tracking its own location, and periodically reporting its travel history to the registered entity receiving payment using C-V communications. Roadway VMT Payment can duplicate the functions of current toll road payment schemes based on F-V communications, parking payment functions, as well as augment and/or replace federal and state gasoline taxes (which are otherwise ineffective for vehicles that don't use gasoline).

The payments per distance traveled can be structured to provide some amount of demand management by motivating vehicle owner travel choices to minimize payments. The use of this service package for demand management is a local policy decision by each roadway owner.

Alternatively, for vehicle owners that prefer a strictly odometer ("high privacy") based payment approach (that does not need to record and report specific locations and times of travel), then the payment amount may assume a payment rate corresponding to the most expensive roads at the most expensive times. Specific payment rates for this option are a local policy decision.

Odometer readings (from vehicle registration and periodic safety inspection events stored at the state DOT where the vehicle is registered) can be used as a back-office audit to detect gross vehicle equipment failures and fraud (e.g. disabling or dismounting vehicle equipment). In addition, vehicle equipment can be read by fixed or mobile roadside equipment using F-V communications for a more immediate audit of in-vehicle equipment and enforcement (for vehicle owners that have not chosen the odometer-only method of payment).

Payment can be made periodically through a normal bill/payment cycle that is part of the registration process a vehicle owner chooses, or using a vehicle mounted or entered payment instrument/information with vehicle operator or owner initiated payment points. This facilitates payment by vehicle operators (instead of owners) for various commercial operations such as rental vehicles, taxi operators. Table 2.2.1-73: ATMS25 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
ISP Traveler Data Collection	Information Service Provider	
Center VMT Payment Administration	Payment Administration	
Personal Interactive Information Reception	Personal Information Access	
Remote Interactive Information Reception	Remote Traveler Support	
Roadway VMT Payment	Roadway Payment	
Vehicle VMT Payment Collection	Vehicle	

Table 2.2.1-74: ATMS25 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management	Increase operational efficiency and reliability of the
and operation;	transportation system

Table 2.2.1-75: ATMS25 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freeway	Increase the share of freeways that are	Lane miles that are
Management: Pricing	priced to X percent by year Y.	priced.
and Tolling		
Freeway	Increase the share of toll roadways and	Share of toll roads and
Management: Pricing	bridges that are using variable pricing (e.g.,	bridges using variable
and Tolling	congestion pricing) to X percent by year Y.	pricing.



ATMS25 - VMT Road User Payment

Mixed Use Warning Systems (ATMS26)

This service package supports the sensing and warning systems used to interact with pedestrians, bicyclists, and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways. These systems could allow automated warning or active protection for this class of users.

Table 2.2.1-76: ATMS26 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Mixed Use Sensing	Roadway
Roadway Warning	Roadway
TMC Roadway Warning	Traffic Management
TMC Signal Control	Traffic Management

Table 2.2.1-77: ATMS26 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.1-78: ATMS26 Associated Objectives and Performance Measures

Objective Category	Objective	Performance
		Measure
Safety: Vehicle	Reduce the total number of crashes in the region	Total crashes per X
Crashes and	by X percent by year Y.	VMT.
Fatalities		
Safety: Vehicle	Reduce the total number of crashes involving	Total crashes
Crashes and	bicyclists and pedestrians in the region by X	involving bicycles.
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes involving	Total crashes
Crashes and	bicyclists and pedestrians in the region by X	involving pedestrians.
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and severe	Total fatalities per X
Crashes and	injuries in the region by X percent by year Y.	VMT.
Fatalities		
Safety: Vehicle	Reduce the total number of fatalities and severe	Total severe injuries
Crashes and	injuries in the region by X percent by year Y.	per X VMT.
Fatalities		



ATMS26 – Mixed Use Warning Systems

2.2.2 Maintenance and Construction Operations Service Packages

Maintenance and Construction Vehicle and Equipment Tracking (MC01)

This service package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

Table 2.2.2-1: MC01 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Vehicle Tracking	Maintenance and Construction Management
MCV Vehicle Location Tracking	Maintenance and Construction Vehicle

Table 2.2.2-2: MC01 Associated Planning Factors and Goals

MetroFactor	Goal
Emphasize the preservation of the existing transportation	Preserve the transportation
system.	system

Table 2.2.2-3: MC01 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Preservation: Preserve	Enhance asset and	Extended pavement life due to truck
Existing Infrastructure	resource management	weight enforcement
Preservation: Preserve	Enhance asset and	Number of assets tracked in real-time
Existing Infrastructure	resource management	
Preservation: Preserve	Enhance asset and	Percentage of fleet/equipment within
Existing Infrastructure	resource management	lifecycle
Preservation: Preserve	Enhance asset and	Percentage of geographic jurisdiction
Existing Infrastructure	resource management	covered by agency electronic
		communications
Preservation: Preserve	Enhance asset and	Percentage of maintenance activities
Existing Infrastructure	resource management	completed in required time-frame
Preservation: Preserve	Enhance asset and	Rate at which equipment is utilized
Existing Infrastructure	resource management	
Preservation: Preserve	Enhance asset and	Vehicle operating costs
Existing Infrastructure	resource management	



MC01 - Maintenance and Construction Vehicle and Equipment Tracking

Maintenance and Construction Vehicle Maintenance (MC02)

This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle maintenance.

Table 2.2.2-4: MC02 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Vehicle and Equipment Maintenance	Maintenance and Construction
Management	Management
MCV Vehicle System Monitoring and Diagnostics	Maintenance and Construction Vehicle
Vehicle Safety Monitoring System	Vehicle

Table 2.2.2-5: MC02 Associated Planning Factors and Goals

MetroFactor	Goal
Emphasize the preservation of the existing transportation	Preserve the transportation
system.	system

Table 2.2.2-6: MC02 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Preservation: Preserve	Enhance asset and	Extended pavement life due to truck
Existing Infrastructure	resource management	weight enforcement
Preservation: Preserve	Enhance asset and	Number of assets tracked in real-time
Existing Infrastructure	resource management	
Preservation: Preserve	Enhance asset and	Percentage of fleet/equipment within
Existing Infrastructure	resource management	lifecycle
Preservation: Preserve	Enhance asset and	Percentage of geographic jurisdiction
Existing Infrastructure	resource management	covered by agency electronic
		communications
Preservation: Preserve	Enhance asset and	Percentage of maintenance activities
Existing Infrastructure	resource management	completed in required time-frame
Preservation: Preserve	Enhance asset and	Rate at which equipment is utilized
Existing Infrastructure	resource management	
Preservation: Preserve	Enhance asset and	Vehicle operating costs
Existing Infrastructure	resource management	




Road Weather Data Collection (MC03)

This service package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway (or guideway in the case of transit related rail systems). In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution service package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The service package may also request and receive qualified data sets from meteorological systems.

Equipment Package Name	Subsystem
MCM Environmental Information Collection	Maintenance and Construction Management
MCV Environmental Monitoring	Maintenance and Construction Vehicle
Roadway Environmental Monitoring	Roadway
TMC Environmental Monitoring	Traffic Management

Table 2.2.2-7: MC03 Included Equipment Packages and Subsystems

Table 2.2.2-8: MC03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people	Enhance mobility, convenience, and comfort
and for freight;	for transportation system users
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system

Table 2.2.2-9: MC03 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Travel Weather	Reduce time to alert travelers of travel	Time from beginning of
Management:	weather impacts (using variable	weather event to posting of
Disseminating	message signs, 511, road weather	traveler information on
Information	information systems, public information	(variable message signs, 511,
	broadcasts, the agency's website, Web	Road Weather Information
	2.0 technologies, etc.) by X (time period	Systems, public information
	or percent) in Y years.	broadcasts etc.).

Objective Category	Objective	Performance Measure
Travel Weather	Reduce time to alert travelers of travel	Time from beginning of
Management:	weather impacts (using variable	weather event to posting of
Disseminating	message signs, 511, road weather	traveler information on agency
Information	information systems, public information	website.
	broadcasts, the agency's website, Web	
	2.0 technologies, etc.) by X (time period	
	or percent) in Y years.	
Travel Weather	Increase the percent of major road	Percent of major road (transit
Management: Road	network (or transit network or regional	or bicycle) network within Z
Weather	bicycle network) covered by weather	miles of an RWIS station.
Information System	sensors or a road weather information	
Coverage	system (RWIS) by X percent in Y years as	
	defined by an RWIS station within Z	
	miles.	





Weather Information Processing and Distribution (MC04)

This service package processes and distributes the environmental information collected from the Road Weather Data Collection service package. This service package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination service package, and aid operators in scheduling work activity.

Table 2.2.2-10: MC04 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Emergency Environmental Monitoring	Emergency Management
ISP Traveler Data Collection	Information Service Provider
MCM Environmental Information Processing	Maintenance and Construction Management
TMC Environmental Monitoring	Traffic Management
Transit Environmental Monitoring	Transit Management

Table 2.2.2-11: MC04 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

Table 2.2.2-12: MC04 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Provide freight operators with traveler	Percent of freight-significant
Management:	alerts and alternate routes in the case	routes where traveler alerts and
Detours and	of incidents, special events, weather,	alternate route information is
Routing	construction, and severe congestion at	provided in the case of incidents,
	choke points on X percent of freight-	special events, weather,
	significant routes by year Y.	construction, and severe
		congestion at choke points.

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Travel Weather	Increase by X percent of significant	Percent of significant travel
Management:	travel routes covered by weather-	routes covered by weather-
Detours for	related diversion plans by year Y.	related diversion plans.
Impacted Roadways		
Travel Weather	Increase the percent of agencies that	Percent of agencies involved in
Management:	have adopted multi-agency weather-	transportation operations during
Detours for	related transportation operations	weather events that have
Impacted Roadways	plans and that are involved in	adopted multi-agency, weather-
	transportation operations during	related transportation operations
	weather events to X percent by year Y.	plans.
Travel Weather	Reduce time to alert travelers of travel	Time from beginning of weather
Management:	weather impacts (using variable	event to posting of traveler
Disseminating	message signs, 511, road weather	information on (variable message
Information	information systems, public	signs, 511, Road Weather
	information broadcasts, the agency's	Information Systems, public
	website, Web 2.0 technologies, etc.)	information broadcasts etc.).
	by X (time period or percent) in Y	
	years.	
Travel Weather	Reduce time to alert travelers of travel	Time from beginning of weather
Management:	weather impacts (using variable	event to posting of traveler
Disseminating	message signs, 511, road weather	information on agency website.
Information	information systems, public	
	information broadcasts, the agency's	
	website, Web 2.0 technologies, etc.)	
	by X (time period or percent) in Y	
	years.	
Travel Weather	Increase the percent of major road	Percent of major road (transit or
Management: Road	network (or transit network or	bicycle) network within Z miles of
Weather	regional bicycle network) covered by	an RWIS station.
Information System	weather sensors or a road weather	
Coverage	information system (RWIS) by X	
	percent in Y years as defined by an	
	RWIS station within Z miles.	





Roadway Automated Treatment (MC05)

This service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, antiicing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.

Table 2.2.2-13: MC05 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Automated Treatment System Control	Maintenance and Construction Management
Roadway Automated Treatment	Roadway
Roadway Equipment Coordination	Roadway
Roadway Traffic Information Dissemination	Roadway

Table 2.2.2-14: MC05 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.2-15: MC05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and
Crashes and Fatalities	limitations	fatalities related to driver
		inattention and distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and
Crashes and Fatalities	limitations	fatalities related to driving
		while intoxicated
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and
Crashes and Fatalities	conditions	fatalities related to weather
		conditions
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and
Crashes and Fatalities	vehicles and cargo on the transportation	fatalities due to commercial
	system	vehicle safety violations

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce lane departure crashes	Number of crashes and fatalities related to inappropriate lane departure, crossing or merging
Safety: Vehicle Crashes and Fatalities	Reduce the total number of crashes in the region by X percent by year Y.	Total crashes per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (interstates, freeways, expressways, all roads, main tracks, and main sidewalks) of weather-related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather-related debris after weather impact.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (mode, hierarchy of facilities, or subarea of region) of weather-related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather-related debris after weather impact.



MC05 - Roadway Automated Treatment

Winter Maintenance (MC06)

This service package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.

Table 2.2.2-16: MC06 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Maintenance Decision Support	Maintenance and Construction
	Management
MCM Winter Maintenance Management	Maintenance and Construction
	Management
MCV Winter Maintenance	Maintenance and Construction Vehicle
TMC Incident Dispatch	Traffic Management
Coordination/Communication	

Table 2.2.2-17: MC06 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.2-18: MC06 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Reduce buffer index on	Buffer Index on regional freight routes
Management:	regional freight routes	during peak and off-peak period.
Travel Time	during peak and off-peak	
Reliability	periods by X percent in Y	
	years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year	
	Υ.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year	
	Υ.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Reliability: Planning Time	Reduce the average planning time for (specific routes in	The planning time index represents the time
Index	region) by X minutes over the next Y years.	flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on- time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (interstates, freeways, expressways, all roads, main tracks, and main sidewalks) of weather-related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather-related debris after weather impact.
Travel Weather Management: Clearance Time (Weather-Related Debris)	Reduce average time to complete clearing (mode, hierarchy of facilities, or subarea of region) of weather-related debris after weather impact by X percent in Y years.	Average time to clear selected surface transportation facilities of weather-related debris after weather impact.



MC06 - Winter Maintenance

Roadway Maintenance and Construction (MC07)

This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.

Table 2.2.2-19: MC07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
MCM Maintenance Decision Support	Maintenance and Construction Management	
MCM Roadway Maintenance and Construction	Maintenance and Construction Management	
MCV Roadway Maintenance and Construction	Maintenance and Construction Vehicle	
Roadway Field Device Monitoring	Roadway	
Traffic Equipment Maintenance	Traffic Management	

Table 2.2.2-20: MC07 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management	Increase operational efficiency and reliability of the
and operation;	transportation system

Table 2.2.2-21: MC07 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Work Zone	Increase the percentage of	Percent of construction project
Management: Travel	construction projects that employ	employing night /off-peak work
Time Delay	night/ off-peak work zones by X	zones.
	percent in Y years.	
Work Zone	Increase the rate of on-time	Percent of construction projects
Management: Travel	completion of construction projects to	completed on-time according to
Time Delay	X percent within Y years.	established schedule.
Work Zone	Reduce the person hours (or vehicle	Person hours (or vehicle hours)
Management: Travel	hours) of total delay associated with	of delay associated with work
Time Delay	work zones by X percent over Y years.	zones.



MC07 - Roadway Maintenance and Construction

Work Zone Management (MC08)

This service package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., ISP, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This service package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.

Table 2.2.2-22: MC08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Work Zone Management	Maintenance and Construction Management
MCV Barrier System Control	Maintenance and Construction Vehicle
MCV Work Zone Support	Maintenance and Construction Vehicle
Roadway Work Zone Traffic Control	Roadway
TMC Work Zone Traffic Management	Traffic Management

Table 2.2.2-23: MC08 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.2-24: MC08 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		

Objective	Objective	Performance Measure
Category		
Arterial	Reduce buffer index on	The buffer index (represents the extra time
Management:	arterials during peak and off-	(buffer) travelers add to their average travel
Reliability	peak periods by X percent in	time when planning trips in order to arrive
	Y years.	on-time 95 percent of the time).
Freeway	Reduce buffer index on the	The buffer index (represents the extra time
Management:	freeway system during peak	(buffer) travelers add to their average travel
Reliability	and off-peak periods by X	time when planning trips in order to arrive
	percent in Y years.	on-time 95 percent of the time).
Freight	Reduce buffer index on	Buffer Index on regional freight routes
Management:	regional freight routes during	during peak and off-peak period.
Travel Time	peak and off-peak periods by	
Reliability	X percent in Y years.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay per
Cost of	cost of congestion per capita	capita.
Congestion	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	recurring congestion on	threshold).
Congestion	major freeways from X to Y	
	by year Z.	
System Efficiency:	Reduce the number of hours	Hours per day at LOS F or V/C > 1.0 (or other
Duration of	per day that the top 20 most	threshold).
Congestion	congested roadways	
	experience recurring	
	congestion by X percent by	
	year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per capita).
Energy	due to congestion by X	
Consumption	percent by year Y.	
System Efficiency:	Reduce total energy	I otal energy consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent	
	by year Y.	
System Efficiency:	Reduce total fuel	rotal fuel consumed per capita for
Energy	transportation by V paraget	transportation.
consumption		

Objective Category	Objective	Performance Measure
System Efficiency: Extent of Congestion	Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate).	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the share of major intersections operating at LOS Z by X percent by year Y.	Percent of intersections operating at LOS F or V/C > 1.0
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel time, using posted or free-flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.

Objective	Objective	Performance Measure
Category		
Non-Recurring	delay (or travel-time delay	and/or unscheduled disruptions to travel.
Delay	per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability:	Reduce the average planning	The planning time index represents the time
Planning Time Index	time index for (specific routes in region) by X (no units) over the next Y years.	that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability:	Reduce the 90th (or 95th)	95th or 90th percentile travel times for
Travel Time	percentile travel times for	selected routes.
90th/95th Percentile	each route selected by X percent over Y years.	
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.

Objective	Objective	Performance Measure
Category		
System Reliability:	Decrease the average buffer	The buffer index represents the extra time
Travel Time	index for (multiple routes or	(buffer) most travelers add to their average
Buffer Index	trips) by X percent over Y	travel time when planning trips. This is the
	years.	extra time between the average travel time
		and near-worst case travel time (95th
		percentile). The buffer index is stated as a
		percentage of the average travel time.
		Average buffer index or buffer time can be
		calculated using miles traveled as a
		weighting factor. Buffer time = 95th
		percentile travel time (min) – average travel
System Reliability:	Decrease the buffer index for	I ne buffer index represents the extra time
Travel Time	(specific travel routes) by X	(buffer) most travelers add to their average
Buller Index	vears	extra time between the average travel time
	years.	and near-worst case travel time (95th
		percentile) The buffer index is stated as a
		percentage of the average travel time.
		Average buffer index or buffer time can be
		calculated using miles traveled as a
		weighting factor. Buffer time = 95th
		percentile travel time (min) – average travel
		time (min).
System Reliability:	Reduce the average buffer	The buffer index represents the extra time
Travel Time	time needed to arrive on-	(buffer) most travelers add to their average
Buffer Index	time for 95 percent of trips	travel time when planning trips. This is the
	on (specified routes) by X	extra time between the average travel time
	minutes over Y years.	and near-worst case travel time (95th
		percentile). The buffer index is stated as a
		percentage of the average travel time.
		Average buffer index or buffer time can be
		calculated using miles traveled as a
		weighting factor. Buffer time = 95th
		percentile travel time (min) – average travel
System Deliability	Doduce the veriability of	Ume (min).
Variability	travel time on specified	of the squared deviations from the mean
variability	routes by X percent during	This can also be calculated as the standard
	neak and off-neak neriods by	deviation of travel time. Standard deviation
	vear Y.	is the square root of variance.
Work Zone	Increase customer	Percentage of customers satisfied with
Management:	satisfaction with region's	region's work zone management practices.
Customer	work zone management by X	
Satisfaction	percent over Y years.	

Service Packages

Objective	Objective	Performance Measure
Category		
Work Zone	Reduce the average and	Length of average and maximum queues in
Management:	maximum length of queues,	work zones.
Extent of	when present, by X percent	
Congestion	over Y years.	
Work Zone	Reduce the average time	Average duration in minutes of queue length
Management:	duration (in minutes) of	greater than X miles.
Extent of	queue length greater than	
Congestion	some threshold (e.g., 0.5	
	mile) by X percent in Y years.	
Work Zone	Reduce the percentage of	Percentage of vehicles experiencing queuing
Management:	vehicles traveling through	in work zones.
Extent of	work zones that are queued	
Congestion	by X percent in Y years.	
Work Zone	Increase the percentage of	Percent of construction project employing
Management:	construction projects that	night /off-peak work zones.
Travel Time Delay	employ night/ off-peak work	
	zones by X percent in Y years.	
Work Zone	Increase the rate of on-time	Percent of construction projects completed
Management:	completion of construction	on-time according to established schedule.
Travel Time Delay	projects to X percent within Y	
	years.	
Work Zone	Reduce the person hours (or	Person hours (or vehicle hours) of delay
Management:	vehicle hours) of total delay	associated with work zones.
Travel Time Delay	associated with work zones	
	by X percent over Y years.	
Work Zone	Reduce vehicle-hours of total	Vehicle-hours of delay due to incidents
Management:	delay in work zones caused	related to work zones.
Travel Time	by incidents (e.g., traffic	
Reliability	crashes within or near the	
	work zone).	



MC08 - Work Zone Management

Work Zone Safety Monitoring (MC09)

This service package includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles. This service package detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment or other potential safety hazards. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone. The service package supports both stationary and mobile work zones. The intrusion detection and alarm systems may be collocated or distributed, allowing systems that detect safety issues far upstream from a work zone (e.g., detection of over dimension vehicles before they enter the work zone).

Table 2.2.2-25: MC09 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
MCM Work Zone Safety Management	Maintenance and Construction Management
MCV Vehicle Safety Monitoring	Maintenance and Construction Vehicle
Roadway Equipment Coordination	Roadway
Roadway Work Zone Safety	Roadway

Table 2.2.2-26: MC09 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system
Promote efficient system management and	Increase operational efficiency and
operation;	reliability of the transportation system

Table 2.2.2-27: MC09 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Worker Safety	Enhance safety of workers	Number of crashes and fatalities
		in work zones
Safety: Worker Safety	Enhance safety of workers	Number of workers injured by
		vehicles in work zones
Safety: Worker Safety	Safeguard public safety personnel	Number of public safety
	while they are at roadway incidents	personnel struck by vehicle at
	and emergencies	incident/emergency site
Safety: Worker Safety	Safeguard public safety personnel	Number of public safety vehicles
	while they are at roadway incidents	struck at incident/emergency site
	and emergencies	
Work Zone	Reduce vehicle-hours of total delay in	Vehicle-hours of delay due to
Management: Travel	work zones caused by incidents (e.g.,	incidents related to work zones.
Time Reliability	traffic crashes within or near the	
	work zone).	



MC09 - Work Zone Safety Monitoring

Maintenance and Construction Activity Coordination (MC10)

This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers.

Table 2.2.2-28: MC10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Emergency Response Management	Emergency Management
MCM Work Activity Coordination	Maintenance and Construction Management
TMC Work Zone Traffic Management	Traffic Management
Transit Center Multi-Modal Coordination	Transit Management

Table 2.2.2-29: MC10 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.2-30: MC10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Arterial Management: Reliability	Reduce buffer index on arterials during peak and off- peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Freeway Management: Reliability	Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Freight Management: Travel Time Reliability	Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years.	Buffer Index on regional freight routes during peak and off-peak period.

Objective	Objective	Performance Measure
Category		
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay per
Cost of	cost of congestion per capita	capita.
Congestion	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per capita).
Energy	due to congestion by X	
Consumption	percent by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent	
	by year Y.	
System Efficiency:	Reduce total fuel	Total fuel consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent	
	by year Y.	
System Efficiency:	Reduce the regional average	Travel time index (the average travel time
Intensity of	travel time index by X	during the peak period, using congested
Congestion	percent per year.	speeds, divided by the off-peak period travel
(Travel Time		time, using posted or free-flow speeds).
Index)		
System Efficiency:	Annual rate of change in	Average commute trip travel time (minutes).
Travel Time	regional average commute	
	travel time will not exceed	
	regional rate of population	
Custom Efficience	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak periods
Travel Time	during peak periods by X	(minutes).
Custom Deliebility	percent by year 4.	Total parage being of dalay during askedulad
Non Recurring	delay (or travel time delay	and/or unschodulod discustions to travel
	nor capita) by time pariod	and/or unscheduled disruptions to travel.
Delay	(peak off-peak) caused by all	
	transient events such as	
	traffic incidents special	
	events, and work zones	

Objective	Objective	Performance Measure
Category		
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free- flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on- time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.

Objective	Objective	Performance Measure
Category		
Work Zone	Decrease the number of work	Percent of work zones on parallel
Management:	zones on parallel	routes/along the same corridor.
Construction	routes/along the same	
Coordination	corridor by X percent in Y	
	years.	
Work Zone	Establish a work zone	Presence of an established work zone
Management:	management system within X	management system.
Construction	years to facilitate	
Coordination	coordination of work zones in	
	the region.	
Work Zone	Increase the number of	Percent of capital projects whose project
Management:	capital projects reviewed for	schedules have been reviewed.
Construction	regional construction	
Coordination	coordination by X percent in	
	Y years.	
Work Zone	Reduce the average and	Length of average and maximum queues in
Management:	maximum length of queues,	work zones.
Extent of	when present, by X percent	
Congestion	over Y years.	
Work Zone	Reduce the average time	Average duration in minutes of queue length
Management:	duration (in minutes) of	greater than X miles.
Extent of	queue length greater than	
Congestion	some threshold (e.g., 0.5	
	mile) by X percent in Y years.	
Work Zone	Reduce the percentage of	Percentage of vehicles experiencing queuing
Management:	vehicles traveling through	in work zones.
Extent of	work zones that are queued	
Congestion	by X percent in Y years.	
Work Zone	Increase the percentage of	Percent of construction project employing
Management:	construction projects that	night /off-peak work zones.
Travel Time Delay	employ night/ off-peak work	
	zones by X percent in Y years.	
Work Zone	Increase the rate of on-time	Percent of construction projects completed
Management:	completion of construction	on-time according to established schedule.
Travel Time Delay	projects to X percent within Y	
	years.	
Work Zone	Reduce the person hours (or	Person hours (or vehicle hours) of delay
ivianagement:	venicle nours) of total delay	associated with work zones.
Travel Time Delay	associated with work zones	
	by X percent over Y years.	



MC10 - Maintenance and Construction Activity Coordination

Environmental Probe Surveillance (MC11)

This service package collects data from vehicles in the road network that can be used to directly measure or infer current environmental conditions. It leverages vehicle on-board systems that measure temperature, sense current weather conditions (rain and sun sensors) and also can monitor aspects of the vehicle operational status (e.g., use of headlights, wipers, and traction control system) to gather information about local environmental conditions. It includes the on-board vehicle systems that collect and report environmental probe data, the infrastructure equipment that collects the probe data and the centers that aggregate and share the collected probe data.

Table 2.2.2-31: MC11 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
ISP Probe Information Collection	Information Service Provider	
MCM Environmental Information Collection	Maintenance and Construction Management	
Roadway Probe Data Communications	Roadway	
Vehicle Environmental Probe Support	Vehicle	

Table 2.2.2-32: MC11 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users

 Table 2.2.2-33: MC11 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Travel Weather Management: Road Weather Information System Coverage	Increase the percent of major road network (or transit network or regional bicycle network) covered by weather sensors or a road weather information system (RWIS) by X percent in Y years as defined by an RWIS station within Z miles.	Percent of major road (transit or bicycle) network within Z miles of an RWIS station.



MC11 – Environmental Probe Surveillance

Infrastructure Monitoring (MC12)

This service package monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure (e.g., culverts) using both fixed and vehicle-based infrastructure monitoring sensors. Fixed sensors monitor vibration, stress, temperature, continuity, and other parameters and mobile sensors and data logging devices collect information on current infrastructure condition. This service package also monitors vehicle probes for vertical acceleration data and other probe data that may be used to determine current pavement condition.

Table 2.2.2-34: MC12 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
MCM Infrastructure Monitoring	Maintenance and Construction Management	
MCV Infrastructure Monitoring	Maintenance and Construction Vehicle	
Roadway Infrastructure Monitoring	Roadway	
Roadway Probe Data Communications	Roadway	
Vehicle Environmental Probe Support	Vehicle	

Table 2.2.2-35: MC12 Associated Planning Factors and Goals

MetroFactor	Goal
Emphasize the preservation of the existing transportation	Preserve the transportation
system.	system

 Table 2.2.2-36: MC12 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Preservation:	Distressed pavement condition	Distressed pavement condition
Preserve Existing	lane-miles not to exceed X percent	lane miles
Infrastructure	of total state highway system	
Preservation:	Enhance asset and resource	Extended pavement life due to
Preserve Existing	management	truck weight enforcement
Infrastructure		
Preservation:	Enhance asset and resource	Number of assets tracked in real-
Preserve Existing	management	time
Infrastructure		
Preservation:	Enhance asset and resource	Percentage of fleet/equipment
Preserve Existing	management	within lifecycle
Infrastructure		
Preservation:	Enhance asset and resource	Percentage of geographic
Preserve Existing	management	jurisdiction covered by agency
Infrastructure		electronic communications

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Preservation:	Enhance asset and resource	Percentage of maintenance
Preserve Existing	management	activities completed in required
Infrastructure		time-frame
Preservation:	Enhance asset and resource	Rate at which equipment is
Preserve Existing	management	utilized
Infrastructure		
Preservation:	Enhance asset and resource	Vehicle operating costs
Preserve Existing	management	
Infrastructure		
Preservation:	Maintain pavement condition index	Pavement condition index
Preserve Existing	(PCI) of X or greater for local streets	
Infrastructure	and roads	

MC12 –Infrastructure Monitoring



2.2.3 Transit Management Service Packages

Transit Vehicle Tracking (APTS01)

This service package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider.

Table 2.2.3-1: APTS01 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Transit Center Vehicle Tracking	Transit Management
On-board Transit Trip Monitoring	Transit Vehicle

Table 2.2.3-2: APTS01 Associated Planning Factors and Goals

MetroFactor	Goal	
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for	
people and for freight;	transportation system users	
Promote efficient system management and	Increase operational efficiency and reliability of the	
operation;	transportation system	

Table 2.2.3-3: APTS01 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure	
Transit Operations and	Decrease delay by X percent per year	Travel time delay on routes	
Management: Transit	by increasing the use of queue	with queue jumping and	
Signal Priority	jumping and automated vehicle	automated vehicle location in	
	location.	use.	
Traveler Information:	Increase the percent of modes in the	Percent of modes in the region	
Data Collection and	region that share their traveler	that share their traveler	
Sharing on Travel	information with other modes in the	information with other modes.	
Conditions	region to 100 percent by Y year.		

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Traveler Information:	Increase the percent of the	Percent of the transportation
Data Collection and	transportation system in which travel	system in which travel
Sharing on Travel	conditions can be detected remotely	conditions can be detected
Conditions	via CCTV, speed detectors, etc. to X	remotely via CCTV, speed
	percent by Y year.	detectors, etc.
Traveler Information:	Increase the percent of	Percent of transportation
Data Collection and	transportation facilities whose	facilities whose owners share
Sharing on Travel	owners share their traveler	their traveler information with
Conditions	information with other agencies in	other agencies in the region.
	the region to X percent by Y year.	

APTS01 – Transit Vehicle Tracking



Transit Fixed-Route Operations (APTS02)

This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service determines the transit vehicle trip performance against the schedule using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

Table 2.2.3-4: APTS02 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Transit Center Fixed-Route Operations	Transit Management
Transit Vehicle Operator Assignment	Transit Management
On-board Schedule Management	Transit Vehicle

Table 2.2.3-5: APTS02 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users
Promote efficient system management and	Increase operational efficiency and reliability of the
operation;	transportation system

Table 2.2.3-6: APTS02 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure	
System Efficiency:	Annual rate of change in regional	Average commute trip travel time	
Travel Time	average commute travel time will not	(minutes).	
	exceed regional rate of population		
	growth through the year Y.		
System Efficiency:	Improve average travel time during	Average travel time during peak	
Travel Time	peak periods by X percent by year Y.	periods (minutes).	
System Efficiency:	Reduce cost of transfer fees paid by X	Average cost of transfers.	
Trip Connectivity	percent by year Y.		
System Efficiency:	Reduce door-to-door trip time by X	Average door-to-door trip time.	
Trip Connectivity	percent by year Y.		
System Reliability:	Improve average on-time	On-time performance of transit.	
Transit On-Time	performance for specified transit		
Performance	routes/facilities by X percent within Y		
	years.		
Objective Category	Objective	Performance Measure	
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Transit Operations	Improve average on-time	Average line-haul transit on-time	
and Management:	performance for specified line-haul	performance for specified line-	
Line-Haul Transit	transit routes by X percent annually.	haul transit routes.	
Transit Operations	Improve average travel speeds by X	Average line-haul transit travel	
and Management:	percent for specified line-haul transit	speeds for specified line-haul	
Line-Haul Transit	routes every Y years.	transit routes.	
Transit Operations	Provide line-haul transit travel times	Number of line-haul transit routes	
and Management:	equal to or less than average auto	operating with travel times equal	
Line-Haul Transit	travel times on same	to or less than average auto travel	
	corridors/parallel corridors for X	times on same corridors/parallel	
	number of routes over Y years.	corridors.	
Transit Operations	Load factors for (route type) routes at	Load factor.	
and Management:	each route's busiest point should not		
Loading Standards	exceed X on any vehicle (or on the		
	average vehicle) during peak/off-peak		
	periods.		
Transit Operations	No more than X standees should be	Maximum standees.	
and Management:	present at each route's busiest point		
Loading Standards	on any vehicle (or on the average		
	vehicle) during peak/off-peak periods.		
Transit Operations	No passenger will have to stand for	Duration of standee time.	
and Management:	more than X minutes during their		
Loading Standards	journey.		
Transit Operations	Passenger loads on (route type) routes	Maximum passenger loads.	
and Management:	at each route's busiest point should		
Loading Standards	not exceed X passengers on any		
	vehicle (or on average) during the		
	hour during peak/off-peak periods		
Transit Operations	At least X percent of trips can be made	Percent of trips with no more than	
and Management:	with no more than Y transfers.	Y transfers.	
Service Directness			
Transit Operations	Scheduled transfer times between	Scheduled transfer times between	
and Management:	routes should be no longer than X	routes.	
Service Directness	minutes.		



APTS02 – Transit Fixed-Route Operations

Demand Response Transit Operations (APTS03)

This service package performs automated dispatch and system monitoring for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this service package performs similar functions to support dynamic features of flexible-route transit services. This package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem. The ISP may either be operated by a transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines that the paratransit service is a viable means of satisfying a traveler request and makes a reservation for the traveler.

Table 2.2.3-7: APTS03 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
Transit Center Paratransit Operations	Transit Management	
Transit Vehicle Operator Assignment	Transit Management	
On-board Paratransit Operations	Transit Vehicle	

Table 2.2.3-8: APTS03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users
Promote efficient system management and	Increase operational efficiency and reliability of the
operation;	transportation system

Table 2.2.3-9: APTS03 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Options: Modal	Increase the availability of transit to	The percent of individuals
Options for Individuals with	individuals with disabilities by X	with disabilities that can
Disabilities	percent by year Y.	access transit.
Transit Operations and	Improve on-time pick-up of demand	Demand response
Management: Demand	response transit passengers.	passenger pick-up on-time
Responsive Transit		performance
Transit Operations and	Improve the operational efficiency of	Operating expense per
Management: Demand	the demand response transit service	passenger mile
Responsive Transit	in the region.	

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Transit Operations and	Improve the operational efficiency of	Operating expense per
Management: Demand	the demand response transit service	passenger trip
Responsive Transit	in the region.	
Transit Operations and	Improve the operational efficiency of	Passenger miles per
Management: Demand	the demand response transit service	vehicle
Responsive Transit	in the region.	
Transit Operations and	Improve the operational efficiency of	Passenger trips per vehicle
Management: Demand	the demand response transit service	
Responsive Transit	in the region.	
Transit Operations and	Increase customer satisfaction with	Customer satisfaction
Management: Demand	the region's demand response transit	ratings
Responsive Transit	service by X percent over Y years.	

APTS03 – Demand Response Transit Operations



Transit Fare Collection Management (APTS04)

This service package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. Two other service packages, ATMS10: Electronic Toll Collection and ATMS16: Parking Facility Management, also provide electronic payment services. These three service packages in combination provide an integrated electronic payment system for transportation services.

Table 2.2.3-10: APTS04 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem	
Remote Transit Fare Management	Remote Traveler Support	
Transit Center Fare Management	Transit Management	
On-board Transit Fare Management	Transit Vehicle	

Table 2.2.3-11: APTS04 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users
Promote efficient system management and	Increase operational efficiency and reliability of the
operation;	transportation system

Table 2.2.3-12: APTS04 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce cost of transfer fees	Average cost of transfers.
Trip Connectivity	paid by X percent by year Y.	
System Efficiency:	Reduce door-to-door trip time	Average door-to-door trip time.
Trip Connectivity	by X percent by year Y.	
System Options:	Achieve X percent alternative	Percent of all trips made using
Mode Share	(non-SOV) mode share in	alternative modes in transit station
	transit station communities (or	communities.
	other destinations) by year Y.	
System Options:	Increase alternative (non-SOV)	Share of trips by each mode of travel.
Mode Share	mode share for all trips by X	
	percent within the next Y years.	
System Options:	Increase average transit load	Number of riders on various transit
Transit Use	factor by X percent by year Y.	units per trip at peak travel times.

Objective Category	Objective	Performance Measure
System Options:	Increase passenger miles	Number of passenger miles traveled
Transit Use	traveled per capita on transit by	per capita.
	X percent by year Y.	
System Options:	Increase transit mode share by	Percent of all peak-period trips made
Transit Use	X percent by year Y during peak	by transit.
	periods.	
System Options:	Increase transit mode share by	Percent of all trips made by transit.
Transit Use	X percent by year Y.	
System Options:	Improve average transit travel	Transit to auto travel time differential
Travel Time - Transit	time compared to auto in major	for a given period (daily, hourly, or
Compared to Auto	corridors by X minutes per year	peak hours), on a given portion of the
	for Y years.	system (system wide, by facility type,
		or by corridor).
System Options:	Maintain a travel time	Transit to auto travel time differential
Travel Time - Transit	differential between transit and	for a given period (daily, hourly, or
Compared to Auto	auto during peak periods of X	peak hours), on a given portion of the
	percent for Y years.	system (system wide, by facility type,
		or by corridor).
System Options:	Reduce the travel time	Transit to auto travel time differential
Travel Time - Transit	differential between transit and	for a given period (daily, hourly, or
Compared to Auto	auto during peak periods by X	peak hours), on a given portion of the
	percent per year for Y years.	system (system wide, by facility type,
		or by corridor).
Transit Operations	Implement an automated fare	Percent of transit providers using the
and Management:	collection system in Y years for	region's automated fare collection
Automated Fare	X percent of transit providers in	system.
Collection	the region.	
Transit Operations	Increase by X percentage	Percent of total transfers performed
and Management:	points, every Y years, the	with automated fare cards.
Automated Fare	percent of transfers performed	
Collection	with automated fare cards.	
Transit Operations	Increase use of system by X	Percent of fares collected using
and Management:	percent per year.	automated fare collection.
Automated Fare		
Collection		
Iransit Operations	Integrate X additional	Number of additional modes/service
and Management:	modes/services into automated	integrated into the fare collection
Automated Fare	fare collection system by Y	system.
Collection	years.	



APTS04 – Transit Fare Collection Management

Transit Security (APTS05)

This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this service package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).

The surveillance and sensor information is transmitted to the Emergency Management Subsystem, as are transit user activated alarms in public secure areas. On-board alarms, activated by transit users or transit vehicle operators are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem, indicating two possible approaches to implementing this service package.

In addition the service package supports remote transit vehicle disabling by the Transit Management Subsystem and transit vehicle operator authentication.

Fouinment Package Name	Subsystem	
	Subsystem	
Center Secure Area Alarm Support	Emergency Management	
Center Secure Area Sensor Management	Emergency Management	
Center Secure Area Surveillance	Emergency Management	
Emergency Response Management	Emergency Management	
Remote Traveler Security	Remote Traveler Support	
Traveler Secure Area Sensor Monitoring	Remote Traveler Support	
Traveler Secure Area Surveillance	Remote Traveler Support	
Field Secure Area Sensor Monitoring	Security Monitoring	
Field Secure Area Surveillance	Security Monitoring	
Transit Center Security	Transit Management	
On-board Transit Security	Transit Vehicle	

Table 2.2.3-13: APTS05 Included Equipment Packages and Subsystems

Table 2.2.3-14: APTS05 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people	Enhance mobility, convenience, and comfort
and for freight;	for transportation system users
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system
Increase the security of the transportation system	Improve the security of the transportation
for motorized and nonmotorized users;	system

Table 2.2.3-15: APTS05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce mean incident notification time	Average incident
Management: Incident	(defined as the time between the first	notification time of
Duration	agency's awareness of an incident and the	necessary response
	time to notify needed response agencies)	agencies.
	by X percent over Y years (i.e., through	
	"Motorist Assist" roving patrol programs,	
	reduction of inaccurate verifications, etc.).	
Emergency/Incident	Reduce mean time of incident duration	Mean time of incident
Management: Incident	(from awareness of incident to resumed	duration.
Duration	traffic flow) on transit services and arterial	
	and expressway facilities by X percent in Y	
	years.	
Security: Crime	Reduce security risks to motorists and	Number of critical sites
	travelers	with security
		surveillance
Security: Crime	Reduce security risks to motorists and	Number of security
	travelers	incidents on roadways
Security: Crime	Reduce security risks to transit passengers	Number of security
	and transit vehicle operators	incidents at transit
		facilities
Security: Crime	Reduce security risks to transit passengers	Number of security
	and transit vehicle operators	incidents on transit
		vehicles
Security: Crime	Reduce security risks to transit passengers	Number of transit
	and transit vehicle operators	facilities and vehicles
		under security
		surveillance
Security: Crime	Reduce security risks to transportation	Number of critical sites
	Intrastructure	with hardened security
		ennancements
Security: Crime	Reduce security risks to transportation	Number of critical sites
	Intrastructure	with security
		surveillance

Objective Category	Obiective	Performance Measure
Security: Crime	Reduce security risks to transportation infrastructure	Number of security incidents on transportation infrastructure
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to motorists and travelers	Number of critical sites with security surveillance
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to motorists and travelers	Number of security incidents on roadways
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transit passengers and transit vehicle operators	Number of security incidents at transit facilities
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transit passengers and transit vehicle operators	Number of security incidents on transit vehicles
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transit passengers and transit vehicle operators	Number of transit facilities and vehicles under security surveillance
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transportation infrastructure	Number of critical sites with hardened security enhancements
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transportation infrastructure	Number of critical sites with security surveillance
Security: Terrorism, Natural Disasters, and Hazardous Material Incidents	Reduce security risks to transportation infrastructure	Number of security incidents on transportation infrastructure
Transit Operations and Management: Customer Service/Safety	Decrease by X percent on an annual basis the number of complaints per 1,000 boarding passengers.	Complaint rate.
Transit Operations and Management: Customer Service/Safety	Decrease the number of personal safety incidents by X percent within Y years.	Number of reported personal safety incidents.
Transit Operations and Management: Customer Service/Safety	Increase customer service and personal safety ratings by X percent within Y years.	Personal safety and customer service ratings.

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Transit Operations and	Increase the number of closed circuit	Number of CCTV
Management: Customer	television (CCTV) cameras installed by X	cameras on platforms,
Service/Safety	percent in Y years on platforms, park-n-ride	park-n-ride lots,
	lots, vehicles, and other transit facilities.	vehicles, and other
		transit facilities.



APTS05 - Transit Security

Transit Fleet Management (APTS06)

This service package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance. The service package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks.

Table 2.2.3-16: APTS06 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Transit Garage Maintenance	Transit Management
Transit Vehicle Assignment	Transit Management
On-board Maintenance	Transit Vehicle
On-board Schedule Management	Transit Vehicle

Table 2.2.3-17: APTS06 Associated Planning Factors and Goals

MetroFactor	Goal
Emphasize the preservation of the existing transportation	Preserve the transportation
system.	system

Table 2.2.3-18: APTS06 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Preservation:	Enhance garage operations efficiency	Number of fleet vehicles with
Transit		maintenance diagnostic
Maintenance		equipment
Preservation:	Enhance garage operations efficiency	Number of vehicles operating
Transit		under computer-aided
Maintenance		dispatch.
Preservation:	Increase the average number of miles	Average number of transit
Transit	between service calls for transit service in	miles per service call
Maintenance	the region to X miles	

APTS06 - Transit Fleet Management



Multi-modal Coordination (APTS07)

This service package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transit transfer points and clusters (a collection of stops, stations, or terminals where transfers can be made conveniently) and also improve operating efficiency. Transit transfer information is shared between Multimodal Transportation Service Providers and Transit Agencies.

Table 2.2.3-19: APTS07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
TMC Multimodal Coordination	Traffic Management
Transit Center Multi-Modal Coordination	Transit Management
On-board Schedule Management	Transit Vehicle

Table 2.2.3-20: APTS07 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the transportation	Enhance the integration and
system, across and between modes, for people and freight;	connectivity of the
	transportation system
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.3-21: APTS07 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Integration:	Reduce cost of transfer fees paid by X	Average cost of transfers.
Connectivity	percent by year Y.	
Integration:	Reduce door-to-door trip time by X	Average door-to-door trip time.
Connectivity	percent by year Y.	

Objective Category	Objective	Performance Measure
Special Event	Reduce average time to clear event's	Average time to clear event's
Management:	exiting queue by X percent in Y years.	exiting queue by year per event.
Entry/Exit Travel		
Times		
Special Event	Reduce average travel time into and	Average travel time away from
Management:	out of the event by X percent in Y	selected special events to a set of
Entry/Exit Travel	years.	locations over a year.
Times		
Special Event	Reduce average travel time into and	Average travel time to selected
Management:	out of the event by X percent in Y	special events from a set of
Entry/Exit Travel	years.	locations in the area over a year.
Times		
Special Event	Reduce buffer time index for travelers	Buffer time index for travelers to
Management:	to multiple similar special events by X	multiple similar special events.
Entry/Exit Travel	percent in Y years.	
Times		
Special Event	Reduce non-special event VMT in the	Non-special event VMT in the
Management:	event area during events by X percent	event area during events over a
Entry/Exit Travel	in Y years.	year.
Times		
Special Event	Decrease the percent of special event	Percent of special event
Management:	attendees traveling to the event in	attendees using single-
Mode Shift from	single-occupancy vehicles by X percent	occupancy vehicles each year for
SOV	in Y years.	selected events.
Special Event	Increase the percent of special event	Percent of special event
Management:	attendees using park & ride lots by X	attendees utilizing park & ride
Mode Shift from	percent in Y years.	lots each year for selected
SUV		events.
Special Event	Increase the percent of special events	Percent of special events with
Management:	with dedicated shuttle service by X	dedicated shuttle service for
Node Shift from	percent in Y years.	selected events during a 1-year
SUV	Poduce hours of dolay par capita by V	period.
Delay	percept by year V	Hours of delay (person-nours).
System Efficiency:	Reduce hours of delay per capita by X	Hours of delay per capita
Delay	nercent by year Y	riours of delay per capita.
System Efficiency:	Reduce excess fuel consumed due to	Excess fuel consumed (total or
Energy	congestion by X percent by year Y.	per capita)
Consumption		
System Efficiency:	Reduce total energy consumption per	Total energy consumed per
Energy	capita for transportation by X percent	capita for transportation.
Consumption	by year Y.	
System Efficiency:	Reduce total fuel consumption per	Total fuel consumed per capita
Energy	capita for transportation by X percent	for transportation.
Consumption	by year Y.	' '

Objective Category	Objective	Performance Measure
System Efficiency: Intensity of Congestion (Travel Time Index)	Reduce the regional average travel time index by X percent per year.	Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel time, using posted or free- flow speeds).
System Efficiency: Travel Time	Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y.	Average commute trip travel time (minutes).
System Efficiency: Travel Time	Improve average travel time during peak periods by X percent by year Y.	Average travel time during peak periods (minutes).
System Efficiency: Trip Connectivity	Reduce cost of transfer fees paid by X percent by year Y.	Average cost of transfers.
System Efficiency: Trip Connectivity	Reduce door-to-door trip time by X percent by year Y.	Average door-to-door trip time.
System Efficiency: Vehicle Miles Traveled	Reduce vehicle miles traveled per capita by X percent by year Y.	Average VMT per capita per day, per week, or per year.
System Options: Modal Options for Individuals with Disabilities	Increase the availability of transit to individuals with disabilities by X percent by year Y.	The percent of individuals with disabilities that can access transit.
System Options: Mode Share	Achieve X percent alternative (non- SOV) mode share in transit station communities (or other destinations) by year Y.	Percent of all trips made using alternative modes in transit station communities.
System Options: Mode Share	Increase active (bicycle/pedestrian) mode share by X percent by year Y.	Share of trips by each mode of travel.
System Options: Mode Share	Increase alternative (non-SOV) mode share for all trips by X percent within the next Y years.	Share of trips by each mode of travel.
System Options: Mode Share	Reduce per capita SOV commute trip rate by X percent in Y years.	SOV commute trips per capita.
System Options: Transit Use	Increase average transit load factor by X percent by year Y.	Number of riders on various transit units per trip at peak travel times.
System Options: Transit Use	Increase passenger miles traveled per capita on transit by X percent by year Y.	Number of passenger miles traveled per capita.
System Options: Transit Use	Increase transit mode share by X percent by year Y during peak periods.	Percent of all peak-period trips made by transit.
System Options: Transit Use	Increase transit mode share by X percent by year Y.	Percent of all trips made by transit.

Objective Category	Objective	Performance Measure
System Options: Travel Time - Transit Compared to Auto	Improve average transit travel time compared to auto in major corridors by X minutes per year for Y years.	Transit to auto travel time differential for a given period (daily, hourly, or peak hours), on a given portion of the system (system wide, by facility type, or by corridor).
System Options: Travel Time - Transit Compared to Auto	Maintain a travel time differential between transit and auto during peak periods of X percent for Y years.	Transit to auto travel time differential for a given period (daily, hourly, or peak hours), on a given portion of the system (system wide, by facility type, or by corridor).
System Options: Travel Time - Transit Compared to Auto	Reduce the travel time differential between transit and auto during peak periods by X percent per year for Y years.	Transit to auto travel time differential for a given period (daily, hourly, or peak hours), on a given portion of the system (system wide, by facility type, or by corridor).
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
Transit Operations and Management: Park-and-Ride Support	Increase traveler awareness of park- and-ride lots by X percent within Y years.	Number of users aware of park- and-ride lots in their region.
Transit Operations and Management: Service Directness	At least X percent of trips can be made with no more than Y transfers.	Percent of trips with no more than Y transfers.
Transit Operations and Management: Service Directness	Scheduled transfer times between routes should be no longer than X minutes.	Scheduled transfer times between routes.



APTS07 – Multi-modal Coordination

Transit Traveler Information (APTS08)

This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.

Table 2.2.3-22: APTS08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Infrastructure Provided Trip Planning	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Personal Interactive Information Reception	Personal Information Access
Remote Transit Information Services	Remote Traveler Support
Transit Center Information Services	Transit Management
On-board Transit Information Services	Transit Vehicle

Table 2.2.3-23: APTS08 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users
Promote efficient system management and	Increase operational efficiency and reliability of the
operation;	transportation system

Table 2.2.3-24: APTS08 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Special Event	Decrease the percent of special event	Percent of special event
Management:	attendees traveling to the event in single-	attendees using single-
Mode Shift from	occupancy vehicles by X percent in Y	occupancy vehicles each year
SOV	years.	for selected events.
Special Event	Increase the percent of special event	Percent of special event
Management:	attendees using park & ride lots by X	attendees utilizing park & ride
Mode Shift from	percent in Y years.	lots each year for selected
SOV		events.
Special Event	Increase the percent of special events	Percent of special events with
Management:	with dedicated shuttle service by X	dedicated shuttle service for
Mode Shift from	percent in Y years.	selected events during a 1-year
SOV		period.

Objective Category	Objective	Performance Measure
Special Event Management: Traveler Information	Increase the methods of effectively disseminating special event information to travelers by X percent in Y years (e.g., media releases, highway advisory radio, dynamic message signs, commercial AM and FM radio).	Number of effective methods to disseminate special event information to travelers.
Special Event Management: Traveler Information	Increase the percentage of planned special events (with attendance above Z) with information on anticipated and actual travel conditions being disseminated to the traveling public at least X hours prior to the event.	Percent of special events with expected attendance over Z that traveler information is disseminated at least X hours prior to the event.
System Efficiency: Vehicle Miles Traveled	Reduce vehicle miles traveled per capita by X percent by year Y.	Average VMT per capita per day, per week, or per year.
System Options: Modal Options for Individuals with Disabilities	Increase the availability of transit to individuals with disabilities by X percent by year Y.	The percent of individuals with disabilities that can access transit.
System Options: Mode Share	Achieve X percent alternative (non-SOV) mode share in transit station communities (or other destinations) by year Y.	Percent of all trips made using alternative modes in transit station communities.
System Options: Mode Share	Increase alternative (non-SOV) mode share for all trips by X percent within the next Y years.	Share of trips by each mode of travel.
System Options: Transit Use	Increase average transit load factor by X percent by year Y.	Number of riders on various transit units per trip at peak travel times.
System Options: Transit Use System Options: Transit Use	Increase passenger miles traveled per capita on transit by X percent by year Y. Increase transit mode share by X percent by year Y during peak periods.	Number of passenger miles traveled per capita. Percent of all peak-period trips made by transit.
System Options: Transit Use	Increase transit mode share by X percent by year Y.	Percent of all trips made by transit.
Transit Operations and Management: Park-and-Ride Support	Increase traveler awareness of park-and- ride lots by X percent within Y years.	Number of users aware of park-and-ride lots in their region.
Transit Operations and Management: Traveler Information	All stops have up-to-date schedule information available within X days of schedule changes.	Percent of stops with up-to- date schedule information available within X days of schedule changes.

Objective Category	Obiective	Performance Measure
Transit Operations	Equip X shelters/platforms with real-time	Number of shelters/platforms
and Management:	arrival displays annually.	equipped with real-time arrival
Traveler		displays per year.
Information		
Transit Operations	Increase the number of web-based trip	Number of web-based trip
and Management:	planner requests each year by X percent.	planner requests per year.
Traveler		
Information		
Transit Operations	Install Wi-Fi service on X number of	The number of routes in which
and Management:	routes annually.	Wi-Fi service was installed.
Traveler		
Information		
Transit Operations	Transit traveler information is available in	Availability of transit traveler
and Management:	the region via 511 web and phone service	information on 511 web and
Traveler	by year Y.	phone service.
Information	- · · · · · · · · · · · · · · · · · · ·	
Travel Demand	Construct visitor information centers in X	Number of communities in
Management:	communities by year Y.	which visitor information
Marketing		centers are constructed.
Iravel Demand	Create a transportation access guide,	Implementation of
Management:	which provides concise directions to	transportation access guide.
warketing	(transit walking bike etc.) by year V	
Travel Domand	Develop and onbance (e.g. through eace	Number of web based travelor
Management:	of navigation techniques) X number of	information tools developed or
Management. Marketing	web-based traveler information tools	enhanced
Travel Demand	Develop and provide travel option	Number of communities
Management [.]	services to X identified communities and	receiving travel option services
Marketing	audiences within Y years.	
Traveler	Increase customer satisfaction rating of	Customer satisfaction ratings
Information:	the timeliness. accuracy, and usefulness	of timeliness. accuracy. and
Customer	of traveler information in the region by	usefulness of traveler
Satisfaction	W, X, and Z percent, respectively, over Y	information.
	years.	
Traveler	Increase number of 511 calls per year by	Number of 511 calls per year.
Information:	X percent in Y years.	
Information		
Dissemination		
Traveler	Increase number of users of notifications	Number of users of
Information:	for traveler information (e.g., e-mail, text	notifications for traveler
Information	message) by X percent in Y years.	information (e.g., e-mail, text
Dissemination		message) per year.
Traveler	Increase number of visitors to traveler	Number of visitors to traveler
Information:	information website per year by X	information website per year.
Information	percent in Y years.	
Dissemination		

Objective Category	Objective	Performance Measure
Traveler	Increase number of Web 2.0 (e.g.,	Number of Web 2.0 (e.g.,
Information:	Twitter, Facebook) followers by X percent	Twitter, Facebook) followers.
Information	in Y months.	
Dissemination		
Traveler	Increase the accuracy and completeness	Number of complaints received
Information:	of traveler information posted (on	from system users about
Information	variable message signs, websites, and/or	inaccurate or missing
Dissemination	web 2.0 technologies) by reducing the	information.
	number of incomplete and inaccurate	
	reports by X percent in Y years.	
Traveler	Enhance regional multimodal trip	The number of data sources
Information: Trip	planning tools to X data sources by year	providing information for
Planning Tools	Υ.	multi-modal trip planning tools.
Traveler	Increase the ease of use of trip planning	Trip planning tools ease of use
Information: Trip	tools by X percent by year Y.	rating.
Planning Tools		
Traveler	Increase the number of uses of	Number of uses of trip planning
Information: Trip	multimodal trip planning tools by X	tools.
Planning Tools	percent by year Y.	



APTS08 - Transit Traveler Information

Transit Signal Priority (APTS09)

This service package determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations. The signal priority may result from limited local coordination between the transit vehicle and the individual intersection for signal priority or may result from coordination between transit management and traffic management centers. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network.

Table 2.2.3-25: APTS09 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Signal Priority	Roadway
TMC Multimodal Coordination	Traffic Management
TMC Signal Control	Traffic Management
Transit Center Signal Priority	Transit Management
On-board Transit Signal Priority	Transit Vehicle

Table 2.2.3-26: APTS09 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

 Table 2.2.3-27: APTS09 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy	due to congestion by X percent	capita).
Consumption	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy	consumption per capita for	transportation.
Consumption	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy	per capita for transportation by	transportation.
Consumption	X percent by year Y.	
System Efficiency:	Reduce the regional average	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Congestion (Travel	per year.	congested speeds, divided by the off-
Time Index)		peak period travel time, using posted or
		free-flow speeds).
System Efficiency:	Annual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes).
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak periods
Travel Time	during peak periods by X	(minutes).
Custom Efficiency	percent by year Y.	Average MAT per conite per dev per
System Efficiency:	Reduce vehicle miles traveled	Average vivit per capita per day, per
	v	week, of per year.
System Ontions:	I. Improve average transit travel	Transit to auto travel time differential
Travel Time - Transit	time compared to auto in major	for a given period (daily, hourly, or peak
Compared to Auto	corridors by X minutes per year	hours) on a given portion of the system
compared to Auto	for Y years	(system wide, by facility type, or by
		corridor).
System Options:	Maintain a travel time	Transit to auto travel time differential
Travel Time - Transit	differential between transit and	for a given period (daily, hourly, or peak
Compared to Auto	auto during peak periods of X	hours), on a given portion of the system
	percent for Y years.	(system wide, by facility type, or by
		corridor).
System Options:	Reduce the travel time	Transit to auto travel time differential
Travel Time - Transit	differential between transit and	for a given period (daily, hourly, or peak
Compared to Auto	auto during peak periods by X	hours), on a given portion of the system
	percent per year for Y years.	(system wide, by facility type, or by
		corridor).
System Reliability:	Improve average on-time	On-time performance of transit.
Transit On-Time	performance for specified	
Performance	transit routes/facilities by X	
	percent within Y years.	

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Transit Operations and Management:	Decrease system-wide signal delay on transit routes by X	System-wide signalized stop delay on transit routes.
Transit Signal	percent per year.	
Priority		
Transit Operations	Increase implementation of transit signal priority strategies	Number of transit routes/intersections
Transit Signal	on X number of routes (or X	capability.
Priority	number of intersections) over	
	the next Y years.	

APTS09 – Transit Signal Priority



Transit Passenger Counting (APTS10)

This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.

Table 2.2.3-28: APTS10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Transit Center Passenger Counting	Transit Management
On-board Passenger Counting	Transit Vehicle

Table 2.2.3-29: APTS10 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users

Table 2.2.3-30: APTS10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Transit Operations and	Load factors for (route type) routes at each route's	Load factor.
Management: Loading	busiest point should not exceed X on any vehicle (or on	
Standards	the average vehicle) during peak/off-peak periods.	
Transit Operations and	No more than X standees should be present at each	Maximum
Management: Loading	route's busiest point on any vehicle (or on the average	standees.
Standards	vehicle) during peak/off-peak periods.	
Transit Operations and	No passenger will have to stand for more than X minutes	Duration of
Management: Loading	during their journey.	standee time.
Standards		
Transit Operations and	Passenger loads on (route type) routes at each route's	Maximum
Management: Loading	busiest point should not exceed X passengers on any	passenger loads.
Standards	vehicle (or on average) during the hour during peak/off-	
	peak periods	



APTS10 – Transit Passenger Counting

Multimodal Connection Protection (APTS11)

This service package supports the coordination of multimodal services to optimize the travel time of travelers as they move from mode to mode (or to different routes within a single mode). A near term function supported by this service package would be for a single transit agency to coordinate crossing routes so that passengers on one route would have the opportunity to transfer with minimum wait time to another route within the same transit system. The next level of complexity of this service package would be for this coordination to occur across transit agencies, or between transit agencies and other modes of transportation. The most advanced functions of this service package would be to track the route of an individual traveler and ensure that connections are properly scheduled on an individual basis. This final capability represents a long-term functionality, which could be managed either through an Information Serviced Provider or through a Transit Management subsystem.

Equipment Package Name	Subsystem
Infrastructure Provided Trip Planning	Information Service Provider
Personal Trip Planning and Route Guidance	Personal Information Access
Remote Transit Information Services	Remote Traveler Support
Transit Center Connection Protection	Transit Management
On-board Connection Protection	Transit Vehicle
On-board Transit Fare Management	Transit Vehicle

Table 2.2.3-31: APTS11 Included Equipment Packages and Subsystems

Table 2.2.3-32: APTS11 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system

Table 2.2.3-33: APTS11 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Integration: Connectivity	Reduce door-to-door trip time by X	Average door-to-door
	percent by year Y.	trip time.
System Efficiency: Trip	Reduce door-to-door trip time by X	Average door-to-door
Connectivity	percent by year Y.	trip time.



APTS11 – Multimodal Connection Protection

2.2.4 Traveler Information Service Packages

Broadcast Traveler Information (ATIS01)

This service package collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet web casts. The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions. Different from the service package ATMS06 - Traffic Information Dissemination, which provides localized HAR and DMS information capabilities, ATIS01 provides a wide area digital broadcast service. Successful deployment of this service package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

Equipment Package Name	Subsystem
Basic Information Broadcast	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Personal Basic Information Reception	Personal Information Access
Remote Basic Information Reception	Remote Traveler Support
Basic Vehicle Reception	Vehicle

Table 2.2.4-1: ATIS01 Included Equipment Packages and Subsystems

Table 2.2.4-2: ATIS01 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

Table 2.2.4-3: ATIS01 Associated Objectives and Performance Measures

Objective Category Objective

Performance Measure

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the person hours (or	Person hours (or vehicle hours) of
Management: Person	vehicle hours) of total delay	delay associated with traffic incidents.
Hours of Delay	associated with traffic incidents	
	by X percent over Y years.	
Emergency/Incident	Increase number of repeat	Number of repeat visitors to traveler
Management:	visitors to traveler information	information website (or 511 system).
Traveler Information	website (or 511 system) by X	
	percent in Y years.	
Emergency/Incident	Reduce the time between	Time between recovery from incident
Management:	recovery from incident and	and removal of traveler alerts.
Traveler Information	removal of traveler alerts for	
	that incident.	
Emergency/Incident	Reduce time between	Time to alert motorists of an
Management:	incident/emergency verification	incident/emergency.
Traveler Information	and posting a traveler alert to	
	traveler information outlets	
	(e.g., variable message signs,	
	agency website, 511 system) by	
	X minutes in Y years.	
Freeway	Reduce the number of person	Hours of delay (vehicle-hours or
Management:	hours (or vehicle hours) of delay	person-hours).
Efficiency	experienced by travelers on the	
	freeway system.	
Freeway	Reduce the number of person	Hours of delay per capita or driver.
Management:	hours (or vehicle hours) of delay	
Efficiency	experienced by travelers on the	
Гиоричан	Treeway system.	Miles et LOG V er V/C > 1.0 (er ether
Freeway	miles at level of Service (LOS) X	threshold)
Efficiency	hilles at Level of Service (LOS) A	tilleshold).
Enciency Eroight Management:	Broyido froight operators with	Porcent of freight significant routes
Dotours and Pouting	traveler alerts and alternate	where traveler alerts and alternate
Detours and Kouting	routes in the case of incidents	route information is provided in the
	special events weather	case of incidents special events
	construction and severe	weather construction and severe
	congestion at choke points on X	congestion at choke points
	nercent of freight-significant	congestion at choke points.
	routes by year Y	
Special Event	Reduce average time to clear	Average time to clear event's exiting
Management:	event's exiting queue by X	queue by year per event.
Entry/Exit Travel	percent in Y years.	
Times		
Special Event	Reduce average travel time into	Average travel time away from
Management:	and out of the event by X	selected special events to a set of
Entry/Exit Travel	percent in Y years.	locations over a year.
Times	. , -	,

Objective Category	Objective	Performance Measure
Special Event	Reduce average travel time into	Average travel time to selected
Management:	and out of the event by X	special events from a set of locations
Entry/Exit Travel	percent in Y years.	in the area over a year.
Times		
Special Event	Reduce buffer time index for	Buffer time index for travelers to
Management:	travelers to multiple similar	multiple similar special events.
Entry/Exit Travel	special events by X percent in Y	
Times	years.	
Special Event	Reduce non-special event VMT	Non-special event VMT in the event
Management:	in the event area during events	area during events over a year.
Entry/Exit Travel	by X percent in Y years.	
Times		
Special Event	Increase the methods of	Number of effective methods to
Management:	effectively disseminating special	disseminate special event information
Traveler Information	event information to travelers	to travelers.
	by X percent in Y years (e.g.,	
	media releases, highway	
	advisory radio, dynamic	
	message signs, commercial AM	
	and FM radio).	
Special Event	Increase the percentage of	Percent of special events with
Management:	planned special events (with	expected attendance over Z that
Traveler Information	attendance above Z) with	traveler information is disseminated
	information on anticipated and	at least X hours prior to the event.
	actual travel conditions being	
	disseminated to the traveling	
	public at least X hours prior to	
Custom Efficiency	the event.	Cost (in dollars) of compaction on
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or
Cost of Congestion	the next X years	delay per capita.
Suctor Efficiency	Life flext X years.	Hours of dolay (norson hours)
Delay	capita by X percent by year V	Hours of delay (person-hours).
System Efficiency:	Reduce hours of delay per	Hours of delay per capita
Delay	capita by X percent by year Y	riours of delay per capita.
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-bours)
Delay	hy X nercent by year Y	
System Efficiency:	Beduce hours of delay per driver	Hours of delay per driver
Delay	hy X percent by year Y	nours of delay per driver.
System Efficiency:	Reduce the regional average	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the neak neriod using
Congestion (Travel	ner vear	congested speeds divided by the off-
Time Index)		peak period travel time, using nosted
		or free-flow speeds).
System Options:	Increase average transit load	Number of riders on various transit
Transit Use	factor by X percent by year Y.	units per trip at peak travel times.

Objective Category	Objective	Performance Measure
System Options:	Increase passenger miles	Number of passenger miles traveled
	X percent by year Y.	per capita.
System Options:	Increase transit mode share by X	Percent of all peak-period trips made
Transit Use	percent by year Y during peak periods.	by transit.
System Options:	Increase transit mode share by X	Percent of all trips made by transit.
Transit Use	percent by year Y.	
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free- flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.

Objective Category	Objective	Performance Measure
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free- flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability:	Decrease the buffer index for	The buffer index represents the extra
Travel Time Buffer	(specific travel routes) by X	time (buffer) most travelers add to
Index	percent over the next Y years.	their average travel time when
		planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Reduce the average buffer time	The buffer index represents the extra
Travel Time Butter	needed to arrive on-time for 95	time (buffer) most travelers add to
Index	percent of trips on (specified	their average travel time when
	routes) by X minutes over Y	between the average travel time and
	years.	between the average travel time and
		nercontilo) The huffer index is stated
		as a perceptage of the average travel
		time Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Reduce the variability of travel	Variance of travel time. Variance is
Variability	time on specified routes by X	the sum of the squared deviations
	percent during peak and off-	from the mean. This can also be
	peak periods by year Y.	calculated as the standard deviation
		of travel time. Standard deviation is
		the square root of variance.
Traveler Information:	Increase customer satisfaction	Customer satisfaction ratings of
Customer Satisfaction	rating of the timeliness,	timeliness, accuracy, and usefulness
	accuracy, and usefulness of	of traveler information.
	traveler information in the	
	region by W, X, and Z percent,	
	respectively, over Y years.	
Traveler Information:	Increase number of users of	Number of users of notifications for
Information	notifications for traveler	traveler information (e.g., e-mail, text
Dissemination	information (e.g., e-mail, text	message) per year.
	message) by X percent in Y	
— — — — — — — — — —	years.	
I raveler information:	increase number of visitors to	Number of visitors to traveler
Discomination	traveler information website per	mormation website per year.
DISSEMINATION	year by A percent in Y years.	
Objective Category	Objective	Performance Measure
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Traveler Information:	Increase the accuracy and	Number of complaints received from
Information	completeness of traveler	system users about inaccurate or
Dissemination	information posted (on variable	missing information.
	message signs, websites, and/or	
	web 2.0 technologies) by	
	reducing the number of	
	incomplete and inaccurate	
	reports by X percent in Y years.	
Work Zone	Provide traveler information	Percent of work zones on major
Management:	regarding work zones using	arterials, freeways, and transit routes
Traveler Information	variable message signs (VMS),	for which traveler information is
	511, traveler information	available via variable message signs
	websites, and/or Web 2.0	(VMS), 511, traveler information
	technologies for at least X	websites, and/or Web 2.0
	percent of work zones on major	technologies.
	arterials, freeways, and transit	
	routes over the next Y years.	
Work Zone	Provide travelers with	Percent of work zones on major
Management:	information on multimodal	arterials, freeways, and transit routes
Traveler Information	alternatives to avoid work zones	for which information on multimodal
	for at least X percent of work	alternatives to avoid work zones is
	zones on major arterials,	available to travelers.
	freeways, and transit routes	
	over the next Y years.	
Work Zone	Provide work zone information	Number of impacted businesses or
Management:	(for upcoming and ongoing	tenants of business centers of X
Traveler Information	construction projects) to all	employees or more receiving work
	impacted businesses or tenants	zone information (for upcoming and
	of business centers with X	ongoing construction projects).
	employees or more by year Y.	



ATIS01 – Broadcast Traveler Information

Interactive Traveler Information (ATIS02)

This service package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications between the traveler and Information Service Provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via kiosk, personal digital assistant, personal computer, and a variety of in-vehicle devices. This service package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices or remote traveler systems to better inform their customers of transportation conditions. Successful deployment of this service package relies on availability of real-time transportation data from roadway instrumentation, transit, probe vehicles or other means. A traveler may also input personal preferences and identification information via a "traveler card" that can convey information to the system about the traveler as well as receive updates from the system so the card can be updated over time.

Equipment Package Name	Subsystem
Interactive Infrastructure Information	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
ISP Traveler Information Alerts	Information Service Provider
Traveler Telephone Information	Information Service Provider
Personal Interactive Information Reception	Personal Information Access
Remote Interactive Information Reception	Remote Traveler Support
Interactive Vehicle Reception	Vehicle

Table 2.2.4-4: ATIS02 Included Equipment Packages and Subsystems

Table 2.2.4-5: ATIS02 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility, convenience, and comfort for transportation system users
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the person hours (or	Person hours (or vehicle hours) of
Management: Person	vehicle hours) of total delay	delay associated with traffic incidents.
Hours of Delay	associated with traffic incidents	
	by X percent over Y years.	
Emergency/Incident	Increase number of repeat	Number of repeat visitors to traveler
Management:	visitors to traveler information	information website (or 511 system).
Traveler Information	website (or 511 system) by X	
	percent in Y years.	
Emergency/Incident	Reduce the time between	Time between recovery from incident
Management:	recovery from incident and	and removal of traveler alerts.
Traveler Information	removal of traveler alerts for	
	that incident.	
Emergency/Incident	Reduce time between	Time to alert motorists of an
Management:	incident/emergency verification	incident/emergency.
Traveler Information	and posting a traveler alert to	
	traveler information outlets	
	(e.g., variable message signs,	
	agency website, 511 system) by	
	X minutes in Y years.	
Freeway	Reduce the number of person	Hours of delay (vehicle-hours or
Management:	hours (or vehicle hours) of delay	person-hours).
Efficiency	experienced by travelers on the	
	freeway system.	
Freeway	Reduce the number of person	Hours of delay per capita or driver.
Management:	hours (or vehicle hours) of delay	
Efficiency	experienced by travelers on the	
	freeway system.	
Freeway	Reduce the share of freeway	Miles at LOS X or V/C > 1.0 (or other
Management:	miles at Level of Service (LOS) X	threshold).
Efficiency	by Y by year Z.	

Objective Category	Objective	Performance Measure
Freight Management: Detours and Routing	Provide freight operators with traveler alerts and alternate routes in the case of incidents, special events, weather, construction, and severe congestion at choke points on X percent of freight-significant routes by year Y.	Percent of freight-significant routes where traveler alerts and alternate route information is provided in the case of incidents, special events, weather, construction, and severe congestion at choke points.
Special Event Management: Entry/Exit Travel Times	Reduce average time to clear event's exiting queue by X percent in Y years.	Average time to clear event's exiting queue by year per event.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time away from selected special events to a set of locations over a year.
Special Event Management: Entry/Exit Travel Times	Reduce average travel time into and out of the event by X percent in Y years.	Average travel time to selected special events from a set of locations in the area over a year.
Special Event Management: Entry/Exit Travel Times	Reduce buffer time index for travelers to multiple similar special events by X percent in Y years.	Buffer time index for travelers to multiple similar special events.
Special Event Management: Entry/Exit Travel Times	Reduce non-special event VMT in the event area during events by X percent in Y years.	Non-special event VMT in the event area during events over a year.
Special Event Management: Traveler Information	Increase the methods of effectively disseminating special event information to travelers by X percent in Y years (e.g., media releases, highway advisory radio, dynamic message signs, commercial AM and FM radio).	Number of effective methods to disseminate special event information to travelers.
Special Event Management: Traveler Information	Increase the percentage of planned special events (with attendance above Z) with information on anticipated and actual travel conditions being disseminated to the traveling public at least X hours prior to the event.	Percent of special events with expected attendance over Z that traveler information is disseminated at least X hours prior to the event.

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or
Cost of Congestion	cost of congestion per capita for	delay per capita.
-	the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	
System Efficiency:	Reduce the regional average	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Congestion (Travel	per year.	congested speeds, divided by the off-
Time Index)		peak period travel time, using posted
		or free-flow speeds).
System Options:	Increase average transit load	Number of riders on various transit
Transit Use	factor by X percent by year Y.	units per trip at peak travel times.
System Options:	Increase passenger miles	Number of passenger miles traveled
Transit Use	traveled per capita on transit by	per capita.
	X percent by year Y.	
System Options:	Increase transit mode share by X	Percent of all peak-period trips made
Iransit Use	percent by year Y during peak	by transit.
System Ontions:	Increase transit mode share by X	Percent of all trips made by transit
Transit Lise	nercent by year Y	referent of an trips made by transit.
System Reliability:	Reduce total person bours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per	scheduled and/or unscheduled
	capita) by time period (peak.	disruptions to travel.
	off-peak) caused by all transient	
	events such as traffic incidents,	
	special events, and work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled
Non-Recurring Delay	delay (or travel-time delay per	and/or unscheduled disruptions to
	capita) by time period (peak,	travel.
	off-peak) caused by scheduled	
	events, work zones, or system	
	maintenance by x hours in y	
	years.	
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per	scheduled and/or unscheduled
	capita) by time period (peak,	disruptions to travel.
	off-peak) caused by	
	unscheduled disruptions to	
	unscheduled disruptions to travel.	

Objective Category	Objective	Performance Measure
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free- flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free- flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off- peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Travel Weather Management: Disseminating Information	Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	Time from beginning of weather event to posting of traveler information on (variable message signs, 511, Road Weather Information Systems, public information broadcasts etc.).

Objective Category	Objective	Performance Measure
Travel Weather	Reduce time to alert travelers of	Time from beginning of weather
Management:	travel weather impacts (using	event to posting of traveler
Disseminating	variable message signs, 511,	information on agency website.
Information	road weather information	
	systems, public information	
	broadcasts, the agency's	
	website, Web 2.0 technologies,	
	etc.) by X (time period or	
	percent) in Y years.	
Traveler Information:	Increase customer satisfaction	Customer satisfaction ratings of
Customer Satisfaction	rating of the timeliness,	timeliness, accuracy, and usefulness
	accuracy, and usefulness of	of traveler information.
	traveler information in the	
	region by W, X, and Z percent,	
	respectively, over Y years.	
Traveler Information:	Increase number of 511 calls per	Number of 511 calls per year.
Information	year by X percent in Y years.	
Dissemination		
Traveler Information:	Increase number of users of	Number of users of notifications for
Information	notifications for traveler	traveler information (e.g., e-mail, text
Dissemination	information (e.g., e-mail, text	message) per year.
	message) by X percent in Y	
Turnel and the former at in an	years.	Number of visitors to travelar
I raveler information:	Increase number of visitors to	Number of visitors to traveler
Discomination	traveler information website per	information website per year.
Travelor Information	Josephered Web 2.0	Number of Web 2.0 (o.g. Twitter
Information	(e.g. Twitter Escebook)	Facebook) followers
Dissemination	followers by X percent in V	racebooky ronowers.
Dissemination	months	
Traveler Information	Increase the accuracy and	Number of complaints received from
Information	completeness of traveler	system users about inaccurate or
Dissemination	information posted (on variable	missing information.
	message signs, websites, and/or	
	web 2.0 technologies) by	
	reducing the number of	
	incomplete and inaccurate	
	reports by X percent in Y years.	
Traveler Information:	Enhance regional multimodal	The number of data sources providing
Trip Planning Tools	trip planning tools to X data	information for multi-modal trip
	sources by year Y.	planning tools.
Traveler Information:	Increase the ease of use of trip	Trip planning tools ease of use rating.
Trip Planning Tools	planning tools by X percent by	
	year Y.	

Service Packages

Objective Category	Objective	Performance Measure
Traveler Information: Trip Planning Tools	Increase the number of uses of multimodal trip planning tools by X percent by year Y.	Number of uses of trip planning tools.
Work Zone Management: Traveler Information	Provide traveler information regarding work zones using variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.	Percent of work zones on major arterials, freeways, and transit routes for which traveler information is available via variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies.
Work Zone Management: Traveler Information	Provide travelers with information on multimodal alternatives to avoid work zones for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.	Percent of work zones on major arterials, freeways, and transit routes for which information on multimodal alternatives to avoid work zones is available to travelers.
Work Zone Management: Traveler Information	Provide work zone information (for upcoming and ongoing construction projects) to all impacted businesses or tenants of business centers with X employees or more by year Y.	Number of impacted businesses or tenants of business centers of X employees or more receiving work zone information (for upcoming and ongoing construction projects).

	transit and fare schedules +	Information	traveler request +	Vehicle
Transit	transit schedule adherence	Service Provider	traveler profile	
Management	information		traveler alerts +	
	1		interactive traveler	Interactive Vehicle
Traffic			Information	Reception
Managamant	road network conditions +			
Management	incident information +		travelar request	Personal
	traffic images		traveler request +	Information
Maintenance and			traveler prome	Access
Construction	maint and constr work plans +		traveler alerts +	
Monogoment	work zone information +		interactive traveler	Personal Interactive
Management	Foadway maintenance status		information	Information Reception
11111111	1			
Emergency	incident information		travalar regresst	Domoto Trovolor
Managamant			 traveler request 	Keniole Traveler
Management				Support
]		interactive traveler	Remote Interactive
	parking lot data request		information	Information Reception
Parking				
Management	parking information		 voice-based traveler 	Telecommunications
		ISP Traveler Data	request	System for
Surface	transportation weather	Collection	voice-based traveler	Traveler Information
Transportation	information request	Travalar Talanhana	information	
Weather Service	transportation weather	Information		
(Meddier Bervice)	information		multimodal information +	+
Weather	weather information	Interactive Infrastructure	tranic images +	
Service		Information	transit service information	+→ Other ISP
		ISP Traveler Information	ncident information +	
Media -	traveler information for media	Alerts	parking information +	
			road network conditions	

ATIS02 – Interactive Traveler Information

Autonomous Route Guidance (ATIS03)

This service package relies on in-vehicle sensory, location determination, computational, map database, and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information. No communication with the infrastructure is assumed or required. Identical capabilities are available to the traveler outside the vehicle by integrating a similar suite of equipment into portable devices.

Table 2.2.4-7: ATIS03 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Personal Autonomous Route Guidance	Personal Information Access
Personal Location Determination	Personal Information Access
Vehicle Autonomous Route Guidance	Vehicle
Vehicle Location Determination	Vehicle

Table 2.2.4-8: ATIS03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users
Promote efficient system management and	Increase operational efficiency and reliability of the
operation;	transportation system

Table 2.2.4-9: ATIS03 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce vehicle miles traveled per	Average VMT per capita per day,
Vehicle Miles Traveled	capita by X percent by year Y.	per week, or per year.
System Options: Mode	Reduce per capita SOV commute	SOV commute trips per capita.
Share	trip rate by X percent in Y years.	



ATIS03 – Autonomous Route Guidance

Dynamic Route Guidance (ATIS04)

This service package offers advanced route planning and guidance that is responsive to current conditions. The package combines the autonomous route guidance user equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information, which is considered by the user equipment in provision of route guidance.

Table 2.2.4-10: ATIS04 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Basic Information Broadcast	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Personal Autonomous Route Guidance	Personal Information Access
Personal Basic Information Reception	Personal Information Access
Personal Location Determination	Personal Information Access
Basic Vehicle Reception	Vehicle
Vehicle Autonomous Route Guidance	Vehicle
Vehicle Location Determination	Vehicle

Table 2.2.4-11: ATIS04 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.4-12: ATIS04 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Person Hours of Delay	Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y years.	Person hours (or vehicle hours) of delay associated with traffic incidents.

Objective Category	Objective	Performance Measure
Freeway	Reduce the number of person	Hours of delay (vehicle-hours or
Management:	hours (or vehicle hours) of	person-hours).
Ffficiency	delay experienced by travelers	
	on the freeway system.	
Freeway	Beduce the number of person	Hours of delay per capita or driver
Management [.]	hours (or vehicle hours) of	
Ffficiency	delay experienced by travelers	
Lindenty	on the freeway system.	
Freeway	Beduce the share of freeway	Miles at LOS X or $V/C > 1.0$ (or other
Management:	miles at Level of Service (LOS) X	threshold).
Efficiency	by Y by year Z.	
Freight Management:	Provide freight operators with	Percent of freight-significant routes
Detours and Routing	traveler alerts and alternate	where traveler alerts and alternate
	routes in the case of incidents.	route information is provided in the
	special events, weather.	case of incidents, special events.
	construction, and severe	weather, construction, and severe
	congestion at choke points on	congestion at choke points.
	X percent of freight-significant	5
	routes by year Y.	
Freight Management:	Reduce buffer index on	Buffer Index on regional freight routes
Travel Time Reliability	regional freight routes during	during peak and off-peak period.
,	peak and off-peak periods by X	
	percent in Y years.	
Special Event	Reduce average time to clear	Average time to clear event's exiting
Management:	event's exiting queue by X	queue by year per event.
Entry/Exit Travel Times	percent in Y years.	
Special Event	Reduce average travel time	Average travel time away from
Management:	into and out of the event by X	selected special events to a set of
Entry/Exit Travel Times	percent in Y years.	locations over a year.
Special Event	Reduce average travel time	Average travel time to selected special
Management:	into and out of the event by X	events from a set of locations in the
Entry/Exit Travel Times	percent in Y years.	area over a year.
Special Event	Reduce buffer time index for	Buffer time index for travelers to
Management:	travelers to multiple similar	multiple similar special events.
Entry/Exit Travel Times	special events by X percent in Y	
	years.	
Special Event	Reduce non-special event VMT	Non-special event VMT in the event
Management:	in the event area during events	area during events over a year.
Entry/Exit Travel Times	by X percent in Y years.	
System Efficiency: Cost	Reduce the annual monetary	Cost (in dollars) of congestion or delay
of Congestion	cost of congestion per capita	per capita.
	for the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delav	capita by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	
System Efficiency:	Reduce the regional average	I ravel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Time Index)	per year.	congested speeds, divided by the off-
rime muex)		or free-flow speeds)
System Efficiency:	Annual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes)
Traver Time	travel time will not exceed	(Initiaces).
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X	periods (minutes).
	percent by year Y.	
System Efficiency:	Reduce vehicle miles traveled	Average VMT per capita per day, per
Vehicle Miles Traveled	per capita by X percent by year	week, or per year.
	Υ.	
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per	scheduled and/or unscheduled
	capita) by time period (peak,	disruptions to travel.
	off-peak) caused by all	
	transient events such as traffic	
	incidents, special events, and	
	work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled
Non-Recurring Delay	delay (or travel-time delay per	and/or unscheduled disruptions to
	capita) by time period (peak,	travel.
	off-peak) caused by scheduled	
	events, work zones, or system	
	years.	

Objective Category	Objective	Performance Measure
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Planning Time Index	Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Planning Time Index	Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years.	The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips. Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit. Average planning time index or planning time can be computed using a weighted average over person miles traveled.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.

Objective Category	Objective	Performance Measure
System Reliability:	Decrease the average buffer	The buffer index represents the extra
Travel Time Buffer	index for (multiple routes or	time (buffer) most travelers add to
Index	trips) by X percent over Y	their average travel time when
	years.	planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Decrease the buffer index for	The buffer index represents the extra
Travel Time Buffer	(specific travel routes) by X	time (buffer) most travelers add to
Index	percent over the next Y years.	their average travel time when
		planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buller index is stated
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time – 05th percentile travel time
		$(\min) = 3 \text{ yerge travel time (min)}$
System Reliability:	Reduce the average buffer	The huffer index represents the extra
Travel Time Buffer	time needed to arrive on-time	time (huffer) most travelers add to
Index	for 95 percent of trips on	their average travel time when
muck	(specified routes) by X minutes	planning trips. This is the extra time
	over Y years.	between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Reduce the variability of travel	Variance of travel time. Variance is
Variability	time on specified routes by X	the sum of the squared deviations
	percent during peak and off-	from the mean. This can also be
	peak periods by year Y.	calculated as the standard deviation of
		travel time. Standard deviation is the
		square root of variance.

Service Packages

Objective Category	Objective	Performance Measure
Work Zone Management: Traveler Information	Provide traveler information regarding work zones using variable message signs (VMS),	Percent of work zones on major arterials, freeways, and transit routes for which traveler information is
	511, traveler information websites, and/or Web 2.0 technologies for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.	available via variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies.
Work Zone Management: Traveler Information	Provide travelers with information on multimodal alternatives to avoid work zones for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.	Percent of work zones on major arterials, freeways, and transit routes for which information on multimodal alternatives to avoid work zones is available to travelers.

ATIS04 – Dynamic Route Guidance



ISP Based Trip Planning and Route Guidance (ATIS05)

This service package offers the user trip planning and en-route guidance services. It generates a trip plan, including a multimodal route and associated service information (e.g., parking information), based on traveler preferences and constraints. Routes may be based on static information or reflect real time network conditions. Unlike ATIS3 and ATIS4, where the user equipment determines the route, the route determination functions are performed in the Information Service Provider Subsystem in this service package. The trip plan may be confirmed by the traveler and advanced payment and reservations for transit and alternate mode (e.g., airline, rail, and ferry) trip segments, and ancillary services (e.g., parking reservations) are accepted and processed. The confirmed trip plan may include specific routing information that can be supplied to the traveler as general directions or as turn-by-turn route guidance depending on the level of user equipment.

Equipment Package Name	Subsystem	
Infrastructure Provided Trip Planning	Information Service Provider	
ISP Traveler Data Collection	Information Service Provider	
Personal Location Determination	Personal Information Access	
Personal Trip Planning and Route Guidance	Personal Information Access	
Remote Interactive Information Reception	Remote Traveler Support	
Vehicle Location Determination	Vehicle	
Vehicle Trip Planning and Route Guidance	Vehicle	

Table 2.2.4-13: ATIS05 Included Equipment Packages and Subsystems

Table 2.2.4-14: ATIS05 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility, convenience, and comfort for transportation system users
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;	Reduce environmental impacts
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.4-15: ATIS05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the annual monetary cost of	Cost (in dollars) of congestion or
Cost of Congestion	congestion per capita for the next X	delay per capita.
	years.	
System Efficiency:	Reduce hours of delay per capita by X	Hours of delay (person-hours).
Delay	percent by year Y.	
System Efficiency:	Reduce hours of delay per capita by X	Hours of delay per capita.
Delay	percent by year Y.	
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay (person-hours).
Delay	percent by year Y.	
System Efficiency:	Reduce hours of delay per driver by X	Hours of delay per driver.
Delay	percent by year Y.	
System Efficiency:	Reduce excess fuel consumed due to	Excess fuel consumed (total or
Energy Consumption	congestion by X percent by year Y.	per capita).
System Efficiency:	Reduce total energy consumption per	lotal energy consumed per capita
Energy Consumption	capita for transportation by X percent	for transportation.
Custom Efficiency	by year Y.	Tatal final ann ann an dia an ann ite
System Efficiency:	Reduce total fuel consumption per	for transportation
Energy Consumption	by year V	
System Efficiency:	Reduce the regional average travel	Travel time index (the average
Intensity of	time index by X percent per year	travel time during the neak
Congestion (Travel		period, using congested speeds.
Time Index)		divided by the off-peak period
,		travel time, using posted or free-
		flow speeds).
System Efficiency:	Annual rate of change in regional	Average commute trip travel time
Travel Time	average commute travel time will not	(minutes).
	exceed regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time during	Average travel time during peak
Travel Time	peak periods by X percent by year Y.	periods (minutes).
System Efficiency:	Reduce vehicle miles traveled per	Average VMT per capita per day,
Vehicle Miles	capita by X percent by year Y.	per week, or per year.
Traveled		
Travel Demand	Annually update bicycle/pedestrian	Number of months since the last
Malking (Disusling	map for accuracy.	update of the bicycle/pedestrian
	In an a set the sum has a four ileble	map.
Managamenti	Increase the number of available	higher of traveler tools with a
Walking/Ricycling	bicycle/pedestrian component by X	bicycle/pedestnan component.
waiking/ Dicycling	nercent by year Y	
Travel Demand	Increase the number of travelers	Number of travelers commuting
Management:	commuting via walking and/or	via walking and/or bicycling.
Walking/Bicvcling	bicycling by X percent over Y years.	

Objective Category	Objective	Performance Measure
Traveler	Increase customer satisfaction rating	Customer satisfaction ratings of
Information:	of the timeliness, accuracy, and	timeliness, accuracy, and
Customer	usefulness of traveler information in	usefulness of traveler
Satisfaction	the region by W, X, and Z percent,	information.
	respectively, over Y years.	
Traveler	Enhance regional multimodal trip	The number of data sources
Information: Trip	planning tools to X data sources by	providing information for multi-
Planning Tools	year Y.	modal trip planning tools.
Traveler	Increase the ease of use of trip	Trip planning tools ease of use
Information: Trip	planning tools by X percent by year Y.	rating.
Planning Tools		
Traveler	Increase the number of uses of	Number of uses of trip planning
Information: Trip	multimodal trip planning tools by X	tools.
Planning Tools	percent by year Y.	
Work Zone	Provide traveler information	Percent of work zones on major
Management:	regarding work zones using variable	arterials, freeways, and transit
Traveler Information	message signs (VMS), 511, traveler	routes for which traveler
	information websites, and/or Web	information is available via
	2.0 technologies for at least X percent	variable message signs (VMS),
	of work zones on major arterials,	511, traveler information
	freeways, and transit routes over the	websites, and/or Web 2.0
	next Y years.	technologies.
Work Zone	Provide travelers with information on	Percent of work zones on major
Management:	multimodal alternatives to avoid	arterials, freeways, and transit
Traveler Information	work zones for at least X percent of	routes for which information on
	work zones on major arterials,	multimodal alternatives to avoid
	freeways, and transit routes over the	work zones is available to
	next Y years.	travelers.



ATIS05 - ISP Based Trip Planning and Route Guidance

Transportation Operations Data Sharing (ATIS06)

This service package makes real-time transportation operations data available to transportation system operators. The Information Service Provider collects, processes, and stores current information on traffic and travel conditions and other information about the current state of the transportation network and makes this information available to transportation system operators, facilitating the exchange of qualified, real-time information between agencies. Using the provided information, transportation system operators can manage their individual systems based on an overall view of the regional transportation system. The regional transportation operations data resource represented by the Information Service Provider may be implemented as a web application that provides a web-based access to system operators, an enterprise database that provides a network interface to remote center applications, or any implementation that supports regional sharing of real-time transportation operations data.

Equipment Package Name	Subsystem	
Emergency Transportation Operations Data	Emergency Management	
Collection		
ISP Operational Data Repository	Information Service Provider	
ISP Traveler Data Collection	Information Service Provider	
MCM Transportation Operations Data Collection	Maintenance and Construction	
	Management	
TMC Transportation Operations Data Collection	Traffic Management	
Transit Transportation Operations Data Collection	Transit Management	

Table 2.2.4-16: ATIS06 Included Equipment Packages and Subsystems

Table 2.2.4-17: ATIS06 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation system

Table 2.2.4-18: ATIS06 Associated Objectives and Performance Measures

Objective Category Objective

Performance Measure

Objective Category	Objective	Performance Measure
Integration:	Enhance planning with better data	Amount of data gathered from
Transportation Data		ITS enhancements used in
Collection		infrastructure and operations
		planning
Integration:	Enhance planning with better data	Number of planning activities
Transportation Data		using data from ITS systems
Collection		
Integration:	Enhance planning with better data	Years of data in database that is
Transportation Data		easily searchable and
Collection		extractable
System Efficiency: Trip	Reduce cost of transfer fees paid by	Average cost of transfers.
Connectivity	X percent by year Y.	
System Efficiency: Trip	Reduce door-to-door trip time by X	Average door-to-door trip time.
Connectivity	percent by year Y.	
Traveler Information:	Increase the percent of modes in the	Percent of modes in the region
Data Collection and	region that share their traveler	that share their traveler
Sharing on Travel	information with other modes in the	information with other modes.
Conditions	region to 100 percent by Y year.	
Traveler Information:	Increase the percent of the	Percent of the transportation
Data Collection and	transportation system in which travel	system in which travel
Sharing on Travel	conditions can be detected remotely	conditions can be detected
Conditions	via CCTV, speed detectors, etc. to X	remotely via CCTV, speed
	percent by Y year.	detectors, etc.
Traveler Information:	Increase the percent of	Percent of transportation
Data Collection and	transportation facilities whose	facilities whose owners share
Sharing on Travel	owners share their traveler	their traveler information with
Conditions	information with other agencies in	other agencies in the region.
	the region to X percent by Y year.	



ATIS06 – Transportation Operations Data Sharing

Travel Services Information and Reservation (ATIS07)

This service package provides travel information and reservation services to the user. These additional traveler services may be provided using the same basic user equipment used for Interactive Traveler Information. This service package provides multiple ways for accessing information either while en route in a vehicle using wide-area wireless communications or pre-trip via fixed-point to fixed-point connections.

Table 2.2.4-19: ATIS07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
ISP Travel Services Information and Reservation	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Personal Interactive Information Reception	Personal Information Access
Remote Interactive Information Reception	Remote Traveler Support
Interactive Vehicle Reception	Vehicle

Table 2.2.4-20: ATIS07 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of	Enhance mobility, convenience, and comfort for
people and for freight;	transportation system users

Table 2.2.4-21: ATIS07 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Options: Mode Share	Achieve X percent alternative (non-SOV) mode share in transit station communities (or other destinations) by year Y.	Percent of all trips made using alternative modes in transit station communities.
System Options: Transit Use	Increase transit mode share by X percent by year Y.	Percent of all trips made by transit.



ATIS07 – Travel Services Information and Reservation

Dynamic Ridesharing (ATIS08)

This service package provides dynamic ridesharing/ride matching services to travelers. This service could allow near real time ridesharing reservations to be made through the same basic user equipment used for Interactive Traveler Information. This ridesharing/ride matching capability also includes arranging connections to transit or other multimodal services.

Table 2.2.4-22: ATIS08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Infrastructure Provided Dynamic Ridesharing	Information Service Provider
Infrastructure Provided Trip Planning	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Personal Interactive Information Reception	Personal Information Access
Remote Interactive Information Reception	Remote Traveler Support
Vehicle Trip Planning and Route Guidance	Vehicle

Table 2.2.4-23: ATIS08 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.4-24: ATIS08 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Special Event Management: Mode Shift from SOV	Decrease the percent of special event attendees traveling to the event in single-occupancy vehicles by X percent in Y years.	Percent of special event attendees using single-occupancy vehicles each year for selected events.
Special Event Management: Mode Shift from SOV	Increase the percent of special event attendees using park & ride lots by X percent in Y years.	Percent of special event attendees utilizing park & ride lots each year for selected events.

Objective Category	Objective	Performance Measure
Special Event	Increase the percent of special	Percent of special events with
Management: Mode	events with dedicated shuttle	dedicated shuttle service for selected
Shift from SOV	service by X percent in Y years.	events during a 1-year period.
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay
Cost of Congestion	cost of congestion per capita for	per capita.
, , , , , , , , , , , , , , , , , , ,	the next X years.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay per capita.
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0 (or
Duration of	recurring congestion on major	other threshold).
Congestion	freeways from X to Y by year Z.	
System Efficiency:	Reduce the number of hours per	Hours per day at LOS F or V/C > 1.0 (or
Duration of	day that the top 20 most	other threshold).
Congestion	congested roadways experience	
	recurring congestion by X	
	percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	
System Efficiency:	Maintain the rate of growth in	Percent of lane-miles (or rail)
Extent of Congestion	facility miles experiencing	operating at LOS F or $V/C > 1.0$
	recurring congestion as less than	
	the population growth rate (or	
	employment growth rate).	
System Efficiency:	Reduce the percentage of	Percent of lane-miles (or rail)
Extent of Congestion	facility miles (nignway, arterial,	operating at LOS F or $V/C > 1.0$
	rail, etc.) experiencing recurring	
	congestion during the peak	
Suctor Efficiency	Period by X percent by year Y.	Demonst of interrepetience encreting at
System Efficiency:	Reduce the share of major	Percent of intersections operating at
Extent of Congestion	hu V percent by year V	LOS F OF V/C > 1.0
	by x percent by year Y.	

Service Packages

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the regional average	Travel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Congestion (Travel	per year.	congested speeds, divided by the off-
Time Index)	. ,	peak period travel time, using posted
,		or free-flow speeds).
System Efficiency:	Annual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes).
	travel time will not exceed	
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X	periods (minutes).
	percent by year Y.	
System Efficiency:	Reduce vehicle miles traveled	Average VMT per capita per day, per
Vehicle Miles	per capita by X percent by year	week, or per year.
Traveled	Υ.	
System Options:	Achieve X percent alternative	Percent of all trips made using
Mode Share	(non-SOV) mode share in transit	alternative modes in transit station
	station communities (or other	communities.
	destinations) by year Y.	
System Options:	Increase alternative (non-SOV)	Share of trips by each mode of travel.
Mode Share	mode share for all trips by X	
	percent within the next Y years.	
System Options:	Reduce SOV vehicle trips by X	Share of employees walking, biking,
Mode Share	percent through travel demand	telecommuting,
	management strategies (e.g.,	carpooling/vanpooling, riding transit,
	employer or residential	driving alone.
	rideshare) by year Y.	
Travel Demand	Create and share regional	Number of employers with access to
Management:	carpool/vanpool database with 2	regional carpool/vanpool database.
Carpool/Vanpool	number of employers per year.	
Iravel Demand	Increase the number of carpools	Share of household trips by each
	by X percent over the next Y	mode of travel.
Travel Domand	Jacrosso uso of vanpools by X	Sharo of household trins by each
Management:	norcont over the payt V years	mode of travel
	percent over the next T years.	
Travel Demand	Provide carpool/vappool	Availability of carpool/vappool
Management:	matching and ridesharing	matching and ridesharing information
Carpool/Vanpool	information services by year Y	services.
Travel Demand	Reduce trips per year in region	Number of person trips by
Management:	by X percent through	carpool/vanpool in region.
Carpool/Vanpool	carpools/vanpools.	
Travel Demand	Reduce trips per year in region	Number of trips in region.
Management:	by X percent through	
Carpool/Vanpool	carpools/vanpools.	



ATIS08 - Dynamic Ridesharing

In Vehicle Signing (ATIS09)

This service package augments regulatory, warning, and informational signs and signals by providing information directly to drivers through in-vehicle devices. The information provided would include static sign information (e.g., stop, curve warning, guide signs, service signs, and directional signs) and dynamic information (e.g., current signal states including highway intersection and highway-rail intersection status and local conditions warnings identified by local environmental sensors). It includes short range communications between field equipment and the vehicle and connections to the Traffic Management Subsystem for monitoring and control. This service package also includes the capability for maintenance and construction, transit, and emergency vehicles to transmit sign information to vehicles in the vicinity so that in vehicle signing can be used without fixed infrastructure in work zones, around incidents, and in areas where transit operations impacts traffic.

Equipment Package Name	Subsystem
On-board EV Incident Management Communication	Emergency Vehicle
MCV Vehicle Safety Monitoring	Maintenance and Construction
	Vehicle
Parking Short Range Traveler Information	Parking Management
Communications	
Roadway Equipment Coordination	Roadway
Roadway Short Range Traveler Information	Roadway
Communications	
TMC In-Vehicle Signing Management	Traffic Management
On-board Transit In Vehicle Signing Communications	Transit Vehicle
Vehicle Short Range Traveler Information Reception	Vehicle

Table 2.2.4-25: ATIS09 Included Equipment Packages and Subsystems

Table 2.2.4-26: ATIS09 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Increase the safety of the transportation system for motorized and	Improve the safety of the
nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system

MetroFactor	Goal
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;	Reduce environmental impacts
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.4-27: ATIS09 Associated Objectives and Performance Measures

Arterial Management:Reduce delay associated with incidents on arterials by X percent by year Y.Hours of delay associated with incidents.Emergency/IncidentReduce the person hours (or vehicle hours) of total delayPerson hours (or vehicle hours) of delay associated with traffic incidents.
Reliability incidents on arterials by X incidents. percent by year Y. percent by year Y. percent by year Y. Emergency/Incident Reduce the person hours (or vehicle hours) of total delay. percent by year Y.
percent by year Y. Emergency/Incident Reduce the person hours (or Person hours (or vehicle hours) of Management: Person vehicle hours) of total delay
Emergency/Incident Reduce the person hours (or Person hours (or vehicle hours) of
Managamant: Darcan Luabicla bourch at total dalay Laborated with trattic incidents
Wanagement. Person vehicle hours) of total delay delay associated with tranic incidents.
Hours of Delay associated with traffic incidents
by X percent over Y years.
Emergency/incident Reduce the time between Time between recovery from incident
Traveler Information removal of traveler alerts for
that incident
Emergency/Incident Reduce time between Time to alert motorists of an
Management: incident / amergency, verification / incident / amergency
Traveler Information and posting a traveler alert to
traveler information outlets
(e.g., variable message signs.
agency website, 511 system) by
X minutes in Y years.
Freeway Reduce the number of person Hours of delay (vehicle-hours or
Management: hours (or vehicle hours) of delay person-hours).
Efficiency experienced by travelers on the
freeway system.
FreewayReduce the number of personHours of delay per capita or driver.
Management: hours (or vehicle hours) of delay
Efficiency experienced by travelers on the
freeway system.
Freeway Reduce the share of freeway Miles at LOS X or V/C > 1.0 (or other
Management: miles at Level of Service (LOS) X threshold).
Efficiency by Y by year 2.
Freeway Reduce buffer index on the The buffer index (represents the extra
Invianagement: Treeway system during peak time (butter) travelers add to their
Reliability and oil-peak periods by X average travel time when planning
percent in r years. In order to arrive on-time 95

Objective Category	Objective	Performance Measure
Freeway	Reduce delay associated with	Hours of delay associated with
, Management:	incidents on the freeway system	, incidents.
Reliability	by X percent by year Y.	
Freight Management:	Provide freight operators with	Percent of freight-significant routes
Detours and Routing	traveler alerts and alternate	where traveler alerts and alternate
_	routes in the case of incidents,	route information is provided in the
	special events, weather,	case of incidents, special events,
	construction, and severe	weather, construction, and severe
	congestion at choke points on X	congestion at choke points.
	percent of freight-significant	
	routes by year Y.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or delay
Cost of Congestion	cost of congestion per capita for	per capita.
	the next X years.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per driver.
Delay	driver by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	—
System Efficiency:	Reduce the regional average	I ravel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
	per year.	congested speeds, divided by the off-
nme index)		peak period travel time, using posted
System Efficiency:	Appual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes)
I aver fille	travel time will not exceed	(minutes).
	regional rate of population	
	growth through the year Y	
System Efficiency:	Improve average travel time	Average travel time during neak
Travel Time	during peak periods by X	periods (minutes).
	percent by year Y.	
Objective Category	Objective	Performance Measure
--	---	--
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by all transient events such as traffic incidents, special events, and work zones.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by scheduled events, work zones, or system maintenance by x hours in y years.	Travel time delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Non-Recurring Delay	Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by unscheduled disruptions to travel.	Total person hours of delay during scheduled and/or unscheduled disruptions to travel.
System Reliability: Travel Time 90th/95th Percentile	Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time 90th/95th Percentile	Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.	95th or 90th percentile travel times for selected routes.
System Reliability: Travel Time Buffer Index	Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Decrease the buffer index for (specific travel routes) by X percent over the next Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off- peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
I ravel weather Management: Disseminating Information	keduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	to posting of traveler information on (variable message signs, 511, Road Weather Information Systems, public information broadcasts etc.).

Objective Category	Objective	Performance Measure
Travel Weather Management: Disseminating Information	Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	Time from beginning of weather event to posting of traveler information on agency website.
Traveler Information: Information Dissemination	Increase number of users of notifications for traveler information (e.g., e-mail, text message) by X percent in Y years.	Number of users of notifications for traveler information (e.g., e-mail, text message) per year.
Traveler Information: Information Dissemination	Increase the accuracy and completeness of traveler information posted (on variable message signs, websites, and/or web 2.0 technologies) by reducing the number of incomplete and inaccurate reports by X percent in Y years.	Number of complaints received from system users about inaccurate or missing information.



ATIS09 - In Vehicle Signing

Short Range Communications Traveler Information (ATIS10)

This service package provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility applications for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass DSRC roadside equipment along their route. This service package provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.

Table 2.2.4-28: ATIS10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
ISP Short Range Communications Traveler Information Distribution	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Roadway Short Range Traveler Information Communications	Roadway
Vehicle Short Range Traveler Information Reception	Vehicle

Table 2.2.4-29: ATIS10 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people and for freight;	Enhance mobility,
	convenience, and comfort
	for transportation system
	users
Increase the safety of the transportation system for motorized and	Improve the safety of the
nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local	
planned growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.4-30: ATIS10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Arterial Management:	Reduce delay associated with	Hours of delay associated with
Reliability	incidents on arterials by X	incidents.
	percent by year Y.	

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the person hours (or	Person hours (or vehicle hours) of
Management: Person	vehicle hours) of total delay	delay associated with traffic incidents.
Hours of Delay	associated with traffic incidents	
	by X percent over Y years.	
Emergency/Incident	Reduce the time between	Time between recovery from incident
Management:	recovery from incident and	and removal of traveler alerts.
Traveler Information	removal of traveler alerts for	
	that incident.	
Emergency/Incident	Reduce time between	Time to alert motorists of an
Management:	incident/emergency verification	incident/emergency.
Traveler Information	and posting a traveler alert to	
	traveler information outlets	
	(e.g., variable message signs,	
	agency website, 511 system) by	
	X minutes in Y years.	
Freeway	Reduce the number of person	Hours of delay (vehicle-hours or
Management:	hours (or vehicle hours) of delay	person-hours).
Efficiency	experienced by travelers on the	
-	freeway system.	
Freeway	Reduce the number of person	Hours of delay per capita or driver.
Fficiency	oversions of vehicle nours) of delay	
Efficiency	freeway system	
Frooway	Reduce the charge of freeway	Miles at LOS X or $V/C > 1.0$ (or other
Management:	miles at Level of Service (LOS) X	threshold)
Efficiency	hilles at Level of Service (LOS) X	theshold).
Erreeway	Beduce buffer index on the	The huffer index (represents the extra
Management:	freeway system during peak and	time (buffer) travelers add to their
Reliability	off-peak periods by X percent in	average travel time when planning
	Y vears.	trips in order to arrive on-time 95
	.,	percent of the time).
Freeway	Reduce delay associated with	Hours of delay associated with
Management:	incidents on the freeway system	incidents.
Reliability	by X percent by year Y.	
Freight Management:	Provide freight operators with	Percent of freight-significant routes
Detours and Routing	traveler alerts and alternate	where traveler alerts and alternate
	routes in the case of incidents,	route information is provided in the
	special events, weather,	case of incidents, special events,
	construction, and severe	weather, construction, and severe
	congestion at choke points on X	congestion at choke points.
	percent of freight-significant	
	routes by year Y.	
System Efficiency:	Reduce the annual monetary	Cost (in dollars) of congestion or
Cost of Congestion	cost of congestion per capita for	delay per capita.
	the next X years.	

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce hours of delay per	Hours of delay (person-hours).
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per	Hours of delay per capita.
Delay	capita by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	
System Efficiency:	Reduce excess fuel consumed	Excess fuel consumed (total or per
Energy Consumption	due to congestion by X percent	capita).
	by year Y.	
System Efficiency:	Reduce total energy	Total energy consumed per capita for
Energy Consumption	consumption per capita for	transportation.
	transportation by X percent by	
	year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy Consumption	per capita for transportation by	transportation.
	X percent by year Y.	-
System Efficiency:	Reduce the regional average	I ravel time index (the average travel
Intensity of	travel time index by X percent	time during the peak period, using
Congestion (Travel	per year.	congested speeds, divided by the off-
Time muex)		or free-flow speeds)
System Efficiency:	Appual rate of change in	Average commute trip travel time
Travel Time	regional average commute	(minutes)
indver fille	travel time will not exceed	(Initiaces).
	regional rate of population	
	growth through the year Y.	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X	periods (minutes).
	percent by year Y.	
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non-Recurring Delay	delay (or travel-time delay per	scheduled and/or unscheduled
	capita) by time period (peak,	disruptions to travel.
	off-peak) caused by all transient	
	events such as traffic incidents,	
	special events, and work zones.	
System Reliability:	Reduce total person hours of	Travel time delay during scheduled
Non-Recurring Delay	delay (or travel-time delay per	and/or unscheduled disruptions to
	capita) by time period (peak,	travel.
	ott-peak) caused by scheduled	
	events, work zones, or system	
	maintenance by x hours in y	
	years.	

Objective Category	Ohiective	Performance Measure
System Reliability:	Reduce total person hours of	Total person hours of delay during
Non Pocurring Dolay	delay (or travel time delay per	schodulod and/or unschodulod
Non-Necurring Delay	capita) by time period (peak	disruptions to travel
	off pook) caused by	
	Un-peak) caused by	
	travel	
System Deliability	Lidvel.	OFth or 00th percentile travel times
Travel Time	nercentile travel times for each	for colocted routes
	percentile travel times for each	for selected foutes.
90th/95th Percentile	Y was the selected by X percent over	
Custom Deliebilitur	Y years.	
System Reliability:	(an Ofth) is a second black the second b	for sole stad you to a
	(or 95th) percentile travel times	for selected routes.
90th/95th Percentile	for (a group of specific travel	
	routes or trips in the region) by	
	X minutes in Y years.	
System Reliability:	Decrease the average buffer	The buffer index represents the extra
Travel Time Buffer	index for (multiple routes or	time (buffer) most travelers add to
Index	trips) by X percent over Y years.	their average travel time when
		planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time. Average buffer index or buffer
		time can be calculated using miles
		traveled as a weighting factor. Buffer
		time = 95th percentile travel time
		(min) – average travel time (min).
System Reliability:	Decrease the buffer index for	The buffer index represents the extra
Travel Time Butter	(specific travel routes) by X	time (buffer) most travelers add to
Index	percent over the next Y years.	their average travel time when
		planning trips. This is the extra time
		between the average travel time and
		near-worst case travel time (95th
		percentile). The buffer index is stated
		as a percentage of the average travel
		time can be calculated using with
		time can be calculated using miles
		tiaveleu as a weighting factor. Butter
		time = 95th percentile travel time
		(min) – average travel time (min).

Objective Category	Objective	Performance Measure
System Reliability: Travel Time Buffer Index	Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.	The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time. Average buffer index or buffer time can be calculated using miles traveled as a weighting factor. Buffer time = 95th percentile travel time (min) – average travel time (min).
System Reliability: Variability	Reduce the variability of travel time on specified routes by X percent during peak and off- peak periods by year Y.	Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Travel Weather Management: Disseminating Information	Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	Time from beginning of weather event to posting of traveler information on (variable message signs, 511, Road Weather Information Systems, public information broadcasts etc.).
Travel Weather Management: Disseminating Information	Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.	Time from beginning of weather event to posting of traveler information on agency website.
Traveler Information: Customer Satisfaction	Increase customer satisfaction rating of the timeliness, accuracy, and usefulness of traveler information in the region by W, X, and Z percent, respectively, over Y years.	Customer satisfaction ratings of timeliness, accuracy, and usefulness of traveler information.

Objective Category	Objective	Performance Measure
Traveler Information:	Increase number of users of	Number of users of notifications for
Information	notifications for traveler	traveler information (e.g., e-mail, text
Dissemination	information (e.g., e-mail, text	message) per year.
	message) by X percent in Y	
	years.	
Traveler Information:	Increase the accuracy and	Number of complaints received from
Information	completeness of traveler	system users about inaccurate or
Dissemination	information posted (on variable	missing information.
	message signs, websites, and/or	
	web 2.0 technologies) by	
	reducing the number of	
	incomplete and inaccurate	
	reports by X percent in Y years.	
Work Zone	Provide traveler information	Percent of work zones on major
Management:	regarding work zones using	arterials, freeways, and transit routes
Traveler Information	variable message signs (VMS),	for which traveler information is
	511, traveler information	available via variable message signs
	websites, and/or Web 2.0	(VMS), 511, traveler information
	technologies for at least X	websites, and/or Web 2.0
	percent of work zones on major	technologies.
	arterials, freeways, and transit	
	routes over the next Y years.	
Work Zone	Provide travelers with	Percent of work zones on major
Management:	information on multimodal	arterials, freeways, and transit routes
Traveler Information	alternatives to avoid work zones	for which information on multimodal
	for at least X percent of work	alternatives to avoid work zones is
	zones on major arterials,	available to travelers.
	freeways, and transit routes	
	over the next Y years.	



ATIS10 – Short Range Communications Traveler Information

2.2.5 Commercial Vehicle Operations Service Packages

Carrier Operations and Fleet Management (CVO01)

This service package provides the capabilities to manage a fleet of commercial vehicles. The Fleet and Freight Management subsystem provides the route for a commercial vehicle by either utilizing an in-house routing software package or an Information Service Provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). Any such restricted areas are determined by the Commercial Vehicle Administration. A route would be electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management subsystem and routing changes can be made depending on current road network conditions. Once a route has been assigned, changes must be coordinated between the Fleet and Freight Management subsystem and the Commercial Vehicle. Commercial Vehicle Drivers would be alerted to any changes in route from the planned route and given an opportunity to justify a rerouting. Any unauthorized or unexpected route changes by the Commercial Vehicle will register a route deviation alert with the Fleet and Freight Management subsystem. The Fleet and Freight Management subsystem can also notify local public safety agencies of the route deviation when appropriate (e.g., if there is safety sensitive HAZMAT being carried), by sending an alarm to the Emergency Management subsystem.

Table 2.2.5-1: CVO01 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board Trip Monitoring	Commercial Vehicle
Fleet Administration	Fleet and Freight Management

Table 2.2.5-2: CVO01 Associated Planning Factors and Goals

MetroFactor	Goal
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness, productivity, and	productivity and development
efficiency;	

Table 2.2.5-3: CVO01	Associated Objectives and Performance Measures	
10010 2.2.0 0. 01001	issociated objectives and renormance measures	

Objective Category	Objective	Performance Measure
Freight	Increase ratings for customer satisfaction	Percentage of customers
Management:	with freight mobility in the region among	satisfied with region's freight
Customer	shippers, receivers, and carriers by X	management practices.
Satisfaction	percent in Y years.	
Freight	Decrease point-to-point travel times on	Point-to-point travel times
Management: Travel	selected freight-significant highways by Y	on selected freight-
Time Delay	minutes within Y years.	significant highways.



CVO01 – Carrier Operations and Fleet Management

Freight Administration (CVO02)

This service package tracks the movement of cargo and monitors the cargo condition. Interconnections are provided to intermodal freight shippers and intermodal freight depots for tracking of cargo from source to destination. In addition to the usual cargo monitoring required to insure that cargo gets from origin to destination, the Fleet and Freight Management subsystem monitors shipments to make sure that no tampering or breach of security occurs to the cargo on commercial vehicles. Any such tampering will be reported to the Fleet and Freight Management subsystem. In addition to exceptions (e.g., alerts) that are reported, on-going indications of the state of the various freight equipment are reported to the Fleet and Freight Management subsystem. The commercial vehicle driver is also alerted of any tampering or breach of cargo security. Freight managers may decide to take further action on the alerts and/or provide responses that explain that the alerts are false alarms. If no explanation is received, the Fleet and Freight Management subsystem may notify the Emergency Management subsystem. Commercial vehicle and freight security breaches may also be sent to the Commercial Vehicle Check subsystem.

Table 2.2.5-4: CVO02 Included	Equipment	Packages and	Subsystems
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Equipment Package Name	Subsystem
On-board Cargo Monitoring	Commercial Vehicle
On-board CV Safety and Security	Commercial Vehicle
On-board Trip Monitoring	Commercial Vehicle
Roadside Safety and Security Inspection	Commercial Vehicle Check
Commercial Vehicle and Freight Security	Fleet and Freight Management
Fleet Administration	Fleet and Freight Management
Freight Administration and Management	Fleet and Freight Management

Table 2.2.5-5: CVO02 Associated Planning Factors and Goals

MetroFactor	Goal
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency:	Support regional economic productivity and development

Table 2.2.5-6: CVO02 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Reduce the average duration	Average duration of delays per month at
Management:	of delays per month at	intermodal facilities.
Intermodal Facilities	intermodal facilities by X	
	percent in Y years.	

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Freight	Reduce the frequency of delays	Frequency of delays per month at
Management:	per month at intermodal	intermodal facilities where a delay is
Intermodal Facilities	facilities by X percent in Y	defined as an addition of Z minutes to
	years.	free flow conditions.





Electronic Clearance (CVO03)

This service package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and Field-Vehicle Communications to the roadside. Results of roadside clearance activities will be passed on to the Commercial Vehicle Administration. The roadside check facility may be equipped with Automated Vehicle Identification (AVI), weighing sensors, transponder read/write devices and computer workstations.

Table 2.2.5-7: CVO03 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board CV Electronic Data	Commercial Vehicle
CV Information Exchange	Commercial Vehicle Administration
CV Safety and Security Administration	Commercial Vehicle Administration
Citation and Accident Electronic Recording	Commercial Vehicle Check
Roadside Electronic Screening	Commercial Vehicle Check

Table 2.2.5-8: CVO03 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.5-9: CVO03 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Increase the use of electronic	Percent of weigh stations and
Management:	credentialing to X percent of weigh	border crossings in the region
Border Crossing	stations and border crossings by year Y.	that use electronic
		credentialing.
Freight	Increase ratings for customer	Percentage of customers
Management:	satisfaction with freight mobility in the	satisfied with region's freight
Customer	region among shippers, receivers, and	management practices.
Satisfaction	carriers by X percent in Y years.	

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Freight	Decrease hours of delay per 1,000	Hours of delay per 1,000
Management: Travel	vehicle miles traveled on selected	vehicle miles on selected
Time Delay	freight-significant highways by X percent	freight-significant highways.
	in Y years.	
Freight	Decrease point-to-point travel times on	Point-to-point travel times on
Management: Travel	selected freight-significant highways by	selected freight-significant
Time Delay	Y minutes within Y years.	highways.
Freight	Decrease the annual average travel time	Travel time index: ratio of
Management: Travel	index for freight by X points in Y years.	observed average travel time
Time Delay		to free-flow travel time.
Freight	Increase the mobility index ([Ton-miles	
Management: Travel	of travel] / [Vehicle-miles of travel *	
Time Delay		
Average speed]) by	Mobility index for system users defined	
X percent in Y years.	as [Ton-miles of travel] / [Vehicle-miles	
	of travel * Average speed].	
Freight	Reduce buffer index on regional freight	Buffer Index on regional freight
Management: Travel	routes during peak and off-peak periods	routes during peak and off-
Time Reliability	by X percent in Y years.	peak period.



CVO03 - Electronic Clearance

CV Administrative Processes (CVO04)

This service package supports program administration and enrollment and provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in a variety of programs including electronic clearance and wireless inspection programs which allow commercial vehicles to be screened at mainline speeds. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration subsystem and snapshots of this data are made available to the roadside check facilities. Current program status is maintained and made available to carriers, drivers, and other authorized users of the data. Enrolled carriers are provided the option to review and challenge the collected data.

Commercial Vehicle Administration subsystems can share current program status and credential information with other Commercial Vehicle Administration subsystems, so that it is possible for any Commercial Vehicle Administration subsystem to have access to all credentials, credential fees, credentials status and safety status information. In addition, it is possible for one Commercial Vehicle Administration subsystem to collect HAZMAT route restrictions information from other Commercial Vehicle Administration subsystems and then act as a clearinghouse for this route restrictions information for Information Service Providers, Map Update Providers, and Fleet and Freight Management subsystems.

Equipment Package Name	Subsystem
Credentials and Taxes Administration	Commercial Vehicle Administration
CV Information Exchange	Commercial Vehicle Administration
Fleet Administration	Fleet and Freight Management
Fleet Credentials and Taxes Management and Reporting	Fleet and Freight Management

Table 2.2.5-10: CVO04 Included Equipment Packages and Subsystems

Table 2.2.5-11: CVO04 Associated Planning Factors and Goals

MetroFactor	Goal
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness, productivity, and	productivity and development
efficiency;	

Table 2.2.5-12: CVO04 Associated Objectives and Performance Measures

Objective Category Objective

Performance Measure

Objective Category	Objective	Performance Measure
Freight	Increase ratings for customer satisfaction	Percentage of customers
Management:	with freight mobility in the region among	satisfied with region's freight
Customer	shippers, receivers, and carriers by X	management practices.
Satisfaction	percent in Y years.	
Freight	Decrease hours of delay per 1,000 vehicle	Hours of delay per 1,000
Management: Travel	miles traveled on selected freight-	vehicle miles on selected
Time Delay	significant highways by X percent in Y	freight-significant highways.
	years.	
Freight	Decrease point-to-point travel times on	Point-to-point travel times
Management: Travel	selected freight-significant highways by Y	on selected freight-
Time Delay	minutes within Y years.	significant highways.
Freight	Decrease the annual average travel time	Travel time index: ratio of
Management: Travel	index for freight by X points in Y years.	observed average travel time
Time Delay		to free-flow travel time.
Freight	Increase the mobility index ([Ton-miles of	
Management: Travel	travel] / [Vehicle-miles of travel *	
Time Delay		
Average speed]) by X	Mobility index for system users defined as	
percent in Y years.	[Ton-miles of travel] / [Vehicle-miles of	
	travel * Average speed].	



CVO04 - CV Administrative Processes

International Border Electronic Clearance (CVO05)

This service package provides for automated clearance at international border crossings. It augments the Electronic Clearance service package by allowing interface with border administration and border inspection related functions. This service package processes the entry documentation for vehicle, cargo, and driver, checks compliance with import/export and immigration regulations, handles duty fee processing, and reports the results of the crossing event to manage release of commercial vehicle, cargo, and driver across an international border. It interfaces with administrative systems used by customs and border protection, immigration, carriers, and service providers (e.g., brokers) and inspection systems at international border crossings to generate, process, and store entry documentation.

Equipment Package Name	Subsystem
On-board CV Electronic Data	Commercial Vehicle
CV Information Exchange	Commercial Vehicle Administration
CV Safety and Security Administration	Commercial Vehicle Administration
International CV Administration	Commercial Vehicle Administration
International Border Crossing	Commercial Vehicle Check
Roadside Electronic Screening	Commercial Vehicle Check
Freight Administration and Management	Fleet and Freight Management

Table 2.2.5-13: CVO05 Included Equipment Packages and Subsystems

Table 2.2.5-14: CVO05 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

Table 2.2.5-15: CVO05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Decrease average crossing times at	Average border crossing time
Management:	international borders by X minutes for	for freight at international
Border Crossing	each border in the region over Y years.	borders per year.
Freight	Increase the use of electronic	Percent of weigh stations and
Management:	credentialing to X percent of weigh	border crossings in the region
Border Crossing	stations and border crossings by year Y.	that use electronic
		credentialing.

Objective Category	Objective	Performance Measure
Freight	Increase ratings for customer	Percentage of customers
Management:	satisfaction with freight mobility in the	satisfied with region's freight
Customer	region among shippers, receivers, and	management practices.
Satisfaction	carriers by X percent in Y years.	
Freight	Decrease hours of delay per 1,000	Hours of delay per 1,000
Management: Travel	vehicle miles traveled on selected	vehicle miles on selected
Time Delay	freight-significant highways by X percent	freight-significant highways.
	in Y years.	
Freight	Decrease point-to-point travel times on	Point-to-point travel times on
Management: Travel	selected freight-significant highways by	selected freight-significant
Time Delay	Y minutes within Y years.	highways.
Freight	Decrease the annual average travel time	Travel time index: ratio of
Management: Travel	index for freight by X points in Y years.	observed average travel time
Time Delay		to free-flow travel time.
Freight	Increase the mobility index ([Ton-miles	
Management: Travel	of travel] / [Vehicle-miles of travel *	
Time Delay		
Average speed]) by	Mobility index for system users defined	
X percent in Y years.	as [Ton-miles of travel] / [Vehicle-miles	
	of travel * Average speed].	
Freight	Reduce buffer index on regional freight	Buffer Index on regional freight
Management: Travel	routes during peak and off-peak periods	routes during peak and off-
Time Reliability	by X percent in Y years.	peak period.



CVO05 - International Border Electronic Clearance

Weigh-In-Motion (CVO06)

This service package provides for high speed weigh-in-motion with or without Automated Vehicle Identification (AVI) capabilities. This service package provides the roadside equipment that could be used as a stand-alone system or to augment the Electronic Clearance (CVO03) service package.

Table 2.2.5-16: CVO06 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board CV Electronic Data	Commercial Vehicle
Roadside WIM	Commercial Vehicle Check

Table 2.2.5-17: CVO06 Associated Planning Factors and Goals

MetroFactor	Goal
Emphasize the preservation of the existing transportation system.	Preserve the transportation system
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Objective Category	Objective	Performance Measure
Freight Management:	Increase the use of electronic	Percent of weigh stations and
Border Crossing	credentialing to X percent of weigh	border crossings in the region
	stations and border crossings by year Y.	that use electronic
		credentialing.
Freight Management:	Increase ratings for customer	Percentage of customers
Customer Satisfaction	satisfaction with freight mobility in the	satisfied with region's freight
	region among shippers, receivers, and	management practices.
	carriers by X percent in Y years.	
Freight Management:	Decrease hours of delay per 1,000	Hours of delay per 1,000
Travel Time Delay	vehicle miles traveled on selected	vehicle miles on selected
	freight-significant highways by X	freight-significant highways.
	percent in Y years.	
Freight Management:	Decrease point-to-point travel times on	Point-to-point travel times on
Travel Time Delay	selected freight-significant highways by	selected freight-significant
	Y minutes within Y years.	highways.
Freight Management:	Decrease the annual average travel	Travel time index: ratio of
Travel Time Delay	time index for freight by X points in Y	observed average travel time
	years.	to free-flow travel time.

Service Packages

Objective Category	Objective	Performance Measure
Freight Management:	Increase the mobility index ([Ton-miles	
Travel Time Delay	of travel] / [Vehicle-miles of travel *	
Average speed]) by X	Mobility index for system users defined	
percent in Y years.	as [Ton-miles of travel] / [Vehicle-miles	
	of travel * Average speed].	
Freight Management:	Reduce buffer index on regional freight	Buffer Index on regional
Travel Time Reliability	routes during peak and off-peak periods	freight routes during peak and
	by X percent in Y years.	off-peak period.
Preservation:	Distressed pavement condition lane-	Distressed pavement
Preserve Existing	miles not to exceed X percent of total	condition lane miles
Infrastructure	state highway system	
Preservation:	Maintain pavement condition index	Pavement condition index
Preserve Existing	(PCI) of X or greater for local streets and	
Infrastructure	roads	
Preservation:	Reduce commercial vehicle size and	Number of size and weight
Preserve Existing	weight violations	violations
Infrastructure		
System Reliability:	Reduce the 90th (or 95th) percentile	95th or 90th percentile travel
Travel Time	travel times for each route selected by	times for selected routes.
90th/95th Percentile	X percent over Y years.	

CVO06 - Weigh-In-Motion



Roadside CVO Safety (CVO07)

This service package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the roadside check locations. The capabilities for performing the safety inspection are shared between this service package and the On-board CVO and Freight Safety & Security (CVO08) service package which enables a variety of implementation options. The basic option, directly supported by this service package, facilitates safety inspection of vehicles that have been pulled off the highway, perhaps as a result of the automated screening process provided by the Electronic Clearance (CVO03) service package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations, supported by the On-board CVO and Freight Safety & Security (CVO08) service package, utilize additional on-board vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

Equipment Package Name	Subsystem
On-board CV Electronic Data	Commercial Vehicle
On-board CV Safety and Security	Commercial Vehicle
Credentials and Taxes Administration	Commercial Vehicle Administration
CV Information Exchange	Commercial Vehicle Administration
CV Safety and Security Administration	Commercial Vehicle Administration
Citation and Accident Electronic Recording	Commercial Vehicle Check
Roadside Electronic Screening	Commercial Vehicle Check
Roadside Safety and Security Inspection	Commercial Vehicle Check
Fleet Administration	Fleet and Freight Management
Fleet Maintenance Management	Fleet and Freight Management

Table 2.2.5-19: CVO07 Included Equipment Packages and Subsystems

Table 2.2.5-20: CVO07 Associated Planning Factors and Goals

MetroFactor	Goal
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness, productivity, and	productivity and development
efficiency;	

Table 2.2.5-21: CVO07 Associated Objectives and Performance Measures

Objective Category Objective

Performance Measure

Objective Category	Objective	Performance Measure
Freight	Increase ratings for customer satisfaction	Percentage of customers
Management:	with freight mobility in the region among	satisfied with region's freight
Customer	shippers, receivers, and carriers by X	management practices.
Satisfaction	percent in Y years.	
Freight	Decrease hours of delay per 1,000 vehicle	Hours of delay per 1,000
Management: Travel	miles traveled on selected freight-	vehicle miles on selected
Time Delay	significant highways by X percent in Y	freight-significant highways.
	years.	
Freight	Decrease point-to-point travel times on	Point-to-point travel times
Management: Travel	selected freight-significant highways by Y	on selected freight-
Time Delay	minutes within Y years.	significant highways.
Freight	Decrease the annual average travel time	Travel time index: ratio of
Management: Travel	index for freight by X points in Y years.	observed average travel time
Time Delay		to free-flow travel time.
Freight	Increase the mobility index ([Ton-miles of	
Management: Travel	travel] / [Vehicle-miles of travel *	
Time Delay		
Average speed]) by X	Mobility index for system users defined as	
percent in Y years.	[Ton-miles of travel] / [Vehicle-miles of	
	travel * Average speed].	



CVO07 - Roadside CVO Safety

On-board CVO Safety (CVO08)

This service package provides for on-board commercial vehicle safety monitoring and reporting. It is an enhancement of the Roadside CVO Safety Service Package and includes support for collecting on-board safety data via transceivers or other means. The on-board safety data are assessed by an off-board system. In some cases the monitoring and safety assessment may occur remotely (i.e., not at a roadside site). Following the assessment, safety warnings are provided to the driver, the Commercial Vehicle Check roadside elements, and carrier. This service package allows for the Fleet and Freight Management subsystem to have access to the on-board safety data.

Table 2.2.5-22: CVO08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board Cargo Monitoring	Commercial Vehicle
On-board CV Safety and Security	Commercial Vehicle
CV Information Exchange	Commercial Vehicle Administration
CV Safety and Security Administration	Commercial Vehicle Administration
Citation and Accident Electronic Recording	Commercial Vehicle Check
Roadside Safety and Security Inspection	Commercial Vehicle Check
Fleet Administration	Fleet and Freight Management
Fleet Maintenance Management	Fleet and Freight Management

Table 2.2.5-23: CVO08 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.5-24: CVO08 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the transportation	due to commercial vehicle safety
Fatalities	system	violations

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.



CVO08 - On-board CVO Safety

CVO Fleet Maintenance (CVO09)

This service package supports maintenance of CVO fleet vehicles with on-board monitoring equipment and Automated Vehicle Location (AVL) capabilities within the Fleet and Freight Management Subsystem. Records of vehicle mileage, repairs, and safety violations are maintained to assure safe vehicles on the highway.

Table 2.2.5-25: CVO09 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board Trip Monitoring	Commercial Vehicle
Fleet Maintenance Management	Fleet and Freight Management

Table 2.2.5-26: CVO09 Associated Planning Factors and Goals

MetroFactor	Goal
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness, productivity, and	productivity and development
efficiency;	

Table 2.2.5-27: CVO09 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Freight	Increase ratings for customer satisfaction	Percentage of customers
Management:	with freight mobility in the region among	satisfied with region's freight
Customer	shippers, receivers, and carriers by X	management practices.
Satisfaction	percent in Y years.	

CVO09 - CVO Fleet Maintenance



HAZMAT Management (CVO10)

This service package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

Table 2.2.5-28: CVO10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-Board Cargo Monitoring	Commercial Vehicle
Emergency Commercial Vehicle Response	Emergency Management
Mayday Support	Emergency Management
Commercial Vehicle and Freight Security	Fleet and Freight Management
Fleet HAZMAT Management	Fleet and Freight Management
Vehicle Mayday I/F	Vehicle

Table 2.2.5-29: CVO10 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.5-30: CVO10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Enhance tracking and	Number of Hazmat shipments
Disasters, and Hazardous	monitoring of sensitive Hazmat	tracked in real-time
Material Incidents	shipments	
Security: Terrorism, Natural	Reduce exposure due to	Homeland security incident
Disasters, and Hazardous	Hazmat & homeland security	response time
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of Hazmat incidents
Disasters, and Hazardous	Hazmat & homeland security	
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of homeland security
Disasters, and Hazardous	Hazmat & homeland security	incidents
Material Incidents	incidents	

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure

CVO10 - HAZMAT Management


Roadside HAZMAT Security Detection and Mitigation (CVO11)

This service package provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology. Credentials information can be accessed to verify if the commercial driver, vehicle and carrier are permitted to transport the identified HAZMAT. If the credentials analysis and sensed HAZMAT information do not agree, the vehicle can be signaled to pull off the highway, and if required, an alarm can be sent to Emergency Management to request they monitor, traffic stop or disable the vehicle.

Table 2.2.5-31: CVO11 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Credentials and Taxes Administration	Commercial Vehicle Administration
Roadside HAZMAT detection	Commercial Vehicle Check
Emergency Commercial Vehicle Response	Emergency Management

Table 2.2.5-32: CVO11 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

 Table 2.2.5-33: CVO11 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Enhance tracking and	Number of Hazmat shipments
Disasters, and Hazardous	monitoring of sensitive Hazmat	tracked in real-time
Material Incidents	shipments	
Security: Terrorism, Natural	Reduce exposure due to	Homeland security incident
Disasters, and Hazardous	Hazmat & homeland security	response time
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of Hazmat incidents
Disasters, and Hazardous	Hazmat & homeland security	
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of homeland security
Disasters, and Hazardous	Hazmat & homeland security	incidents
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure





CV Driver Security Authentication (CVO12)

This service package provides the ability for Fleet and Freight Management to detect when an unauthorized commercial vehicle driver attempts to drive their vehicle based on stored driver identity information. If an unauthorized driver has been detected, Fleet and Freight Management can activate commands to safely disable the commercial vehicle. Alarms can also be sent to emergency management to inform them of a potential commercial vehicle hijacking or theft and potential hazardous situation. In addition, Emergency Management can request Fleet and Freight Management to disable a specific vehicle in their fleet.

Table 2.2.5-34: CVO12 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
On-board Driver Authentication	Commercial Vehicle
Roadside Safety and Security Inspection	Commercial Vehicle Check
Emergency Commercial Vehicle Response	Emergency Management
Manage CV Driver Identification	Fleet and Freight Management

Table 2.2.5-35: CVO12 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.5-36: CVO12 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Enhance tracking and	Number of Hazmat shipments
Disasters, and Hazardous	monitoring of sensitive Hazmat	tracked in real-time
Material Incidents	shipments	
Security: Terrorism, Natural	Reduce exposure due to	Homeland security incident
Disasters, and Hazardous	Hazmat & homeland security	response time
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of Hazmat incidents
Disasters, and Hazardous	Hazmat & homeland security	
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of homeland security
Disasters, and Hazardous	Hazmat & homeland security	incidents
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure





Freight Assignment Tracking (CVO13)

This service package provides for the planning and tracking of three aspects of commercial vehicle shipments. For each shipment, the commercial vehicle, the freight equipment, and the commercial vehicle driver are monitored for consistency with the planned assignment. Any unauthorized changes are determined by the Fleet and Freight Management subsystem and then the appropriate people and subsystems are notified. Data collected by the On-board CV and Freight Safety & Security and the On-board Driver Authentication equipment packages used in other service packages are also used to monitor the three aspects of assignment for this service package. In addition to this service package, Fleet and Freight Managers may also monitor routes and itineraries and this capability is included in Fleet Administration.

Equipment Package Name	Subsystem
On-board Cargo Monitoring	Commercial Vehicle
On-board Driver Authentication	Commercial Vehicle
On-board Trip Monitoring	Commercial Vehicle
Commercial Vehicle and Freight Security	Fleet and Freight Management
Fleet Administration	Fleet and Freight Management
Freight Administration and Management	Fleet and Freight Management

Table 2.2.5-37: CVO13 Included Equipment Packages and Subsystems

Table 2.2.5-38: CVO13 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.5-39: CVO13 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Enhance tracking and	Number of Hazmat shipments
Disasters, and Hazardous	monitoring of sensitive Hazmat	tracked in real-time
Material Incidents	shipments	
Security: Terrorism, Natural	Reduce exposure due to	Homeland security incident
Disasters, and Hazardous	Hazmat & homeland security	response time
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of Hazmat incidents
Disasters, and Hazardous	Hazmat & homeland security	
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of homeland security
Disasters, and Hazardous	Hazmat & homeland security	incidents
Material Incidents	incidents	

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure

CVO13 – Freight Assignment Tracking



2.2.6 Emergency Management Service Packages

Emergency Call-Taking and Dispatch (EM01)

This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an Emergency Vehicle supports dispatch and provision of information to responding personnel.

Table 2.2.6-1: EM01 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Emergency Call-Taking	Emergency Management
Emergency Dispatch	Emergency Management
On-board EV En Route Support	Emergency Vehicle

Table 2.2.6-2: EM01 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

 Table 2.2.6-3: EM01 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident	Increase customer satisfaction with the	Percentage of customers
Management:	region's incident management by X	satisfied with region's
Customer Satisfaction	percent over Y years.	incident management
		practices.

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce mean incident clearance time per	Mean incident clearance
Management: Incident	incident by X percent over Y years	time per incident.
Duration	(Defined as the time between awareness	
Durution	of an incident and the time the last	
	responder has left the scene.)	
Emergency/Incident	Reduce mean incident notification time	Average incident
Management: Incident	(defined as the time between the first	notification time of
Duration	agency's awareness of an incident and the	necessary response
	time to notify needed response agencies)	agencies.
	by X percent over Y years (i.e., through	
	"Motorist Assist" roving patrol programs.	
	reduction of inaccurate verifications. etc.).	
Emergency/Incident	Reduce mean roadway clearance time per	Mean roadway clearance
Management: Incident	incident by X percent over Y years.	time per incident.
Duration	(Defined as the time between awareness	
	of an incident and restoration of lanes to	
	full operational status.)	
Emergency/Incident	Reduce mean time for needed responders	Mean time for needed
Management: Incident	to arrive on-scene after notification by X	responders to arrive on-
Duration	percent over Y years.	scene after notification.
Emergency/Incident	Reduce mean time of incident duration	Mean time of incident
Management: Incident	(from awareness of incident to resumed	duration.
Duration	traffic flow) on transit services and arterial	
	and expressway facilities by X percent in Y	
	years.	
Emergency/Incident	Increase percentage of incident	Number of agencies in the
Management: Inter-	management agencies in the region that	region with interoperable
Agency Coordination	(participate in a multi-modal information	voice communications.
	exchange network, use interoperable	
	voice communications, participate in a	
	regional coordinated incident response	
	team, etc.) by X percent in Y years.	
Emergency/Incident	Increase percentage of incident	Number of participating
Management: Inter-	management agencies in the region that	agencies in a regional
Agency Coordination	(participate in a multi-modal information	coordinated incident
	exchange network, use interoperable	response team.
	voice communications, participate in a	
	regional coordinated incident response	
	team, etc.) by X percent in Y years.	
Emergency/Incident	Increase percentage of incident	Percentage of incident
Management: Inter-	management agencies in the region that	management agencies in
Agency Coordination	(participate in a multi-modal information	region participating in
	exchange network, use interoperable	multi-modal information
	voice communications, participate in a	exchange network.
	regional coordinated incident response	
	team, etc.) by X percent in Y years.	

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the person hours (or vehicle	Person hours (or vehicle
Management: Person	hours) of total delay associated with	hours) of delay associated
Hours of Delay	traffic incidents by X percent over Y years.	with traffic incidents.

EM01 – Emergency Call-Taking and Dispatch



Emergency Routing (EM02)

This service package supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions, and suggested routing information are provided to enhance emergency vehicle routing. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The Emergency Vehicle may also be equipped with dedicated short range communications for local signal preemption and the transmission of alerts to surrounding vehicles. The service provides for information exchange between care facilities and both the Emergency Management Subsystem and emergency vehicles.

Equipment Package Name	Subsystem
Emergency Routing	Emergency Management
On-board EV En Route Support	Emergency Vehicle
Roadway Signal Preemption	Roadway
TMC Incident Dispatch Coordination/Communication	Traffic Management
TMC Signal Control	Traffic Management

Table 2.2.6-4: EM02 Included Equipment Packages and Subsystems

Table 2.2.6-5: EM02 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system

 Table 2.2.6-6: EM02 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce mean incident clearance time per	Mean incident clearance
Management: Incident	incident by X percent over Y years.	time per incident.
Duration	(Defined as the time between awareness	
	of an incident and the time the last	
	responder has left the scene.)	

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce mean roadway clearance time	Mean roadway clearance
Management: Incident	per incident by X percent over Y years.	time per incident.
Duration	of an incident and restoration of lanes to	
	full operational status.)	
Emergency/Incident	Reduce mean time for needed	Mean time for needed
Management: Incident	responders to arrive on-scene after	responders to arrive on-
Duration	notification by X percent over Y years.	scene after notification.
Emergency/Incident	Reduce mean time of incident duration	Mean time of incident
Management: Incident	(from awareness of incident to resumed	duration.
Duration	traffic flow) on transit services and	
	arterial and expressway facilities by X	
	percent in Y years.	
Emergency/Incident	Increase percentage of incident	Number of agencies in the
Agency Coordination	(narticipate in a multi-modal information	
Agency Coordination	exchange network use interonerable	voice communications.
	voice communications participate in a	
	regional coordinated incident response	
	team. etc.) by X percent in Y years.	
Emergency/Incident	Increase percentage of incident	Number of participating
Management: Inter-	management agencies in the region that	agencies in a regional
Agency Coordination	(participate in a multi-modal information	coordinated incident
	exchange network, use interoperable	response team.
	voice communications, participate in a	
	regional coordinated incident response	
	team, etc.) by X percent in Y years.	
Emergency/Incident	Increase percentage of incident	Percentage of incident
Management: Inter-	management agencies in the region that	management agencies in
Agency Coordination	(participate in a multi-modal information	region participating in
	exchange network, use interoperable	multi-modal information
	voice communications, participate in a	exchange network.
	team etc) by X percent in X years	
Emergency/Incident	Increase number of ITS-related assets	Number of ITS-related
Management: Use of	(e.g., roadside cameras, dynamic message	assets in use for incident
Technology	signs, vehicle speed detectors) in use for	detection.
	incident and emergency detection by X in	
	Y years.	
Emergency/Incident	Increase number of regional road miles	Number of regional
Management: Use of	covered by ITS-related assets (e.g.,	roadway miles covered by
Technology	roadside cameras, dynamic message	ITS-related assets in use
	signs, vehicle speed detectors) in use for	for incident detection.
	incident detection by X percent in Y years.	

Objective Category	Objective	Performance Measure
Emergency/Incident	Increase number of traffic signals	Number of traffic signals
Management: Use of	equipped with emergency vehicle	equipped with emergency
Technology	preemption by X percent in Y years.	vehicle preemption.

EM02 – Emergency Routing



Mayday and Alarms Support (EM03)

This service package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user, gather information about the incident, and determine the appropriate response. The request for assistance may be manually initiated or automated and linked to vehicle sensors. This service package also includes general surveillance capabilities that enable the Emergency Management Subsystem to remotely monitor public areas (e.g., rest stops, parking lots) to improve security in these areas. The Emergency Management Subsystem may be operated by the public sector or by a private sector telematics service provider.

Table 2.2.6-7: EM03 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Center Secure Area Alarm Support	Emergency Management
Center Secure Area Surveillance	Emergency Management
Mayday Support	Emergency Management
Personal Location Determination	Personal Information Access
Personal Mayday I/F	Personal Information Access
Remote Traveler Security	Remote Traveler Support
Traveler Secure Area Surveillance	Remote Traveler Support
Vehicle Location Determination	Vehicle
Vehicle Mayday I/F	Vehicle

Table 2.2.6-8: EM03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.6-9: EM03 Associated Objectives and Performance Measures

Objective Category	Objective	Performance
		Measure
Emergency/Incident	Reduce mean incident clearance time per	Mean incident
Management: Incident	incident by X percent over Y years. (Defined as	clearance time per
Duration	the time between awareness of an incident and	incident.
	the time the last responder has left the scene.)	

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Incident Duration	Reduce mean incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies) by X percent over Y years (i.e., through "Motorist Assist" roving patrol programs, reduction of inaccurate verifications, etc.).	Average incident notification time of necessary response agencies.
Emergency/Incident Management: Incident Duration	Reduce mean roadway clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and restoration of lanes to full operational status.)	Mean roadway clearance time per incident.
Emergency/Incident Management: Incident Duration	Reduce mean time for needed responders to arrive on-scene after notification by X percent over Y years.	Mean time for needed responders to arrive on-scene after notification.
Emergency/Incident Management: Incident Duration	Reduce mean time of incident duration (from awareness of incident to resumed traffic flow) on transit services and arterial and expressway facilities by X percent in Y years.	Mean time of incident duration.



EM03 – Mayday and Alarms Support

Roadway Service Patrols (EM04)

This service package supports roadway service patrol vehicles that monitor roads that aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The service package monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

Table 2.2.6-10: EM04 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Service Patrol Management	Emergency Management
On-board EV En Route Support	Emergency Vehicle
On-board EV Incident Management Communication	Emergency Vehicle

Table 2.2.6-11: EM04 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system
Increase the accessibility and mobility of people and for	Enhance mobility, convenience, and
freight;	comfort for transportation system
	users
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational efficiency and
	reliability of the transportation
	system
Support the economic vitality of the metropolitan area,	Support regional economic
especially by enabling global competitiveness,	productivity and development
productivity, and efficiency;	

Table 2.2.6-12: EM04 Associated Objectives and Performance Measures

Objective Category

Objective

Performance Measure

Objective Category	Objective	Performance Measure
Arterial Management: Reliability	Reduce buffer index on arterials during peak and off-peak periods by X percent in Y years.	The buffer index (represents the extra time (buffer) travelers add to
		their average travel time when planning trips in order to arrive on-time 95 percent of the time).
Arterial Management: Reliability	Reduce delay associated with incidents on arterials by X percent by year Y.	Hours of delay associated with incidents.
Emergency/Incident Management: Customer Satisfaction	Increase customer satisfaction with the region's incident management by X percent over Y years.	Percentage of customers satisfied with region's incident management practices.
Emergency/Incident Management: Incident Duration	Reduce mean incident clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and the time the last responder has left the scene.)	Mean incident clearance time per incident.
Emergency/Incident Management: Incident Duration	Reduce mean incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies) by X percent over Y years (i.e., through "Motorist Assist" roving patrol programs, reduction of inaccurate verifications, etc.).	Average incident notification time of necessary response agencies.
Emergency/Incident Management: Incident Duration	Reduce mean roadway clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and restoration of lanes to full operational status.)	Mean roadway clearance time per incident.
Emergency/Incident Management: Incident Duration	Reduce mean time for needed responders to arrive on-scene after notification by X percent over Y years.	Mean time for needed responders to arrive on- scene after notification.
Emergency/Incident Management: Incident Duration	Reduce mean time of incident duration (from awareness of incident to resumed traffic flow) on transit services and arterial and expressway facilities by X percent in Y years.	Mean time of incident duration.
Emergency/Incident Management: Inter- Agency Coordination	Increase the number of corridors in the region covered by regional coordinated incident response teams by X percent in Y years.	Number of TIM corridors in the region covered by regional coordinated incident response teams.

Service Packages

Relating Service Packages to the National ITS Architecture

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Person Hours of Delay	Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y	Person hours (or vehicle hours) of delay associated with traffic incidents.
	years.	
System Efficiency: Cost of Congestion	Reduce the annual monetary cost of congestion per capita for the next X years.	Cost (in dollars) of congestion or delay per capita.





Transportation Infrastructure Protection (EM05)

This service package includes the monitoring of transportation infrastructure (e.g., bridges, tunnels and management centers) for potential threats using sensors and surveillance equipment and barrier and safeguard systems to control access. preclude an incident, and mitigate the impact of an incident if it occurs. Threats can result from acts of nature (e.g., hurricanes, earthquakes), terrorist attacks or other incidents causing damage to the infrastructure (e.g., stray barge hitting a bridge support). Infrastructure may be monitored with acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors and video and audio surveillance equipment. Data from such sensors and surveillance equipment may be processed in the field or sent to a center for processing. The data enables operators at the center to detect and verify threats. When a threat is detected, agencies are notified. Detected threats or advisories received from other agencies result in an increased level of system preparedness. In response to threats, barrier and safeguard systems may be activated by Traffic Management Subsystems to deter an incident, control access to an area or mitigate the impact of an incident. Barrier systems include gates, barriers and other automated and remotely controlled systems that manage entry to transportation infrastructure. Safeguard systems include blast shields, exhaust systems and other automated and remotely controlled systems that mitigate impact of an incident.

Equipment Package Name	Subsystem
Center Secure Area Sensor Management	Emergency Management
Center Secure Area Surveillance	Emergency Management
On-Board EV Barrier System Control	Emergency Vehicle
Traveler Secure Area Sensor Monitoring	Remote Traveler Support
Traveler Secure Area Surveillance	Remote Traveler Support
Field Barrier System Control	Roadway
Field Safeguard System Control	Roadway
Field Secure Area Sensor Monitoring	Security Monitoring
Field Secure Area Surveillance	Security Monitoring
Barrier System Management	Traffic Management
Safeguard System Management	Traffic Management
TMC Incident Dispatch Coordination/Communication	Traffic Management
Vehicle Secure Area Access System	Vehicle

Table 2.2.6-13: EM05 Included Equipment Packages and Subsystems

Table 2.2.6-14: EM05 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.6-15: EM05 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	at transit facilities
Material Incidents	operators	
Security: Terrorism, Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	on transit vehicles
Material Incidents	operators	
Security: Terrorism, Natural	Reduce security risks to transit	Number of transit facilities and
Disasters, and Hazardous	passengers and transit vehicle	vehicles under security
Material Incidents	operators	surveillance
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure



EM05 - Transportation Infrastructure Protection

Wide-Area Alert (EM06)

This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information web sites.

Equipment Package Name	Subsystem
Emergency Early Warning System	Emergency Management
ISP Emergency Traveler Information	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Traveler Telephone Information	Information Service Provider
MCM Incident Management	Maintenance and Construction
	Management
Toll Operator Alert	Payment Administration
Personal Basic Information Reception	Personal Information Access
Remote Basic Information Reception	Remote Traveler Support
Remote Transit Information Services	Remote Traveler Support
Roadway Traffic Information Dissemination	Roadway
Toll Plaza Toll Collection	Roadway Payment
TMC Incident Dispatch	Traffic Management
Coordination/Communication	
TMC Traffic Information Dissemination	Traffic Management
Transit Center Information Services	Transit Management
Transit Center Security	Transit Management
Basic Vehicle Reception	Vehicle

Table 2.2.6-16: EM06 Included Equipment Packages and Subsystems

Table 2.2.6-17: EM06 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.6-18: EM06 Associated (bjectives and Performance Measures
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Objective Category	Objective	Performance Measure
Security: Crime	Reduce security risks to	Number of critical sites with
	motorists and travelers	security surveillance
Security: Crime	Reduce security risks to	Number of security incidents
	motorists and travelers	on roadways
Security: Crime	Reduce security risks to transit	Number of security incidents
	passengers and transit vehicle	at transit facilities
	operators	
Security: Crime	Reduce security risks to transit	Number of security incidents
	passengers and transit vehicle	on transit vehicles
	operators	
Security: Crime	Reduce security risks to transit	Number of transit facilities and
	passengers and transit vehicle	venicles under security
	Operators	Surveinance
Security: Crime	Reduce security risks to	Number of critical sites with
	transportation intrastructure	anhancoments
Security: Crime	Peduce security ricks to	Number of critical sites with
Security. Chine	transportation infrastructure	security surveillance
Security: Crime	Reduce security risks to	Number of security incidents
Security. Chine	transportation infrastructure	on transportation
		infrastructure
Security: Terrorism, Natural	Enhance tracking and	Number of Hazmat shipments
Disasters, and Hazardous	monitoring of sensitive Hazmat	tracked in real-time
Material Incidents	shipments	
Security: Terrorism, Natural	Reduce exposure due to	Homeland security incident
Disasters, and Hazardous	Hazmat & homeland security	response time
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of Hazmat incidents
Disasters, and Hazardous	Hazmat & homeland security	
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce exposure due to	Number of homeland security
Disasters, and Hazardous	Hazmat & homeland security	incidents
Material Incidents	incidents	
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveinance
Socurity: Torrorism Natural	Poduco socurity ricks to	Number of security incidents
Disasters and Hazardous	metorists and travelers	on roadways
Material Incidents		on roadways
Security: Terrorism Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	at transit facilities
Material Incidents	operators	
Material Incidents	operators	at transit facilities

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	on transit vehicles
Material Incidents	operators	
Security: Terrorism, Natural	Reduce security risks to transit	Number of transit facilities and
Disasters, and Hazardous	passengers and transit vehicle	vehicles under security
Material Incidents	operators	surveillance
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	hardened security
Material Incidents		enhancements
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	transportation infrastructure	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	transportation infrastructure	on transportation
Material Incidents		infrastructure



EM06 – Wide-Area Alert

Early Warning System (EM07)

This service package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The service package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.

Table 2.2.6-19: EM07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Center Secure Area Sensor Management	Emergency Management
Center Secure Area Surveillance	Emergency Management
Emergency Early Warning System	Emergency Management
Emergency Environmental Monitoring	Emergency Management
MCM Incident Management	Maintenance and Construction Management
Field Secure Area Sensor Monitoring	Security Monitoring
Field Secure Area Surveillance	Security Monitoring
TMC Incident Detection	Traffic Management
Transit Center Security	Transit Management

Table 2.2.6-20: EM07 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.6-21: EM07 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to	Number of critical sites with
Disasters, and Hazardous	motorists and travelers	security surveillance
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to	Number of security incidents
Disasters, and Hazardous	motorists and travelers	on roadways
Material Incidents		
Security: Terrorism, Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	at transit facilities
Material Incidents	operators	
Security: Terrorism, Natural	Reduce security risks to transit	Number of security incidents
Disasters, and Hazardous	passengers and transit vehicle	on transit vehicles
Material Incidents	operators	

Objective Category	Objective	Performance Measure
Security: Terrorism, Natural	Reduce security risks to transit	Number of transit facilities
Disasters, and Hazardous	passengers and transit vehicle	and vehicles under security
Material Incidents	operators	surveillance

EM07 - Early Warning System



Disaster Response and Recovery (EM08)

This service package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).

The service package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The service package 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 maintains situation awareness regarding the disaster itself. In addition, this service package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response.

The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management subsystem represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Subsystem and the other center subsystems provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities.

This service package builds on the basic traffic incident response service that is provided by ATMS08, the Traffic Incident Management service package. This service package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of the National ITS Architecture will want to consider both ATMS08 and this service package since every region is concerned with both day-to-day management of traffic-related incidents and occasional management of disasters that require extraordinary response.

Disaster Response and Recovery is also supported by EM10, the "Disaster Traveler Information" service package that keeps the public informed during a disaster response. See that service package for more information.

Table 2.2.6-22: EM08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Emergency Response Management	Emergency Management
Incident Command	Emergency Management
MCM Incident Management	Maintenance and Construction
	Management
MCM Roadway Maintenance and Construction	Maintenance and Construction
	Management
TMC Incident Dispatch	Traffic Management
Coordination/Communication	
Transit Center Security	Transit Management

Table 2.2.6-23: EM08 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;	Enhance the integration and connectivity of the transportation system
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.6-24: EM08 Associated Objectives and Performance Measures

Objective Category Objective Performance Measure

Objective Category	Objective	Performance Measure
Emergency/Incident Management: Inter- Agency Coordination	At least X percent of transportation operating agencies have a plan in place for a representative to be at the local or State Emergency Operations Center (EOC) to coordinate strategic activities and response planning for transportation during emergencies by year Y.	X percent of transportation operating agencies that have a plan in place for a representative to be at the local (city or county) EOC or State EOC to coordinate strategic activities and response planning for transportation during emergencies.
Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Number of agencies in the region with interoperable voice communications.
Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Number of participating agencies in a regional coordinated incident response team.
Emergency/Incident Management: Inter- Agency Coordination	Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.	Percentage of incident management agencies in region participating in multi-modal information exchange network.



EM08 - Disaster Response and Recovery

Evacuation and Reentry Management (EM09)

This service package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The service package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning.

This service package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times.

Evacuations are also supported by EM10, the "Disaster Traveler Information" service package, which keeps the public informed during evacuations. See that service package for more information.

Equipment Package Name	Subsystem
Emergency Evacuation Support	Emergency Management
MCM Incident Management	Maintenance and Construction Management
TMC Evacuation Support	Traffic Management
Transit Evacuation Support	Transit Management

Table 2.2.6-25: EM09 Included Equipment Packages and Subsystems

 Table 2.2.6-26: EM09 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system
Increase the security of the transportation system for	Improve the security of the
motorized and nonmotorized users;	transportation system

Table 2.2.6-27: EM09 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the per capita time to evacuate Z	Per capita time to
Management: Evacuation Times	persons in the region by X percent over Y	evacuate.
	years.	



EM09 - Evacuation and Reentry Management

Disaster Traveler Information (EM10)

This service package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This service package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems.

A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This service package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster.

This service package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this service package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters.

This service package augments the ATIS service packages that provide traveler information on a day-to-day basis for the surface transportation system. This service package provides focus on the special requirements for traveler information dissemination in disaster situations.

Equipment Package Name	Subsystem
Emergency Evacuation Support	Emergency Management
Emergency Response Management	Emergency Management

Table 2.2.6-28: EM10 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
ISP Emergency Traveler Information	Information Service Provider
ISP Traveler Data Collection	Information Service Provider
Traveler Telephone Information	Information Service Provider
Personal Basic Information Reception	Personal Information Access
Personal Interactive Information Reception	Personal Information Access
Remote Basic Information Reception	Remote Traveler Support
Remote Interactive Information Reception	Remote Traveler Support
Basic Vehicle Reception	Vehicle
Interactive Vehicle Reception	Vehicle

Table 2.2.6-29: EM10 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the accessibility and mobility of people	Enhance mobility, convenience, and comfort
and for freight;	for transportation system users
Increase the safety of the transportation system	Improve the safety of the transportation
for motorized and nonmotorized users;	system
Increase the security of the transportation system	Improve the security of the transportation
for motorized and nonmotorized users;	system
Promote efficient system management and	Increase operational efficiency and
operation;	reliability of the transportation system

Table 2.2.6-30: EM10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Emergency/Incident	Reduce the per capita time to evacuate	Per capita time to
Management: Evacuation	Z persons in the region by X percent	evacuate.
Times	over Y years.	
Traveler Information: Customer Satisfaction	Increase customer satisfaction rating of the timeliness, accuracy, and usefulness of traveler information in the region by W, X, and Z percent, respectively, over Y years.	Customer satisfaction ratings of timeliness, accuracy, and usefulness of traveler information.



EM10 – Disaster Traveler Information

2.2.7 Archived Data Management Service Packages

ITS Data Mart (AD1)

This service package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

Equipment Package Name	Subsystem
Government Reporting Systems Support	Archived Data Management
ITS Data Repository	Archived Data Management
Traffic and Roadside Data Archival	Archived Data Management
CV Data Collection	Commercial Vehicle Administration
Emergency Data Collection	Emergency Management
Emissions Data Collection	Emissions Management
ISP Data Collection	Information Service Provider
MCM Data Collection	Maintenance and Construction Management
Parking Data Collection	Parking Management
Toll Data Collection	Payment Administration
Roadway Data Collection	Roadway
Roadway Probe Data Communications	Roadway
Traffic Data Collection	Traffic Management
Transit Data Collection	Transit Management
Vehicle Traffic Probe Support	Vehicle

Table 2.2.7-1: AD1 Included Equipment Packages and Subsystems

Table 2.2.7-2: AD1 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system

Table 2.2.7-3: AD1 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Integration:	Enhance planning	Amount of data gathered from ITS
Transportation Data	with better data	enhancements used in infrastructure and
Collection		operations planning
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Objective Category	Objective	Performance Measure
Integration: Transportation Data Collection	Enhance planning with better data	Number of planning activities using data from ITS systems
Integration: Transportation Data Collection	Enhance planning with better data	Years of data in database that is easily searchable and extractable



AD1 - ITS Data Mart

ITS Data Warehouse (AD2)

This service package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this service package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

Equipment Package Name	Subsystem	
Government Reporting Systems Support	Archived Data Management	
ITS Data Repository	Archived Data Management	
On-Line Analysis and Mining	Archived Data Management	
Traffic and Roadside Data Archival	Archived Data Management	
CV Data Collection	Commercial Vehicle Administration	
Emergency Data Collection	Emergency Management	
Emissions Data Collection	Emissions Management	
ISP Data Collection	Information Service Provider	
MCM Data Collection	Maintenance and Construction Management	
Parking Data Collection	Parking Management	
Toll Data Collection	Payment Administration	
Roadway Data Collection	Roadway	
Roadway Probe Data Communications	Roadway	
Traffic Data Collection	Traffic Management	
Transit Data Collection	Transit Management	
Vehicle Traffic Probe Support	Vehicle	

Table 2.2.7-4: AD2 Included Equipment Packages and Subsystems

Table 2.2.7-5: AD2 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system

Table 2.2.7-6: AD2 Associated Objectives and Performance Measures

Objective Category

Objective

Performance Measure

Service Packages

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Objective Category	Objective	Performance Measure
Integration:	Enhance planning	Amount of data gathered from ITS
Transportation Data	with better data	enhancements used in infrastructure and
Collection		operations planning
Integration:	Enhance planning	Number of planning activities using data from
Transportation Data	with better data	ITS systems
Collection		
Integration:	Enhance planning	Years of data in database that is easily
Transportation Data	with better data	searchable and extractable
Collection		



AD2 - ITS Data Warehouse

ITS Virtual Data Warehouse (AD3)

This service package provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse service package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse service package are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

Table 2.2.7-7: AD3 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
ITS Data Repository	Archived Data Management
Virtual Data Warehouse Services	Archived Data Management

Table 2.2.7-8: AD3 Associated Planning Factors and Goals

MetroFactor	Goal
Enhance the integration and connectivity of the	Enhance the integration and
transportation system, across and between modes, for	connectivity of the transportation
people and freight;	system

Table 2.2.7-9: AD3 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Integration:	Enhance planning	Amount of data gathered from ITS
Transportation Data	with better data	enhancements used in infrastructure and
Collection		operations planning
Integration:	Enhance planning	Number of planning activities using data from
Transportation Data	with better data	ITS systems
Collection		
Integration:	Enhance planning	Years of data in database that is easily
Transportation Data	with better data	searchable and extractable
Collection		

AD3 - ITS Virtual Data Warehouse



2.2.8 Advanced Vehicle Safety Service Packages

Vehicle Safety Monitoring (AVSS01)

This service package will diagnose critical components of the vehicle and warn the driver of potential dangers. On-board sensors will determine the vehicle's condition, performance, on-board safety data, and display information.

Table 2.2.8-1: AVSS01 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Safety Monitoring System	Vehicle

Table 2.2.8-2: AVSS01 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-3: AVSS01 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to red-light running	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the transportation	due to commercial vehicle
Fatalities	system	safety violations
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in the	
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving
Crashes and	involving bicyclists and pedestrians in the	pedestrians.
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	

Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	

AVSS01 - Vehicle Safety Monitoring



Driver Safety Monitoring (AVSS02)

This service package will determine the driver's condition, and warn the driver of potential dangers. On-board sensors will determine the driver's condition, performance, on-board safety data, and display information.

Table 2.2.8-4: AVSS02 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Driver Safety Monitoring System	Vehicle

Table 2.2.8-5: AVSS02 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-6: AVSS02 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes at railroad crossings	Number of crashes and fatalities at
Crashes and		railroad crossings
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driving while intoxicated
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities due
Crashes and	vehicles and cargo on the	to commercial vehicle safety
Fatalities	transportation system	violations
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging

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Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce the total number of crashes	Total crashes per X VMT.
Crashes and	in the region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	

AVSS02 - Driver Safety Monitoring



Longitudinal Safety Warning (AVSS03)

This service package allows for longitudinal warning. It utilizes safety sensors and collision sensors. It requires on-board sensors to monitor the areas in front of and behind the vehicle and present warnings to the driver about potential hazards.

Table 2.2.8-7: AVSS03 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Location Determination	Vehicle
Vehicle Longitudinal Warning System	Vehicle

Table 2.2.8-8: AVSS03 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-9: AVSS03 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		at signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		at unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unexpected	Number of crashes and fatalities
Crashes and	congestion	related to unexpected
Fatalities		congestion
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the transportation	due to commercial vehicle
Fatalities	system	safety violations

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce secondary crashes	Number of secondary crashes
Crashes and		
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of crashes and fatalities
Crashes and		related to excessive speeding
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in the	
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving
Crashes and	involving bicyclists and pedestrians in the	pedestrians.
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	

AVSS03 - Longitudinal Safety Warning



Lateral Safety Warning (AVSS04)

This service package allows for lateral warning. It utilizes safety sensors and collision sensors. It requires on-board sensors to monitor the areas to the sides of the vehicle and present warnings to the driver about potential hazards.

Table 2.2.8-10: AVSS04 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Lateral Warning System	Vehicle

Table 2.2.8-11: AVSS04 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-12: AVSS04 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while intoxicated
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the	due to commercial vehicle safety
Fatalities	transportation system	violations
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging
Safety: Vehicle	Reduce the total number of crashes in	Total crashes per X VMT.
Crashes and	the region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving pedestrians.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	

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Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	





Intersection Safety Warning (AVSS05)

This service package monitors vehicles approaching an intersection and warns drivers when hazardous conditions are detected. The service package detects impending violations (e.g., red-light violations) and potential conflicts between vehicles occupying or approaching the intersection (e.g., situations where a left turn would be unsafe because of approaching traffic). When a potentially hazardous condition is detected, a warning is communicated to the involved vehicles using short range communications and/or signs/signals in the intersection.

Table 2.2.8-13: AVSS05 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway Intersection Safety Warning	Roadway
Vehicle Intersection Safety Warning	Vehicle
Vehicle Location Determination	Vehicle

Table 2.2.8-14: AVSS05 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-15: AVSS05 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		at signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		at unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes at railroad crossings	Number of crashes and fatalities
Crashes and		at railroad crossings
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to red-light running	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the transportation	due to commercial vehicle
Fatalities	system	safety violations
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in the	
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving
Crashes and	involving bicyclists and pedestrians in the	pedestrians.
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	



AVSS05 - Intersection Safety Warning

Pre-Crash Restraint Deployment (AVSS06)

This service package provides in-vehicle sensors and on-board communications to monitor the vehicle's local environment, determine collision probability and deploy a pre-crash safety system. It will include on-board sensors to measure lateral and longitudinal gaps and together with weather and roadway conditions will determine lateral and longitudinal collision probability. It will exchange messages with other equipped vehicles to determine the precise location of surrounding vehicles. It will deploy a pre-crash safety system when a crash is imminent.

Table 2.2.8-16: AVSS06 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Pre-Crash Safety Systems	Vehicle
Vehicle Warning System	Vehicle

Table 2.2.8-17: AVSS06 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-18: AVSS06 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total fatalities per X VMT.
Safety: Vehicle Crashes and Fatalities	Reduce the total number of fatalities and severe injuries in the region by X percent by year Y.	Total severe injuries per X VMT.

AVSS06 - Pre-Crash Restraint Deployment



Driver Visibility Improvement (AVSS07)

This service package will enhance driver visibility using an enhanced vision system. On-board display hardware is needed.

Table 2.2.8-19: AVSS07 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Driver Visibility Improvement System	Vehicle

Table 2.2.8-20: AVSS07 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-21: AVSS07 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors	Number of crashes and fatalities
Crashes and	and limitations	related to driving while intoxicated
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unexpected	Number of crashes and fatalities
Crashes and	congestion	related to unexpected congestion
Fatalities		
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging
Safety: Vehicle	Reduce secondary crashes	Number of secondary crashes
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in	Total crashes per X VMT.
Crashes and	the region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	

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Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving pedestrians.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	

AVSS07 - Driver Visibility Improvement



Advanced Vehicle Longitudinal Control (AVSS08)

This service package automates the speed and headway control functions on board the vehicle. It utilizes safety sensors and collision sensors combined with vehicle dynamics processing to control the throttle and brakes. It requires onboard sensors to measure longitudinal gaps and a processor for controlling the vehicle speed.

Table 2.2.8-22: AVSS08 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Location Determination	Vehicle
Vehicle Longitudinal Control	Vehicle

Table 2.2.8-23: AVSS08 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for motorized and	Improve the safety of the
nonmotorized users;	transportation system
Promote efficient system management and operation;	Increase operational
	efficiency and reliability of
	the transportation system
Protect and enhance the environment, promote energy	Reduce environmental
conservation, improve the quality of life, and promote consistency	impacts
between transportation improvements and State and local planned	
growth and economic development patterns;	
Support the economic vitality of the metropolitan area, especially	Support regional economic
by enabling global competitiveness, productivity, and efficiency;	productivity and
	development

Table 2.2.8-24: AVSS08 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and
Fatalities		intersections
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and
Crashes and		fatalities at unsignalized
Fatalities		intersections
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and
Crashes and		fatalities related to red-light
Fatalities		running
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and
Crashes and	limitations	fatalities related to driver
Fatalities		inattention and distraction

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and
Crashes and	limitations	fatalities related to driving
Fatalities		while intoxicated
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and
Crashes and	conditions	fatalities related to weather
Fatalities		conditions
Safety: Vehicle	Reduce crashes due to unexpected congestion	Number of crashes and
Crashes and		fatalities related to
Fatalities		unexpected congestion
Safety: Vehicle	Reduce crashes due to unsafe drivers, vehicles	Number of crashes and
Crashes and	and cargo on the transportation system	fatalities due to commercial
Fatalities		vehicle safety violations
Safety: Vehicle	Reduce secondary crashes	Number of secondary
Crashes and		crashes
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of crashes and
Crashes and		fatalities related to
Fatalities		excessive speeding
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes involving	Total crashes involving
Crashes and	bicyclists and pedestrians in the region by X	bicycles.
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes involving	Total crashes involving
Crashes and	bicyclists and pedestrians in the region by X	pedestrians.
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent by	
Fatalities	year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X
Crashes and	severe injuries in the region by X percent by	VMT.
Fatalities	year Y.	
System Efficiency:	Reduce the annual monetary cost of	Cost (in dollars) of
Cost of	congestion per capita for the next X years.	congestion or delay per
Congestion		capita.
System Efficiency:	Reduce the daily hours of recurring	Hours per day at LOS F or
Duration of	congestion on major freeways from X to Y by	V/C > 1.0 (or other
Congestion	year Z.	threshold).
System Efficiency:	Reduce the number of hours per day that the	Hours per day at LOS F or
Duration of	top 20 most congested roadways experience	V/C > 1.0 (or other
Congestion	recurring congestion by X percent by year Y.	unresnoia).

Service Packages

Objective Category	Objective	Performance Measure
System Efficiency: Extent of Congestion	Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate).	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.	Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0
System Efficiency: Extent of Congestion	Reduce the share of major intersections operating at LOS Z by X percent by year Y.	Percent of intersections operating at LOS F or V/C > 1.0

AVSS08 - Advanced Vehicle Longitudinal Control



Advanced Vehicle Lateral Control (AVSS09)

This service package automates the steering control on board the vehicle. It utilizes safety sensors and collision sensors combined with vehicle dynamics processing to control the steering. It requires on-board sensors to measure lane position and lateral deviations and a processor for controlling the vehicle steering.

Table 2.2.8-25: AVSS09 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Vehicle Lateral Control	Vehicle

Table 2.2.8-26: AVSS09 Associated Planning Factors and Goals

MetroFactor	Goal	
Increase the safety of the transportation system for	Improve the safety of the	
motorized and nonmotorized users;	transportation system	

Table 2.2.8-27: AVSS09 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while intoxicated
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the	due to commercial vehicle safety
Fatalities	transportation system	violations
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging

Service Packages

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce the total number of crashes in	Total crashes per X VMT.
Crashes and	the region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving pedestrians.
Crashes and	involving bicyclists and pedestrians in	
Fatalities	the region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT.
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	

AVSS09 - Advanced Vehicle Lateral Control



Intersection Collision Avoidance (AVSS10)

This service package will determine the probability of an intersection collision and provide timely warnings to approaching vehicles so that avoidance actions can be taken. This service package builds on the Intersection Safety Warning field and in-vehicle equipment and adds equipment in the vehicle that can take control of the vehicle to avoid intersection violations and potential collisions. The same sensors and communications equipment in the roadway infrastructure are used to assess vehicle locations and speeds near an intersection. This information is determined and communicated to the approaching vehicle using a short range communications system. The vehicle uses this information to develop control actions which alter the vehicle's speed and steering control and potentially activate its pre-crash safety system.

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway Intersection Safety Warning	Roadway
Vehicle Intersection Control	Vehicle
Vehicle Location Determination	Vehicle

Table 2.2.8-28: AVSS10 Included Equipment Packages and Subsystems

Table 2.2.8-29: AVSS10 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

 Table 2.2.8-30: AVSS10 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
Safety: Vehicle Crashes and Fatalities	Reduce crashes at intersections	Number of crashes and fatalities at signalized intersections
Safety: Vehicle Crashes and Fatalities	Reduce crashes at intersections	Number of crashes and fatalities at unsignalized intersections
Safety: Vehicle Crashes and Fatalities	Reduce crashes at intersections	Number of crashes and fatalities related to red-light running
Safety: Vehicle Crashes and Fatalities	Reduce crashes due to driver errors and limitations	Number of crashes and fatalities related to driver inattention and distraction

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while
Fatalities		intoxicated
Safety: Vehicle	Reduce crashes due to red-light running	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		
Safety: Vehicle	Reduce crashes due to unsafe drivers,	Number of crashes and fatalities
Crashes and	vehicles and cargo on the transportation	due to commercial vehicle
Fatalities	system	safety violations
Safety: Vehicle	Reduce speed differential	Number of crashes and fatalities
Crashes and		related to excessive speeding
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in the	Total crashes per X VMT.
Crashes and	region by X percent by year Y.	
Fatalities		
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving bicycles.
Crashes and	involving bicyclists and pedestrians in the	
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of crashes	Total crashes involving
Crashes and	involving bicyclists and pedestrians in the	pedestrians.
Fatalities	region by X percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total fatalities per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	
Safety: Vehicle	Reduce the total number of fatalities and	Total severe injuries per X VMT.
Crashes and	severe injuries in the region by X percent	
Fatalities	by year Y.	



AVSS10 - Intersection Collision Avoidance

Automated Vehicle Operations (AVSS11)

This service package enables "hands-off" operation of the vehicle on automated portions of the highway system. Implementation requires lateral lane holding, vehicle speed and steering control. Communications between vehicles and between the vehicles and supporting infrastructure equipment supports cooperative check-in to the automated portion of the system and transition to automated mode, coordination of maneuvers between vehicles in automated mode, and checkout from the automated system as the driver resumes control of the vehicle.

Table 2.2.8-31: AVSS11 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Automated Vehicle Operations	Roadway
TMC Automated Vehicle Operations	Traffic Management
Vehicle Automated Operations	Vehicle

Table 2.2.8-32: AVSS11 Associated Planning Factors and Goals

MetroFactor	Goal
Promote efficient system management and operation;	Increase operational efficiency and reliability of the transportation system
Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;	Reduce environmental impacts
Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;	Support regional economic productivity and development

Table 2.2.8-33: AVSS11 Associated Objectives and Performance Measures

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the annual monetary cost	Cost (in dollars) of congestion or
Cost of Congestion	of congestion per capita for the	delay per capita.
	next X years.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per capita	Hours of delay per capita.
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay (person-hours).
Delay	by X percent by year Y.	
System Efficiency:	Reduce hours of delay per driver	Hours of delay per driver.
Delay	by X percent by year Y.	

Objective Category	Objective	Performance Measure
System Efficiency:	Reduce the daily hours of	Hours per day at LOS F or V/C > 1.0
Duration of	recurring congestion on major	(or other threshold).
Congestion	freeways from X to Y by year Z.	
System Efficiency:	Reduce the number of hours per	Hours per day at LOS F or V/C > 1.0
Duration of	day that the top 20 most	(or other threshold).
Congestion	congested roadways experience	
-	recurring congestion by X percent	
	by year Y.	
System Efficiency:	Reduce excess fuel consumed due	Excess fuel consumed (total or per
Energy	to congestion by X percent by year	capita).
Consumption	Υ.	
System Efficiency:	Reduce total energy consumption	Total energy consumed per capita for
Energy	per capita for transportation by X	transportation.
Consumption	percent by year Y.	
System Efficiency:	Reduce total fuel consumption	Total fuel consumed per capita for
Energy	per capita for transportation by X	transportation.
Consumption	percent by year Y.	
System Efficiency:	Maintain the rate of growth in	Percent of lane-miles (or rail)
Extent of	facility miles experiencing	operating at LOS F or V/C > 1.0
Congestion	recurring congestion as less than	
	the population growth rate (or	
	employment growth rate).	
System Efficiency:	Reduce the percentage of facility	Percent of lane-miles (or rail)
Extent of	miles (highway, arterial, rail, etc.)	operating at LOS F or V/C > 1.0
Congestion	experiencing recurring congestion	
	during the peak period by X	
Custom Efficiences	percent by year Y.	
System Efficiency:	Reduce the share of major	Percent of intersections operating at
Extent of	hu V percent by year V	LOS F OF V/C > 1.0
	by A percent by year Y.	Troughtime index (the eveness trough
System Efficiency:	Reduce the regional average	time during the neak paried using
Congression (Travel	traver time index by X percent per	congested speeds, divided by the off
Time Index)	year.	congested speeds, divided by the on-
Time muex)		or free-flow speeds)
System Efficiency:	Appual rate of change in regional	Average commute trip travel time
Travel Time	average commute travel time will	(minutes)
navernine	not exceed regional rate of	(minuces).
	nonulation growth through the	
	vear Y.	
System Efficiency:	Improve average travel time	Average travel time during peak
Travel Time	during peak periods by X percent	periods (minutes).
-	by year Y.	



AVSS11 - Automated Vehicle Operations

Cooperative Vehicle Safety Systems (AVSS12)

This service package enhances the on-board longitudinal and lateral warning stand-alone systems by exchanging messages with other surrounding vehicles and roadside equipment. Vehicles send out information concerning their location, speed, and direction to surrounding vehicles. The roadside equipment provides information about potential safety hazards in the vehicle path such as stalled (unequipped) vehicles, wrong-way drivers, debris, or water hazards. The on-board systems can then process this information and present warnings to the driver including headway warnings, merge warnings, unsafe passing warnings, and warnings about hazards detected in the vehicle path. Special messages from approaching emergency vehicles may also be received and processed.

Table 2.2.8-34: AVSS12 Included Equipment Packages and Subsystems

Equipment Package Name	Subsystem
Roadway Equipment Coordination	Roadway
Roadway Safety Warning System	Roadway
Vehicle Warning System	Vehicle

Table 2.2.8-35: AVSS12 Associated Planning Factors and Goals

MetroFactor	Goal
Increase the safety of the transportation system for	Improve the safety of the
motorized and nonmotorized users;	transportation system

Table 2.2.8-36: AVSS12 Associated Objectives and Performance Measures

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		signalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities at
Crashes and		unsignalized intersections
Fatalities		
Safety: Vehicle	Reduce crashes at intersections	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes at railroad crossings	Number of crashes and fatalities at
Crashes and		railroad crossings
Fatalities		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driver inattention and
Fatalities		distraction

Objective	Objective	Performance Measure
Category		
Safety: Vehicle	Reduce crashes due to driver errors and	Number of crashes and fatalities
Crashes and	limitations	related to driving while intoxicated
Fatalities		
Safety: Vehicle	Reduce crashes due to red-light running	Number of crashes and fatalities
Crashes and		related to red-light running
Fatalities		
Safety: Vehicle	Reduce crashes due to road weather	Number of crashes and fatalities
Crashes and	conditions	related to weather conditions
Fatalities		Number of such as and fatalities
Safety: venicle	Reduce crasnes due to unexpected	Number of crashes and fatalities
	congestion	related to unexpected congestion
Safety: Vehicle	Reduce crashes due to unsafe drivers	Number of crashes and fatalities
Crashes and	vehicles and cargo on the	due to commercial vehicle safety
Fatalities	transportation system	violations
Safety: Vehicle	Reduce lane departure crashes	Number of crashes and fatalities
Crashes and		related to inappropriate lane
Fatalities		departure, crossing or merging
Safety: Vehicle	Reduce secondary crashes	Number of secondary crashes
Crashes and		,
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of crashes and fatalities
Crashes and		related to excessive speeding
Fatalities		
Safety: Vehicle	Reduce speed differential	Number of speed violations
Crashes and		
Fatalities		
Safety: Vehicle	Reduce the total number of crashes in	Total crashes per X VMT.
Crashes and	the region by X percent by year Y.	
Fatalities		Total conduct to all the life allow
Safety: Venicle	Reduce the total number of crashes	lotal crashes involving bicycles.
	the region by X percent by year X	
Faldilles	Reduce the total number of crashes	Total crashes involving podestrians
Crashes and	involving bicyclists and pedestrians in	rotal crashes involving pedestrians.
Fatalities	the region by X percent by year V	
Safety: Vehicle	Reduce the total number of fatalities	Total fatalities per X VMT
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	
Safety: Vehicle	Reduce the total number of fatalities	Total severe injuries per X VMT
Crashes and	and severe injuries in the region by X	
Fatalities	percent by year Y.	



AVSS12 – Cooperative Vehicle Safety Systems

3 Service Packages and User Services

The Service Packages are directly traceable to the User Services and often include capabilities that span more than one user service. Conversely, a single User Service sometimes includes a range of incremental capabilities that are segregated into separate Service Packages so that they may be considered separately from a deployment perspective. As a result, there is often a many-tomany relationship between the Service Packages and the User Services.

To illustrate these relationships, consider the following examples:

- The Traffic Control user service requires distinct surveillance, freeway and surface street traffic control, integrated area-wide traffic control, HOV lane control, and traffic information dissemination capabilities. Since each of these capabilities may be deployed individually by a local jurisdiction, they are allocated to distinct Service Packages. The Service Packages also distinguish between different traffic surveillance approaches. Roadside instrumentation (i.e., the Network Surveillance Service Package) and vehicle probes (i.e. the Traffic Probe Surveillance Service Package) are separated due to fundamentally different technical and institutional issues for the two approaches. In total, sixteen separate Service Packages provide different mechanisms and levels of support for satisfying the Traffic Control User Service Requirements.
- The HOV Lane Management Service Package supports both the Traffic Control and Travel Demand Management User Services since both services could include HOV lane management capabilities. This single deployable package satisfies portions of the requirements associated with both of these user services.

The relationship between User Services and Service Packages is presented in Table 3-1. As shown in the table, the identified Service Packages support all required User Services.
Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	1_4 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	1_7 - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	3_1 - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	- 4_4 - CONTINENCIAI VENICIE AURINISII AUVE Drocesses	4_5 - Hazmat Security and Incident Response	4_6 - Freight Mobility	יד - בווויאיז איז איז איז איז איז איז איז איז איז	5_2 - Emergency Vehicle Management	5_3 - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
AD1: ITS Data Mart																																•	
AD2: ITS Data Warehouse																																•	
AD3: ITS Virtual Data Warehouse																																•	\square
APTS01: Transit Vehicle Tracking											•			•																			\square
APTS02: Transit Fixed-Route Operations											•																						
APTS03: Demand Response Transit Operations											•		•																				
APTS04: Transit Fare Collection Management								•			•				•																		
APTS05: Transit Security											•			•								•											
APTS06: Transit Fleet Management											•																						
APTS07: Multi- modal Coordination						•					•																						
APTS08: Transit Traveler Information											•	•	•		•																		
APTS09: Transit Signal Priority						•					•																						
APTS10: Transit Passenger Counting											•																						
APTS11: Multimodal Connection Protection											•	•																					
ATIS01: Broadcast Traveler Information	•	•										•																					
ATIS02: Interactive Traveler Information	•	•		•	•		•					•			•																		
ATIS03: Autonomous Route Guidance			•																														
ATIS04: Dynamic Route Guidance			•		•																												

Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	1_4 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	1_7 - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	3_1 - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	4_4 - COMMERCIAI VENICIE AUMINISUAUVE Pronosceae	4_5 - Hazmat Security and Incident Response	4_6 - Freight Mobility	2_1 - Emergency Nouncation and Personal Serurity	5_2 - Emergency Vehicle Management	5_3 - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
ATIS05: ISP Based Trip Planning and Route Guidance	•		•																														
ATIS06: Transportation Operations Data Sharing						•	•				•				•						•			•									•
ATIS07: Travel Services Information and Reservation	•				•										•																		
ATIS08: Dynamic Ridesharing				•				•					•																				
ATIS09: In Vehicle Signing		•									•												•										
ATIS10: Short Range Communications Traveler Information		•			•	•																		•									•
ATMS01: Network Surveillance						•	•																										
ATMS02: Traffic Probe Surveillance						•																											
ATMS03: Traffic Signal Control						•	•			•																							
ATMS04: Traffic Metering						•	•																										
ATMS05: HOV Lane Management						•		•																									
ATMS06: Traffic Information Dissemination		•				•	•																										
ATMS07: Regional Traffic Management						•																											
ATMS08: Traffic Incident Management System							•																•	•									
ATMS09: Transportation Decision Support and Demand Management						•		•																									
ATMS10: Electronic Toll Collection								•							•																		
ATMS11: Emissions								•	•																								

Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	1_4 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	1_7 - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	3_1 - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	4_4 - COMMERCIAI VENICIE AGMMINSUAUVE Drocecee	4_5 - Hazmat Security and Incident Response	4_6 - Freight Mobility	o_i - Emergency Notincation and Personal Security	5_2 - Emergency Vehicle Management	5_{-3} - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
Monitoring and Management																																	
ATMS12: Roadside Lighting System Control						•																•											
ATMS13: Standard Railroad Grade Crossing										•																							
ATMS14: Advanced Railroad Grade Crossing										•																							
ATMS15: Railroad Operations Coordination										•																							
ATMS16: Parking Facility Management															•																		
ATMS17: Regional Parking Management								•																									
ATMS18: Reversible Lane Management						•																											
ATMS19: Speed Warning and Enforcement						•																											•
ATMS20: Drawbridge Management						•																											
ATMS21: Roadway Closure Management						•	•			•										•		•	•	•									
ATMS22: Variable Speed Limits						•																											
ATMS23: Dynamic Lane Management and Shoulder Use						•																											
ATMS24: Dynamic Roadway Warning						•	•																										
ATMS25: VMT Road User Payment								•							•																		
ATMS26: Mixed Use Warning Systems						•																											
AVSS01: Vehicle Safety Monitoring																													•				
AVSS02: Driver Safety Monitoring																													•				

Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	1_4 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	1_7 - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	$3_{-}1$ - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	4_4 - COMMETCIAL VEMICIE AUMINISTIATIVE Droroscos	4_{-5} - Hazmat Security and Incident Response	4_6 - Freight Mobility	ס_ו - בווופרספורכא ואסנוונכאנוסוו אויד אביווויויע	5_2 - Emergency Vehicle Management	$5_{-}3$ - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
AVSS03: Longitudinal																									•				•				
Safety Warning AVSS04: Lateral																										•			•				
Safety Warning AVSS05: Intersection Safety																											•		•				
AVSS06: Pre- Crash Restraint Deployment																														•			
AVSS07: Driver Visibility Improvement																												•					
AVSS08: Advanced Vehicle Longitudinal Control																									•								
AVSS09: Advanced Vehicle Lateral Control																										•							
AVSS10: Intersection Collision Avoidance																											•						
AVSS11: Automated Vehicle Operations																															•		
AVSS12: Cooperative Vehicle Safety Systems																									•	•							
CVO01: Carrier Operations and Fleet Management																					•												
CVO02: Freight Administration																					•												
CVO03: Electronic Clearance																•			•														
CVO04: CV Administrative Processes																•			•		•												
CVO05: International Border Electronic Clearance																•			•		•												
CVO06: Weigh-In- Motion																•																	
CVO07: Roadside CVO Safety																•	•				•												\square

Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	14 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	$1_{-}7$ - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	$3_{-}1$ - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	4_4 - COMMERCIAL VENICIE AUMINISUANVE Droroccoc	4_5 - Hazmat Security and Incident Response	4_6 - Freight Mobility	ס_ו - בתופופותכי אסנוונכמנוסת מחגו דפר Sonal Soruritiv	5_2 - Emergency Vehicle Management	5_3 - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
CVO08: On-board CVO Safety																		•															
CVO09: CVO Fleet Maintenance																	•	•			•												
CVO10: HAZMAT Management																			•	•	•	•	•										
CVO11: Roadside HAZMAT Security Detection and Mitigation																				•	•												
CVO12: CV Driver Security Authentication																		•		•													
CVO13: Freight Assignment Tracking																		•		•	•												
EM01: Emergency Call-Taking and Dispatch																				•			•										
EM02: Emergency Routing			•			•																	•										
EM03: Mayday and Alarms Support																						•											
EM04: Roadway Service Patrols																							•										
EM05: Transportation Infrastructure Protection																						•		•									
EM06: Wide-Area Alert												•										•											
EM07: Early Warning System																								•									
EM08: Disaster Response and Recovery																								•									
EM09: Evacuation and Reentry Management																								•									
EM10: Disaster Traveler Information																								•									
MC01: Maintenance and Construction Vehicle and Equipment Tracking																																	•
IVICU2:					1																l I												•

Service Packages

Service Package Analysis and Use

Service Package	1_1 - Pre-trip Travel Information	1_2 - En-route Driver Information	1_3 - Route Guidance	1_4 - Ride Matching And Reservation	1_5 - Traveler Services Information	1_6 - Traffic Control	1_7 - Incident Management	1_8 - Travel Demand Management	1_9 - Emissions Testing And Mitigation	1_10 - Highway Rail Intersection	2_1 - Public Transportation Management	2_2 - En-route Transit Information	2_3 - Personalized Public Transit	2_4 - Public Travel Security	3_1 - Electronic Payment Services	4_1 - Commercial Vehicle Electronic Clearance	4_2 - Automated Roadside Safety Inspection	4_3 - On-board Safety And Security Monitoring	4_4 - COMMERCIAL VENICIE AUMINISUAUVE Dronoscooc	4_5 - Hazmat Security and Incident Response	4_6 - Freight Mobility	2_1 - Emergency Notmcation and Personal Security	5_2 - Emergency Vehicle Management	5_3 - Disaster Response And Evacuation	6_1 - Longitudinal Collision Avoidance	6_2 - Lateral Collision Avoidance	6_3 - Intersection Collision Avoidance	6_4 - Vision Enhancement For Crash Avoidance	6_5 - Safety Readiness	6_6 - Pre-crash Restraint Deployment	6_7 - Automated Vehicle Operation	7_1 - Archived Data	8_1 - Maintenance and Construction Operations
Maintenance and Construction Vehicle Maintenance																																	
MC03: Road Weather Data Collection																																	•
MC04: Weather Information Processing and Distribution	•																																•
MC05: Roadway Automated Treatment																																	•
MC06: Winter Maintenance																																	•