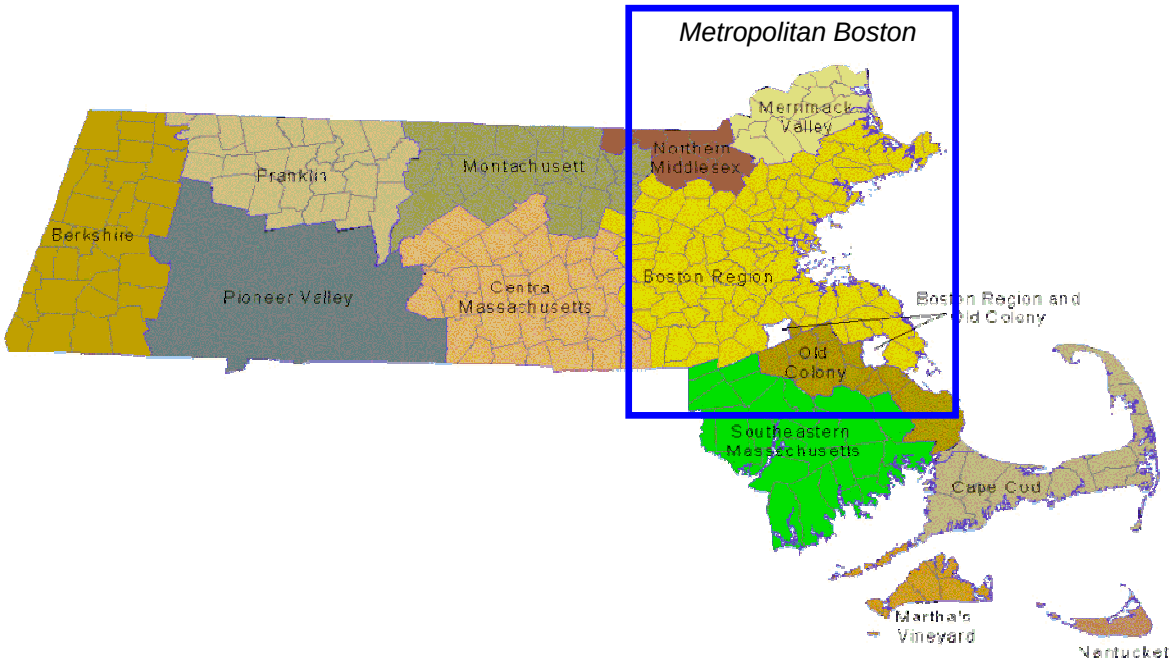
Commonwealth of Massachusetts

REGIONAL ITS ARCHITECTURE FOR METROPOLITAN BOSTON



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16. Abstract

This Final Report describes the development of the Regional Intelligent Transportation System (ITS) Architecture for Metropolitan Boston. The discussion provides background information on ITS and ITS architectures, explains the collaborative process used in Metropolitan Boston to develop the architecture and presents the important outcomes of the initiative.

Intelligent Transportation Systems (ITS) are applications of advanced technology in the field of transportation, with the goals of increasing operational efficiency and capacity, improving safety, reducing environmental costs, and enhancing personal mobility. Successful ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility of individual systems. At the core of this process is an "ITS architecture" that guides the coordination and integration of individual ITS projects. This ITS architecture is a framework that defines the component systems and their interconnections. In addition, developing an ITS architecture offers three important benefits to the region: improved interagency coordination, cost savings for transportation operations, and better services to the traveling public.

Key transportation agencies and other stakeholders in the region provided extensive input in the process, with many serving on a Guidance Committee. Their involvement included participating in meetings and workshops and reviewing project deliverables. Out of this process, with the help of these stakeholders, came an architecture that represents a vision of an integrated transportation system for the Metropolitan Boston region and the interagency relationships needed to support it.

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The Project Team would like to acknowledge the efforts of the Guidance Committee and thank its members for maintaining focus throughout the multi-year architecture development process. With over 25 agencies represented on the committee, the endeavor required patience and determination on the part of each participant. Especially for those individuals who joined the committee later in the process, the Project Team appreciates the work that was involved in bringing the Metropolitan Boston Regional ITS Architecture to this major milestone.

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Massachusetts Executive Office of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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Introduction

This document describes the development of the Regional Intelligent Transportation System (ITS) Architecture for Metropolitan Boston. The discussion provides background information on ITS and ITS architectures, explains the collaborative process used in Metropolitan Boston to develop the architecture and summarizes the important outcomes of the initiative.

Intelligent Transportation Systems (ITS) are applications of advanced technology in the field of transportation, with the goals of increasing operational efficiency and capacity, improving safety, reducing environmental costs, and enhancing personal mobility. Successful ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility of individual systems. At the core of this process is an "ITS architecture" that guides the coordination and integration of individual ITS projects. This ITS architecture is a framework that defines the component systems and their interconnections. In addition, developing an ITS architecture offers three important benefits to the region: improved interagency coordination, cost savings for transportation operations, and better services to the traveling public.

The Commonwealth of Massachusetts, through the Executive Office of Transportation (EOT), has undertaken the development of a Regional Intelligent Transportation Systems Architecture for Metropolitan Boston. The Office of Transportation Planning (OTP) has led a project team consisting of IBI Group in association with ConSysTec Corporation and Rizzo Associates. The consultant team also included an advisory panel consisting of James McGrail, Esq. of Nora Burke and Co., Paula Okunieff of Systems & Solutions, Inc., and Dr. Joseph Sussman of the Massachusetts Institute of Technology.

Key transportation agencies and other stakeholders in the region provided extensive input in the process, with many serving on a Guidance Committee. Their involvement included participating in meetings and workshops and reviewing project deliverables. Out of this process, with the help of these stakeholders, came an architecture that represents a vision of an integrated transportation system for the Metropolitan Boston region and the interagency relationships needed to support it.

Background

Technology has influenced almost every facet of modern living, and transportation is no exception. By now, most drivers have seen electronic tolling that allows properly equipped vehicles to speed through toll plazas instead of waiting in line to collect a ticket or pay a toll. Drivers are also familiar with electronic signs on highways that provide information, such as warnings of accidents and delays. In many areas, travelers are able to obtain information on traffic conditions and transit operations via the internet or by phone.

These are just a few examples of what are referred to as *Intelligent Transportation Systems*, or *ITS*. Other examples of ITS are less obvious to the everyday commuter. Traffic signal operators, transit agencies, and public safety agencies agree to deploy compatible equipment so that buses and emergency vehicles can have priority when approaching a signalized intersection. Transit and other vehicles are equipped with Global Positioning Systems (GPS) so that their location can be known at all times. Some roadways have sensors installed so that potential icy conditions can be detected by a centralized monitoring system and appropriate measures can be implemented. All of these various examples, however, have one thing in common: the use of technology to get more productivity or value out of the transportation infrastructure and human resources.

With the enactment of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), there was a policy shift from building roadways to seeking multimodal solutions to congestion and other problems. ISTEA specifically promoted ITS as a tool in the transportation planning toolbox. By 1998, however, when ISTEA was reauthorized, there was a concern that the deployment of ITS initiatives lacked coordination, leading to the duplication of efforts and incompatibility of systems. The new law, the Transportation Equity Act for the 21st Century (TEA-21) included a provision that called for the coordination of ITS investments.

In 2001, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) issued guidance on how this federal law was to be carried out around the country. FHWA's rule, "Intelligent Transportation System Architecture and Standards" and FTA's "National ITS Architecture Policy on Transit Projects" established that any ITS project funded by the Highway Trust Fund, including the Mass Transit Account, has to be consistent with a *Regional ITS Architecture*, which is to be adapted from a national template.

In this context, the word "architecture" refers not to a plan of physical construction, such as the architecture of a building or city, but instead to the relationship between transportation-related systems and institutions. An ITS architecture covers how systems interface and interact, as well as the institutional relationships that are required to support these interfaces. A regional ITS architecture, therefore, describes how a set of agencies will share responsibility and information for the vast array of technologies and systems deployed in a region.

As an example, a traffic signal may be owned and maintained by the municipality in which it is located, but it may be operated by a state highway department if it is adjacent to a roadway in the state's jurisdiction. At the same time, the municipality may agree to allow fire trucks, police cars, ambulances, or transit vehicles to use technology that enables such vehicles to trigger a green light at the appropriate time. Quickly, one can see that the technical and institutional issues surrounding this single traffic signal involve a variety of interfaces, interactions, and responsibilities. Should the signal happen to be on or near the boundary with another municipality, it is easy to see how the complexity would increase dramatically. A regional ITS architecture is intended to help all of these institutions collaborate on the deployment and management of these systems.

Architecture Development Process

As the traffic signal example illustrates, the architecture of a single element or system can be quite complex, and this complexity quickly escalates when all systems within a region are considered. To address this challenge, the USDOT created the *National ITS Architecture* as a resource for ITS planning and implementation. The FHWA Rule/FTA Policy requires the use of the National ITS Architecture as a template in the development of regional ITS architectures.

The National ITS Architecture is not a system design or a plan for deployment; instead it is a model that provides a framework for ITS planning and integration. The building block of the National Architecture is a *market package*, which includes the set of components related to a specific function or "market," such as work zone management, parking facility management, demand-responsive transit operations, or emergency routing. For each of these market packages, the National Architecture includes all of the interagency linkages, or *interfaces*, considered likely. Because the National Architecture was designed to be comprehensive, a regional architecture should be a subset, including only those market packages and interfaces relevant to that region.

CONSTRUCTING THE ARCHITECTURE

Developing a regional ITS Architecture begins with the strategic question of how to customize the National ITS Architecture to regional circumstances. On the one hand, it is necessary to generate an inventory of local ITS elements, both existing and planned. On the other hand, it is prudent to

work backwards from the National Architecture, eliminating irrelevant market packages and interfaces and using the rest to organize the local inventory.

In Massachusetts, the process also requires addressing the complex question: what is *regional*? As ITS has already been deployed throughout Massachusetts, including both urban and rural areas, it was clear that it was important to include all parts of the state. As Exhibit ES-1 illustrates, the Commonwealth's 13 MPO planning areas were grouped into four regions for the purpose of creating regional ITS architectures.

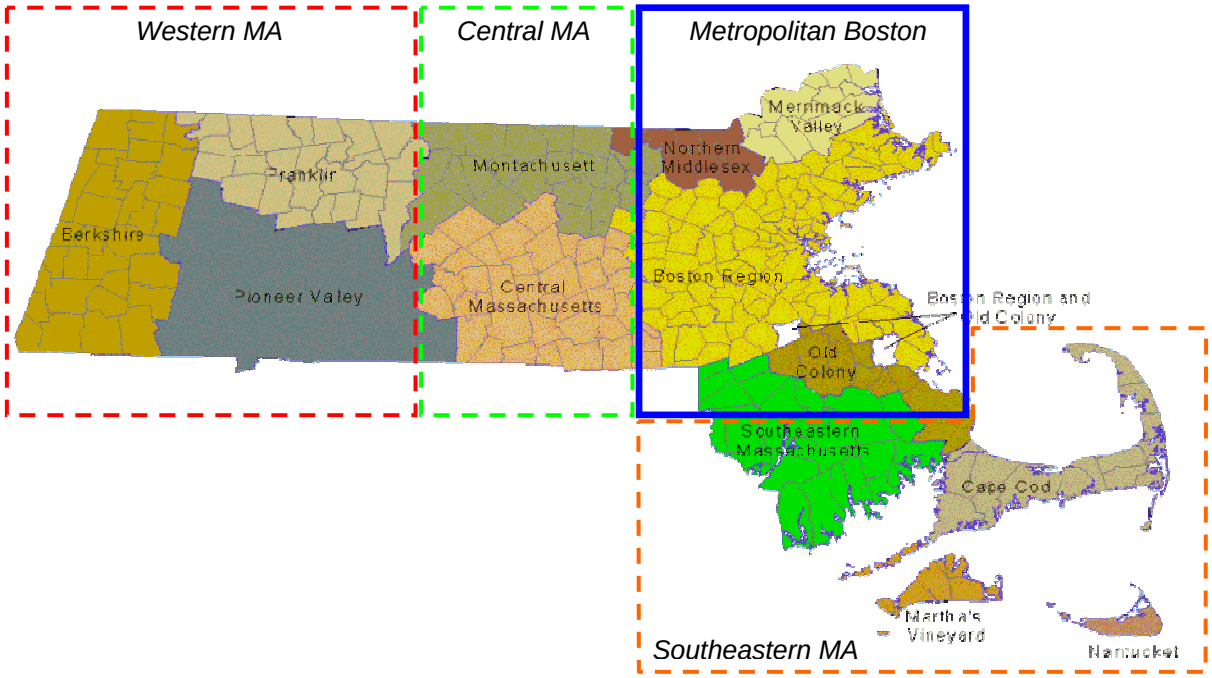


Exhibit ES-1: Study Regions

This Regional ITS Architecture was developed for the Metropolitan Boston area. For the purposes of this study, Metropolitan Boston was defined as the area generally within I-495, Boston's outer circumferential highway. Covering approximately 2,000 square miles, the region includes the Boston, Northern Middlesex, and Merrimack Valley MPO planning areas, as well as portions of the Old Colony and Southeastern Massachusetts MPO planning areas.

To ensure consistency throughout the Commonwealth, the Executive Office of Transportation's Office of Transportation Planning (OTP) organized the development of four regional ITS architectures. In each region, the process was the same and was led by a guidance committee of liaisons from regional stakeholders. Throughout the architecture development process, this Guidance Committee provided input, reviewed documents prepared by the Project Team, and made critical decisions to achieve consensus about implementation approaches. Each Regional ITS Architecture reflects the unique characteristics of its region and stakeholders.

In the Metropolitan Boston region, numerous agencies were invited to participate in the initial meeting or were subsequently invited by the Guidance Committee to participate in the process. These agencies are listed in Exhibit ES-2.

Exhibit ES-2: Guidance Committee Invitees

Regional Planning Agencies ▪ Metropolitan Area Planning Council (MAPC) ▪ Merrimack Valley Planning Commission (MVPC) ▪ Northern Middlesex Council of Governments (NMCOG) ▪ Old Colony Planning Council (OCPC) ▪ Southeastern Regional Planning & Economic Development District (SRPEDD) **Transit Authorities** ▪ Brockton Area Transit (BAT) ▪ Cape Ann Transportation Authority (CATA) ▪ Greater Attleboro-Taunton Regional Transit Authority (GATRA) ▪ Lowell Regional Transit Authority (LRTA) ▪ Massachusetts Bay Transportation Authority (MBTA) ▪ Merrimack Valley Regional Transit Authority (MVRTA) **Municipal/Regional Agencies, Authorities, Commissions, and Organizations** ▪ Boston Emergency Management Agency (BEMA) ▪ Boston Transportation Department (BTD) ▪ City of Brockton	**State Agencies** ▪ Executive Office of Transportation (EOT) ▪ Massachusetts Emergency Management Agency (MEMA) ▪ Massachusetts Highway Department (MassHighway) ▪ Massachusetts Port Authority (Massport) ▪ Massachusetts State Police (MSP) ▪ Massachusetts Turnpike Authority (MassPike), including the Central Artery/Tunnel (CA/T) ▪ Metropolitan District Commission (MDC)[1] ▪ Registry of Motor Vehicles (RMV) **Federal Agencies** ▪ Federal Highway Administration (FHWA) ▪ Federal Transit Administration (FTA) ▪ Federal Motor Carrier Safety Administration (FMCSA)

Following the kickoff meeting, the Project Team reviewed planning documents, including each MPO's Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP). OTP then organized a series of input meetings during which members of the Guidance Committee and other stakeholders contributed to the comprehensive inventory of local ITS-related initiatives, including those already deployed, those ready for implementation, and those still in the planning stages. During this needs-assessment step, stakeholders also discussed the issues facing the region and other needs that shape transportation planning and spending.

Based on this input, the Project Team began assembling the relevant market packages, customizing the National ITS Architecture to regional circumstances. At a two-day workshop, the Project Team reviewed each and every market package diagram with the Guidance Committee, discussing with the committee how input from the previous meetings had been distilled into the diagrams presented. This prompted extensive feedback from the Guidance Committee, both at the meeting and during the subsequent review period. On the basis of that response, the Project Team made revisions and updated the market packages before assembling them into an architecture, which was made accessible to the Guidance Committee via an interactive website.

[1] As of July 1, 2003, the Metropolitan District Commission (MDC) as an organization no longer exists. Functions formerly carried out by the MDC are being distributed among various state agencies. For the purposes of this document, however, "MDC" will continue to be used to refer to elements and functions previously under MDC control.

As the traffic signal example used earlier demonstrates, a regional ITS architecture can easily become large and complex when the many market packages that comprise the National ITS Architecture are taken into account. Navigating the architecture as a website, however, makes it significantly more user-friendly. Links allow a user to investigate common questions such as, "If my agency engages in a certain project or investment, what other agencies are involved?" Alternatively, an agency might simply want to know all of the other agencies to which it is linked in the architecture. A website provides a versatile medium for such searches.

Needs Analysis Outcomes

During the needs analysis step, the Guidance Committee identified key regional needs and major themes for the Regional ITS Architecture. These findings helped shape the architecture to the unique circumstances of the Metropolitan Boston region.

Regional Needs

- Safety and Security
- Congestion Management
- Transit Demand
- Paratransit Efficiency
- Information Sharing
- Communications Infrastructure
- Operations and Maintenance
- Access to ITS Data

Major Themes

- Security
- Information Sharing
- Communications Infrastructure
- Operations and Maintenance

Through this process of identifying existing and planned projects as well as general needs, preparing market packages, and then building and reviewing the architecture, the Guidance Committee has produced a regional ITS architecture that reflects the needs and priorities of the region. The Regional ITS Architecture for Metropolitan Boston is now available in an interactive format on the internet. The interface allows a user to view the architecture in multiple ways and varying levels of detail. The architecture is available on the Commonwealth's website at http://www.mass.gov/RegionalITSArchitecture.

BUILDING ON THE ARCHITECTURE

The Regional ITS Architecture for Metropolitan Boston was constructed with extensive input from stakeholders around the region. Having developed an architecture, however, there are important questions that must be addressed: What does this mean for a transit authority, a highway department, or a metropolitan planning organization? How does the architecture influence the development of new plans or projects? When an agency begins work on a project that includes ITS elements, how should it take the architecture into account? To address these questions, the Project Team and the Guidance Committee developed two additional documents, an *Operational Concept* and an *Implementation Plan*.

Operational Concept

The Operational Concept describes the institutional relationships that must be established in order to address the interagency interfaces defined in the architecture. The purpose of the Operational Concept is to define the roles and responsibilities of the stakeholders in the implementation and operation of the component systems of the architecture. The Operational Concept details the requirements of each agency interface defined in the architecture, addressing the information to be exchanged, the roles of the interfacing agencies, and the operational agreements that will be required.

The presentation of the Operational Concept in the Final Report includes an inventory of all the interagency interfaces. Because there are hundreds of interfaces, the inventory is organized by function, such as *roadway management* or *emergency management*. The Operational Concept chapter also includes an analysis of current and future interagency relationships that might benefit from formalization through interagency agreements, samples of which are included in Appendix F of the Final Report.

Implementation Plan

The Implementation Plan provides a strategy for achieving the integrated transportation system envisioned by the architecture. The Implementation Plan addresses the planned components of the architecture, identifying a series of initiatives that can be undertaken to implement these components. The Implementation Plan also considers prioritization of the identified multi-agency initiatives, identifying candidates for near-term and longer-term implementation. This prioritization is based on the needs analysis, the input received from the stakeholders throughout the architecture development process, and interdependencies among the initiatives. As Exhibit ES-3 shows, there are ten *Near-Term Multi-Agency Initiatives* recommended by the Guidance Committee for Metropolitan Boston.

Exhibit ES-3: Recommended Near-Term Multi-Agency Initiatives

Functional Area	***Initiative***
Multimodal	▪ **Event Reporting System:** Internet-based tool that serves as a centralized repository for information on events affecting the transportation network. ▪ **Expansion of the Massachusetts Interagency Video Information System (MIVIS):** Expansion of video sharing and distribution system to allow sharing of real-time video feeds among a larger group of agencies. ▪ **Interagency Communications Network:** Communications network linking the region's roadway and transit agencies. ▪ **511 Travel Information System:** Public travel information system, covering the roadways and transit services in the region. ▪ **Planning Data Archive:** System for coordinating the planning data archives for the transportation agencies in the region.
Roadway	▪ **Remote MassHighway TOC Workstation (MassHighway and MEMA):** Back-up workstation for the MassHighway Traffic Operations Center at MEMA headquarters in Framingham. ▪ **Interface between MassHighway TOC and MassPike CA/T OCC:** Direct data interface between the MassHighway Traffic Operations Center and the MassPike CA/T Operations Control Center to support exchange of traffic data.
Transit	▪ **Traffic Signal Priority for MBTA Buses:** Extension of the signal priority system currently in place on the Silver Line to other bus routes in the MBTA system.
Parking	▪ **Logan Parking Management System:** Parking Management System for the parking facilities at Logan Airport. ▪ **ETC Integration at MBTA Parking Facilities:** Acceptance of the regional electronic toll collection transponders at MBTA-operated parking facilities.

WORKING WITH THE ARCHITECTURE

The FHWA Rule and FTA Policy include two important provisions that motivated the Project Team and the Guidance Committee to focus on how ITS and the Regional ITS Architecture can be integrated into the mainstream transportation planning process. First, the Rule/Policy requires that before the architecture is completed, there must be a process put in place for maintaining the architecture in the future, as needs evolve and implementation continues. Second, the Rule/Policy states that federal approval and funding cannot be given to a project with ITS elements unless it is consistent with the architecture. To address these requirements, plans for maintaining the architecture and for ensuring project consistency have been developed.

Consistency

> *"The final design of all ITS projects funded with highway trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated." – FHWA Rule/FTA Policy*

In plain terms, this regulatory language means that if an agency makes a commitment in the architecture, such as sharing the data generated by a system it plans to deploy in the future, then when it actually begins developing that element as a part of a project, the project should be consistent with the architecture. Consistency may be a matter of technical design or a matter of institutional coordination but the requirement essentially says that commitments should be honored. The language is very clear, however, that if there is a conflict, the architecture should be updated to accommodate the project.

The Guidance Committee and Project Team, working with the FHWA Rule/FTA Policy, developed a process for ensuring that consistency between projects with ITS elements and the Regional ITS Architecture would be addressed in the course of the existing regional transportation planning process. This process reflects the intent of the Rule/Policy that the relationship between a project and the architecture should be considered early and often and that collaboration and cooperation among planning partners should be maximized.

As noted, a major objective in addressing the consistency requirement was to develop a process that could be integrated seamlessly into the mainstream transportation planning process. As such, the process relies on existing collaborative relationships between each MPO and its local planning partners. This approach ensures that before a project reaches the Transportation Improvement Program (TIP), the Rule/Policy's intent of examining consistency early and often and maximizing collaboration will be fulfilled. In turn, when each MPO submits its TIP to the Executive Office of Transportation and when EOT submits the Statewide TIP to FHWA and FTA, all parties will be comfortable that the consistency requirement has been addressed.

In addition to this initial review in the early stages of the project development process, consistency with the architecture must be revisited as a project develops further in order to ensure that it has not been affected by changes to the scope of the project. Moreover, as a project progresses into the design stage, it must undergo a systems engineering analysis, as is typical of ITS projects and as is required by the federal Rule and Policy.

The bottom line is that by examining consistency early and often during the planning process and by maximizing collaboration and cooperation – all within the context of existing practices – the region can avoid any delays to federal funding and approval.

Maintenance

The Regional ITS Architecture is a vision of the future transportation system, documented at one point in time. The architecture, like an MPO's Regional Transportation Plan (RTP), reflects the current situation and documents planned changes or investments. However, in order to remain relevant, the architecture has to be maintained. As regional needs evolve, as planned elements are deployed, and as other changes occur, the architecture must be updated to reflect those developments. Maintenance of the architecture is also motivated by federal requirements that require consistency between all federally funded projects with ITS elements and the Regional ITS Architecture.

The Office of Transportation Planning, which has led the initial development of the Regional ITS Architecture, will be responsible for the maintenance of the architecture. However, other stakeholders will be involved, as they have been throughout the development process. The maintenance strategy relies on two elements:

- Periodic Architecture Updates

  The maintenance strategy calls for the Regional ITS Architecture to be formally updated at the same frequency as an MPO's Regional Transportation Plan (currently a three-year cycle). Since the RTPs will provide valuable input to the architecture, the architecture update process will be staggered to occur after the RTP update. In this way, it is expected that the revised architecture can incorporate new ideas and/or projects that are included in an updated RTP.

  The Office of Transportation Planning will initiate the Regional ITS Architecture update process with a request for information from stakeholders in the region regarding new ITS-related projects, initiatives, or needs. OTP will also gather information from the stakeholders in order to evaluate the status of the architecture's implementation, identifying, for example, ITS elements or interfaces that have evolved from "planned" to "existing" or that are no longer relevant and should be removed.

  Based on the information gathered through this process, OTP will generate a draft list of architecture modifications and distribute it to the stakeholders for review. OTP can then call a stakeholder meeting for the region to review the draft list. This meeting can also provide an opportunity to discuss emerging ITS issues. After the stakeholder review of the draft list, OTP will make any modifications necessary and release the updated architecture.

- Interim Architecture Modifications

  The strategy also calls for interim architecture modifications that may occur at any point in the update cycle, outside of the formal update process. Just as project developments necessitate TIP amendments, it is anticipated that some modifications to the architecture will be needed during the interval between the periodic updates. Therefore, on the basis of project developments or other circumstances that require modifications, the project proponent will be responsible for drafting an architecture modification proposal and submitting it to OTP. The proposal will then be circulated to affected stakeholders for their review. It is expected that most architecture modifications, whether periodic or interim, will involve adding new ideas, dimensions, or stakeholders to existing market packages, interfaces, or functions.

CONCLUSION

The Regional ITS Architecture for Metropolitan Boston is the result of the significant efforts and contributions of the participants in the process and it provides a strong foundation and opportunity for moving forward with ITS planning and implementation in the region. This process of developing the architecture was motivated by the federal requirements and by the benefits of having a regional ITS architecture.

The first of these benefits is improved interagency coordination. The architecture development process addresses this objective not only in the recommendations that have come out of the architecture, but also through the process of developing the architecture itself. The establishment of the multi-agency stakeholder group that met throughout the architecture development process is a significant step towards coordinating ITS planning in the region. The numerous meetings and workshops of the Guidance Committee demonstrated the benefit of such a forum to exchange information on needs and project plans. The maintenance plan for the architecture offers an opportunity for this interaction to continue, with mutual benefits for all of the participants.

The second benefit is cost savings, which is addressed through the recommendations of the architecture. For example, coordination of investments and consideration of standards for interagency interfaces offer opportunities for cost savings, especially in terms of long-term maintenance and operational costs.

The third benefit is better services to the traveling public. The public has the potential to benefit from this process, as the architecture addresses needs and priorities that cut across agency lines and that are not able to be addressed through single-agency initiatives. The framework outlined by the architecture is for a regional transportation system that can provide the public with a seamless and consistent travel experience across multiple agency jurisdictions.

RECOMMENDATIONS

Through the process and from the results of developing the Regional ITS Architecture, including the Operational Concept and Implementation Plan, a number of recommendations should be considered as the region continues to move forward with deployment of ITS:

- Of the initiatives in the Implementation Plan, the ten "near-term" multi-agency initiatives identified by the Guidance Committee and shown in Exhibit ES-3 are vital for working towards the integrated transportation system envisioned by the architecture. Although not as urgent in the short term, the remaining "future" multi-agency initiatives are also important in that they provide the foundation for interagency coordination throughout the region.

- Formal agreements should be established for the interagency interfaces identified in the architecture. This includes existing interfaces as well as new ones. Existing informal agreements should be formalized in order to ensure that their benefits are maintained. This can be achieved through new agreements that document specific existing working arrangements. Operational agreements for new interfaces should be drawn up as these new interfaces are established. Proper documentation of the arrangement will be easiest in the planning stages and will facilitate implementation and operation in the long term.

- ITS architecture consistency should be incorporated into the existing MPO transportation planning process. While the process outlined in the Implementation Plan identifies times when the consistency issue should be addressed, consideration of the architecture throughout the project development process will ensure a satisfactory outcome.

- The Regional ITS Architecture should be updated to reflect the changing needs and priorities of the region. To make this work with the existing transportation planning process, it is recommended that the architecture be updated regularly to reflect the needs identified in the Regional Transportation Plans in the region. In addition, informal updates to ensure consistency with newly proposed projects should be done on an as-needed basis.

- The agencies and organizations that were represented on the Guidance Committee, as well as other relevant ITS stakeholders, should continue to meet and remain involved, not only in the maintenance of the architecture, but also in coordinating ITS in the region. The benefits of this working group that have been realized in the architecture development process should be built upon as the transportation system envisioned by the architecture takes shape.

USING THE ARCHITECTURE

This process has yielded a valuable tool for planners and operators of the region's transportation system and there are a number of ways in which the architecture should be used:

First, the architecture should be used by agencies as a framework for planning ITS projects, as it documents what they have planned, as expressed in the architecture development process. If it does not reflect the current plans, it should be revised so that it is up to date.

Second, agencies should use the architecture as a guide to how they should interface with other agencies. The ITS architecture documents the interfaces that are planned for development, as well as standards that are relevant to these interfaces. In addition, the Operational Concept details the

operational arrangements that are required for managing these interfaces and provides a model for the interagency agreements that should be established.

Finally, the Regional ITS Architecture provides the basis for satisfying the federal architecture consistency requirement for projects with ITS elements. Therefore, it is vital that project proponents use the architecture as a guideline during project development, just as the FHWA and FTA will be using the architecture when considering whether to approve the project. It is also important that consistency with the architecture is revisited throughout the project development process and as part of the systems engineering analysis that is required of all ITS projects. Incorporating the architecture into the planning, design, and operations process will ensure that all stakeholders in the region are moving together towards the vision that they have created through this process.

To make sure that the Regional ITS Architecture for Metropolitan Boston is readily available to stakeholders, the architecture has been published on the Commonwealth's website at http://www.mass.gov/RegionalITSArchitecture.

1. INTRODUCTION

This document describes the development of the Regional Intelligent Transportation System (ITS) Architecture for Metropolitan Boston. Intelligent Transportation Systems are applications of advanced technology in the field of transportation, with the goals of increasing operational efficiency and capacity, improving safety, reducing environmental costs, and enhancing personal mobility. Successful ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility of individual systems. At the core of this process is an architecture that guides the coordination and integration of individual ITS deployment projects. This ITS architecture is a framework that defines the component systems and their interconnections, and that provides a tool for facilitating institutional relationships within a region.

The Commonwealth of Massachusetts, through the Executive Office of Transportation (EOT), has undertaken the development of a Regional Intelligent Transportation Systems Architecture for Metropolitan Boston. The Office of Transportation Planning (OTP) has led a project team consisting of IBI Group in association with ConSysTec Corporation and Rizzo Associates. The consultant team also included an advisory panel consisting of James McGrail, Esq. of Nora Burke and Co., Paula Okunieff of Systems & Solutions, Inc., and Dr. Joseph Sussman of the Massachusetts Institute of Technology.

Key transportation agencies and other stakeholders in the region provided extensive input in the process, with many serving on a Guidance Committee. Their involvement included participating in meetings and workshops and reviewing project deliverables. Out of this process, with the help of these stakeholders, came an architecture that represents a vision of an integrated transportation system for the Metropolitan Boston region and the interagency relationships needed to support it.

This report documents the development of the Regional ITS Architecture, including both its process and its outcome. The report serves as a complement to the CD-ROM included in Appendix A, which presents the architecture in an interactive format. More information on the CD, including instructions on navigating the architecture, is provided in Chapter 4 of this report.

1.1 Background

The development of a regional ITS architecture is part of the federal requirements meant to encourage regional integration of transportation systems. ITS has a history that predates the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), but that landmark federal legislation ushered in an era of transportation planning and programming that placed greater emphasis on regional systems analysis, interagency collaboration, and multimodal thinking. It also explicitly marked the end of the interstate highway era, which had produced over 40,000 miles of interstate since the mid-1950s. With limited ability to expand capacity, many metropolitan areas began looking for ways to better utilize existing infrastructure, a task for which ITS is ideally suited.

Throughout the 1990s, the U.S. Department of Transportation (USDOT) guided the development of ITS through the National ITS Program, which addressed three main areas: research, field testing, and deployment support. The first two of these areas covered specific projects and initiatives. Research initiatives included projects such as ITS analysis and technology development efforts, while field projects included operational tests such as the ITS Priority Corridors Program. In contrast, deployment support focused more generally on ITS planning, specifically through the Early Deployment Planning Program. This program assisted in the development of numerous strategic deployment plans, which provided recommended approaches for deployment of ITS to address regional needs.

Building on the initiatives established in ISTEA, the Transportation Equity Act for the 21st Century (TEA-21) was enacted in 1998. TEA-21 included a requirement for ITS projects funded through the

highway trust fund, including the mass transit account, to conform to the National ITS Architecture and applicable standards. In January 2001, an FHWA Rule and FTA Policy were published that implemented the ITS architecture requirement of TEA-21. The Rule and Policy require that any ITS project funded with highway trust funds, including the mass transit fund, be consistent with the relevant regional ITS architecture.

In this context, the word "architecture" refers not to a plan of physical construction, such as the architecture of a building or city, but instead to the relationship between transportation-related systems and institutions. An ITS architecture covers how systems interface and interact, as well as the institutional relationships that are required to support these interfaces. A regional ITS architecture, therefore, describes how a set of agencies will share responsibility and information for the vast array of technologies and systems deployed in a region.

The Rule and Policy also require that all ITS projects be based on a systems engineering analysis. Such an analysis is typical of any transportation engineering project involving the application of advanced technology. For reference, including further information on the systems engineering requirement, the FHWA Rule and FTA Policy are attached in Appendices B and C, respectively.

The Regional ITS Architecture for Metropolitan Boston was developed with consideration of these federal requirements. Accordingly, it was developed based on the National ITS Architecture and following guidance provided by USDOT. Further information on the National ITS Architecture and its requirements is available online from the FHWA's ITS Architecture Implementation Program, which is located at http://www.ops.fhwa.dot.gov/its_arch_imp/index.htm. As a further aid, Appendix D provides a glossary of architecture terms from the National ITS Architecture.

1.2 Benefits

Although the Metropolitan Boston Regional ITS Architecture has been developed to satisfy federal requirements, there are a number of other benefits that result from developing this architecture for the region:

- **Improved Interagency Coordination:** One important benefit is improved interagency coordination, which is essential for integration of ITS within the region and for the transportation system as a whole. The architecture development process, therefore, seeks to facilitate communication among the region's agencies, providing an opportunity for agencies to find out what others are doing in terms of ITS. The architecture process also includes the definition of operational concepts for interagency interfaces, as well as recommendations for agreements among agencies.

- **Cost Savings:** Cost savings are another potential benefit of the regional architecture. The primary means of lowering costs is the coordination of capital investment among agencies, which reduces duplication of effort and allows more efficient investment. This coordination can result in lower overall costs for the agencies in the region. Another means is through adherence to standards. Adoption of standards can result in long-term maintenance cost savings, since standards allow competition among ITS industry suppliers, leading to lower costs for operating agencies. Use of standards also facilitates future system upgrades and expansion by reducing the potential for obsolescence.

- **Improved Services to the Public:** The regional architecture will help the agencies in the region provide better services to the public, specifically in terms of consistency across agency jurisdictions. An example of this is provision of multimodal travel information, which requires coordination by multiple agencies. Another example is interoperability of electronic toll collection systems or transit fare cards, which requires technical and institutional agreements. The role of the architecture is to define the requirements for this institutional coordination, with the goal of a seamless transportation experience for the end user.

1.3 Definition of the Region

This Regional ITS Architecture was developed for the Metropolitan Boston area, as shown in Exhibit 1-1. In addition to the Metropolitan Boston region, regional ITS architectures were also developed for the regions of Southeastern, Central, and Western Massachusetts, ensuring that all parts of the Commonwealth are covered by a regional ITS architecture.

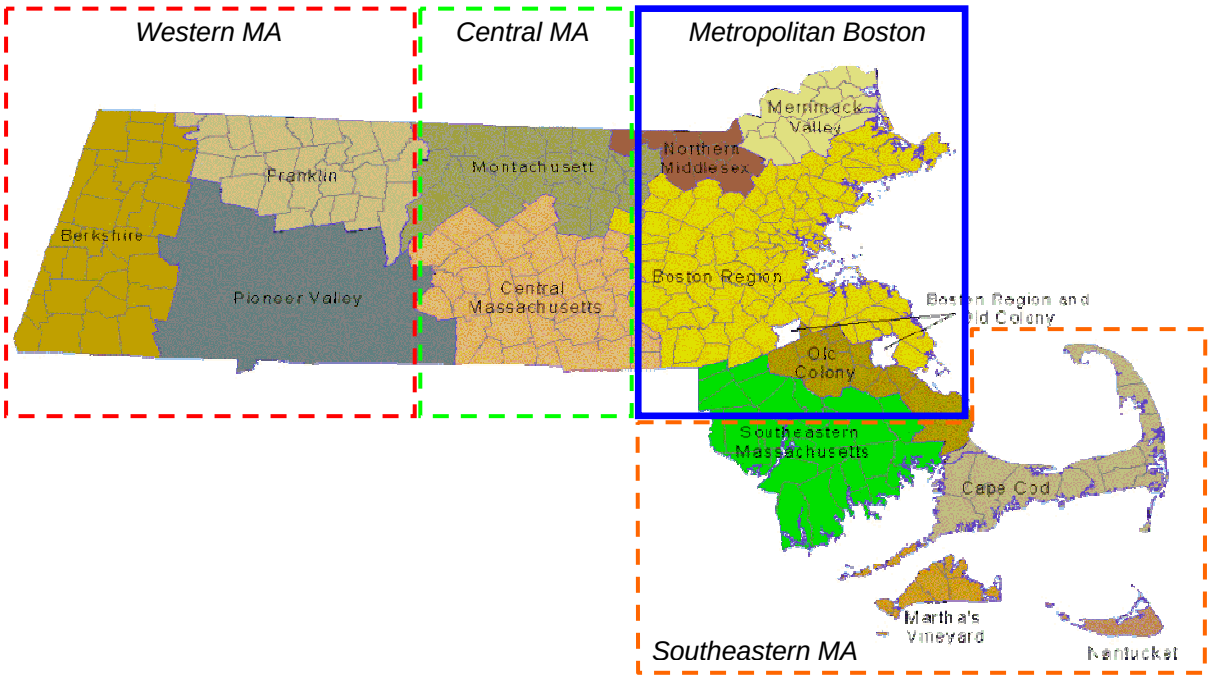


Exhibit 1-1: Study Region

For the purposes of this study, Metropolitan Boston was defined as the area generally within I-495, Boston's outer circumferential highway. Covering approximately 2,000 square miles, the study region includes Boston, Northern Middlesex, and Merrimack Valley MPO planning areas, as well as portions of the Old Colony and Southeastern Massachusetts MPO planning areas.

1.4 Process

The process undertaken for the development of the Regional ITS Architecture for Metropolitan Boston is illustrated in Exhibit 1-2.

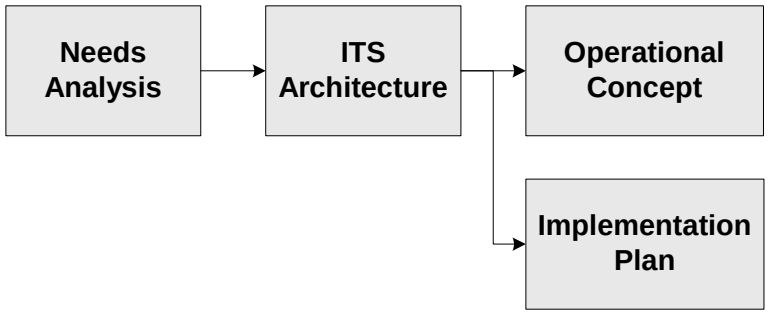


Exhibit 1-2: Architecture Development Process

The first step of this process was the ***Needs Analysis***, which identifies the ITS-related projects and needs of the operating and planning agencies in the region. This analysis served as the basis for the development of the functional requirements of the ITS Architecture and its component systems, developed in the following step. This approach ensured that the systems recommended for implementation, as well as the architecture that provides a framework for these systems, were consistent with the needs and goals of the region. Planning documents from the region, including Regional Transportation Plans (RTPs) and Transportation Improvement Programs (TIPs), were reviewed as part of the needs analysis. Further information was obtained at a meeting of the Guidance Committee and through follow-up meetings with individual agencies.

The next step in the process was the development of the ***ITS Architecture***, which defines the existing and planned component systems and the interfaces among them. As with the needs analysis, stakeholder involvement was critical to this step of the process. An initial draft of the architecture was developed from an inventory of ITS elements identified in the needs analysis and from stakeholder input at an architecture development workshop. Refinements to the architecture were made following stakeholder review, including a series of follow-up review meetings with various groups of stakeholders. Final refinements to the architecture were made once the architecture process was completed, allowing the architecture to reflect all of the comments received.

The next two steps resulted in documents derived directly from the ITS architecture. The first was the development of the ***Operational Concept***, which describes the institutional relationships that must be established in order to address the interagency interfaces defined in the architecture. The purpose of the Operational Concept is to define the roles and responsibilities of the stakeholders in the implementation and operation of the component systems of the architecture. The Operational Concept details the requirements of each interagency interfaces in the architecture, addressing the information to be exchanged, the roles of the interfacing agencies, and the operational agreements that will be required.

The final piece of the architecture development process was the development of the ***Implementation Plan***, which provides a strategy for achieving the integrated transportation system envisioned by the architecture. The Implementation Plan addresses the planned components of the architecture, identifying a series of initiatives that can be undertaken to implement these components. The Implementation Plan also considers prioritization of the identified multi-agency initiatives, identifying candidates for near-term and longer-term implementation. This prioritization is based on the needs analysis, the input received from the stakeholders throughout the architecture development process, and interdependencies among the initiatives. Also included in this step was the development of a plan for maintaining the architecture and ensuring consistency between the architecture and projects with ITS components. Due to its importance, this topic is discussed separately in Chapter 7 of this report.

1.5 Organization of the Report

This Final Report details the process undertaken in the development of the Regional ITS Architecture for Metropolitan Boston, and provides the results and recommendations from each of the steps of this process. The remainder of the report is structured as follows:

- Chapter 2 discusses the stakeholder involvement process.
- Chapter 3 presents the results of the Needs Analysis.
- Chapter 4 discusses the Regional ITS Architecture and website.
- Chapter 5 presents the Operational Concept.
- Chapter 6 presents the Implementation Plan.
- Chapter 7 discusses architecture maintenance and project consistency.
- Finally, Chapter 8 presents conclusions from the architecture development process.

2. STAKEHOLDER INVOLVEMENT

To ensure that a regional ITS architecture fully addresses the needs of a region, the architecture development process requires input and participation of numerous agencies and organizations. The stakeholders in the process should include any stakeholder involved in planning or operating transportation systems in the region. This chapter identifies these stakeholders and describes their involvement in the architecture development process.

2.1 Committee Composition

Federal guidance for developing a regional ITS architecture suggests use of a guidance committee that informs and contributes to the process. At the outset of this project, a comprehensive list of stakeholders was compiled, including municipal, regional, state, and federal agencies, as well as academic institutions and other committees and organizations with relevance to transportation and ITS in Metropolitan Boston. From this pool of stakeholders, members were invited to sit on the Guidance Committee who broadly represented the agencies and organizations involved in transportation in the region. The following stakeholders were invited to participate in the initial meeting or were subsequently invited by the Guidance Committee:

- **Regional Planning Agencies**
  - Metropolitan Area Planning Council (MAPC)
  - Merrimack Valley Planning Commission (MVPC)
  - Northern Middlesex Council of Governments (NMCOG)
  - Old Colony Planning Council (OCPC)
  - Southeastern Regional Planning & Economic Development District (SRPEDD)

- **Transit Authorities**
  - Brockton Area Transit (BAT)
  - Cape Ann Transportation Authority (CATA)
  - Greater Attleboro-Taunton Regional Transit Authority (GATRA)
  - Lowell Regional Transit Authority (LRTA)
  - Massachusetts Bay Transportation Authority (MBTA)
  - Merrimack Valley Regional Transit Authority (MVRTA)

- **State Agencies**
  - Executive Office of Transportation (EOT)
  - Massachusetts Emergency Management Agency (MEMA)
  - Massachusetts Highway Department (MassHighway)
  - Massachusetts Port Authority (Massport)
  - Massachusetts State Police (MSP)
  - Massachusetts Turnpike Authority (MassPike), including the Central Artery/Tunnel (CA/T)
  - Metropolitan District Commission (MDC) [2]
  - Registry of Motor Vehicles (RMV)

- **Municipal/Regional Agencies, Authorities, Commissions, and Organizations**
  - Boston Emergency Management Agency (BEMA)
  - Boston Transportation Department (BTD)
  - Central Transportation Planning Staff (CTPS), technical staff to the Boston MPO
  - City of Brockton

TP[2]PT As of July 1, 2003, the Metropolitan District Commission (MDC) as an organization no longer exists. Functions formerly carried out by the MDC are being distributed among various state agencies. For the purposes of this document, however, "MDC" will continue to be used to refer to elements and functions previously under MDC control.

- **Federal Agencies**
  - Federal Highway Administration (FHWA)
  - Federal Transit Administration (FTA)
  - Federal Motor Carrier Safety Administration (FMCSA)

2.2 Participant Meetings

The Guidance Committee met throughout the project to review and provide input for each phase of the process. While participation by the invited committee members varied, the participants in the meetings represented a broad cross-section of the agencies listed above. At each stage – needs analysis, architecture, operational concept, and implementation plan – the committee reviewed project documents and provided input. In addition, a number of smaller group meetings with agencies were also held during the process to assist in information collection. For reference, Appendix E lists the names and affiliations of all meeting attendees. The following meetings were held as part of the architecture development process:

- **Guidance Committee Meetings:** In these meetings, held throughout the architecture development process, the project team briefed the Guidance Committee on the progress of the project, presented new material to the attendees, and solicited feedback on material that had been circulated among the committee members. These meetings also offered Committee members an opportunity to provide input on issues relating to the architecture process.

- **Individual Stakeholder Meetings:** In the initial stages of the project, meetings were held with individual stakeholders to review preliminary information received and to clarify questions that had arisen in the review of this material and in early Guidance Committee meetings. Meetings were held with MassHighway, CTPS, BTD, MBTA, MassPike, Massport, SRPEDD, and RMV.

- **Architecture Input Workshop:** The purpose of this workshop, which was attended by the Guidance Committee members, was to review and further develop the preliminary ITS architecture, ensuring that it accurately reflects the existing and planned ITS efforts in the region. In this workshop, the project team reviewed the architecture interactively with the stakeholders, revising the inventory and interface details based on information provided by the participants. The input from this workshop was used to develop the initial Draft Regional ITS Architecture.

- **Architecture Review Sessions:** In these sessions, the members of the Guidance Committee met in break-out groups to review the relevant portions of the architecture and to provide feedback. Four meetings were held, organized around the following functions: Traffic Management and Information Sharing, Signals and City Street Control, Transit and Regional Planning, and Emergency Management. The focus of the review was those interfaces that crossed institutional boundaries to assure that there was consensus between the affected agencies. Relevant comments received during the comment period were also discussed in this workshop. The input received in this workshop was incorporated into the Final Regional ITS Architecture.

3. NEEDS ANALYSIS

The creation of a regional architecture is based on an assessment of needs among the architecture's stakeholders. Existing documents, studies, and reports, including the Transportation Plans and TIPs for each planning region, provided initial information about regional transportation needs and certain ITS deployments in the region. This assessment was reviewed at the initial meeting of the Guidance Committee. At the subsequent stakeholder input meetings, further information was collected, resulting in an inventory of existing or planned ITS elements and known areas of need for the region. These needs continued to evolve and be refined throughout the architecture development process.

This chapter summarizes the results of the needs analysis. The first section presents general needs identified for the region through the architecture development process. The second section presents the inventory of existing and planned systems and initiatives relating to ITS, as well as agency-specific needs that were raised. The final section discusses how the results of the needs analysis were used in moving forward with the architecture development process.

3.1 Regional Needs

Through this assessment, a number of general needs have been identified for the region. These needs, obtained from documentation and input from the Guidance Committee, are not specifically ITS needs. Instead, these are identified regional transportation needs that have the potential to be addressed through the use of ITS. The following are the identified need areas:

- **Safety and Security –** In the wake of 9/11, safety and security concerns were at the top of the list for many agencies in the region. Specific needs that were identified included increased surveillance capabilities (via CCTV, for example) for public areas and key infrastructure elements, improved coordination with emergency management personnel coordinators, and securing and providing redundancy in the communications infrastructure.

- **Congestion Management –** Recurring congestion on roadways was identified as an issue throughout the region. This included delays on major highways (including Interstates and major State highways), other State routes, as well as specific intersections and town centers in the region. ITS was identified as a potential means for improving congestion by providing information to motorists about delays and by allowing them to adjust their travel accordingly.

- **Transit Demand –** The need for increased transit service was seen as an issue in many parts of the region. This spanned many transit modes, including subway service in the Boston area, commuter rail, buses, as well as paratransit. Public demand was seen as driving this need, in terms of providing better service to existing riders as well as improving service to raise ridership. New demand patterns also need to be addressed, such as the growing demand at suburban workplaces. In the case of commuter rail, capacity of parking lots was also identified as an issue, as parking at many stations is not adequate for the demand.

- **Paratransit Efficiency –** Another need related to transit is more effective use of paratransit. Due to the high per-trip subsidy for paratransit, the Regional Transit Agencies want to improve the efficiency of paratransit operations, including coordinating better with fixed-route transit and combining paratransit trips.

- **Information Sharing –** An issue that was often raised by the operating agencies in the region was the need for information from other agencies. The information that was seen as valuable included traffic data, information on incidents or other events, and video feeds from other agencies. This need cut across all modes and functions in the region. For example, agencies with transit management functions desire information from other transit agencies (for

coordinating service, e.g.) as well as information from traffic management agencies (for information on road conditions, e.g.). As another example, emergency management agencies look for information from all other operating agencies in order to evaluate the state of the transportation network for response planning. This need was seen as especially critical in the Boston area, where management of the transportation system is shared by a large number of agencies.

- **Communications Infrastructure –** In addition to external information needs, agencies also require communications infrastructure to support their internal operating needs. This includes communications between field equipment and control centers, as well as among centers within a single agency with different functions (transit management vs. emergency management, e.g.). Much of this need is currently being met through the use of leased communications lines from local phone service providers. Many agencies cited the high monthly costs of these leased lines as the primary factor driving the need for dedicated communications infrastructure.

- **Operations and Maintenance –** Staffing requirements for operating and maintaining ITS deployments was another concern raised by agencies in the region. Concern was expressed both about the additional burden on operational staff (control center operators, e.g.) as new systems are deployed, as well as the need for specialized knowledge by those maintaining the systems.

- **Access to ITS Data** – The ITS systems already in place in the region offer a significant resource for transportation data. This includes both real-time data that can be used for operations, as well as archived data that can be used for planning purposes. Planning agencies in the region expressed interest in having access to these data sources.

3.2 ITS Inventory

Many of the needs discussed above are presently being addressed through initiatives by the agencies in the region. In addition to considering regional needs and concerns, the needs analysis process also considered the existing and planned ITS initiatives in the region. This section presents the ITS inventory, arranged by functional area, in Exhibit 3-1 through Exhibit 3-4. The exhibits also include key issues and priorities that were identified by stakeholders during the needs analysis.

Exhibit 3-1: ITS Inventory – Emergency Management

Existing Systems and Ongoing Initiatives:	▪ Massachusetts State Police ▫ *SP and wireless 911 ▫ Video from MassPike and Massport ▫ Amber Alert ▪ MEMA ▫ Incident Command System ▫ Emergency Operations Center (EOC) and Web-EOC system ▫ Backup for MassHighway TOC ▫ 800 MHz trunked radio system
Planned and Proposed Initiatives:	▪ Massachusetts State Police ▫ Crash Data System (with RMV and MassHighway)
Agency Issues and Priorities:	▪ Massachusetts State Police ▫ Video surveillance of roadways ▫ Increased speed of accident reconstruction (to open roads more quickly) ▪ MEMA ▫ Information coordination and dissemination

Exhibit 3-2: ITS Inventory – Roadway (Existing/Ongoing)

Existing Systems and Ongoing Initiatives:	▪ Massachusetts Highway Department ▫ SmarTraveler (Travel Information Service Provider) ▫ CaresVans (roadway service patrols) ▫ I-93 Integrated Traffic Management System (ITMS) ▫ Route 128 Advanced Traffic Management System (ATMS) ▫ Southeast Expressway HOV lane ▫ Traffic Operations Center (TOC) ▫ Variable Message Signs (VMSs) ▫ Emergency motorist call boxes ▫ Weather stations ▫ Amber Alert ▫ GPS on snowplows ▫ Massachusetts Interagency Video Information System (MIVIS) ▪ Massachusetts Turnpike Authority ▫ CA/T Integrated Project Control System (IPCS) ▫ Integration of Metropolitan Highway System ▫ Security Program (CA/T and Prudential tunnels, CCTV and motion detectors) ▫ Security system for entire Turnpike ▫ Traffic webcams ▫ 800 MHz radio conversion (compatible with State Police) ▫ Fiber-optic cable along Turnpike ▫ FAST LANE electronic toll collection ▫ Weather stations ▫ Variable Message Signs (VMS) ▫ Coordination with BTD on traffic signals ▫ Amber Alert ▪ City of Boston ▫ Traffic Management Center (TMC) ▫ Centralized signal control ▫ CCTV monitoring ▫ Signal priority for Silver Line ▫ Signal timing coordination with MBTA ▫ Traffic coordination with CA/T (including CCTV sharing) ▫ Incident notification via pager ▪ Massachusetts Port Authority ▫ Tobin Bridge ETC ▫ Gate Management / Flight Information Display System (FIDS) ▫ Logan Travel Information Website ▫ Logan Parking Management / Revenue Control System, including pay-on-foot stations ▫ Security improvements ▫ Logan Express buses as probe vehicles for SmarTraveler ▪ Metropolitan District Commission ▫ Traffic signals connected to BTD signal system ▪ City of Brockton ▫ Traffic signal coordination

Exhibit 3-3: ITS Inventory – Roadway (Planned/Proposed, Issues/Priorities)

Planned and Proposed Initiatives:	▪ Massachusetts Highway Department ▫ 511 Travel Information System ▫ Expansion of MIVIS ▫ Integration of Route 3 North systems ▪ Massachusetts Turnpike Authority ▫ Improved travel information website ▪ City of Boston ▫ Expansion of traffic signal system ▫ Communications network expansion/upgrade ▫ Communications infrastructure sharing with MBTA ▪ Massachusetts Port Authority ▫ Logan Parking Management System enhancements (pre-selling of parking spaces, parking space wayfinding system, Fast Lane payment) ▪ City of Brockton ▫ Traffic Operations Center
Agency Issues and Priorities:	▪ Massachusetts Highway Department ▫ Deployment of communications infrastructure ▫ Increased traffic detector coverage ▫ Increased surveillance coverage (video) ▫ Centralization of ITS functions statewide at the TOC ▪ Massachusetts Turnpike Authority ▫ Completion of communications infrastructure ▫ Communications infrastructure redundancy ▫ Backup facilities for emergency operation ▫ Interagency coordination for emergency management ▪ City of Boston ▫ Expansion of CCTV deployment ▫ Remote access to TOC ▫ Sharing of video with other agencies ▫ Traffic and event information from other agencies ▪ Massachusetts Port Authority ▫ Traffic/incident coordination with other agencies ▫ En-route travel information ▫ Taxi availability at seaport ▫ Monitoring of Logan roadway traffic ▫ Video from adjacent CA/T roadways ▫ Subway coordination with MBTA ▪ Metropolitan District Commission ▫ Traffic and event management

Exhibit 3-4: ITS Inventory – Transit

Existing Systems and Ongoing Initiatives:	▪ Massachusetts Bay Transportation Authority ▫ Control Centers · OCC (subway, overall hub) · Bus Control Center · Commuter Rail Control Centers ▫ Silver Line · Signal priority (coordinated with BTD) ▫ Commuter Rail information system ▫ Automated Fare Collection (AFC) ▫ Fast Lane payment at garages ▫ System-wide radio upgrade ▫ Subway signal system upgrades ▫ South Station travel information kiosks ▫ Travel information website ▪ Greater Attleboro-Taunton Regional Transit Authority (GATRA) ▫ Automatic Vehicle Location (AVL) for paratransit
Planned and Proposed Initiatives:	▪ Massachusetts Bay Transportation Authority ▫ Expansion of AFC system (parking and commuter rail) ▫ Hub Station Management (subway system communication hubs) ▫ Completion of wide-area network (WAN) ▫ CCTV deployment in stations ▪ Brockton Area Transit (BAT): ▫ Automatic Vehicle Location (AVL) ▫ Automated Fare Collection (AFC)
Agency Issues and Priorities:	▪ Massachusetts Bay Transportation Authority ▫ Customer service ▫ Safety and security ▫ CCTV deployment on vehicles ▫ Improved paratransit dispatching ▫ Signal Priority (repair of Green Line system, expansion to bus system for Urban Ring) ▫ Expansion of Commuter Rail information system ▪ Other Regional Transit Authorities ▫ Service planning ▫ Paratransit operations ▫ Transit security ▫ Coordination with MBTA

3.3 Basis for the Regional ITS Architecture

The next step in the architecture development process uses the results of the needs analysis as an initial basis for developing the draft architecture. The ITS inventory presented in the previous section is the primary basis, as it holds the existing and planned elements that must be included in the architecture. For the purposes of the architecture, elements are classified as "existing" if their interface design is complete, regardless of whether the actual element is deployed. Elements are classified as planned if their interfaces have not yet been designed. In addition, the architecture considers a time horizon of up to fifteen years, with a focus on elements that are likely to be implemented within the next ten years. This timeframe helps ensure that the elements included in the architecture are relevant to the region and are not just a long-term "wish list" for the future.

In addition to the identified inventory elements that must be included in the architecture, the identified needs must also be considered. The needs help determine what new elements the stakeholders may want to consider, and they also help determine what new interfaces between existing systems may be useful to consider.

Based on the stakeholder input in the early stages of the architecture development process, four major themes were identified as especially important to the region:

- **Security** – A common theme expressed was the new focus on security after 9/11. Many agencies expressed the concern that their ITS projects were being overshadowed by security initiatives. However, the opportunity to link ITS elements with security concerns also offers other opportunities for implementing ITS in the region.

- **Information Sharing** – The agencies in the region have a need for better sharing of information among each other. This includes both real-time data such as traffic conditions and events, as well as more static data such as planned events and response plans.

- **Communications Infrastructure** – Many agencies are in the process of building a communications network for operations, but many are missing portions of their network. Many agencies also indicated a desire to reduce their reliance on leased lines for their operations, thereby reducing operating costs. Opportunities exist for taking advantage of geographic overlap of the networks, allowing for joint implementation and cost savings.

- **Operations and Maintenance** – A frequent concern expressed was the need for resources to support ITS. This included both financial resources as well as staffing resources required for operations and ongoing maintenance of ITS deployments. This illustrates the need for considering operations in the planning of ITS for the region.

These four themes were considered throughout the remainder of the architecture development process, and specifically in the Implementation Plan, presented in Chapter 6. The outcome of this process is presented in the remaining chapters of this report.

4. ITS ARCHITECTURE

At the core of the architecture development process is the identification of the existing and planned component systems and the interfaces among them. Collectively, these components and interfaces define the architecture. Pursuant to the Federal requirements, the Regional ITS Architecture must be developed using the National ITS Architecture. As such, the regional architecture builds on the national architecture, incorporating functions that are relevant to the region and calling out specific ITS elements that exist in the region.

Building on the work of the needs analysis, which resulted in an ITS inventory and an assessment of regional transportation needs, an architecture input workshop was held with the Guidance Committee. In this two-day workshop, the participants worked together to develop the components of the draft architecture. This draft was subsequently distributed to the committee for review, and was further discussed in later meetings. Additionally, review of deliverables in the remaining steps in the process led to further comments on the draft architecture, and all comments received were addressed in the final version of the architecture.

Turbo Architecture, a software program created by FHWA to facilitate development of regional ITS architectures, was used to develop the architecture. Version 2.0 of Turbo Architecture, which provides consistency with Version 4.0 of the National ITS Architecture, was used to develop the draft architecture. Following the release of the draft architecture, updated versions of the National ITS Architecture and Turbo Architecture were released. Consequently, the draft architecture was updated to Version 3.0 of Turbo Architecture before it was finalized, thus providing consistency with Version 5.0 of the National ITS Architecture.

The architecture is presented in an interactive format that provides users with an accessible way to view the architecture. The interface allows a user to view the architecture in multiple ways and in varying levels of detail. The architecture is provided on the CD-ROM included in Appendix A. As discussed in Chapter 7, the architecture is not a static document and instead must be maintained so that it remains current and relevant to the region. Therefore, it should be noted that the architecture as presented on the CD is current as of the date of this document. The latest version of the architecture is accessible at http://www.mass.gov/RegionalITSArchitecture.

The first section of this chapter provides a summary of various elements of the Regional ITS Architecture. Following this summary is a guide to navigating the interactive architecture. The final section discusses ITS standards and their applicability.

4.1 Summary of the Regional Architecture

In its most basic form, the architecture is a collection of ITS elements and the interfaces between them. However, due to their sheer number, it is impossible in a single view to display all these elements and interfaces in an understandable way. The architecture therefore provides a number of ways of approaching this information.

One approach is by the ITS inventory, which is a listing of the component elements. The inventory can be considered either by stakeholder (e.g. all elements held by MassHighway) or by function (e.g. all elements relating to Emergency Management). Each element in the inventory has a number of interfaces with other elements, both of the same stakeholder as well as of others. Another approach is by market packages, which group elements and interfaces by function. These approaches to viewing the architecture are described further in the following subsections.

4.1.1 STAKEHOLDERS AND ENTITIES

In the context of the architecture, a stakeholder is any entity that holds or is responsible for an element in the architecture. Exhibit 4-1 presents the stakeholders holding existing or planned elements in the Metropolitan Boston Regional ITS Architecture. This includes public agencies that operate transportation systems, private organizations that have transportation-related functions, as well as the traveling public who interacts with the transportation network.

The list also includes a number of "generic" stakeholders, such as "Local City/Town" or "Local Transit Agencies." These are included to account for stakeholders that are not specifically called out in the architecture, and they serve as a placeholder for future additions. For example, consider a town not currently deploying ITS. This town is not included in the architecture as a stakeholder because it does not hold any ITS elements. However, if that town later decides to implement an ITS project, it can consider the generic "Local City/Town" stakeholder as an example for how this might be done. Once the project design is more complete, the town can then be added to the list of stakeholders through the architecture update process, discussed in Chapter 7.

Exhibit 4-1: Stakeholders with Elements in the Regional ITS Architecture

- Amtrak
- Anderson Regional Transportation Center
- BAT - Brockton Area Transit Authority
- BEMA - Boston Emergency Management Agency
- BPWD - Boston Public Works Department
- BTD - Boston Transportation Department
- CATA - Cape Ann Transportation Authority
- City of Boston
- City of Brockton
- CTPS - Central Transportation Planning Staff
- Executive Office of Transportation - Office of Transportation Planning
- Financial Institution
- GATRA - Greater Attleboro-Taunton Regional Transit Authority
- Greater Boston Convention and Visitors Bureau
- Greater Merrimack Valley Convention and Visitors Bureau
- Hospitals
- Local City/Town
- Local City/Town Shuttle Services
- Local City/Town/County Public Safety
- Local Human Service Transit Providers
- Local Media
- Local/Regional School Districts
- LRTA - Lowell Regional Transit Authority
- MAPC - Metropolitan Area Planning Council
- MassHighway - Massachusetts Highway Department
- MassPike - Massachusetts Turnpike Authority
- Massport - Massachusetts Port Authority
- MBTA - Massachusetts Bay Transportation Authority
- MDC - Metropolitan District Commission
- MEMA - Massachusetts Emergency Management Agency
- MSP - Massachusetts State Police
- MVPC - Merrimack Valley Planning Commission
- MVRTA - Merrimack Valley Regional Transit Authority
- NMCOG - Northern Middlesex Council of Governments
- NOAA - National Oceanic and Atmospheric Administration
- North of Boston Convention and Visitors Bureau
- OCPC - Old Colony Planning Council
- Other Toll Agencies
- Private Ground Transportation Providers
- Private Motor Carriers
- Private Traveler Information Service Providers
- Private Weather Service Providers
- Rail Operators
- Regional Event Promoters
- Regional Fare Card Agencies
- RMV - Registry of Motor Vehicles
- SRPEDD - Southeastern Regional Planning and Economic Development District
- TMA - Transportation Management Associations
- Travelers

Associated with each of these stakeholders is a number of ITS elements in the inventory. For example, elements in the architecture belonging to MassHighway include existing elements, such as its Traffic Operations Center (TOC), District Offices, and field equipment, as well as planned elements, such as its 511 Travel Information System.

Exhibit 4-2 presents the ITS entities from the National ITS Architecture that have been included in the Metropolitan Boston Regional ITS Architecture. The types of entities included in the regional architecture represent only a portion of those that exist in the National ITS Architecture. The ones included are only those that were determined by the stakeholders to be relevant to the region.

The entities are divided into "subsystems" and "terminators." Subsystems are the component systems of the overall ITS architecture, representing the general functional areas that are addressed by ITS. Included within each subsystem are the real-world ITS components that are part of the transportation system, such as operations centers or transit vehicles. Terminators define the boundary of the architecture, and represent the components that interface with these subsystems. Terminators can include components without ITS functions that interface with ITS components, such as hospitals or the media, or can include ITS components that are external to the region.

Exhibit 4-2: National ITS Architecture Entities Included in the Regional Architecture

Subsystems:	*Terminators:*
▪ Archived Data Management Subsystem ▪ Commercial Vehicle Administration ▪ Emergency Management ▪ Emergency Vehicle Subsystem ▪ Emissions Management ▪ Fleet and Freight Management ▪ Information Service Provider ▪ Maintenance and Construction Management ▪ Maintenance and Construction Vehicle ▪ Parking Management ▪ Personal Information Access ▪ Remote Traveler Support ▪ Roadway Subsystem ▪ Toll Administration ▪ Toll Collection ▪ Traffic Management ▪ Transit Management ▪ Transit Vehicle Subsystem ▪ Vehicle	▪ Archived Data User Systems ▪ Care Facility ▪ Department of Motor Vehicles ▪ Equipment Repair Facility ▪ Event Promoters ▪ Financial Institution ▪ Intermodal Freight Depot ▪ Media ▪ Multimodal Crossings ▪ Multimodal Transportation Service Provider ▪ Other Archives ▪ Other Commercial Vehicle Administration Subsystem ▪ Other Emergency Management ▪ Other Information Service Provider ▪ Other Maintenance and Construction Management ▪ Other Maintenance and Construction Vehicle ▪ Other Parking ▪ Other Roadway ▪ Other Toll Administration ▪ Other Traffic Management ▪ Other Transit Management ▪ Other Vehicle ▪ Rail Operations ▪ Storage Facility ▪ Traffic Operations Personnel ▪ Transit System Operators ▪ Traveler Card ▪ Wayside Equipment ▪ Weather Service

Associated with each of these entities is a number of ITS elements in the inventory. For example, the Traffic Management Subsystem includes all operations centers with roadway management functions, including the MassHighway TOC, MassPike CA/T Operations Control Center (OCC), and Local City/Town Traffic Management Centers (TMCs). As an example of a terminator, the Storage Facility entity includes equipment depots, such as those of MassHighway, MassPike, and local cities and towns.

4.1.2 MARKET PACKAGES

Another way of approaching the architecture is by considering Market Packages. These are groupings of elements and interfaces that address a specific functional area (e.g. maintenance vehicle tracking). Market Packages represent collections of subsystems and terminators that exchange information to provide a specific service. A market package can cut across stakeholders, including all elements and interfaces required to support a function.

Exhibit 4-3 presents the market packages for the Metropolitan Boston region, grouped by service area. As with the entities, not all of the market packages in the National ITS Architecture are included here. Instead, only the market packages that are relevant to the region are included.

Exhibit 4-3: Regional ITS Architecture Market Packages

Traffic Management
- Network Surveillance
- Probe Surveillance
- Surface Street Control
- Freeway Control
- HOV Lane Management
- Traffic Information Dissemination
- Regional Traffic Control
- Incident Management System
- Electronic Toll Collection
- Emissions Monitoring and Management
- Standard Railroad Grade Crossing
- Railroad Operations Coordination
- Parking Facility Management
- Drawbridge Management

Maintenance & Construction Management
- Maintenance and Construction Vehicle Tracking
- Maintenance and Construction Vehicle Maintenance
- Road Weather Data Collection
- Weather Information Processing and Distribution
- Winter Maintenance
- Roadway Maintenance and Construction
- Work Zone Management
- Work Zone Safety Monitoring
- Maintenance and Construction Activity Coordination

Public Transportation
- Transit Vehicle Tracking
- Transit Fixed-Route Operations
- Demand Response Transit Operations
- Transit Passenger and Fare Management
- Transit Security
- Transit Maintenance
- Multi-modal Coordination
- Transit Traveler Information

Traveler Information
- Interactive Traveler Information
- ISP Based Route Guidance
- Dynamic Ridesharing

Commercial Vehicle Operations
- CV Administrative Processes

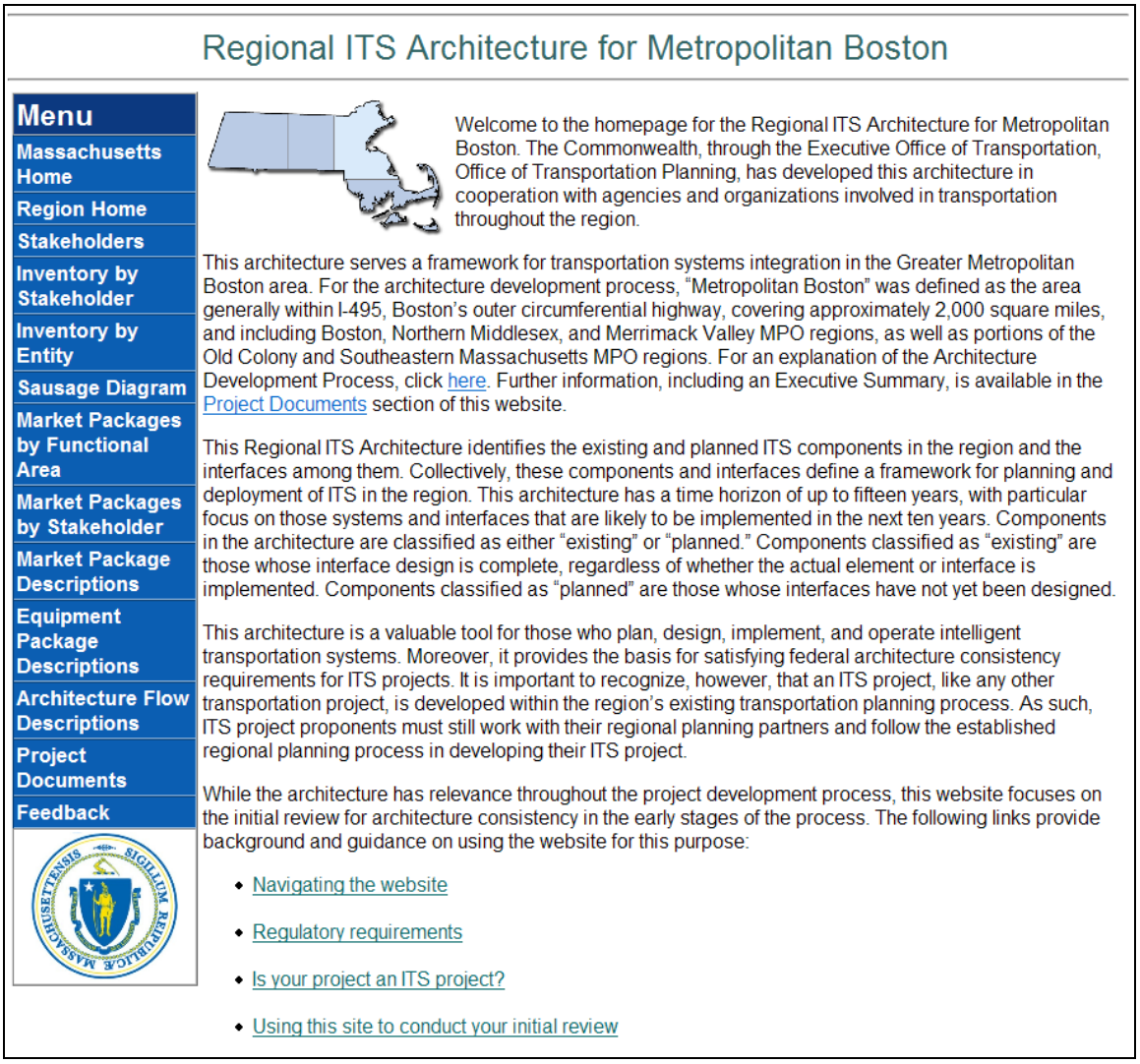
Emergency Management
- Emergency Response
- Emergency Routing
- Mayday Support
- Roadway Service Patrols
- Disaster Response and Recovery
- Evacuation and Reentry Management

Archived Data Management
- ITS Data Mart
- ITS Virtual Data Warehouse

4.2 Navigating the Regional ITS Architecture

This section provides an overview of the architecture as included on the CD-ROM in Appendix A. Exhibit 4-4 depicts the architecture homepage. Along the left side of the page are a series of buttons that link to different pages of the architecture. The pages to which each of these buttons leads are described below.

Exhibit 4-4: Regional ITS Architecture Homepage



- **Massachusetts Home:** This button takes the user to the homepage for the Massachusetts Regional ITS Architectures

- **Region Home:** This button returns the user to the Metropolitan Boston homepage.

- **Stakeholders:** This page presents the full list of regional stakeholders, along with descriptions for each.

- **Inventory by Stakeholder:** This page presents the inventory of ITS elements, arranged by stakeholder. This allows all the elements held by a single stakeholder to be viewed simultaneously. Clicking on an element name links to a detail page for that element that provides more information, including a listing of all interfacing elements.

- **Inventory by Entity:** This page presents the inventory of ITS elements, arranged by entity (subsystems and terminators). This allows all elements with related functions to be viewed simultaneously. Clicking on an element name links to a detail page for that element.

- **Sausage Diagram:** The Architecture Interconnect Diagram (a.k.a. the "Sausage Diagram") illustrates the ITS subsystems and terminators present in the Regional ITS Architecture. Along the perimeter of the diagram are tables for each subsystem and terminator, identifying the specific regional instances of each subsystem or terminator.

- **Market Package Descriptions:** This page presents descriptions for each of the market packages that are included in the architecture.

- **Market Packages by Functional Area:** This page presents a table of the relevant market packages for the region. Clicking on the market package number links to a series of customized diagrams for each package. These market package diagrams illustrate the elements and interfaces that are contained in that market package. Each subsystem or terminator in a market package diagram is labeled with both its generic National ITS Architecture name and the name of the local stakeholder instance that participates in the customized market package. In this way the market package identifies the information exchange (using architecture flows) between specific elements in the region to achieve a particular service or set of services.

- **Market Packages by Stakeholder:** This page presents a list of the relevant market packages for each stakeholder. Clicking on a market package links to the customized diagram in which that stakeholder's element appears.

- **Equipment Package Descriptions:** This page presents descriptions of the relevant equipment packages from the architecture. Equipment packages represent specific functions carried out by the subsystems.

- **Architecture Flow Descriptions:** This page presents descriptions of the relevant architecture flows from the architecture. Architecture flows appear in the interface diagrams, indicating what information is exchanged between two different components.

- **Project Documents:** This page contains documents generated through the architecture development process, including the deliverables reviewed by the Guidance Committee.

- **Feedback:** This button launches the user's email application, allowing the user to send comments to the project team.

4.3 Applicable Standards

Standards are technical specifications established by consensus that provide rules, guidelines or characteristics for data interfaces. ITS standards, in particular, govern the interfaces of transportation system components. They contain and specify the technical details on how to build and integrate ITS systems and components in a way that facilitates interoperability. Standards provide the technical detail that enables the design and deployment of an integrated ITS system. Standards allow different systems to speak to each other in a common language, using common data elements, well-defined data structures or "messages," and well-understood protocols or rules for data exchange and sharing.

ITS standards are being developed by several working groups composed of public and private sector stakeholders within Standards Development Organizations (SDOs). The process is partially supported by the US Department of Transportation. There are seven SDOs actively participating in ITS standards development activities:

- AASHTO (American Association of State Highway and Transportation Officials)
- ANSI (American National Standards Institute)
- ASTM (American Society for Testing and Materials)
- IEEE (Institute of Electrical and Electronics Engineers)
- ITE (Institute of Transportation Engineers)
- NEMA (National Electrical Manufacturers Association)
- SAE (Society of Automotive Engineers)

There are approximately 80 standards that are unique to ITS applications. Many of these 80 standards have already passed through the development process, and have been approved and published by the applicable SDOs. Others are progressing and will be approved soon.

To date, USDOT has not yet adopted specific ITS standards. However, in TEA-21, Congress required the USDOT to "ensure that ITS projects carried out using funds made available from the Highway Trust Fund . . . conform to the national architecture, applicable standards, or provisional standards and protocols." Therefore, it is anticipated that ITS standards will eventually be adopted by USDOT and that their use will be made mandatory. In the interim, it makes good sense to utilize approved ITS standards in system design and implementation regardless of their being mandatory. This approach has little risk and facilitates future integration opportunities.

The Regional ITS Architecture, therefore, does not recommend a specific standard for each interface. Because standards continue to evolve and have not yet been adopted, it would be premature for the architecture to dictate what standards to use when an initiative is only in the conceptual stage. Instead, the architecture presents the standards that are relevant for each architecture flow, with the expectation that they will be considered in the project design. These standards can be found in the architecture on each architecture flow detail page, which contains a description of the architecture flow and a list of relevant communications, message, and data standards.

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5. OPERATIONAL CONCEPT

In the initial steps of the architecture development process, stakeholder interviews, workshops, and working sessions determined the technical components of the architecture. This process developed an architecture that defines the existing and planned component systems, as well as the interfaces among them. The architecture provides a vision of an integrated transportation system that involves numerous agencies. It is critical, therefore, to address the many interagency relationships needed to plan, operate, and maintain those systems. For this reason, the architecture development process includes the creation of an operational concept.

The operational concept focuses on the institutional aspects of the Regional ITS Architecture. It defines the relationships among the organizations in the region required for the deployment and operation of an integrated transportation system. The purpose of the operational concept is to define the roles and responsibilities of the stakeholders in the implementation and operation of the systems that make up the architecture.

The first section of this chapter, *Operational Coordination*, discusses the different levels of interaction and types of information exchange that may be required for operation of interagency interfaces. The second section, *Interagency Interfaces*, presents a detailed operational concept for each of the interagency interfaces that the architecture identifies. Finally, the third section, *Institutional Coordination*, covers the key institutional issues, including interagency agreements.

5.1 Operational Coordination

ITS initiatives that involve cross-jurisdictional relationships will require a detailed operational concept. In some cases, multiple agencies will need to form relationships with each other to define specific roles and responsibilities for the deployment and operation of the system.

Operational relationships between agencies are defined by two main components: 1) the roles/responsibilities of each agency in the relationship, and 2) the types of information that each agency shares. Exhibit 5-1 identifies seven types of agency-to-agency relationships, spanning the range of potential institutional interactions that might occur between two organizations in the operation and maintenance of an ITS application. The exhibit lists the relationships from lowest to highest level of interaction and provides definitions and examples for each of the identified relationships.

Each of these relationships implies some exchange of information between two agencies. The information being exchanged can be classified into one of six types of information flows. Exhibit 5-2 provides definitions and examples for these information flows.

As these exhibits illustrate, the extent of interaction and information exchange between agencies can vary greatly. Relationships can vary from consultation and cooperation, where electronic information is not exchanged, to full transfer of operational responsibility. The extent of the interaction will depend on many factors, including the nature of the information being exchanged, the technical capabilities of the agencies, and the institutional relationships already in place. A different relationship may therefore be appropriate for each particular interagency interface. The next section discusses all of the interagency interfaces in the architecture and proposes an operational concept for each, based on the relationships and information flows identified by the participants.

Exhibit 5-1: Agency-to-Agency Relationships

Relationship	Definition	Example
Consultation	One party confers with another party, in accordance with an established process, about an anticipated action and then keeps that party informed about the actions taken. Information is exchanged through traditional means of communication, such as phone or face-to-face meetings.	Agency A provides information on activities to Agency B.
Cooperation	The parties involved in carrying out the planning, project development and operations processes work together to achieve common goals or objectives. Information is exchanged through traditional means of communication.	Both agencies cooperate in the development and execution of common plans, projects, and operational procedures.
Information Sharing	The electronic exchange of data and device status information between parties for the purposes of coordinated operations, planning, and analysis.	Agency A will provide status, data, and/or video information from Agency A's field devices (e.g. detectors) to Agency B.
Control Sharing	The ability, through operational agreements, to allow for one party to control another party's field devices to properly respond to incident, event, weather, or traffic conditions.	Agency A is allowed by Agency B to control the Agency B's field devices (e.g. VMS, select signal timing patterns) for specified defined occurrences.
Operational Responsibility Shifted	One party operates the field equipment of a second party on a full time basis.	Agency A will operate the field devices of Agency B (e.g. County operates a City's traffic signals but the City is responsible for maintenance and repairs.)
Maintenance Responsibility Shifted	One party maintains the field equipment of a second party.	Agency A maintains the field devices of Agency B, but the Agency B is responsible for operations.
Full Responsibility Shifted	One party has full responsibility for the field equipment of a second party including operations and preventative and emergency maintenance.	Agency A operates and maintains the field devices of Agency B.

Exhibit 5-2: Information Flow Definitions

Information Flow	Definition	Example
Data	The dissemination of raw, unprocessed data gathered from one party's field devices or systems to another party. Data can include, but is not limited to, traffic, weather, parking, transit data, etc. Video images are not included in this information flow.	Agency A sends data from its field devices to Agency B.
Video	The dissemination of live video and still images from one party's field camera's to another party	Agency A sends live video and still images to Agency B.
Event Information	The dissemination of event/incident information or other processed data from one party to another party.	Agency A sends processed data to Agency B.
Device Status	The ability for one party to monitor another party's field devices, and to receive such information as current signal timing/response plan, current message sets, etc.	Agency A sends status information on its devices to Agency B.
Request	The ability for one party to solicit either information or a command change, such as Variable Message Sign (VMS) or signal timing changes, from another party.	Agency A requests information or action from Agency B.
Control	The ability for one party to control another party's field devices. Control can include but is not limited to, changing VMS messages, changing traffic signal timings, camera control, etc.	Agency A issues control instruction to Agency B's field devices.

5.2 Interagency Interfaces

Of the hundreds of interfaces included in the architecture, the ones considered in the Operational Concept are those that involve multiple agencies. The interagency interfaces called for in the Regional ITS Architecture are identified and defined in this section. The interfaces are addressed within the following categories:

- Roadway Management
- Transit Management
- Emergency Management
- Data Archives
- Electronic Fare Payment
- Electronic Toll Collection

It should be noted that these categories are not the same as the functional areas used in the "Market Packages by Functional Area" section of the architecture and as defined by the National ITS Architecture. Instead, these categories have been defined in order to help in the discussion of the large number of interfaces. They do not directly correspond to the market package functional areas because the interfaces of interest do not necessarily fall under a single market package or even a single functional area. For example, the interface supporting the provision of traffic information from a traffic management center to a bus control center falls under both the "Traffic Information Dissemination" and "Transit Fixed-Route Operations" market packages. The interface might also support the provision of traffic signal priority for buses, which would fall under both the "Transit Fixed-Route Operations" market package and the "Regional Traffic Control" market package.

To reduce this overlap, the following subsections group the interfaces under the more basic categories defined above. Within each category, operational concepts have been defined for either individual interfaces or groups of similar interfaces. The intent of the discussion of each interface is to outline how the interface will be addressed by the two agencies, including what information will be exchanged and how this exchange will occur. Defining these interfaces serves as the initial step in the development of agreements between the interfacing agencies, as it starts the process of identifying the content and the issues that must be addressed in the interagency agreements.

5.2.1 ROADWAY MANAGEMENT

Exhibit 5-3 illustrates the interagency interfaces required to support regional roadway management functions. There are numerous interfaces between the various traffic management centers in the region. An additional set of interfaces exists between each of the traffic management centers and private traveler information service providers to support traveler information functions.

Exhibit 5-3: Interagency Interfaces – Roadway Management

	BTD	City of Brockton	Local Cities and Towns	MassHighway	MassPike	Massport	MDC	Private Traveler Information Service Providers
BTD			✓	✓	✓	✓	✓	✓
City of Brockton			✓	✓				✓
Local Cities and Towns				✓	✓	✓	✓	✓
MassHighway					✓	✓	✓	✓
MassPike						✓	✓	✓
Massport								✓
MDC								

Each of these interfaces is addressed by an operational concept. The following operational concepts are defined for Roadway Management:

- Center-to-Center
  - MassHighway and MassPike
  - BTD and MassHighway
  - BTD and MassPike
  - BTD and Massport
  - Massport and MassHighway
  - Massport and MassPike
  - Other
- Traffic Signal Operation
- Private Traveler Information

Note that a separate Center-to-Center operational concept is defined between each of the major control centers in the region. This is due to the specialized nature of the major control centers in the region (i.e. those of BTD, MassHighway, MassPike, and Massport) and the need to recognize preexisting relationships established among them. These operational concepts are presented in Exhibit 5-4 through Exhibit 5-12.

Exhibit 5-4: Operational Concept: Roadway Management – Center-to-Center (MassHighway and MassPike)

Operational Concept:	**Center-to-Center (MassHighway and MassPike)**
Functional Area:	Roadway Management
The interface between MassHighway and MassPike will be implemented between their respective traffic control centers, namely the MassHighway Traffic Operations Center and the MassPike CA/T Operations Control Center. The interface will support a number of functions, including traffic management, maintenance management, and traveler information (e.g. the 511 Travel Information System).	
Interfacing Agencies:	▪ MassHighway and MassPike

Information Flow	*Relationship*
Data:	*Information Sharing:* Traffic data, including flows and speeds calculated at vehicle detector stations, will be exchanged between the two control centers. This will be achieved by a link between the traffic management systems at both facilities. An operator at the MassHighway TOC, for example, will be able to view sensor output from selected CA/T traffic detectors on his/her control console.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. For MassHighway, the central traffic management system software will automatically send event information to the database. For the MassPike, entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for its traffic management software. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Consultation:* Data exchange will be automatic and thus not require requests between agencies. Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-5: Operational Concept: Roadway Management – Center-to-Center (BTD and MassHighway)

Operational Concept:	**Center-to-Center (BTD and MassHighway)**
Functional Area:	Roadway Management
The interface between BTD and MassHighway will be implemented between their respective traffic control centers, namely the BTD Traffic Management Center and the MassHighway Traffic Operations Center. The interface will support a number of functions, including traffic management, maintenance management, and traveler information (e.g. the 511 Travel Information System). Some of the interfaces covered by this operational concept already exist, such as the interface to exchange video through the Massachusetts Interagency Video Information System (MIVIS).	
Interfacing Agencies:	▪ BTD and MassHighway

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* As part of the Massachusetts Interagency Video Information System, video images are exchanged between the two control centers, allowing operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera remains in the control of the agency owning the camera, but requests for camera repositioning can be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. For MassHighway, the central software will automatically send event information to the database. For BTD, entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for its traffic management software. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Consultation:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-6: Operational Concept: Roadway Management – Center-to-Center (BTD and MassPike)

Operational Concept:	**Center-to-Center (BTD and MassPike)**
Functional Area:	Roadway Management
The interface between BTD and MassPike will be implemented between their respective traffic control centers, namely the BTD Traffic Management Center and the MassPike CA/T Operations Control Center.	
Interfacing Agencies:	▪ BTD and MassPike

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio). Currently, some CA/T cameras are viewable at the TMC as described.
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-7: Operational Concept: Roadway Management – Center-to-Center (BTD and Massport)

Operational Concept:	**Center-to-Center (BTD and Massport)**
Functional Area:	Roadway Management
The interface between BTD and Massport will be implemented between their respective traffic control centers, namely the BTD Traffic Management Center and the Massport Landside Operations Control Center.	
Interfacing Agencies:	▪ BTD and Massport

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-8: Operational Concept: Roadway Management – Center-to-Center (Massport and MassHighway)

Operational Concept:	**Center-to-Center (Massport and MassHighway)**
Functional Area:	Roadway Management
The interface between Massport and MassHighway will be implemented between their respective traffic control centers, namely the Massport Landside Operations Control Center and the MassHighway Traffic Operations Center. The interface will support a number of functions, including traffic management, maintenance management, and traveler information (e.g. the 511 Travel Information System).	
Interfacing Agencies:	▪ Massport and MassHighway

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. For MassHighway, the central software will automatically send event information to the database. For Massport, entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for its traffic management software. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-9: Operational Concept: Roadway Management – Center-to-Center (Massport and MassPike)

Operational Concept:	**Center-to-Center (Massport and MassPike)**
Functional Area:	Roadway Management
The interface between Massport and MassPike will be implemented between their respective traffic control centers, namely the Massport Landside Operations Control Center and the MassPike CA/T Operations Control Center.	
Interfacing Agencies:	▪ Massport and MassPike

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. Similarly, event information will be received by each traffic management center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-10: Operational Concept: Roadway Management – Center-to-Center (Other)

Operational Concept:	**Center-to-Center (Other)**
Functional Area:	Roadway Management
This operational concept covers interfaces between major traffic control centers and smaller dispatch/operation centers (such as those of the MDC and some local cities/towns). The interfaces included in this operational concept will support a number of functions, including traffic management, maintenance management, and traveler information (e.g. the 511 Travel Information System).	
Interfacing Agencies:	▪ Local Cities/Towns and BTD ▪ Local Cities/Towns and MassHighway ▪ Local Cities/Towns and MassPike ▪ Local Cities/Towns and Massport ▪ City of Brockton and Local Cities/Towns ▪ City of Brockton and MassHighway ▪ MDC and Local Cities/Towns ▪ MDC and MassHighway ▪ MDC and MassPike ▪ MDC and Massport

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* If the smaller operation has capability for video, video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two centers through a shared connection to a centralized database. Each agency will enter event information into the database for roadways within its jurisdiction. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the central software (if applicable). Similarly, event information will be received by each traffic management center either through operator monitoring of a web-based interface or through an automated link with the central software.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as VMS messages, will occur via voice communications. Coordination via phone or radio will be essential when incident response on one agency's roadways will affect operations on the other agency's roadways. Automated exchange of device status information, such as the ability to monitor messages displayed on the other agency's VMSs, is recommended for future implementation.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on the other agency's VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

Exhibit 5-11: Operational Concept: Roadway Management – Traffic Signal Operation

Operational Concept:	**Traffic Signal Operation**
Functional Area:	Roadway Management
This operational concept applies to the interface between BTD and MDC. This interface is implemented between the BTD Traffic Management Center and select MDC traffic signal controllers within the City of Boston.	
Interfacing Agencies:	▪ BTD and MDC

Information Flow	*Relationship*
Data:	Not applicable.
Video:	Not applicable.
Event Information:	Not applicable.
Device Status:	Not applicable.
Request:	Not applicable.
Control:	*Operational Responsibility Shifted:* Traffic signals and signal controllers owned by MDC will be monitored and operated by BTD as part of the central traffic signal system at the Traffic Management Center. MDC will be responsible for maintenance of all field equipment, but BTD will have full operational control.

Exhibit 5-12: Operational Concept: Roadway Management – Private Traveler Information

Operational Concept:	**Private Traveler Information**
Functional Area:	Roadway Management
This operational concept applies to the interfaces between Private Traveler Information Service Providers' control centers and traffic management agency control centers.	
Interfacing Agencies:	▪ Private Traveler Information Service Providers and BTD ▪ Private Traveler Information Service Providers and City of Brockton ▪ Private Traveler Information Service Providers and Local Cities/Towns ▪ Private Traveler Information Service Providers and MassHighway ▪ Private Traveler Information Service Providers and MassPike ▪ Private Traveler Information Service Providers and Massport

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio). This interface already exists from SmartRoutes, a private traveler information service provider, to MassHighway and to BTD through the Massachusetts Interagency Video Information System (MIVIS).
Event Information:	*Information Sharing:* Event information, such as accident, delay, and construction information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information for roadways within its jurisdiction or coverage area into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the central software at each control center. Similarly, event information will be received by each control center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	*Independent:* No exchange of device status information is planned. However, automated exchange of device status information, such as VMS states, is recommended for future implementation, so that information provided by the private service provider is consistent with agency messages.
Request:	*Coordination:* Requests for CCTV camera repositioning, as mentioned above, will be made via voice communications.
Control:	*Independent:* Direct control of the other agency's field equipment will not be permitted. All control will remain with the agency that owns the equipment. Indirect control is possible via requests to the other agency, as discussed above.

5.2.2 TRANSIT MANAGEMENT

Exhibit 5-13 illustrates the interagency interfaces required to support regional transit management functions. These interfaces include center-to-center interfaces among transit control centers, interfaces between transit control centers and traffic control centers, and interfaces with private travel information service providers.

Exhibit 5-13: Interagency Interfaces – Transit Management

	Transit Management												Traffic Management					
	Amtrak	Local City/Town Shuttle Services	Local Human Service Transit Providers	Massport	MBTA	Private Ground Transportation Providers	BAT	CATA	GATRA	LRTA	MVRTA	TMAs	BTD	Local Cities and Towns (Traffic)	MassHighway	MassPike	Massport (Traffic)	Private Traveler Information Service Providers
Amtrak					✓									✓				✓
Local City/Town Shuttle Services					✓									✓	✓			✓
Local Human Service Transit Providers					✓									✓	✓			✓
Massport (Transit)					✓								✓	✓	✓	✓		✓
MBTA						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Private Ground Transportation Providers													✓	✓	✓	✓		✓
BAT								✓	✓	✓	✓			✓	✓			✓
CATA									✓	✓	✓			✓	✓			✓
GATRA										✓	✓			✓	✓			✓
LRTA											✓			✓	✓			✓
MVRTA														✓	✓			✓
TMAs														✓	✓			✓

Each of these interfaces is addressed by one of the following operational concepts:

- Center-to-Center
- Traffic Coordination
- Traffic Coordination and Signal Priority
- Grade Crossings
- Private Traveler Information

These operational concepts are presented in Exhibit 5-14 through Exhibit 5-18, respectively.

Exhibit 5-14: Operational Concept: Transit Management – Center-to-Center

Operational Concept:	**Center-to-Center**
Functional Area:	Transit Management
This operational concept applies to the interfaces among the various transit operations control centers. The interfaces included in this operational concept will support transit management and traveler information functions.	
Interfacing Agencies:	▪ MBTA and Amtrak ▪ MBTA and Local City/Town Shuttle Services ▪ MBTA and Local Human Service Transit Providers ▪ MBTA and Massport (transit) ▪ MBTA and Private Ground Transportation Providers ▪ MBTA and BAT ▪ MBTA and CATA ▪ MBTA and GATRA ▪ MBTA and LRTA ▪ MBTA and MVRTA ▪ MBTA and TMAs ▪ BAT and CATA ▪ BAT and GATRA ▪ BAT and LRTA ▪ BAT and MVRTA ▪ CATA and GATRA ▪ CATA and LRTA ▪ CATA and MVRTA ▪ GATRA and LRTA ▪ GATRA and MVRTA ▪ LRTA and MVRTA

Information Flow	*Relationship*
Data:	Not applicable.
Video:	Not applicable.
Event Information:	*Information Sharing:* Event information such as service updates will be exchanged through a shared connection to a centralized database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the central software at each control center. Event information will be received by each control center either through an automated link with the central software or through operator monitoring of a web-based interface. *Consultation:* Exchange of response status information, including incident response measures such as service modifications, will occur via voice communications. Coordination via phone or radio will be essential when incident response by one agency affects operations by the other.
Device Status:	Not applicable.
Request:	*Coordination:* Requests, such as those for service modifications such as vehicle holding or rerouting, will be made via voice communications. An automated system and protocol is recommended for situations where requests are frequent.
Control:	Not applicable.

Exhibit 5-15: Operational Concept: Transit Management – Traffic Coordination

Operational Concept:	**Traffic Coordination**
Functional Area:	Transit Management
This operational concept applies to the interfaces between transit operations control centers and traffic management control centers. The interfaces included in this operational concept will support a number of functions, including traffic management, transit management, and traveler information (e.g. the 511 Travel Information System).	
Interfacing Agencies:	▪ BTD and Massport (transit) ▪ BTD and Private Ground Transportation Providers ▪ City of Brockton and BAT ▪ Local Cities/Towns (traffic) and Local City/Town Shuttle Services ▪ Local Cities/Towns (traffic) and Local Human Service Transit Providers ▪ Local Cities/Towns (traffic) and Massport (transit) ▪ Local Cities/Towns (traffic) and Private Ground Trans. ▪ Massport (traffic) and MBTA ▪ MassHighway and Local City/Town Shuttle Services ▪ MassHighway and Local Human Service Transit Providers ▪ MassHighway and Massport (transit) ▪ MassHighway and MBTA ▪ MassHighway and Private Ground Transportation Providers ▪ MassHighway and BAT ▪ MassHighway and CATA ▪ MassHighway and GATRA ▪ MassHighway and LRTA ▪ MassHighway and MVRTA ▪ MassHighway and TMAs ▪ MassPike and Massport (transit) ▪ MassPike and Private Ground Transportation Providers

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* The transit agency will have access to video feeds from select traffic cameras to support dispatching operations. Pan/tilt/zoom control of the camera will remain in the control of the traffic operations center, but requests for camera repositioning by the transit agency may be made via voice communications (e.g. phone or radio). This interface already exists between MassHighway and the MBTA through the Massachusetts Interagency Video Information System (MIVIS).
Event Information:	*Information Sharing:* Event information from the traffic operations center, such as accident, delay, and construction information, will be provided to the transit agency through a shared connection to a centralized database. The traffic operations center will enter event information for roadways within its jurisdiction into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at the control center. The transit agency will receive event information through operator monitoring of a web-based interface. *Consultation:* Exchange of response status information, including incident response measures such as street closures or service modifications, will occur via voice communications. Coordination via phone or radio will be essential when incident response by the traffic operations center affects operations by the transit agency, and vice versa.
Device Status:	Not applicable.
Request:	*Consultation:* Requests from the transit agency to the traffic operations center for CCTV camera repositioning, as discussed above, will be made via voice communications.
Control:	*Independent:* Direct control of roadway field equipment will not be permitted, as all control will remain with the traffic operations center. Indirect control by the transit agency is possible via requests to the traffic operations center, as discussed above.

Exhibit 5-16: Operational Concept: Transit Management – Traffic Coordination and Signal Priority

Operational Concept:	**Traffic Coordination and Signal Priority**
Functional Area:	Transit Management
As with the "Traffic Coordination" operational concept described in Exhibit 5-15, this operational concept applies to the interfaces between transit operations control centers and traffic management control centers. However, this operational concept also includes the provision of signal priority for transit vehicles.	
Interfacing Agencies:	▪ BTD and MBTA ▪ Local Cities/Towns (traffic) and MBTA ▪ Local Cities/Towns (traffic) and BAT ▪ Local Cities/Towns (traffic) and CATA ▪ Local Cities/Towns (traffic) and GATRA ▪ Local Cities/Towns (traffic) and LRTA ▪ Local Cities/Towns (traffic) and MVRTA ▪ Local Cities/Towns (traffic) and TMAs

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* The transit agency will have access to video feeds from select traffic cameras to support dispatching operations. Pan/tilt/zoom control of the camera will remain in the control of the traffic operations center, but requests for camera repositioning by the transit agency may be made via voice communications (e.g. phone or radio).
Event Information:	*Information Sharing:* Event information from the traffic operations center, such as accident, delay, and construction information, will be provided to the transit agency through a shared connection to a centralized database. The traffic operations center will enter event information for roadways within its jurisdiction into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. The transit agency will receive event information through operator monitoring of a web-based interface. *Consultation:* Exchange of response status information, including incident response measures such as street closures or service modifications, will occur via voice communications. Coordination via phone or radio will be essential when incident response by the traffic operations center affects operations by the transit agency, and vice versa.
Device Status:	*Information Sharing:* Relevant status information for field devices will include traffic signal status and information about transit priority calls. Field device status will be reported to the transit authority from the traffic management center by means of a direct connection between the central systems.
Request:	*Information Sharing:* Requests for traffic signal priority for buses or light rail vehicles will be made to the traffic signal system controlled by the traffic operations center. This may occur locally at the signal controller or through a request to the central system. If the request is to the central system, the traffic operations center will make the determination of whether or not to grant priority. *Consultation:* Requests from the transit agency to the traffic operations center for CCTV camera repositioning, as mentioned above, will be made via voice communications.
Control:	*Independent:* Direct control of roadway field equipment will not be permitted, as all control will remain with the traffic operations center. Indirect control by the transit agency is possible via requests to the traffic operations center, as discussed above.

Exhibit 5-17: Operational Concept: Transit Management – Grade Crossings

Operational Concept:	**Grade Crossings**
Functional Area:	Transit Management
This operational concept applies to the interfaces between rail operations control centers and traffic management control centers, specifically for coordination of activity at at-grade rail crossings.	
Interfacing Agencies:	▪ Amtrak and Local Cities/Towns ▪ Rail Operators and Local Cities/Towns ▪ Rail Operators and MassHighway

Information Flow	*Relationship*
Data:	Not applicable.
Video:	Not applicable.
Event Information:	*Information Sharing:* Event information, such as construction activity affecting a grade crossing or rail schedule information, will be exchanged between the two control centers through a shared connection to a centralized database. Each agency will enter event information into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the software at each control center. Similarly, event information will be received by each control center either through an automated link with the central software or through operator monitoring of a web-based interface.
Device Status:	Not applicable.
Request:	Not applicable.
Control:	Not applicable.

Exhibit 5-18: Operational Concept: Transit Management – Private Traveler Information

Operational Concept:	**Private Traveler Information**
Functional Area:	Transit Management
This operational concept applies to the interfaces between transit agency control centers and control centers of Private Traveler Information Service Providers (ISPs).	
Interfacing Agencies:	▪ Private Traveler ISPs and Amtrak ▪ Private Traveler ISPs and Local Cities and Towns (transit) ▪ Private Traveler ISPs and Local Human Service Transit Providers ▪ Private Traveler ISPs and Massport (transit) ▪ Private Traveler ISPs and MBTA ▪ Private Traveler ISPs and Private Ground Transportation Providers ▪ Private Traveler ISPs and BAT ▪ Private Traveler ISPs and CATA ▪ Private Traveler ISPs and GATRA ▪ Private Traveler ISPs and LRTA ▪ Private Traveler ISPs and MVRTA ▪ Private Traveler ISPs and TMAs

Information Flow	*Relationship*
Data:	Not applicable.
Video:	Not applicable.
Event Information:	*Information Sharing:* Service updates from the transit operations center will be provided to the private service provider through a shared connection to a centralized database. The transit operations center will enter event information into the database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the software at the control center. The private service provider will receive event information through operator monitoring of a web-based interface. *Information Sharing:* Exchange of response status information, including incident response measures such as service modifications, will occur through a shared connection to a centralized database or by via voice communications in urgent situations.
Device Status:	Not applicable.
Request:	Not applicable.
Control:	Not applicable.

5.2.3 EMERGENCY MANAGEMENT

Exhibit 5-19 illustrates the interagency interfaces required to support regional emergency management functions. These interfaces include center-to-center interfaces among the emergency management centers, as well as interfaces between emergency management centers and traffic control centers.

Exhibit 5-19: Interagency Interfaces – Emergency Management

	Emergency Management					Traffic Management							Transit Management						
	BEMA	Local City/Town/County Public Safety	MBTA (police)	MEMA	State Police	BTD	City of Brockton	Local Cities and Towns	MassHighway	MassPike	Massport	MDC	BAT	CATA	GATRA	LRTA	MBTA	MVRTA	Local City/Town Shuttle Services
BEMA		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓							
Local City/Town/County Public Safety			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MBTA (police)				✓	✓	✓		✓											
MEMA					✓	✓	✓	✓	✓	✓	✓	✓							
State Police						✓	✓	✓	✓	✓	✓	✓							

Each of these interfaces is addressed by one of the following operational concepts:

- Center-to-Center
- Traffic Coordination
  - Local
  - MEMA
  - MEMA/MassHighway
  - State Police
- Transit Coordination

These operational concepts are presented in Exhibit 5-20 through Exhibit 5-25, respectively.

Exhibit 5-20: Operational Concept: Emergency Management – Center-to-Center

Operational Concept:	**Center-to-Center**
Functional Area:	Emergency Management
This operational concept applies to the interfaces among the various emergency management control centers.	
Interfacing Agencies:	▪ BEMA and Local Cities/Towns ▪ BEMA and MBTA ▪ BEMA and MEMA ▪ BEMA and State Police ▪ Local Cities/Towns and MBTA ▪ Local Cities/Towns and MEMA ▪ Local Cities/Towns and State Police ▪ MBTA (police) and MEMA ▪ MBTA (police) and State Police ▪ MEMA and State Police

Information Flow	*Relationship*
Data:	Not applicable.
Video:	No video exchange will be made between the two agencies.
Event Information:	*Cooperation:* Emergency event information, such as reports of accidents and other major incidents, will be exchanged by voice communication (phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information will be exchanged through a shared connection to a centralized database. Entering and viewing of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the control center software.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures, will occur via voice communications. Automated exchange of device status information, such as the ability for one agency to monitor information being disseminated by another, is recommended for future implementation.
Request:	*Cooperation:* All requests, such as emergency operations procedures or dissemination of information via the other agency's equipment, will be made via voice communications.
Control:	Not applicable.

Exhibit 5-21: Operational Concept: Emergency Management – Traffic Coordination (Local)

Operational Concept:	**Traffic Coordination (Local)**
Functional Area:	Emergency Management
This operational concept applies to the interfaces between local or regional emergency management control centers and traffic management centers.	
Interfacing Agencies:	▪ BEMA and BTD ▪ BEMA and Local Cities/Towns ▪ BEMA and MassHighway ▪ BEMA and MassPike ▪ BEMA and Massport ▪ BEMA and MDC ▪ MBTA and BTD ▪ MBTA and Local Cities/Towns ▪ Local City/Town/County Public Safety and Local Cities/Towns (traffic) ▪ Local City/Town/County Public Safety and City of Brockton ▪ Local City/Town/County Public Safety and MassHighway ▪ Local City/Town/County Public Safety and MassPike ▪ Local City/Town/County Public Safety and Massport ▪ Local City/Town/County Public Safety and MDC

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* The emergency operations center will have access to video feeds from select traffic cameras to support incident management operations. Pan/tilt/zoom control of the camera will remain in the control of the traffic management center, but requests for camera repositioning by the emergency operations center may be made via voice communications (e.g. phone or radio).
Event Information:	*Cooperation:* Emergency event information, such as reports of accidents and other major incidents, will be exchanged by voice communication (phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information from the traffic management center, such as traffic and construction information, will be provided to the emergency operations center through a shared connection to a centralized database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management center software. The emergency operations center will receive event information through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as road closures and detours, will occur via voice communications. Coordination via phone or radio will be essential when incident response by the emergency operations center affects operations by the traffic management center, and vice versa. Automated exchange of device status information, such as the ability for the emergency operations center to monitor event responses by the traffic management center, is recommended for future implementation.
Request:	*Cooperation:* Emergency operations center requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on VMSs controlled by the traffic management center, will also be made via voice communications.
Control:	*Independent:* Direct control of traffic field equipment will not be permitted, as all control will remain with the traffic management center. Indirect control by the emergency operations center is possible via requests to the traffic management center, as discussed above.

Exhibit 5-22: Operational Concept: Emergency Management – Traffic Coordination (MEMA)

Operational Concept:	**Traffic Coordination (MEMA)**
Functional Area:	Emergency Management
This operational concept applies to the interfaces between the MEMA control center and traffic management control centers.	
Interfacing Agencies:	▪ MEMA and BTD ▪ MEMA and City of Brockton ▪ MEMA and Local Cities/Towns ▪ MEMA and MassPike ▪ MEMA and Massport ▪ MEMA and MDC

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* MEMA will have access to video feeds from select traffic cameras to support incident management operations. Pan/tilt/zoom control of the camera will remain in the control of the traffic operations center, but requests for camera repositioning by MEMA may be made via voice communications (e.g. phone or radio).
Event Information:	*Cooperation:* Emergency event information, such as reports of accidents and other major incidents, will be exchanged by voice communication (phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information from the traffic operations center, such as traffic and construction information, will be provided to MEMA through a shared connection to a centralized database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic operations center software. MEMA will receive event information through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as road closures and detours, will occur via voice communications. Coordination via phone or radio will be essential when incident response by MEMA affects operations by the traffic operations center, and vice versa. Automated exchange of device status information, such as the ability for MEMA to monitor messages displayed on VMSs controlled by the traffic operations center, is recommended for future implementation.
Request:	*Cooperation:* MEMA requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on VMSs, will also be made via voice communications.
Control:	*Independent:* Direct control of traffic field equipment will not be permitted, as all control will remain with the traffic operations center. Indirect control by MEMA is possible via requests to the traffic operations center, as discussed above.

Exhibit 5-23: Operational Concept: Emergency Management – Traffic Coordination (MEMA and MassHighway)

Operational Concept:	**Traffic Coordination (MEMA and MassHighway)**
Functional Area:	Emergency Management
This operational concept applies to the interface between MEMA and MassHighway. This interface differs from the other "Traffic Coordination" interfaces in that direct control of MassHighway's central software and field equipment by MEMA will be possible under certain circumstances. The interface will be implemented between the MEMA Operations Center and the MassHighway Traffic Operations Center.	
Interfacing Agencies:	▪ MEMA and MassHighway

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* MEMA will have access to video feeds from select MassHighway cameras to support incident management operations. In non-critical conditions, pan/tilt/zoom control of the camera will remain in the control of MassHighway, but requests for camera repositioning by MEMA may be made via voice communications (e.g. phone or radio). *Control Sharing:* A back-up operator workstation for the MassHighway TOC will be located at the MEMA Operations Center. This workstation will have the same functionality as workstations in the TOC, allowing full control of all MassHighway field equipment. In critical circumstances, MEMA will be able to view and control MassHighway cameras via the remote TOC workstation.
Event Information:	*Cooperation:* Emergency event information, such as reports of accidents and other major incidents, will be exchanged by voice communication (phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information from MassHighway, such as traffic and construction information, will be provided to MEMA through a shared connection to a centralized database. The MassHighway central software will automatically send event information to the database. MEMA will receive event information through operator monitoring of a web-based interface.
Device Status:	*Information Sharing:* Automated exchange of MassHighway device status information will be provided through the remote TOC workstation. This will provide MEMA with the ability to monitor response measures, such as messages displayed on MassHighway VMSs.
Request:	*Cooperation:* MEMA requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, such as placement of messages on MassHighway VMSs, will also be made via voice communications.
Control:	*Control Sharing:* As mentioned above, MEMA will be able to take direct control of MassHighway field equipment under critical circumstances. The back-up TOC workstation will have the same functionality as workstations in the TOC, allowing full control of all MassHighway field equipment.

Exhibit 5-24: Operational Concept: Emergency Management – Traffic Coordination (State Police)

Operational Concept:	**Traffic Coordination (State Police)**
Functional Area:	Emergency Management
This operational concept applies to the interfaces between the State Police and the various traffic management control centers.	
Interfacing Agencies:	▪ State Police and BTD ▪ State Police and City of Brockton ▪ State Police and Local Cities/Towns ▪ State Police and MassHighway ▪ State Police and MassPike ▪ State Police and Massport ▪ State Police and MDC

Information Flow	*Relationship*
Data:	Not applicable.
Video:	*Information Sharing:* The State Police will have access to video feeds from select traffic cameras to support dispatching and event management operations. Pan/tilt/zoom control of the camera will remain in the control of the traffic operations center, but requests for camera repositioning by the State Police may be made via voice communications (e.g. phone or radio).
Event Information:	*Cooperation:* Emergency event information, such as reports of accidents and other major incidents, will be exchanged by voice communication (phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information from the traffic operations center, such as traffic and construction information, will be provided to the State Police through a shared connection to a centralized database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic operations center software. The State Police will receive event information through operator monitoring of a web-based interface.
Device Status:	*Consultation:* Exchange of device status information, including incident response measures such as road closures and detours, will occur via voice communications. Coordination via phone or radio will be essential when incident response by the State Police affects operations by the traffic operations center, and vice versa. Automated exchange of device status information, such as the ability for the State Police to monitor messages displayed on VMSs controlled by the traffic operations center, is recommended for future implementation.
Request:	*Cooperation:* State Police requests for CCTV camera repositioning, as mentioned above, will be made via voice communications. All other requests, including the use of VMSs for displaying emergency messages (such as Amber Alert messages), will also be made via voice communications.
Control:	*Independent:* Direct control by the State Police of roadway field equipment will not be permitted, as all control will remain with the traffic operations center. Indirect control by the State Police is possible via requests to the traffic operations center, as discussed above.

Exhibit 5-25: Operational Concept: Emergency Management – Transit Coordination

Operational Concept:	**Transit Coordination**
Functional Area:	Emergency Management
This operational concept applies to the interfaces between local or regional emergency management control centers and transit management centers.	
Interfacing Agencies:	▪ Local City/Town/County Public Safety and BAT ▪ Local City/Town/County Public Safety and CATA ▪ Local City/Town/County Public Safety and GATRA ▪ Local City/Town/County Public Safety and LRTA ▪ Local City/Town/County Public Safety and MBTA ▪ Local City/Town/County Public Safety and MVRTA ▪ Local City/Town/County Public Safety and Local City/Town Shuttle Services

Information Flow	*Relationship*
Data:	Not applicable.
Video:	Not applicable.
Event Information:	*Cooperation:* Emergency event information, such as reports of major incidents or incident response measures such as service modifications, will be exchanged by voice communication (e.g. phone or radio). The critical nature of such communication requires this direct person-to-person interface. *Information Sharing:* Non-emergency event information from the transit management center, such as service updates, will be provided to the emergency operations center through a shared connection to a centralized database. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the central software at the transit management center. The emergency operations center will receive event information through operator monitoring of a web-based interface.
Device Status:	Not applicable.
Request:	*Coordination:* Requests, such as those for service modifications such as vehicle holding or rerouting, will be made via voice communications. An automated system and protocol is recommended for situations where requests are frequent.
Control:	Not applicable.

5.2.4 DATA ARCHIVES

Exhibit 5-26 illustrates the interagency interfaces required to support regional data archive management functions. These include interfaces with the Office of Transportation Planning (proposed as the hub of an integrated data archive system), as well as an interface between the RMV and state/local police for crash reporting.

Exhibit 5-26: Interagency Interfaces – Data Archives

	BTD	CTPS	EOT (OTP)	MassHighway	MassPike	Massport	MBTA	MAPC	MVPC	NMCOG	OCPC	SRPEDD	RMV	State Police	Local Public Safety
BTD			✓												
CTPS			✓												
EOT (OTP)				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
MassHighway															
MassPike															
Massport															
MBTA															
MAPC															
MVPC															
NMCOG															
OCPC															
SRPEDD															
RMV														✓	✓

Each of these interfaces is addressed by one of the following operational concepts:

- Planning Archives
- Crash Data System

These operational concepts are presented in Exhibit 5-27 and Exhibit 5-28, respectively.

Exhibit 5-27: Operational Concept: Data Archives – Planning Archives

Operational Concept:	**Planning Archives**
Functional Area:	Data Archives
This operational concept addresses the interfaces between the Office of Transportation Planning (OTP) and other agencies holding data archives. As envisioned by the architecture, OTP will serve as the regional archived data management system hub, holding information managed by OTP as well as providing a portal to the information held by other agencies.	
Interfacing Agencies:	▪ OTP and BTD ▪ OTP and CTPS ▪ OTP and MassHighway ▪ OTP and MassPike ▪ OTP and Massport ▪ OTP and MBTA ▪ OTP and RMV ▪ OTP and MAPC ▪ OTP and MVPC ▪ OTP and NMCOG ▪ OTP and OCPC ▪ OTP and SRPEDD

Information Flow	*Relationship*
Data:	*Information Sharing:* As the regional archived data management system hub, the Office of Transportation Planning archive will hold key data collected and reported by other agencies. However, data exchange will also be possible between OTP and each of the other agencies' archives, allowing OTP to serve as a portal to other data held by other agencies. This will provide OTP with access to data held by the other agencies, and will provide the other agencies with access to data held by OTP. Moreover, this will also provide participating agencies with access to each others' data, allowing one RPA, for example, to access data held by an adjacent RPA through the system maintained by OTP. This data exchange will occur over a link between the databases at each location. Access to data on the other systems will be initiated by the agency requesting the information.
Video:	Not applicable.
Event Information:	Not applicable.
Device Status:	Not applicable.
Request:	*Information Sharing:* As noted above, data exchange will occur between the databases following a request by the initiating agency.
Control:	Not applicable.

Exhibit 5-28: Operational Concept: Data Archives – Crash Data System

Operational Concept:	**Crash Data System**
Functional Area:	Data Archives
This operational concept applies to the interface between the RMV and state/local police, which supports the exchange of information between police systems and the RMV Crash Data System.	
Interfacing Agencies:	▪ RMV and State Police ▪ RMV and Local Public Safety

Information Flow	*Relationship*
Data:	*Information Sharing:* Data exchange will occur over a link between the police and the RMV database. This interface will allow submission of records to the RMV database by state or local police.
Video:	Not applicable.
Event Information:	Not applicable.
Device Status:	Not applicable.
Request:	*Information Sharing:* Data exchange will occur between the databases following a request by the initiating agency.
Control:	Not applicable.

5.2.5 ELECTRONIC FARE PAYMENT

Exhibit 5-29 illustrates the interagency interfaces required to support regional implementation of electronic fare payment. The plan for EFP in the region is based on a Regional Fare Card that will be interoperable among the various transit agencies. It is envisioned that this regional fare card will be interoperable with the fare card that is currently being introduced by the MBTA. However, for the purposes of the architecture, the regional fare card will be considered as a separate entity managed by a generic "Regional Fare Card agency."

Exhibit 5-29: Interagency Interfaces – Electronic Fare Payment

	Local Cities and Towns	MBTA	Private Ground Transportation Providers	BAT	CATA	GATRA	LRTA	MVRTA	TMAs	Regional Fare Card Agency
Local Cities and Towns										✓
MBTA										✓
Private Ground Transportation Providers										✓
BAT										✓
CATA										✓
GATRA										✓
LRTA										✓
MVRTA										✓
TMAs										✓
Regional Fare Card Agency										

The interfaces to support electronic fare payment are addressed by a single operational concept, as presented in Exhibit 5-30.

Exhibit 5-30: Operational Concept: Electronic Fare Payment

Operational Concept:	**Electronic Fare Payment**
Functional Area:	Electronic Fare Payment
This operational concept applies to the interagency interfaces required to support regional implementation of electronic fare payment.	
Interfacing Agencies:	▪ Regional Fare Card Agency and Local City/Town Shuttle Services ▪ Regional Fare Card Agency and MBTA ▪ Regional Fare Card Agency and Private Ground Transportation Providers ▪ Regional Fare Card Agency and BAT ▪ Regional Fare Card Agency and CATA ▪ Regional Fare Card Agency and GATRA ▪ Regional Fare Card Agency and LRTA ▪ Regional Fare Card Agency and MVRTA ▪ Regional Fare Card Agency and TMAs

Information Flow	*Relationship*
Data:	*Information Sharing:* The Regional Fare Card Agency will hold all administrative and financial data related to the fare cards. In order for the fare card to be used on services by the transit providers in the region, data exchange is required between the fare collection systems of the transit providers and the Regional Fare Card Agency. Two primary data exchanges are required. The first data exchange occurs when the fare card is used on a transit provider's fare-box. At that time, the fare card information is sent to the Regional Fare Card Agency for validation, ensuring that the balance on the card is adequate and deducting the fare from the balance. The second data exchange occurs when the transit provider's account is reconciled with the Regional Fare Card Agency. This is usually done periodically, e.g. at the end of each service day. At that time, the total value of the transit provider's fares paid by fare cards is transferred from the Regional Fare Card Agency to the transit provider.
Video:	Not applicable.
Event Information:	Not applicable.
Device Status:	Not applicable.
Request:	*Information Sharing:* The data exchange occurring during the validation of the fare card will be performed following a request of the transit provider. This request will be initiated upon the use of the fare card in the transit provider's farebox.
Control:	Not applicable.

5.2.6 ELECTRONIC TOLL COLLECTION

Exhibit 5-31 illustrates the interagency interfaces required to support regional implementation of Electronic Toll Collection (ETC). As the MassPike is the ETC system provider for the region, these consist of the interfaces between the Massachusetts Turnpike Authority's Account Processing Center (APC) and other agencies accepting the toll transponders. These agencies include other toll agencies outside of the region (e.g. E-ZPass Inter-Agency Group members) as well as parking facility operators.

Exhibit 5-31: Interagency Interfaces – Electronic Toll Collection

	Tolls			Parking								
	Massport (Tobin Bridge)	MassPike	Other Toll Agencies	BTD	Local Cities and Towns	MBTA	Massport (Logan)	BAT	CATA	GATRA	LRTA	MVRTA
Massport (Tobin Bridge)		✓										
MassPike			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other Toll Agencies												

These interfaces are addressed by a single operational concept, as presented in Exhibit 5-32.

Exhibit 5-32: Operational Concept: Electronic Toll Collection

Operational Concept:	**Electronic Toll Collection**
Functional Area:	Electronic Toll Collection
As the MassPike is the ETC system provider for the region, this operational concept applies to the interfaces between the Massachusetts Turnpike Authority's Account Processing Center (APC) and other agencies accepting the toll transponders, including parking facility operators.	
Interfacing Agencies:	▪ MassPike and Massport (Tobin) ▪ MassPike and Other Toll Agencies ▪ MassPike and BTD ▪ MassPike and Local Cities/Towns ▪ MassPike and MBTA ▪ MassPike and Massport (Logan) ▪ MassPike and BAT ▪ MassPike and CATA ▪ MassPike and GATRA ▪ MassPike and LRTA ▪ MassPike and MVRTA

Information Flow	*Relationship*
Data:	*Information Sharing:* As the lead agency in the implementation of ETC, the MassPike will hold all administrative and financial data related to the toll transponders. In order for the toll transponders to be used at non-Turnpike facilities in the region, data exchange is required between the toll collection system of the other operator and the MassPike. Two primary data exchanges are required. The first data exchange occurs when the transponder is used at the other operator's toll facility. At that time, the other operator's toll system sends the transaction information to the MassPike, which deducts the appropriate amount from the customer's account. The second data exchange occurs when the other toll operator's account is reconciled with the MassPike. At that time, the total value of the ETC transactions at the other toll facility is transferred from the MassPike to the other operator.
Video:	Not applicable.
Event Information:	Not applicable.
Device Status:	Not applicable.
Request:	*Information Sharing:* The data exchange occurring during the toll transaction will be performed following a request of the other operator's toll system. This request will be initiated upon the reading of a MassPike toll transponder by the other agency's toll system.
Control:	Not applicable.

5.3 Institutional Coordination

The Regional ITS Architecture provides both a technical and institutional framework for the deployment of ITS in the Metropolitan Boston region. This involves coordination between various agencies and jurisdictions to achieve seamless operations and/or interoperability. The existing and recommended operational concepts defined in the previous section provide guidance for the functional requirements of inter-jurisdictional interactions. These inter-jurisdictional operational concepts in turn point directly to the types of agreements that may be required between individual agencies in order to define the agency roles and responsibilities for each of these interactions. This section discusses considerations for developing inter-jurisdictional agreements for implementing the operational concepts, achieving the information flows, and operating the systems defined in the regional architecture.

5.3.1 EXISTING AGREEMENTS

Interagency coordination already occurs among the operating agencies in the Metropolitan Boston region. In some cases, the responsibilities of the coordinating agencies are detailed in interagency agreements or Memoranda of Understanding (MOUs), which provide formal documentation of agency roles, procedures, and responsibilities. In many cases, however, such as where jurisdictions meet or overlap, coordination occurs without formal agreements. In these cases, protocols may have been developed at the operating level, and the cooperating agencies rely on informal arrangements.

This section documents information regarding formal and informal interagency agreements relevant to the Regional ITS Architecture. This information was obtained from the initial architecture input meetings and subsequent contact with stakeholders. Exhibit 5-33 summarizes the operational agreements identified by the stakeholders in the region. Each of the agreements is discussed in the following subsections.

Exhibit 5-33: Existing Operational Agreements

Function	*Participants*	*Agreement*	*Status*
Traffic Management	MassHighway, MassPike	Control center co-location	Formalized (April 2000)
	BTD, MassPike	CA/T video sharing	Not formalized
	BTD, MassHighway, MBTA	Video and information sharing	Formalized (2004)
	BTD, MDC	MDC traffic signal operation (Boston)	Not formalized
	BTD, Massport	Massport traffic signal operation (S. Boston)	Under discussion
Incident Management	MassHighway, MassPike, State Police, et al.	Unified Response Manual for Roadway Traffic Incidents	Formalized (December 1998), Update under development
	MassHighway, State Police	Accident Response/Quick Clearance Agreement	Formalized (August 2003)
	MassHighway, MassPike, Massport, et al.	CA/T Incident Management & Communication Agreement	Formalized (December 1995), Updated 2001
	MassHighway, Massport	Mutual aid (Tobin Bridge incidents)	Not formalized
Multimodal Coordination	BTD, MBTA	Transit signal priority	Not formalized
Traveler Information	MassHighway, SmarTraveler	Traveler information services	Formalized (MassHighway contract)
	MBTA, SmarTraveler	Traveler information services	Formalized (MBTA contract)
	Massport, SmarTraveler	Travel time data from Logan Express vehicles	Not formalized
Electronic Toll Collection	MassPike, Massport, IAG	E-ZPass toll coalition	Formalized (coalition members)
	MassPike, Massport	Tobin Bridge electronic toll collection	Formalized
	MassPike, MBTA	ETC parking facility payment	Formalized
Emergency Management	BEMA et al.	Boston emergency management plans	Formalized
	MEMA, State Police, et al.	Massachusetts Amber Alert Plan	Formalized (October 2002)
	MassHighway, State Police	Expansion of Amber Alert Plan (highway VMSs)	Under development

5.3.1.1 Traffic Management

Agreements regarding traffic management fall into two primary categories: control center coordination and traffic signal control. Agreements regarding control center coordination are the following:

- An agreement between MassHighway and the Massachusetts Turnpike for co-location of MassHighway's Regional Traffic Operations Center (RTOC) at the CA/T Operations Control Center in South Boston. A formal agreement was signed in April 2000.

- Access to Central Artery/Tunnel (CA/T) project CCTV images at the BTD Traffic Management Center. Camera control remains with the CA/T. No formal agreement has been established.

- BTD, MassHighway, and the MBTA have signed an agreement to share information among the BTD Traffic Management Center, the MBTA's Operations Control Center, and MassHighway's RTOC. This agreement includes video sharing, established through the Massachusetts Interagency Video Information System (MIVIS), as well as data sharing and communications network expansion.

For traffic signal operations, no formal agreements are in place. However, existing coordination is described below:

- Out of approximately 124 signalized intersections on MDC roadways within the city of Boston, 20 are linked with BTD's central system and are operated from its TMC. No formal agreement has been established.

- BTD is in discussion with Massport regarding the potential operations of Massport traffic signals in South Boston by BTD. This same issue will need to be addressed for the traffic signals along the CA/T corridor.

5.3.1.2 Incident Management

The following formal agreements have been established for incident management:

- The *Unified Response Manual (URM) for Roadway Traffic Incidents* establishes a statewide traffic management plan for roadway incidents. The scope of the manual is limited to incidents on designated National Highway System (NHS) roadways and other principal arterials. The URM was developed by the Massachusetts Operations Action Group, consisting of representatives from the following agencies:

  - Massachusetts Highway Department
  - Massachusetts Turnpike Authority
  - Massachusetts Department of Public Health
  - Federal Highway Administration
  - Massachusetts State Police
  - Fire Chiefs' Association of Massachusetts
  - Massachusetts Department of Environmental Protection
  - Statewide Towing Association

  The original agreement was approved and signed in December 1998, but is currently being updated.

- An "Accident Response / Quick Clearance Agreement" between MassHighway and the State Police, originally signed in April 1993, is included in the 1998 URM as an annex. This agreement has since been updated, a revised version having been signed in August 2003.

- As part of the CA/T project, an Incident Management and Communication Agreement was developed by and among the following agencies:

  - Massachusetts Highway Department
  - Massachusetts Turnpike Authority
  - Massachusetts Port Authority
  - Massachusetts State Police
  - Boston Fire Department
  - Boston Emergency Medical Services
  - Boston Police Department
  - Boston Transportation Department

  An initial agreement was developed and approved for the opening of the Ted Williams Tunnel in December 1995. The document was revised in 2001 in anticipation of opening additional portions of the project, but this revised draft has not been formally approved.

Informal mutual-aid agreements also exist between agencies for incident response. For example, Massport and MassHighway coordinate response to incidents on the Tobin Bridge and its approaches without formal written agreements.

5.3.1.3 Multimodal Coordination

Agreements for multimodal coordination in the region relate to traffic signal priority for MBTA transit vehicles. BTD is working with the MBTA on transit signal priority on Washington Street as part of the Silver Line project. Signal priority is also provided to Green Line vehicles on Commonwealth Avenue. However, no formal agreements have been established for this coordination.

5.3.1.4 Traveler Information

SmarTraveler, a private traveler information service provider, is under contract with MassHighway and the MBTA to provide traveler information services to those agencies. SmarTraveler also has an agreement with Massport to obtain travel time information from Logan Express buses acting as probe vehicles. This agreement is not formalized, however. SmarTraveler also has access to MDC radio frequencies as a source of incident information.

5.3.1.5 Electronic Toll Collection

The Massachusetts Turnpike Authority operates the “Fast Lane” electronic toll collection (ETC) system for use at its toll plazas across the state. The Turnpike Authority is a member of the Inter-Agency Group (IAG), a coalition of toll agencies in the Northeast U.S. operating the E-ZPass ETC system, with which the Fast Lane system is interoperable.

Massport, which operates the Tobin Bridge toll plaza, is also a member of the IAG. However, Massport does not issue toll transponders and instead relies on the Turnpike Authority to issue transponders and administer accounts. The Turnpike Authority’s Account Processing Center (APC) handles these functions and manages the transfer of Tobin Bridge toll charges to Massport. An MOU between Massport and the Turnpike Authority formalizes this relationship.

Fast Lane transponders are also accepted for payment at the Route 128 MBTA/Amtrak parking garage in Westwood. Massport is also planning support for Fast Lane payment in its new parking management and revenue control system for its garages at Logan Airport.

5.3.1.6 Emergency Management

The Boston Emergency Management Agency (BEMA), in association with other emergency management agencies in the region, has developed of a number of emergency management plans that establish procedures for coordination during emergencies. These include the following:

- Boston Emergency Response Plan
- Boston Comprehensive Emergency Management Plan
- Boston's Emergency Liaisons Response Plan
- Boston's Interoperability Communications Plan
- Boston's Critical Incident Exodus Evacuation Plan
- Boston's Emergency Shelters
- Boston's Local Emergency Planning Committee Title III Facilities
- Boston's Corporate Community Access Plan for Business Continuity
- Boston's Threat Conditions Matrix Response Plan
- Boston's Threat and Vulnerability Analysis
- Critical Public Safety Infrastructure Earthquake Analysis and HAZUS (Loss Estimation Software)
- Boston's Consequences Assessment Tool Set (CATS) and Hazard Prediction and Assessment Capability (HPAC) (Plume Modeling Capability)

5.3.1.7 Amber Alerts

The Massachusetts Amber Alert Plan documents the criteria and procedures for issuing public alerts about abducted children and their kidnappers. The initial implementation of the plan in October 2002 was an agreement by and among the Massachusetts Chiefs of Police Association, the Massachusetts State Police, the Massachusetts Emergency Management Agency (MEMA), and local broadcasters for the broadcast of child abduction alert messages via radio, cable and television stations statewide.

Extension of the plan to include posting of messages on highway variable message signs is under development. MassHighway is leading a project to review and establish policies and procedures for managing Amber Alert notifications. Participants in this project include MassHighway, MassPike, Massport, SmartRoutes, MEMA, and the State Police.

5.3.2 ELEMENTS OF AN AGREEMENT

Agreements are established to clearly define responsibilities among the involved parties. The level of formality generally increases as risks escalate and when financial transactions take place. Formality will also increase when the performance or lack of performance on the part of one agency impacts the operations of another. For example, if an agency maintains and operates the traffic signals of another agency, clear definition of responsibilities for both parties will help ensure smooth operations.

Exhibit 5-34 presents a list of elements to consider in the development of an agreement for ITS operations and maintenance. Not all elements are relevant to each exchange of information. The level of specificity will depend on the nature of the interface.

Exhibit 5-34: Elements of an Agreement

- Operational Concept (a layperson's introduction to the nature and purpose of the agreement)
- Benefits of the agreement (e.g. operational, economic)
- Duties of Responsible Agencies (a summary of duties and responsibilities)
- Data Sharing (aspects of sharing data to be considered)
  - Provision of Data
  - Data Rights
  - Data Reuse
  - Data Identification
  - Data Availability
  - Data Accuracy
- Control Sharing (aspects of sharing control to be considered with rights and priorities being clearly understood)
  - Provision of Control
  - Control Rights
  - Control Restrictions
  - Control Priority
  - Control Availability
- Connections (defines how the connection is made)
  - Provision of Equipment
  - Physical Access Point
  - Demarcation Point / Boundary
  - Security
  - Configuration Management
  - Standards and Protocols
- System Documentation
- Operations
  - Contacts
  - Hours of Operations
  - Responsibilities
- Maintenance
  - Contacts
  - Hours of Operations
  - Responsibilities
  - Response Time
- Liability
  - Indemnity
  - Damage to Equipment
- Ownership
  - Equipment
  - Software
  - Intellectual Property
- Coordination
  - Notification
  - Periodic Reporting
  - Pre-Change Coordination
- Dispute Resolution
- Termination of Agreement
- Compensation

5.3.3 RECOMMENDED AGREEMENTS

In general, all interagency interfaces identified in this architecture should be covered by formal agreements. This includes interfaces under development or proposed in the architecture that have not yet been implemented, as well as interfaces that are currently operational but without a formal agreement.

5.3.3.1 Formalization of Existing Working Arrangements

Although some existing informal agreements may be operating without apparent problems, there are a number of considerations that point to the need for adoption of a formal agreement:

- *Rationale for agreement:* A formal agreement that explains the reasoning behind the agreement and that lays out the benefits of the cooperation will help justify the arrangement to the participating parties, other agencies that would benefit from coordination, and to the public. This will help build and maintain support for continuing a beneficial relationship, especially when the agreement may be reconsidered in the future.

- *Documentation of procedures:* By documenting existing procedures that are operating successfully, a formal agreement can help maintain an interface in the face of personnel or administrative change. An informal agreement that relies solely on interpersonal relationships at the operating level may quickly dissolve if operating staff changes occur.

- *Institutional commitment:* Adopting a formal agreement shows commitment by the participating agencies to continue the relationship. While an informal agreement shows commitment at the operating level, a formal agreement shows commitment at the institutional level. Support for a relationship at the administrative levels of the participating agencies will be essential for continued operation of the interface.

- *Address liability issues:* In a cooperative arrangement, situations may arise where one or both parties may be held liable for damage or injuries sustained as a result of human or technical error. A formal agreement that documents agency roles and responsibilities with consideration for liability concerns will speed the process of conflict resolution and reduce resulting legal costs.

For the reasons outlined above, it is therefore recommended that existing working arrangements be considered for formalization. Especially important are those working arrangements that involve technical coordination and cost considerations, as well as arrangements involving public safety. Therefore, the following existing arrangements are recommended for formalization:

- BTD and MassPike: CA/T video sharing
- BTD and MDC: MDC traffic signal operation
- BTD and MBTA: Transit signal priority
- MassHighway and Massport: Mutual aid for Tobin Bridge incidents

5.3.3.2 Agreements for New Interfaces

Agreements should also be developed for the new interfaces proposed in the Regional ITS Architecture. All of the interagency interfaces in the architecture are identified and categorized in Section 5.2. As with the existing informal agreements, all interfaces should have formal agreements. However, the key interfaces to consider initially are those involving technical coordination and those involving emergency management, as shown in Exhibit 5-35.

Exhibit 5-35: Recommended Agreements for New Interfaces

Functional Area	*Interface Type*
Roadway Management	Center-to-Center
Transit Management	Center-to-Center
	Traffic Coordination
Emergency Management	Center-to-Center
	Traffic Coordination
Data Archives	Planning Archives
Electronic Fare Payment	Regional Fare Card
Electronic Toll Collection	Parking Facility Payment

5.3.3.3 Sample Interagency Agreements

To illustrate the components of an interagency agreement, Appendix F presents two sample interagency agreements:

- The first is an example of an agreement between an RTA and a municipality. This agreement corresponds to the "Transit Management – Traffic Coordination and Signal Priority" operational concept that was shown in Exhibit 5-16.

- The second is an example of an agreement between a traffic management agency and an emergency management or public safety agency. This agreement corresponds to the "Emergency Management – Traffic Coordination" operational concept that was shown in Exhibit 5-21.

As recommended, the agreements document the rationale for the agreement as well as the operational procedures that govern the relevant interfaces.

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6. IMPLEMENTATION PLAN

This chapter presents a strategy for implementing the systems defined in the Regional ITS Architecture for Metropolitan Boston. This strategy is developed directly from preceding steps in the architecture development process, as illustrated in Exhibit 6-1.

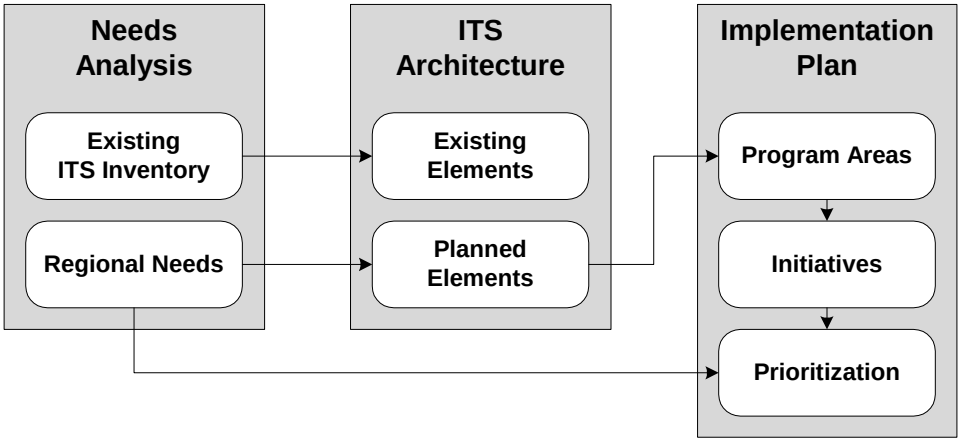

Exhibit 6-1: Implementation Plan Development Process

The architecture identifies a large number of ITS elements for the region, classified as either "existing" or "planned." Elements classified as "existing" are those that are already implemented or those that are far enough along in the design stage that the interfaces are already determined. These elements, identified in the ITS inventory from the needs analysis, therefore are not addressed in the Implementation Plan.

The elements that must be considered in the Implementation Plan are those classified as "planned," i.e. those that have not yet been designed or implemented but that are envisioned to be implemented within a ten-year horizon. These elements were identified based on the outcome of the Needs Analysis and the input from stakeholders during the architecture workshop. In addition to the planned ITS elements, there are planned interfaces that must be considered. For example, a planned interface between two existing control centers must be included in the Implementation Plan, even though it is not associated with a planned element in the inventory.

In developing the Implementation Plan, the planned elements identified are considered both by function and by stakeholder. Considered functionally, the planned elements are grouped into ***program areas*** that encompass elements that address a specific functional need. Each program area represents a general area for investment identified through the architecture development process.

Within each of the program areas, a series of ***initiatives*** is defined, representing a means of implementing the elements with that program area. Each initiative may encompass a number of planned elements that are recommended for simultaneous implementation. Although a single stakeholder will lead some initiatives, many initiatives will require the participation of two or more agencies.

As an example, consider the interface between a MassHighway District Office and MassHighway maintenance vehicles. The information flows between these entities include maintenance and construction dispatch data, location data, and status data. These interfaces can be grouped under a single initiative, namely "MassHighway CAD/AVL," as each of these information flows would likely be implemented as part of a single CAD/AVL deployment. These interfaces would also fall under a broader program area, namely "CAD/AVL for Maintenance Vehicles," that would also include CAD/AVL projects for maintenance vehicles at other agencies, such as local cities and towns. As

the example illustrates, the program area defines the functional area recommended for implementation, namely CAD/AVL for Maintenance and Construction, while the initiative defines a specific deployment.

Finally, the Implementation Plan also considers prioritization of the identified initiatives, identifying candidates for near-term and longer-term implementation. This prioritization is based on the needs analysis, the input received from the stakeholders throughout the architecture development process, and interdependencies among the initiatives.

Through this process, a comprehensive list of program areas and initiatives has been developed that encompasses all of the planned elements from the architecture. The remainder of this chapter is organized as follows:

- Section 6.1 presents the program areas and initiatives of the Implementation Plan, grouped by function.
- Section 6.2 presents the strategy for implementation, considering the prioritization of the initiatives identified in Section 6.1.

6.1 Program Areas and Initiatives

This section presents a set of program areas, along with a recommended set of initiatives to be implemented within each program area. Each program area represents a general area of investment that is needed for implementation of the architecture.

Presented within each program area is a series of initiatives that provide a method of implementing that portion of the architecture. Some of the initiatives are currently planned initiatives that were identified in the development of the architecture. The others are recommendations for initiatives that address the needs identified in the development process. The initiatives defined in this section are not the only means by which the architecture can be implemented, however. Instead, this plan provides one method of grouping the planned elements of the architecture into initiatives that together address the needs and planned components from the architecture.

Each of the initiatives presented indicates the stakeholders that are involved. While many initiatives involve only a single stakeholder, in some cases an initiative requires participation from multiple agencies. Furthermore, some initiatives are listed for a collective group of stakeholders, such as Regional Transit Authorities. These initiatives are not necessarily meant to cover multiple agencies or to consist of a one-time deployment. Instead, each represents an initiative that can be implemented multiple times within the region and on any scale, from single-agency to multi-agency to region-wide implementation.

The subsections below present the program areas and initiatives arranged by function, based on the service areas or high-level grouping of market packages defined in the National ITS Architecture. The program areas are presented under the following functional groupings:

- Traffic Management
  - Roadway Management
  - Parking Management
- Maintenance and Construction Management
- Public Transportation
  - Transit Management
  - Electronic Fare Payment
- Traveler Information
- Commercial Vehicle Operations
- Emergency Management
- Archived Data Management

In addition, there are a number of program areas that cut across multiple functions and thus do not fall under a single classification. These multi-function programs are presented in Section 6.1.1.

6.1.1 MULTI-FUNCTION PROGRAM AREAS

Presented in this section are the program areas that cut across multiple functional areas, and therefore cannot be classified under a single function. These program areas consist of those that provide or support more than one function, such as both traffic management and transit management.

6.1.1.1 Information Sharing (Events)

This program area covers the sharing of event information among the various operations centers in the region. This addresses the center-to-center interfaces for event data that are shown in the architecture between these elements, including both roadway and transit control centers. The functional areas covered by this program area are Traffic Management, Maintenance and Construction Management, Public Transportation, and Traveler Information.

The interfaces covered by this program area can be implemented through an event reporting system, as recommended through the architecture development process. The following initiative addresses this program area.

Event Reporting System

This initiative will develop an event reporting system for exchanging of event information. This system, envisioned to be an expansion of the pilot system for Pioneer Valley developed by MassHighway, is an Internet-based tool that serves as a centralized repository for information on events affecting the transportation network. Participating agencies can enter information about events within their jurisdiction and can view information entered by other agencies, thus providing a central system for information exchange. The participating agencies are the following:

- *Roadway Agencies:*
  - Boston Transportation Department (BTD)
  - City of Brockton
  - Local Cities/Towns
  - Massachusetts Highway Department (MassHighway)
  - Massachusetts Turnpike Authority / Central Artery/Tunnel (MassPike / CA/T)
  - Massachusetts Port Authority (Massport)
  - Metropolitan District Commission (MDC)
- *Transit Agencies:*
  - Brockton Area Transit (BAT)
  - Cape Ann Transportation Authority (CATA)
  - Greater Attleboro-Taunton Regional Transit Authority (GATRA)
  - Lowell Regional Transit Authority (LRTA)
  - Massachusetts Bay Transportation Authority (MBTA)
  - Merrimack Valley Regional Transit Authority (MVRTA)
  - Local Cities/Towns
  - Other Transit Providers
- *Emergency Management Agencies:*
  - Boston Emergency Management Agency (BEMA)
  - Local City/Town Public Safety
  - MBTA Police
  - Massachusetts Emergency Management Agency (MEMA)
  - State Police

Examples of information to be exchanged include real-time information on incidents and delays, as well as planned events such as construction, road closures, or traffic-generating special events. While emergency management agencies are included in the list of participants, the system to be developed in this program area is only meant for the exchange of information for traffic and transit management purposes. Emergency management coordination is addressed by an extension of this system, as described in Section 6.1.9.1.

This system will provide multiple ways for each agency to interface with the system. For agencies with central control center software, the system will support an automated interface with the agency, allowing event information to be sent directly to the system from the control center's central software. For agencies that have yet to implement central operations software, the event reporting system can also be used as a stand-alone system, with information entered by an operator through a web-based interface.

In addition to being used for information sharing among the participating agencies, the system will also serve as tool for information dissemination by allowing other users to view information entered into the system. These other users can include emergency management agencies, private information service providers, or even the public. The system can also serve as a source of data for the planned 511 Travel Information System, as described in Section 6.1.7.1.

6.1.1.2 Information Sharing (Video)

This program area covers the sharing of video data between the various operations centers in the region. This addresses the center-to-center interfaces for video data that are shown in the architecture between roadway control centers. The functional areas covered by this program area are Traffic Management, Maintenance and Construction Management, Public Transportation, and Traveler Information.

The interfaces covered by this program area can be implemented through an expansion to the Massachusetts Interagency Video Information System (MIVIS). The following initiative addresses this program area.

Expansion of MIVIS

MassHighway, BTD, MBTA, SmartRoutes, and the State Police have already established video sharing in the Boston area through the Massachusetts Interagency Video Information System (MIVIS). This initiative expands this system to allow sharing of real-time video feeds among a larger group of agencies. The primary participating agencies are those with video capabilities, including:

- BTD
- Local Cities/Towns (as applicable)
- MassHighway
- MassPike / CA/T
- Massport
- Private Information Service Providers
- State Police

Other agencies, however, such as transit and other emergency management agencies, can also be included as recipients of the video data. This will support coordination among operations centers within the region, allowing one center to view the CCTV images from other participating agencies. The system will also provide travel information functions, allowing video to be distributed to private information service providers or publicly available websites, such as the planned 511 Travel Information System website, as described in Section 6.1.7.1. The system to be developed through this initiative is only meant for the exchange of video for traffic and transit management purposes. Emergency management coordination is addressed by an extension of this system, as described in Section 6.1.9.1.

6.1.1.3 Interagency Communications Network

This program area addresses the communications requirements of the center-to-center and center-to-field interfaces that are shown in the architecture. The functional areas covered by this program area are Traffic Management, Maintenance and Construction Management, Public Transportation, Traveler Information, and Archived Data Management. The following initiative addresses this program area.

Interagency Communications Network

This initiative establishes a communications network linking the region's roadway and transit agencies. The primary participating agencies are the following:

- BTD
- Local Cities/Towns
- MassHighway
- MassPike / CA/T
- Massport
- MDC
- MBTA

These agencies have developed or are developing communications networks to support their operational needs, but many of these networks do not provide the full coverage necessary for their operations. For example, many agencies fill the gaps in their communications networks with leased lines from private telecom providers, leading to high operational costs.

This initiative takes advantage of the geographic overlap of many of these networks and addresses the communications requirements in two ways. First, opportunities for sharing existing communications infrastructure will be identified, leading to agreements for unused bandwidth on an agency's network to be used by other agencies with need. This will allow better use of the existing network and eliminate unnecessary duplication of infrastructure. Second, existing gaps in the overall communications network will be identified, and these gaps will be filled though joint implementation projects. This will allow agencies to pool resources to build infrastructure that benefits each of the partners.

The network to be developed in this program area this is meant for traffic and transit management purposes. Communications for emergency management is addressed in a separate initiative, as described in Section 6.1.9.1.

6.1.2 TRAFFIC MANAGEMENT: ROADWAY MANAGEMENT

6.1.2.1 Roadway Monitoring

This program area covers improvements to the traffic monitoring capabilities of the region's agencies with traffic management functions. This addresses planned elements in the architecture relating to field surveillance, additional deployments of field equipment and control centers, and the interfaces of field equipment with the appropriate control center.

This program area addresses the need for traffic data through two means: deployment of devices for monitoring traffic conditions on roadways, and obtaining traffic data through probe surveillance. The following initiatives fall under this program area:

Traffic Monitoring Deployment (Local Cities/Towns, including Brockton)

This initiative covers the further deployment of devices for monitoring traffic conditions on city and town roads. This will include placement of vehicle detectors and roadside CCTV cameras, as well as devices for monitoring roadway conditions such as weather sensors. This field

equipment will be connected to local control centers, where it will provide data to control center operators. The initiative will cover the installation of these devices, establishment of control centers in municipalities where they are not currently present, and implementation of a communications link with the appropriate control center.

Traffic Monitoring Deployment (BTD)

This initiative covers the further deployment of devices for monitoring traffic conditions on roadways operated by the Boston Transportation Department. This will include installation of vehicle detectors and CCTV cameras. This field equipment will be monitored at the BTD Traffic Management Center (TMC). The initiative will cover the installation of these devices along with the communications link to the TMC.

Traffic Monitoring Deployment (MassHighway)

This initiative covers the further deployment of devices for monitoring traffic conditions on roadways operated by MassHighway. This will include placement of vehicle detectors and roadside CCTV cameras. This field equipment will be connected to the MassHighway Traffic Operations Center (TOC), where it will be integrated into the TOC central software. The initiative will cover the installation of these devices along with the communications link to the TOC.

Traffic Monitoring Deployment (Private Information Service Providers)

This initiative covers private-sector deployment of field equipment for traffic monitoring. This equipment, including vehicle detectors and roadside CCTV cameras, will be linked to centers operated by private travel information service providers. The initiative will cover the installation of this equipment, communications links with the private operations center, and communications links from the private operations center to relevant public-sector operations centers.

Highway Probe Surveillance (MassHighway, MassPike)

This initiative makes use of existing and planned vehicle identification systems to produce travel time data for operations and planning purposes. The prime implementing agencies will be those managing highway operations, namely MassHighway and the Turnpike Authority. This initiative will make use of probe information from systems that provide vehicle identification, including Electronic Toll Collection (ETC) systems and Automatic Vehicle Location (AVL) systems. Either through ETC roadside readers or through AVL data provided by fleet operators, the agencies will obtain travel time information for roadways under their jurisdiction.

6.1.2.2 Roadway Control

This program area covers improvements to traffic control capabilities for agencies with traffic management functions. This addresses planned elements in the architecture relating to information dissemination, as well as the interfaces of this equipment with the appropriate control center. The program area includes installation and expansion of centralized signal control systems as well as further deployment of field equipment.

Expansion of City of Boston Centralized Signal Control (BTD)

This initiative builds on the existing interface between the BTD Traffic Management Center and BTD Traffic Signals by expanding the scope of the centralized signal system. This initiative addresses a need for system expansion identified by BTD in the Needs Analysis.

BTD operates approximately 400 signalized intersections under central control from its Traffic Management Center (TMC). In addition to city signals, certain signals owned by MDC, MassPike, and Massport are also operated from the TMC. This initiative increases the number

of intersections tied into the central system, thereby expanding the coverage of the control center and allowing greater traffic control within the city. In addition to upgrades and further deployment of field equipment, this initiative also covers additional communication infrastructure to support the expanded system.

Centralized Signal Control (Local Cities/Towns, including Brockton)

This initiative covers the integration of existing and new traffic signals into a centralized signal control system for a city or town. This would allow coordination of signals and adjustments to signal timings to be made in real-time from a centralized location. In addition to upgrades and further deployment of field equipment, this initiative also covers additional communication infrastructure to support the signal system.

Expansion of Centralized Signal Control (MassHighway)

This initiative builds on the existing interface between MassHighway Districts and MassHighway traffic signals by expanding the scope of existing closed-loop signal systems. This initiative increases the number of intersections tied into the systems at district offices, thereby expanding coverage and facilitating signal coordination within the region. In addition to upgrades and further deployment of field equipment, this initiative also covers additional communication infrastructure to support the expanded system.

Variable Message Sign Deployment (BTD)

This initiative comprises the deployment of Variable Message Signs (VMSs) on roadways operated by BTD. These VMSs will be controlled from the TMC, allowing real-time information to be disseminated to drivers on city streets. This information can include traffic conditions, routing information, and parking space availability. These signs will require a communications interface with the TMC.

Variable Message Sign Deployment (Local Cities/Towns, including Brockton)

This initiative comprises the deployment of Variable Message Signs on roadways operated by local cities and towns. These VMSs will be controlled from local control centers, allowing real-time information to be disseminated to drivers on city and town roads. This information can include traffic conditions, routing information, and parking space availability. These signs will require a communications interface with local control centers.

Expansion of Variable Message Sign Deployment (MassHighway, MassPike)

This initiative comprises the deployment of additional Variable Message Signs on roadways operated by MassHighway and the Turnpike Authority. Like those already deployed in the region, these VMSs will be controlled from the operating agency's control center. In addition to upgrades and further deployment of field equipment, this initiative also covers additional communication infrastructure to support the system expansion.

6.1.2.3 Roadway Management Coordination

This program area covers improvements to coordination among agencies with traffic management functions. This addresses the center-to-center interfaces shown in the architecture among the various centers operated by traffic management agencies and private information service providers.

In addition to the initiatives described in this section, there are a number of multi-function program areas that address Roadway Management Coordination, including the video integration and event reporting systems. These are described in Section 6.1.1.

Remote MassHighway TOC Workstation

This initiative consists of the installation of a back-up workstation for the Traffic Operations Center (TOC) at the Massachusetts Emergency Management Agency (MEMA) in Framingham. This workstation will allow viewing of event and response information at MEMA under normal operating conditions, and will allow remote operation of MassHighway field equipment under emergency operating conditions. This initiative will include the workstation hardware and software, as well as the necessary communications between the remote workstation and the TOC.

Interface between MassHighway TOC and MassPike CA/T OCC (MassHighway and MassPike)

This initiative provides a direct data interface between the MassHighway Traffic Operations Center (TOC) and the MassPike CA/T Operations Control Center (OCC). The interface will support the exchange of traffic data such as speed, flow, and occupancy between the two control centers. This will allow an operator at one control center to view output from selected traffic detectors from the other control center.

6.1.3 TRAFFIC MANAGEMENT: PARKING MANAGEMENT

6.1.3.1 ETC Integration for Parking

This program area covers acceptance of Electronic Toll Collection transponders at parking facilities within the region. This addresses the interfaces in the architecture between the MassPike FAST LANE transponders and various parking facilities and parking management systems.

Agencies with parking facilities include BTD, Local Cities and Towns, Massport, and the MBTA. Due to the means by which the transponders are read, the use of the regional electronic collection transponders is limited to parking lots and garages with controlled entry and exit points. This implementation allows parking fees to be deducted from the user's account balance. In addition to acceptance of the transponders at parking facilities, the system will also support reconciliation of accounts between each parking facility operator and the MassPike, who operates the current electronic toll collection program.

ETC Integration at Parking Facilities (BTD)

This initiative introduces acceptance of the regional ETC transponders at parking facilities operated by BTD. In addition to acceptance of the transponders at parking facilities, the system will also support reconciliation of accounts between BTD and the MassPike.

ETC Integration at Parking Facilities (Local Cities/Towns, including Brockton)

This initiative introduces acceptance of the regional ETC transponders at parking facilities operated by local cities and towns. In addition to acceptance of the transponders at parking facilities, the system will support reconciliation of accounts between local parking facility operators and the MassPike.

ETC Integration at Parking Facilities (MBTA)

This initiative provides for acceptance of the regional ETC transponders at MBTA-operated parking facilities, extending the current pilot project at the Route 128 Station parking garage. In addition to acceptance of the transponders at parking facilities, the system will support reconciliation of accounts between the MBTA and the MassPike.

Logan Parking Management System (Massport)

This initiative establishes a Parking Management System for the parking facilities at Logan Airport. As part of this system, the regional ETC transponders will be accepted for payment at the parking facilities. The system also includes revenue and inventory control functions, as well as ITS elements such as pre-selling of parking spaces, parking space wayfinding, a pay-on-foot system for parking and bus ticketing, and display of parking information on airport VMSs.

ETC Integration at Parking Facilities (Massport)

This initiative introduces acceptance of the regional ETC transponders at Massport-operated parking facilities. As ETC payment at Logan parking facilities in included in the Logan Parking Management System project, this will cover facilities such as Logan Express parking lots. This system will make use of the existing agreement between Massport and the Turnpike for reconciliation of ETC accounts for Tobin Bridge tolls.

ETC Integration at Parking Facilities (Other Parking Operators)

In addition to the parking facilities operated by the agencies discussed above, there are a large number of parking facilities operated by other organizations. These organizations include other public agencies (e.g. the Massachusetts Convention Center Authority) as well as private companies. This initiative introduces acceptance of the regional ETC transponders at parking facilities parking facilities operated by these other organizations. In addition to acceptance of the transponders at parking facilities, the system will support reconciliation of accounts between parking facility operators and the MassPike.

6.1.3.2 Regional Fare Card Integration for Parking

This program area covers acceptance of the planned Regional Fare Card, discussed in Section 6.1.6.2, at parking facilities operated by agencies within the region. This addresses the interfaces in the architecture between the Regional Fare Card and the various parking facilities and parking management systems.

Agencies with parking facilities include BTD, Local Cities and Towns, Massport, the MBTA, and the other Regional Transit Authorities. This program area covers metered parking as well as ticketed parking lots and garages, allowing parking fees to be deducted from the balance on a patron's Fare Card. In addition to acceptance of the new media at meters and parking facilities, the systems will also support reconciliation of accounts between the parking operators and the Regional Fare Card agency.

Automated Fare Collection for Parking Facilities (MBTA)

This initiative extends the MBTA's planned Automatic Fare Collection (AFC) system, described in Section 6.1.6.1, to MBTA parking facilities, allowing payment by fare card for parking fees. This will include fare card readers at parking facility exits, potentially additional fare vending machines at parking facilities, and upgrading the communications infrastructure to support the new data requirements.

Regional Fare Card Integration at Parking Facilities (BTD)

This initiative introduces acceptance of the planned Regional Fare Card at parking facilities operated by BTD. This includes both on-street metered parking as well as off-street municipal lots. In addition to acceptance of the new media at BTD parking meters, the system will also support reconciliation of accounts between BTD and the Regional Fare Card agency.

Regional Fare Card Integration at Parking Facilities (Local Cities/Towns, including Brockton)

This initiative introduces acceptance of the planned Regional Fare Card at parking facilities operated by local cities and towns. This will include metered parking as well as ticketed parking lots and garages. In addition to acceptance of the new media at meters and parking facilities, the system will support reconciliation of accounts between the local parking operators and the Regional Fare Card agency.

Regional Fare Card Integration at Parking Facilities (Massport)

This initiative will introduce acceptance of the planned Regional Fare Card at Massport-operated parking facilities. This will include Logan parking facilities (through an extension to the Logan Parking Management System) as well as other facilities, such as Logan Express lots. In addition to acceptance of the new media, the system will support reconciliation of accounts between Massport and the Regional Fare Card agency.

Regional Fare Card Integration at Parking Facilities (BAT, CATA, GATRA, LRTA, MVRTA)

This initiative introduces acceptance of the planned Regional Fare Card at parking facilities operated by Regional Transit Authorities within the study area. In addition to acceptance of the new media parking facilities, the system will support reconciliation of accounts between each RTA and the Regional Fare Card agency.

Regional Fare Card Integration at Parking Facilities (Other Parking Operators)

This initiative introduces acceptance of the planned Regional Fare Card at parking facilities operated by other parking facility operators. In addition to acceptance of the new media at parking facilities, the system will support reconciliation of accounts between the parking operators and the Regional Fare Card agency.

6.1.4 MAINTENANCE AND CONSTRUCTION MANAGEMENT

6.1.4.1 Environmental Sensors

This program area covers the deployment of environmental sensors on roadways in the region. It addresses the planned environmental sensor elements in the architecture, including those for BTD, Massport, and local cities and towns, as well as expansion of existing deployments.

These devices include weather stations reporting measures such as air temperature and precipitation, as well as sensors reporting on the condition of the roadway surface. Through a communications link with a central control center, the sensors will provide their information on a computer interface for control center operators.

Environmental Sensors (BTD)

This initiative comprises the deployment of environmental sensors on roadways operated by BTD, as well as an interface with the BTD Traffic Management Center (TMC).

Environmental Sensors (Local Cities/Towns, including Brockton)

This initiative comprises the deployment of environmental sensors on roadways operated by local cities and towns, as well as an interface with local control centers.

Environmental Sensors (Massport)

This initiative comprises the deployment of environmental sensors on roadways operated by Massport, as well as interfaces with the relevant control centers (i.e. the Landside Operations Control Center, the Facilities Maintenance Unit, and/or the Aviation Operations Unit).

6.1.4.2 CAD/AVL for Maintenance Management

This program area covers the provision of Computer-Aided Dispatching/Automatic Vehicle Location (CAD/AVL) systems for managing maintenance vehicles. This addresses the planned interfaces in the architecture between control centers and maintenance vehicles, such as those of BTD, MassHighway, MassPike, and Massport.

The systems to be implemented under this program area allow a control center to track its vehicles in real-time and to dispatch those vehicles in the most efficient manner. This program requires equipment in each vehicle to be tracked, as well as a central system at the dispatch center to receive and manage the tracking information.

CAD/AVL for Maintenance Vehicles (Local Cities/Towns, including Brockton)

This initiative provides CAD/AVL systems for managing city and town maintenance vehicles. This initiative will require equipment in each vehicle to be tracked, as well as a central system at the local dispatch center to receive and manage the tracking information.

CAD/AVL for Maintenance Vehicles (MassHighway)

This initiative provides a CAD/AVL system for managing MassHighway maintenance vehicles. Similar to the system in place for tracking the CaresVan roadway service patrol vehicles and snowplow contractors, this system will require equipment in each vehicle to be tracked, as well as central systems at the MassHighway District TOC and statewide TOC to receive and manage the tracking information.

CAD/AVL for Maintenance Vehicles (MassPike)

This initiative provides a CAD/AVL system for managing MassPike maintenance vehicles. This system will require equipment in each vehicle to be tracked, as well as a central system at the operations depots to receive and manage the tracking information.

6.1.5 PUBLIC TRANSPORTATION: TRANSIT MANAGEMENT

6.1.5.1 CAD/AVL for Transit

This program area covers the provision of Computer-Aided Dispatching/Automatic Vehicle Location (CAD/AVL) systems for managing transit vehicles. This addresses the planned interfaces in the architecture between transit control centers and transit vehicles for agencies such as the MBTA and the other Regional Transit Authorities, Local City/Town services, and other transit providers such as TMAs and local human service agencies.

The systems to be implemented under this program area allow a dispatch center to track its vehicles in real-time and to manage its fleet more efficiently. This will be applicable to both fixed-route and paratransit operations centers. For fixed-route services, real-time tracking allows more efficient fleet management and allows the provision of real-time service status to passengers both pre-trip and en-route. For paratransit services, it allows more efficient dispatching and faster response time.

This information is also used to provide real-time service status to passengers both pre-trip and en-route. The systems will require equipment in each vehicle to be tracked, as well as a central system

at the dispatch center to receive and manage the tracking information. For the traveler information component, this system will also include a means for disseminating this information, such as electronic signs at shuttle stops or a websites with real-time information.

CAD/AVL for Transit Vehicles (Local Cities/Towns)

This initiative provides a CAD/AVL system for managing local city and town transit vehicles. This initiative will require equipment in each vehicle to be tracked, a central system at the local dispatch center to receive and manage the tracking information, and a means for disseminating this information to the public.

CAD/AVL for Transit Vehicles (MBTA)

This initiative establishes a CAD/AVL system for managing MBTA buses. Similar to the system in place for the Silver Line buses, this system will allow the Bus Operations Center to track vehicles in real-time and to manage the fleet more efficiently. This information will also be used to provide real-time service status to passengers both pre-trip and en-route. This initiative will require equipment in each vehicle to be tracked, a central system at the Operations Center to receive and manage the tracking information (perhaps building on the existing system for the Silver Line), and a means for disseminating this information to the public.

CAD/AVL for Transit Vehicles (BAT, CATA, GATRA, LRTA, MVRTA)

This initiative provides a CAD/AVL system for managing transit vehicles operated by Regional Transit Authorities within the study area, allowing an RTA dispatch center to track its vehicles in real-time. This initiative will require equipment in each vehicle to be tracked, a central system at each RTA dispatch center to receive and manage the tracking information, and a means for disseminating this information to the public.

CAD/AVL for Transit Vehicles (Other Transit Providers)

In addition to the MBTA and the other RTAs, there are a number of other providers of transit service in the region. These include Transportation Management Associations (TMAs), local human service transit providers, as well as private paratransit operators under contract with the MBTA. This initiative establishes a CAD/AVL system for managing transit vehicles operated by these other transit providers, allowing a transit dispatch center to track its vehicles in real-time. This initiative will require equipment in each vehicle to be tracked, a central system at each dispatch center to receive and manage the tracking information, and a means for disseminating this information to the public.

6.1.5.2 Traffic Signal Priority

This program area covers signal priority for buses operated by transit agencies within the study area. This addresses the planned interfaces between transit vehicles and traffic signal systems shown in the architecture.

The systems to be implemented under this program area require coordination between the relevant agency and the cities or towns in which signal priority will be requested for buses. Requests for traffic signal priority will be made to the traffic signal system controlled by the local city/town. This will occur either locally at the signal controller or through a request to the central system, if the signal is part of such a system. Depending on the type of system used, the system may include elements on the buses to identify them to the signal system, elements on the controller hardware in the field, elements in the central signal system, and the network infrastructure to support communications between these system elements.

Traffic Signal Priority (MBTA)

This initiative extends the signal priority system currently in place on the Silver Line to other bus routes in the MBTA system. This will require coordination with BTD and any other cities or towns in which signal priority will be requested for MBTA buses. Requests for traffic signal priority will be made to the traffic signal system controlled by BTD or the local city/town.

Traffic Signal Priority (BAT, CATA, GATRA, LRTA, MVRTA)

This initiative introduces signal priority on buses operated by Regional Transit Authorities within the study area. This will require coordination the relevant RTA and the cities or towns in which signal priority will be requested for buses. Requests for traffic signal priority will be made to the traffic signal system controlled by the local city/town.

6.1.6 PUBLIC TRANSPORTATION: ELECTRONIC FARE PAYMENT

6.1.6.1 Automated Fare Collection for the MBTA

This program area covers the replacement of the MBTA's existing fare collection system with a fare card system. This addresses the planned element of the Regional Fare Card in the architecture, as well as its interfaces with MBTA transit services. The system will cover fare collection on all subway, trolley, and bus services, with planned expansion to MBTA commuter rail services.

Automated Fare Collection for Subway/Bus (MBTA)

This initiative, currently being implemented, replaces the existing fare collection system with a cashless system based on fare cards. The Automated Fare Collection (AFC) system will consist of upgrades to turnstiles and fareboxes to accept the new fare media, vending machines for the new fare cards, a centralized fare collection and revenue management system, and supporting communications infrastructure upgrades. The system will cover fare collection on all subway, trolley, and bus services.

Automated Fare Collection for Commuter Rail (MBTA)

This initiative extends the AFC system to MBTA commuter rail services, allowing payment by fare card for commuter rail trips. This will include fare vending machines at commuter rail stations, fare card readers at stations or aboard trains, and upgrading the communications infrastructure to support the new data requirements.

6.1.6.2 Regional Fare Card

This program area covers acceptance of the planned Regional Fare Card (envisioned in the architecture to be interoperable with the MBTA's automated fare collection system) on non-MBTA transit services. This program area addresses the planned interfaces between the Regional Fare Card and services operated by the Regional Transit Authorities and other transit providers.

The systems to be implemented under this program area will allow fares on these services to be deducted from the balance carried on the Fare Card. In addition to acceptance of the new media aboard the vehicles, the system will also support reconciliation of accounts between the transit operator and the Regional Fare Card agency.

Regional Fare Card Integration for Transit Vehicles (Local Cities/Towns)

This initiative introduces acceptance of the planned Regional Fare Card on local shuttle services operated by local cities and towns. In addition to acceptance of the new media aboard the shuttles, the system will support reconciliation of accounts between the shuttle service operator and the Regional Fare Card agency.

Regional Fare Card Integration for Transit Vehicles (BAT, CATA, GATRA, LRTA, MVRTA)

This initiative introduces acceptance of the planned Regional Fare Card on transit services operated by Regional Transit Authorities within the study area. In addition to acceptance of the new media aboard transit vehicles, the system will support reconciliation of accounts between the RTA and the Regional Fare Card agency.

Regional Fare Card Integration for Transit Vehicles (Other Transit Providers)

This initiative introduces acceptance of the planned Regional Fare Card on transit services operated by other transit providers in the region. In addition to acceptance of the new media aboard the buses, the system will support reconciliation of accounts between the appropriate transit provider and the Regional Fare Card agency.

6.1.6.3 Regional Fare Card Integration for ETC

This program area covers the integration of the Regional Fare Card with the regional electronic toll collection (ETC) transponders. This addresses the planned interface shown in the architecture between the Regional Fare Card and the MassPike FAST LANE transponders. The following initiative addresses this program area.

Regional Fare Card Integration with ETC Transponders (Regional Fare Card Agency and MassPike)

This initiative covers the integration of the Regional Fare Card with the regional ETC transponders. This initiative will extend the planned Regional Fare Card for use in highway toll transactions, allowing transfer of funds from the fare card to the toll transponder. In addition to acceptance of the fare card media by the toll transponder, the system will also support reconciliation of accounts between the MassPike (the operator of the FAST LANE system) and the Regional Fare Card agency.

6.1.7 TRAVELER INFORMATION

6.1.7.1 Regional Travel Information

This program area covers the deployment of a regional travel information system, including a telephone-based system as well as other systems (e.g., websites, kiosks) covering the region's roadways and transit services. This program covers the regional implementation of the planned statewide 511 Travel Information System. This addresses the planned Travel Information Interactive Telephone System in the architecture, as well as its interfaces with MassHighway and Private Information Service Provider Operations Centers. The following initiative addresses this program area.

511 Travel Information System

This initiative consists of the deployment of a public travel information system covering the roadways and transit services in the region. The participating agencies are the following:

- *Roadway Agencies:*
  - BTD
  - City of Brockton
  - Local Cities/Towns
  - MassHighway
  - MassPike / CA/T
  - Massport
  - MDC

- *Transit Agencies:*
  - BAT
  - CATA
  - GATRA
  - LRTA
  - MBTA
  - MVRTA
  - Local Cities/Towns
  - Other Transit Providers

Although the lead agency for implementation will be MassHighway, all roadway and transit agencies in the region can provide information for dissemination through the system to be implemented under this program area. Examples of information to be provided include real-time information on incidents and delays, as well as planned events such as construction, road closures, or traffic-generating special events.

The system will provide travel information consolidated from the various roadway and transit agencies in the region. A travel information website will supplement the information provided over the phone-based system. The proposed event reporting system, described in Section 6.1.1.1, can serve as a source of data for this system, allowing event information to be collected from the various participating agencies for dissemination to the public via the telephone system and its associated website.

6.1.7.2 Agency-Specific Travel Information

This program area covers the development or expansion of travel information systems specific to particular roadway and transit agencies. This addresses planned components in the architecture relating to travel information dissemination, such as information kiosks and websites, as well as their interfaces with the appropriate travel information system.

The systems to be implemented under this program area consist of central information systems that serve as an agency's travel information repository, as well as the elements allowing dissemination of information to the public.

Travel Information Website (BTD)

This initiative establishes a travel information website for the City of Boston, covering the roadways operated by BTD. The website will provide information from the TMC such as traffic advisories and CCTV images. The server for this website will obtain information from the central systems at the TMC for dissemination to the public via the World-Wide Web.

Travel Information Kiosks (MassPike)

This initiative comprises the deployment of Travel Information Kiosks at service areas along the MassPike. The kiosks will provide travel information such as traffic conditions and weather advisories, as well as tourism information. These kiosks will require connections to central servers at the Turnpike Authority where the information will reside.

6.1.8 COMMERCIAL VEHICLE OPERATIONS

6.1.8.1 Automated Oversize/Overweight Credentialing

This program area covers the provision of electronic systems for managing oversize/overweight vehicle permits. This addresses the elements planned in the architecture for this purpose, namely a central system for managing these permits electronically at Oversize/Overweight Permit Offices, as

well as an interface with Private Motor Carriers. The following initiative addresses this program area.

Automated Oversize/Overweight Credentialing System

This initiative establishes a computer-based system for managing oversize/overweight (OS/OW) vehicle permits. This includes a central system for managing these permits electronically at the Oversize/Overweight Permit Office at BTD, as well as an interface with Private Motor Carriers. This interface will allow electronic submission of credentials and permit applications, as well as electronic distribution of permits and credential status confirmations.

6.1.9 EMERGENCY MANAGEMENT

6.1.9.1 Emergency Management Coordination

This program area covers the extension of the Interagency Communications Network and the Event Reporting and Video Integration Systems to support emergency management functions for the transportation systems in the region. This covers the planned center-to-center interfaces among emergency operations centers, as well as interfaces between emergency management and traffic/transit management centers. The following initiative addresses this program area.

Emergency Management Network

This initiative extends the functionality of the interagency systems proposed in the architecture, namely the Interagency Communications Network and the Event Reporting and Video Integration Systems, to support emergency management functions. The participating agencies are those with roadway, transit, or emergency management functions, including the following:

- *Roadway Agencies:*
  - BTD
  - City of Brockton
  - Local Cities/Towns
  - MassHighway
  - MassPike / CA/T
  - Massport
  - MDC
- *Transit Agencies:*
  - BAT
  - CATA
  - GATRA
  - LRTA
  - MBTA
  - MVRTA
  - Local Cities/Towns
  - Other Transit Providers
- *Emergency Management Agencies:*
  - BEMA
  - Local City/Town Public Safety
  - MBTA Police
  - MEMA
  - State Police

In emergency management, coordination among agencies may often require the transmission of sensitive or privileged information. This includes information that must remain restricted due to

security concerns and that must be managed more securely. This initiative addresses this need by adding a secure layer to these systems, allowing sensitive information to be accessible only to users with appropriate privileges. Once a user's identification is established (e.g. through password or other means of verification), each user will be able to view information appropriate for his/her access level.

The initiative also extends the event reporting system, described in Section 6.1.1.1, to support new categories and protocols for information exchange. This includes incident information essential for emergency response (e.g. nature of event or threat, severity, etc.) as well as response information (e.g. units dispatched, response plans, route diversions, etc.). The initiative also includes the development of tools for evacuation planning and management, allowing a coordinated response in case of local or regional evacuations.

6.1.9.2 CAD/AVL for Emergency Management

This program area provides Computer-Aided Dispatching/Automatic Vehicle Location systems for managing emergency vehicles. This addresses the planned interfaces in the architecture between emergency dispatch centers and emergency vehicles. The following initiative addresses this program area.

CAD/AVL for Emergency Vehicles (Local Cities/Towns)

This initiative provides a CAD/AVL system for managing emergency vehicles. This system will allow a local or regional emergency dispatch center to track its vehicles in real-time and to dispatch those vehicles in the most efficient manner. This initiative will require equipment in each vehicle to be tracked, as well as a central system at the dispatch center to receive and manage the tracking information.

6.1.9.3 Transit Safety

This program area covers the deployment of emergency call boxes at transit facilities. This addresses the planned emergency call box elements in the architecture, as well as the interfaces with the emergency call centers. The following initiative addresses this program area.

Emergency Call Boxes (CATA, GATRA, LRTA, MVRTA)

This initiative comprises the deployment of emergency call boxes at Regional Transit Authority facilities. Locations for deployment will include bus stops, terminals, and parking facilities. These call boxes will allow a voice connection to security personnel either at RTA control centers or at relevant police dispatch centers. They will also support silent alarms, alerting security personnel to a problem without the need for voice communications. This initiative will require a communications interface between the call boxes and the dispatch center.

6.1.10 ARCHIVED DATA MANAGEMENT

6.1.10.1 Planning Data Archive Coordination

This program area covers the development of interfaces among the planning data archives held by transportation agencies in the region. This addresses the planned interfaces between the Office of Transportation Planning (OTP) archive and the other databases in the region. The following initiative addresses this program area.

Planning Data Archive

This initiative consists of the development of a system for coordinating the planning data archives for the transportation agencies in the region. The system will provide access to the planning data collected by roadway and transit agencies, planning agencies such as the five

RPAs and CTPS, and the Registry of Motor Vehicles. As envisioned by the architecture, OTP will serve as the regional archived data management system hub, holding information managed by OTP as well as providing a portal to the information held by other agencies. This initiative will require interfaces between OTP and each of the other participating agencies' databases. This will provide OTP with access to data held by the other agencies, and will provide the other agencies with access to data held by OTP. Moreover, this will also provide participating agencies with access to each others' data, allowing one RPA, for example, to access data held by an adjacent RPA through the system maintained by OTP.

6.2 Implementation Strategy

When implemented, the initiatives identified in the previous section will provide the integrated transportation system envisioned by the Regional ITS Architecture. However, due to limitations in resources and time, it is not possible to implement of all of these initiatives immediately. Therefore, this section recommends a strategy for the implementation of these initiatives, taking into account existing agency initiatives and program areas, regional needs, and potential for successful implementation.

Many initiatives in this plan, however, are identified for implementation by a single agency. For example, there are a number of initiatives that can be implemented independently by a local city or town, such as CAD/AVL for emergency vehicles, CAD/AVL for maintenance vehicles, or variable message signs. As these initiatives are independent of any other agency or organization, this implementation strategy does not address them. Prioritization of these initiatives will be the responsibility of the implementing agency, as only that agency will be able to determine how these initiatives fit into its overall capital and operational planning strategies.

Therefore, this strategy only addresses initiatives that require the participation of multiple agencies or organizations. For the purposes of this plan, the multi-agency initiatives have been sorted into two categories: "near-term" and "future." The determination of which group an initiative falls into is based on a number of factors. The primary source is the Needs Analysis, presented in Chapter 3, in which specific initiatives were identified by agencies as high priority and in which a number of critical needs and themes were identified. In addition, initiatives of clear relevance to specific needs identified in the needs analysis were also given priority. However, in addition to an initiative's priority and relevance, dependencies between initiatives must also be considered. For example, an initiative that has others dependent on its completion should be elevated in priority to avoid delays to these other initiatives.

The recommended "near-term" multi-agency initiatives are presented in Exhibit 6-2. These include ones that are currently under development, as well as ones that are not ongoing but are seen as critical for the region.

Exhibit 6-2: Recommended Near-Term Multi-Agency Initiatives

Functional Area	***Initiative***
Multimodal	▪ Event Reporting System ▪ Expansion of MIVIS ▪ Interagency Communications Network ▪ 511 Travel Information System ▪ Planning Data Archive
Roadway	▪ Remote MassHighway TOC Workstation (MassHighway and MEMA) ▪ Interface between MassHighway TOC and MassPike CA/T OCC
Transit	▪ Traffic Signal Priority for MBTA Vehicles
Parking	▪ Logan Parking Management System ▪ ETC Integration at MBTA Parking Facilities

Specific considerations for each of the initiatives are discussed below:

- The ***Event Reporting System*** initiative has been identified as high priority as it addresses interagency coordination, a key need identified through the architecture development process. In addition, as the system serves as a centralized information repository, it will be a source of data for other initiatives, such as the planned 511 Travel Information System and the planned Emergency Management Network. Implementation of this initiative, either as an expansion of the existing pilot system or as an independent effort, is therefore key to moving ahead with these other initiatives.

- The ***Expansion of MIVIS*** addresses the need for interagency coordination by allowing the sharing of video images among agencies. The initiative also supports emergency management, which was identified as another regional need. This system can provide a source of data for the proposed 511 Travel Information website and the planned Emergency Management Network. Expansion of this system will support the development of these other important initiatives.

- The ***Interagency Communications Network*** is a high priority initiative because it supports the communications requirements of all other initiatives in the Implementation Plan, and is especially key for center-to-center coordination needs. It also has the potential to significantly reduce agency operational costs through the elimination of leased communication lines, which was a key concern that was identified in the needs analysis.

- The ***511 Travel Information System*** initiative is currently under development. This initiative also addresses the need for travel information, another need identified through the architecture development process.

- The ***Planning Data Archive*** initiative was identified as high-priority because it addresses the need for coordination of ITS data for planning purposes. During the architecture development process, regional planning stakeholders indicated that data being collected for operational purposes would have significant value for planning purposes, but that this data was not currently being utilized.

- The initiative to implement a ***Remote MassHighway TOC Workstation*** at the MEMA operations center is currently under development. This initiative addresses the need for center-to-center coordination. It also provides a backup system for emergency operations, addressing safety and security needs.

- The initiative to develop an ***Interface between MassHighway TOC and MassPike CA/T OCC*** was specifically identified as high priority in the needs analysis. It also addresses the key need of center-to-center coordination.

- ***Traffic Signal Priority*** for the MBTA is an ongoing initiative, currently focused on priority for the Silver Line in Boston. This initiative is planned to continue as part of the development of the Urban Ring.

- The ***Logan Parking Management System*** initiative is currently under development. The multi-agency component of this initiative is the integration with MassPike ETC transponders.

- The MBTA's initiative for ***ETC Integration at Parking Facilities*** builds on the existing pilot project for acceptance of MassPike ETC transponders.

The remaining multi-agency initiatives are identified as future initiatives and are presented in Exhibit 6-3. As discussed previously, the determination of the initiatives as "future" rather than "near-term" is based primarily on the needs analysis. Therefore, if the needs of the region change, the

classification of the initiatives should be reconsidered. For example, if a regional transit agency identifies a crucial need for traffic signal priority at a particular intersection, this initiative could be implemented in the near-term, as it does not depend on the completion of any other initiatives. If other initiatives are related, however, these should be considered. For example, if an RTA wishes to move integration of the Regional Fare Card to the near-term, coordination with similar initiatives by other RTAs will be a factor.

As Exhibit 6-3 shows, there are a number of initiatives that are shared by many agencies, such as the signal priority and Regional Fare Card integration initiatives. Although not required, coordinated implementation of initiatives across these agencies is recommended, since the agencies involved, as well as the public, would benefit from the coordinated approach and broad-based deployment.

Exhibit 6-3: Future Multi-Agency Initiatives

Functional Area	Initiative (*and Lead Agency*)
Multimodal	▪ Emergency Management Network ▪ Regional Fare Card Integration with ETC Transponders
Transit	▪ Traffic Signal Priority (BAT, CATA, GATRA, LRTA, MVRTA) ▪ Regional Fare Card Integration for Transit Vehicles (BAT, CATA, GATRA, LRTA, MVRTA, Cities/Towns, Other Transit Providers)
Parking	▪ ETC Integration at Parking Facilities (BTD, Cities/Towns, Massport, Other Parking Operators) ▪ Regional Fare Card Integration at Parking Facilities (BTD, Cities/Towns, Massport, MBTA, Other Parking Operators, BAT, CATA, GATRA, LRTA, MVRTA)

7. ARCHITECTURE CONSISTENCY AND MAINTENANCE

The Implementation Plan discussed in the preceding chapter outlines a strategy for implementation of the ITS components contained in the architecture. However, it is recognized that in order for ITS implementation to be successful, ITS must be integrated into the mainstream transportation planning process. This chapter addresses two separate but related issues. The first is ensuring that when projects are developed, any ITS elements are consistent with the architecture. The second is maintaining the architecture so that it remains relevant and useful to stakeholders in the region. Both of these are valuable exercises, and both are also the subject of the federal rules and policies governing metropolitan planning.

As it did for the development of the architecture, the Office of Transportation Planning will take responsibility for the oversight of the architecture for Metropolitan Boston. This approach recognizes the complexity of coordinating planning across five MPO regions. To be successful, this approach will require ongoing information exchange and collaboration among the stakeholders in this region.

This chapter outlines the approach by which OTP plans – in collaboration with stakeholders in the region – to address the federal consistency and maintenance requirements. This approach recognizes the importance of integrating ITS planning into the mainstream transportation planning process. Therefore, ensuring consistency between projects with ITS elements and the architecture is based on the MPO-oriented capital programming process, and maintaining the Regional ITS Architecture is designed to be responsive to updates of the long-term regional transportation plans and other planning activities. The following sections present the proposed approach.

7.1 Architecture Consistency

The United States Department of Transportation is responsible for ensuring that federal transportation dollars are used in a manner that is consistent with federal laws and regulations, including the Clean Air Act, the Americans with Disabilities Act, and others. As stated in the 2001 FHWA Rule and FTA Policy:

> "The final design of all ITS projects funded with highways trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated."[3]

As with the other federal requirements, this ITS consistency policy means that if agencies seeking federal funds want to avoid costly delays during the approval and funding process, they need to be sure that the consistency requirement has been met. The objective of the policy is to help an agency at the earliest stage possible to realize the opportunities for collaboration with other stakeholders, to take advantage of synergies with projects under development at other agencies, and to avoid conflicts or duplication of effort.

The federal regulations also require that all ITS projects be based on a systems engineering analysis at a scale commensurate with the project scope, meaning that the more complex the project, the more complex the analysis. Such an analysis is typical of any transportation engineering project involving the application of advanced technology. While the architecture has relevance throughout the project development process, the discussion in this section focuses on the initial review for architecture consistency in the early stages of the process.

[3] Federal Highway Administration "Intelligent Transportation System Architecture and Standards; Final Rule" and Federal Transit Administration "National ITS Architecture Policy on Transit Projects; Notice" in Federal Register volume 66 number 5, Monday, January 8, 2001.

Since the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, transportation planning has been driven by a set of rules governing metropolitan and statewide transportation planning. The path that leads from a project concept to federal approval and funding goes through two major phases: project initiation and federal approval. The former involves all of the work that leads up to submission of a project to a Metropolitan Planning Organization; the latter begins with the adoption by that MPO of a fiscally-constrained, prioritized set of projects known as a Transportation Improvement Program (TIP), and concludes with federal approval of the state TIP (STIP), which is an aggregation of TIPs from around the state, as shown in Exhibit 7-1. The process for addressing consistency with the Regional ITS Architecture is designed to fit into this existing transportation planning process. As such, this approach relies on existing collaborative relationships between each MPO and its local planning partners.

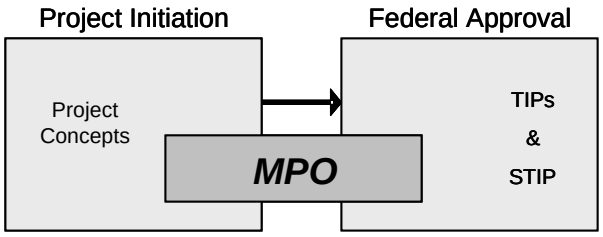

Exhibit 7-1: Project Planning Process

7.1.1 FEDERAL APPROVAL PHASE

Because the rule/policy driving this process is focused on the final approval granted by FHWA and FTA, the description of the process begins with the federal approval phase. During the federal approval phase, each MPO submits its TIP to the state. In Massachusetts, the State Transportation Improvement Program (STIP) is an aggregation of the TIPs from around the state and the Executive Office of Transportation is responsible for submitting the STIP for approval by FHWA and FTA. The approach to addressing the consistency requirement that was developed by the Guidance Committee and Project Team was designed to fit into this process. As the discussion of the project initiation process explains, a project with ITS elements should not reach the TIP unless consistency has been addressed. As a result of addressing the issue before projects reach the TIP, each TIP that is submitted to EOT – and by extension the STIP – should be ready for federal approval with respect to the consistency issue.

7.1.2 PROJECT INITIATION PHASE

The project initiation phase begins with project concepts. By the end of this stage when the TIP is being developed, each MPO needs to be certain that the consistency requirement has been addressed for all projects that have ITS elements. Each MPO, therefore, will work with its planning partners during the project initiation phase, when concepts are being developed for eventual inclusion in the TIP, to ensure that the consistency issue is addressed.

As planning practices vary by region, differences are expected among the MPOs in Massachusetts but in general it is expected that the focus will be on whichever agency or entity assumes responsibility for a project concept's development. The role of "project proponent" is often assumed by a Regional Transit Authority or MassHighway District office, which often facilitate the development of a concept. Consultants and contractors, who often provide extensive technical assistance, could also occupy this niche on behalf of their client, as could the individual municipalities that often champion specific projects. Regardless of who acts as the project proponent, however, the MPO will want to know if a project that has ITS elements is consistent with the architecture. Based on input from MPO participants in each region, it is anticipated that this will

be handled through the project submission forms employed by each MPO. These forms, which document many project attributes, vary among the MPOs. By adding architecture consistency as an additional attribute, the MPOs can ensure that the consistency requirement is addressed within existing planning practices.

In this context, it is necessary to differentiate roadway and transit projects, because the paths through which they reach the MPO are different in some respects. Transit projects are developed and eventually submitted by transit authorities, of which there are seven in the area covered by this architecture. Each transit authority develops a list of capital projects, which depend on funds over which the MPO has authority. For all kinds of projects but especially for major projects, the authorities tend to work closely with the Federal Transit Administration, and proposals are often scrutinized closely for various policy issues before they reach the TIP. In most cases, therefore, the authority acts as a project proponent. When projects are submitted for inclusion in the TIP, regardless of scope or funding type, the transit authority, as project proponent, will document whether or not the project has ITS elements and, if it does, that the transit authority affirms that they are consistent with the architecture.

In contrast, aside from major highway improvements, roadway projects tend to begin with an advocate such as a city or town within the region proposing an idea to the appropriate MassHighway District office. In general, therefore, the Districts will serve as the project proponent for most roadway projects from the region that will eventually reach the TIP. When roadway projects are submitted for inclusion in the TIP, the District, as the project proponent, will document whether or not each project has ITS elements and, if it does, will affirm that they are consistent with the architecture.

For roadway projects, there is another piece of the project initiation phase that happens to benefit the consistency requirement. A Project Initiation Form (PIF), required of all project concepts, is often drafted by the project advocate and completed by the District, which then submits each PIF to a statewide Project Review Committee. This creates an additional opportunity to ensure that the project proponent has examined the project for consistency with the architecture.

This process is illustrated in Exhibit 7-2:

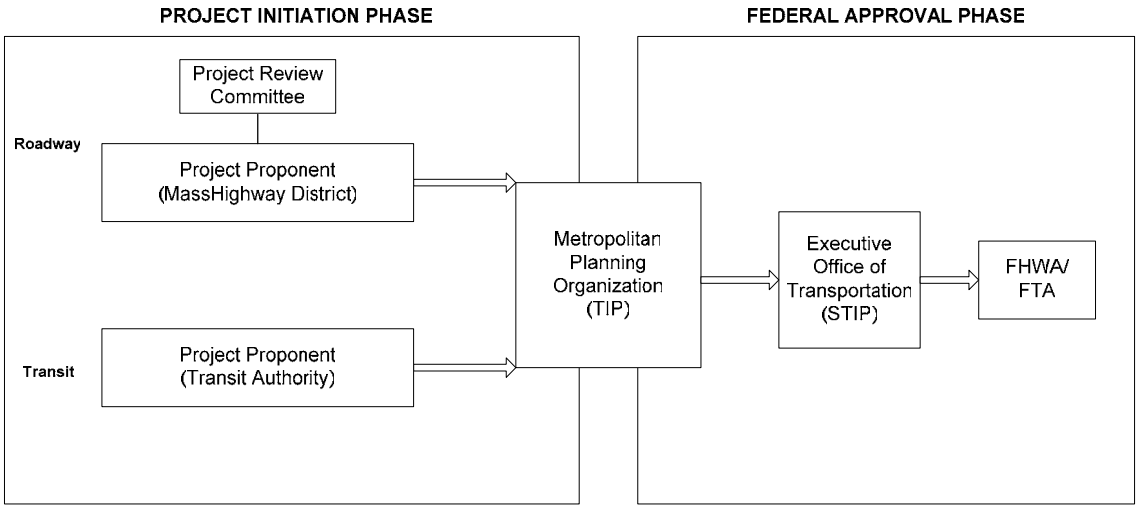

Exhibit 7-2: Project Initiation and Approval Process

In addition to this initial review in the early stages of the project development process, consistency with the architecture must be revisited as a project develops further in order to ensure that it has not been affected by changes to the scope of the project. Moreover, as a project progresses into the

design stage, it must undergo a systems engineering analysis, as is typical of ITS projects and as is required by the federal Rule and Policy.

A note about the term "consistency":

> Because of the superficial similarity to air quality conformity, it is important to clarify the differences between the terms consistency and conformity. Whereas air quality goals are definitive and fixed, the Regional ITS Architecture is a dynamic product of the transportation planning process. The goal of air quality conformity is, in large part, to filter out detrimental projects; the intent of the ITS consistency policy is to ensure that when actual projects are developed and become candidates for federal funding, the technical and institutional aspects are consistent with the architecture. A project may prompt a modification to the architecture, as discussed in Section 7.2.2, or may be revised to be consistent with the architecture. As such, demonstrating consistency places a great emphasis on considering the relationship between a project and the architecture as early and as often as possible.

7.2 Architecture Maintenance

Comparable to a Regional Transportation Plan (RTP), the Regional ITS Architecture is a vision of the future transportation system, documented at one point in time. The architecture, like an RTP, reflects the current situation and documents planned changes or investments. However, in order to remain relevant, the architecture has to be maintained. As regional needs evolve, as planned elements are deployed, and as other changes occur, the architecture must be updated to reflect those developments. Maintenance of the architecture is also motivated by federal requirements that require consistency between all federally funded projects with ITS elements and the Regional ITS Architecture.

This section describes how the architecture will be maintained so that it remains relevant to the transportation system and useful to planners and operators. The maintenance strategy relies on two elements. The first is a formal periodic update at the same frequency as the RTPs, which are currently on a three-year update cycle. However, since the RTPs will provide valuable input to the architecture, the architecture update process will be staggered to occur after the RTP update. The second is interim architecture modifications that may occur at any point in the update cycle, outside of the formal update process. This two-pronged approach will have the added benefit of sustaining an ongoing region-wide dialogue about ITS.

The Office of Transportation Planning, which has led the initial development of the Regional ITS Architecture, will be responsible for the maintenance of the architecture. However, other stakeholders will be involved, as they have been throughout the development process. The maintenance strategy describes who will be involved and what responsibilities transportation stakeholders in the region should assume.

7.2.1 PERIODIC ARCHITECTURE UPDATES

Under this strategy, the Regional ITS Architecture will be formally revisited on the same cycle as the Regional Transportation Plan updates (currently every three years), with timing that allows the architecture update to take a revised RTP into consideration. In this way, it is expected that the revised architecture can incorporate new ideas and/or projects that are included in an updated RTP.

The Office of Transportation Planning will initiate the Regional ITS Architecture update process with a request for information from stakeholders in the region regarding new ITS-related projects, initiatives, or needs. OTP will also gather information from the stakeholders in order to evaluate the status of the architecture's implementation, identifying, for example, ITS elements or interfaces that have evolved from "planned" to "existing" or that are no longer relevant and should be removed.

Based on the information gathered through this process, OTP will generate a draft list of architecture modifications and distribute it to the stakeholders for review. OTP can then call a stakeholder meeting for the region to review the draft list. This meeting can also provide an opportunity to discuss emerging ITS issues. After the stakeholder review of the draft list, OTP will make any modifications necessary and release the updated architecture.

7.2.2 INTERIM ARCHITECTURE MODIFICATIONS

Just as project developments necessitate TIP amendments, it is anticipated that some modifications to the architecture will be needed during the interval between the periodic updates. Therefore, on the basis of project developments or other circumstances that require modifications, the project proponent will be responsible for drafting an architecture modification proposal and submitting it to OTP. The proposal will then be circulated to affected stakeholders for their review. It is expected that most architecture modifications, whether periodic or interim, will involve adding new ideas, dimensions, or stakeholders to existing market packages, interfaces, or functions.

7.2.3 SUMMARY

This maintenance strategy is meant to accomplish several objectives. First, it ensures that the architecture will remain current and will reflect the most recent Regional Transportation Plans. Second, it allows the architecture to be responsive to changes between updates. And third, it helps facilitate an ongoing dialogue about ITS and the implementation of the architecture. Through the interim modifications and the periodic updates, this strategy should help to integrate ITS into the mainstream transportation planning process.

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8. CONCLUSION

8.1 Reasons for the Regional ITS Architecture

This process of developing a Regional ITS Architecture for Metropolitan Boston has been undertaken for a number of reasons. While Federal requirements are certainly a motivating factor, there are other objectives that the architecture addresses.

The first of these objectives is improved interagency coordination. The architecture development process addresses this objective not only in the recommendations that have come out of the architecture, but also through the process of developing the architecture itself. The establishment of the multi-agency stakeholder group that met throughout the architecture development process is a significant step towards coordinating ITS planning in the region. The numerous meetings and workshops of the Guidance Committee demonstrated the benefit of such a forum to exchange information on needs and project plans. The maintenance plan for the architecture offers an opportunity for this interaction to continue, with mutual benefits for all of the participants.

The second objective is cost savings, which is addressed through the recommendations of the architecture. For example, coordination of investments and consideration of standards for interagency interfaces offer opportunities for cost savings, especially in terms of long-term maintenance and operational costs.

The third objective is better services to the traveling public. The public has the potential to benefit from this process, as the architecture addresses needs and priorities that cut across agency lines and that are not able to be addressed through single-agency initiatives. The framework outlined by the architecture is for a regional transportation system that can provide the public with a seamless and consistent travel experience across multiple agency jurisdictions.

8.2 Architecture Development Approach

The most critical component of the architecture development process is the participation of the region's stakeholders. The reason that participation is so critical is that stakeholder input is the foundation of the architecture. The architecture is not meant to impose a plan for ITS on the region. Instead, the architecture builds on the needs of the region, as voiced by the stakeholders. These identified needs lead to functional requirements, which in turn lead to recommendations for systems and technologies that address these regional needs. However, the architecture is not based solely on the needs of the region, as it must also take into consideration the existing systems that must be integrated and the plans that agencies have developed. This is yet another reason why participation of the stakeholders is essential and why stakeholder involvement was emphasized throughout the process.

The first step in the process, the Needs Analysis, identified these existing systems, plans, and needs. Based on this analysis, the ITS architecture was developed, defining the existing and planned ITS elements in the region as well as the interfaces among them. The architecture, presented interactively on the CD-ROM included in Appendix A, provides a vision of how the ITS components in the region will interact to form an integrated transportation system.

While the architecture addresses what systems will exist and what information they will exchange, it does not address how those interfaces will operate and how we move from the current state of deployment to the full system envisioned by the architecture. These issues are addressed in the Operational Concept and the Implementation Plan, respectively. The Operational Concept considers each of the interagency interfaces, including the information to be exchanged and the roles of each participant. This provides guidelines for how the interface should operate once it is actually implemented and what operational agreements might be necessary. The Implementation

Plan considers what steps are necessary in order to fulfill the architecture's vision, specifically what areas of investment are required and what initiatives will need to be undertaken in order to implement the component systems of the architecture.

8.3 Architecture Themes

Through the development of the architecture, especially in the assessment of needs, a number of themes emerged that merited consideration. In the wake of 9/11, a primary overarching theme was security. Throughout the architecture development process, links between ITS infrastructure and security initiatives were considered. Emergency Management market packages also explicitly address safety and security functions. The Implementation Plan also addresses this need through the Emergency Management Network initiative, which creates a secure layer to other center-to-center initiatives for safety and security usage.

A second theme was information sharing, specifically the need for better sharing of data and information among the region's agencies and organizations. This theme continued to be prevalent throughout the architecture development process, and has been explicitly addressed in its recommendations. For example, center-to-center interfaces are key components of the ITS Architecture, the Operational Concept, and the Implementation Plan. In the architecture, these are addressed in market packages such as Regional Traffic Control and Multimodal Coordination. The Operational Concept considers center-to-center interfaces within traffic, transit, and emergency management, as well as across the functional jurisdictions. Finally, the Implementation Plan has prioritized initiatives such as the event reporting system that address the need for coordination of information.

A third theme was the need for communications infrastructure, weighed against the high costs associated with leasing this bandwidth from local telephone providers. As communications infrastructure is a requirement for nearly all of the systems in the architecture, this is clearly a concern that will continue to grow in importance as systems become implemented. As such, this infrastructure requirement is directly addressed in the Implementation Plan, which calls for an interagency communications network initiative that supports the infrastructure needs of the architecture.

A final theme was the concerns regarding operations and maintenance, specifically resource requirements for these activities. This was addressed in the architecture by focusing on automating information flows that currently rely on manual intervention or voice communications. Freeing up personnel on these tasks allows more effective use of agency resources. The Operational Concept also addresses these issues for the interagency interfaces, laying out the details of each of the interface and the roles and responsibilities of each agency. Through this, an agency will be better able to plan for the required resources as these interfaces become implemented.

8.4 Recommendations

Through the process and from the results of developing the Regional ITS Architecture, including the Operational Concept and Implementation Plan, a number of recommendations should be considered as the region continues to move forward with deployment of ITS:

- Of the initiatives in the Implementation Plan, the most critical are the "near-term" multi-agency initiatives. Completion of ongoing projects, such as the Event Reporting System and the 511 Travel Information System, and implementation of the new initiatives, such as the Planning Data Archive and the expansion of MIVIS, are vital for working towards the integrated transportation system envisioned by the architecture. Although not as urgent in the short term, the remaining "future" multi-agency initiatives are also important in that they provide the foundation for interagency coordination throughout the region.

- Formal agreements should be established for the interagency interfaces identified in the architecture. This includes existing interfaces as well as new ones. Existing informal agreements should be formalized in order to ensure that their benefits are maintained. This can be achieved through new agreements that document specific existing working arrangements. Operational agreements for new interfaces should be drawn up as these new interfaces are established. Proper documentation of the arrangement will be easiest in the planning stages and will facilitate implementation and operation in the long term.

- ITS architecture consistency should be incorporated into the existing MPO transportation planning process. While the process outlined in the Implementation Plan identifies the steps at which consistency with the architecture will need to be certified, consideration of the Regional ITS Architecture throughout the project development process will ensure a satisfactory outcome.

- The Regional ITS Architecture should stay relevant to the region and therefore should be updated to reflect the changing needs and priorities of the region. To make this work with the existing transportation planning process, it is recommended that the architecture be updated regularly to reflect the needs identified in the Regional Transportation Plans in the region. In addition, informal updates to ensure consistency with newly proposed projects should be done on an as-needed basis.

- The agencies and organizations that were represented on the Guidance Committee, as well as other relevant ITS stakeholders, should continue to meet and remain involved, not only in the maintenance of the architecture, but also in coordinating ITS in the region. The benefits of this working group that have been realized in the architecture development process should be built upon as the transportation system envisioned by the architecture takes shape.

8.5 Using the Architecture

This process has yielded a valuable tool for planners and operators of the region's transportation system, and there are a number of ways in which the architecture should be used: First, the architecture should be used by agencies as a framework for planning ITS projects, as it documents what they have planned, as expressed in the architecture development process. If it does not reflect the current plans, it should be revised so that it is up to date.

Second, agencies should use the architecture as a guide to how they should interface with other agencies. The ITS architecture documents the interfaces that are planned for development, as well as standards that are relevant to these interfaces. In addition, the Operational Concept details the operational arrangements that are required for managing these interfaces and provides a model for the interagency agreements that should be established.

Finally, the Regional ITS Architecture provides the basis for satisfying the federal architecture consistency requirement for projects with ITS elements. Therefore, it is vital that project proponents use the architecture as a guideline during project development, just as the FHWA and FTA will be using the architecture when considering whether to approve the project. It is also important that consistency with the architecture is revisited throughout the project development process and as part of the systems engineering analysis that is required of all ITS projects. Incorporating the architecture into the planning, design, and operations process will ensure that all stakeholders in the region are moving together towards the vision that they have created through this process.

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APPENDIX A

REGIONAL ARCHITECTURE INTERACTIVE CD

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APPENDIX B

FHWA RULE ON ITS ARCHITECTURE AND STANDARDS

Federal Register

Monday,

January 8, 2001

Part IV

Department of Transportation

Federal Highway Administration

23 CFR Parts 655 and 940

Intelligent Transportation System Architecture and Standards; Final Rule

Federal Transit Administration

Federal Transit Administration National ITS Architecture Policy on Transit Projects; Notice

DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

23 CFR Parts 655 and 940

[FHWA Docket No. FHWA–99–5899]

RIN 2125–AE65

Intelligent Transportation System Architecture and Standards

AGENCY: Federal Highway Administration (FHWA), DOT.

ACTION: Final rule.

SUMMARY: The purpose of this document is to issue a final rule to implement section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), enacted on June 9, 1998, which required Intelligent Transportation System (ITS) projects funded through the highway trust fund to conform to the National ITS Architecture and applicable standards. Because it is highly unlikely that the entire National ITS Architecture would be fully implemented by any single metropolitan area or State, this rule requires that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a ''regional ITS architecture.'' Therefore, conformance with the National ITS Architecture is defined under this rule as development of a regional ITS architecture within four years after the first ITS project advancing to final design, and the subsequent adherence of ITS projects to the regional ITS architecture. The regional ITS architecture is based on the National ITS Architecture and consist of several parts including the system functional requirements and information exchanges with planned and existing systems and subsystems and identification of applicable standards, and would be tailored to address the local situation and ITS investment needs.

EFFECTIVE DATE: February 7, 2001.

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Background

A notice of proposed rulemaking (NPRM) concerning this rule was published at 65 FR 33994 on May 25, 2000, and an extension of the comment period to September 23, 2000, was published at 65 FR 45942 on July 26, 2000.

In the NPRM on this rule, the FHWA had proposed that the regional ITS architecture follow from the ITS integration strategy proposed in another NPRM entitled ''Statewide Transportation Planning; Metropolitan Transportation Planning'' published at 65 FR 33922 on May 25, 2000. That rule is being developed according to a different schedule and will be issued separately. For this reason, all references to the proposed integration strategy have been removed from this rule. However, it is still the intent of this rule that regional ITS architectures be based on established, collaborative transportation planning processes. The other major changes to the final rule relate to options for developing a regional ITS architecture and the time allowed to develop such an architecture. Additional changes to the final rule largely deal with clarification of terms, improved language dealing with staging and grandfathering issues, and clarification of use of ITS standards.

Intelligent Transportation Systems represent the application of information processing, communications technologies, advanced control strategies, and electronics to the field of transportation. Information technology in general is most effective and cost beneficial when systems are integrated and interoperable. The greatest benefits in terms of safety, efficiency, and costs are realized when electronic systems are systematically integrated to form a whole in which information is shared with all and systems are interoperable.

In the transportation sector, successful ITS integration and interoperability require addressing two different and yet fundamental issues; that of technical and institutional integration. *Technical integration* of electronic systems is a complex issue that requires considerable up-front planning and meticulous execution for electronic information to be stored and accessed by various parts of a system. *Institutional integration* involves coordination between various agencies and jurisdictions to achieve seamless operations and/or interoperability.

In order to achieve effective institutional integration of systems, agencies and jurisdictions must agree on the benefits of ITS and the value of being part of an integrated system. They must agree on roles, responsibilities, and shared operational strategies. Finally, they must agree on standards and, in some cases, technologies and operating procedures to ensure interoperability. In some instances, there may be multiple standards that could be implemented for a single interface. In this case, agencies will need to agree on a common standard or agree to implement a technical translator that will allow dissimilar standards to interoperate. This coordination effort is a considerable task that will happen over time, not all at once. Transportation organizations, such as, transit properties, State and local transportation agencies, and metropolitan planning organizations must be fully committed to achieving institutional integration in order for integration to be successful. The transportation agencies must also coordinate with agencies for which transportation is a key, but not a primary part of their business, such as, emergency management and law enforcement agencies.

Successfully dealing with both the technical and institutional issues requires a high-level conceptual view of the future system and careful, comprehensive planning. The framework for the system is referred to as the *architecture.* The architecture defines the system components, key functions, the organizations involved, and the type of information shared

between organizations and parts of the system. The architecture is, therefore, fundamental to successful system implementation, integration, and interoperability.

Additional background information may be found in docket number FHWA–99–5899.

The National ITS Architecture

The Intermodal Surface Transportation Efficiency Act of 1991, Public Law 102–240, 105 Stat. 1914, initiated Federal funding for the ITS program. The program at that time was largely focused on research and development and operational tests of technologies. A key part of the program was the development of the National ITS Architecture. The National ITS Architecture provides a common structure for the design of ITS systems. The architecture defines the functions that could be performed to satisfy user requirements and how the various elements of the system might connect to share information. It is not a system design, nor is it a design concept. However, it does define the framework around which multiple design approaches can be developed, each one specifically tailored to meet the needs of the user, while maintaining the benefits of a common approach.

The National ITS Architecture, Version 3.0 can be obtained from the ITS Joint Program Office of the DOT in CD–ROM format and on the ITS web site *http://www.its.dot.gov*. The effort to develop a common national system architecture to guide the evolution of ITS in the United States over the next 20 years and beyond has been managed since September 1993 by the DOT. The National ITS Architecture describes in detail what types of interfaces should exist between ITS components and how they will exchange information and work together to deliver the given ITS user service requirements.

The National ITS Architecture and standards can be used to guide multi-level government and private-sector business planners in developing and deploying nationally compatible systems. By ensuring system compatibility, the DOT hopes to accelerate ITS integration nationwide and develop a strong, diverse marketplace for related products and services.

It is highly unlikely that the entire National ITS Architecture will be fully implemented by any single metropolitan area or State. For example, the National ITS Architecture contains information flows for an Automated Highway System that is unlikely to be part of most regional implementations. However, the National ITS Architecture has considerable value as a framework for local governments in the development of regional ITS architectures by identifying the many functions and information sharing opportunities that may be desired. It can assist local governments with both of the key elements: technical interoperability and institutional coordination.

The National ITS Architecture, because it aids in the development of a high-level conceptual view of a future system, can assist local governments in identifying applications that will support their future transportation needs. From an institutional coordination perspective, the National ITS Architecture helps local transportation planners to identify other stakeholders who may need to be involved and to identify potential integration opportunities. From a technical interoperability perspective, the National ITS Architecture provides a logical and physical architecture and process specifications to guide the design of a system. The National ITS Architecture also identifies interfaces where standards may apply, further supporting interoperability.

Transportation Equity Act for the 21st Century

As noted above, section 5206(e) of the TEA–21, Public Law 105–178, 112 Stat. 457, requires ITS projects funded from the highway trust fund to conform to the National ITS Architecture, applicable or provisional standards, and protocols. One of the findings of Congress in section 5202 of the TEA–21, is that continued investment in systems integration is needed to accelerate the rate at which ITS is incorporated into the national surface transportation network. Two of the purposes of the ITS program, noted in section 5203(b) of the TEA–21, are to expedite the deployment and integration of ITS, and to improve regional cooperation and operations planning for effective ITS deployment. Use of the National ITS Architecture provides significant benefits to local transportation planners and deployers as follows:

1. The National ITS Architecture provides assistance with technical design. It saves considerable design time because physical and logical architectures are already defined.

2. Information flows and process specifications are defined in the National ITS Architecture, allowing local governments to accelerate the process of defining system functionality.

3. The architecture identifies standards that will support interoperability now and into the future, but it leaves selection of technologies to local decisionmakers.

4. The architecture provides a sound engineering framework for integrating multiple applications and services in a region.

ITS Architecture and Standards NPRM

Discussion of Comments

The FHWA received 105 comments on this docket from a wide range of stakeholders, including major industry associations, State departments of transportation, Metropolitan Planning Organizations (MPOs), and local agencies. The comments were generally favorable about the scope and content, but requested additional clarification and guidance on implementation of specific items. On many issues, some commenters wanted more specific requirements, while others wanted more flexibility. Most commenters, including major industry associations and public sector agencies, agreed with the overall scope, but some felt that the specifics might be difficult to implement and asked for clarification of key terms. A few commenters wanted the FHWA to reduce the number of requirements or convert the rulemaking into a guidance activity until more ITS deployment experience is gained.

In summary, the FHWA received a large number of generally favorable comments about the NPRM that suggested minor specific changes and expressed a need for further guidance on implementation. Since the general tenor of the comments was positive, the FHWA has kept the scope of the NPRM and made appropriate clarifications to the text of the final rule to address concerns raised in comments. In response to the many comments requesting it, starting in early 2001, the FHWA will also provide a program of guidance, training, and technical support to assist with the implementation of this rule. The following is a detailed discussion of the comments and their disposition, organized by subject matter.

Section 940.3 Definitions

ITS Project. There were 34 comments submitted to the docket concerning the definition of an ITS project. Many of the commenters felt the definition was not clear enough, was too broad, or was too subject to interpretation. Some comments questioned how much of a project's budget would have to be spent on ITS before a project would be considered an ITS project. Some suggested specific language to more narrowly define an ITS project by

focusing on the portion of the overall project that is actually ITS or by suggesting language that would narrow the definition of an ITS project to only include projects which introduce new or changed integration opportunities.

Since the intent of this rule and the supporting legislation is to facilitate the deployment of integrated ITS systems, it is the position of the FHWA that the definition of an ITS project must be fairly broad to include any ITS system being funded with highway trust fund dollars. It is only by properly considering all planned ITS investments in the development of a regional ITS architecture that the integration opportunities and needs can even be identified. This consideration should be carried out in the development of an architecture prior to the specific project being advanced. If, in the development of a regional ITS architecture, it is determined that a specific planned project offers no real integration opportunities for the region, then the impact of this rule on that specific project is minimal.

As a response to the comments concerning the clarity of the definition, the definition of an ITS project has been slightly modified to remove the examples since they were considered misleading. The FHWA recognizes that any definition will be subject to interpretation by the stakeholders and acknowledges the need for guidance in this area to ensure clear and consistent interpretation of this rule. Guidance on what constitutes an ITS project (including examples) will be developed to assist the various stakeholders, including the FHWA Division Offices, to better understand what projects should be considered ITS projects.

Region. There were 26 comments submitted related to the definition of a region. Seven comments supported the open definition provided in the NPRM, arguing that the possible integration opportunities in an area should define the region and that there were too many possible variations to allow a restrictive definition. Six commenters who expressed concern over varying conditions interpreted the definition to mean Metropolitan Planning Area (MPA). Five comments suggested an MPA was too restrictive. Eight other comments indicated that the proposed definition of a region did not clearly identify what entity would have the lead in developing a regional ITS architecture or thought the definition implied the MPO should have the lead. Nine comments suggested various limits or boundaries to fit specific situations. Ten comments expressed a need for greater clarification of the definition for a region.

The intent of the proposed definition was to allow considerable flexibility on the part of the stakeholders in defining the boundaries of a region to best meet their identified integration opportunities. While there was no intent to generally restrict the definition to MPAs or States, the FHWA determined that regional ITS architectures should be based on an integration strategy that was developed by an MPO or State as part of its transportation planning process.

Given that the final rule does not require or reference an integration strategy, the FHWA feels a need to provide more specific guidance on the definition of a region. As such, the definition of a region has been revised to indicate that the MPA should be the minimum area considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture within a metropolitan area. This should not be interpreted to mean that a region must be an MPA, or no less than an MPA, but the MPA and all the agencies and jurisdictions within the MPA should be at least considered for inclusion in the process of developing a regional ITS architecture within a metropolitan area. This rule is silent on other possible limits or minimum areas for defining a region, relying on the flexible nature of this rule to accommodate those special circumstances. The FHWA also acknowledges it is possible that overlapping regions could be defined and overlapping regional ITS architectures be developed to meet the needs of the regions.

Other Definitions. There were 20 comments suggesting that other terms used in the NPRM be defined. These included ''interoperability,'' ''standards,'' ''concept of operations,'' ''conceptual design,'' and ''integration strategy.'' Several of these are no longer used in the final rule and, therefore, were not defined. Other terms, such as ''interoperability'' and ''standards,'' were determined to be common terms whose definition did not effect the implementation of the final rule. Furthermore, language regarding standards conformity has been clarified in the body of the final rule.

Section 940.5 Policy

Twenty-eight commenters addressed the issue of consistency between the two related FHWA notices of proposed rulemaking (23 CFR parts 940 and 1410) and the Federal Transit Administration's (FTA) notice (FTA Docket No. FTA–99–6417) on National ITS Architecture published at 65 FR 34002 on May 25, 2000. The comments revealed a lack of understanding about the relationship between the regional ITS architecture and the integration strategy proposed as part of the revisions to FHWA's transportation planning rules. There were five comments suggesting a single DOT rule addressing how all ITS projects would meet the National ITS Architecture conformance requirements of the TEA–21 instead of an FHWA rule for highway projects and an FTA policy for transit projects. Four other comments acknowledged the need for two policies, but recommended they articulate the same process.

A final transportation planning rule is being developed on a different schedule than this rule, and comments regarding the portions of the National ITS Architecture conformity process included in the transportation planning rule will be addressed as it proceeds toward issuance. The FHWA and FTA have chosen to go forward with policies that have been developed cooperatively to implement the National ITS Architecture conformance process. This FHWA rule and the parallel FTA policy have been developed without reference to the proposed changes to the transportation planning process, including no mention of the development of an integration strategy. However, the policy statement of this rule notes a link to established transportation planning processes, as provided under 23 CFR part 450. This rule fully supports these collaborative methods for establishing transportation goals and objectives, and does not provide a mechanism for introducing projects outside of the transportation planning processes.

This final rule on National ITS Architecture conformance and the FTA policy on the same subject have been developed cooperatively and coordinated among the agencies to ensure compatible processes. Any differences between this rule and the parallel FTA policy are intended to address differences in highway and transit project development and the way the FHWA and the FTA administer projects and funds.

Fifteen commenters questioned the need for an integration strategy, and the relationship between the strategy and the regional ITS architecture.

Given the fact that proposed revisions to the FHWA's transportation planning rules are being developed according to a different schedule, this rule has been revised to remove any references to an integration strategy. Comments regarding the integration strategy will be addressed in the final transportation

planning rule, and the discussion of the regional ITS architecture in § 940.9 has been revised to clarify its content.

Section 940.7 Applicability

A few commenters noted that the proposed rule had not addressed the TEA–21 language that allows for the Secretary to authorize certain exceptions to the conformity provision. These exceptions relate to those projects designed to achieve specific research objectives or, if three stated criteria are met, to those intended to upgrade or expand an ITS system in existence on the date of enactment of the TEA–21. The legislation also included a general exemption for funds used strictly for operations and maintenance of an ITS system in existence on the date of enactment of the TEA–21.

The FHWA acknowledges this omission and has included the appropriate language in this section of the rule.

Section 940.9 Regional ITS Architecture

Several comments were received related to the way the proposed rule referred to developing regional ITS architectures. Eight comments, from State agencies and metropolitan planning organizations, supported an incremental approach to developing regional ITS architectures, starting with project ITS architectures and building them together. Four other comments, from metropolitan planning organizations and industry associations, noted that an ad hoc regional ITS architecture developed incrementally through projects would result in an architecture less robust than if there were a single, initial effort to develop it.

Also, thirteen comments from the Association of American State Highway and Transportation Officials (AASHTO) and a number of States recommended extending the time for developing regional ITS architectures, as the proposed two year implementation would be too short. Ten of the commenters preferred four years in order to acquire the necessary resources for developing regional ITS architectures.

Most commenters were in agreement with the content of the regional ITS architecture as defined in the proposed rule. However, there were 19 comments that dealt with confusion over the definition of both ''conceptual design'' and ''concept of operations.'' In addition, there were 17 other comments on the makeup of the stakeholders, involvement of the private sector, and the need and desirability of ''agreements'' between stakeholders.

The comments indicated confusion regarding the development of regional ITS architectures, and especially so in discussing the period of time for their development. Therefore, the final rule has clarified the time period for developing regional ITS architectures by adopting the proposed extension to four years subsequent to beginning to deploy ITS projects (§ 940.9(c)), or four years from the effective date of this rule for those areas that are currently deploying ITS projects (§ 940.9(b)). In clarifying the time for development, this rule has eliminated any references to specific methods for developing regional ITS architectures. By not prescribing any methods, the rule provides flexibility to a region in deciding how it should develop its regional ITS architecture. Guidance and information related to developing regional ITS architectures is available from FHWA Division Offices and from the ITS web site, *http://www.its.dot.gov*, and will be expanded to provide assistance in meeting the intent of the rule.

Both the terms ''conceptual design'' and ''concept of operations'' have been deleted from the final rule. In their stead are descriptions of the content that is expected to form the basis for a regional ITS architecture. This content has not significantly changed from that defined in the NPRM but is now contained in § 940.9(d). The level of detail required is to the architecture flow level as defined in the National ITS Architecture. The regional ITS architecture must identify how agencies, modes, and systems will interact and operate if the architecture is to fulfill the objective of promoting ITS integration within a region.

The relevant stakeholders for a region will vary from region to region. The list articulated in § 940.9(a) is representative only and not meant to be inclusive or exclusive. On the specific issue of private sector participation, if the private sector is deploying ITS systems in a region or otherwise providing an ITS-based service, it would be appropriate to engage them in the development of a regional ITS architecture. Because of these variations from region to region, the FHWA felt it inappropriate to attempt to define an all inclusive list of stakeholders. The group of relevant stakeholders will be a function of how the region is defined and how transportation services are provided to the public. Section 940.9(d)(4) specifies that in the development of the regional ITS architecture, it shall include ''any agreements (existing or new) required for operations.'' The formalization of these types of agreements is at the discretion of the region and participating stakeholders.

There were 14 comments from a broad range of organizations questioning how existing regional ITS architectures, strategic plans or ITS Early Deployment Plans would be treated under this rule. It is the intent of the FHWA that any existing ITS planning documents should be used to the extent practical to meet the requirements of this rule. If a regional ITS architecture is in place, is up to date, and addresses all the requirements of a regional ITS architecture as described in this rule, there is no requirement to develop a ''new'' one. If the existing regional ITS architecture does not address all the requirements of the rule, it may be possible to update it so that it meets the regional ITS architecture requirements of this rule. What is necessary is that the end result is an architecture that meets the requirements of this rule and properly addresses the ITS deployments and integration opportunities of that region. This issue is specifically addressed in § 940.9(e) of this rule.

There were five comments related to the impact of this rule on legacy systems (*i.e.*, ITS systems already in place) and requesting some sort of ''grandfathering'' for them. The language in § 940.11(g) of the final rule clarifies the grandfathering or staging aspects of the process. The final rule does not require any changes or modifications to existing systems to conform to the National ITS Architecture. It is very likely that a regional ITS architecture developed by the local agencies and other stakeholders would call for changes to legacy systems over time to support desired integration. However, such changes would not be required by the FHWA; they would be agreed upon by the appropriate stakeholders as part of the development of the regional ITS architecture.

There were 15 comments dealing with the maintenance process and status of the National ITS Architecture. Two comments suggested the need for the FHWA to formally adopt the National ITS Architecture. Four other comments also supported the formalization of a process for maintaining or updating it with the full opportunity for public input.

Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. This rule requires that the National ITS Architecture be used as a resource in developing a regional ITS architecture.

As a technical resource, it is important that the National ITS Architecture be maintained and updated as necessary in response to user input or to add new user services, but formal adoption of the National ITS Architecture is not necessary. However, the FHWA recognizes the need to maintain the National ITS Architecture and to establish an open process for configuration control that includes public participation. The process currently used by the DOT to maintain the National ITS Architecture is very rigorous and involves significant public participation. That process is currently being reviewed by the DOT with the intent of establishing a configuration management process that engages the public at key stages and ensures a consensus for updating the National ITS Architecture.

Four comments suggested that this rule should not be implemented until the National ITS Architecture was complete. The National ITS Architecture will never stop evolving since there always is a potential need to regularly update it as more is learned about ITS deployment. The FHWA believes the National ITS Architecture is developed to a stage where it can be used as a resource in developing regional ITS architectures, as required by this rule.

Seventeen comments asked the FHWA to define the agency that is responsible for the development and maintenance of the regional ITS architecture; specifically MPOs and/or the State as those entities that are already responsible for the planning process.

The FHWA did not define the responsibility for either creating or maintaining the regional ITS architecture to a specific entity because of the diversity of transportation agencies and their roles across the country. It is recognized that in some regions traditional State and MPO boundaries may not meet the needs of the traveling public or the transportation community. This is also why the FHWA did not rigidly define a region. The FHWA encourages MPOs and States to include the development of their regional ITS architectures as part of their transportation planning processes. However, the decision is best left to the region to determine the approach that best reflects their needs, as indicated in § 940.9. It is clear that the value of a regional ITS architecture will only be realized if that architecture is maintained through time. However, in accepting Federal funds under title 23, U.S.C., the State is ultimately responsible for complying with Federal requirements, as provided in 23 U.S.C. 106 and 133.

Four commenters noted that the proposed rule did not adequately address planning for, or committing to, a defined level of operations and maintenance.

The final rule addresses this concern on two primary levels, in the development of the regional ITS architecture and the development of individual projects. Section 940.9(d)(4) specifies that in the development of the regional ITS architecture, it shall include ''any agreements (existing or new) required for operations.'' The formalization of these types of agreements is at the discretion of the region and participating stakeholders.

Also, relative to operations and management at a project level, § 940.11(c)(7) specifies that the systems engineering analysis (required of all ITS projects) includes ''procedures and resources necessary for the operations and management of the system.''

Section 940.11 Project Implementation

In addition to the comments on regional ITS architecture development noted above, the docket received 86 comments on systems engineering and project implementation. These comments revealed that the structure of the NPRM in discussing regional ITS architecture development, project systems engineering analysis, and project implementation was confusing and difficult to read.

To clarify these portions of the rule, the systems engineering and project implementation sections of the NPRM have been combined into § 940.11, Project Implementation. Also, paragraphs that were in the regional ITS architecture section of the NPRM that discussed major ITS projects and the requirements for developing project level ITS architectures have been rewritten to clarify their applicability. Since these paragraphs deal with project development issues, they have been moved to § 940.11(e). A definition for ''project level ITS architecture'' was added in § 940.3 and a description of its contents provided in § 940.11(e).

The docket received 33 comments regarding systems engineering and the systems engineering analysis section of the proposed rule. Most of the comments related to the definition, the process not being necessary except for very large projects, and confusion as to how these requirements relate to existing FHWA policy.

In response to the docket comments, the definition of systems engineering in § 940.3 has been clarified and is more consistent with accepted practice. In order to provide consistency in the regional ITS architecture process, the systems engineering analysis detailed in §§ 940.11(a) through 940.11(c) must apply to all ITS projects regardless of size or budget. However, the analysis should be on a scale commensurate with project scope. To allow for the greatest flexibility at the State and local level, in § 940.11(c), a minimum number of elements have been clearly identified for inclusion in the systems engineering analysis. Many of those elements are currently required as provided in 23 CFR 655.409, which this rule replaces. Recognizing the change in some current practices this type of analysis will require, the FHWA intends to issue guidance, training, and technical support in early 2001 to help stakeholders meet the requirements of the final rule.

Fifty-three comments were submitted regarding ITS standards and interoperability tests. The commenters expressed concern about requiring the use of ITS standards and interoperability tests prematurely, the impact on legacy systems of requiring ITS standards, and confusion regarding the term ''adopted by the DOT.''

In response to the comments, the FHWA has significantly modified the final rule to eliminate reference to the use of standards and interoperability tests prior to adoption in § 940.11(f). Section 940.11(g) addresses the applicability of standards to legacy systems. It is not the intent of the DOT to formally adopt any standard before the standard is mature; and also, not all ITS standards should, or will, be formally adopted by the DOT. Formal adoption of a standard means that the DOT will go through the rulemaking process, including a period of public comment, for all standards that are considered candidates for adoption.

The DOT has developed a set of criteria to determine when a standard could be considered for formal adoption. These criteria include, at a minimum, the following elements:

1. The standard has been approved by a Standard Development Organization (SDO).

2. The standard has been successfully tested in real world applications as appropriate.

3. The standard has received some degree of acceptance by the community served by the standard.

4. Products exist to implement the standard.

5. There is adequate documentation to support the use of the standard.

6. There is training available in the use of the standard where applicable.

Therefore, the intent of the rule is to require the use of a standard only when these criteria have been met, and there has been a separate rulemaking on adoption of the standard.

The only interoperability tests that are currently contemplated by the DOT are those associated with the Commercial Vehicle Operations (CVO) program. These tests are currently being used by States deploying CVO systems and will follow a similar set of criteria for adoption as those defined for standards.

Section 940.13 Project Administration

There were nine comments related to how conformity with the final rule would be determined, and by whom. There were 11 comments about how conformity with the regional ITS architecture would be determined, and by whom. Six comments specifically suggested methods for determining conformance, including a process similar to current Federal planning oversight procedures. Six other commenters suggested that determination be made by the MPO or State. For either case, the comments reflected a lack of clarity as to what documentation would be necessary. There were six related comments suggesting the level of documentation be commensurate with the scale of the planned ITS investments in the region.

In § 940.13 of the final rule, the FHWA has attempted to clarify the process for determining conformance. Conformance of an ITS project with a regional ITS architecture shall be made prior to authorization of funding for project construction or implementation as provided in 23 U.S.C. 106 and 133. We do not intend to create new oversight procedures beyond those provided in 23 U.S.C. 106 and 133, but in those cases where oversight and approval for ITS projects is assumed by the State, the State will be responsible for ensuring compliance with this regulation and the FHWA's oversight will be through existing processes.

There were 14 comments concerning the documentation requirements of the proposed rule and generally suggesting they be reduced. Certainly the development of a regional ITS architecture and evidence of conformance of a specific project to that regional ITS architecture implies some level of documentation be developed. However, to allow flexibility on the part of the State or local agency in demonstrating compliance with the final rule, no specific documentation is required to be developed or submitted to the FHWA for review or approval. The FHWA recognizes the need to be able to scale the regional ITS architecture and the associated documentation to the needs of the region. Section 940.9(a) of the final rule contains specific language allowing such scaling.

Summary of Requirements

I. The Regional ITS Architecture

This final rule on the ITS Architecture and Standards requires the development of a local implementation of the National ITS Architecture referred to as a regional ITS architecture. The regional ITS architecture is tailored to meet local needs, meaning that it does not address the entire National ITS Architecture and can also address services not included in the National ITS Architecture. The regional ITS architecture shall contain a description of the region and the identification of the participating agencies and other stakeholders; the roles and responsibilities of the participating agencies and other stakeholders; any agreements needed for operation; system functional requirements; interface requirements and information exchanges with planned and existing systems; identification of applicable standards; and the sequence of projects necessary for implementation. Any changes made in a project design that impact the regional ITS architecture shall be identified and the appropriate revisions made and agreed to in the regional ITS architecture.

Any region that is currently implementing ITS projects shall have a regional ITS architecture within four years of the effective date of this rule. All other regions not currently implementing ITS projects shall have a regional ITS architecture within four years of the first ITS project for that region advancing to final design. In this context, a region is a geographical area that is based on local needs for sharing information and coordinating operational strategies among multiple projects. A region can be specified at a metropolitan, Statewide, multi-State, or corridor level. Within a metropolitan area, the metropolitan planning area should be the minimum area that is considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture. A regional approach promotes integration of transportation systems. The size of the region should reflect the breadth of the integration of transportation systems.

II. Project Development

Additionally, this rule requires that all ITS projects be developed using a systems engineering analysis. All ITS projects that have not yet advanced to final design are required to conform to the system engineering requirements in § 940.11 upon the effective date of this rule. Any ITS project that has advanced to final design by the effective date of this rule is exempt from the requirements of § 940.11. When the regional ITS architecture is completed, project development will be based on the relevant portions of it which the project implements. Prior to completion of the regional ITS architecture, major ITS projects will develop project level ITS architectures that are coordinated with the development of the regional ITS architecture. ITS projects will be required to use applicable ITS standards and interoperability tests that have been officially adopted by the DOT. Where multiple standards exist, it will be the responsibility of the stakeholders to determine how best to achieve the interoperability they desire.

Rulemaking Analyses and Notices

Executive Order 12866 (Regulatory Planning and Review) and DOT Regulatory Policies and Procedures

The FHWA has determined that this action is not a significant regulatory action within the meaning of Executive Order 12866 or significant within the meaning of the Department of Transportation's regulatory policies and procedures. It is anticipated that the economic impact of this rulemaking will be minimal. This determination is based upon preliminary and final regulatory assessments prepared for this action that indicate that the annual impact of the rule will not exceed $100 million nor will it adversely affect the economy, a sector of the economy, productivity, jobs, the environment, public health, safety, or State, local, or tribal governments. In addition, the agency has determined that these changes will not interfere with any action taken or planned by another agency and will not materially alter the budgetary impact of any entitlements, grants, user fees, or loan programs. Copies of the preliminary and final regulatory assessments are included in the docket.

Costs

The FHWA prepared a preliminary regulatory evaluation (PRE) for the NPRM and comments were solicited. That analysis estimated the total costs of this rule over 10 years to be between $38.1 million and $44.4 million (the net present value over 10 years was between $22.3 million and $31.2 million). The annual constant dollar impact was estimated to range between $3.2 million and $4.4 million. We believe that the

cost estimates as stated in the PRE are negligible. The FHWA received only one comment in response to the PRE. That commenter, the Capital District Transportation Committee of Albany, New York suggested that our cost estimates were too low, but provided no further detail or rationale which would cause us to reconsider or increase our cost estimates in the initial regulatory evaluation.

These 10-year cost estimates set forth in the PRE included transportation planning cost increases, to MPOs ranging from $10.8 million to $13.5 million, and to States from $5.2 million to $7.8 million associated with our initial requirement to develop an ITS integration strategy that was proposed as part of the metropolitan and statewide planning rulemaking effort. The agency now plans to advance that proposed ITS integration strategy in the planning rule on a different time schedule than this final rule. Thus, the costs originally set forth in the PRE for the ITS integration strategy have been eliminated from the final cost estimate in the final regulatory evaluation (FRE) for this rule.

In the FRE, the agency estimates the cost of this rule to be between $1 million an $16 million over ten years, which are the estimated costs of this rule to implementing agencies for the development of the regional ITS architectures. These costs do not include any potential additional implementation costs for individual projects which are expected to be minimal and were extremely difficult to estimate. Thus, the costs to the industry are less than that originally estimated in the agency's NPRM.

Benefits

In the PRE, the FHWA indicated that the non-monetary benefits derived from the proposed action included savings from the avoidance of duplicative development, reduced overall development time, and earlier detection of potential incompatibilities. We stated that, as with project implementation impacts, the benefits of the rule are very difficult to quantify in monetary terms. Thus, we estimated that the coordination guidance provided through implementation of the rule could provide savings of approximately $150,000 to any potential entity seeking to comply with the requirements of section 5206(e) of the TEA–21 as compared with an entity having to undertake compliance individually. The costs may be offset by benefits derived from the reduction of duplicative deployments, reduced overall development time, and earlier detection of potential incompatibilities.

In developing a final regulatory evaluation for this action, we did not denote a significant change in any of the benefits anticipated by this rule. This is so notwithstanding the fact that our planning costs for the ITS integration strategy have been eliminated from the final cost estimate. The primary benefits of this action that result from avoidance of duplicative development, reduced overall development time, and earlier detection of potential incompatibilities will remain the same.

In sum the agency believes that the option chosen in this action will be most effective at helping us to implement the requirements of section 5206(e) of the TEA–21. In developing the rule, the FHWA has sought to allow broad discretion to those entities impacted, in levels of response and approach that are appropriate to particular plans and projects, while conforming to the requirements of the TEA–21. The FHWA has considered the costs and benefits of effective implementation of ITS through careful and comprehensive planning. Based upon the information above, the agency anticipates that the economic impact associated with this rulemaking action is minimal and a full regulatory evaluation is not necessary.

Regulatory Flexibility Act

In compliance with the Regulatory Flexibility Act (5 U.S.C. 601–612), the FHWA has evaluated, through the regulatory assessment, the effects of this action on small entities and has determined that this action will not have a significant economic impact on a substantial number of small entities. Small businesses and small organizations are not subject to this rule, which applies to government entities only. Since § 940.9(a) of this rule provides for regional ITS architectures to be developed on a scale commensurate with the scope of ITS investment in the region, and § 940.11(b) provides for the ITS project systems engineering analysis to be on a scale commensurate with the project scope, compliance requirements will vary with the magnitude of the ITS requirements of the entity. Small, less complex ITS projects have correspondingly small compliance documentation requirements, thereby accommodating the interest of small government entities. Small entities, primarily transit agencies, are accommodated through these scaling provisions that impose only limited requirements on small ITS activities. For these reasons, the FHWA certifies that this action will not have a significant impact on a substantial number of small entities.

Unfunded Mandates Reform Act of 1995

This action does not impose unfunded mandates as defined by the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4, March 22, 1995, 109 Stat. 48). This rule will not result in an expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year.

Executive Order 13132 (Federalism)

This action has been analyzed in accordance with the principles and criteria contained in Executive Order 13132, dated August 4, 1999, and the FHWA has determined that this action does not have sufficient federalism implications to warrant the preparation of a federalism assessment. The FHWA has also determined that this action does not preempt any State law or State regulation or affect the State's ability to discharge traditional State governmental functions.

Executive Order 12372 (Intergovernmental Review)

Catalog of Federal Domestic Assistance Program Number 20.205, Highway planning and construction. The regulations implementing Executive Order 12372 regarding intergovernmental consultation on Federal programs and activities apply to this program.

Paperwork Reduction Act of 1995

This action does not contain information collection requirements for the purposes of the Paperwork Reduction Act of 1995, 44 U.S.C. 3501–3520.

Executive Order 12988 (Civil Justice Reform)

This action meets applicable standards in sections 3(a) and 3(b)(2) of Executive Order 12988, Civil Justice Reform, to minimize litigation, eliminate ambiguity, and reduce burden.

Executive Order 13045 (Protection of Children)

We have analyzed this action under Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks. This rule is not an economically significant rule and does not concern an environmental risk to health or safety that may disproportionately affect children.

Executive Order 12630 (Taking of Private Property)

This rule does not effect a taking of private property or otherwise have taking implications under Executive Order 12630, Government Actions and Interference with Constitutionally Protected Property Rights.

National Environmental Policy Act

The agency has analyzed this action for the purposes of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321–4347), and has determined that this action will not have any effect on the quality of the environment.

Regulation Identification Number

A regulation identification number (RIN) is assigned to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. The RIN contained in the heading of this document can be used to cross reference this proposed action with the Unified Agenda.

List of Subjects

23 CFR Part 655

Design standards, Grant programs-transportation, Highways and roads, Incorporation by reference, Signs and symbols, Traffic regulations.

23 CFR Part 940

Design standards, Grant programs-transportation, Highways and roads, Intelligent transportation systems.

Issued on: January 2, 2001.

Kenneth R. Wykle,

Federal Highway Administrator.

In consideration of the foregoing, the FHWA amends Chapter I of title 23, Code of Federal Regulations, as set forth below:

PART 655—[AMENDED]

1. The authority citation for part 655 continues to read as follows:

Authority: 23 U.S.C. 101(a), 104, 109(d), 114(a), 217, 315, and 402(a); 23 CFR 1.32, and 49 CFR 1.48(b).

Subpart D—[Removed and reserved]

2. Remove and reserve subpart D of part 655, consisting of §§ 655.401, 655.403, 655.405, 655.407, 655.409, 655.411.

3. Add a new subchapter K, consisting of part 940, to read as follows:

Subchapter K—Intelligent Transportation Systems

PART 940—INTELLIGENT TRANSPORTATION SYSTEM ARCHITECTURE AND STANDARDS

Sec.

Authority: 23 U.S.C. 101, 106, 109, 133, 315, and 508; sec 5206(e), Public Law 105–178, 112 Stat. 457 (23 U.S.C. 502 note); and 49 CFR 1.48.

§ 940.1 Purpose.

This regulation provides policies and procedures for implementing section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), Public Law 105–178, 112 Stat. 457, pertaining to conformance with the National Intelligent Transportation Systems Architecture and Standards.

§ 940.3 Definitions.

Intelligent Transportation System (ITS) means electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

ITS project means any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture.

Major ITS project means any ITS project that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems.

National ITS Architecture (also ''national architecture'') means a common framework for ITS interoperability. The National ITS Architecture comprises the logical architecture and physical architecture which satisfy a defined set of user services. The National ITS Architecture is maintained by the United States Department of Transportation (DOT) and is available on the DOT web site at *http://www.its.dot.gov.*

Project level ITS architecture is a framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.

Region is the geographical area that identifies the boundaries of the regional ITS architecture and is defined by and based on the needs of the participating agencies and other stakeholders. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.

Regional ITS architecture means a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

Systems engineering is a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives.

§ 940.5 Policy.

ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning.

§ 940.7 Applicability.

(a) All ITS projects that are funded in whole or in part with the highway trust fund, including those on the National Highway System (NHS) and on non-NHS facilities, are subject to these provisions.

(b) The Secretary may authorize exceptions for:

(1) Projects designed to achieve specific research objectives outlined in the National ITS Program Plan under section 5205 of the TEA–21, or the Surface Transportation Research and Development Strategic Plan developed under 23 U.S.C. 508; or

(2) The upgrade or expansion of an ITS system in existence on the date of enactment of the TEA–21, if the Secretary determines that the upgrade or expansion:

(i) Would not adversely affect the goals or purposes of Subtitle C (Intelligent Transportation Systems Act of 1998) of the TEA–21;

(ii) Is carried out before the end of the useful life of such system; and

(iii) Is cost-effective as compared to alternatives that would meet the conformity requirement of this rule.

(c) These provisions do not apply to funds used for operations and maintenance of an ITS system in existence on June 9, 1998.

§ 940.9 Regional ITS architecture.

(a) A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. The regional ITS architecture shall be on a scale commensurate with the scope of ITS investment in the region. Provision should be made to include participation from the following agencies, as appropriate, in the development of the regional ITS architecture: Highway agencies; public safety agencies (*e.g.,* police, fire, emergency/medical); transit operators; Federal lands agencies; State motor carrier agencies; and other operating agencies necessary to fully address regional ITS integration.

(b) Any region that is currently implementing ITS projects shall have a regional ITS architecture by February 7, 2005.

(c) All other regions not currently implementing ITS projects shall have a regional ITS architecture within four years of the first ITS project for that region advancing to final design.

(d) The regional ITS architecture shall include, at a minimum, the following:

(1) A description of the region;

(2) Identification of participating agencies and other stakeholders;

(3) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;

(4) Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture;

(5) System functional requirements;

(6) Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);

(7) Identification of ITS standards supporting regional and national interoperability; and

(8) The sequence of projects required for implementation.

(e) Existing regional ITS architectures that meet all of the requirements of paragraph (d) of this section shall be considered to satisfy the requirements of paragraph (a) of this section.

(f) The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve within the region.

§ 940.11 Project implementation.

(a) All ITS projects funded with highway trust funds shall be based on a systems engineering analysis.

(b) The analysis should be on a scale commensurate with the project scope.

(c) The systems engineering analysis shall include, at a minimum:

(1) Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture);

(2) Identification of participating agencies roles and responsibilities;

(3) Requirements definitions;

(4) Analysis of alternative system configurations and technology options to meet requirements;

(5) Procurement options;

(6) Identification of applicable ITS standards and testing procedures; and

(7) Procedures and resources necessary for operations and management of the system.

(d) Upon completion of the regional ITS architecture required in §§ 940.9(b) or 940.9(c), the final design of all ITS projects funded with highway trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated as provided in the process defined in § 940.9(f) to reflect the changes.

(e) Prior to the completion of the regional ITS architecture, any major ITS project funded with highway trust funds that advances to final design shall have a project level ITS architecture that is coordinated with the development of the regional ITS architecture. The final design of the major ITS project shall accommodate the interface requirements and information exchanges as specified in this project level ITS architecture. If the project final design is inconsistent with the project level ITS architecture, then the project level ITS architecture shall be updated to reflect the changes. The project level ITS architecture is based on the results of the systems engineering analysis, and includes the following:

(1) A description of the scope of the ITS project;

(2) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS project;

(3) Functional requirements of the ITS project;

(4) Interface requirements and information exchanges between the ITS project and other planned and existing systems and subsystems; and

(5) Identification of applicable ITS standards.

(f) All ITS projects funded with highway trust funds shall use applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the DOT.

(g) Any ITS project that has advanced to final design by February 7, 2001 is exempt from the requirements of paragraphs (d) through (f) of this section.

§ 940.13 Project administration.

(a) Prior to authorization of highway trust funds for construction or implementation of ITS projects, compliance with § 940.11 shall be demonstrated.

(b) Compliance with this part will be monitored under Federal-aid oversight procedures as provided under 23 U.S.C. 106 and 133.

[FR Doc. 01–391 Filed 1–5–01; 8:45 am]

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APPENDIX C

FTA NATIONAL ITS ARCHITECTURE POLICY ON TRANSIT PROJECTS

DEPARTMENT OF TRANSPORTATION

Federal Transit Administration

Federal Transit Administration National ITS Architecture Policy on Transit Projects

AGENCY: Federal Transit Administration (FTA), DOT.

ACTION: Notice.

SUMMARY: The Federal Transit Administration (FTA) announces the FTA National ITS Architecture Policy on Transit Projects, which is defined in this document. The National ITS Architecture Policy is a product of statutory changes made by the Transportation Equity Act for the 21st Century (TEA–21) (Pub. L. 105–178) enacted on June 9, 1998. The National ITS Architecture Policy is also a product of the Request for Comment on the National ITS Architecture Consistency Policy for Project Development that was published in the **Federal Register** on May 25, 2000. Because it is highly unlikely that the entire National ITS Architecture would be fully implemented by any single metropolitan area or State, this policy requires that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a ''regional ITS architecture.'' Therefore, conformance with the National ITS Architecture is defined under this policy as development of a regional ITS architecture within four years after the first ITS project advancing to final design, and the subsequent adherence of ITS projects to the regional ITS architecture. The regional ITS architecture is based on the National ITS Architecture and consists of several parts including the system functional requirements and information exchanges with planned and existing systems and subsystems and identification of applicable standards, and would be tailored to address the local situation and ITS investment needs.

DATE: *Effective Date:* This policy is effective from February 7, 2001.

ADDRESSES: For FTA staff, Federal Transit Administration, Department of Transportation (DOT), 400 Seventh Street, SW., Washington, DC 20590.

FOR FURTHER INFORMATION CONTACT: *For Technical Information:* Ron Boenau, Chief, Advanced Public Transportation Systems Division (TRI–11), at (202) 366–0195 or Brian Cronin, Advanced Public Transportation Systems Division (TRI–11), at (202) 366–8841. *For Legal Information:* Richard Wong, Office of the Chief Council (202) 366–1936. The policy is posted on the FTA website on the Internet under http://www.fta.dot.gov.

Electronic Access: An electronic copy of this document may be downloaded using a computer, modem and suitable communications software from the Government Printing Office's Electronic Bulletin Board Service at (202) 512–1661. Internet users may reach the Office of the Federal Register's home page at: *http://www.nara.gov/fedreg* and the Government Printing Office's web page at: *http://www.access.gpo.gov/nara.*

Internet users may access all comments received by the U.S. DOT Dockets, Room PL–401, for the Request for Comment that was issued on May 25, 2000 which were used to clarify this Policy, by using the universal resource locator (URL): *http://dms.dot.gov.* It is available 24 hours each day, 365 days each year. Please follow the instructions online for more information and help. The docket number for the Request for Comment was FTA–99–6417.

SUPPLEMENTARY INFORMATION:

I. Background

The Federal Transit Administration (FTA) published a Request for Comment on May 25, 2000, to implement section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21) (Pub.L. 105–178), which was enacted on June 9, 1998.

Section 5206(e) of TEA–21 requires that the Secretary of the DOT must

> Ensure that intelligent transportation system projects carried out using funds made available from the Highway Trust Fund, * * * conform to the national architecture, applicable standards or provisional standards, and protocols developed under subsection(a).

The objectives for the FTA's National ITS Architecture Policy for Transit Projects are to:

- Provide requirements for ITS project development for projects implemented wholly or partially with highway trust funds.
- Achieve system integration of ITS projects funded through the highway trust fund with other transportation projects planned for the region, which will thereby enable electronic information and data sharing for advanced management and operations of the ITS infrastructure.
- Engage stakeholders (state DOT's, transit agencies, public safety agencies, other transportation operating agencies) in the project development and implementation process.
- Facilitate future expansion capability of the ITS infrastructure.
- Save design time through use of the National ITS Architecture requirements definitions and market packages.

FTA has developed this policy to meet the TEA–21 requirement contained in Section 5206(e) and the DOT/FTA goal to encourage effective deployment of ITS projects. Additionally, DOT and FTA encourage the coordination of local ITS strategies and projects to help meet national and local goals for mobility, accessibility, safety, security, economic growth and trade, and the environment.

The National ITS Architecture documents were developed by the US DOT, and are updated on an as-needed basis. Current work to update the National ITS Architecture is the Archive Data User Service, which provides the ability to store and process data over an extended period of time. FTA is pursuing the addition of a Rail ITS program for travel management, vehicles, and users. New versions of the documents, when they are issued, will be available from the US DOT on the DOT website at *www.its.dot.gov.* Version 3.0 is the latest version of the National ITS Architecture.

The first section of this policy contains a complete analysis of and response to the comments provided to the docket. The remainder of the Notice contains the FTA National ITS Architecture Policy for Transit Projects.

II. Public Comments

Eighteen comments were submitted to the FTA National ITS Architecture Consistency Policy for Project Development docket by the September 23, 2000, close of the comment period. Comments were submitted by transit operators (3), state and local governments (5), metropolitan planning organizations (4), industry associations (3), and consultants (3). As indicated earlier, a complete analysis and response to the docket comments is provided. In order to facilitate focused comments, FTA asked a series of questions about the policy. The public comment section is organized first by analysis and response to the specific questions asked; second by responses to comments not specifically related to one of the nine questions; and finally by an explanation of other changes. In general, the comments received were positive. Therefore, the FTA has kept the scope of the policy and made appropriate clarifications to the text of the policy to address concerns raised in comments. In response to the many comments requesting it, the FTA, in association with the ITS Joint Program Office, in the Federal Highway Administration (FHWA) will also provide a program of guidance, training, and technical

support to assist with the implementation of this policy.

Questions

1. Do reviewers understand the definition of a major ITS investment as defined in Section IV, ''Regional ITS Architecture,'' or is more clarification needed, and if so please explain?

Comments: Nine commenters submitted responses to this question. In general, commenters found the definition confusing, and did not understand why major ITS projects need to be called out over other ITS projects. One commenter noted that small dollar projects can have a major impact on future development, while an expensive system may have no impact. Another commenter was unclear about the term ''supporting national interoperability.''

Response: Of specific concern to the agency is the timing in which requirements for this policy are enacted. As such, the terms ''major ITS investment'' and ''major ITS project'' were provided so as to distinguish between projects that will require immediate correlation to the regional ITS architecture and those that do not. The term ''major ITS investment'' was also found to be redundant to ''major ITS project'' and was removed from the policy. Guidance on the classification of ''ITS projects'' and ''major ITS projects'' will be provided upon enactment of the policy.

2. Do reviewers understand the definition of an ITS project, or is more clarification needed, and if so please explain?

Comments: Nine commenters submitted responses to this question. Commenters found this term less confusing than ''major ITS investments,'' but requested more clarification. Some commenters proposed alternative language or asked for clarification on particular examples.

Response: The agency has clarified the definition by deleting the potentially ambiguous examples provided and will develop guidance material that provides examples of projects that will be considered ITS projects and those that will not be considered ITS projects. In general, unless a technology project is implementing one of the ITS user services defined in the National ITS Architecture, it would not be considered an ITS project.

3. Do reviewers understand the difference between a ''major ITS investment,'' and an ''ITS project'', or is more clarification needed, and if so please explain?

Comments: Eight commenters submitted responses to this question. Commenters had mixed responses, as some commenters found the differences to be clear, while others requested that guidance material be provided to further explain the differences. Commenters did suggest that a ''project'' is a ''project'' and should not be quantified in terms of dollar amounts.

Response: As described in the response to question 1, the agency has removed the term ''major ITS investment'' and will provide guidance on the term ''ITS project.''

4. Are the requirements for development of a Regional ITS Architecture clear? If not, what is not clear about the requirement?

Comment: Nine commenters provided responses to the question. Most commenters found the requirements to be unclear and/or did not agree with the requirements. One commenter suggested that a region will have different definitions. One commenter noted that a concept of operations and conceptual design are normally conducted at the project level. One commenter requested clarification as to the appropriate place to program projects, in the regional ITS architecture, or in the planning process.

Response: Of specific concern to the agency is providing a flexible policy that allows the transportation stakeholders to define their region and the roles and responsibilities of each stakeholder during the development of a regional ITS architecture. As such, the agency has clarified the requirements of a regional ITS architecture and also removed the specific requirements for a Concept of Operations and a Conceptual Design. Instead, the agency has listed the specific requirements for a regional ITS architecture and has left the development, documentation, and maintenance of the regional ITS architecture to the stakeholders involved. Also, the region is defined as ''a geographical area that is based on local needs for sharing information and coordinating operational strategies among multiple projects.'' A region can be specified at a metropolitan, Statewide, multi-State, or corridor level. Additional guidance on this topic will be provided after enactment of the policy.

5. What additional guidance, if any, is required to explain how to implement this proposed policy?

Comments: Ten commenters provided responses to this question. All the comments called for additional guidance on the specifics of implementing this policy. Commenters requested guidance on the definition of a ''region,'' the ownership of the regional ITS architecture, determination of stakeholders, regional ITS architecture maintenance, certification and simplification of definitions. One commenter requested that the policy be limited to only the ITS Integration Requirements defined in the Metropolitan and Statewide Planning NPRM.

Response: The agency will provide guidance materials to address the comments suggested. The ITS Integration Strategy, as defined in the NPRM, is part of the planning process and as such does not satisfactorily address project level requirements.

6. The proposed rule allows regions to develop a Regional Architecture as a separate activity, or incrementally, as major ITS investments are developed within a region. Do reviewers anticipate particular difficulties with implementing and documenting either approach?

Comments: Nine commenters provided responses to this question. Commenters largely did not favor one approach over the other. One commenter suggested that a regional ITS architecture with a twenty year time horizon is impractical and infeasible. One commenter suggested that either approach would require additional staff resources.

Response: The agency was concerned about the time horizon and development process needed to create a regional ITS architecture within the time period required and as a result suggested both an incremental and initial comprehensive approach. Based on the responses, the agency has modified the policy to be silent on the approach used to develop the regional ITS architecture. Instead, the agency focused on the products included in the regional ITS architecture, the effective date of the requirements, and the catalyst for requiring the development of a regional ITS architecture.

7. Do reviewers understand the relationships between the Integration Strategy, the Regional ITS Architecture, and the ITS Project Architecture?

Comment: Seven commenters provided a response to this question. In general, commenters did not understand the relationship between the Integration Strategy, regional ITS architecture, and the ITS Project Architecture. One commenter suggested that flexibility in application of project architecture must be maintained to accommodate legacy systems and to take advantage of technological innovation, while maintaining the outcome of interoperability, where applicable.

Response: The Agency is concerned with linkage between the planning process and the project development process. However, this policy only deals with the project level requirements.

Planning level requirements, including the Integration Strategy, will be explained as the Metropolitan and Statewide Planning Process rulemaking process is advanced. This policy only requires that the regional ITS architecture should be consistent with the transportation planning process. A definition for a project level ITS architecture has been added to the policy.

8. What additional guidance, if any, is required regarding phasing of this rule?

Comments: Six commenters submitted responses to this question. In general, the commenters stated that the phasing was clear. However, one commenter requested a three-year phase-in period. Several commenters requested that existing projects be exempt from the policy.

Response: The agency has clarified the policy statements that refer to the project status and the applicability of this policy. Projects that have reached final design by the date of this policy are exempt from the policy requirements. The agency has extended the time period for regional ITS architecture development to four years. Any region that is currently implementing ITS projects shall have a regional architecture within four years of the effective date of the final policy. All other regions not currently implementing ITS projects shall have a regional ITS architecture in place within four years of the first ITS project for that region advancing to final design.

9. Are the oversight and documentation requirements clear? If not, what is not clear about the requirements?

Comments: Eight commenters submitted responses to this question. Commenters in general requested more guidance from FTA on oversight and documentation requirements, but few provided suggestions to clarify the requirements. One commenter suggested that checklists to verify consistency requirements will be needed. Other commenters suggested that self-certification should be allowed, but also needs to be clearly defined.

Response: The agency will continue to use normal existing oversight procedures to review grantee compliance with FTA policies and regulations. Normal oversight procedures include the annual risk assessment of grantees performed by regional office staff, triennial reviews, planning process reviews, and project management oversight reviews, as applicable. In TEA–21, FTA was granted authority to use oversight funds to provide technical assistance to grantees in which oversight activities suggested non-compliance with agency policies and regulations. FTA is using oversight funds to specifically hire contractors with ITS experience who will monitor and assist grantees who are at risk of NOT meeting the National ITS Architecture Policy requirements. Additional guidance on oversight and documentation requirements will be provided.

Additional Comments

One commenter suggested that the proposed guidance circular requires that all of the agencies in a region agree before a project can be implemented, thus conferring ''veto'' power over the project. The agency does not intend for the policy to halt ITS deployment in areas where agencies cannot agree on project designs. As part of the regional ITS Architecture development, the agencies can agree to disagree, however, the regional ITS architecture should include a representation of the stand-alone ITS deployments.

One commenter suggests that the proposal infers that existing agreements between agencies will now need to be amended or redone, which would result in a halt in operations of successful ITS projects and prevent the completion of other ITS projects. In response to the comment, the agency has clarified the regional ITS architecture requirements to specify that existing agreements that address the regional ITS architecture requirements are sufficient and that new agreements are not necessarily required.

One commenter noted that a definition of ITS was not included in the policy. The commenter suggested that the definition provided in TEA–21 section 5206(e) should be included in the policy. The agency agrees and has added the definition of ITS to the list of definitions. However, the legislative definition of ITS is broad and other commenters have suggested that if the policy is written to include every new piece of electronics or hardware, then the policy would be too limiting. As a result, the policy is intended to apply only to projects meeting the definition of an ''ITS project'' listed in the ''Definitions'' section of the policy.

One commenter suggested that DOT should ensure that the Federal Highway Administration's (FHWA's) regulation and the FTA policy have the same statutory standing and that their requirements in ITS planning and deployment be consistent if not identical. The FTA and FHWA have different processes and procedures for project development. Therefore, the FHWA has issued a regulation, and FTA has issued the policy. The policy language in each document is consistent and will be carried out in a coordinated fashion, as applicable under FTA and FHWA project management and oversight procedures. FTA and FHWA planning procedures are a joint regulation and as such will be identical.

FTA received some comments regarding the use of standards. Several comments concern the premature use of required standards and interoperability tests, their impact on legacy systems, and confusion regarding the term ''adopted by the USDOT.''

In response to the comments, FTA has significantly modified the final policy to eliminate reference to the use of standards and interoperability tests prior to adoption through formal rulemaking. It is not the intent of the USDOT to formally adopt any standard before the standard is mature; also, not all ITS standards should, or will, be formally adopted by the USDOT. The only interoperability tests that are currently contemplated by the USDOT are those associated with the Commercial Vehicle Operations (CVO) program. These tests are currently being used by States deploying CVO systems and will follow a similar set of criteria for adoption as those defined for standards.

Other Changes

Several commenters expressed concern about linkages to the planning rule and the integration strategy. Comments regarding the portions of the National ITS Architecture conformity process included in the proposed transportation planning rule will be addressed as that rule proceeds to its issuance. The FHWA rule and the parallel FTA policy have been developed without direct reference to the proposed changes to the transportation planning process, including no mention of the development of an integration strategy. However, the policy statement of this guidance notes a link to transportation planning processes, and fully supports those collaborative methods for establishing transportation goals and objectives.

Policy Contents

I. Purpose

This policy provides procedures for implementing section 5206(e) of the Transportation Equity Act for the 21st

Century, Public Law 105–178, 112 Stat. 547, pertaining to conformance with the National Intelligent Transportation Systems Architecture and Standards.

II. Definitions

Intelligent Transportation Systems (ITS) means electronics, communications or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

ITS project means any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture.

Major ITS project means any ITS project that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems.

National ITS Architecture (also ''national architecture'') means a common framework for ITS interoperability. The National ITS Architecture comprises the logical architecture and physical architecture which satisfy a defined set of user services. The National ITS Architecture is maintained by U.S. DOT (Department of Transportation) and is available on the DOT web site at *http://www.its.dot.gov.*

Project level ITS architecture is a framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.

Region is the geographical area that identifies the boundaries of the regional ITS architecture and is defined by and based on the needs of the participating agencies and other stakeholders. A region can be specified at a metropolitan, Statewide, multi-State, or corridor level. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.

Regional ITS architecture means a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

Systems engineering is a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives.

III. Policy

ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture in support of integration and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning (49 CFR part 613 and 621).

IV. Applicability

(a) All ITS projects that are funded in whole or in part with the Highway Trust Fund (including the mass transit account) are subject to these provisions.

(b) The Secretary may authorize exceptions for:

1. Projects designed to achieve specific research objectives outlined in the National ITS Program Plan under section 5205 of the Transportation Equity Act for the 21st Century or the Surface Transportation Research and Development Strategic Plan developed under section 5208 of Title 23, United States Code; or

2. The upgrade or expansion of an ITS system in existence on the date of enactment of the Transportation Equity Act for the 21st Century if the Secretary determines that the upgrade or expansion—

a. Would not adversely affect the goals or purposes of Subtitle C (Intelligent Transportation Systems) of the Transportation Equity Act for the 21st Century and

b. Is carried out before the end of the useful life of such system; and

c. Is cost-effective as compared to alternatives that would meet the conformity requirement of this rule

(c) These provisions do not apply to funds used for Operations and Maintenance of an ITS system in existence on June 9, 1998.

V. Regional ITS Architecture

(a) A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. The regional ITS architecture shall be on a scale commensurate with the scope of ITS investment in the region. Provision should be made to include participation from the following agencies, as appropriate, in the development of the regional ITS architecture: Highway agencies; public safety agencies (*e.g.,* police, fire, emergency/medical); transit agencies; federal lands agencies; state motor carrier agencies; and other operating agencies necessary to fully address regional ITS integration.

(b) Any region that is currently implementing ITS projects shall have a regional ITS architecture February 7, 2005.

(c) All other regions not currently implementing ITS projects shall have a regional ITS architecture within four years of the first ITS project for that region advancing to final design.

(d) The regional ITS architecture shall include, at a minimum, the following:

(1) A description of the region;

(2) Identification of participating agencies and other stakeholders;

(3) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;

(4) Any agreements (existing or new) required for operations, including at a minimum those affecting integration of ITS projects; interoperability of different ITS technologies, utilization of ITS-related standards, and the operation of the projects identified in the regional ITS architecture;

(5) System functional requirements;

(6) Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);

(7) Identification of ITS standards supporting regional and national interoperability;

(8) The sequence of projects required for implementation of the regional ITS architecture.

(e) Existing regional ITS architectures that meet all of the requirements of section V(d) shall be considered to satisfy the requirements of V(a).

(f) The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining the regional ITS architecture, as needs evolve within the region.

VI. Project Implementation

(a) All ITS projects funded with mass transit funds from the highway trust

fund shall be based on a systems engineering analysis.

(b) The analysis should be on a scale commensurate with the project scope.

(c) The systems engineering analysis shall include, at a minimum:

(1) Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture).

(2) Identification of participating agencies' roles and responsibilities;

(3) Requirements definitions:

(4) Analysis of alternative system configurations and technology options to meet requirements;

(5) Analysis of financing and procurement options;

(6) Identification of applicable ITS standards and testing procedures; and

(7) Procedures and resources necessary for operations and management of the system;

(d) Upon completion of the regional ITS architecture required in section V, the final design of all ITS projects funded with highway trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated as per the process defined in V(f) to reflect the changes.

(e) Prior to completion of the regional ITS architecture, any major ITS project funded with highway trust funds that advances to final design shall have a project level ITS architecture that is coordinated with the development of the regional ITS architecture. The final design of the major ITS project shall accommodate the interface requirements and information exchanges as specified in this project level ITS architecture. If the project final design is inconsistent with the project level architecture, then the project level ITS architecture shall be updated to reflect the changes. The project level ITS architecture is based on results of the systems engineering analysis, and includes the following:

(1) A description of the scope of the ITS project

(2) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS project;

(3) Functional requirements of the ITS project;

(4) Interface requirements and information exchanges between the ITS project and other planned and existing systems and subsystems; and

(5) Identification of applicable ITS standards

(b) All ITS projects funded with Mass Transit Funds from the Highway Trust Funds shall use applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the United States Department of Transportation (US DOT).

(c) Any ITS project that has advanced to final design by (effective date of policy) is exempt from the requirements of VI.

VII. Project Oversight

(a) Prior to authorization of Mass Transit Funds from the Highway Trust Fund for acquisition or implementation of ITS projects, grantees shall self-certify compliance with sections V and VI. Compliance with this policy shall be monitored under normal FTA oversight procedures, to include annual risk assessments, triennial reviews, and program management oversight reviews as applicable.

(b) Compliance with the following FTA Circulars shall also be certified:

- C5010.1C, Grant Management Guidelines
- C6100.1B, Application Instructions and Program Management Guidelines

VIII. FTA Guidance

FTA will develop appropriate guidance materials regarding the National ITS Architecture Consistency Policy.

Issued on: January 2, 2001.

Nuria I. Fernandez,

Acting Administrator.

[FR Doc. 01–392 Filed 1–5–01; 8:45 am]

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APPENDIX D

GLOSSARY OF ITS ARCHITECTURE TERMS

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Glossary of Architecture Terms from the National ITS Architecture

Full glossary available online at:
http://itsarch.iteris.com/itsarch/html/glossary/glossary.htm

Architecture	A framework within which a system can be built. Requirements dictate what functionality the architecture must satisfy. An architecture functionally defines what the pieces of the system are and the information that is exchanged between them. An architecture is functionally oriented and not technology-specific which allows the architecture to remain effective over time. It defines "what must be done," not "how it will be done."
Architecture Flow	Information that is exchanged between subsystems and terminators in the physical architecture view of the National ITS Architecture. Architecture flows are the primary tool that is used to define the Regional ITS Architecture interfaces. These architecture flows and their communication requirements define the interfaces which form the basis for much of the ongoing standards work in the national ITS program. The terms "information flow" and "architecture flow" are used interchangeably.
Element	This is the basic building block of Regional ITS Architectures and Project ITS Architectures. It is the name used by stakeholders to describe a system or piece of a system.
Equipment Package	Equipment packages are the building blocks of the physical architecture subsystems. Equipment Packages group similar processes of a particular subsystem together into an "implementable" package. The grouping also takes into account the user services and the need to accommodate various levels of functionality.
Information Flow	Information that is exchanged between subsystems and terminators in the physical architecture view of the National ITS Architecture. These information flows are normally identical to the architecture flows in the National ITS Architecture. The terms "information flow" and "architecture flow" are used interchangeably.
Intelligent Transportation System	The system defined as the electronics, communications or information processing used singly or integrated to improve the efficiency or safety of surface transportation.
Inventory	See *System Inventory*.
ITS Architecture	Defines an architecture of interrelated systems that work together to deliver transportation services. An ITS architecture defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation services.
ITS Project	Any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services.
Logical Architecture	The logical architecture view of the National ITS Architecture defines what has to be done to support the ITS user services. It defines the processes that perform ITS functions and the information or data flows that are shared between these processes.
Market Package	The market packages provide an accessible, service-oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. Market packages collect together one or more equipment packages that must work together to deliver a given transportation service and the architecture flows that connect them and other important external systems. In other words, they identify the pieces of the physical architecture that are required to implement a particular transportation service.

National ITS Architecture	A common, established framework for developing integrated transportation systems. The National ITS Architecture is comprised of the logical architecture and the physical architecture, which satisfy a defined set of user service requirements. The National ITS Architecture is maintained by the United States Department of Transportation (USDOT).
Physical Architecture	The physical architecture is the part of the National ITS Architecture that provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the logical architecture. The principal elements in the physical architecture are the subsystems and architecture flows that connect these subsystems and terminators into an overall structure. The physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems, which form the basis for much of the ongoing standards work in the ITS program.
Project ITS Architecture	A framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.
Region	The geographical area that identifies the boundaries of the Regional ITS Architecture and is defined by and based on the needs of the participating agencies and other stakeholders. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.
Regional ITS Architecture	A specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects in a particular region. It functionally defines what pieces of the system are linked to others and what information is exchanged between them.
Stakeholders	A widely used term that notates a public agency, private organization or the traveling public with a vested interest, or a “stake” in one or more transportation elements within a Regional ITS Architecture.
Standards	Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for the interchange of data. A broad array of ITS standards is currently under development that will specifically define the interfaces identified in the National ITS Architecture.
Subsystem	The principle structural element of the physical architecture view of the National ITS Architecture. Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers. Example subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem. These correspond to the physical world: respectively traffic operations centers, automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the subsystems, the subsystem interfaces are prime candidates for standardization.
System	A collection of hardware, software, data, processes, and people that work together to achieve a common goal. Note the scope of a “system” depends on one’s viewpoint. To a sign manufacturer, a dynamic message sign is a “system.” To a state DOT, the same sign is only a component of a larger Freeway Management “System.” In a Regional ITS Architecture, a Freeway Management System is a part of the overall surface transportation “system” for the region.
System Inventory	The collection of all ITS-related elements in a Regional ITS Architecture.

Terminator	Terminators define the boundary of an architecture. The National ITS Architecture terminators represent the people, systems, and general environment that interface to ITS. The interfaces between terminators and the subsystems and processes within the National ITS Architecture are defined, but no functional requirements are allocated to terminators. The logical architecture and physical architecture views of the National ITS Architecture both have exactly the same set of terminators. The only difference is that logical architecture processes communicate with terminators using data flows, while physical architecture subsystems use architecture flows.
Turbo Architecture	An automated software tool used to input and manage system inventory, market packages, architecture flows and interconnects with regard to a Regional ITS Architecture and/or multiple Project ITS Architectures.
User Services	User services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. User services, including the corresponding user service requirements, form the basis for the National ITS Architecture development effort. The initial user services were jointly defined by USDOT and ITS America with significant stakeholder input and documented in the National Program Plan. The concept of user services allows system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs. New or updated user services have been and will continue to be satisfied by the National ITS Architecture over time.

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APPENDIX E

COMPILED LIST OF MEETING PARTICIPANTS

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Compiled List of Meeting Participants

Organization	Name
Brockton Area Transit	Kathy Riddell
Cape Ann Transportation Authority	Paul Talbot
Central Transportation Planning Staff	Efi Pagitsas Alicia Wilson
City of Boston – Management and Information Services Department	Georges Hawat
City of Boston – Transportation Department	Don Burgess Jim Gillooly
Consensus Systems Technologies Corp.	Manny Insignares Rob Jaffe
Executive Office of Transportation	Ed Carr Jim Cope David Luce Chuck McCarthy Patrick McMahon Ken Miller Sean Dennison Steve Pepin
Federal Highway Administration	Chris DiPalma Ed Silva
Federal Motor Carrier Safety Administration	Kevin Carter
Federal Transit Administration	Noah Berger MaryBeth Mello Andy Motter
Greater Attleboro-Taunton Regional Transit Authority	Francis Gay Lorri Emond
IBI Group	Angus Davol Ammar Kanaan Jon Makler Carl-Henry Piel Derek Sims
Lowell Regional Transit Authority	Robert Kennedy Frank Romano
Massachusetts Bay Transportation Authority	Joe Cosgrove Dennis DiZoglio Ron Morgan
Massachusetts Emergency Management Agency	David Martineau Steve McGrail John Tommaney

Organization	Name
Massachusetts Highway Department	Joe Amato Russ Bond Jim Silveria
Massachusetts Institute of Technology	Joe Sussman
Massachusetts Port Authority	Rick Handman Craig Leiner Bob Reyes Doug Wheaton
Massachusetts State Police	William Coulter Ken DuBinski Oscar Langford Wayne Mackiewicz Steve McCarthy Charles McKinnon Paul Sullivan Tom Walsh
Massachusetts Turnpike Authority	Bill Catania Andrew Davidson Sergiu Luchian
Merrimack Valley Planning Commission	Tony Komornick Jim Terlizzi
Merrimack Valley Regional Transit Authority	Joe Costanzo Bill Hoff
Metropolitan Area Planning Council	Jim Fitzgerald Simon van Leeuwen
Metropolitan District Commission	Julia O'Brien
Northern Middlesex Council of Governments	Chris Curry Justin Howard David Tilton Beverly Woods
Old Colony Planning Council	Ed Coviello Charlie Kilmer Bill McNulty
Registry of Motor Vehicles	Robert McInnis Matt Poirer
Rizzo Associates	Joe Beggan
Southeastern Regional Planning & Economic Development District	John Charbonneau Roland Herbert

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APPENDIX F

SAMPLE INTERAGENCY AGREEMENTS

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AGREEMENT

This AGREEMENT, dated the __ day of, _____, is entered into by and between the _____ Regional Transit Authority ("_RTA") a body politic and corporate and public instrumentality of the Commonwealth, organized and existing under Chapter 161B of the Massachusetts General Laws, as amended and the _____ ("___") an agency of the City of _____, a municipal corporation of the Commonwealth of Massachusetts, as amended.

RECITALS

WHEREAS, Chapter 161B, Section 2, of the Massachusetts General Laws ("Chapter 161B") authorizes the _RTA to enter into all contracts and agreements and to do all acts and things necessary, convenient or desirable in the performance of its duties and the execution of its powers under Chapter ____; and

WHEREAS, _RTA operates the _RTA Operations Control Center and the ___ operates the ___ Traffic Management Center in order to, among other things, facilitate intermodal traffic flow, enhance passenger and motorist safety, improve the efficiency of incident management resources and enhance incident response for the _RTA and the city of _____; and

WHEREAS, the parties desire to improve their efforts to facilitate intermodal traffic flow, enhance passenger and motorist safety, improve the efficiency of incident management resources and enhance incident response for the _RTA and the city of _____; and

WHEREAS, the parties desire to set forth in this Agreement the terms and conditions of the interface between the transit operations center and the city traffic management centers described herein.

NOW, THEREFORE, THE _RTA AND ___ agree as follows:

1. The term of this Agreement will be for (xx) years, subject to renewal by mutual agreement.

2. _RTA will have access to video feed from select traffic cameras, identified in "Exhibit A" and attached hereto and made part of this agreement, to support dispatching operations.

3. Pan/tilt/zoom control of the camera will remain in the control of the ___ traffic operations center, but requests for camera repositioning by the _RTA may be made via voice communications (e.g. phone or radio).

4. Video will be transmitted by means of a Video Integration System, which will transmit video over a secure Internet connection.

5. Event information form the ___ traffic operations center, such as accident, delay, and construction information, will be provided to the _RTA via the Internet-based Event Reporting System (ERS).

6. The ___ traffic operations center will enter event information for roadways within its jurisdiction into the ERS. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. The _RTA will receive event information through operator monitoring of the ERS interface.

7. Exchange of device status information, including incident response measures such as street closures or service modifications, will occur via voice communications.

8. Coordination via voice or radio will be essential when incident response by the ___ traffic operations center affects operations by the _RTA, and vice versa.

9. Relevant status information for field devices will include traffic signal status and information about transit priority calls.

10. Field device status will be reported to the _RTA from the ___ traffic management center by means of a direct connection between the central systems.

11. Requests for traffic signal priority for buses or light rail vehicles will be made to the traffic signal system controlled by the ___ traffic operations center.

12. Direct control of roadway field equipment will not be permitted, as all control will remain with the ___ traffic operations center.

13. Indirect control by the _RTA is possible via a voice communications (e.g. phone or radio) request to the ___ traffic operations center.

14. _RTA and ___ agree that there will be no transfer of rights under this Agreement to any party without the written consent of both the _RTA and ___.

Whenever notice to one party by the other party is necessary or appropriate under this Agreement, such notice will be in writing and will be sent by first class mail, overnight delivery, hand delivery or facsimile to the following persons, unless otherwise directed by a formal notice:

_RTA: Executive Director
_____ Regional Transit Authority

Copy to: General Counsel
_____ Regional Transit Authority

"City":

Copy to: City Solicitor

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be duly exercised as a sealed instrument as of the date first written above.

_____ REGIONAL TRANSIT AUTHORITY

_____

Approved as to Form:

_____
General Counsel

CITY OF _____

_____

Approved as to Form:

_____
City Solicitor

AGREEMENT

This AGREEMENT, dated the __ day of, _____, is entered into by and between the _____and the _____.

RECITALS

WHEREAS,; and

WHEREAS,; and

WHEREAS, the parties desire to improve their efforts to facilitate traffic flow, enhance motorist safety, improve the efficiency of incident management resources and enhance incident response for _____through the interface of _____ emergency management control centers and _____traffic management centers; and

WHEREAS, the parties desire to set forth in this Agreement the terms and conditions of their duties for the traffic coordination between the _____ emergency management control centers and the _____traffic management centers described herein.

NOW, THEREFORE, THE ___ AND ____ agree as follows:

1. The term of this Agreement will be for (xx) years, subject to renewal by mutual agreement.

2. Video images will be exchanged between the two control centers to allow operator viewing of select CCTV cameras from the other agency.

3. ___ and ___ will agree on the exchange of video by means of a Video Integration System, which will transmit video over a secure Internet connection.

4. Pan/tilt/zoom control of the camera will remain in the control of the agency owning the camera, but requests for camera repositioning may be made via voice communications (e.g. phone or radio).

5. All costs related to the establishment and maintenance of the Video Integration System will be divided equally by the parties.

6. ___ and ___ will develop Standard Operating Procedures (SOPs) for operation of the Video Integration System.

7. Event information form the ___ traffic operations center, such as accident, delay, and construction information, will be provided to the ____ via the Internet-based Event Reporting System (ERS).

8. The ___ traffic operations center will enter event information for roadways within its jurisdiction into the ERS. Entering of information may be manual, by means of a web-based interface, or automatic, by means of an automated process developed for the traffic management software at each control center. The ____ will receive event information through operator monitoring of the ERS interface.

9. Exchange of device status information, including incident response measures such as street closures or service modifications, will occur via voice communications.

10. Coordination via voice or radio will be essential when incident response by the ___ traffic operations center affects operations by the ____, and vice versa.

11. Direct control of roadway field equipment will not be permitted, as all control will remain with the ___ traffic operations center.

12. Indirect control by the ____ is possible via a voice communications (e.g. phone or radio) request to the ____ traffic operations center.

13. ___ and ___ agree that there will be no transfer of rights under this Agreement to any party without the written consent of both the ___ and ___.

Whenever notice to one party by the other party is necessary or appropriate under this Agreement, such notice will be in writing and will be sent by first class mail, overnight delivery, hand delivery or facsimile to the following persons, unless otherwise directed by a formal notice:

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be duly exercised as a sealed instrument as of the date first written above.

_____ _____

Approved as to Form: Approved as to Form:

_____ _____