

# Baltimore Regional Management and Operations (M&O) Strategic Deployment Plan



Prepared for:



**Baltimore  
Metropolitan  
Council**

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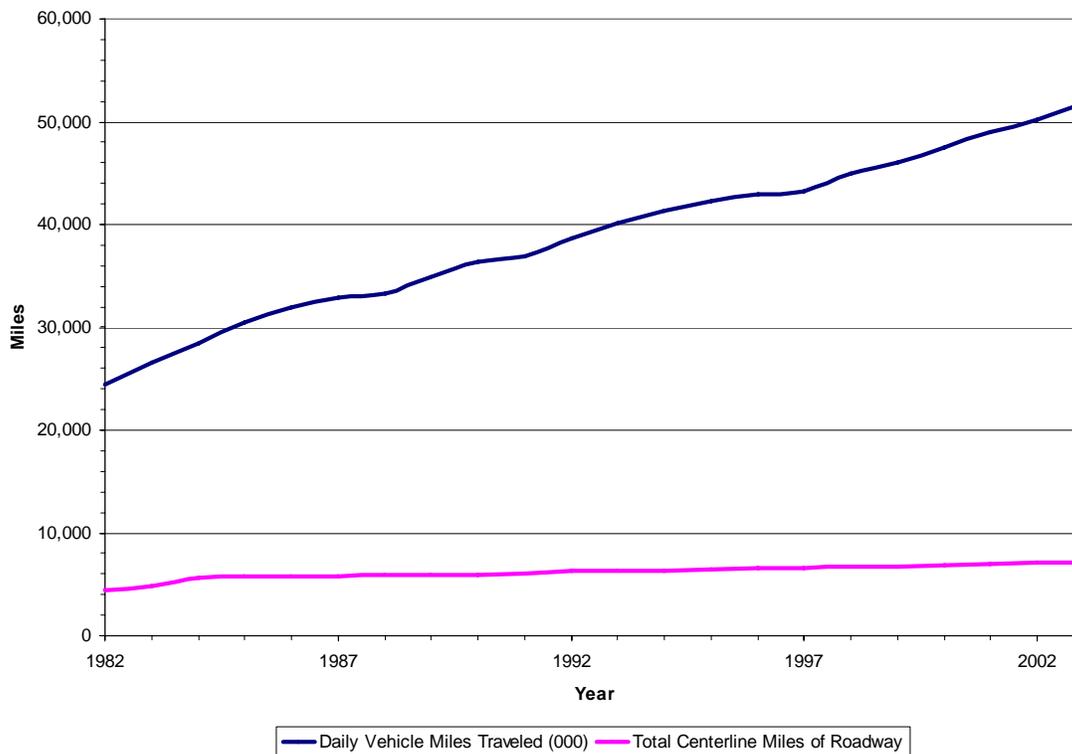
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## EXECUTIVE SUMMARY

### Background

A comparison of 2000 and 2004 mobility data shows a dramatic increase in vehicle miles traveled annually in the Baltimore region. During this four-year period, annual vehicle miles traveled increased by 9.6 percent or 2.1 billion miles.



This graph illustrates the relationship between the rate at which the amount of vehicle miles traveled has increased versus the rate at which roadway miles have increased over time. This relationship illustrates the importance of investing in regional transportation system management and operations (M&O).

One of the tools used to enhance transportation system M&O within the Baltimore region is Intelligent Transportation System (ITS). ITS is described as the application of current and evolving technologies to enhance transportation system safety and mobility.

In 1998, the Baltimore region developed the Metropolitan Baltimore ITS Strategic Deployment Plan which provided a framework for regional ITS deployment and identified nine high priority ITS projects. Since its adoption, significant progress has been made on a number of the identified high priority projects. The status of those nine high priority projects is presented in the succeeding table. This table also indicates whether the project has been initiated as a regional effort.

Other regional transportation system M&O initiatives have evolved since 1998 and are presented below:

- Baltimore Regional Operations Coordination Committee – initiated in 2000 to enhance coordination, cooperation, and communication during incidents impacting the regional transportation network.
- Traffic Signal Subcommittee – initiated in 2001 to provide a forum for the region’s signal engineers to discuss and address common issues.
- Multi-Modal Traveler Information System – a regional initiative to provide accurate and timely traveler information.
- Regional Protective Action Coordination Guidelines – completed in October 2006, this document addresses regional coordination issues arising as a result of a major emergency. Five major areas are covered: command and management, communications, public information, evacuation, and shelter/mass care.

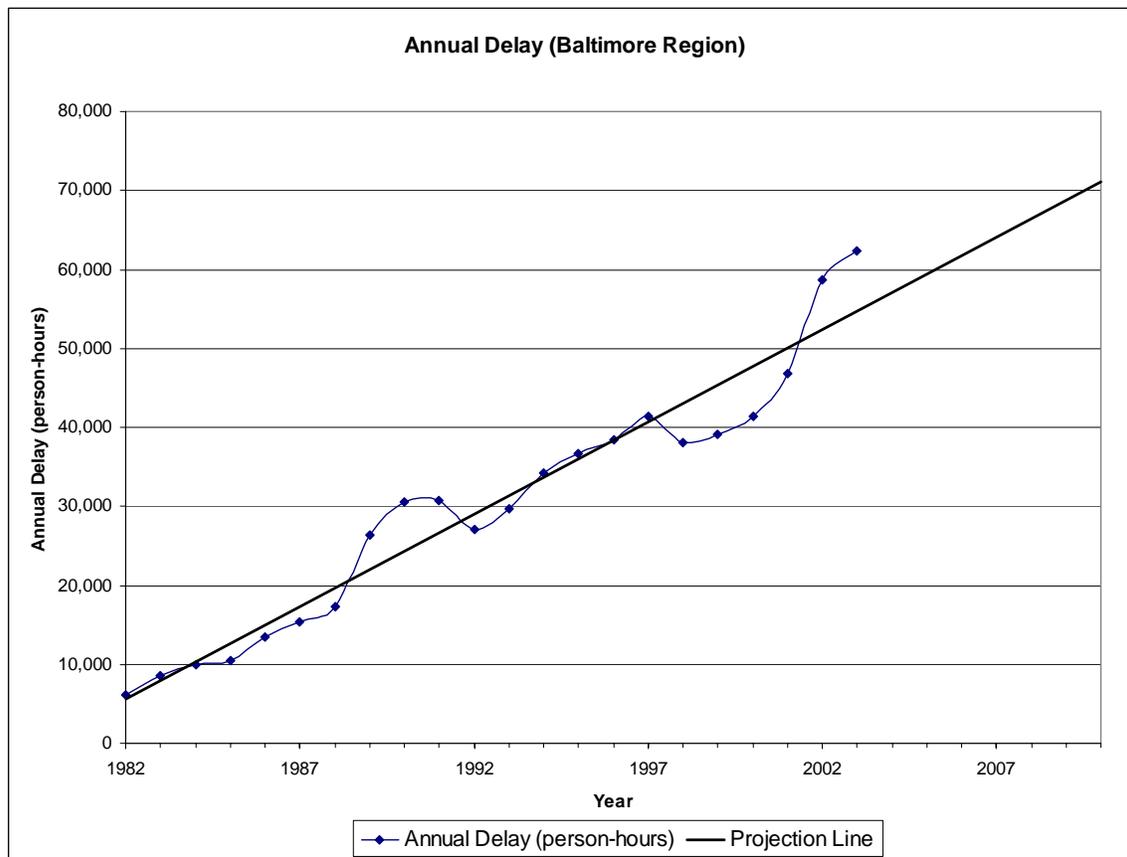
Like many urban areas in the country, the Baltimore region continues to experience increasing levels of congestion and delay on its transportation system, and opportunities to add capacity are severely limited. The safe, secure, reliable and efficient movement of people and goods throughout the Baltimore region is critical to the region’s socio-economic vitality.

This graph shows that annual delay has continuously grown in the Baltimore region. At this rate, annual delay will exceed 70 million person-hours annually. Recent studies<sup>1</sup>, done by the University of Maryland, estimate that delay costs travelers \$19.58/hour. Therefore, it can be projected that delay will cost the region’s travelers over \$1 billion dollars in 2010.

Catastrophic events, such as Hurricane Katrina and the 9/11 terrorist attacks, have heightened the nation’s awareness of the role and importance of transportation system management and operations (M&O) in emergency preparedness, response, and recovery. In addition, safety is a core program of SAFETEA-LU. The SAFETEA-LU Highway Safety Improvement Program targets transportation system M&O improvements such as work zone management.

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<sup>1</sup> Performance Evaluation of CHART – Year 2005



This Plan identifies various transportation system M&O strategies that enable the safe, secure, reliable, and efficient movement of people and goods throughout the Baltimore region and provides a framework for continued expansion of the region's M&O program.

The Baltimore Regional M&O Strategic Deployment Plan scope of work included:

- Updating the 1998 ITS Strategic Deployment Plan, including a review of regional M&O project deployments and development of a new priority project list and a path for deployment of the high priority projects
- Developing a vision for regional M&O deployment and a road map to achieve that vision
- Providing recommendations for continued integration of M&O into the transportation planning process, with consideration given to provisions in SAFETEA-LU
- Providing updates to the Maryland ITS Architecture<sup>2</sup>

<sup>2</sup> See Plan Appendix

**Status of Projects from the Metropolitan Baltimore ITS Strategic Deployment Plan**

Project	Description	Status Update	Reflects Regional Activity
Expand Incident Management Program	Expansion of the areas covered by the state's Emergency Traffic Patrols (ETP's), as well as improved communications among emergency service providers.	ETP coverage has increased but continued funding is required to maintain these services. Improved incident management procedures have shown measurable reductions in incident duration with additional estimated benefits of reduced delay, fuel consumption, and secondary incidents. The Baltimore Regional Operations Coordination (B-ROC) Committee supports interagency communication through training, policy improvements, self-assessments, and other activities. Acceptance and implementation of the Memorandum of Regional Coordination (MORC) may facilitate desired improvements in communications. Continued expansion of the CHART program also supports improved communications.	No
Provide Multi-Modal Traveler Information	An automated, region-wide multi-modal traveler information system that includes real-time traffic and transit information. This will provide both pre-trip and en-route information in a format that is readily accessible to the traveling public such as the telephone and internet.	This project has resulted in the development of a concept of operations, identification of federal funding, and award of a contract to develop, deploy, and operate a regional Multi-Modal Traveler Information System (MMTIS). The system is scheduled for an initial operational release in 2007. Internet access to real-time traffic information will be available as part of the initial release with system enhancements such as real-time transit information and telephone-based access planned for future deployment.	Yes
Provide En-Route Transit Information	The objective of this project is to provide en-route transit/travel information to the public. Real-time information will be relayed to customers using Variable Message Signs (VMS) and interactive kiosks. Location and schedule adherence data from the Automated Vehicle Location (AVL) project will also be applied.	The Maryland Transit Administration (MTA) is deploying information technology to provide AVL based real-time transit information via variable message signs located at the region's busiest transit stops. Other regional transit agencies have successfully deployed real-time transit information systems. Howard Transit utilizes the commercially available NextBus system to provide AVL based real-time transit information via message signs at bus stops and also via the Internet. Regional initiatives such as the MMTIS are expected to leverage available AVL data for transit/travel information services.	No

**Status of Projects from the Metropolitan Baltimore ITS Strategic Deployment Plan**

<b>Project</b>	<b>Description</b>	<b>Status Update</b>	<b>Reflects Regional Activity</b>
Expand Surveillance and Detection	Building on the success of the CHART program, it is suggested that surveillance and detection be expanded to cover all arterial roadways in the Baltimore Metropolitan region. Prime candidates would be those that parallel interstate routes.	Arterial surveillance and detection has been supplemented with CCTV deployments, particularly in Baltimore City, with plans to deploy similar systems in counties such as Anne Arundel and Harford. Not all CCTV systems are integrated with the current CHART program. The MMTIS project will provide surveillance functions to the region by utilizing floating vehicle probe data to monitor conditions on arterial routes.	Yes
Expand Motorist Information	It is proposed that motorist information be provided on major arterial roadways in the Baltimore Metropolitan region in the form of Variable Message Signs (VMS) and Traveler Advisory Radio (TAR).	There has been minimal deployment of VMS and Highway Advisory Radio (HAR) based motorist information services. Baltimore City has deployed VMS to support stadium event traffic management. Plans for regional deployment of a 511-type telephone based interactive voice response system for motorist information have been developed as part of the MMTIS. The SHA conducted a pilot study on I-70 in which travel time information was provided to drivers using VMS.	Yes
Encourage Use/Management of Parking Capacity	The purpose of this project is to encourage the use of transit from satellite parking lots to the downtown area by providing real-time information on available parking.	There has been minimal deployment of advanced parking information systems in the downtown area. Commercial broadcast traffic reports provide limited parking lot information during stadium events. The planned renovation of the Baltimore City Transportation Management Center may support this functionality in the future.	No
Improve Traffic Signal Coordination	The purpose of this project is to improve coordination between Baltimore City and the individual county controlled signal equipment. This will accommodate remote access from the Statewide Operations Center (SOC) to county signal systems for incident management purposes. Emergency vehicle preemption is also of importance.	The Traffic Signal Subcommittee was formed to provide a forum to discuss and plan for coordinated signal control and other options to improve traffic signal system operations. Corridors for interagency coordination have been identified. The planned system-wide update of Baltimore City traffic signal controllers, central signal system equipment, field communication equipment and operating software will support this functionality in the future. Emergency vehicle preemption systems have seen limited deployment throughout the region. Transit preemption has been investigated for the Howard Street Light Rail corridor.	Yes

**Status of Projects from the Metropolitan Baltimore ITS Strategic Deployment Plan**

<b>Project</b>	<b>Description</b>	<b>Status Update</b>	<b>Reflects Regional Activity</b>
Provide a Common Electronic Payment System	This project will develop an electronic payment system to allow travelers to pay for transportation services with a common fare medium.	The MTA has developed plans to deploy an electronic payment system known as Maryland Transit Pass. This system will be integrated with the SmarTrip system currently deployed in the National Capital Region for a planned Maryland statewide electronic payment system for transit services. Additional transportation services may be added to this system in the future. The Maryland Transportation Authority (MdTA) operates EZ Pass, an electronic payment system serving toll facilities in the Baltimore region. This system builds upon the earlier M-TAG system but now supports electronic toll payment through EZ Pass facilities in other states.	No

## **M&O Strategic Deployment Plan Development Approach & Results**

Stakeholder input into the development of the M&O Strategic Deployment Plan was solicited from the Project Steering Committee, through a survey of a wide range of regional stakeholders, and through stakeholder participation in a one-day Visioning Workshop. Information gathered led to the development of regional M&O:

- Vision,
- Needs,
- Goals and Objectives and
- Projects/Strategies.

The regional M&O vision, goals, objectives, strategies and projects are all components of the M&O Strategic Deployment Plan.

Ten survey responses were received from transportation, transit and public safety agencies throughout the region.

In summary, the survey revealed:

- With the exceptions of Maryland State Highway Administration (SHA) and Baltimore City DOT, there has been limited ITS deployed within the Baltimore region.
- Congested roadways exist throughout the region, not just in urban areas.
- Better inter/intra-agency coordination is needed to manage congestion.

On March 30, 2006, a one-day Visioning Workshop was held. The workshop was attended by 30 regional stakeholders from local, state, federal and academic agencies/organizations. During the Visioning Workshop, stakeholders identified regional M&O issues. Those issues were then compiled and ranked.

Leveraging the results of the survey and workshop, a vision for regional transportation system M&O and goals were identified.

### **Regional M&O Vision**

***The Baltimore regional transportation system will be managed and operated such that people and goods arrive at their destinations safely, securely, reliably and efficiently; thereby protecting the environment and supporting economic vitality.***

## **Regional M&O Goals**

- **Goal 1: Coordinated regional transportation system M&O**

Coordinated transportation system M&O requires the establishment of policies, practices, and procedures that will allow stakeholders to address regional M&O issues in a collaborative manner. The sharing of information between operating agencies is an outcome of coordinated transportation system M&O.

- **Goal 2: Stakeholders educated on the benefits of coordinated transportation system M&O**

In this goal, stakeholders represent regional transportation system planners, operators, senior agency personnel (i.e. decision makers) and users (i.e. the traveling public) and their legislative representatives. Educated stakeholders will promote regionally coordinated transportation system M&O within their own jurisdictions. Stakeholders educated on the benefits of coordinated transportation system M&O are critical to realizing the regional M&O vision.

- **Goal 3: Accessible real-time, multi-modal transportation network condition data**

Access to real-time, multi-modal transportation network condition data will help transportation system operators collaboratively manage the regional transportation network. Access to real-time, multi-modal transportation network condition data will keep transportation system users informed, which allows users to make better trip choices. Transportation system operator and user access to real-time, multi-modal transportation network condition data supports the realization of the regional M&O vision.

- **Goal 4: Allocated funding for regional transportation system M&O initiatives**

Some sources that have been traditionally used to fund regional M&O initiatives no longer exist. Therefore, allocated funding for regional transportation system M&O initiatives is needed to ensure that the regional M&O vision is reached.

- **Goal 5: Secure critical transportation infrastructure and data**

In order to achieve the regional M&O vision, critical transportation infrastructure and data must be reliable. Securing critical transportation infrastructure and data will ensure critical transportation infrastructure and data reliability.

- **Goal 6: Influence roadway design**

M&O initiatives can be implemented most efficiently when done in coordination with roadway/interchange enhancement or construction projects. Through early coordination in the planning and design phases, M&O initiatives can be implemented most cost effectively.

## **Regional M&O Vision Realization**

In order to achieve the regional M&O vision and associated goals, two enabling initiatives and eight high priority projects were identified. The enabling initiatives will provide a basis from which the M&O Strategic Deployment Plan will be executed and maintained and should be implemented prior to or in conjunction with the high priority regional projects. The enabling initiatives outlined below should be undertaken by the BRTB working with the M&O Partnership.

### Enabling Initiatives

*Define BRTB Role in Regional Transportation System M&O.* The role of an MPO in regional transportation system M&O varies from region-to-region. An Association of Metropolitan Planning Organizations (AMPO) White Paper titled, The MPO Role in M&O, defines the “traditional” role of the MPO in M&O as one that merely promotes efficient transportation system M&O as required (initially) by TEA-21. Beyond the “traditional” role, the AMPO White Paper suggests that an MPO could assume the following transportation system M&O responsibilities:

- **Convener** of meetings to facilitate the planning for transportation system M&O improvements.
- **Champion** of plans to improve transportation system M&O efficiency.
- **Developer** of metropolitan-level transportation system M&O plans.
- **Operator** of the metropolitan transportation system.

Using the AMPO White Paper as a starting point, the BRTB needs to define its role in regional transportation system M&O. This will help determine the role of the BRTB in the implementation of the projects identified in this Plan as well as other regional M&O initiatives.

*Establish Regional Transportation System M&O Performance Measures.* Based on the regional M&O objectives identified in the Strategic Deployment Plan, metrics, benchmarks and temporal constraints need to be established in order to monitor and track the execution of the Plan and to assist in the definition of regional M&O performance measures.

### Prioritized High Priority Projects

Out of the 38 regional M&O projects identified in this Plan, eight high priority projects were selected. Seven screening factors were used to prioritize the high priority projects.

The prioritized high priority projects are listed and described in the table below. All eight of the high priority projects are valuable; they were identified by the region's stakeholders as critical to implement because of the benefits they would bring to the transportation system. Since it is not possible to implement all of the projects at the same time, the project prioritization was performed to provide an implementation framework. Through this process, two **early winners** were identified, **priority projects 1 and 2**, based on their low cost and ease of implementation, as well as the role they play in helping to gain support for future M&O projects.

## **Regional Planning for Operations**

Regional transportation system M&O projects were traditionally funded through federal ITS earmarks. The new transportation legislation, SAFETEA-LU, marks the end of the ITS Integration (or Earmark) Program. Therefore, funding for regional transportation system M&O projects has to be secured via the regional transportation planning process or from alternative funding sources (i.e. grants, public-private partnerships, etc.).

Regional planning for operations is a joint effort between regional transportation system operators and planners that enables effective regional transportation system M&O. Regional planning for operations requires:

1. Regional transportation operations coordination,
2. Consideration of M&O within the context of the ongoing regional transportation planning and investment process, and
3. Establishment of a link between regional operations coordination and regional planning.

<b>Project Priority</b>	<b>Project Name</b>	<b>Project Description</b>	<b>Proposed Committee Assignment</b>
1	<i>Facilitate Incident Management Training Opportunities</i>	<i>In most cases, incident management involves many agencies and organizations. Education and training opportunities, such as incident management training, conferences, and table-top exercises, improve coordination amongst the many stakeholders.</i>	<i>B-ROC Committee</i>
2	<i>Facilitate Regional M&amp;O Outreach, Education and Training Opportunities</i>	<i>Develop and use regional M&amp;O outreach, education and training material in order to educate decision makers on the benefits of regional transportation system M&amp;O.</i>	<i>M&amp;O Strategic Deployment Plan Implementation Steering Committee*</i>
3	Link Regional Transportation Planning and Operations	This project involves the implementation of policies, practices and procedures that maximize the utilization of traditional and alternative funding sources including, but not limited to: integrating M&O into the regional transportation system planning process, securing funding from non-traditional funding sources (i.e. public-private partnerships and homeland security grants), regional planning and operations coordination and collaboration and performance measurement	BRTB M&O Partnership
3	Enhance M&O along Critical Corridors and Evacuation Routes	Congestion on the transportation network can be categorized into two types: recurring and non-recurring. This effort attempts to address non-recurring congestion that is the result of a major incident. This project will identify and implement M&O improvements that support integrated corridor/incident management along critical corridors and evacuation routes.	Transportation & Public Works Subcommittee

<b>Project Priority</b>	<b>Project Name</b>	<b>Project Description</b>	<b>Proposed Committee Assignment</b>
5	Establish a Regional Transportation Information System	SAFETEA-LU requires the establishment of data exchange formats that ensure that data provided by highway and transit monitoring systems can be exchanged across jurisdictional boundaries and be available nationally. A regional effort to develop such a system would be an extension of the federal program and allow transportation system planners and operators, responders, and other travelers access to real-time and archived data collected via automated transportation infrastructure.	Baltimore Region Technology Group
6	Traffic Control System Reliability Enhancements	Replace existing conventional traffic signals with LED (Light Emitting Diode) Traffic Signals and specify LED traffic signals for all future installations. And, install battery backup systems on LED traffic signals along evacuation/critical routes to increase reliability during emergencies.	Traffic Signal Subcommittee
7	Secure Critical Regional Transportation Infrastructure	Threats to transportation infrastructure can result from acts of nature, terrorist attacks and other incidents that cause damage to the infrastructure. Transportation infrastructure can be protected by a wide range of ITS technologies. This Project will explore and implement the most appropriate policies and technologies to secure regional transportation infrastructure.	Transportation & Public Works Subcommittee
8	Implement Regionally Coordinated Adaptive Traffic Control Systems	This project promotes the evolution of local traffic control systems to adaptive traffic control systems and proposes to coordinate local adaptive control systems via the exchange of real-time traffic conditions data between local traffic management centers/signal operations centers.	Traffic Signal Subcommittee

The Baltimore region has made substantial strides towards linking planning and operations. Those efforts have been included in the table below.

<b>Mechanism For Linking Planning And Operations</b>	<b>Corresponding Regional Effort to Link Planning and Operations</b>
Performance Measurement Systems	Following the development of national and statewide performance measures  Customer Satisfaction Survey
Congestion Management	Established under Guidelines for the Congestion Management System (CMS) in the Baltimore region. As required by SAFETEA-LU, the Baltimore region's CMS will be replaced by a Congestion Management Process (CMP).
Regional ITS Architecture	Maryland Statewide ITS Architecture
Institutional Arrangements	The M&O Partnership oversees, recommends, and directs regional M&O initiatives. The M&O Partnership is supported by the following committees: <ul style="list-style-type: none"> <li>• Baltimore Regional Operations Coordination Committee</li> <li>• Traffic Signal Subcommittee</li> <li>• Transportation and Public Works Subcommittee</li> </ul> The M&O Partnership annually recommends projects to the BRTB.  The M&O Partnership is currently drafting a regional priority letter.  Memorandum of Regional Cooperation has been established in order to encourage cooperation between regional agencies during an incident.
Data Collection and Sharing	The region is in the process of developing the Multi-Modal Traveler Information System to collect and share traveler information throughout the region.
Funding and Resource Sharing	Baltimore Regional Emergency Assistance Compact
Regional Transportation Systems Management and Operations Projects	The advancement of projects recommended in the 1998 ITS Strategic Deployment Plan.

In an effort to improve the coordination between transportation system planning and operations, it is recommended that the Baltimore region consider the development of regional M&O priority letters and regional ITS project architectures and use of planning analysis tools that acknowledge transportation system O&M improvements. Each recommendation has been detailed below.

**Priority Letters**

The M&O Partnership is currently drafting a Regional M&O Priority Letter. State law requires each jurisdiction to submit a priority letter to MDOT each year. Priority letters request that certain projects be included in the Maryland Consolidated Transportation Program (CTP) and in the regional Transportation Improvement Program (TIP). The Regional M&O Priority Letter will be submitted to MDOT requesting that a list of regional M&O projects be included in the CTP and the TIP. The priority letter that is currently being drafted represents the first time that the Baltimore region has collectively submitted a Regional Priority Letter. This approach will identify several regional M&O projects that are considered a priority by all jurisdictions.

Alternatively, it has been suggested that a regional M&O project be included in all jurisdictional priority letters. This approach would identify one or more regional M&O project(s) that the entire region considers as a priority.

*Regional ITS Project Architecture Development.* The FHWA Rule on ITS Architecture and Standards (Rule 940) requires that all ITS projects funded with highway trust funds shall be developed based on system engineering analysis. Rule 940 states that a systems engineering analysis should include:

1. Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture);
2. Identification of participating agencies' roles and responsibilities;
3. Requirements definitions;
4. Analysis of alternative system configurations and technology options to meet requirements;
5. Procurement options;
6. Identification of applicable ITS standards and testing procedures; and
7. Procedures and resources necessary for operations and management of the system.

The development of a project ITS architecture satisfies FHWA Rule 940 systems engineering analysis requirements 1, 2, 3 and 6 and provides a basis for satisfying the remaining requirements.

Furthermore, the development of a project ITS architecture:

- Provides a forum in which an ITS project can be properly explored
- Documents stakeholder roles and responsibilities
- Documents high-level ITS project requirements
- Identifies standards

The development of Regional ITS Project Architectures based on the Maryland Statewide ITS Architecture can be used as a forum to initiate relationships and institutional arrangements that support regional transportation system planning for operations.

*Planning Analysis Tools.* Planning analysis tools such as ITS Deployment Analysis System (IDAS) and Dynamic Network Assignment Simulation Model for Advanced Road Telematics for Planning Applications (DYNASMART-P) determine the benefits and costs associated with ITS deployments. Benefit-cost data can be used to help transportation planners and decision makers program ITS projects.

In support of regional planning for operations, the use of planning analysis tools should be integrated into the regional planning process.

### **Next Steps**

In summary, the next steps for the region are to execute and maintain the M&O Strategic Deployment Plan. This can only be successful if the region's stakeholders continue to be included in the process.

Prior to execution of the high priority projects, it will be important for the region to undertake the two enabling initiatives which will help lay a strong foundation for future M&O implementation. Once the enabling initiatives have been addressed, it is suggested that the region use the Maryland Statewide ITS Architecture to develop high priority regional ITS project architectures (as necessary). This will allow regional stakeholders the opportunity to collaboratively scope high priority projects. Also, the development of the ITS project architectures will satisfy the majority of FHWA Rule 940.

## **1.0 INTRODUCTION**

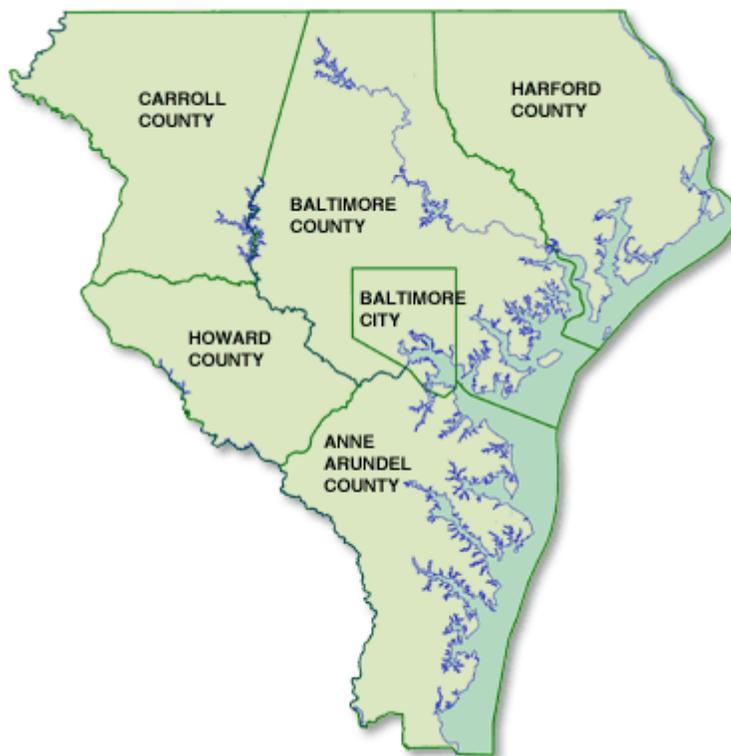
The purpose of Baltimore Regional M&O Strategic Deployment Plan is to update the 1998 ITS Strategic Deployment Plan and expand the scope to include:

- the wider focus of transportation system M&O
- M&O projects that improve security and emergency response,
- recommendations on how to address the SAFETEA-LU regulations, especially those focused on improving the linkage between regional transportation planning and operations, and
- potential updates to the Maryland ITS Architecture.

This section provides an overview of the Baltimore region, a summary of current M&O activities in the region, and the motivation for pursuing and expanding regional M&O activities.

### **1.1 Overview of the Baltimore Region**

The Baltimore region includes Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County and Howard County (see Figure 1).



**Figure 1. Baltimore Region Jurisdictions**

The Baltimore Regional Transportation Board (BRTB) is the Metropolitan Planning Organization for the Baltimore region. The BRTB oversees the regional transportation planning process. Since the Baltimore region is designated as a “severe” non-attainment area with regard to its air quality, the BRTB is federally obligated to update a long range transportation plan (LRTP) for the Baltimore region at minimum every four years. Transportation 2030 (T2030) is the region’s current LRTP. The Baltimore region Transportation Improvement Program (TIP) is the region’s short-range transportation plan. The TIP allocates fiscal resources for the next five years to transportation projects based on guiding principles and goals identified in the regions’ LRTP. The TIP is updated annually. Both T2030 and the TIP support the use of transportation system M&O enhancements to improve regional transportation system efficiency and safety.

**1.1.1 Population Statistics**

With a population of 2,594,135 in 2004, the Baltimore region is the nation’s 19th largest market. The most populous jurisdictions are Baltimore County (780,821), Baltimore City (636,251), and Anne Arundel County (508,600). A breakdown of the region’s population by jurisdiction is given in Table 1.

**Table 1. Population by Jurisdiction**

Jurisdiction	Population (2004)	Population Change 1990 - 2004
Anne Arundel County	508,600	81,400
Baltimore City	636,300	-99,700
Baltimore County	780,800	88,700
Carroll County	166,200	42,800
Harford County	235,600	53,500
Howard County	266,700	79,400

Source: Baltimore Metropolitan Council – Regional Economic Indicators 2006

During the 15-year period from 1990 to 2004, the population in the region increased by approximately 10%. Howard, Carroll and Harford counties, the smaller counties in the region, saw the fastest growth rate in population. After a steady stream of increasing population losses in the early 1990’s, Baltimore City saw its population decrease at a slower rate from 1999 onward. Baltimore County experienced a moderate increase in its population during the 15-year period. There was an increase of 88,700 over the 1990 population in Baltimore County.

### 1.1.2 Regional Transportation System Infrastructure & Statistics

The region is served by a total of 7,065 centerline miles of roadway. There are 1,530 lane miles of freeway and 1,495 lane miles of principal arterial streets. Interstate travel within the region is facilitated by two tunnels (Fort McHenry and Baltimore Harbor) and the Francis Scott Key Bridge. These facilities are owned and operated by the Maryland Transportation Authority. Air passenger travel in the region is served by the Baltimore Washington Thurgood Marshall International Airport (BWI). Commercial air freight services are served by the Martin State Airport. Airports within the State are governed by the Maryland Aviation Administration. Sea cargo services are conducted at the Port of Baltimore. The Maryland Port Administration governs the Port of Baltimore. The Maryland Transit Administration (MTA) operates local bus, metro subway, light rail, commuter bus, and commuter train service within the region. Additionally, the MTA supports Locally Operated Transit Systems (LOTS) throughout the region.

One of the tools used to enhance transportation system M&O within the Baltimore region is Intelligent Transportation System (ITS). ITS is described as the application of current and evolving technologies to enhance transportation system safety and mobility. ITS enhances system operations through roadway monitoring and incident detection, traffic and transit management, provision of real-time traffic, transit, and parking information to travelers, and deploying weigh-in-motion and pre-clearance systems for commercial vehicles. The majority of the ITS infrastructure deployed within the Baltimore region is owned and operated by Baltimore City and the Maryland State Highway Administration (SHA). The SHA Office of CHART and ITS Development manages and operates the Coordinated Highways Action Response Team (CHART), Maryland's ITS program.

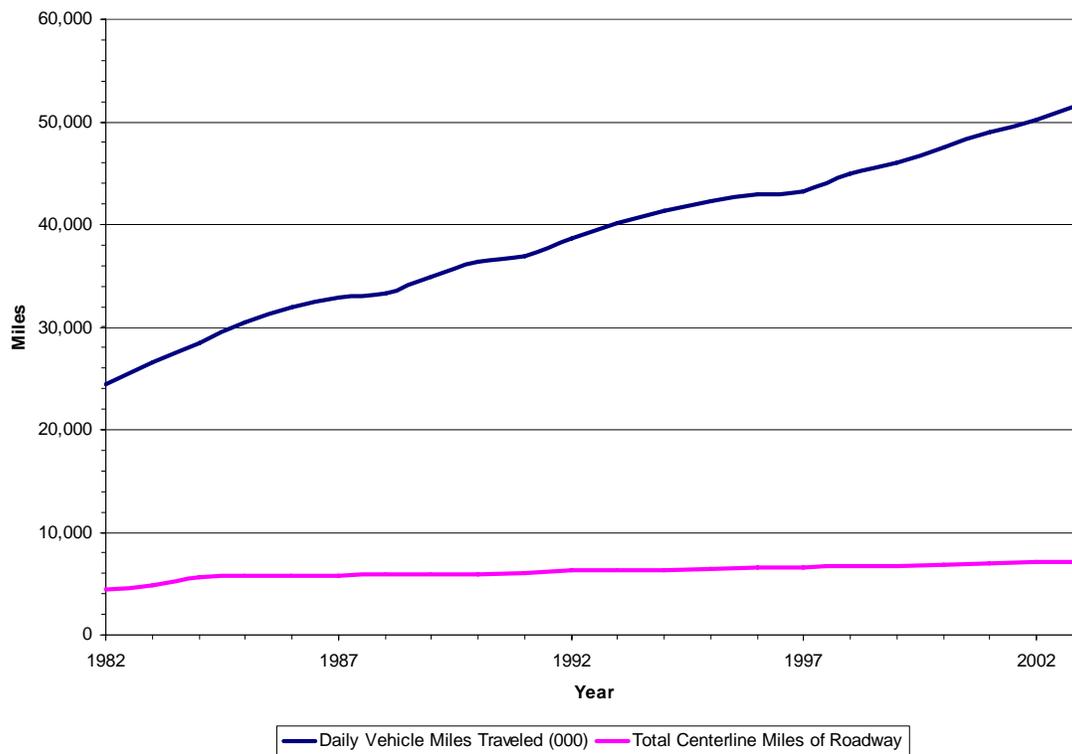
A comparison of 2000 and 2004 mobility data shows a dramatic increase in vehicle miles traveled annually in the region. During this four-year period, annual vehicle miles traveled increased by 9.6 percent or 2.1 billion miles. Within the region, the rate of increase was highest in Howard County (16.8 percent) and lowest in Baltimore City (1.3 percent).

Daily vehicle miles traveled in the region reached 57.3 million in 2004. This total represents a gain of 4.2 million miles or 7.9 percent above the year 2000. While daily vehicle miles traveled continues to increase each year, the number of roadway miles does not. Figure 2 illustrates the relationship between the rate at which the amount of vehicle miles traveled has increased versus the rate at which roadway miles have increased over time. This relationship illustrates the importance of investing in regional transportation system M&O.

## **1.2 Background and Need**

In 1998, the Baltimore region developed the Metropolitan Baltimore ITS Strategic Deployment Plan which provided a framework for regional ITS deployment and identified nine high priority ITS projects. Since its adoption, significant progress has been made on a number of the identified high priority projects. The status of those nine

high priority projects are presented in Table 2. This table also indicates whether the project has been initiated as a regional effort.



**Figure 2. Vehicle Miles Traveled vs. Roadway Miles**

Other regional transportation system M&O initiatives have evolved since 1998 and are presented below:

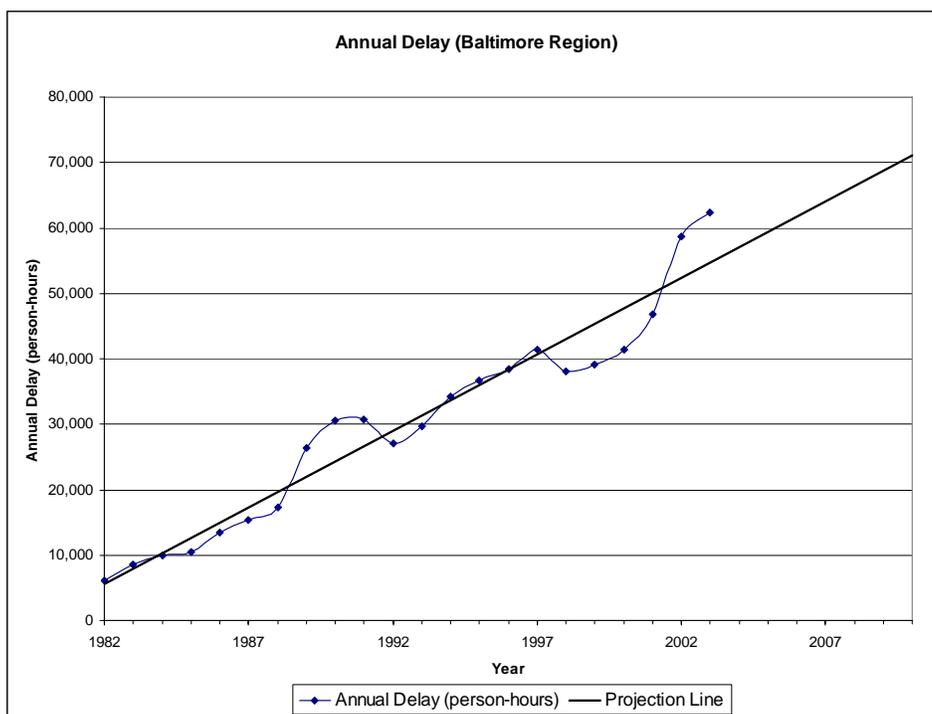
- Baltimore Regional Operations Coordination Committee – initiated in 2000 to enhance coordination, cooperation, and communication during incidents impacting the regional transportation network.
- Traffic Signal Subcommittee – initiated in 2001 to provide a forum for the region’s signal engineers to discuss and address common issues.
- Multi-Modal Traveler Information System – a regional initiative to provide accurate and timely traveler information.
- Regional Protective Action Coordination Guidelines – completed in October 2006, this document addresses regional coordination issues arising as a result of a major emergency. Five major areas are covered: command and management, communications, public information, evacuation, and shelter/mass care. A Regional Protective Action Coordination Agreement was also developed as part of this project.

**Table 2. Deployment Plan Status**

<b>Project</b>	<b>Description</b>	<b>Status Update</b>	<b>Reflects Regional Activity</b>
Expand Incident Management Program	Expansion of the areas covered by the state's Emergency Traffic Patrols (ETP's), as well as improved communications among emergency service providers.	ETP coverage has increased but continued funding is required to maintain these services. Improved incident management procedures have shown measurable reductions in incident duration with additional estimated benefits of reduced delay, fuel consumption, and secondary incidents. The Baltimore Regional Operations Coordination (B-ROC) Committee supports interagency communication through training, policy improvements, self-assessments, and other activities. Acceptance and implementation of the Memorandum of Regional Coordination (MORC) may facilitate desired improvements in communications. Continued expansion of the CHART program also supports improved communications.	No
Provide Multi-Modal Traveler Information	An automated, region-wide multi-modal traveler information system that includes real-time traffic and transit information. This will provide both pre-trip and en-route information in a format that is readily accessible to the traveling public such as the telephone and internet.	This project has resulted in the development of a concept of operations, identification of federal funding, and award of a contract to develop, deploy, and operate a regional Multi-Modal Traveler Information System (MMTIS). The system is scheduled for an initial operational release in 2007. Internet access to real-time traffic information will be available as part of the initial release with system enhancements such as real-time transit information and telephone-based access planned for future deployment.	Yes
Develop an Information Exchange System for Information Sharing	This project will develop an information sharing system as a means of communication for participating agencies.	A basic Information Exchange System (IES) was deployed on a trial basis for evaluation. This trial involved the use of cellular telephones for push-to-talk communications and receipt of text alerts from the CHART program. Results showed a need and agency demand for such a system. Expansion of the Capital Wireless Integrated Network (CapWIN) program into the Baltimore region and development of interagency agreements such as the Memorandum of Regional Coordination (MORC) may facilitate desired improvements in information sharing. Continued expansion of the CHART program and regional acceptance of interoperable emergency management technology also support information sharing.	Yes
Provide En-Route Transit Information	The objective of this project is to provide en-route transit/travel information to the public. Real-time information will be relayed to customers using Variable Message Signs (VMS) and interactive kiosks. Location and schedule adherence data from the Automated Vehicle Location (AVL) project will also be applied.	The Maryland Transit Administration (MTA) is deploying information technology to provide AVL based real-time transit information via variable message signs located at the region's busiest transit stops. Other regional transit agencies have successfully deployed real-time transit information systems. Howard Transit utilizes the commercially available NextBus system to provide AVL based real-time transit information via message signs at bus stops and also via the Internet. Regional initiatives such as the MMTIS are expected to leverage available AVL data for transit/travel information services.	No

Project	Description	Status Update	Reflects Regional Activity
Expand Surveillance and Detection	Building on the success of the CHART program, it is suggested that surveillance and detection be expanded to cover all arterial roadways in the Baltimore Metropolitan region. Prime candidates would be those that parallel interstate routes.	Arterial surveillance and detection has been supplemented with CCTV deployments, particularly in Baltimore City, with plans to deploy similar systems in counties such as Anne Arundel and Harford. Not all CCTV systems are integrated with the current CHART program. The MMTIS project will provide surveillance functions to the region by utilizing floating vehicle probe data to monitor conditions on arterial routes.	Yes
Expand Motorist Information	It is proposed that motorist information be provided on major arterial roadways in the Baltimore Metropolitan region in the form of Variable Message Signs (VMS) and Traveler Advisory Radio (TAR).	There has been minimal deployment of VMS and Highway Advisory Radio (HAR) based motorist information services. Baltimore City has deployed VMS to support stadium event traffic management. Plans for regional deployment of a 511-type telephone based interactive voice response system for motorist information have been developed as part of the MMTIS. The SHA conducted a pilot study on I-70 in which travel time information was provided to drivers using VMS.	Yes
Encourage Use/Management of Parking Capacity	The purpose of this project is to encourage the use of transit from satellite parking lots to the downtown area by providing real-time information on available parking.	There has been minimal deployment of advanced parking information systems in the downtown area. Commercial broadcast traffic reports provide limited parking lot information during stadium events. The planned renovation of the Baltimore City Transportation Management Center may support this functionality in the future.	No
Improve Traffic Signal Coordination	The purpose of this project is to improve coordination between Baltimore City and the individual county controlled signal equipment. This will accommodate remote access from the Statewide Operations Center (SOC) to county signal systems for incident management purposes. Emergency vehicle preemption is also of importance.	The Traffic Signal Subcommittee was formed to provide a forum to discuss and plan for coordinated signal control and other options to improve traffic signal system operations. Corridors for interagency coordination have been identified. The planned system-wide update of Baltimore City traffic signal controllers, central signal system equipment, field communication equipment and operating software will support this functionality in the future. Emergency vehicle preemption systems have seen limited deployment throughout the region. Transit preemption has been investigated for the Howard Street Light Rail corridor.	Yes
Provide a Common Electronic Payment System	This project will develop an electronic payment system to allow travelers to pay for transportation services with a common fare medium.	The MTA has developed plans to deploy an electronic payment system known as Maryland Transit Pass. This system will be integrated with the SmarTrip system currently deployed in the National Capital Region for a planned Maryland statewide electronic payment system for transit services. Additional transportation services may be added to this system in the future. The Maryland Transportation Authority (MdTA) operates EZ Pass, an electronic payment system serving toll facilities in the Baltimore region. This system builds upon the earlier M-TAG system but now supports electronic toll payment through EZ Pass facilities in other states.	No

Like many urban areas in the country, the Baltimore region continues to experience increasing levels of congestion and delay on its transportation system, and opportunities to add capacity are severely limited. The safe, secure, reliable and efficient movement of people and goods throughout the Baltimore region is critical to the region's socio-economic vitality. Transportation system efficiency and reliability can be gauged based on the amount of congestion or delay that transportation system users (or travelers) experience while traveling. According to the Texas Transportation Institute (TTI) 2005 Urban Mobility Study, the annual delay experienced by travelers in the region, which continues to increase yearly, was calculated to be 62,436,000 person-hours during 2003. This statistic ranks the Baltimore region as the 17<sup>th</sup> most congested urban area in the United States. Figure 3 shows that annual delay has continuously grown in the Baltimore region. At this rate, annual delay will exceed 70 million person-hours annually. Recent studies done by the University of Maryland<sup>3</sup> estimate that delay costs travelers \$19.58/hour. Therefore, it can be projected that delay will cost the region's travelers over \$1 billion dollars in 2010.



**Figure 3. Baltimore Region Annual Delay**

Catastrophic events, such as Hurricane Katrina and the 9/11 terrorist attacks, have heightened the nation's awareness of the role and importance of transportation system management and operations (M&O) in emergency preparedness, response, and recovery. In addition, safety is a core program of SAFETEA-LU. The SAFETEA-LU Highway Safety Improvement Program targets transportation system M&O improvements such as work zone management.

<sup>3</sup> Performance Evaluation of CHART – Year 2005

This Plan identifies various transportation system M&O strategies that enable the safe, secure, reliable, and efficient movement of people and goods throughout the Baltimore region and provides a framework for continued expansion of the region's M&O program.

## 2.0 M&O STRATEGIC DEPLOYMENT PLAN DEVELOPMENT SCOPE & APPROACH

The Baltimore Regional M&O Strategic Deployment Plan scope of work included:

- Updating the 1998 ITS Strategic Deployment Plan, including a review of regional M&O project deployments and development of a new priority project list and a path for deployment of the high priority projects
- Developing a vision for regional M&O deployment and a road map to achieve that vision
- Providing recommendations for continued integration of M&O into the transportation planning process, with consideration given to provisions in SAFETEA-LU
- Providing updates to the Maryland ITS Architecture

### 2.1 Project Scope

The following tasks were derived to guide the development of the Baltimore Regional M&O Strategic Deployment Plan. A Project Steering Committee was formed to oversee the execution of these tasks (See Appendix A for a list of members).

#### 2.1.1 Task 1 – Outreach and Information Gathering

This task focused on the collection and analysis of information in order to determine the status of transportation system M&O within the region. Relevant plans and documents were reviewed and regional stakeholders were surveyed.

#### 2.1.2 Task 2 – Assess the Status of Regional M&O Deployment

Based on the information gathered in Task 1, the status of regional M&O deployment was determined. An understanding of the status of regional M&O deployment provided a basis for identifying regional M&O issues and priorities.

#### 2.1.3 Task 3 – Develop a 25-Year Vision for M&O in the Region

This task called for the development of a regional M&O vision, goals, objectives, strategies and projects. The regional M&O vision was developed collaboratively by stakeholders during a one-day workshop. Also during that workshop, regional M&O issues were identified. The results of the Workshop and Task 2 were used to develop regional M&O goals, objectives, strategies and projects.

**2.1.4 Task 4 – Identify High Priority Regional M&O Projects**

With guidance from the Project Steering Committee, high priority regional M&O projects were identified based on the results of Tasks 1 through 3.

**2.1.5 Task 5 – Develop Recommendations for Continued Integration of M & O into the Transportation Planning Process**

The intent of this task was to identify policies, processes and procedures that link regional transportation system M&O and planning. The regional transportation planning process and practices were examined to determine opportunities to further integrate regional M&O strategies into the regional transportation planning process. Relevant documents and case studies were reviewed to support this task.

**2.1.6 Task 6 – Coordination with Maryland Statewide ITS Architecture**

The Maryland Statewide ITS Architecture was reviewed to determine the portions that would need to be updated, based on the results of Tasks 1 through 5.

**2.1.7 Task 7 – Preparation of the Draft M&O Strategic Deployment Plan**

For this task, the draft M&O Strategic Deployment Plan was prepared and reviewed by the Project Steering Committee.

**2.1.8 Task 8 - Preparation of the Final M&O Strategic Deployment Plan**

Based on the comments received from the Project Steering Committee, the final M&O Strategic Deployment Plan was prepared.

**2.2 Strategic Planning Framework**

Stakeholder input into the development of the M&O Strategic Deployment Plan was solicited from the Project Steering Committee, through a survey of a wide range of regional stakeholders, and through stakeholder participation in a one-day Visioning Workshop. Information gathered led to the development of regional M&O:

- Vision,
- Needs,
- Goals and Objectives and
- Projects/Strategies.

The regional M&O vision, goals, objectives, strategies and projects are all components of the M&O Strategic Deployment Plan. Figure 4 presents a framework that defines each component of the Plan.

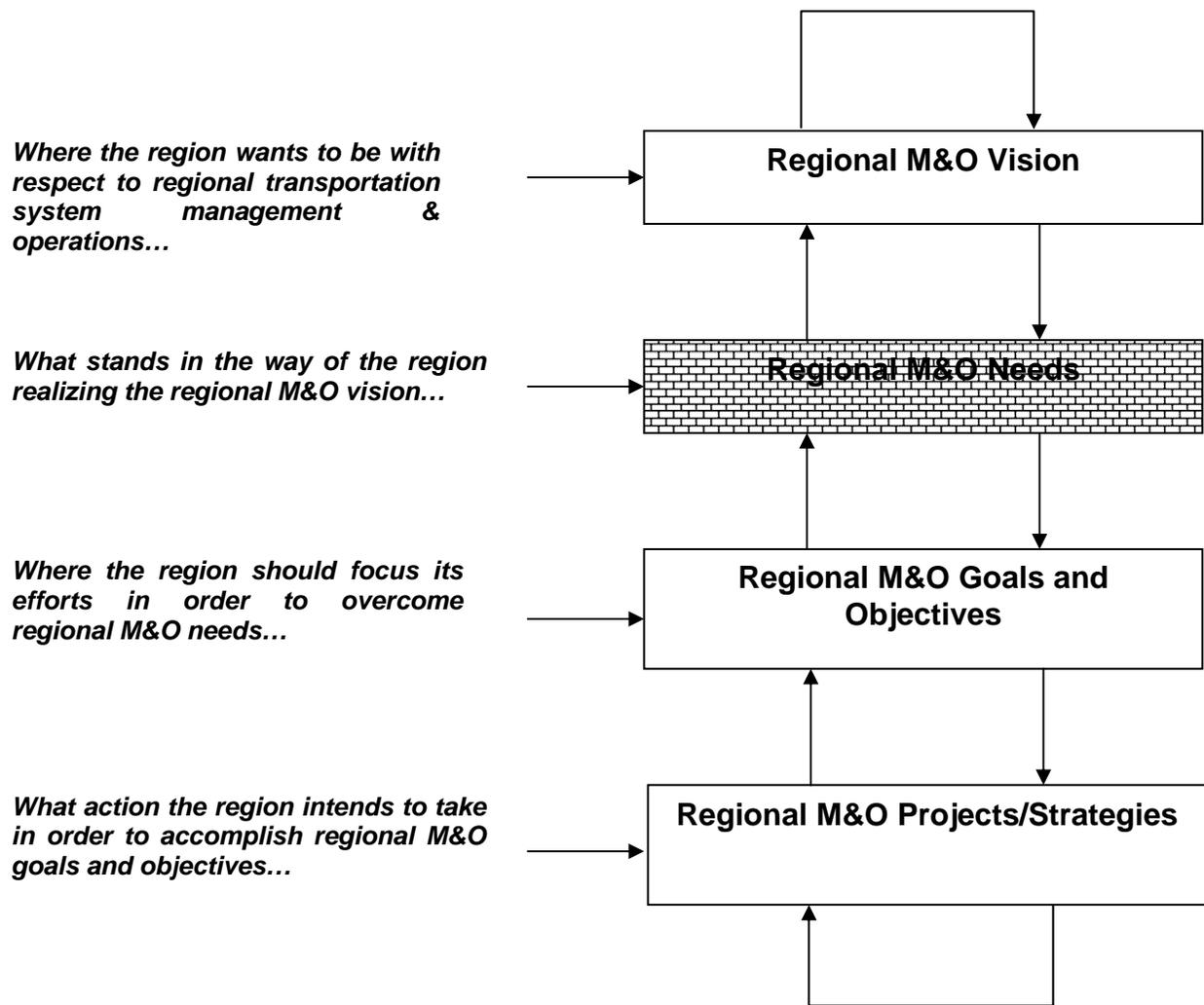


Figure 4. Strategic Planning Framework

### **3.0 REGIONAL M&O ISSUES**

Using the 1998 Metropolitan Baltimore ITS Early Deployment Plan as a starting point, the Project Team engaged regional stakeholders in order to determine regional M&O issues and to establish a regional M&O Vision. The Project Steering Committee assisted with the identification of regional stakeholders. Regional stakeholders included representatives from public and private organizations that influence regional transportation system management and operations. A list of participating stakeholders is included in Appendix A.

#### **3.1 Regional M&O Survey Overview**

Two techniques were used to engage regional stakeholders. Initially, a survey was developed and distributed to regional stakeholders. The survey was used to determine the state of transportation system management and operations within the region and to identify regional transportation system management and operations issues. A sample survey is included in Appendix C. The survey was distributed to transportation, public safety and emergency management agencies within the Baltimore region.

Ten survey responses were received from the following agencies:

- Annapolis City Department of Transportation (DOT)
- Baltimore City Department of Transportation (DOT)
- Carroll County (Multiple Agencies)
- Harford County (Multiple Agencies)
- Howard County Department of Public Works (DPW)
- Maryland State Highway Administration (SHA)

In general, the survey revealed:

- With the exceptions of SHA and Baltimore City DOT, there has been limited ITS (Intelligent Transportation Systems) deployed within the Baltimore region.
- Congested roadways exist throughout the region, not just in urban areas.
- Better inter/intra-agency coordination is needed to manage congestion.

More specifically, the survey identified major operational deficiencies in the regional transportation system. These deficiencies were used to guide the development of regional M&O goals, objectives, strategies and projects and are summarized in Table 3.

Table 3. Regional M&O Issues Identified in Survey Responses

Regional M&O Issues Identified in Survey Results	
A	Limited Resources
B	Better Management of Congested Roadways
C	Traffic Signal Retiming
D	Traffic Control Equipment Deployment & Coordination
E	Increased Road Network Capacity
F	Improved Transit Service
G	Improved Security Measures

### 3.2 Regional M&O Workshop Overview

On March 30, 2006, a one-day Visioning Workshop was held. The stakeholder input gathered during the workshop was used in conjunction with the information gathered via the survey to develop the regional M&O vision, goals, objectives, strategies and projects. The workshop was attended by representatives from the following agencies/organizations:

- Local
  - Annapolis Department of Transportation
  - Anne Arundel County Department of Public Works
  - Baltimore City Department of Transportation
  - Baltimore County Department of Public Works
  - Baltimore County Office of Homeland Security & Emergency Management
  - Carroll County Department of Public Works
  - Carroll County Sheriff's Office
  - Harford County Department of Public Works
  - Howard County Department of Public Works
  - Howard County Office of Emergency Management
  - Howard County Police
  
- State
  - Maryland Department of Transportation
  - Maryland State Police
  - Maryland Transportation Authority
  - Maryland Transportation Authority Police
  - State Highway Administration –CHART
  
- Federal
  - Federal Highway Administration, MD Division
  - Federal Highway Administration, Eastern Federal Lands
  - National Park Service, Ft. McHenry National Monument

- Other
- Baltimore Metropolitan Council
  - Corridor Transportation Corp
  - Intelligent Transportation Society of Maryland
  - Metropolitan Washington Council of Governments
  - University of MD, CATT/T2

During the Visioning Workshop, stakeholders were separated into two groups in order to participate in concurrent “breakout” sessions. Each breakout group identified regional M&O issues. Those issues were then compiled into one comprehensive list. Stakeholders then ranked the issues.

Points were used to rank issues. The ranked issues identified during the workshop are presented in Table 4. The ranked issues presented below were considered when developing the regional M&O vision, goals, objectives, strategies and projects.

**Table 4. Ranked M&O Issues Determined at the Visioning Workshop**

Rank	Issue	Points
1	Better real-time management of capacity	9
2	Transit technology (AVL, APC.....) integration	7
3	More detailed mile markings and ramp designations	7
4	Adequate ongoing operations	6
5	Multimodal/Multi-agency corridor based operations	5
6	Leveraging MMTIS	4
7	Coordination between counties and state on reroutes of traffic onto county roads	3
8	Improved traveler information for major Baltimore routes	3
9	Automated traffic control with manual override option	2
10	Real-time traveler information for emergency service vehicles	2
11	Emergency priority/awareness in construction and emergency zones	2
12	Policies for Roadway Fatalities	2
13	Telecommuting and flextime (contact major employers)	1
14	Emergency response plans (conventional or unconventional)	1
15	Road weather management	1
16	Adaptive signal control to support detours (remote/automated signal optimization for evacuation routes)	1
17	Attention to governance of regional info sharing with respect to [regional funding] for operations and services	1
18	Improved arterial incident response	1
19	Alternative source of funding/resources	1
20	Public acceptance through outreach	1

Rank	Issue	Points
21	Travel time reliability	1
22	Increase situation awareness on our transportation systems	1
23	Improved operations through smart automated enforcement	1
24	More detailed traveler information	1
25	Incorporate operations in existing and future safety plans	1
26	Reversible/Special Use Lanes	1
27	Need for detection	
28	Travel information for tourists	
29	Improve communication technology to support signal control (i.e. battery backup)	
30	HOT lane management (access/incidents)	
31	Throughput measures	
32	Improve design	
33	Better use of existing technology or maximization	
34	Traveler information (collection and dissemination)	
35	Transit utilization	
36	Expansion of services	
37	Improved tools to facilitate evacuation	
38	Personal highway safety	
39	Integration of systems	
40	Real-time traffic management (+ research)	
41	Emergency management coordination that includes transit	
42	Evacuation resource consideration	
43	Leverage homeland security/transportation funding resources	
44	Demonstrate measurable results	
45	Resource redundancy	
46	Room for increased capacity needs	
47	Incident ridesharing	
48	Subsidize other modal options during emergencies	
49	Improved accident investigation techniques through use of technology	
50	Improved freight and port presence of operational planning	
51	Better towing regulations	
52	Encourage telecommuting	
53	Encourage demand pricing	
54	Outreach to elected officials and public	
55	Pre-designated list of contacts for coordination	
56	Improved adoptive corridor signalization	
57	Continue with 1998 M&O/ITS Plan Needs	
58	M&O Training	
59	Pre-designated/Pre-signed Alt. Routes	
60	Informing public about roadway projects	
61	Expansion of motorist information for incidents	

## 4.0 REGIONAL M&O VISION, GOALS, OBJECTIVES, STRATEGIES AND PROJECTS

### 4.1 Regional M&O Vision

The regional M&O vision presented below was developed collaboratively during the Visioning Workshop. The regional M&O issues identified in the survey responses and during the workshop provide context for the development of the regional M&O vision. The regional transportation system referenced in the vision includes all modes of transportation that operate within the Baltimore region.

***The Baltimore regional transportation system will be managed and operated such that people and goods arrive at their destinations safely, securely, reliably and efficiently; thereby protecting the environment and supporting economic vitality.***

Based on the ranked regional M&O issues and the 1998 SDP, updated regional M&O goals, objectives, strategies, and projects were derived under the guidance of the Project Steering Committee. In summary, six regional M&O goals were identified. A series of objectives, strategies, and projects were developed in order to map out how the goals will be achieved. The regional M&O goals, objectives, strategies, and projects are presented later in this section. As detailed below, each identified goal supports the realization of the regional M&O Vision.

- **Goal 1: Coordinated regional transportation system M&O**

Coordinated transportation system M&O requires the establishment of policies, practices, and procedures that will allow stakeholders to address regional M&O issues in a collaborative manner. The sharing of information between operating agencies is an outcome of coordinated transportation system M&O.

- **Goal 2: Stakeholders educated on the benefits of coordinated transportation system M&O**

In this goal, stakeholders represent regional transportation system planners, operators, senior agency personnel (i.e. decision makers) and users (i.e. the traveling public) and their legislative representatives. Educated stakeholders will promote regionally coordinated transportation system M&O within their own jurisdictions. Stakeholders educated on the benefits of coordinated transportation system M&O are critical to realizing the regional M&O vision.

- **Goal 3: Accessible real-time, multi-modal transportation network condition data**

Access to real-time, multi-modal transportation network condition data will help transportation system operators collaboratively manage the regional transportation network. Access to real-time, multi-modal transportation network condition data will keep transportation system users informed, which allows users to make better trip choices. Transportation system operator and user access to real-time, multi-modal transportation network condition data supports the realization of the regional M&O vision.

- **Goal 4: Allocated funding for regional transportation system M&O initiatives**

Some sources that have been traditionally used to fund regional M&O initiatives no longer exist. Therefore, allocated funding for regional transportation system M&O initiatives is needed to ensure that the regional M&O vision is reached.

- **Goal 5: Secure critical transportation infrastructure and data**

In order to achieve the regional M&O vision, critical transportation infrastructure and data must be reliable. Securing critical transportation infrastructure and data will ensure critical transportation infrastructure and data reliability.

- **Goal 6: Influence roadway design**

M&O initiatives can be implemented most efficiently when done in coordination with roadway/interchange enhancement or construction projects. Through early coordination in the planning and design phases, M&O initiatives can be implemented most cost effectively.

## 4.2 Regional M&O Goals, Objectives, Strategies and Projects

<b>1 - Goal:</b> <i>Coordinated Regional Transportation System M&amp;O</i>	
<b>1.1 - Objective:</b> Improve regional road network reliability and efficiency.	
<b>Strategy 1.1.1</b>	
<i>Real-time transportation system M&amp;O</i>	
<u>No.</u>	<u>Project</u>
1.1.1.1	Coordinate traffic control systems in order to provide for, and increase the use of, adaptive (real-time) traffic control
1.1.1.2	Deploy roadway weather management system(s) in order to better monitor and forecast weather conditions along major regional corridors

<b>Strategy 1.1.2</b>	
<i>Integrated Corridor Management</i>	
<u>No.</u>	<u>Project</u>
1.1.2.1	Implement congestion pricing to better manage travel demand
1.1.2.2	Identify critical regional corridors (i.e. evacuation routes) and the resources needed to support integrated corridor management

<b>1.2 - Objective:</b> Improve incident (and event) management (response time, clearance time, etc.)	
<b>Strategy 1.2.1</b>	
<i>Cross-jurisdictional/multi-agency incident /event management</i>	
<u>No.</u>	<u>Project</u>
1.2.1.1	Provide real-time traveler information to emergency service vehicles
1.2.1.2	Develop predesignated/presigned alternate routes for emergency and incident management
1.2.1.3	Install detailed mile markings and ramp designations
1.2.1.4	Continue implementation of the Memorandum of Regional Cooperation
1.2.1.5	Coordinate with the tow truck industry to improve existing towing regulations
<b>Strategy 1.2.2</b>	
<i>Emergency vehicle priority/ awareness through work zones and approaching an incident</i>	
<u>No.</u>	<u>Project</u>
1.2.2.1	Identify and implement technologies that enable emergency vehicle priority through work zones and approaching an incident
<b>Strategy 1.2.3</b>	
<i>Utilize transportation M&amp;O technologies (i.e. ITS) to support emergency response</i>	
<u>No.</u>	<u>Project</u>
1.2.3.1	Upgrade existing traffic control systems to support and include battery backup and other technologies that improve reliability during emergencies
1.2.3.2	Adopt standards that promote interoperability between signal prioritization systems
1.2.3.3	Identify and deploy transportation system M&O tools and policies that support transportation functions in emergency preparedness, response and recovery
<b>Strategy 1.2.4</b>	
<i>Integrate the use of transit resources to support emergency response plans</i>	
<u>No.</u>	<u>Project</u>
1.2.4.1	Develop MOU that allows the use of transit resources to support regional emergency response plans

<b>Strategy 1.2.5</b>	
<i>Train transportation operators on incident response tools and policies</i>	
<u>No.</u>	<u>Project</u>
1.2.5.1	Hold multi-agency incident management training
<b>Strategy 1.2.6</b>	
<i>Coordinated Incident Management Plans</i>	
<u>No.</u>	<u>Project</u>
1.2.6.1	Coordinate Incident Management Plans
1.2.6.2	Hold tabletop exercises

<b>2 - Goal:</b> Stakeholders educated on the benefits of coordinated transportation system M&O	
<b>2.1 - Objective:</b> Increase research, outreach, education and training opportunities that demonstrate the benefits achieved through coordinated transportation system M&O	
<b>Strategy 2.1.1</b>	
<i>Promote methods (i.e. transit utilization, carpooling, telecommuting and flextime) to reduce travel demand)</i>	
<u>No.</u>	<u>Project</u>
2.1.1.1	Support outreach efforts that inform major employers of the benefits associated with telecommuting and flextime
<b>Strategy 2.1.2</b>	
<i>Educate decision-makers and the public on the benefits achieved through coordinated transportation system M&amp;O</i>	
<u>No.</u>	<u>Project</u>
2.1.2.1	Develop training materials that can be used to educate decision makers about the benefits achieved through coordinated transportation system M&O
2.1.2.2	Hold workshops to educate decision makers on the benefits achieved through coordinated transportation system M&O
2.1.2.3	Identify opportunities to coordinate outreach, education and training opportunities with regional conferences
2.1.2.4	Identify and execute outreach efforts to educate the public on the benefits achieved through coordinated transportation system M&O
2.1.2.5	Support training opportunities for local jurisdictions
<b>Strategy 2.1.3</b>	
<i>Improve existing roadway fatality policies, practices and procedures</i>	
<u>No.</u>	<u>Project</u>
2.1.3.1	Research and implement technologies, policies, practices, and procedures that expedite the clearance of roadway fatalities

<b>3 - Goal:</b> <i>Accessible real-time, multi-modal transportation network condition data</i>	
<b>3.1 - Objective:</b> Increase traveler access to detailed, multi-modal traveler information and road network condition data for major regional routes	
<b>Strategy 3.1.1</b>	
<i>Leverage Developing Regional Traveler Information Systems (e.g. MMTIS and RITIS)</i>	
<u>No.</u>	<u>Project</u>
3.1.1.1	Establish Internet and telephone access (via 511) to real-time multi-modal traveler information data collected by regional traveler information systems
3.1.1.2	Integrate region-wide incident, planned event, road network condition, commuter parking lot capacity and real-time transit data into existing and planned traveler information systems
<b>Strategy 3.1.2</b>	
<i>Provide Regional En-Route Transit Information</i>	
<u>No.</u>	<u>Project</u>
3.1.1.1	Deploy regional en-route transit information systems (i.e. on buses and trains and at stops and stations)
<b>Strategy 3.1.3</b>	
<i>Provide En-Route Traveler Information</i>	
<u>No.</u>	<u>Project</u>
3.1.3.1	Display real-time traveler information on dynamic message signs (DMS)
<b>3.2 - Objective:</b> Increase transportation system operator access to detailed road network condition data for major regional routes	
<b>Strategy 3.2.1</b>	
<i>Expand Surveillance and Detection (i.e. environmental sensors, detectors, CCTV, etc.)</i>	
<u>No.</u>	<u>Project</u>
3.2.1.1	Identify road network condition data gaps and resources needed to address identified gaps
3.2.1.2	Deploy resources to fill identified gaps
<b>Strategy 3.2.2</b>	
<i>Share road network condition data (in real-time) amongst regional transportation system operators</i>	
<u>No.</u>	<u>Project</u>
3.2.2.1	Identify standards that support the sharing of road network condition data
3.2.2.2	Develop an approach to share work zone information

3.2.2.3	Develop a system to collect, process, store, and disseminate real-time data (Consider expanding the Regional Integrated Transportation Information System (RITIS) into the Baltimore region)
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<b>4 - Goal:</b> <i>Allocated funding for regional transportation system M&amp;O initiatives</i>	
<b>4.1 - Objective:</b> Increase funds allocated to transportation M&O initiatives via the regional transportation planning process	
<b>Strategy 4.1.1</b>	
<i>Establish a link between planning and operations</i>	
<u>No.</u>	<u>Project</u>
4.1.1.1	Develop a methodology to better integrate M&O into the regional transportation planning process

<b>4.2 - Objective:</b> Increase funds secured for transportation M&O initiatives from non-traditional funding sources	
<b>Strategy 4.2.1</b>	
<i>Utilize non-traditional funding sources (i.e. public-private partnerships, federal grants, etc.) to fund regional transportation system M&amp;O initiatives</i>	
<u>No.</u>	<u>Project</u>
4.2.1.1	Identify and secure funding for regional transportation system M&O initiatives from non-traditional funding sources

<b>5 - Goal:</b> <i>Secure critical transportation infrastructure, systems, and data</i>	
<b>5.1 - Objective:</b> Reliable critical transportation infrastructure, systems, and data	
<b>Strategy 5.1.1</b>	
<i>Utilize ITS to secure critical transportation infrastructure, systems, and data</i>	
<u>No.</u>	<u>Project</u>
5.1.1.1	Identify regional critical transportation infrastructure, systems, and data
5.1.1.2	Identify and implement tools and policies that secure critical transportation infrastructure, systems, and data

<b>6 - Goal:</b> <i>Influence roadway design</i>	
<b>6.1 - Objective:</b> Increase the number of M&O initiatives implemented in coordination with roadway/interchange enhancements or construction	
<b>Strategy 6.1.1</b>	
<i>Establish a link between transportation system designers and operators</i>	
<u>No.</u>	<u>Project</u>
6.1.1.1	Create a forum for transportation system operators and designers to discuss opportunities for coordinating roadway/interchange enhancements or construction projects with the implementation of M&O initiatives

### 4.3 Mapping Regional M&O Issues to the Strategic Plan

As mentioned earlier, the regional M&O issues identified by the survey and in the workshop served as the basis for the development of regional M&O goals, objectives, strategies and projects. The issues were bundled in order to identify regional M&O goals. The issue bundles were then used to derive regional M&O objectives, strategies and projects for each goal. Table 5 maps regional M&O issue bundles to regional M&O goals. Regional M&O issues identified by the survey and workshop were shown previously in Tables 3 and 4.

**Table 5. Issue Bundles**

Goal/Issue Bundle	Regional M&O Issues Identified by the Survey	Regional M&O Issues Identified in the Workshop
1	B, C, D, E, F	1, 3, 5, 7, 9, 10, 11, 14, 15, 16, 18, 21, 25, 26, 27, 29, 30, 37, 40, 41, 42, 47, 48, 51, 53, 55, 56, 59
2		12, 13, 20, 33, 35, 49, 52, 54, 58
3	F	2, 6, 8, 22, 24, 28, 34, 39, 50, 60, 61
4	A	19, 43
5	G	23, 38, 45
6	E	32, 46

## 5.0 REGIONAL M&O VISION REALIZATION

At the conclusion of the information gathering phase, several themes emerged. As shown previously in Table 5, six goals were developed based on the issues raised in the earlier stages of the project. In addition, two enabling initiatives were identified. This section presents the enabling initiatives, as well as the high priority projects and a framework for their deployment.

### 5.1 Enabling Initiatives

Two initiatives were identified to support the realization of the Regional M&O Vision. These enabling initiatives should be implemented prior to or in conjunction with the high priority regional projects to assist in establishing the basis from which the M&O Strategic Deployment Plan will be executed and maintained. The enabling initiatives outlined below should be undertaken by the BRTB working with the M&O Partnership.

#### 5.1.1 Define BRTB Role in Regional Transportation System M&O

The role of an MPO in regional transportation system M&O varies from region-to-region. An Association of Metropolitan Planning Organizations (AMPO) White Paper titled, *The MPO Role in M&O*, defines the “traditional” role of the MPO in M&O as one that merely promotes efficient transportation system M&O as required (initially) by TEA-21. Beyond the “traditional” role, the AMPO White Paper suggests that an MPO could assume the following transportation system M&O responsibilities:

- **Convener** of meetings to facilitate the planning for transportation system M&O improvements.
- **Champion** of plans to improve transportation system M&O efficiency.
- **Developer** of metropolitan-level transportation system M&O plans.
- **Operator** of the metropolitan transportation system.

Using the AMPO White Paper as a starting point, the BRTB needs to define its role in regional transportation system M&O. This will help determine the role of the BRTB in the implementation of the projects identified in this Plan as well as other regional M&O initiatives.

#### 5.1.2 Establish Regional Transportation System M&O Performance Measures

As illustrated in Figure 2, regional M&O objectives identify where efforts should be focused in order to address regional M&O issues. More specifically, regional M&O objectives identify a means to measure the accomplishment of regional M&O goals or regional M&O performance measures. Based on the regional M&O objectives identified in the Strategic Deployment Plan, metrics, benchmarks and temporal constraints need to be established in order to define regional M&O performance measures.

## 5.2 High Priority Regional M&O Projects

There are 38 regional M&O projects identified in this Plan. Fifteen of those projects were combined to create eight high priority projects. The Project Steering Committee identified high priority regional M&O projects based on the ranked issues (shown in Table 4). Projects identified as high priority are intended to be implemented in the near future in accordance with the deployment framework presented later in this section.

In the tables below, each high priority regional M&O project is evaluated in terms of benefits and lessons learned (if available). High priority projects can be mapped to regional M&O issues by mapping the *Issues Addressed* back to Tables 3 and 4. The tables below also show which projects (from section 4.2) are incorporated in each high priority project. In some cases, the region has already begun similar projects. Those efforts are also documented in the tables below.

**Table 6. High Priority Project A - Implement Regionally Coordinated Adaptive Traffic Control Systems**

Description	This project promotes the evolution of local traffic control systems to adaptive traffic control systems and proposes to coordinate local adaptive control systems via the exchange of real-time traffic conditions data between local traffic management centers/signal operations centers.
Issues Addressed	B, D, 1, 9, 21, 40, 56
Projects Included	1.1.1.1
Ongoing Efforts	The future development of RITIS or MMTIS may enable the exchange of real-time traffic condition data.
Benefits	In a study documented by the FHWA, the following benefits were observed after deployment of adaptive control devices: <ul style="list-style-type: none"> <li>- 11.4% travel time reduction,</li> <li>- 24.9% delay reduction</li> <li>- 27.0% reduction in the number of stops</li> </ul>
Lesson Learned	The following lessons were documented: <ul style="list-style-type: none"> <li>- High volume systems with predominant through movements achieved the greatest improvements.</li> <li>- Systems with actuated signals and easily changed control parameters achieved greater benefits.</li> <li>- The largest savings were obtained on arterials.</li> </ul>

**Table 7. High Priority Project B – Link Regional Transportation Planning and Operations**

Description	This project involves the implementation of policies, practices and procedures that maximize the utilization of traditional and alternative funding sources including, but not limited to: <ul style="list-style-type: none"> <li>• integrating M&amp;O into the regional transportation system planning process,</li> <li>• securing funding from non-traditional funding sources (i.e. public-private partnerships and homeland security grants),</li> <li>• regional planning and operations coordination and collaboration and</li> <li>• performance measurement</li> </ul>
Issues Addressed	A, 19, 43
Projects Included	4.1.1.1, 4.2.1.1
Ongoing Efforts	See Table 12
Benefits	Maximizes the utilization of resources
Lesson Learned	The Capital District Transportation Commission (CDTC), the Metropolitan Planning Organization for Albany, established new funding prioritization procedures that acknowledging the importance of a variety of transportation options including: management and operations (M&O) improvements, transportation demand management (TDM), and smart growth.

**Table 8. High Priority Project C - Facilitate Incident Management Training Opportunities**

Description	In most cases, incident management involves many agencies and organizations. Education and training opportunities, such as incident management training, conferences, and table-top exercises, improve coordination amongst the many stakeholders.
Issues Addressed	B, 18
Projects Included	1.2.6.1, 1.2.7.1, 1.2.7.2
Ongoing Efforts	In the past, the B-ROC Committee has hosted several successful incident management conferences attended by representatives of a wide range of response agencies.
Benefits	Provides an opportunity for incident management coordination and collaboration, which in turn leads to improved incident management
Lesson Learned	

**Table 9. High Priority Project D - Traffic Control System Reliability Enhancements**

Description	Replace existing conventional traffic signals with LED (Light Emitting Diode) Traffic Signals and specify LED traffic signals for all future installations. And, install battery backup systems on LED traffic signals along evacuation/critical routes to increase reliability during emergencies.
Issues Addressed	A, B, D, 18, 29, 37
Projects Included	1.2.3.1
Ongoing Efforts	This project has been included in the regional priority letter.
Benefits	A study by the California Energy Commission reported an increased energy efficiency of up to 90 percent for LED's over conventional traffic control signal heads, and significant savings in electric bills. The study also noted increased public safety and reduced traffic congestion as additional benefits derived when traffic control signals functioned during power failures.
Lesson Learned	Systems functioned for considerable periods (as many as 14 hours on a single charge or indefinitely when a generator was installed to allow battery recharge) after loss of power. System allowed work crews additional time to get to signals. Many signal controllers went through an orderly shutdown and did not require intervention when power was restored in effect reducing down time.

**Table 10. High Priority Project E - Secure Critical Regional Transportation Infrastructure**

Description	Threats to transportation infrastructure can result from acts of nature, terrorist attacks and other incidents that cause damage to the infrastructure. Transportation infrastructure can be protected by a wide range of ITS technologies. This Project will explore and implement the most appropriate policies and technologies to secure regional transportation infrastructure.
Issues Addressed	G, 38
Projects Included	5.1.1.1, 5.1.1.2
Ongoing Efforts	MdTA has initiated a project to use advanced technologies to secure critical transportation infrastructure.
Benefits	Improves transportation system security and reliability. Also improves traveler safety.
Lesson Learned	In Maine, the DOT has integrated USGS flood gauges into their network monitoring system. Once the flood gauges pass a set threshold, the DOT is automatically alerted. Once alerted, Maine DOT implements procedures to manage the situation.

**Table 11. High Priority Project F - Establish a Regional Transportation Information System**

Description	SAFETEA-LU requires the establishment of data exchange formats that ensure that data provided by highway and transit monitoring systems can be exchanged across jurisdictional boundaries and be available nationally. A regional effort to develop such a system would be an extension of the federal program and allow transportation system planners and operators, responders, and other travelers access to real-time and archived data collected via automated transportation infrastructure.
Issues Addressed	B, 8, 10, 22, 24, 28, 34, 41
Projects Included	1.2.1.1, 3.1.1.1, 3.1.1.2, 3.2.2.3
Ongoing Efforts	The further development of the Multi-Modal Traveler Information System (MMTIS) and the participation in the development of the Regional Integrated Transportation Information System (RITIS) may support this project.
Benefits	SAFETEA-LU identifies the benefits of such a system as providing the capability to monitor, in real-time, the traffic and travel conditions of major highways and to share that information to improve the security of the surface transportation system, to address congestion problems, to support improved response to weather events and surface transportation incidents, and to facilitate national and regional highway traveler information.
Lesson Learned	The Mobility Monitoring Program ( <a href="http://mobility.tamu.edu/mmp/">http://mobility.tamu.edu/mmp/</a> ) provides valuable insights with respect to using archived traffic detector data for monitoring highway performance (e.g., traffic congestion and travel reliability).

**Table 12. High Priority Project G – Enhance M&O along Critical Corridors and Evacuation Routes**

Description	Congestion on the transportation network can be categorized into two types: recurring and non-recurring. This effort attempts to address non-recurring congestion that is the result of a major incident. This project will identify and implement M&O improvements that support integrated corridor/incident management along critical corridors and evacuation routes.
Issues Addressed	A, G, 5, 21, 26, 27, 30
Projects Included	1.1.2.2
Ongoing Efforts	CHART has partnered with the University of Maryland on an effort to prototype a system that would enable traffic operators to utilize real-time traffic data to better manage evacuations on the DelMarVa peninsula.
Benefits	In the aftermath of September 11, 2001, the District of Columbia Department of Transportation initiated an evacuation plan which identified evacuation routes and developed traffic signal timings and coordination along these routes to allow for rapid evacuation of the City. On July 4, 2005, after the annual July 4 <sup>th</sup> fireworks display on the National Mall, the system was deployed and performance evaluated. Transportation officials say the exercise pointed out potential problem areas and the need for better coordination with law enforcement. The test also prompted calls for subsequent testing with the lessons learned from the previous tests implemented into the subsequent tests.
Lesson Learned	National studies have documented that an evacuation plan is an important part of an incident management plan. Such plan is not static, but must be tested, refined and retested to meet changing needs.

**Table 13. High Priority Project H - Facilitate Regional M&O Outreach, Education and Training Opportunities**

Description	Develop and use regional M&O outreach, education and training material in order to educate decision makers on the benefits of regional transportation system M&O.
Issues Addressed	20, 28, 54
Projects Included	2.1.2.1
Ongoing Efforts	None
Benefits	Opportunities to influence funding decisions and bring increased funding to M&O.
Lesson Learned	The FHWA paper "Understanding the Communications and Information Needs of Elected Officials for Transportation Planning and Operations" provides an approach to informing decision makers. ( <a href="http://www.planning.dot.gov/Documents/PublicInvolvement/understandComm.htm">http://www.planning.dot.gov/Documents/PublicInvolvement/understandComm.htm</a> ).

Appendix C utilizes the Maryland Statewide ITS Architecture to consider each high priority project in greater detail.

### **5.3 Deployment Framework**

The seven screening factors identified in the 1998 ITS Early Deployment Plan were used to rank the eight identified high priority projects. Each of the high priority projects identified above was assigned a value for each of the screening factors. The higher the number of total points, the greater the potential for a successful project in the near term. Therefore, it is advisable that the highest ranked projects be implemented first.

(The basis for the following text was taken, in part, from the 1998 ITS Early Deployment Plan.)

#### **5.3.1 Prioritization of Proposed Projects**

Seven screening factors were applied to the eight high priority projects. Screening factors were chosen in an attempt to assess projects based upon criteria that were felt to be important for successful deployment in the Baltimore region. These screening factors are:

- **Continuation of Existing or Programmed Initiative:** This screening factor describes the degree to which the proposed project is an expansion of an M&O deployment that already exists (or is programmed). It is an important screening factor, as it identifies the opportunity to capitalize on the presence of existing ITS devices, the communications infrastructure, an institutional framework, demonstrated benefits, etc. On a five-step scale, a “1” indicates that the proposed project does not build at all upon existing or planned deployment(s); a “5” indicates that the proposed project is a direct continuation of existing or planned deployment(s). A high assessment of this screening factor indicates a greater desirability of deploying the proposed project.
- **Foundation for Other Initiatives:** Some projects must be in place before others can logically be considered. For example, motorist information-type projects typically require that surveillance- and detection-type projects are deployed first. On a five-step scale, a “1” indicates that the proposed project would not be considered a foundation for other M&O projects; a “5” indicates that the project should be considered as a basic building block upon which other deployments could build. (It should be noted that the reverse is not necessarily the case: a project that receives a “1” assessment may still require other deployments to be in place.) A high assessment of this screening factor indicates a greater desirability of deploying the proposed project in the near term.

- **Capital Cost:** This screening factor assesses the capital cost of initial deployment of the proposed project. Capital cost is assessed as low, medium, or high, with the following cost ranges for each category:  
Low = Less than \$500,000  
Medium = Between \$500,000 and \$3,000,000  
High = Greater than \$3,000,000  
It should be noted that these costs assume full deployment of the project. Cost ranges are from the 1998 ITS Strategic Deployment Plan and were not adjusted because as a result of inflation present value was only minimally affected.
- **Operations, Maintenance and Repair, and Personnel Cost:** This screening factor assesses the costs for operating, maintaining, and staffing the proposed project. These costs are assessed as low, medium, or high, with the following cost ranges for each category:  
Low = Less than \$250,000 per year  
Medium = Between \$250,000 and \$750,000 per year  
High = Greater than \$750,000 per year  
It should be noted that these costs assume full deployment of the project. Cost ranges are from the 1998 ITS Strategic Deployment Plan and were not adjusted because as a result of inflation present value was only minimally affected.
- **Institutional Issues:** M&O is inherently a regional issue, involving many jurisdictions and agencies. As such, it is inevitable that a range of institutional issues will need to be resolved before deployment can be considered. For example, in the case of Project 1 (Implement Regionally Coordinated Adaptive Traffic Control Systems), it should be agreed, among the affected jurisdictions, under what circumstances or traffic conditions neighboring jurisdictions can access signal systems on roadways. This would be expected to present a significant institutional issue. On a five-step scale, a “1” indicates significant institutional barriers to be overcome; a “5” indicates few institutional issues to be resolved for deployment. A high assessment of this screening factor indicates a greater ease of deploying the proposed project in the near term.
- **Alternative Funding Opportunities:** As funding becomes increasingly challenging, alternative funding (i.e. public/private partnerships, pooled funding and homeland security grants) have been considered as a way to cost-effectively deploy projects and share financial burdens. This screening factor assesses proposed projects based upon the potential to secure alternative funding. On a five-step scale, a “1” indicates little or no alternative funding opportunity; a “5” indicates great potential for alternative funding. A high assessment of this screening factor indicates a greater desirability of deploying the proposed project.

- **Stageability:** It is unlikely that any of the proposed projects will be deployed, in their entirety, at one time. Rather, it is likely that each project will be deployed in a number of stages. For example, Project 6 (Develop a System to Collect, Process, Store, and Disseminate Transportation Information), suggests a preliminary priority for arterial corridors to be considered; even with that suggested priority, not all arterial roadways that are considered part of the corridor are likely to be fully instrumented at the same time. However, not all proposed projects may be suited for such staging. This screening factor assesses projects based upon the degree to which they can be staged. On a five-step scale, a “1” indicates little or no opportunity for staged deployment; a “5” indicates great opportunity for staged deployment. A high assessment of this screening factor indicates a greater desirability of deploying the proposed project.

In the final step, the screening factors discussed above were applied to the eight identified high priority projects. As mentioned earlier, the ranking of projects under this method is an indicator of “early winners”, as it highlights projects that have the kinds of characteristics that would make them especially desirable: they generally build on previous deployments, present relatively few institutional barriers, and/or present significant opportunities to utilize alternative funding. With these characteristics, their identified order of project implementation is presented in Table 14.

These projects represent a wide range of areas of responsibility, and it is recommended that whenever possible, projects be assigned to existing regional committees to facilitate mainstreaming M&O into the traditional transportation planning process and to broaden the responsibility for M&O deployment.

Table 15 provides a suggested implementation order for the high priority projects, based on the results from Table 14, and a proposed committee to take responsibility for implementation of these projects.

Table 14. Project Prioritization

	Prioritization Factors							Total Points
	Continuation of Existing or Programmed Deployments	Foundation for Other Deployments	Capital Cost (L=3, M=2, H=1)	Operations, Maintenance and Repair, and Personnel Cost (L=3, M=2, H=1)	Institutional Issues	Alternative Funding Opportunities	Stageability	
<b>High Priority Projects</b>								
A) Implement Regionally Coordinated Adaptive Traffic Control Systems	2	3	2	2	2	1	5	17
B) Link Regional Transportation Planning and Operations	3	5	3	3	2	2	3	21
C) Facilitate Incident Management Training Opportunities	5	4	3	3	5	3	4	27
D) Traffic Control System Reliability Enhancements	4	3	1	2	2	2	5	19
E) Secure Critical Regional Transportation Infrastructure	2	4	2	2	2	3	3	18
F) Establish a Regional Transportation Information System	5	5	1	2	2	3	2	20
G) Enhance M&O along Critical Corridors and Evacuation Routes	4	4	3	3	4	1	2	21
H) Facilitate Regional M&O Outreach, Education and Training Opportunities	3	4	3	3	4	4	4	25

Table 15. Proposed Implementation Order and Committee Assignment

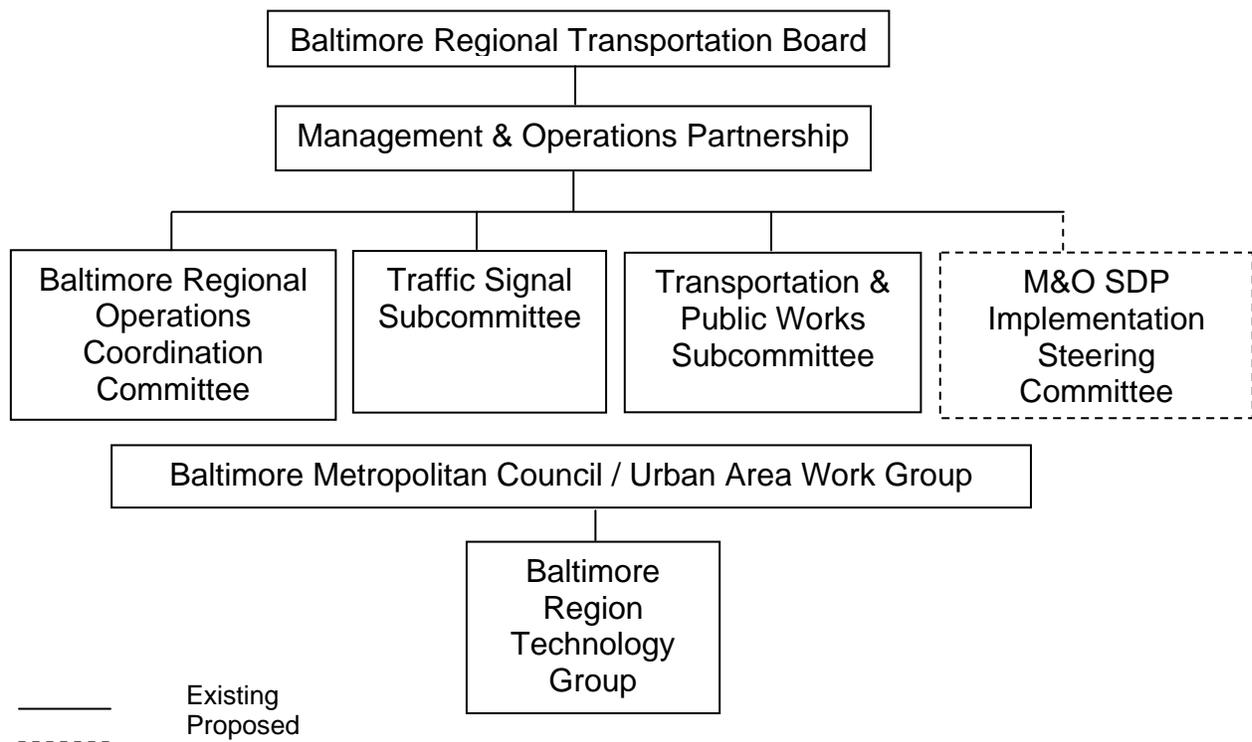
Project Priority	Project ID	Project Name	Proposed Committee Assignment
1	C	Facilitate Incident Management Training Opportunities	B-ROC Committee
2	H	Facilitate Regional M&O Outreach, Education and Training Opportunities	M&O Strategic Deployment Plan Implementation Steering Committee*
3	B	Link Regional Transportation Planning and Operations	BRTB M&O Partnership
3	G	Enhance M&O along Critical Corridors and Evacuation Routes	Transportation & Public Works Subcommittee
5	F	Establish a Regional Transportation Information System	Baltimore Region Technology Group
6	D	Traffic Control System Reliability Enhancements	Traffic Signal Subcommittee
7	E	Secure Critical Regional Transportation Infrastructure	Transportation & Public Works Subcommittee
8	A	Implement Regionally Coordinated Adaptive Traffic Control Systems	Traffic Signal Subcommittee

\* Proposed as a continuation of the M&O SDP Project Steering Committee

**5.3.2 Project Implementation**

As shown in Table 15, it is proposed that existing committees take responsibility for seven of the eight proposed high priority projects. This approach will help to further mainstream planning for operations as well as to offer an expeditious way to assign ownership of these projects. It is proposed that the M&O Strategic Deployment Plan Project Steering Committee continue as the M&O Strategic Deployment Plan Implementation Steering Committee to track implementation progress and to take responsibility for projects that do not fit into an existing committee.

The organizational chart below provides an overview of existing and proposed committees that would be involved in M&O project implementation.



Members of the M&O Partnership include public works and local DOT directors, MDOT, the Director of the SHA – Office of CHART, and academia. M&O Partnership members are the decision makers at their respective agencies. Therefore, the focus of the M&O Partnership is to authorize and advance regional M&O initiatives. M&O Partnership membership does not include transportation system operators and planners.

Members of the Baltimore Regional Operations Coordination (B-ROC) Committee include transportation system operators and first responders (i.e. police, fire, emergency management, medical examiners and other responders). Members of the B-ROC Committee represent the agencies that manage incidents along the transportation system road network. Therefore, the focus of the Committee’s work is identifying and overseeing regional M&O initiatives that support coordinated incident management.

BROCC membership does not include transportation system planners from the various agencies within the region.

The other subcommittees that support the M&O Partnership focus on specific regional M&O initiatives, such as traffic signals and transportation emergency management. The members of these subcommittees are primarily transportation system operators.

The Baltimore Region Technology Group falls under the Baltimore Metropolitan Council/Urban Area Work Group and currently focuses primarily on information technology (IT) issues related to emergency preparedness and homeland security. The members of this committee include representatives of IT and emergency management agencies within the jurisdictions and the state.

### **5.3.3 Identification of Early Winners**

All eight of the high priority projects are valuable; they were identified by the region's stakeholders as critical to implement because of the benefits they would bring to the transportation system. Since it is not possible to implement all of the projects at the same time, the project prioritization was performed to provide an implementation framework. Through this process, two early winners were identified, projects C and H, based on their low cost and ease of implementation, as well as the role they play in helping to gain support for future M&O projects.

Project H (the second highest scoring project) also has a favorable score for institutional issues. All jurisdictions can reach agreement on the concept that effective M&O needs support from the very top down to the front lines of an organization. The completion of this project will also pave the way/secure a foundation for educating decision-makers on other important transportation related issues. In addition to relatively low costs for this project, the potential to attract private sector input is also very good.

Project C (the highest scoring project) has a favorable score for institutional issues. Several successful incident management (IM) training events have been held in the past. Most jurisdictions will agree that training their staff on the best methods for IM is a worthwhile exercise. This project also has high potential for developing training for other IM related issues such as evacuation procedures. In addition, this training does not have to take place at one time in one location. It can easily be staged and conducted quarterly, or even annually in different locations.

## **6.0 REGIONAL PLANNING FOR OPERATIONS**

Regional transportation system M&O projects were traditionally funded through federal ITS earmarks. The new transportation legislation, SAFETEA-LU, marks the end of the ITS Integration (or Earmark) Program. Therefore, funding for regional transportation system M&O projects has to be secured via the regional transportation planning process or from alternative funding sources (i.e. grants, public-private partnerships, etc.).

Regional planning for operations is a joint effort between regional transportation system operators and planners that enables effective regional transportation system M&O. Regional planning for operations requires:

1. Regional transportation operations coordination,
2. Consideration of M&O within the context of the ongoing regional transportation planning and investment process, and
3. Establishment of a link between regional operations coordination and regional planning.

### **6.1 SAFETEA-LU Provisions Addressing Regional Planning for Operations**

On August 10, 2005, the President signed into law the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). SAFETEA-LU builds on the federal transportation program established in the Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21).

In TEA-21, ITS was a distinct program authorized by Title V. In SAFETEA-LU, ITS is considered in coordination with other approaches to improve transportation system M&O and incorporated in various programs throughout the bill. This fact supports the federal goal to “mainstream” ITS with other methods to improve transportation system M&O. Regional planning for operations supports mainstreaming ITS and other methods to improve transportation system M&O.

SAFETEA-LU Title V – Research and Title VI – Transportation Planning and Project Delivery address regional planning for operations. Title V requires the development of a National ITS Program Plan. Section 5303 states that the purpose of the National ITS Program Plan is to:

- ensure that Federal, State and local transportation officials have adequate knowledge of ITS for consideration in the transportation planning process... and
- improve regional cooperation and operations planning for effective ITS deployment...”

Furthermore, Section 5305 authorizes the National ITS Program Plan to provide funding to support adequate consideration of transportation systems management and

operations, including ITS, within the metropolitan and statewide transportation planning process, but it does not allocate funds to support regional planning for operations. Once the National ITS Program Plan is developed, federal funds may be made available to support regional planning for operations.

Section 5502 establishes a research initiative to investigate:

- methods to monitor, measure and report congestion and
- techniques to communicate congestion problems to decision makers in order to secure funding.

As this research initiative evolves, training and technical assistance will be made available to disseminate the research results.

Title VI, section 6001 requires that regional transportation plans contain operational and management approaches to relieve congestion and maximize the safety and mobility of people and goods. This section identifies the Congestion Management Process (CMP) as a means to incorporate planned operational improvements in the regional transportation planning process. An FHWA Rule and guidance addressing the development of a CMP is forthcoming. On June 9, 2006, FHWA released a notice of proposed rulemaking to announce and support the development of the federal rule that will govern the Congestion Management Process.

In summary, SAFETEA-LU promotes regional planning for operations, but does not provide funding or guidance to support regional planning for operations. Over time, SAFETEA-LU provisions may allocate funding and generate guidance to support regional planning for operations. The Baltimore region should continue to monitor the status of the execution of relevant SAFETEA-LU provisions in order to take advantage of regional planning for operations funding or guidance that may be made available.

## **6.2 Linking Planning and Operations**

Establishing a link between regional operations coordination and regional planning facilitates effective transportation system management and operations. Traditionally, projects that support the effective management and operation of *existing* transportation infrastructure were not adequately considered in the regional transportation planning process and therefore were not fiscally supported. Linking planning and operations involves establishing mechanisms that support regional planning for operations. Regional planning formal operations will bridge the “disconnect” between regional operational coordination and regional planning and enable the adequate consideration of effective transportation system management and operations in the regional planning process. FHWA has identified seven mechanisms that link transportation planning and transportation system management and operations.

1. **Performance Measurement** – Involves development of system performance metrics and tracking these metrics. Performance measures provide

transportation system operators and users a means of gauging how well the transportation system is being managed and operated.

2. **Congestion Management Process (CMP)** – An established process to incorporate planned operational improvements in the regional transportation planning process. Transportation legislation prior to SAFETEA-LU, required the development of a Congestion Management System (CMS). In SAFETEA-LU, the CMS requirement was replaced by the requirement to develop a CMP.
3. **Regional ITS Architecture** – The National ITS Architecture describes what types of interfaces could exist between ITS components and how they will exchange information and work together. A regional ITS architecture illustrates and documents regional integration so planning and development of ITS projects can proceed in an organized and coordinated manner. A region can be specified at a corridor, metropolitan, statewide, or multi-state level.
4. **Institutional Arrangements** – Refers to agreements and organizational structures both within transportation agencies and between agencies that regularly bring together transportation planners and operations practitioners as well as agreements that promote involvement of management and operations practitioners in the planning process or promote a regional planning perspective in operations. Examples of institutional arrangements include regional management and operations committees within the MPO or other regional body and regional traffic management centers co-managed by public safety officials and traffic operations staff.
5. **Data Collection and Sharing** – Refers to a wide range of activities that fully utilize readily available transportation data. Data sharing implies knowledge of the data collection efforts of many government and private sector organizations and beneficial and innovative ways in which this data could be utilized.
6. **Funding and Resource Sharing** – Refers to arrangements between transportation and other operating agencies to submit funding requests, develop pooled funding mechanisms, or share equipment and facilities.
7. **Regional Transportation Systems Management and Operations Projects** – Refers to an integrated program to optimize the performance of existing infrastructure through implementation of multi-modal, cross-jurisdictional systems, services, and projects.

### **6.3 Regional Efforts to Link Planning and Operations**

Table 16 highlights the efforts of the Baltimore region to utilize the mechanisms for linking planning and operations identified by FHWA.

**Table 16. Regional Efforts to Link Planning and Operations**

Mechanism For Linking Planning And Operations	Corresponding Regional Effort to Link Planning and Operations
Performance Measurement Systems	Following the development of national and statewide performance measures  Customer Satisfaction Survey
Congestion Management	Established under Guidelines for the Congestion Management System (CMS) in the Baltimore region. As required by SAFETEA-LU, the Baltimore region's CMS will be replaced by a Congestion Management Process (CMP).
Regional ITS Architecture	Maryland Statewide ITS Architecture
Institutional Arrangements	The M&O Partnership oversees, recommends, and directs regional M&O initiatives. The M&O Partnership is supported by the following committees: <ul style="list-style-type: none"> <li>• Baltimore Regional Operations Coordination Committee</li> <li>• Traffic Signal Subcommittee</li> <li>• Transportation and Public Works Subcommittee</li> </ul> The M&O Partnership annually recommends projects to the BRTB.  The M&O Partnership is currently drafting a regional priority letter.  Memorandum of Regional Cooperation has been established in order to encourage cooperation between regional agencies during an incident.
Data Collection and Sharing	The region is in the process of developing the Multi-Modal Traveler Information System to collect and share traveler information throughout the region.
Funding and Resource Sharing	Baltimore Regional Emergency Assistance Compact
Regional Transportation Systems Management and Operations Projects	The status of projects recommended in the 1998 ITS Strategic Deployment Plan and other M&O projects is presented in <b>Table 2</b> .

**6.4 Additional Opportunities for Linking Planning and Operations**

As noted in the previous section, the Baltimore region has made substantial strides towards linking planning and operations. Additional opportunities for linking planning and operations are presented in this section.

### 6.4.1 Priority Letters

As previously documented in Table 16, the M&O Partnership is currently drafting a Regional M&O Priority Letter. State law requires each jurisdiction to submit a priority letter to MDOT each year. Priority letters request that certain projects be included in the Maryland Consolidated Transportation Program (CTP) and in the regional Transportation Improvement Program (TIP). The Regional M&O Priority Letter will be submitted to MDOT requesting that a list of regional M&O projects be included in the CTP and the TIP. The priority letter that is currently being drafted represents the first time that the Baltimore region has collectively submitted a Regional Priority Letter. This approach will identify several regional M&O projects that are considered a priority by all jurisdictions.

Alternatively, it has been suggested that a regional M&O project be included in all jurisdictional priority letters. This approach would identify one or more regional M&O project(s) that the entire region considers as a priority.

### 6.4.2 Regional ITS Project Architecture Development

The FHWA Rule on ITS Architecture and Standards (Rule 940) requires that all ITS projects funded with highway trust funds shall be developed based on system engineering analysis. Rule 940 states that a systems engineering analysis should include:

1. Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture);
2. Identification of participating agencies' roles and responsibilities;
3. Requirements definitions;
4. Analysis of alternative system configurations and technology options to meet requirements;
5. Procurement options;
6. Identification of applicable ITS standards and testing procedures; and
7. Procedures and resources necessary for operations and management of the system.

The development of a project ITS architecture satisfies FHWA Rule 940 systems engineering analysis requirements 1, 2, 3 and 6 and provides a basis for satisfying the remaining requirements.

Furthermore, the development of a project ITS architecture:

- Provides a forum in which an ITS project can be properly explored
- Documents stakeholder roles and responsibilities
- Documents high-level ITS project requirements
- Identifies standards

The development of Regional ITS Project Architectures based on the Maryland Statewide ITS Architecture can be used as a forum to initiate relationships and institutional arrangements that support regional transportation system planning for operations.

### **6.4.3 Planning Analysis Tools**

Planning analysis tools such as ITS Deployment Analysis System (IDAS) and Dynamic Network Assignment Simulation Model for Advanced Road Telematics for Planning Applications (DYNASMART-P) determine the benefits and costs associated with ITS deployments. Benefit-cost data can be used to help transportation planners and decision makers program ITS projects.

In support of regional planning for operations, the use of planning analysis tools should be integrated into the regional planning process.

## **7.0 SUMMARY AND NEXT STEPS**

In developing the M&O Strategic Deployment Plan, the region's M&O stakeholders conducted a data gathering and visioning process to assess the current status of M&O projects in the region as well as to prepare an M&O vision, goals, objectives, strategies, and projects. Eight high priority projects were identified and a prioritization process was used to provide a framework for deployment. During the Plan development, two enabling initiatives were identified as foundational steps that will strengthen regional M&O implementation. This section offers suggestions of next steps to execute this Plan.

### **7.1 Gaining Support of Regional Stakeholders for Project Implementation**

Similar to the approach used to develop this Plan, the execution of it should be done cooperatively by regional stakeholders. The first proposed step to executing this Plan should be to brief the region's stakeholder committees about the Plan. There are two types of stakeholder committees, those proposed to implement at least one of the high priority projects, and those who would be impacted by the Plan. At the briefing meetings, it will be important to lay out for each committee what is being asked of it and to show how its role fits within the M&O planning process. In addition, at these meetings, the regional M&O issues, goals, objectives and strategies should be validated to ensure that they adequately support the regional M&O vision.

The enabling initiatives and the high priority regional M&O projects will need to be scoped. While scoping these projects, it may be determined that these projects should be divided into sub-projects.

The M&O Strategic Deployment Plan Implementation Steering Committee (which will be a continuation of the Project Steering Committee) should meet several times per year to oversee, coordinate, and track execution of the Plan.

### **7.2 Plan Maintenance**

In addition to implementation, this Plan will need to be maintained. Maintenance involves continuous validation and verification. The maintenance of this Plan could be overseen by the proposed Plan Implementation Steering Committee with input from the regional stakeholders. Similar to the approach used to develop the Plan, tools such as workshops and surveys can be used to solicit input from regional stakeholders. At minimum, this Plan should be validated and verified for consistency with current regional M&O needs bi-annually to determine if any updates are needed. Depending on the result of this effort, it can be determined if the Plan needs to be updated.

### **7.3 High Priority Regional ITS Project Architectures**

As documented earlier, a regional ITS architecture links planning and operations. More specifically, an ITS architecture provides a [symbolic] table at which coordination for

regional transportation system M&O can be initiated. The Baltimore region is included in the Maryland Statewide ITS Architecture. FHWA Rule 940 requires that all ITS projects funded (in whole or in part) by the Highway Trust Fund be developed using systems engineering and be in conformance with a governing regional ITS architecture. If high priority regional M&O projects include ITS and are to be federally funded, then the development of project architectures is a requirement.

Project stakeholders develop project architectures collaboratively. A project architecture defines the interfaces between systems associated with a given ITS project. Furthermore, a project architecture defines project stakeholder roles and responsibilities. By using the Maryland Statewide ITS Architecture to develop project architectures for regional ITS projects, key project stakeholders will have an opportunity to collaboratively use systems engineering to develop regional ITS architectures. Appendix C should be considered when developing project architectures for the high priority regional M&O projects.

#### **7.4 Summary**

The next steps for the region are to execute and maintain the M&O Strategic Deployment Plan. This can only be successful if the region's stakeholders continue to be included in the process, as detailed above.

Prior to execution of the high priority projects, it will be important for the region to undertake the two enabling initiatives which will help lay a strong foundation for future M&O implementation. Once the enabling initiatives have been addressed, it is suggested that the region use the Maryland Statewide ITS Architecture to develop high priority regional ITS project architectures (as necessary). This will allow regional stakeholders the opportunity to collaboratively scope high priority projects. Also, the development of the ITS project architectures will satisfy the majority of FHWA Rule 940.

## **8.0 REFERENCES AND USEFUL LINKS**

The following references were used to support the development of the Baltimore Regional M&O Strategic Deployment Plan.

1. Metropolitan Baltimore Early ITS Deployment Plan: Final Strategic Deployment Plan
2. Best Practices of Rural and Statewide ITS Strategic Planning  
[http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS\\_TE//13608.pdf](http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE//13608.pdf)
3. Strategic Plan Northern Virginia District (NOVA) Smart Travel Program  
<http://www.virginiadot.org/infoservice/resources/smart-nova-strategic-plan.pdf>
4. Mississippi ITS Strategic Plan  
<http://www.mdot.state.ms.us/its/default.htm>
5. South Dakota Rural Intelligent Transportation Systems (ITS) Deployment Plan  
[http://www.state.sd.us/Applications/HR19ResearchProjects/Projects%5CSD1999\\_11\\_final\\_report.pdf](http://www.state.sd.us/Applications/HR19ResearchProjects/Projects%5CSD1999_11_final_report.pdf)
6. San Joaquin Valley Intelligent Transportation System (ITS) Strategic Deployment Plan Working Paper #4 – Functional Areas and Technology Options  
<http://www.mcag.coq.ca.us/sjivits/pages/..%5CPDF%20Files%5CWorking%20Paper%20No4.pdf>
7. Oregon Statewide ITS Architecture and Operational Concept Plan  
<http://www.oregon.gov/ODOT/HWY/ITS/PDFs/ITSDocuments/StatewideITSPan/Oregon ITS Architecture Report.pdf>
8. New Mexico ITS Strategic Plan  
[http://nmshtd.state.nm.us/upload/images/Intelligent Transportation Systems/Final\\_Report.pdf](http://nmshtd.state.nm.us/upload/images/Intelligent Transportation Systems/Final_Report.pdf)
9. Oklahoma City Area Regional Transportation Study (OCARTS) Intelligent Transportation System (ITS) Implementation Plan  
<http://www.okladot.state.ok.us/hqdiv/p-r-div/itscvo/pdfs/okcimplan.pdf>
10. Intelligent Transportation System (ITS) Implementation Plan for the Tulsa Region  
<http://www.incoq.org/Transportation/its/Implementation%20Plan.pdf>
11. Tahoe Gateway Counties Intelligent Transportation Systems Strategic Deployment Plan  
<http://www.tahoegateway.com/tahoegateway/pdf/wp2.pdf>

12. Schuylkill Expressway Corridor: Transportation Systems Management Strategic Deployment Plan  
<http://www.i76tsm.com/SECTSM%20Strategic%20Deployment%20Plan.pdf>
13. Wichita – Sedgwick County Regional Intelligent Transportation System (ITS) Architecture  
[http://www.wichita.gov/NR/rdonlyres/0633B02D-F0EE-420A-B7C3-3351C825C330/0/Vol2Wichita\\_Arch\\_Impl\\_Plan\\_05032005.pdf](http://www.wichita.gov/NR/rdonlyres/0633B02D-F0EE-420A-B7C3-3351C825C330/0/Vol2Wichita_Arch_Impl_Plan_05032005.pdf)
14. Intelligent Transportation Systems Strategic Plan - Kentucky Transportation Center  
[http://www.kytc.state.ky.us/traffic/systemoperations/ITS\\_Strategic\\_Plan.pdf](http://www.kytc.state.ky.us/traffic/systemoperations/ITS_Strategic_Plan.pdf)
15. Intelligent Transportation System Technical Report: 2030 Statewide Transportation Plan for Colorado  
[http://www.dot.state.co.us/StatewidePlanning/PlansStudies/files\\_final2030update\\_jdc/2030%20Plan%20Technical%20Reports/ITS%20Technical%20Report.pdf](http://www.dot.state.co.us/StatewidePlanning/PlansStudies/files_final2030update_jdc/2030%20Plan%20Technical%20Reports/ITS%20Technical%20Report.pdf)
16. Intelligent Transportation Systems at the 2002 Salt Lake City Olympic Games: Traffic Management and Traveler Information Case Study  
[http://www.itdocs.fhwa.dot.gov/JPODOCS/REPTS\\_TE/13851.html](http://www.itdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13851.html)
17. Atlantic Provinces Intelligent Transportation Systems Strategic Planning Study  
<http://www.itscanada.ca/english/documents/AtlanticStrategicPlan.pdf>
18. Rural Intelligent Transportation Systems Activities Update – 03/2003  
[http://www.itsa.org/itsnews.nsf/0/2c53a1779656e49785256d350069fa1b/\\$FILE/RuralITS\\_Activities\\_Update.doc](http://www.itsa.org/itsnews.nsf/0/2c53a1779656e49785256d350069fa1b/$FILE/RuralITS_Activities_Update.doc)
19. National Rural ITS Activities Update – 01/2003  
[http://www.itsa.org/subject.nsf/Files/ruralits~8901769/\\$file/ruralits~8901769.doc](http://www.itsa.org/subject.nsf/Files/ruralits~8901769/$file/ruralits~8901769.doc)
20. British Columbia's Provincial Intelligent Transportation System (ITS): Vision and Strategic Plan  
[http://www.itscanada.ca/english/documents/BC\\_FinalReportMar2002.pdf](http://www.itscanada.ca/english/documents/BC_FinalReportMar2002.pdf)
21. District 7 Regional ITS Architecture: Workshop Presentation December 13, 1999  
[http://www.itsa.org/committe.nsf/0/eaac2bae66ce8bc48525686c007867e0/\\$FILE/Workshop%20Proceedings.pdf](http://www.itsa.org/committe.nsf/0/eaac2bae66ce8bc48525686c007867e0/$FILE/Workshop%20Proceedings.pdf)
22. Columbus Metropolitan Freeway Management System Detailed Project Plan  
<http://morpc.org/web/transportation/its/CMFMSPlan.pdf>
23. Twenty-Year Transportation Plan 2000 – 2020: Keeping Maine Moving – 01/2001  
<http://mainegov-images.informe.org/mdot-stage/pubs/pdf/20yr.pdf>

24. Alaska IWAYS Architecture: Implementation Plan  
<http://www.dot.state.ak.us/iways/Documents/iways-FinRptCh6ImpPln.pdf>
25. Ohio-Kentucky-Indiana Regional Council of Governments' Evaluation of ARTIMIS and ITS Program Plan  
<http://www.camsys.com/idas/CaseStudies/CaseStudy1/CaseStudyBody.htm>
26. A Guide to Updating Highway Emergency Response Plans for Terrorist Incidents  
<http://security.transportation.org/sites/security/docs/guide-ResponsePlans.pdf>
27. Linking Operations and Transportation Planning  
[http://www.ampo.org/mpo\\_issues/operations/Linking%20Planning%20&%20Ops%20-%20Exec%20Brief%20-%20June%2028%20%2005.ppt](http://www.ampo.org/mpo_issues/operations/Linking%20Planning%20&%20Ops%20-%20Exec%20Brief%20-%20June%2028%20%2005.ppt)
28. Measuring System Performance: The Key to Establishing Operations as a Core Agency Mission  
<http://www.gcu.pdx.edu/download/FHWAPerfMeas.doc>
29. Institute of Transportation Studies Library References (University of California, Berkeley) - Sources of Information in Intelligent Transportation Systems: A Bibliography  
<http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1025&context=its>
30. Dynamic Late Merge System Evaluation: Initial Deployment – Summer 2003  
<http://www.dot.state.mn.us/trafficeng/research/data/DynLateMerge.pdf>
31. Regional Concept for Transportation Operations Context and Getting Started (Prepared for the Detroit, Michigan RTOCC Demonstration Team) – May 16, 2005  
[http://www.semco.org/TranPlan/RegionalOperations/assets/FHWA\\_5\\_16\\_05.pdf](http://www.semco.org/TranPlan/RegionalOperations/assets/FHWA_5_16_05.pdf)
32. Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation  
[http://www.ops.fhwa.dot.gov/congestion\\_report/index.htm](http://www.ops.fhwa.dot.gov/congestion_report/index.htm)
33. Traffic Congestion and Reliability: Linking Solutions to Problems  
[http://www.ops.fhwa.dot.gov/congestion\\_report\\_04/index.htm](http://www.ops.fhwa.dot.gov/congestion_report_04/index.htm)
34. SACOG ITS SOLUTIONS TOOLBOX FOR MAINSTREAMING ITS: Project Types and ITS Solutions  
<http://www.sacog.org/websites/kimley-horn/documents/2005/10/17/ITS%20Solutions%20Toolbox.pdf>

- 35.A Framework For Developing Integrated Its Solutions To Improve Traffic Operations  
<http://swuttc.tamu.edu/Reports/167248-1.pdf>
  
- 36. Intelligent Transportation Systems (ITS) in Texas: Deployment Summary and a Case Study of Deployment Methodologies  
[http://www.utexas.edu/research/ctr/pdf\\_reports/1790\\_3.pdf](http://www.utexas.edu/research/ctr/pdf_reports/1790_3.pdf)

## 9.0 DEFINITIONS AND ACRONYMS

**Congestion** – In general, congestion occurs when transportation system demand exceeds capacity. For example, during “rush hour” or peak travel times there is more demand than capacity. This is typically classified as recurring congestion.

Often, incidents reduce transportation system capacity resulting in congestion. This type of congestion is classified as non-recurring congestion.

**Delay** – The difference between a desired and actual travel time between two points.

**MMTIS (Baltimore Multi-Modal Traveler Information System)** – This project involves the use of probe data to support a regional traveler information system.

**RITIS (Regional Integrated Transportation Information System)** – A system developed by the University of Maryland that serves as a traveler information fusion and dissemination tool. RITIS also serves as a traveler information data archive system. Initial development of RITIS has focused on the National Capital Region.

**SAFETEA – LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)** – Legislation that governs federal surface transportation spending and actions through 2010.

**Transportation System Management and Operation (M & O)** – An integrated program to optimize the performance of existing infrastructure through the implementation of multimodal and inter-modal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of Federal-aid highways.

**APPENDIX A  
LIST OF STAKEHOLDERS**

The list of stakeholders includes Project Steering Committee members, survey responders and workshop participants.

<b>Name</b>	<b>Agency</b>	<b>Project Steering Committee Member</b>	<b>Survey Responder</b>	<b>Workshop Participant</b>
Sonny Hinton	Annapolis Department of Transportation			X
Danielle Matland	Annapolis Department of Transportation		X	X
Kevin Newton	Anne Arundel County Department of Public Works			X
Al Foxx	Baltimore City Department of Transportation	X		
Leif Dormsjo	Baltimore City Department of Transportation		X	X
Emery Hines	Baltimore County Department of Public Works		X	X
Richard Muth	Baltimore County Office of Emergency Management	X		
Mark Demski	Baltimore County Office of Emergency Management			X
Eileen Singleton	Baltimore Metropolitan Council	X		X
Bala Akundi	Baltimore Metropolitan Council			X
Chris Letnaunchyn	Carroll County Department of Public Works	X	X	
Tom Long	Carroll County Sheriff			X

<b>Name</b>	<b>Agency</b>	<b>Project Steering Committee Member</b>	<b>Survey Responder</b>	<b>Workshop Participant</b>
Joe Gannon	Corridor Transportation Corp.			X
M.G. Habib	Federal Highway Administration, Eastern Federal Lands			X
Breck Jeffers	Federal Highway Administration, MD Division	X	X	X
Hassan Raza	Federal Highway Administration, MD Division			X
Alex Rawls	Harford County Department of Planning & Zoning		X	
Jeff Stratmeyer	Harford County Department of Public Works		X	X
Michael Hannan	Harford County Transit		X	
Diane Schwarzman	Howard County Department of Public Works		X	X
William Smith	Howard County Office of Emergency Management			X
Glenn Hansen	Howard County Police	X		X
John Contestabile	Maryland Department of Transportation	X		X
Patrick Fleming	Maryland Department of Transportation	X		X
Earl Lewis	Maryland Department of Transportation			X
Janet Harrison	Maryland State Police			X

<b>Name</b>	<b>Agency</b>	<b>Project Steering Committee Member</b>	<b>Survey Responder</b>	<b>Workshop Participant</b>
Suhair Alkhatib	Maryland Transportation Authority			X
Laureen Billmeyer	Maryland Transportation Authority Police			X
Andrew Meese	Metropolitan Washington Council of Governments			X
Bob Winick	Motion Maps, LLC			X
Paul Bitzel	National Park Service, Ft. Mc Henry National Monument			X
Glenn McLaughlin	State Highway Administration / CHART	X		X
Alvin Marquess	State Highway Administration / CHART	X		X
Egua Igbinosun	State Highway Administration / CHART	X		X
Steve Rochon	State Highway Administration / CHART		X	
Phil Tarnoff	University of Maryland / Center for Advanced Transportation Technology	X		X

**APPENDIX B  
SAMPLE REGIONAL M&O SURVEY**

## **BALTIMORE REGIONAL MANAGEMENT AND OPERATIONS STRATEGIC DEPLOYMENT PLAN SURVEY**

The Baltimore Metropolitan Council has hired a consultant team led by Edwards & Kelcey (EK) to prepare the Baltimore Regional Management & Operations (M&O) Strategic Deployment Plan. M&O strategies focus on optimizing the performance of existing infrastructure. These strategies include the implementation of multimodal, intermodal, and often cross-jurisdictional systems, services, and projects.

M&O strategies include Intelligent Transportation Systems (ITS). ITS is the application of communications and information technologies (i.e. dynamic message signs (DMS), closed-circuit television (CCTV) cameras, traffic speed detection sensors, etc.) to transportation system management and operations challenges. (For additional information about ITS, visit the Federal Highway Administration (FHWA) ITS website at [www.its.dot.gov](http://www.its.dot.gov).)

The M&O Strategic Deployment Plan will essentially be an update of the Metropolitan Baltimore ITS Strategic Deployment Plan developed in 1998 and it will:

- identify regional transportation needs and priorities (including needs and priorities that support safety and security),
- document a vision that articulates the ideal view of transportation system management and operations within the region,
- identify high priority M&O projects and strategies that will aid in achieving the vision,
- identify additional methods for linking transportation planning and operations, and
- provide updates to the Maryland Statewide ITS Architecture.

The M&O Strategic Deployment Plan will provide a framework for implementation of regional M&O projects and strategies and will ultimately be used to support the regional transportation planning process. The coordination of M&O projects and strategies allows regional stakeholders the opportunity to pool resources, achieve economies of scale, and maximize M&O deployment functionality in order to best address regional transportation needs.

We are conducting this survey to gather input from regional stakeholders. Your participation will aid in developing the vision and identifying high priority M&O projects. If you have any additional information that may help in this effort, please include it at the bottom of the survey. When access information is requested, please provide information that will give the EK Project Team the means to obtain a particular reference/resource.

A member of the EK Project Team may contact you to get additional information about your responses.

Please return your completed survey to Ivana Lucic by email at [ilucic@ekmail.com](mailto:ilucic@ekmail.com) by February 21, 2006. The EK Project Team will compile the survey responses and provide the results at a Visioning Workshop to be held on March 16<sup>th</sup>. You are encouraged to attend this meeting to provide additional input to the process.

If you have any questions, please contact Ivana Lucic ([ilucic@ekmail.com](mailto:ilucic@ekmail.com), 410-747-3420) or Eileen Singleton ([esingleton@baltometro.org](mailto:esingleton@baltometro.org); 410-732-0500 x 1033).

Thank you for your help!  
BMC and EK Project Team

Jurisdiction Name \_\_\_\_\_

Agency Name \_\_\_\_\_

Person Completing Survey \_\_\_\_\_

Contact Telephone Number and E-mail Address \_\_\_\_\_

A) Are there any documents, databases or maps available that identify existing ITS (DMS, CCTV, etc.) devices owned and operated by your agency? \_\_\_\_\_

If so, then please list and provide information regarding access to these references:

Existing ITS Deployment References

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_

B) If there are no existing ITS deployment references or the references are not comprehensive, then list ITS infrastructure owned and operated by your agency.

	ITS Device Type (such as DMS, CCTV, etc.)	Quantity	Location
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
11	_____	_____	_____
12	_____	_____	_____
13	_____	_____	_____
14	_____	_____	_____

C) Are there any documents, databases or maps available that identify existing data and voice communications infrastructure owned and operated by your agency? \_\_\_\_\_

If so, then please list and provide information regarding access to these references:

Existing Voice and Data Infrastructure References

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_

D) If there are no existing voice and data infrastructure references or the references are not comprehensive, then please list voice and data infrastructure owned and operated by your agency.

Existing Voice and Data Infrastructure

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5 \_\_\_\_\_
- 6 \_\_\_\_\_
- 7 \_\_\_\_\_
- 8 \_\_\_\_\_
- 9 \_\_\_\_\_
- 10 \_\_\_\_\_
- 11 \_\_\_\_\_
- 12 \_\_\_\_\_
- 13 \_\_\_\_\_
- 14 \_\_\_\_\_

E) Does your agency share control of and/or share data gathered by ITS devices? \_\_\_\_\_

If so, then please identify the ITS devices, information exchanged, agreements, standards/protocols and agencies/jurisdictions involved.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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**APPENDIX C  
MARYLAND STATEWIDE ITS ARCHITECTURE IMPLICATIONS**

## **MARYLAND STATEWIDE ITS ARCHITECTURE IMPLICATIONS**

The latest version of the Maryland Statewide ITS Architecture<sup>4</sup> (MITSA) was released on April 2005. The Maryland Statewide ITS Architecture identifies stakeholders, elements (or ITS components), subsystems, applicable ITS standards and agreements. In doing so, the statewide ITS architecture provides a framework for the integrated implementation of ITS technologies throughout the state, including the Baltimore region. The statewide ITS architecture also provides context for enhanced collaboration and coordination between state and local transportation agencies.

In addition to the aforementioned benefits associated with the development of a statewide ITS architecture, a statewide (or regional) ITS architecture facilitates the use of federal Highway Trust Funds on state and local ITS projects. More specifically, FHWA Rule 940<sup>5</sup> requires that all state and local ITS projects that use federal funding be in conformance with a regional ITS architecture. The Maryland Statewide ITS Architecture is the regional ITS architecture that governs the Baltimore region.

FHWA Rule 940 also requires that the Maryland Statewide ITS Architecture be maintained and updated regularly. This appendix is intended to support the next update of the statewide ITS architecture. More specifically, this appendix identifies stakeholders and interconnects that should be considered for future updates of the statewide ITS architecture.

FHWA Rule 940 also requires that a systems engineering process be used to develop federally funded ITS projects. Therefore, the high priority projects identified in this Plan that involve the deployment of ITS and may be federally funded will be required to be developed using a systems engineering process. The fundamental stages of a systems engineering process are representative of the systems engineering life cycle. Figure C-1 illustrates the systems engineering life cycle. Achieving ITS project conformance to the MITSA provides a starting point from which a systems engineering process can be initiated.

It should also be noted that this appendix directly supports the Concept Exploration stage of the systems engineering life cycle. In doing so, this appendix provides input into the Concept of Operations and High-Level Design (Project Architecture) Subsystem Requirements development stage of the systems engineering life cycle for the considered High Priority Regional M&O Projects.

<sup>4</sup> The Maryland Statewide ITS Architecture is available on the Internet at <http://www.itsmd.org>.

<sup>5</sup> More information on FHWA Rule 940 is available at [http://www.ops.fhwa.dot.gov/its\\_arch\\_imp/index.htm](http://www.ops.fhwa.dot.gov/its_arch_imp/index.htm).

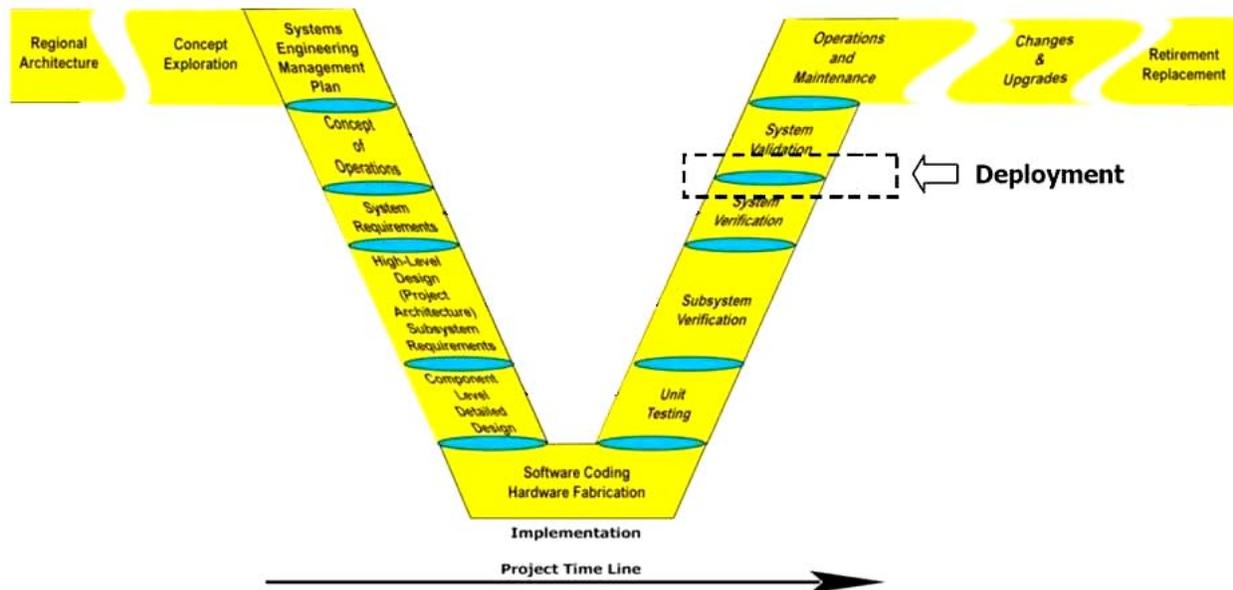


Figure C-1. Systems Engineering Life Cycle

### **High Priority Regional ITS Projects that Impact the MITSA**

The Baltimore Regional Transportation System M&O Strategic Deployment Plan identifies eight High Priority Regional M&O Projects. Of those eight projects, only four will have a direct impact on the MITSA:

- **High Priority Project A:** Implement Regionally Coordinated Adaptive Traffic Control Systems
- **High Priority Project E** - Implement Strategies to Secure Critical Regional Transportation Infrastructure
- **High Priority Project F** - Develop a System to Collect, Process, Store and Disseminate Transportation Information
- **High Priority Project G** - Implement M&O Strategies Along Critical Corridors and Evacuation Routes

The remainder of this appendix will document exactly how these four projects will impact the MITSA.

### **Stakeholders**

ITS architecture stakeholders represent the owners and operators of ITS infrastructure (or elements) within the scope of a specific ITS architecture.

The following list of stakeholders were identified in the development of the M&O Strategic Deployment Plan, but are not currently included in the MITSA. The stakeholders listed below should be considered for inclusion into the MITSA.

- Annapolis City Department of Transportation
- Baltimore County Office of Homeland Security & Emergency Management

NOTE: The Baltimore County 911 Central Communications Center was identified as a stakeholder in the statewide ITS architecture. It may be more appropriately identified as an Element.

- Corridor Transportation Corp
  - Howard County Office of Emergency Management
- NOTE: The Howard County Emergency Operation Center was identified as a stakeholder in the statewide ITS architecture. It may be more appropriately identified as an Element.
- Maryland Transportation Authority Police
  - Federal Highway Administration, Eastern Federal Lands
  - National Park Service, Ft. McHenry National Monument

The inclusion of additional stakeholders will require that the Maryland Statewide ITS Architecture Description of Elements, Operational Concept, Functional Requirements, Interface Requirements and ITS Standards be verified and validated based on new stakeholder input.

Appendix B provides a point-of-contact for each stakeholder.

### **Interconnects**

ITS architecture interconnects document and illustrate how elements owned and operated by stakeholders within a specific ITS architecture interface.

Using the MITSA as a framework, relevant High Priority Regional M&O Projects were evaluated to determine the potential affect that each project may have on the Maryland Statewide ITS Architecture. Evaluation results are documented in this section.

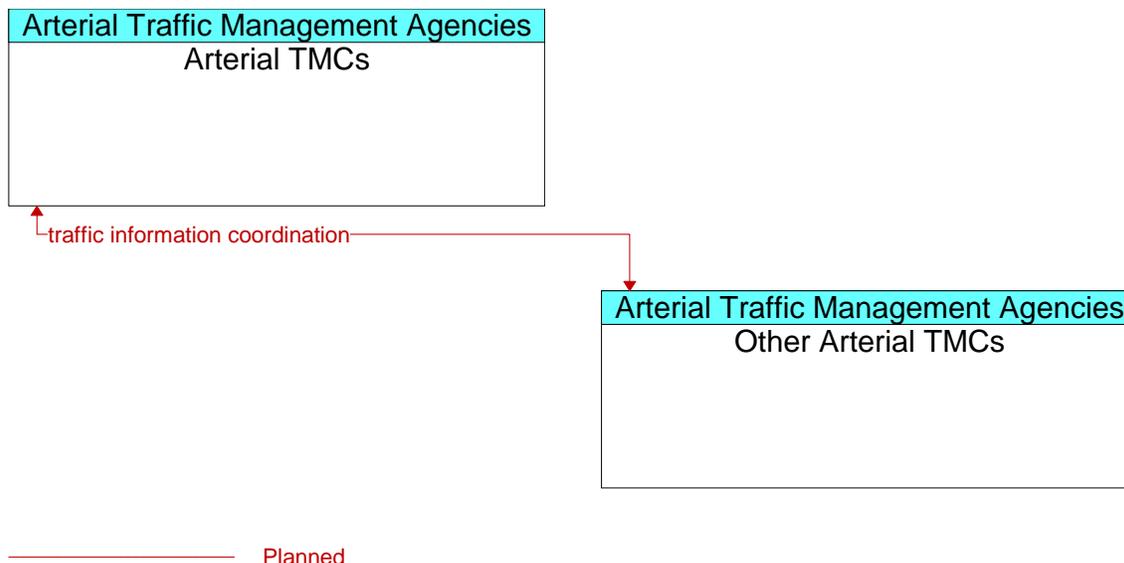
### **High Priority Project A: Implement Regionally Coordinated Adaptive Traffic Control Strategies**

In order to implement regionally coordinated traffic control strategies, real-time traffic data will have to be shared between local and state transportation agencies responsible for managing and operating traffic control systems. Local and state transportation agencies responsible for managing and operating traffic control systems are represented by the Traffic Management Center Subsystem in the Maryland Statewide ITS Architecture. National ITS Architecture Market Package ATMS07 – Regional Traffic Control (illustrated in Figure C-2) provides a framework for the implementation of regionally coordinated traffic control strategies.

The *traffic information coordination* information flow represents the critical Interconnect between Traffic Management Centers that will support the implementation of regionally coordinated traffic control strategies. Figure C-2 provides one example of this planned interconnect in the MITSA. The *traffic information coordination* information flow includes real-time incident data, traffic data (i.e. volume, occupancy and speed), signal timing plans, and signal control information.

The following standards should be considered when implementing the *traffic information coordination* information flow. Information on these standards can be obtained via the National ITS Architecture.

- NTCIP C2C: NTCIP Center-to-Center Standards Group
- ITE TM 1.03: Standard for Functional Level Traffic Management Data Dictionary (TMDD)
- ITE TM 2.01: Message Sets for External TMC Communication (MS/ETMCC)



**Figure C-2. Critical Regional Traffic Control Interconnect Diagram**

Prior to implementation of regionally coordinated adaptive traffic control systems, the standards mentioned above and any other relevant standards that govern the exchange of traffic information between regional traffic management centers need to be considered and evaluated. Then, regional standards need to be adopted through consensus.

Upon the implementation of regionally coordinated adaptive traffic control systems, the *traffic information coordination* information flow will have to be updated from planned to existing in the MITSA.

High Priority Project F: Implement Strategies to Secure Critical Regional Transportation Infrastructure

One strategy to secure critical regional transportation infrastructure would be to deploy and integrate sensor and surveillance devices to monitor critical transportation infrastructure. National ITS Architecture Market Package EM05 – Transportation

Infrastructure Protection provides the framework for the integrated deployment of this project.

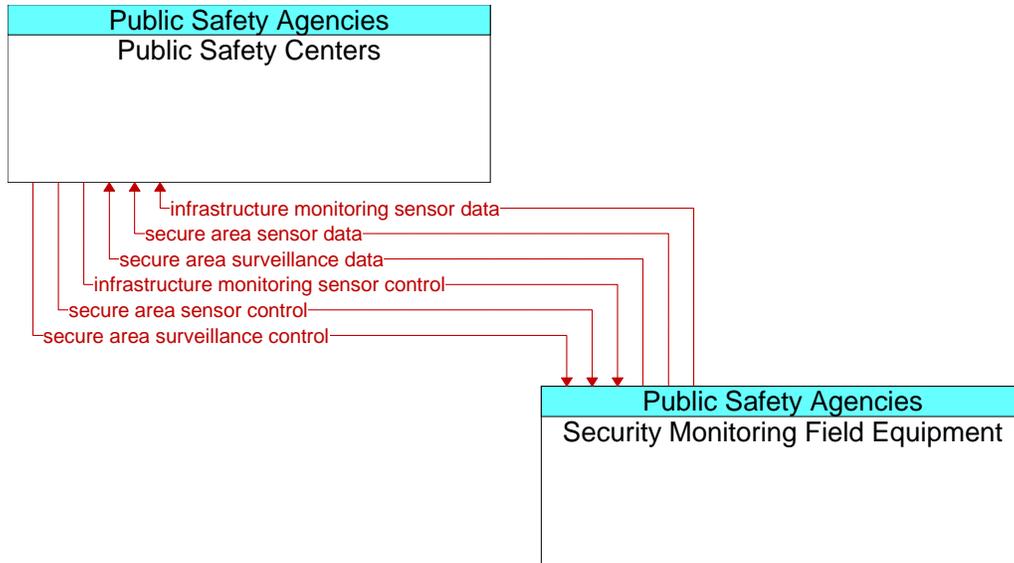
Based on the Maryland Statewide ITS Architecture, these devices are controlled and monitored by Public Safety Centers. Traffic Management Centers may also be responsible for monitoring and controlling critical transportation infrastructure sensor and surveillance devices. Therefore, **the MITSA may need to be updated to allow traffic management centers to monitor and control critical transportation infrastructure sensor and surveillance devices.** This would be accomplished by mapping Public Safety Center functionality to Traffic Management Centers in the MITSA Turbo Architecture database.

Currently, critical transportation infrastructure sensor and surveillance devices are controlled and monitored by way of planned interfaces between Security Monitoring Field Equipment and Public Safety Centers MITSA Elements as identified in Figure C-3.

If it is desired to share access to secure area surveillance data and control of secure area surveillance devices, then the following standards should be considered in conjunction with standards already being used by stakeholders for surveillance:

- NTCIP 1201: Global Object Definitions
- NTCIP 1205: Data Dictionary for Closed Circuit Television (CCTV)
- NTCIP 1208: Object Definitions for Video Switches
- NTCIP 1402: TCIP - Incident Management (IM) Business Area Standard

Information on these standards can be obtained via the National ITS Architecture.



Planned

**Figure C-3. Regional Transportation Infrastructure Protection Interconnect Diagram**

Prior to the deployment and integration of critical transportation infrastructure sensor and surveillance devices, the standards mentioned above and any other relevant standards, that govern the access and control of secure area surveillance devices, need to be considered and evaluated. Then, regional standards need to be adopted through consensus.

Upon the deployment and integration of critical transportation infrastructure sensor and surveillance devices, the information flows identified in Figure C-3 will have to be updated from planned to existing in the MITSA.

Furthermore, relevant information flows between Traffic Management Centers and Security Monitoring Field Equipment will have to be established in the MITSA.

High Priority Project F - Develop a System to Collect, Process, Store and Disseminate Transportation Information

**Once a concept of operations for the proposed regional Information Exchange System has been developed, the MITSA will have to be updated accordingly.** Preliminary interface requirements will be defined by the concept of operations.

The integrated deployment of this project is supported by several National ITS Architecture Market Packages. Similarly, the proposed system will be mapped to several MITSA Interconnects in order to collect, process, store, and disseminate transportation information from various sources (or MITSA Elements) to system operators and possibly the traveling public.

Based on research done by the University of Maryland Center for Advanced Transportation Technology Laboratory, the following standards should be considered:

- SAE J2345: Message Set for Advanced Traveler Information System
- ITE Traffic Management Data Dictionary v2.1
- IEEE Incident Management 1512
- ASTM WK7604: Standards Specification for Archiving ITS-Generated Traffic Monitoring Data
- NTCIP C2C: NTCIP Center-to-Center Standards Group

**Prior to the deployment and integration of a system to collect, process, store and disseminate transportation information, the standards mentioned above and any other relevant standards need to be considered and evaluated. Then, regional standards need to be adopted through consensus.**

**High Priority Project G - Implement M&O Strategies Along Critical Corridors and Evacuation Routes**

In addition to the coordination of M&O strategies between regional multi-modal transportation agencies, this project will primarily involve the following M&O strategies:

- the exchange of information between regional multi-modal transportation agencies,
- the deployment and integration of additional transportation network control, surveillance and detection devices,
- the possible exchange of information between transit/emergency vehicles and field equipment to support M&O initiatives such as traffic signal preemption/priority and
- the provision of information to emergency vehicles to improve incident/event management.

The exchange of information between regional multi-modal transportation agencies will have similar MITSA implications as High Priority Project 6.

In some cases, the deployment and integration of additional transportation network surveillance and detection devices will be an expansion of existing MITSA interconnects and therefore would require minimal change to the MITSA. In other cases, planned interconnects will need to be updated to existing interconnects. For example, the planned MITSA interconnect between the Baltimore City TMC and Arterial TMC Field Equipment illustrated in Figure C-4 will need to be updated to existing interconnects. NTCIP Center-to-Field standards govern these interconnects and should be considered for this project.

**Regarding the possible exchange of information between transit/emergency vehicles and field equipment to support M&O initiatives such as traffic signal preemption/priority, the region needs to first collaboratively develop a concept of operations.** This is an important step in the development of all systems, but is especially important in this case because transit and emergency vehicles often cross jurisdictional boundaries. Therefore, a concept of operations needs to be agreed on by regional stakeholders in order to ensure interoperability and continuity of service across jurisdictional boundaries.

Interconnects between transit/emergency vehicles and field equipment are critical to the interoperable deployment of traffic signal priority/preemption systems. A framework for the integrated deployment of these interconnects is provided by National ITS Architecture Market Package APTS7 – Multimodal Coordination and Market Package EM02 – Emergency Routing. Figure C-5 illustrates how these interconnects are currently represented in the MITSA.

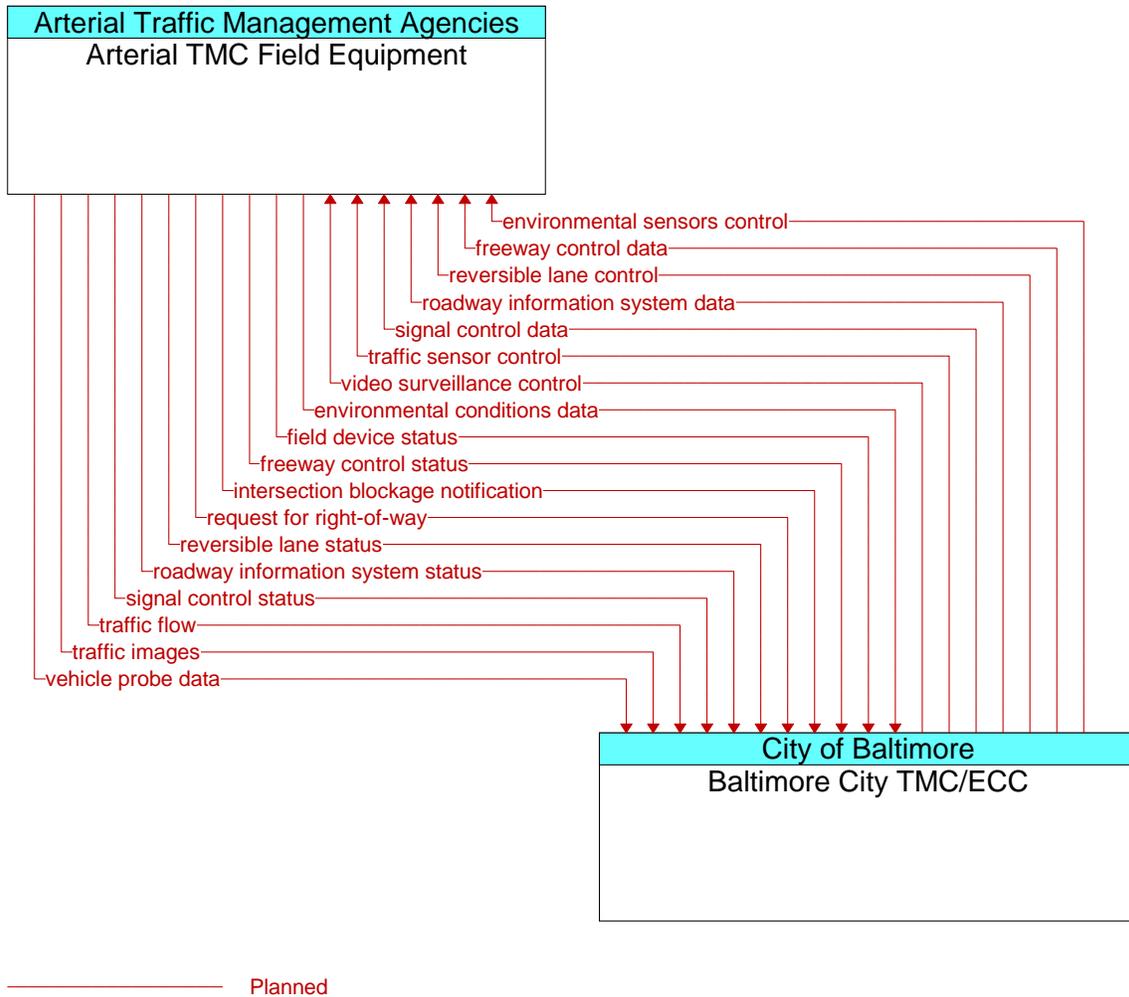
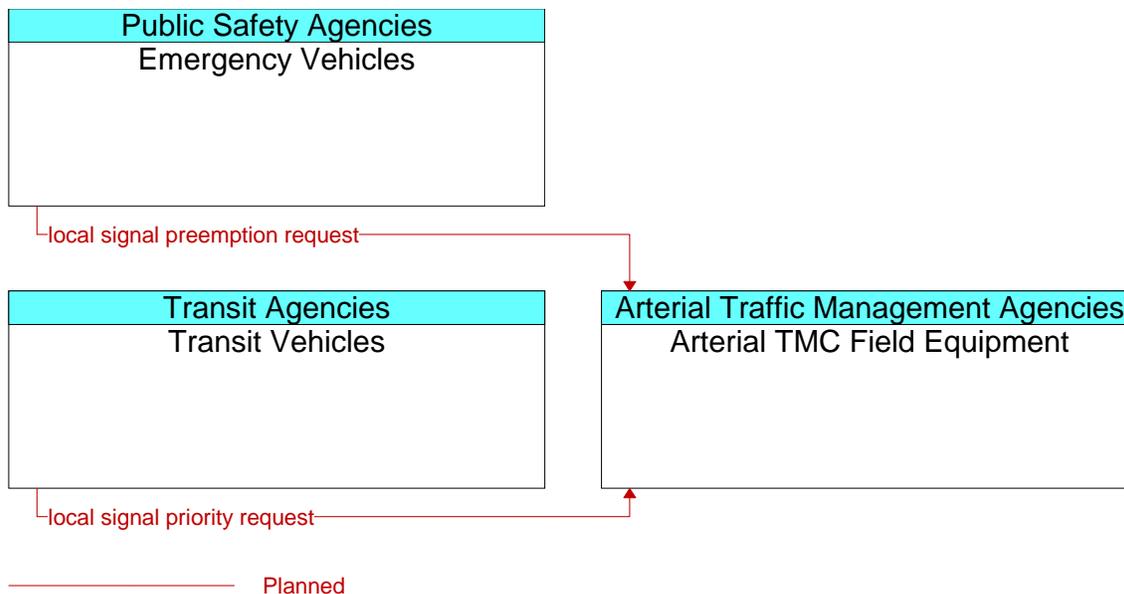


Figure C-4. Sample Coordinated Corridor M&O Interconnect Diagram



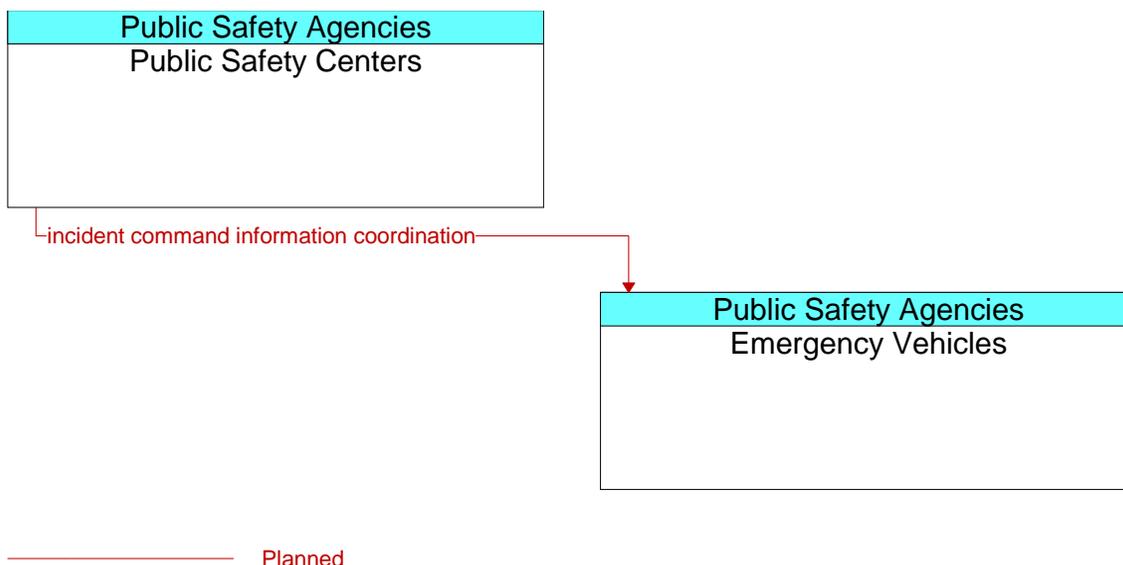
**Figure C-5. Multimodal Coordination Interconnect Diagram**

To further ensure interoperability and continuity of traffic signal priority/preemption system functionality across jurisdictional boundaries, relevant regional standards need to be established. In doing so, the following standards should be considered:

- DSRC 5GHz: Dedicated Short Range Communication at 5.9 GHz Standards Group
- DSRC 915MHz: Dedicated Short Range Communication at 915 MHz Standards Group
- NTCIP 1201: Global Object Definitions
- NTCIP 1211: Object Definitions for Signal Control and Prioritization (SCP)

**Prior to the deployment and integration of transit signal priority and emergency vehicle preemption systems, the standards mentioned above and any other relevant standards need to be considered and evaluated. Then, regional standards need to be adopted through consensus.**

Finally, the provision of information to emergency vehicles to improve incident/event management involves the exchange of critical information pertaining to incident/event status and circumstances from public safety centers or public safety information service providers to emergency vehicles. In most cases, the response to and recovery from an incident/event involves multiple public agencies. This being the case, there is often a need to coordinate response/recovery efforts. Coordinated response/recovery efforts require that responders, which are represented by Emergency Vehicles in the MITSA, share or have the same information. The provision of this information to Emergency Vehicles is supported by the *incident command information coordination* information flow in the MITSA. Figure C-6 illustrates this interface.



**Figure C-6. Sample Incident Management Coordination Interconnect Diagram**

The following standards should be considered when implementing the *incident command information coordination* information flow. Information on these standards can be obtained via the National ITS Architecture.

- IEEE IM: Incident Management Standards Group
- NTCIP C2C: NTCIP Center-to-Center Standards Group

**Prior to implementation of a system to provide coordinated incident/event information to emergency vehicles, the standards mentioned above and any other relevant standards need to be considered and evaluated. Then, regional standards need to be adopted through consensus.**

**Upon the implementation of such a system, the *incident command information coordination* information flow will have to be updated from planned to existing in the MITSA.**