

**3rd DRAFT**  
**NYMTC ITS Integration Strategy Report**

**Prepared for**

**New York Metropolitan Transportation Council (NYMTC)**

**Prepared by**

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# 1 Introduction

## ***1.1 What are Intelligent Transportation Systems?***

Until recently, the building and improvement of a transportation infrastructure meant the civil and mechanical construction or enlargement of roads, bridges and tunnels, as well as the associated enterprises that provide the vehicles (including public and private transit agencies, trucking, public safety and personal) that travel on the infrastructure. Now, as travel demand steadily increases and the opportunities to build new infrastructure becomes prohibitively expensive because of the high costs and limited resources, including land space, the use of ITS technologies to more efficiently operate and manage the region's transportation systems becomes increasingly important. This makes the deployment of ITS technologies to make more efficient use of the existing transportation network an attractive alternative.

As one component of a larger mobility program, ITS refers to the application of data processing, data communications, and systems engineering methodologies with the purpose of improved management, safety and efficiency of the surface transportation network. These ITS technological and management advances can address the following: the overall mobility needs of the region, the travel requirements of transportation network users, and the development, operation, management and maintenance needs of the transportation system providers, both public and private.

ITS provides agencies and their customers a means to address current urban problems, as well as anticipate and address future demand through an intermodal, strategic approach to transportation. The application of ITS allows agencies to use modern technologies to better monitor their systems, providing the agencies with more accurate information to make more informed decisions on safely operating their systems. ITS also allows agencies to distribute this information to the public, so the public can make smarter travel choices.

The deployment of ITS technologies in the region began several years ago with noticeable benefits to the general public. The continued widespread use and expansion of E-ZPass has yielded a significant decrease in travel delays at the toll crossings, even as traffic volumes across these facilities have continued to increase over the same period. The expansion of MetroCard has provided the region with expanded flexibility on transit fare policies, such as the elimination of a two-fare zone, while decreasing operating costs. The establishment of the Highway Emergency Local Patrol (HELP) programs has assisted thousands of stranded motorists on the region's highway system, helping move their vehicles to a safe location and removing stalled vehicles from the travel lanes so they do not impede traffic flow. Other benefits include the availability of updated traveler information, including current traffic surveillance images, in various forms including agency websites, traveler information telephone numbers, and cable television access channels. Such easy access of traveler information provides the general public with valuable information, allowing them to make intelligent travel choices.

With many of the basic ITS components already in place or being deployed, the next step in the development of the region's transportation network is to further develop and expand the use of ITS technologies to obtain more efficiencies from the existing transportation network. One important portion of this development is to facilitate the ability to exchange information between the different agencies that have a stake in the regional transportation network. To reach this goal, NYMTC has

developed an ITS Integration Strategy to help plan the regional coordination of the transportation systems.

## **1.2 What is an ITS Integration Strategy and its Purpose**

The NYMTC ITS Integration Strategy is a roadmap and framework for the efficient, cost-effective integration of ITS systems in the NYMTC Region over the next 20 years. The ITS Integration Strategy identifies a series of regional ITS initiatives and policies based on the region's transportation goals and needs over the next several years. The key motivating factors behind the development of the ITS Integration Strategy are:

- To identify opportunities where ITS investments can work together towards regional interoperability and provide the desired regional ITS services (for example, fire and rescue services can communicate with traffic control and transit services)
- To enhance interagency cooperation in the management and development of intelligent transportation systems
- To identify and target those ITS projects and initiatives early in the planning process which will facilitate more effective integration.

The development of this ITS Integration Strategy would not have been possible were it not for the stakeholders and public agencies who understand the transportation system needs and who ultimately will own and operate ITS systems. The ITS Integration Strategy is being developed through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. The ITS Integration Strategy document represents a common vision among the stakeholders of how each agencies' systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region. This vision identifies where ITS can support regional goals and objectives and also establishes the boundaries and constraints to be placed on the regional ITS deployments.

The ITS Integration Strategy project was started in November, 2002. The first draft of the ITS Integration Strategy was developed from existing documentation from previous efforts, including the New York City Early Deployment Plan (EDP), the 1999 NYMTC Regional Transportation Plan, the TRANSCOM Regional Architecture Project, and the New York Statewide Services Architecture.

This ITS Integration Strategy has a time horizon of up to twenty years with particular focus on those transportation elements likely to be implemented in the next ten years. The ITS Integration Strategy covers the broad spectrum of Intelligent Transportation Systems, including Traffic Management, Transit Management, Traveler Information, Maintenance and Construction, Emergency Management, and Archived Data Management over this time horizon.

## **1.3 Report Organization**

This draft document has been prepared in support of the New York Metropolitan Transportation Council's ITS Integration Strategy. This document, in summary form, will also be included in the next update of the NYMTC Regional Transportation Plan. The ITS Integration Strategy Report includes 9 sections:

- **Section 1: Introduction** - Provides introductory and background information about this document, its purpose and why it is needed.

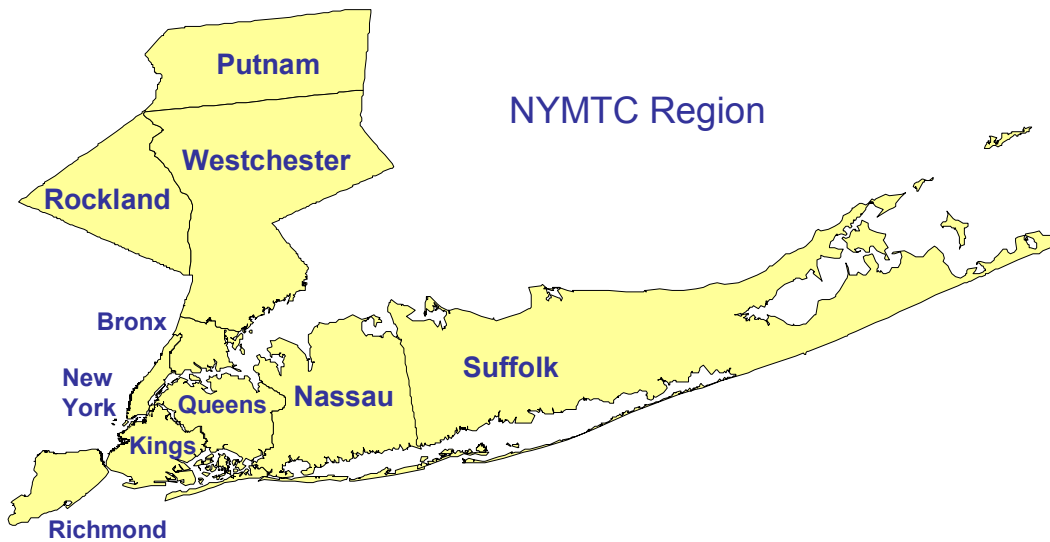
- **Section 2: Description of the Region** - Contains a textual description and graphic of the NYMTC 10 county region.
- **Section 3: Regional ITS Vision** - This section contains a definition of the National ITS Architecture and a summary of the region's ITS Vision. The vision establishes the requirements and constraints to be placed on regional ITS deployments, and a common view of ITS among the stakeholders.
- **Section 4: ITS Inventory and Stakeholder Identification** - Identifies key ITS systems in the region that may be implemented to support the ITS Vision, the process used to develop the NYMTC Integration Strategy including stakeholder workshops, comment review process, and provides definitional information and background about the contents of the ITS Integration Strategy.
- **Section 5: ITS Systems Functions and Electronic Information Sharing Expectations** - Provides an overview of ITS Services and System Functions. The section highlights the concept of using customized market packages as an operational concept (high level requirements) for information and control exchanges.
- **Section 6: Project Identification and Integration Phasing** - Beginning with the ITS Vision elements, this section walks through the regional ITS services, and identifies ITS deployment project sequencing and priority.
- **Section 7: ITS Standards** - Provides a discussion of existing ITS standards and system interoperability for future deployments in the region.
- **Section 8: Recommendations and Next Steps** - This section outlines how the ITS Integration Strategy may be used to facilitate planning for ITS systems at the regional level, and potential steps to keep the ITS Integration Strategy up-to-date.
- **Section 9: Conclusions** – This section briefly summarizes the benefits and results of the ITS Integration Strategy document.
- **Appendix A: List of ITS Stakeholders**
- **Appendix B: ITS System Inventory by Stakeholder**
- **Appendix C: Market Package Définitions**
- **Appendix D: Customized Market Packages Diagrams**
- **Appendix E: System Interconnect Diagrams**

## 2 NYMTC Region ITS Vision

### 2.1 Description of the Region

The NYMTC Region's ITS Integration Strategy covers a 10 county region encompassing the Lower Hudson Valley, Long Island, and New York City. The list of counties that make up the NYMTC Region includes: Putnam, Westchester, Rockland, Suffolk, Nassau, New York, Richmond, Kings, Queens, and The Bronx). The geographic extents of the region are illustrated in the figure below.

**Figure 1. NYMTC Region Map**



The NYMTC Region contains a population of 12 million, or 64% of New York State's 19 million. Located in the southeastern part of the state, the NYMTC region comprises 10 counties. For the purposes of transportation analysis, the 10 counties are grouped into 3 sub regions: Mid-Hudson South, New York City, and Long Island. This information is summarized in the table below.

**Table 1: NYMTC Region Population**

<b>Transportation Coordinating Committee Sub Region</b>	<b>County</b>	<b>2002 Population</b>
Mid-Hudson South	Putnam	98,257
	Rockland	291,835
	Westchester	937,279
New York City	Bronx	1,354,068
	Kings	2,488,194
	New York	1,546,856
	Queens	2,237,815
	Richmond	457,383
Nassau / Suffolk	Nassau	1,344,892
	Suffolk	1,458,655

NYMTC Region 12,215,234

### 3 NYMTC Region ITS Vision

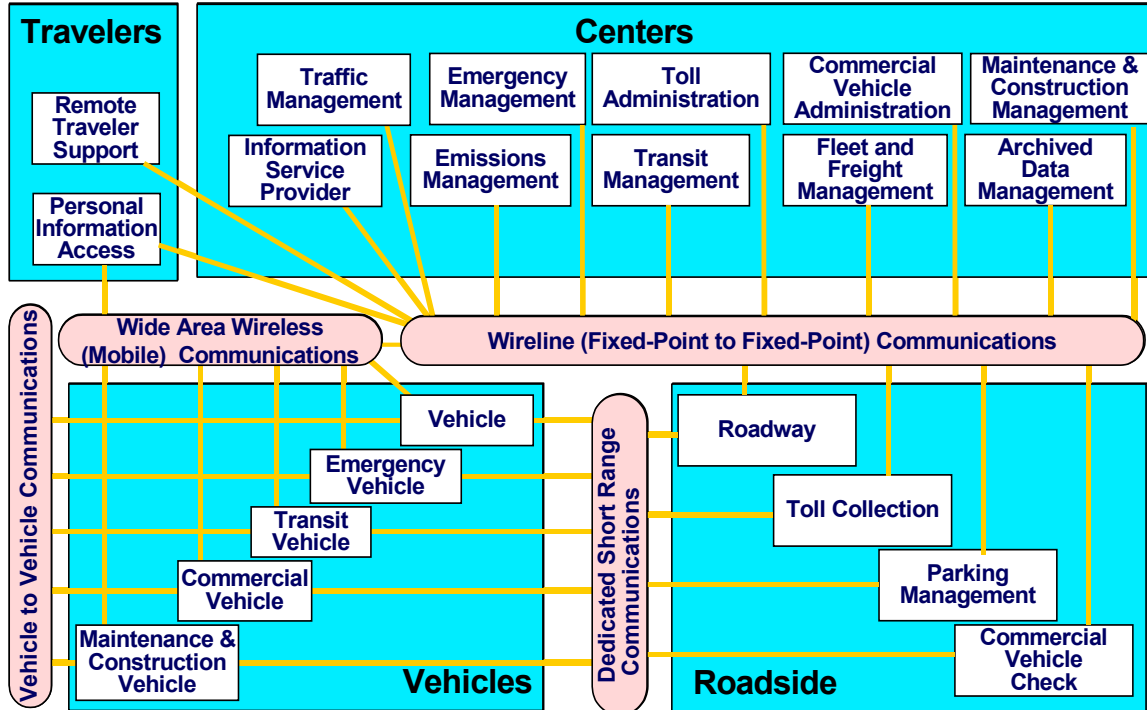
#### 3.1 ITS Vision Development

The ITS Integration Strategy represents a shared vision of how each transportation agencies' systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region. The ITS Vision was developed through stakeholder consensus to identify transportation system needs using a workshop format. In subsequent steps, the National ITS Architecture was used as a basis for analysis of the ITS Vision needs and the development of the NYMTC ITS Integration Strategy.

#### 3.2 The National ITS Architecture

The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems and defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS.
- The physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle).
- The information flows and data flows that connect these functions and physical subsystems together into an integrated system.



The National ITS Architecture also introduces the concept of Market Packages. Market packages define potential ITS deployments in both narrative and diagrammatic form. Market package diagrams



show which ITS systems are required to work together (across different operators, whether public or private) to deliver a given transportation service. Market packages are designed to address specific transportation problems and needs and relate back to the ITS services and their more detailed requirements. Market package definitions and customized market package diagrams for the NYMTC region are shown in Appendices C and D, respectively.

### **3.3 Stakeholder Workshops**

The NYMTC Region's ITS Vision was initially developed during a 1-day workshop held on December 16, 2002. The ITS Vision was then used to identify which market packages support the ITS Vision needs. The identified market packages were then customized to depict stakeholder roles in implementing the ITS Vision.

A draft set of customized market packages were then reviewed by stakeholders at a second 1-day workshop held on January 9, 2003. Based on stakeholder input, a revised set of customized market packages was created and made available to all stakeholders for review. During the review period, comments were collected and initial disposition of comments developed. A third comment review workshop was held on February 7, 2003 to address stakeholder comments and possible disposition of those comments. Changes were made, and the customized market packages were again submitted to stakeholders for comment. One last set of changes were made to the customized market packages. The current version of the customized market packages can be found in Appendix B.

### **3.4 Summary ITS Vision**

The NYMTC Region's ITS Vision identifies transportation needs along various transportation system functional areas (e.g., traffic, public transportation, emergency managements, traveler information, etc). The following sections summarize the NYMTC Region's ITS Vision organized by functional area. The ITS Integration Strategy can be used to guide the planning for and development of projects and requirements for projects. Based on an initial stakeholder workshop held in December 2002 and subsequently refined during a second workshop, the needs and requirements for the region were identified.

#### **3.4.1 Advanced Traffic Management Systems**

In the area of Advanced Traffic Management Systems (ATMS), a wide range of ATMS capabilities are recommended for deployment, including:

- Continue the expansion of the Joint Traffic Management Center. Located in Long Island City, this management center is jointly operated and co-habitated by New York City Department of Transportation, New York City Police Department and New York State Department of Transportation. The center facilitates regional coordination between the agencies, sharing of resources, and quicker responses to incidents.
- Continue the expansion of the network surveillance system to support the collection of real-time traffic information and distribute the information to other operating agencies and the traveling public.
- Investigate the use of traffic signal priority for emergency vehicles and transit buses.

- Expand the use of IIMS (Integrated Incident Management Systems) to other agencies, including the Department of Sanitation and the Mayor's Office of Emergency Management.
- Expand the use of E-ZPass applications beyond toll crossings to include parking at airports.
- Develop systems to track parking spaces and guide drivers to available parking.

### **3.4.2 Maintenance and Construction Operations**

In the area of Maintenance and Construction Operations (MCO):

- Install vehicle tracking technologies on maintenance vehicles so resources can be more efficiently dispatched.
- Install roadway pavement sensors, anti-icing equipment on bridges, and vehicle on-board devices to monitor resources to quickly and efficiently mitigate poor traveling conditions, such as roadway icing, flooding or snow.
- Automate and track roadway maintenance operations to improve coordination and scheduling of maintenance and construction activities across agencies.

### **3.4.3 Advanced Public Transportation Systems**

For Advanced Public Transportation Systems (APTS), several APTS capabilities were identified for deployment, including:

- Equip all buses with Automated Vehicle Location (AVL) so vehicle locations and estimated time of arrivals are available to the general public and to other agencies to support service coordination.
- Improve transit security on transit vehicles and stations.
- Improve coordination with other modes of transportation in the region, including Amtrak, airlines, inter-city buses, and ferries.

### **3.4.4 Advanced Traveler Information Systems**

In the area of Advanced Traveler Information Systems (ATIS):

- Extend the capabilities of TRIPS123, the region's traveler information system. This may include providing traveler information on different modes (all transit agencies, car, park-and-ride, bicycles), and providing real-time transit information. TRANSCOM's Model Deployment Initiative will provide basic and personalized traveler information as well as route assistance for users of the region's public transit systems.
- Investigate the implementation of a 5-1-1 traveler information system for the region.

### **3.4.5 Archived Data Management Systems**

For Archive Data Management Systems (AD):

- Collect regional geographic data from the regional transportation agencies into centralized databases and make the data available on the Internet for authorized users. Such data may include transit ridership, traffic counts and classifications, travel speeds/travel times, and crash data.

### **3.4.6 Emergency Management Systems**

For Emergency Management (EM):

- Install automatic vehicle location (AVL) technologies in emergency response vehicles and add computer aided dispatch (CAD) technologies to enable more efficient dispatching of resources. CAD technologies can also allow for incident information exchange with other agencies and mutual aid coordination.
- Supply emergency vehicles with Mobile Data Terminals (MDTs) for dispatch information and electronic accident reports.
- Continue funding roadway service patrol vehicles, such as the HELP patrols.

### **3.4.7 Commercial Vehicle Operations**

For Commercial Vehicle Operations (CVO):

- Coordinate the credentialing of commercial vehicles across regional and statewide agencies, including HAZMAT, and overheight/overweight vehicles.

## **4 ITS Systems Stakeholders and Inventory**

### **4.1 Stakeholders**

Stakeholder coordination and involvement is one of the key elements in the development of a regional ITS architecture. Because ITS often transcends traditional transportation infrastructure, it is important to consider a range of stakeholders beyond the traditional traffic, transit, and maintenance areas. In addition, it is important to consider stakeholders in adjoining regions.

Each stakeholder agency, company, or group owns, operates, maintains or plans ITS systems in the region. Appendix A identifies the stakeholders and provides a description of the agency, department, or organization represented by the stakeholder.

### **4.2 NYMTC Region Inventory by Stakeholder**

An ITS architecture inventory is a list of “elements” that represent all existing and planned ITS systems in the region as well as non-ITS systems that provide information to or get information from the ITS systems. The focus of the inventory is on those systems that support, or may support, interfaces that cross stakeholder boundaries (e.g., inter-agency interfaces, public/private interfaces). Each element in the inventory is described by a name, the associated stakeholder, a description, general status (e.g. existing or planned), and the associated subsystem(s) or terminator(s) from the National ITS Architecture that most closely describe the function of the element. In addition, a geographic classification will be provided for each inventory item that indicates whether the elements are county-wide, TCC-wide, region-wide, or State.

The complete ITS Systems Inventory by Stakeholder is shown in Appendix B. Appendix B is sorted by stakeholder so that each stakeholder can easily identify all the relevant elements that are allocated to them in the ITS architecture.

### **4.3 NYMTC Region “Sausage Diagram”**

A system interconnect diagram, or sausage diagram, shows the systems and primary types of interconnections in the region. This diagram depicts all the systems identified in the region and mapped to the National ITS Architecture and the potential basic communication channels which may be used between these subsystems. The NYMTC Integration Strategy sausage diagram has been customized based on the information gathered from the stakeholders and the system inventory. The sausage diagram summarizes the existing and planned ITS elements for the region in the context of their physical interconnects. ITS elements identified for the NYMTC region deployments (and their primary associated architecture entity) are called out in the boxes surrounding the central interconnect diagram.

In the center of the figure the rectangles represent the subsystems of the National ITS Architecture. The NYMTC ITS Integration Strategy has elements that map to all 21 subsystems defined. In addition, the Integration Strategy has elements that map to the terminators of the National ITS Architecture (not shown in the figure).

# NYMTC Integration Strategy Report

## NYMTC Region ITS Integration Strategy "Sausage Diagram"

<b>Remote Traveler Support</b> AMTRAK/LIRR/NJ Transit Penn Station Information Displays Long Island Transit Operators Customer Info Systems Mid Hudson South Transit Operators Customer Info Systems MTA LIRR Customer Info Systems MTA LIRR Fare Point of Sale MTA LIRR Security Equipment MTA LIB Customer Info Systems MTA LIB Fare POS MTA LIB Security Equip MTA MNR Customer Info Syst MTA MNR Fare Point of Sale MTA MNR Security Equipment MTA NYCT Bus Security Equipment MTA NYCT Customer Info Systems MTA NYCT Fare Point of Sale MTA NYCT Subway Security Equip MTA Regional Transit Fare POS NYC DOITT Kiosks NYCDOT Division of Ferry Operations Customer Info Systems NYCDOT Franchise Bus Info Syst PANYNJ Airports In-Terminal Customer Information Systems PANYNJ Bus Terminals/Stations In-Terminal Customer Info Systems PANYNJ PATH Fare Point of Sale PANYNJ PATH PATHVISION TRANSCOM Kiosks WC Bee Line Customer Info Syst	<b>Emergency Management (1)</b> AMTRAK Emergency Dispatch FDNY Fire/EMS Dispatch *MTA NYCT Security MTA Police Dispatch / Command Center Municipal/County EOCs Municipal/County Public Safety Dispatch New York City Joint TMC  <b>Archived Data Management</b> *Hudson Valley Traveler ITS Operators Operational DB PANYNJ PAPD 211 Communications Center Operational DB *Long Island ITS Operators Operational DB MTA Bridges/Tunnels OCCCC Special Operations Vehicles *NYC ITS Operators ITS Data Arch *NYMTC Member Agencies Data Collection Systems *NYMTC/DCP Regional Planning Database NYS DMV Accident Reporting Syst NYSDOT Accident Reporting Syst TRANSCOM Archived Data System	<b>Emergency Management (2)</b> NYCDEP Dispatch Center NYCDOT Office of Emergency Response NYCOEM Watch Command Center NYPD 911 Communications Center Dispatch NYPD Dispatch NYPD Operations NYPD TMC NYPD Transit Bureau NYS Police Dispatch NYSDEC Systems PANYNJ PAPD 211 Communications Center Dispatch State EOCs TRANSCOM RA Servers  <b>Toll Administration</b> E-ZPass CSC E-ZPass Reciprocity Network
<b>Personal Information Access</b> Private Travelers Computing Dev TRANSCOM Mobile Comm Devices TRIPS123 Subscriber Systems	<b>Fleet and Freight Management</b> *PANYNJ Port Commerce CARGO*MATE Private Commercial Vehicle and Fleet Dispatch Private Terminal Operators Systems	<b>Information Service Provider (1)</b> Agency Run Traveler Info Syst *E-ZPass CSC Web Site MTA Bridges/Tunnels Web Site MTA LIRR Customer Info Center MTA LIRR Web Site MTA LIB Customer Info Center MTA LIB Web Site MTA MNR Customer Info Center MTA MNR Web Site MTA NYCT Customer Info Center MTA NYCT Web Site *New York State Emergency Road Reporting System NYCDOT Bus Franchise Website
<b>Transit Vehicle</b> Long Island Transit Operators Veh Mid Hudson South Transit Operators Vehicles MTA LIRR Trains MTA LIB Buses MTA LIB Paratransit Buses MTA MNR Trains MTA MetroCard Reader MTA NYCT Buses MTA NYCT Staten Is. Railway Veh MTA NYCT Subway Vehicles NYCDOT Ferry Operations Ferries NYCDOT Franchise Buses/AVL PANYNJ PATH Transit Vehicles NYCDOT Franchise Buses/AVL PANYNJ PATH Transit Vehicles Private Long-Distance Bus Buses Private Paratransit Vehicles WC Bee Line Buses WC Bee Line Paratransit Vehicles	<b>Emergency Vehicle Subsystem</b> FDNY EMS Vehicles FDNY Fire Vehicles MTA Bridges/Tunnels Emergency and Maintenance Vehicles MTA Bridges/Tunnels OCCCC Special Operations Vehicles MTA NYCT Bus Depot Road Service Trucks MTA Police Vehicles Municipal/County Public Safety Veh NYCDOT OER Emergency Vehicles NYCOEM Watch Command Veh NYPD Vehicles NYS Police Vehicles NYS Police Vehicles NYSDOT/NYPD Help Vehicles PANYNJ Tunnels/Bridges/Terminals Emergency Response Vehicles	<b>Information Service Provider (2)</b> NYCDOT Bus Franchise Operators Website NYCDOT Traveler Info Web Site NYCDOT/DCP Parking Infor System NYSDOT Traveler Infor Systems PANYNJ PATH Web Site PANYNJ Port Commerce CARGO*MATE Web Site PANYNJ Port Commerce FIRST Web Site PANYNJ Traveler Info Systems Private ISPs TRANSCOM RA Servers TRIPS123 *WC Bee Line Traveler Info System WC Bee Line Web Site
<b>Vehicle</b> Private Travelers Vehicles	<b>Commercial Vehicle</b> Private Commercial and Fleet Veh	<b>Information Service Provider (2)</b> NYCDOT Bus Franchise Operators Website NYCDOT Traveler Info Web Site NYCDOT/DCP Parking Infor System NYSDOT Traveler Infor Systems PANYNJ PATH Web Site PANYNJ Port Commerce CARGO*MATE Web Site PANYNJ Port Commerce FIRST Web Site PANYNJ Traveler Info Systems Private ISPs TRANSCOM RA Servers TRIPS123 *WC Bee Line Traveler Info System WC Bee Line Web Site
<b>Maintenance &amp; Const Vehicle</b> MTA Bridges/Tunnels Emergency and Maintenance Vehicles Municipal/County PWD Vehicles NYCDOS Vehicles NYCDOT Maintenance Vehicles NYSDOT Maintenance Vehicles PANYNJ Tunnels/Bridges/Terminals Maintenance Vehicles	<b>Maintenance &amp; Const Vehicle</b> MTA Bridges/Tunnels Emergency and Maintenance Vehicles Municipal/County PWD Vehicles NYCDOS Vehicles NYCDOT Maintenance Vehicles NYSDOT Maintenance Vehicles PANYNJ Tunnels/Bridges/Terminals Maintenance Vehicles	<b>Information Service Provider (2)</b> NYCDOT Bus Franchise Operators Website NYCDOT Traveler Info Web Site NYCDOT/DCP Parking Infor System NYSDOT Traveler Infor Systems PANYNJ PATH Web Site PANYNJ Port Commerce CARGO*MATE Web Site PANYNJ Port Commerce FIRST Web Site PANYNJ Traveler Info Systems Private ISPs TRANSCOM RA Servers TRIPS123 *WC Bee Line Traveler Info System WC Bee Line Web Site

<b>Emergency Management (1)</b> AMTRAK Emergency Dispatch FDNY Fire/EMS Dispatch *MTA NYCT Security MTA Police Dispatch / Command Center Municipal/County EOCs Municipal/County Public Safety Dispatch New York City Joint TMC  <b>Archived Data Management</b> *Hudson Valley Traveler ITS Operators Operational DB PANYNJ PAPD 211 Communications Center Operational DB *Long Island ITS Operators Operational DB MTA Bridges/Tunnels OCCCC Special Operations Vehicles *NYC ITS Operators ITS Data Arch *NYMTC Member Agencies Data Collection Systems *NYMTC/DCP Regional Planning Database NYS DMV Accident Reporting Syst NYSDOT Accident Reporting Syst TRANSCOM Archived Data System
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<b>Emergency Management (2)</b> NYCDEP Dispatch Center NYCDOT Office of Emergency Response NYCOEM Watch Command Center NYPD 911 Communications Center Dispatch NYPD Dispatch NYPD Operations NYPD TMC NYPD Transit Bureau NYS Police Dispatch NYSDEC Systems PANYNJ PAPD 211 Communications Center Dispatch State EOCs TRANSCOM RA Servers  <b>Toll Administration</b> E-ZPass CSC E-ZPass Reciprocity Network
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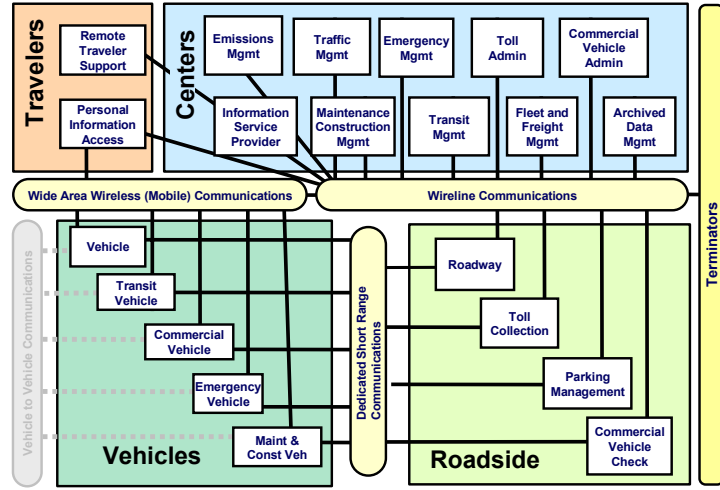
<b>Information Service Provider (1)</b> Agency Run Traveler Info Syst *E-ZPass CSC Web Site MTA Bridges/Tunnels Web Site MTA LIRR Customer Info Center MTA LIRR Web Site MTA LIB Customer Info Center MTA LIB Web Site MTA MNR Customer Info Center MTA MNR Web Site MTA NYCT Customer Info Center MTA NYCT Web Site *New York State Emergency Road Reporting System NYCDOT Bus Franchise Website
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<b>Information Service Provider (2)</b> NYCDOT Bus Franchise Operators Website NYCDOT Traveler Info Web Site NYCDOT/DCP Parking Infor System NYSDOT Traveler Infor Systems PANYNJ PATH Web Site PANYNJ Port Commerce CARGO*MATE Web Site PANYNJ Port Commerce FIRST Web Site PANYNJ Traveler Info Systems Private ISPs TRANSCOM RA Servers TRIPS123 *WC Bee Line Traveler Info System WC Bee Line Web Site
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<b>Maintenance &amp; Construction Management</b> Municipal/County PWD Operations NYCDOS Dispatch NYCDOT Bridge Maintenance NYCDOT OCMC NYCDOT Street and Arterial Maintenance Division NYS Bridge Authority Mid Hudson Bridges Maintenance NYSDOT Construction Operations NYSDOT Maintenance Ops PANYNJ Tunnels/Bridges/Terminals Maintenance Unit  <b>Emissions Management</b> NYCDEP Office of Environmental Analysis
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<b>Commercial Vehicle Admin</b> MTA Bridges/Tunnels Engineers Office MTA Bridges/Tunnels Facility Operations Center MTA Bridges/Tunnels OCCCC NYC DEP HAZMAT Permitting NYCDOT Commercial Vehicle Permits Office *PANYNJ Port Commerce CARGO*MATE *PANYNJ Port Commerce Credentialing Back Office (SEALINK) PANYNJ Port Commerce Operations Centers PANYNJ Tunnels/Bridges/Terminals Communications Desk/Operations Center Private Terminal Operators Systems
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<b>Transit Management Subsystem</b> Long Island Transit Operators Maintenance Long Island Transit Operators Systems Mid Hudson South Transit Operators Maintenance Facilities Mid Hudson South Transit Operators Systems MTA Agencies Transit Maintenance MTA LIRR Fare Mgmt Syst MTA LIRR Maintenance Yards MTA LIRR Operations Center MTA LIB Depot / Garage MTA LIB Fare Mgmt System MTA LIB Fixed Route Bus Ops MTA LIB Paratransit Operations MTA MNR Fare Mgmt Syst MTA MNR Maintenance Yards MTA MNR Operations Center Syst MTA MetroCard Fare Mgmt Syst MTA NYCT Bus Command Center - Operations MTA NYCT Bus Depot Central Road Operations MTA NYCT Bus Depot Central Road Service Unit MTA NYCT Customer Info Center MTA NYCT Fare Mgmt Syst MTA NYCT Paratransit Command MTA NYCT Service Planning MTA NYCT Staten Island Railway Control Facility MTA NYCT Subway Rail Control Center MTA NYCT Subway Yard MTA NYCT Transit Bus Depot Maintenance NJT Bus Operations Systems NJT Fare Mgmt System NJT Rail Operations Systems NYCDOT (Franchise Bus) Systems NYCDOT Division of Ferry Operations Systems NYCDOT Franchise Bus Operators Systems PANYNJ Airports Communications Desk/Operations Center PANYNJ Airports AirTrain Ops Center PANYNJ Airports Communications Desk/Operations Center PANYNJ Bus Terminals/Stations Communications Desk/Ops Center TRANSCOM Other Member / Non-Member Agencies Systems TRANSCOM RA Servers PANYNJ PATH Fare Mgmt System PANYNJ PATH Operations Center PANYNJ PATH Vehicle Maint Private Ferry Operators Systems Private Long-Distance Bus Ops Private Paratransit Operators Regional Transit Fare Reciprocity TRANSCOM Other Member / Non-Member Agencies Systems TRIPS123 WC Bee Line Fare Mgmt System WC Bee Line Operations Center WC Bee Line Transit Maintenance
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<b>Parking Management Subsystem</b> E-ZPass Plus Systems *MTA MNR Parking Facilities NYCDOT Parking Facilities NYCDOT/DCP Parking Facilities NYCDOT/DCP Parking Info System Public & Private Park and Ride Syst
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<b>Toll Collection</b> E-ZPass Plus Systems MTA Bridges/Tunnels Facility Toll Collection Equipment NYS Bridge Authority Mid Hudson Bridges Toll NYSTA Toll Collection Equipment PANYNJ Airports Vehicle Identification Systems PANYNJ Tunnels/Bridges/Terminals Electronic Toll Collection Equipment
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<b>Roadway Subsystem</b> Long Island Municipal/County Field Equipment Mid Hudson South Municipal/County Field Equipment MTA Bridges/Tunnels Facility Field Equipment MTA Bridges/Tunnels Lift Span Control System MTA Bridges/Tunnels Security Equipment MTA LIRR Drawbridge Control Sys MTA MNR Drawbridge Control Sys NYCDEP Environmental Monitoring Stations NYCDOT Drawbridge Control Syst NYCDOT Field Equipment
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<b>Roadway Subsystem</b> NYSDOT R8 Field Equipment NYSDOT R10 Field Equipment NYSDOT R11 Field Equipment PANYNJ Airports Field Equipment PANYNJ Bus Terminals/Stations Field Equipment PANYNJ PATH Vehicle Detection System PANYNJ Port Commerce Field Equipment PANYNJ Tunnels/Bridges/Terminals Field Equipment Private Terminal Operators Roadside Tag Readers TRANSMIT Agencies Field Equip
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<b>Commercial Vehicle Check</b> MTA Bridges/Tunnels Facility Commercial Vehicle Check *PANYNJ Port Commerce Terminal Access Equipment PANYNJ Tunnels/Bridges/Terminals Commercial Vehicle Check Private Terminal Operators Roadside Tag Readers
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\* Elements are *planned/future*, not *existing*.

The diagram also identifies the three basic types of communications used to interconnect the elements of the ITS architecture. These communications types are defined as:

- **Wireline Communications:**  
A communications link serving stationary sources. It may be implemented using a variety of public or private communications networks that may physically include wireless (e.g., microwave) as well as wireline infrastructure. Both dedicated and shared communications resources may be used.
- **Wide Area Wireless Communications:**  
A communications link that provides communications via a wireless device between a user and an infrastructure-based system. Both broadcast (one-way) and interactive (two-way) communications services are grouped into wide-area wireless communications. These links support a range of services including real-time traveler information and various forms of fleet communications.
- **Dedicated Short Range Communications:**  
A wireless communications channel used for close-proximity communications between vehicles and the immediate infrastructure. It supports location-specific communications for ITS capabilities such as toll collection, transit vehicle management, driver information, and automated commercial vehicle operations.

## 5 ITS System Functions and Electronic Information Sharing Expectations

The ITS Integration Strategy defines the transportation services (e.g., control traffic signals, track locations of transit vehicles, disseminate traveler information) that must be provided to satisfy the transportation needs within the region. The U.S. National ITS Architecture was used as a template because it defines some basic user services that a region can provide and what basic information is needed between the various stakeholders and systems to properly provide those user services. Some basic user services and functions described in the U.S. National ITS Architecture include Advanced Traveler Information, Surface Street (Arterial) Control, Demand Responsive Transit, and Commercial Vehicle Operations.

### 5.1 Customized Market Packages

The information sharing expectations and system ITS transportation services have been expressed in terms of the National ITS Architecture market packages in which each element participates. These market packages of the National ITS Architecture were customized to reflect the unique systems and connections in the NYMTC region. Each market package is shown graphically with the market package name, and the market package elements (shown as boxes) identified by the entity from the National ITS Architecture that they represent and the specific instances of NYMTC ITS elements associated with the entity.

Market packages collect together two or more system elements (from the same or multiple stakeholders) that must work together to deliver a given transportation service and the architecture flows that connect them and other important external systems on the boundary of ITS. In other words, they identify the ITS system elements required to implement a particular transportation service.

In the context of an operational concept, market packages provide an expansion on the role of the stakeholder. The customized market packages defined for the NYMTC region were tailored to fit, separately or in combination, to meet the real-world transportation problems and needs of the region. The customized market packages document each stakeholder's current and future roles and responsibilities in the operation of its systems to provide a transportation service for the region. Market packages, customized for the specific consensus requirements, represent the information that may be exchanged between specific stakeholder elements to effect specific sets of user services. As such, they collectively represent the concept of operations for the NYMTC region.

The customized market package diagrams are shown on the NYMTC ITS Integration Strategy web site, and organized by transportation functional area as follows:

- Archived Data Management Systems (AD). These are systems used to collect transportation data for use in non-operational purposes (e.g. planning and research).

- Advanced Public Transportation Systems (APTS). These are systems used to more efficiently manage fleets of transit vehicles or transit rail. This functional area also includes systems to provide transit traveler information both pre-trip and during the trip.
- Advanced Traveler Information Systems (ATIS). These are systems used to provide static and real time transportation information to travelers.
- Advanced Traffic Management Systems (ATMS). These are traffic signal control systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions. This functional area also include systems used to monitor freeway (or tollway) traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. These systems may also provide information to motorists on the roadway.
- Commercial Vehicle Operations (CVO). These are systems used to more efficiently manage commercial fleets, monitor freight movements, hazardous materials movement, safety inspections, and electronic clearance (both domestic and international).
- Emergency Management (EM). These are systems that provide emergency call taking, public safety dispatch, and support emergency operations center operations.
- Maintenance and Construction (MC). These are systems used to manage the maintenance of roadways and equipment in the region, including winter snow and ice clearance, and construction operations.

Incident management systems are generally associated to some degree with several of the transportation functional areas shown above. For example, within the functional area of traffic management (ATMS), a market package exists called ATMS08 - Incident Management; within public transportation (APTS), the Transit Security market package APTS5 exists; and for commercial vehicle operations (CVO), market package CVO10 - HAZMAT Management exists.

Market Package descriptions are included in Appendix C. A complete set of customized market packages is included in Appendix D.

## **5.2 ITS System Interconnects**

For each ITS system identified in the Integration Strategy, one can identify the other systems with which it interconnects. In other words, a list can be created that depicts the connections between one ITS system and other ITS systems. A list of ITS system interconnects on a system-by-system basis is shown in Appendix E.



## **6 Project Identification and Integration Phasing**

### **6.1 Project Identification**

The previous steps of the Implementation Strategy identified the region's transportation needs in terms of customized market packages. Projects can now be derived to implement these customized market packages and provide the transportation services required to meet the region's transportation needs. Each identified project should clearly:

- Contribute to meeting the identified goals of the region
- Contribute to the seamless regional integration of ITS systems
- Support national interoperability by the use of standards, where available.

Projects, for the purposes of the Integration Strategy, are not projects in the traditional sense, that is, a specific scope of work for a specific agency(ies) with a defined budget. Rather, projects are characterized in the Integration Strategy document as a set of interfaces and flows that provide specific transportation services.

The process of identifying projects starts at two points. First, identify potential projects from existing documentation, such as the current TIP or any existing Early Deployment Plans. Potential projects may be the completion or expansion of existing projects or projects previously identified but not completed.

Candidate projects can also be identified by reviewing the customized market packages, which describes the system interfaces and the information flows between the systems required to support the transportation services. Those system interfaces and information flows not already included in existing project scopes should be added as part of new projects.

Each identified project also should be evaluated in terms of anticipated costs and benefits and to determine whether there are any institutional or technical issues that will impede implementation.

### **6.2 Project Sequencing**

The integration of ITS in the region is "implemented" with many individual ITS projects and private sector initiatives that occurs over years, or even decades. Together, these projects and initiatives will require a significant investment by the public agencies and private companies in the region. To most efficiently use this investment and to yield the most benefits to the public up front, it is important to define a sequence, or ordering, to implement ITS projects and systems that will contribute to the integrated regional transportation system.

A good project sequence is dependent on two things:

- Transportation planning factors that are used to prioritize projects (e.g., identify early winners)

- Project dependencies that require successive ITS projects to build on one another.

Transportation planning factors that may affect the project sequence include cost-benefit ratios, technical feasibility, institutional issues, financial constraints and the strategic priorities of the region. These factors may also include data or policy decisions that support the projects. For example, the lack of a common database identifying street names may impede properly sharing road network information, since there is no agreement on how locations are established.

Agency priorities and local priorities also will influence the actual sequencing of projects. Priorities can be established by reviewing the candidate projects and either identifying them as short-, medium- or long- term projects; or by identifying them as High, Medium, or Low priority projects.

High priority projects are those projects that serve the region's, or agency's, immediate needs and goals and are generally identified as short-term projects. For example, public safety, public security, and emergency responses are areas identified as critical goals to the regional plan, thus, projects in these areas or that satisfy these goals can be considered high priority projects. High priority projects may also include "early-winner" projects, that is, those projects that will provide immediate benefits to the region.

Medium priority projects are recommended for implementation between six and ten years in the future. These projects generally build on the existing ITS systems and infrastructure to provide enhanced functionality and expanded geographic coverage.

Low priority projects are recommended for implementation between eleven and twenty years in the future and are intended to complete the comprehensive ITS deployments in the region. Some projects are rated as low priority because the technologies to deploy the desired transportation services are not yet available or prohibitively expensive.

Project dependencies should also be considered when developing a project sequence. Several factors can determine project dependencies.

The most important factor is when deployment of certain transportation services "enables" other transportation services. That is, certain projects and services must be implemented first before other transportation services can be provided because these initial projects and services provide basic functions that must be supported before more advanced functions or capabilities can be implemented.

For example, traffic signal priority for emergency vehicles cannot occur until the traffic signal systems are provided the capability to change signal timing plans, or until the location of the emergency vehicles can be determined. Another example is that incidents cannot be detected or verified until traffic detectors or CCTV cameras are deployed on the roadways. Simultaneously, road network conditions are not available to the traffic agency that operates the roadway, to other traffic agencies, or to the general public, until these traffic detectors or CCTV cameras are deployed.

Another factor is the status of current and planned ITS deployments and the readiness of proposed projects. Specific ITS elements may be deployed simultaneously with other


projects or other ITS elements or when ITS elements can incrementally build on each other, saving money and time as the region invests in future ITS systems. For example, if the construction of a critical roadway link is being designed, the installation of ITS roadway devices should be considered in the design to take advantage of certain efficiencies.

Project dependencies also occur where information flows between different systems are required to satisfy a regional need. In these cases, both systems (one to send the flow, one to receive the flow) must be deployed before the information can be exchanged. Without this flow, the regional need cannot be satisfied.

As each project is identified and sequenced, it should also list all other projects that it is dependent on and describe the nature of the dependency. The dependency description could be a narrative description, a categorization (e.g., functional or information dependency), or both.

### **6.3 Project Priorities**

This section identifies a set of project priorities organized along the functional areas (e.g. ATMS) used in the discussion of ITS Vision. These functional areas are further separated into general transportation services that are desired by the region. For each transportation service, the appropriate ITS Vision elements are identified, along with candidate market packages that address the elements of vision. Existing deployments that provide those services are then listed to provide a comparison of “what has been done” versus “what should be done”, motivating the discussion of project priorities to address the differences.

The customized market package selections identified by user input to support the ITS Vision are then listed. A discussion of the customizing market packages providing the transportation services is given, including how it contributes to satisfying the  transportation need and what enabling transportation services are needed.

Projects are then defined by what transportation services can be packaged together. These projects, packages of services, are prioritized by HIGH, MEDIUM, and LOW. Descriptions on the reasons why a project market package was rated as such are then provided. Certain projects by themselves are not high priorities in terms of the regional plan, but may be ranked as such because they enable other projects or services.

Table 2 indicates what market packages support which general transportation services, and what the priority is. In certain instances, a market package may support more than one specific ITS service with different priorities and the different priorities will be noted as such. The table also summarizes the market package dependencies.

### 6.3.1 Functional Area: ATMS - Advanced Transportation Management Systems

#### Traveler Information and Regional Traffic Control

##### ITS Vision Elements:

- Instrument key highway, arterials, and transit links to monitor real-time roadway network conditions
- Disseminate real-time road network information to the traveling public
- Share real-time road network information with adjacent and other regional relevant operating agencies
- Provide real-time road network information to information service providers so they can provide pre-trip and en-route guidance to their subscribers.

##### Existing Deployments:

- Limited video and detection along key transportation network links.
- The TRANSCOM IRVN (Integrated Regional Video Network) supports sharing of video among agencies.
- NYCDOT ATIS website with CCTV images

##### Candidate Market Packages:

- ATMS01 – Network Surveillance (Sensors and CCTV) – This market package supports the detection of traffic flow conditions on the road network. This is an “enabling” market package for many other traffic management functions, such as incident detection and traffic information dissemination. Deployment of network surveillance technologies provides the basis for information sharing and coordination of the roadway network among agencies.
- ATMS06 – Traffic Information Dissemination (DMS - Dynamic Message Signs, HAR - Highway Advisory Radio) – This market package distributes current traffic information directly to the traveling public, allowing them to select less congested or alternate routes in case of unexpected delays. This is a highly visible market package to the general public.
- ATMS07 – Regional Traffic Control – This market package enables the sharing of traffic information and control with other agencies. The deployment of this market package enables a region’s ability to support different regional control strategies, particularly during incidents and emergencies.
- ATIS1 – Broadcast Traveler Information – This market package collects transportation information and advisories and broadly disseminates the information to the general public. This market package is discussed in more detail elsewhere.

##### Priority:

- Projects supporting network surveillance, dissemination of traveler information and information exchange between traffic management centers provide critical functions and information to all agencies in the region and also provide early, visible benefits to the traveling public. Existing deployments of these systems are limited in scope and capability. The continued deployment and expansion of these systems to support this regional need is a HIGH priority.

- Network surveillance systems provide an enabling technology for other transportation functions and needs, such as incident detection and management, traffic information dissemination, and support of regional traffic network control. Deployment of projects installing network surveillance should be sequenced ahead of or simultaneously with other traffic management projects.
- The dissemination of traffic information provides high visibility and quick benefits for the region. It may also be an important component of the region's traffic control and information sharing strategy, thus projects supporting traffic information dissemination capabilities should be deployed before or simultaneously with projects supporting regional traffic control.
- Systems supporting regional traffic control allow neighboring agencies to share traffic information, and coordinate responses to incidents or other events.

### Probe Monitoring

#### ITS Vision Elements:

- Extend probe surveillance to other highway links and on arterials for use in arterial management
- Utilize AVL on public agency vehicles as probes as a means of traffic monitoring

#### Existing:

- The TRANSMIT system uses E-ZPass equipped vehicles as anonymous probes. The system is currently deployed only on certain freeways and toll roads/crossings.
- Limited deployments of automated vehicle location (AVL) systems on transit vehicles.

#### Candidate Market Packages:

- ATMS02 – Probe Surveillance – This market package enables traffic managers to use probe information to monitor road conditions, detect incidents, and to analyze and reduce the collected traffic flow data. It is an alternative to the network surveillance market package, although each market package also provides additional traffic information that the other market package cannot.
- APTS01 – Transit Vehicle Tracking - This market package monitors transit vehicle locations using Automated Vehicle Location (AVL) systems.
- MC01 – Maintenance and Construction Vehicle Tracking - This market package monitors agency vehicle locations using Automated Vehicle Location (AVL) systems.

#### Priority:

- The deployment of probe surveillance provides important road traffic network information to the region and supplements the road network data collected from the Network Surveillance. Existing deployments of probe surveillance in the region is limited and thus the expansion of the system to include other critical links will provide a more complete, regional view of

the road traffic network. The continued deployment of probe surveillance systems to complete the road network is a HIGH priority.

### Surface Street Control

#### ITS Vision Elements:

- Extend computerized traffic signal systems
- Provide bus signal priority along critical routes
- Provide emergency vehicle priority for emergency response vehicles (fire and rescue).
- Deploy technologies to improve highway-rail intersection safety
- Develop multi-jurisdictional traffic signal coordination

#### Existing:

- Traffic signal control systems deployed in most parts of the region and are operated by an agency, municipality, county, or state. This includes NYCDOT's VTCS computerized traffic signal system.
- Red-Light Camera Enforcement deployed at problem signalized intersections.

#### Candidate Market Packages:

- ATMS03 – Surface Street Control – This market package enables traffic signal systems to implement different control plans and strategies. Full deployment allows agencies to dynamically adjust traffic signals based on current traffic conditions, coordination requests and priority requests. These requests may originate from transit agencies, emergency responders or other traffic agencies in support of a regional control strategy, incident or emergency.
- ATMS07 – Regional Traffic Control – This market package enables the sharing of traffic information and control with other agencies. The deployment of this market package enables a region's ability to support different regional control strategies, particularly during incidents and emergencies.
- APTS7 – Multi-modal Coordination (Bus Priority) - This market package establishes communications between transit and traffic agencies to support bus priority for transit vehicles at traffic signals along critical routes when transit vehicles deviates from its schedule. Deployment of these systems enables transit vehicles to continue on their routes traffic signal priority until it adheres to its schedule again.
- EM2 - Emergency Routing (Emergency Vehicle Preemption) – A portion of this market package allows emergency vehicles to request traffic signal priority along its selected route, either by directly communicating with the traffic signals, or with the traffic management center via its emergency management center.
- ATMS13 – Standard Railroad Grade Crossing – This market package manages roadway traffic at highway-rail intersections (HRIs). Warning systems deployed with this market package can be interconnected with adjacent signalized intersections so that local traffic signal control can be coordinated with highway-rail intersection activities. These systems improve public safety at these intersections and provide road traffic

information to traffic agencies for traffic coordination and to travelers for alternate route selection.

- ATMS14 – Advanced Railroad Grade Crossing – This market package is similar to the Standard Railroad Grade Crossing market package but with additional features to support high speed rail.
- ATMS15 – Railroad Operations Coordination - This market package provides strategic coordination between rail operation centers and traffic management centers. Rail operation centers provide train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures to the traffic management centers. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.
- ATMS20 – Drawbridge Management – This market package supports systems managing roadway drawbridges at rivers and other multimodal crossings. These systems may include managing control devices (e.g., gates, warning lights, dynamic message signs) at the drawbridge as well as the information systems that keep travelers and other agencies apprised of current and forecasted drawbridge status. These information systems can also be used to coordinate road traffic in the area surrounding the drawbridge and for alternate route selection.

Priority:

- Basic surface street control is critical to managing arterial traffic in this region and the continued deployment and expansion of these systems will enable more advanced control and control strategies. Thus, projects that include the deployment of these control systems are ranked as HIGH priorities. However, some of these identified transportation needs are vital to public safety at a low number of locations, and have limited benefits to the region or regional traffic network as a whole. These market packages are ranked as MEDIUM priority.
- Surface street control is critical to the movement of vehicles within the region. Although basic control of the traffic signals exists, the region needs projects to expand the traffic signal control systems to remote areas of the region not under centralized control and to add enhancements that enable other advanced functions, including support of emergency and transit priority. Projects to support the continued deployment of these systems are a HIGH priority.
- The deployment of systems supporting exchange of information and data, including video data, between traffic management centers is important to allow traffic agencies to share information about the road traffic network and to support traffic coordination between neighboring agencies. These functions are a key component of the region's goal to implement regional control strategies, and thus projects supporting these systems are a HIGH priority.
- Providing bus priority at traffic signals for transit vehicles, particular for schedule adherence, is very desirable. However, bus priority in the region is not critical to the smooth operation of the region's transportation network or transportation goals, and may in fact disrupt the road traffic network. Thus, projects deploying these technologies are a MEDIUM

- priority and should be sequenced after or simultaneously with projects that enhances the capabilities of the traffic signal control systems.
- Providing emergency vehicles with traffic signal priority during emergencies or incident responses is very desirable. Even though this capability may disrupt the road traffic network, emergency response and public safety is a key goal for the region. Projects deploying emergency vehicle signal priority in more remote areas are a HIGH priority, and only a MEDIUM priority in more congested areas where traffic flow will be significantly disrupted when priority is provided. These projects should be sequenced after or simultaneously with projects that enhances the capabilities of the traffic signal control systems.
  - Deploying railroad grade crossing systems are important to the region for public safety reasons and for proper traffic coordination in the immediate areas around these crossings. Projects continuing the deployment and expansion of such warning and safety systems are a HIGH priority.
  - Coordination between railroad operations centers and traffic management centers provide limited immediate benefits to this region. The number of railroad grade crossings in the region is relatively small and the railroad grade crossing systems provide the required public safety technologies. The deployment of railroad operations coordination systems is a LOW priority.
  - The existing deployments of drawbridge management systems are sufficient for basic control of these roadways. Future projects deploying drawbridge management systems should include supporting the collection and distribution of information to other agencies and travelers for traffic coordination and route diversion purposes. However, the disruption of drawbridges to the transportation network in this region is generally limited to specific areas and is of short duration. For these reasons, projects supporting the expansion of drawbridge management systems to support information dissemination are a MEDIUM priority.

### Highway Control

#### ITS Vision Elements:

- Manage traffic flow on limited access roadways (enforce vehicle restrictions, ramp metering, dynamic speed limits).
- Manage High-Occupancy Vehicle and reversible lanes (detect number of occupants, lane control system).
- Inform the public of road traffic network conditions.

#### Existing:

- Some deployments of ramp metering systems on limited-access roadways in the region.
- Lane Use Control systems deployed throughout the region, including some systems which are also used for reversible lane management.
- Limited deployments of High Occupancy Vehicle (HOV) systems for dedicated HOV lanes.
- Video images of highways available to the public on the Internet and on public access cable channels.



Candidate Market Packages:

- ATMS04 – Freeway Control (Ramp Meters, Lane Controls) – This market package supports ramp metering control systems and lane control systems on limited-access roadways. These systems allow traffic management agencies to control access to and on these roadways. This market package enables the ability to implement regional traffic control strategies on highways.
- ATMS05 – HOV Lane Management - This market package manages HOV lanes by coordinating HOV lane usage signals and access controls. The deployment of this market package provides timely and efficient control and operations of the HOV lanes and status information to traffic management agencies and travelers.
- ATMS06 – Traffic Dissemination (DMS and HAR Control) – This market package distributes current traffic information directly to the traveling public, allowing them to select alternate routes in case of unexpected delays. This is a highly visible market package to the general public and could provide direct benefits to the public.
- ATMS18 – Reversible Lane Management – This market package supports the management of reversible lane facilities. It includes physical lane access controls, sensors that detect wrong-way vehicles, and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes.

Priority:

- The deployment of these highway-related systems provides basic controls and monitoring of the highways in the region. These systems enable agencies to implement regional control strategies and to more efficiently use these highways by allocating their limited resources as travel demands warrant it. These systems also enhance public safety by continuously monitoring safety control equipment for problems. Projects that deploy these basic highway control systems are a HIGH priority for the region.

Incident Management

ITS Vision Elements:

- Build on broader monitoring (e.g. TRANSMIT and video monitoring) capabilities to enhance incident identification and verification.
- Enhance incident response coordination, including IIMS.

Existing:

- TRANSCOM - Region-wide/multi-modal Incident Reporting
- NYCDOT's Computerized Area Tracking System (CATS) and (MICE). Used for incident tracking in New York City
- Limited deployments of NYPD Highway Patrol vehicles equipped with NYSDOT's IIMS (Integrated Incident Management Systems).
- NYCDOT Emergency Response field units

Candidate Market Packages:

- ATMS06 – Traffic Information Dissemination (DMS and HAR) - This market package distributes current traffic information directly to the traveling public, allowing them to select less congested or alternate routes in case of unexpected delays. This is a highly visible market package to the general public and could provide direct benefits to the public.
- ATMS07 – Regional Traffic Management (Coordination between Traffic Management Centers) – This market package enables the sharing of road network information with other traffic management centers for coordination purposes. The deployment of this market package enables a region's ability to support different regional control strategies, particularly during incidents and emergencies.
- ATMS08 – Incident Management – This market package allows traffic agencies to manage unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. These systems provide incident detection and incident monitoring capabilities through roadside surveillance devices, and the capability to collect and correlate incident information to detect and verify incidents. This information is used to implement an appropriate response, generally in coordination with emergency responders, maintenance and construction personnel, and other incident response personnel.
- EM1 – Emergency Response - This market package includes equipment used to receive and route emergency calls, and that enable safe and rapid deployment of appropriate resources to an emergency. The equipment may be located on the roadside, emergency vehicles, or emergency management centers. These systems support emergency notification and coordinated responses between agencies.
- EM2 – Emergency Vehicle Routing – This market package supports the dynamic routing of emergency vehicles based on current road network conditions and other information provided by traffic agencies. The market package also includes traffic signal priority along selected routes. Deployment of these systems allows emergency vehicles to reach its destination in the shortest time based on the current traffic network conditions and the current traffic signal control strategy.

Priority:

- The detection, confirmation and management of incidents, and the coordination between agencies in response to these incidents, is critical to smooth operation and management of the region's road traffic network. Some elements of these systems have been deployed or are in the process of being deployed in existing projects. However, projects that have deployed these systems have limited coverage and capabilities. The region needs projects that deploy these systems on critical links that currently do not have these systems and enhance the reliability and capabilities of existing systems. Projects deploying and enhancing these incident management systems are a HIGH priority.
- Supporting the dynamic routing of emergency vehicles based on its current location and current road network conditions generally results in improved response times to emergencies and incidents. However, the technologies to support this capability are costly at this time and the

benefits to the region are limited when compared to other current transportation needs and goals. Projects deploying these capabilities are a MEDIUM priority for the region. Enhancements to the traffic signal control systems are an enabling technology.

### Electronic Toll Collection

#### ITS Vision Elements:

- Expand regional standards for electronic payment to other business areas.

#### Existing:

- E-ZPass has reduced toll plaza delay for users.
- E-ZPass Plus with parking used for parking at airports and other locations
- Free flow non-barrier toll collection

#### Candidate Market Packages:

- ATMS10 – Electronic Toll Collection - This market package provides toll operators with the ability to collect tolls electronically and detect and process violations. Vehicle tags of toll violators are read and electronically posted to vehicle owners. Regional standards, inter-agency coordination, and financial clearinghouse capabilities enable regional interoperability for these services. The toll tags and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities.

#### Priority:

- The deployment of electronic toll collection in the region has improved traffic flow on toll highways and crossings and provided customer convenience in other electronic payment applications. Continued deployment, improvements, and expansion of electronic payments are a HIGH priority.

### Emission Monitoring

#### ITS Vision Elements:

- Decrease emissions due to traffic congestion.

#### Existing:

- None.

#### Candidate Market Packages:

- ATMS11 – Emissions Monitoring and Management - This market package monitors vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to an emissions management system for processing. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

#### Priority:

- The deployment of emissions monitoring systems is important to track progress of transportation demand management programs and for public

safety purposes. Continued deployment of these systems is a MEDIUM priority.

### Parking Management

ITS Vision Elements:

- Track the availability of parking space
- Advise and guide travelers to available parking spaces
- Create incentives to reserve parking that will clear vehicles off the streets more quickly than “looking for parking”
- Deploy area parking management systems (for special events)
- Expand agency parking programs and encourage use of electronic payment cards

Existing:

- Commercial parking program for on-street and municipal parking (“Muni-meter”)
- E-ZPass Plus at regional airport parking lots

Candidate Market Packages:

- ATMS16 – Parking Facility Management - This market package provides enhanced monitoring and management of parking facilities. It assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. It collects current parking status and shares this data with traffic management centers and information service providers.

Priority:

- The deployment of parking facility management is a component of the regional strategy to decrease traffic congestion. Parking facility management systems can be used to inform travelers where parking is available. This will reduce congestion as drivers are informed of where parking spaces are and are not available, instead of blindly searching for available parking spaces, particularly where none exists. Deployment of these capabilities is a MEDIUM priority.
- The acceptance and deployment of a regional electronic payment instrument (E-ZPass) has improved customer convenience at parking garages and other business areas. Continued deployment of electronic payment markets to other garages and other business areas is a MEDIUM priority for the region.

### **6.3.2 Functional Area: MCO - Maintenance and Construction Operations**

#### Maintenance and Construction Vehicle Tracking

ITS Vision Elements:

- Generate and track maintenance tickets
- Monitor vehicle and equipment status and schedule preventive vehicle and equipment maintenance

- Deploy AVL (automated vehicle location) technologies for maintenance and construction vehicles to support more effective dispatching of resources.

Existing:

- None.

Candidate Market Packages:

- MC01 – Maintenance and Construction Vehicle Tracking - This market package tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities include ensuring the correct roads are being plowed and work activity is being performed at the correct locations. This market package also enables computer aided dispatching (CAD) of maintenance and construction vehicles, allowing for more efficient deployment of available resources.
- MC02 – Maintenance and Construction Vehicle Maintenance - This market package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle maintenance.

Priority:

- The deployment of vehicle tracking technologies on maintenance and construction vehicles provides multiple benefits to an agency and to the region. These technologies support computer aided dispatching, probe surveillance, and tracking the effectiveness of work and maintenance plans. Deployment of these technologies is a MEDIUM priority.
- The deployment of vehicle maintenance technologies is a LOW priority.

### Road Weather Maintenance

ITS Vision Elements:

- Deploy roadway sensors to collect roadway environmental conditions.
- Deploy anti-icing equipment on bridges and other roadways.
- Improve the efficiency of snow removal operations by deploying technologies such as automated tracking of vehicles and vehicle on-board devices to monitor resources (e.g., chemicals, sand).

Existing:

- NYSDOT's Road Weather Information System (RWIS) Network
- NYCDOT's Brooklyn Bridge anti-icing system
- Road Weather Information Dissemination (e.g., TRANSCOM's "Snow Operations Report")
- MTA Bridges and Tunnels Weather Recording System

Candidate Market Packages:

- MC03 – Road Weather Data Collection - This market package collects current road and weather conditions using environmental sensors

deployed on and about the roadway and enables the distribution and processing of this information. These conditions can also be collected from sensors installed on maintenance and construction vehicles.

- MC04 – Weather Information Processing and Distribution - This market package processes and distributes the environmental information collected from the Road Weather Data Collection market package. This market package uses the environmental data to detect hazards such as icy road conditions, high winds, dense fog, etc., so system operators can make decisions on corrective actions to take. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers, and aid operators in scheduling work activity.
- MC05 – Roadway Automated Treatment - This market package automatically treats a roadway section based on environmental or atmospheric conditions. The market package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated. Treatments may include fog dispersion, anti-icing chemicals, etc.
- MC06 – Winter Maintenance - This market package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package also monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.

Priority:

- The deployment of basic road weather technologies detecting dangerous environmental conditions and distributing that information so corrective action can be taken is important to the safe operation of the roadway network. Thus, projects deploying roadway weather collection sensor and weather information processing and distribution systems are a HIGH priority. The deployment of roadway weather collection sensors enables the weather processing and distribution systems, and should be sequenced before or simultaneously with projects deploying weather information processing and distribution systems.
- Deployment of roadway automated treatment systems at remote locations difficult for roadway maintenance crews to reach or where there is a history of problems may be important to public safety. The deployment of these technologies is a MEDIUM priority.
- Winter maintenance systems support the corrective actions and responses after hazards related to winter or environmental conditions have been identified. The deployment of these support systems is a MEDIUM priority.

Roadway Maintenance and Construction Activity

ITS Vision Elements:

- Track roadway maintenance operations

- Improve coordination and scheduling of maintenance and construction activities across agencies
- Continue expansion of the uses of the NYC Base Map (GIS)

Existing:

- NYCDOT Office of Construction and Maintenance Coordination tracking system
- TRANSCOM Regional Architecture

Candidate Market Packages:

- MC07 – Roadway Maintenance and Construction - This market package supports scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. This market package provides systems that support maintenance services such as hazard removal, routine maintenance activities, and repair and maintenance of roadway equipment. Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.
- MC10 – Maintenance and Construction Activity Coordination – This market package supports the dissemination of maintenance and construction activity to other centers to coordinate scheduling, roadway closures and route diversions, and to information service providers for dissemination of this information to travelers.

Priority:

- The deployment of roadway maintenance systems assists agencies to efficiently dispatch maintenance crews where they are most needed. Although deployment of these systems is important to individual agencies, from a regional perspective, the deployment of these systems is a MEDIUM priority.
- The dissemination of maintenance and construction activities to other agencies is important for regional traffic coordination. The deployment of this capability is a HIGH priority.

### Work Zone Management

ITS Vision Elements:

- Improve work zone safety
- Automate safety detection and alarms for work zone intrusion

Existing:

- Coordination and information dissemination about construction work zones

Candidate Market Packages:

- MC08 – Work Zone Management - This market package directs activities in work zones, controlling traffic through portable dynamic message signs and keeping other groups informed of activities for coordination purposes. This market package enables Work Zone Safety Monitoring.
- MC09 – Work Zone Safety Monitoring – This market package includes systems that improve work crew safety and reduce collisions between the

motoring public and maintenance and construction vehicles. This market package detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment or other potential safety hazards.

Priority:

- The distribution of information regarding the activities of the work zone is important to the regional coordination of the road network. The deployment of these work zone management systems is a MEDIUM priority.
- The technologies to support safety monitoring of work zones are not currently available, so this market package is a LOW priority.

### **6.3.3 Functional Area: APTS - Advanced Public Transportation Systems**

#### Transit Operations and Transit Information Dissemination

ITS Vision Elements:

- Equip all transit vehicles with Automated Vehicle Location (AVL) systems.
- Install Computer Aided Dispatch (CAD) systems.
- Supply transit vehicle locations and ETAs (estimated time of arrival) to other transit operator systems.
- Provide bus/train ETAs to travelers on the Internet and other traveler information access devices.
- Display real-time arrival and departure information at subway and multimodal stations and bus stops.
- Provide pre-trip planning services.

Existing:

- Traveler information kiosks
- Subway/multimodal stations and in-terminal information displays of arrival/departure information
- TRIPS123

Candidate Market Packages:

- APTS1 – Transit Vehicle Tracking - This market package tracks the location of transit vehicles using AVL technologies to determine real time schedule adherence and update the transit system's schedule in real-time. This is an enabling market package for transit support systems, transit agency coordination, and dissemination of transit information to transit users.
- APTS2 – Transit Fixed-Route Operations - This market package performs vehicle routing and scheduling, automatic driver assignment and system monitoring for fixed-route transit services. This service determines current schedule performance using location data and provides data to transit information displays. This market package also exchanges static and real time transit data with information service providers, where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.
- APTS3 – Demand Responsive Transit Operations - This market package performs vehicle routing and scheduling as well as automatic driver assignment and monitoring for demand responsive transit services. This



package monitors the current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. This service includes the capability for a traveler request for personalized transit services to be made through the information service providers, which may be operated by a transit agency.

- APTS7 – Multimodal Coordination - This market package establishes communications between transit and traffic agencies to improve service coordination, such as bus priority for transit vehicle at traffic signals along critical routes when transit vehicles are behind schedule.
- APTS8 – Transit Traveler Information - This market package provides transit users at transit stops and on-board transit vehicles with access to real-time transit information, including transit stop annunciation, imminent arrival signs, and transit schedule displays. This market package also includes systems providing custom transit trip itineraries and other tailored transit information services.

Priority:

- Transit vehicle tracking systems and technologies are enablers for other transit operating systems, including dissemination of real-time transit traveler information and regional transit coordination. The deployment of transit vehicle tracking technologies is a HIGH priority.
- Transit fixed-route systems and demand-responsive systems support the efficient routing and scheduling of transit vehicles. These systems also provide static and real-time transit data to other systems, including the general public. The priority for deploying these systems is a MEDIUM priority.
- The ability to coordinate between transit and traffic agencies to improve transit service is an important function for the region, but is not critical to meeting the region's goals. The deployment of systems to support this function is a MEDIUM priority and should be sequenced after or simultaneously with projects that enhances the capabilities of the traffic signal control systems.
- Systems to provide transit users at transit stops and on transit vehicles real-time transit information is highly visible and provides measurable benefits to transit users. Projects deploying these systems contribute to meeting the region's transit goals, and thus, the continued deployment and expansion of these technologies is a HIGH priority.

Transit Passenger and Fare Management

ITS Vision Elements:

- Integrate a regional fare payment card between the regional transit agencies.

Existing:

- Metrocard has enabled the use of new fare policies and resulted in dramatic increase in transit ridership

Candidate Market Packages:

- APTS4 – Transit Passenger and Fare Management - This market package manages passenger loading and fare payments on-board vehicles using electronic means. Systems on the transit vehicle permit the driver and central operations to determine vehicle loads. Data can be processed, stored, and displayed on the transit vehicle and communicated as needed to the transit centers.

Priority:

- The basic deployment of transit fare management systems in the region provides benefits to the transit agencies in the area of planning, scheduling and transit fare policies. These systems also benefits travelers, because of more efficient transit scheduling. A regional fare payment instrument provides direct benefits to transit users, not unlike the electronic toll collection technologies. The deployment of transit fare management systems is a MEDIUM priority.

Transit Security

ITS Vision Elements:

- Equip transit facilities and stations with audio/video monitoring
- Deploy additional security sensors, including video monitoring onboard transit vehicles

Existing:

- Silent alarm and acknowledge, and AVL (to determine bus/incident location)

Candidate Market Packages:

- APTS5 – Transit Security - This market package provides for the physical security of transit passengers. These security systems perform surveillance of transit facilities (such as transit stops and stations) and transit vehicles and warn of potentially hazardous situations. Security related information may be transmitted from the transit management center and to an emergency responder when an emergency is identified.

Priority:

- Transit security is important to the safety of the traveling public. The continued deployment of transit security systems in this region is a HIGH priority. Installing AVL systems on transit vehicles may be an enabling technology.

Transit Vehicle Maintenance

ITS Vision Elements:

- Deploy preventive vehicle maintenance systems, including automated monitoring of vehicles, trouble ticket generation, and scheduling of routine maintenance as needed

Candidate Market Packages:

- APTS6 – Transit Vehicle Maintenance - This market package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the transit management center or transit maintenance facilities. Maintenance systems process this data and schedule preventative and corrective maintenance.

Priority:

- Transit maintenance is important to the safety of the traveling public. The deployment of systems to monitor vehicle system status is important to the safety of transit users and is a HIGH priority. The deployment of maintenance systems to schedule maintenance is not critical to the efficient movement of transit users in the region and is a MEDIUM priority.

Multi-Modal Coordination

ITS Vision Elements:

- Provide transit priority where appropriate
- Coordinate with other modes of transportation (Amtrak, Airline Schedules, Inter-city Bus, Ferries, Helicopters)

Candidate Market Package:

- APTS7 – Multi-modal Coordination - This market package establishes communications between transit agencies, and between transit agencies and other modes of transportation. Multimodal coordination between transit agencies and other modes of transportation can increase traveler convenience at transfer points and also improve operating efficiency.

Priority:

- Coordination between transit agencies and with other modes of transportation yields significant, visible benefits to the traveling public. The deployment of systems to support such coordination is a HIGH priority, although it is not as critical as other enabling technologies such as transit vehicle location.

**6.3.4 Functional Area: ATIS - Advanced Traveler Information Systems**

Traveler Information

ITS Vision Elements:

- Extend traveler information systems in the region to all modes of transportation (all transit agencies, car, park-and-ride, walk, bike).
- Extend the capabilities of TRIPS123 by interfacing with private sector ISPs and providing additional types of information such as improved quality of information, more agencies and in more geographic locations.
- Provide dynamic routing and updated transit trip information.

Existing:

- Online multimodal transportation planning (TRIPS 123) for many transit agencies (schedule and cost information).
- Ride Sharing and Park-and-Ride Systems.

Candidate Market Packages:

- ATIS1 – Broadcast Traveler Information - This market package collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, and weather information, and broadly disseminates this information through wide area broadcast services. Agencies provide this information directly to travelers or to traveler services. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.
- ATIS2 – Interactive Traveler Information - This market package provides tailored travel information in response to a traveler request. The market package supports both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile. A variety of interactive devices are available by travelers to access information prior to a trip or en route including phone, kiosk, personal digital assistants, personal computer, and a variety of in-vehicle devices.
- ATIS5 – ISP Based Route Guidance - This market package offers pre-trip route planning and turn-by-turn route guidance services to travelers. Routes may be based on static information or reflect real time network conditions. The package includes data communications with vehicles and optionally equips the vehicle with the databases, location determination capability, and display technology to support turn by turn route guidance.

Priority:

- One of the key regional transportation goals is to provide travelers with faster and more accurate transportation information, so travelers can make informed decisions. Providing this information allows travelers to use the transportation network more efficiently, reducing travel delay times and improving productivity. Deploying systems that collects traveler information and broadcasts it, reaches a wide audience and has low costs, is therefore a HIGH priority for the region. Deploying systems that provides customized traveler information also provide high benefits for the region, but reaches a smaller audience and higher costs, and therefore is a MEDIUM priority for the region.
- Systems providing route guidance offers the most benefits to non-commuters in general, and to commuters during congestion. However, deploying these systems at this time has a higher cost, is dependent on the availability of road network conditions, and reaches a limited audience. Deployment of route guidance systems are a MEDIUM priority at this time.

### 6.3.5 Functional Area: AD - Archived Data

#### Operational Data Archives

##### ITS Vision Elements:

- Collect regional geographic data and provide access on the Internet for authorized users
- Collect regional traffic data, including traffic counts and classification, travel speeds and travel times, and commercial vehicle counts for planning purposes
- Gather transit ridership data and other performance measures for reporting purposes
- Accumulate transportation safety data, including crash (incident) data for mitigation and enforcement purposes

##### Existing:

- NYMTC/NYCDOP Regional Planning Database

##### Candidate Market Packages:

- AD1 – ITS Data Mart - This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This archive includes data covering a single transportation mode and jurisdiction collected from an operational data store and archived for future use. This market package enables the systems for the ITS Data Warehouse market package.
- AD2 – ITS Data Warehouse - This market package includes all the data collection and management capabilities provided by the ITS Data Mart, but adds the functionality and interfaces that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. This market package also enables the Virtual Data Warehouse market package.
- AD3 – Virtual Data Warehouse - This market package provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse market package, but also provides seamless access to data archives physically located at another remote location.

##### Priority:

- The collection of transportation archive data is important to the transportation planning process for the region. This data provides the details and basis for transportation planners to project areas where further improvements and enhancements in the regional transportation network are needed. Basic archiving of transportation data already exists in the region, however projects supporting enhancements and new tools to efficiently access the transportation data from multiple modes and agencies are needed and are a MEDIUM priority.

### 6.3.6 Functional Area: EM - Emergency Management

#### Emergency Response and Vehicle Routing

##### ITS Vision Elements:

- Deploy AVL technologies on emergency vehicles
- Supply emergency vehicles with Mobile Data Terminals (MDTs) or other integrated messaging systems for dispatch, accident reports (including images), etc.
- Support information exchange and mutual aid coordination between public safety, transportation and other relevant public works agencies.

##### Existing:

- NYCDOT CATS/MICE, NYSDOT IIMS, Computer Aided Dispatch (CAD), and TRANSCOM

##### Candidate Market Packages:

- EM1 – Emergency Response - This market package includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. This market package also supports coordination and responses between public safety agencies, and emergency notification.
- EM2 – Emergency Vehicle Routing – This market package supports automated vehicle location systems on emergency vehicles and allows emergency responders to collect current road network traffic conditions from traffic management centers. The market package also supports traffic signal priority along selected routes, route guidance, and dynamic route guidance. Supporting AVL systems and sensors is an enabling technology for other emergency services and market packages, including emergency response coordination, computer aided dispatch, route guidance, and probe surveillance.

##### Priority:

- The ability to coordinate between various public safety agencies and emergency responders is critical to public safety in all regions. Systems supporting this coordination allow a region to quickly dispatch the correct resources to an incident, mitigate life-threatening situations and reduce traffic delays as quickly as possible. The continued deployment and expansion of these projects and capabilities is a HIGH priority.
- Deploying AVL systems and technologies on emergency vehicles is an enabling technology for other transportation and response-related functions, such as probe surveillance and computer aided dispatching of emergency vehicles. Providing current road network information from traffic management centers to emergency responders is also an enabling technology for other functions including computer aided dispatching and route guidance. Projects supporting the deployment of AVL and the exchange of road network conditions are a HIGH priority for the region.
- Systems supporting route guidance of emergency vehicles and traffic signal priority for emergency vehicles require the deployment of other enabling technologies. The deployment of these systems is a MEDIUM

priority, and should occur after the deployment of systems supporting AVL on emergency vehicles, exchange of information with traffic management centers, and expansion of the traffic signal systems to provide traffic signal priority.

#### Roadway Service Patrols

##### ITS Vision Elements:

- Deploy automated vehicle location sensors on roadway service patrol vehicles
- Supply roadway service patrol vehicles with Mobile Data Terminals (MDTs) for dispatch

##### Existing:

- HELP vehicles on NYSDOT highways

##### Candidate Market Packages:

- EM4 – Roadway Service Patrols - This market package supports roadway service patrol vehicles that monitor roadways which are critical to the regional roadway network or that typically have incidents. These vehicles provide rapid response to minor incidents and to motorists, including pushing vehicles to a safe location while minimizing the vehicle's disruption to the traffic flow.

##### Priority:

- The deployment of roadway service patrols in the region is very successful, with visible and measurable benefits to the region's road transportation network and to the traveling public. Continued deployment and support for this program is a HIGH priority.

### **6.3.7 Functional Area: CVO - Commercial Vehicle Operations**

#### Fleet and Freight Management

##### ITS Vision Elements:

- None.

##### Existing:

- None.

##### Candidate Market Packages:

- CVO01 – Fleet Administration – This market package provides services to manage commercial vehicle fleets. Services provided by this market package includes route guidance, vehicle location systems, on-board vehicle sensors, and processing requests for assistance or road network information.
- CVO02 – Freight Administration – This market package tracks the movement of cargo and monitors the cargo condition. Interconnections are provided to intermodal freight shippers and intermodal freight depots for tracking of cargo from source to destination.

Priority

- Fleet and freight administration systems provide important services and information for private companies regarding the transport of goods and cargo. These services include tracking the location of HAZMAT vehicles, and the ability to monitor its cargo. The deployment of services to monitor HAZMAT vehicles and its cargo are prohibitively expensive, but is critical to public safety, and therefore is a MEDIUM priority. These services may be an enabling technology to support certain HAZMAT services (See HAZMAT).
- Other services provided by fleet and freight administration systems are deployed by private transport companies to improve efficiencies in their operations, with some assistance from public agencies. The deployment of these services using public funds is a LOW priority.

Regional CVO Services

ITS Vision Elements:

- Provide seamless credentialing through the region.

Existing:

- FIRST (PANYNJ)
- NYCDOT provides e-Permits and Commercial Vehicle permits.
- MTA and PANYNJ require permits to overheight/overweight vehicles.
- Other county or municipal credentialing that might not be managed by NYSDOT.

Candidate Market Packages:

- CVO03 – Electronic Clearance - This market package provides for automated clearance at roadside check facilities. The roadside check facility retrieves snapshots of critical carrier, vehicle, and driver data from the commercial vehicle administration systems to sort passing vehicles. The roadside check facility may be equipped with Automated Vehicle Identification (AVI), weighing sensors, transponder read/write devices and computer workstations.
- CVO04 – CV Administrative Processes - This market package provides electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in the electronic clearance program which allows commercial vehicles to be screened at mainline speeds at roadside check facilities. Current profile databases are maintained and snapshots of these profiles are made available to the roadside check facilities to support the electronic clearance process.
- CVO06 – Weigh-In-Motion - This market package provides for high speed weigh-in-motion with or without automated vehicle identification (AVI) capabilities. This market package provides the roadside equipment that could be used as a stand-alone system or to augment electronic clearance functions.



Priority

- Commercial Vehicle Operations is important to the economic development and vitality of the region. The ability to efficiently register, identify and clear commercial vehicles their cargo, results in significant cost savings to the freight companies, agencies and to the general public (in travel time). Thus, the deployment of commercial vehicle administration systems and electronic clearance technologies is a HIGH priority.
- Weigh-In-Motion is an important component of the electronic clearance process, but the available existing technologies are prohibitively expensive and difficult to maintain. The deployment of weigh-in-motion technologies is a MEDIUM priority for the region.

HAZMAT

ITS Vision Elements:

- Track HAZMAT vehicles/cargo across jurisdictions.

Existing:

- NYCDEP provides HAZMAT permits
- Other county or municipal credentialing that might not be managed by NYSDOT

Candidate Market Packages:

- CVO10 – HAZMAT Management - This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. The commercial vehicle company or the commercial vehicle itself, notifies emergency responders if a potential incident occurs or is detected. The response is tailored based on information provided as part of the original incident notification or derived from supplemental information provided by the commercial fleet company. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

Priority

- HAZMAT management is critical to public safety in the region and is a HIGH priority. The deployment of the appropriate services in a region or state is dependent on the regional polices on handling HAZMAT incidents, and may require other enabling functions, systems, or technologies. For example, automatic HAZMAT tracking of vehicles and freight may be a requirement of the region, and that is an enabling technology for HAZMAT management for the region.

**Table 2. Project Sequencing**

Market Package	Advanced Traffic Management Systems							Maintenance and Construction Operations				Advanced Public Transportation Systems					ATIS	Archived Data	Emergency Management		Commercial Vehicle Operations			Market Package Dependencies	
	Traveler Information and Regional Traffic	Probe Monitoring	Surface Street Control	Highway Control	Incident Management	Electronic Toll Collection	Emissions Monitoring	Parking Management	M&C Vehicle Tracking	Road Weather Maintenance	Road Maint. & Construct. Activity	Work Zone Management	Transit Operations & Info. Dissemination	Transit Passenger & Fare Management	Transit Security	Transit Vehicle Maintenance	Multi-Modal Coordination	Traveler Information	Operational Data Archive	Emergency Response & Vehicle Routing	Road Service Patrols	Fleet and Freight Management	Regional CVO Services		HAZMAT
H = High Priority M = Medium Priority L = Low Priority H/M = High/Medium Priority* M/L = Medium/Low Priority*																									
ATMS01 - Network Surveillance	H																								
ATMS02 - Probe Surveillance		H																							
ATMS03 - Surface Street Control			H																						
ATMS04 - Freeway Control				H																					
ATMS05 - HOV and Reversible Lane Management				H																					
ATMS06 - Traffic Information Dissemination	H			H	H																				ATMS01
ATMS07 - Regional Traffic Control	H		H		H																				ATMS01, ATMS06
ATMS08 - Incident Management System					H																				
ATMS10 - Electronic Toll Collection						H																			
ATMS11 - Emissions Monitoring and Management							M																		
ATMS13 - Standard Railroad Grade Crossing			H																						
ATMS14 - Advanced Railroad Grade Crossing			H																						
ATMS15 - Railroad Operations Coordination			L																						

\*A Market Package may support more one specific ITS service with different priorities. Each priority is indicated.

Market Package	Advanced Traffic Management Systems							Maintenance and Construction Operations				Advanced Public Transportation Systems					ATIS	Archived Data	Emergency Management		Commercial Vehicle Operations			Market Package Dependencies		
	Traveler Information and Regional Traffic	Probe Monitoring	Surface Street Control	Highway Control	Incident Management	Electronic Toll Collection	Emissions Monitoring	Parking Management	M&C Vehicle Tracking	Road Weather Maintenance	Road Maint. & Construct. Activity	Work Zone Management	Transit Operations & Info. Dissemination	Transit Passenger & Fare Management	Transit Security	Transit Vehicle Maintenance	Multi-Modal Coordination	Traveler Information	Operational Data Archive	Emergency Response & Vehicle Routing	Road Service Patrols	Fleet and Freight Management	Regional CVO Services		HAZMAT	
H = High Priority M = Medium Priority L = Low Priority H/M = High/Medium Priority* M/L = Medium/Low Priority*								M																		
ATMS16 - Parking Facility Management																										
ATMS 18 - Reversible Lane Management				H																						
ATMS20 - Drawbridge Management			M																							
MC01 - Maint. and Const. Vehicle Tracking		H						M																		
MC02 - Maint. and Const. Vehicle Maintenance								L																		
MC03 - Road Weather Data Collection									H																	
MC04 - Weather Information Processing and Distribution									H																	MC03
MC05 - Roadway Automated Treatment									M																	
MC06 - Winter Maintenance									M																	
MC07 - Roadway Maintenance and Construction										M																
MC08 - Work Zone Management											M															
MC09 - Work Zone Safety Monitoring											L															MC08
MC10 - Maint. and Const. Activity Coordination										H																

\*A Market Package may support more one specific ITS service with different priorities. Each priority is indicated.

Market Package	Advanced Traffic Management Systems							Maintenance and Construction Operations				Advanced Public Transportation Systems					ATIS	Archived Data	Emergency Management		Commercial Vehicle Operations		Market Package Dependencies				
	Traveler Information and Regional Traffic	Probe Monitoring	Surface Street Control	Highway Control	Incident Management	Electronic Toll Collection	Emissions Monitoring	Parking Management	M&C Vehicle Tracking	Road Weather Maintenance	Road Maint. & Construct. Activity	Work Zone Management	Transit Operations & Info. Dissemination	Transit Passenger & Fare Management	Transit Security	Transit Vehicle Maintenance	Multi-Modal Coordination	Traveler Information	Operational Data Archive	Emergency Response & Vehicle Routing	Road Service Patrols	Fleet and Freight Management		Regional CVO Services	HAZMAT		
H = High Priority M = Medium Priority L = Low Priority H/M = High/Medium Priority* M/L = Medium/Low Priority*																											
APTS1 - Transit Vehicle Tracking		H											H														
APTS2 - Transit Fixed-Route Operations													H														APTS1
APT3 - Demand Response Transit Operations													M														APTS1
APTS4 - Transit Passenger and Fare Management														M													
APTS5 - Transit Security															H												APTS1
APTS6 - Transit Maintenance																H/M											
APTS7 - Multi-modal Coordination			M										M				M										ATMS03, APTS1
APTS8 - Transit Traveler Information													H														APTS1
ATIS1 - Broadcast Traveler Information	H																	H									ATMS01, APTS1
ATIS2 - Interactive Traveler Information																		M									ATMS01, APTS1
ATIS5 - ISP Based Route Guidance																		M									ATMS01, APTS1
AD1 - ITS Data Mart																			M								
AD2 - ITS Data Warehouse																			M								AD1
AD3 - ITS Virtual Data Warehouse																			M								AD1, AD2
EM1 - Emergency Response					H															H							
EM2 - Emergency Routing			H		M															H/M							ATMS03
EM4 - Roadway Service Patrols																					H						

\*A Market Package may support more one specific ITS service with different priorities. Each priority is indicated.

Market Package	Advanced Traffic Management Systems							Maintenance and Construction Operations				Advanced Public Transportation Systems					ATIS	Archived Data	Emergency Management		Commercial Vehicle Operations			Market Package Dependencies		
	Traveler Information and Regional Traffic	Probe Monitoring	Surface Street Control	Highway Control	Incident Management	Electronic Toll Collection	Emissions Monitoring	Parking Management	M&C Vehicle Tracking	Road Weather Maintenance	Road Maint. & Construct. Activity	Work Zone Management	Transit Operations & Info. Dissemination	Transit Passenger & Fare Management	Transit Security	Transit Vehicle Maintenance	Multi-Modal Coordination	Traveler Information	Operational Data Archive	Emergency Response & Vehicle Routing	Road Service Patrols	Fleet and Freight Management	Regional CVO Services		HAZMAT	
H = High Priority M = Medium Priority L = Low Priority H/M = High/Medium Priority* M/L = Medium/Low Priority*																										
CVO01 – Fleet Administration																							M/L			
CVO02 – Freight Administration																							L			
CVO03 – Electronic Clearance																								H		
CVO04 – CV Administrative Processes																								H		
CVO06 – Weigh-In-Motion																								M		
CVO10 – HAZMAT Management																								H		Possibly CVO01

\*A Market Package may support more one specific ITS service with different priorities. Each priority is indicated.

## 7 ITS Standards and System Interoperability

ITS standards establish a common way in which systems and devices connect and communicate with one another. These standards allow transportation agencies to implement systems that cost-effectively exchange pertinent data and accommodate equipment replacement, system upgrades, and system expansion. Standards benefit the traveling public by providing products that will function consistently and reliably throughout the region. ITS standards contribute to a safer and more efficient transportation system, facilitate regional interoperability, and promote an innovative and competitive market for transportation products and services.

Keeping abreast of SDO (Standards Development Organizations) activities will help ensure that the latest standards are utilized. The SDOs involved with the development of transportation-related standards include:

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Electronic Industries Alliance/Consumer Electronic Association (EIA/CEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- Society of Automotive Engineers (SAE)

For more information on standards please contact the SDOs directly or visit the US ITS standards web site at [www.its-standards.net](http://www.its-standards.net).

### 7.1 Interoperability Issues

This discussion of interoperability is divided into two sections: Center-to-Center Interoperability and Center-to-Field Interoperability. In general, center-to-center interoperability refers to interoperability between systems inside of centers, and primarily covers information exchanges (information formats, information exchange sequences) between systems, and command and control. Center-to-field interoperability involves interoperability not only of information exchanges, and command and control between center and field systems, but also interoperability between different manufacturers' equipment, including electrical and mechanical specifications.

#### 7.1.1 Center-to-Center Communications Interoperability

Interoperability between center systems allows them to share the following kinds of information:

- Incident information (type, location, severity, type of vehicles involved), incident response and status
- Traffic and road network conditions, road weather information, and road closure information (type, location, number of lanes)
- Location (of incidents, vehicles, ITS devices)
- Traffic images and video surveillance control
- Shared device control, and device control requests (sign messages, traffic patterns, highway advisory radio)

- Maintenance resource requests (equipment for incident removal, weather emergencies, roadway disasters)

The impact of not having interoperable center-to-center communication formats and protocols is that custom (and generally expensive) interfaces will need to be developed for each center-to-center pair.

### **7.1.2 Center-to-Field Communications Interoperability**

Interoperability between center and field-based systems, and between equipment manufacturers equipment, may include the following:

- Passenger fare cards and readers
- Toll tags and readers
- Motorist Information Systems (highway advisory radio, dynamic message signs)
- Transit Customer Information Systems (information displays at stations and stops, kiosk systems, electronic passenger point-of-sale systems)
- Surveillance equipment (CCTV, vehicle sensors, traffic image formats, camera control)
- Environmental Sensors (weather and air quality sensors, flood warning devices)
- Traffic Control (traffic signal controllers, ramp meters, lane controllers)

The primary impact of not having interoperability between manufacturers equipment is that it limits system expansion opportunities to a limited number (or perhaps a single) of manufacturers and vendors.

## 8 Recommendations and Next Steps

The real success of the ITS Integration Strategy effort hinges on effective use of the plan. Since the ITS Integration Strategy reflects the region's ITS needs and its strategy for satisfying those goals, it is the region's implementation plan for ITS. It is the region's action plan, recommending a set of general projects and in a particular sequence, specifically for the implementation of ITS projects. Thus, the ITS Integration Strategy becomes an important tool for use in transportation planning and project implementation.

This is the step where the benefits are realized. The ITS Integration Strategy identifies the opportunities for making ITS investments in a more cost-effective fashion by identifying the urgency of the need for particular projects, how the project satisfies the regional goals and strategy, and project sequencing. It also identifies areas where policies and agreements are needed between the stakeholders to support the regional goals, needs and transportation services.

### 8.1.1 Support the Transportation Planning Process

The ITS Integration Strategy provides information for updating both the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP).

Federal requirements dictate that the RTP be updated every three years and that an RTP be maintained for each region as part of the process for long-range transportation planning, as mandated by federal statute. The current version of the NYMTC Regional Transportation Plan (RTP) was last updated in 1999. However, NYMTC is currently working on a full update of the RTP, based on workshops and focus groups held over the last year, with participation from the public and the member agencies.

The ITS Integration Strategy identifies those ITS services to be deployed over the next several years. Through the project sequencing, as the high priority ITS services are deployed, the next ITS services required by the region can be identified. As ITS services are deployed, the deployment of the next ITS services should then be reflected in the future updates of the RTP.

NYMTC is also in the process of updating the TIP for fiscal years 2004 through 2006. The new TIP, which is federally-required, is a list of proposed transportation improvements which will be implemented in the region using Federal transportation funding. NYMTC's draft 2004-2006 TIP currently identifies over \$14 billion in transportation improvements.

As the region updates the current TIP, and as it develops future TIPs, the ITS Integration Strategy can be used as a guideline, by the agencies as they developed their TIPs and by NYMTC, to ensure that high priority projects are included in the TIP, and that the near-term regional goals are satisfied. The ITS Integration Strategy can also be used to determine how federal and state transportation dollars will be divided among the agencies to ensure that high priority ITS projects are allocated a certain percentage of funds in support of ITS activities. In comparison to large, construction capital projects, ITS projects can generally be lower in cost and easier to implement. The ITS Integration Strategy can be used to emphasize the benefits of ITS and how it can be deployed to meet the region's transportation goals.



### **8.1.2 Develop Memorandum of Agreements and Policies**

The ITS Integration Strategy can be used to identify areas where policies and agreements are needed to support the deployment of ITS in the region to meet the regional needs and goals. These policies and agreements are necessary because many ITS services involve the sharing of data between multiple agencies and jurisdictions.

For example, to support the ITS service for the collection of Operational Archive Data, a policy on archived data may be needed for the region. This policy should support the collection of archived data by individual agencies in the region, so that the various agency data archives can be merged into a single, useful regional data archive. The data archive policy may include:

- Guidelines on the allowable uses of the regional data archive
- Standards to be used to exchange archive data and for storing the archived data.
- Rules for submitting, accessing and disseminating the archived data
- Agreements on which the roles and responsibilities of the contributing agencies, including which agency will be responsible for maintaining and supporting the regional data archive and how to share the costs for its maintenance

Other policies or agreements that may be required to support the ITS Integration Strategy include:

- Coordination of transportation activities between agencies during incidents and emergencies
- Maintenance of the regional ITS Architecture
- Deployment of projects to support the regional ITS architecture. This may include agreements on data interfaces, data flows and data elements between agencies as indicated in the regional ITS architecture.

### **8.1.3 Updating the ITS Integration Strategy**

The delivery of this ITS Integration Strategy document does not mean the work is completed. The ITS Integration Strategy is a living document and transportation plan for the region. The ITS Integration Strategy must be maintained so it remains current and useful. As ITS projects are implemented, new ITS priorities and strategies emerge through the transportation planning process, and new user functions and needs are identified. The ITS Integration Strategy must be updated so it continues to accurately reflect the region's existing ITS capabilities and future plans. An important future task is to develop a plan to update the ITS Integration Strategy at regular intervals so it remains current and useful.

For example, the NYMTC RTP is the region's long-term transportation plan, and discusses the region's vision for transportation in the region for the next twenty-, thirty-years. Federal mandates require that the RTP be updated every three years. As NYMTC updates the current and future RTPs, either because of changes in regional priorities and goals, or as ITS and transportation elements are deployed, the ITS Integration Strategy will need to be updated.

## 9 Conclusions

Considering the great potential for ITS as outlined in this document, information gathered from national and international experience, and the expectations for ITS deployment over the medium term, it is possible to formulate a vision for the transportation system within the region. In this context, the weaving of ITS more deeply into the framework of the transportation infrastructure of the region will achieve the following:

- An infrastructure for information exchange between the operators and users of the transportation system that works in coordination with the physical infrastructure to maximize the efficiency and utility of the transportation system and promote modal integration.
- A safe and secure transportation system, able to detect and to respond promptly to incidents along the region's roadways.
- A significant reduction in the number and severity of traffic accidents, and improved response times to traffic accidents when they occur.
- An information system for operators and users of the transportation system to help reduce traffic congestion and to more efficiently utilize the capacity of roadways, diminishing the need for additional roadway infrastructure.
- An infrastructure of devices, technologies and information to reduce the consumption of energy and limit adverse impact to the environment.

As a result, the citizens of the region can be assured:

- That the transportation system of the region is administered and operated to provide intermodal services door-to-door without regard to the location of the passengers being transported, or the location or type of cargo being transported; and,
- That transport within the region is safe, oriented towards the user, and efficiently and economically engineered using the most advanced telecommunications and transportation monitoring systems available.

## **Appendix A - List of ITS Stakeholders**

To be supplied

## **Appendix B - ITS Systems Inventory by Stakeholder**

To be supplied

## **Appendix C - Market Package Definitions**

To be supplied

## **Appendix D - Customized MP Diagrams (2 to a page)**

To be supplied

## **Appendix E - Table of System Interconnects**

To be supplied