

Metropolitan Washington Regional Intelligent Transportation Systems Architecture

Summary Report

DRAFT

April 6, 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
1.0 INTRODUCTION	12
1.1 PURPOSE	12
1.2 PROJECT BACKGROUND AND HISTORY	13
1.2.1 <i>Architecture Development Process</i>	13
1.3 FINAL ARCHITECTURE RULE AND CONFORMITY	14
2.0 REGIONAL BOUNDARIES	16
2.1 REGIONAL DESCRIPTION.....	16
2.2 STAKEHOLDER DESCRIPTIONS	23
3.0 ITS SYSTEMS INVENTORY	24
3.1 ELEMENT DESCRIPTIONS	24
3.2 SYSTEMS INVENTORY	30
4.0 OPERATIONAL CONCEPTS.....	36
4.1 OPERATIONAL CONCEPT DEFINED.....	36
4.2 ROLES AND RESPONSIBILITIES	36
5.0 FUNCTIONAL REQUIREMENTS.....	39
6.0 REGIONAL ARCHITECTURE.....	96
6.1 HIGH LEVEL ARCHITECTURE.....	96
6.2 INTERCONNECT MATRIX.....	97
6.3 INFORMATION EXCHANGES	101
7.0 AGENCY AGREEMENT.....	102
7.1 TYPES OF AGREEMENTS.....	102
7.2 AGREEMENT FOCUS.....	103
7.3 LIST OF AGREEMENTS OUTPUT.....	104
8.0 ITS STANDARDS TO CONSIDER.....	105
8.1 STATE OF THE NATIONAL STANDARDS	105
8.2 STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs).....	105
8.3 STANDARDS ELEMENTS	107
8.4 DECISION MAKING STRATEGY FOR STANDARDS	109
8.5 STANDARDS TO CONSIDER	109
8.5.1 <i>Common Standards</i>	109
8.5.2 <i>NTCIP For Traffic Systems</i>	110
8.5.3 <i>NTCIP For Transit - TCIP</i>	115
9.0 SEQUENCING OF PROJECTS.....	117
10.0 USE AND MAINTENANCE OF THE ARCHITECTURE.....	119
10.1 USE OF REGIONAL ARCHITECTURE	119
10.1.1 <i>Support Planning Process</i>	119
10.1.2 <i>Support Project Development</i>	121
10.2 MAINTENANCE OF THE REGIONAL ARCHITECTURE	121
10.2.1 <i>Responsibility for Maintaining the Regional ITS Architecture</i>	121
10.2.2 <i>Items To Be Maintained in the Architecture</i>	121
10.2.3 <i>Frequency of Updating the Architecture</i>	122

10.2.4 Update Process 122

11.0 NEXT STEPS AND FUTURE NEEDS..... 124

Appendix A Stakeholder Description

Appendix B Operational Concept Matrix

Appendix C Interface Requirements

Appendix D Architecture Entity Description

Appendix E Information Flow Description

Executive Summary

Overview

The Metropolitan Washington Regional Intelligent Transportation Systems Architecture is a framework for describing and developing integrated transportation systems technology. The Regional Architecture is intended to provide a regional ITS systems framework for the foreseeable future, to define and validate ITS operations of regional significance, and to address national and statewide conformity in accordance with federal law and guidance. The architecture aims to ensure knowledge of ITS operations across the region, encouraging appropriate systems integration and enhanced technical systems interoperability.

In addition to describing the interrelationships among existing transportation technology systems, the Regional ITS Architecture can provide a starting point for identifying responsibility for ITS Projects and applicable standards. It can inform business cases for state and federal ITS investment in transportation improvement programs as well as other plans, programs, and projects. The Regional ITS Architecture is based upon the structure of the official U.S. Department of Transportation's National ITS Architecture. It is intended to be a "living plan" that is updated with latest National Architecture releases, and to take full advantage of the comprehensive, standards-oriented approach of the national structure.

Major Components of the Regional ITS Architecture

The Federal Rule addressing ITS Architectures identifies nine major issues that the Regional ITS Architecture must address. These are:

1. Description of the Region
2. Identification of Stakeholders
3. Operational Concepts
4. Agreements
5. Functional Requirements
6. Interface Requirements
7. Standards
8. Sequence of Projects
9. Maintenance (of the Architecture)

The Regional ITS Architecture addresses all nine major issues, and provides an additional section on next steps and future needs. The significance of each issue is explained in that section of the document. The systems engineering concepts embodied in the issues follow the practices and nomenclature provided in the National ITS Architecture. Highlights of these issues are as follows.

The membership geography of the National Capital Region Transportation Planning Board (TPB) at the Metropolitan Washington Council of Governments (COG) is the region described in the Regional ITS Architecture. The architecture defines for the region major stakeholders to transportation technology and operations, a core set of public or private agencies with transportation-related oversight, responsibilities, and/or duties. All

TPB members as well as other involved agencies are stakeholders; the Regional ITS Architecture is particularly intertwined the architectures of the departments of transportation of the District of Columbia, Maryland, and Virginia (DDOT, MDOT, VDOT), as well as the Washington Metropolitan Area Transit Authority (WMATA).

A third section of the Regional ITS Architecture provides operational concepts for systems in the architecture. An operational concept identifies the roles and responsibilities of participating agencies and other stakeholders in the operation and implementation of a system included in the regional ITS architecture. Operational concepts include overviews of roles and responsibilities of regional stakeholders, providing the basis for placement in architecture. As noted in the Operational Concepts section, operational concepts are distinct from concepts of operations, which define in detail the specifics of how a system or project operates in different scenarios by combining user and system functions in a narrative fashion. The Regional ITS Architecture also describes interagency agreements or working relationships in place in the region regarding technology and information sharing.

The Functional Requirements section describes what systems must do to address a regional need, to provide a regional service, and/or to facilitate a stakeholder regional responsibility. Functional requirements focus on the high-level requirements needed to support regional integration. A functional requirement is characterized by naming the system, the stakeholder, and presenting a list of “shall” statements that constitute the functions to be provided by the system.

The Interface Requirements section describes what information needs to be exchanged with planned and existing systems and subsystems. The nationally standard “Turbo Architecture” software was used to identify interconnects existing or planned between ITS elements in order to support services in the region. Standard outputs from “Turbo” include voluminous numbers of diagrams representing interconnects between ITS elements and their associated information flows, which were reviewed by technical personnel of stakeholder agencies and TPB staff to ensure accuracy.

Sections on ITS Standards, Sequencing of Projects, and Maintenance of the Architecture look to how the Regional ITS Architecture can be applied. The Regional ITS Architecture addresses standards in the context of data and information exchange (not in transportation policy or operations areas). The Sequencing of Projects section addresses a handful of major ongoing and contemplated efforts for data and information exchange. The Maintenance of the Architecture section describes the ongoing support of the architecture within the TPB Metropolitan Planning Organization (MPO) Unified Planning Work Program as directed by the TPB on policy issues, and as advised by the TPB’s Management, Operations, and Intelligent Transportation Systems (MOITS) Policy and Technical Task Forces and supporting MOITS subcommittees on technical details.

A final section of the document addresses next steps and future needs. The complexity of ITS architectures and the quickly-evolving nature of technical systems mean that the process of describing and maintaining a regional ITS architecture must be an ongoing process. The process to develop this current architecture was descriptive of the existing situation rather than proactive or mandating in nature. There is still much work to be done in the coming years going beyond describing existing systems to describing what stakeholders would want to develop, and this is addressed in this section.

About This Version of the Regional ITS Architecture

This report is the culmination of work performed under MOITS by TPB staff, in consultation with ITS engineers from TPB member agencies. It updates an earlier draft version of the architecture developed by the consultant team of Computer Sciences Corporation and PB Farradyne, Inc. in 2002.

Transportation operating agencies in the TPB region have moved towards a consensus that regional ITS operations and cooperation are both necessary and possible. This change has been evident through the efforts of the TPB and its MOITS Task Forces. This change is documented in reports such as the Multi-Jurisdictional Transportation Telecommunications Study (2000), developed on behalf of COG/TPB and the Maryland State Highway Administration. That study found that:

- There is "... growing interest in the sharing of ITS data to support traveler information systems, traffic signal control systems, transit management systems, and incident management systems...., particularly in the sharing of video to support traveler information and incident management systems across most jurisdictions."
- "Connecting Virginia Department of Transportation (VDOT), MD SHA, and Washington Metropolitan Area Transit Authority (WMATA) fiber optic cable systems will allow for regional data sharing and information exchange among COG agencies"
- "Regional fiber optic cable connections could represent a first step in expanding overall transportation planning and operations from a local focus to a more regional context."
- "Immediate opportunities exist to provide direct communications between VDOT, WMATA, and MD SHA Fiber."

What ITS Architecture Addresses and Enables

ITS offers non-traditional solutions to transportation problems and provides an alternative to new infrastructure. An ITS Architecture provides a structured framework for development and integration. It helps to introduce and interconnect ITS services across a region. An ITS architecture identifies "gaps" in system and services and it assists in the development of cooperative agreements between/among agencies jointly deploying ITS.

The Regional ITS Architecture provides the framework to address such topics as:

Data Archiving

- Archiving regional transportation data for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, research applications, and inputs into Federal, State, and local data reporting systems

Emergency / Incident Management

- Coordination of information exchange among area stakeholders to facilitate freeway and arterial incident management practices, particularly at jurisdictional boundaries and with transit agencies
- Emergency vehicle priority at signalized intersections

Traveler Information

- Dissemination of traveler information via the private sector. The regional architecture can support basic advisories, real time traffic condition and transit schedule information, yellow pages information, ride-matching information, and parking information.

Traffic Management

- Bus vehicle priority at signalized intersections
- Regional traffic management and coordination of traffic information among jurisdictions

Transit Management

- Transit management by coordinating fleet operations and schedule information among transit agencies as well as special event and real-time incident data with traffic management agencies

Electronic Toll Collection

- WMATA's on-going regional transit electronic toll clearinghouse initiative
- Regional electronic roadway toll collection and administration by interfacing with other regional toll programs such as EZ-Pass and the Maryland MTAG Program

Parking Management

- Coordination with traffic and transit management agencies to monitor and manage transit parking facilities

Official Endorsement of the Regional ITS Architecture

Overall endorsement of the Regional ITS Architecture is in the form of agreement by the TPB as the region's MPO that the architecture supports and follows from goals and objectives specified in the TPB's Regional [Financially] Constrained Long-Range Transportation Plan (CLRP), adopted October 2004. The Regional ITS Architecture and plan was guided by local and regional transportation policy goals. ITS goals, derived from adopted regional goals, provided the basis for assessment of ITS integration in the region and mapping out a program of future activities.

The CLRP consists of eight goals with multiple objectives for each goal. Table E-1 lists the eight adopted CLRP goals.

Table E-1. TPB Policy Goals Specified in the Regional Long-Range Transportation Plan (CLRP)
Goal 1. The Washington metropolitan region's transportation system will provide reasonable access at reasonable cost to everyone in the region.
Goal 2. The Washington metropolitan region will develop, implement, and maintain an interconnected transportation system that enhances quality of life and promotes a strong and growing economy throughout the entire region, including a healthy regional core and dynamic regional activity centers with a mix of jobs, housing, and services in a walkable environment.
Goal 3. The Washington metropolitan region's transportation system will give priority to management, performance, maintenance, and safety of all modes and facilities.
Goal 4. The Washington metropolitan region will use the best available technology to maximize system effectiveness.
Goal 5. The Washington metropolitan region will plan and develop a transportation system that enhances and protects the region's natural environmental quality, cultural and historic resources, and communities.
Goal 6. The Washington metropolitan region will achieve better interjurisdictional coordination of transportation and land use planning.
Goal 7. The Washington metropolitan region will achieve an enhanced funding mechanism(s) for regional and local transportation system priorities that cannot be implemented with current and forecasted federal, state, and local funding.
Goal 8. The Washington metropolitan region will support options for international and inter-regional travel and commerce.

CLRP Policy Goal 4 is the goal that addresses technology and operations, and therefore is the guide for development of the Regional ITS Architecture. Goal 4 states that the Washington metropolitan region will use the best available technology to maximize system effectiveness, following ITS action strategies has been identified for integration of the ITS in the region and provide basis of the future ITS planning. Table E-2 lists the detailed objectives associated with Goal 4 described in the regional long-range transportation plan (CLRP), and addresses how the Regional ITS Architecture supports that each objective.

Table E-2. Transportation Operations and Technology-Related Goal 4 and Associated Objectives from the Regional Long-Range Transportation Plan (CLRP).	
<i>Goal 4. The Washington metropolitan region will use the best available technology to maximize system effectiveness.</i>	
Objective	How the Regional ITS Architecture Addresses This Objective
Deploy technologically advanced systems to monitor and manage traffic, and to control and coordinate traffic control devices, such as traffic signals, including providing priority to transit vehicles where appropriate.	The architecture describes the breadth of transportation systems monitoring and management centers and activities, and addresses how they may be interconnected to share information and thus improve systems management.
Improve incident management capabilities in the region through enhanced detection technologies and improved incident response.	The architecture describes how interconnections may enable information to be shared to and from those managing incidents, thus improving response, and addresses technological systems to support incident management personnel.
Improve highway lighting, lane markings, and other roadway delineation through the use of advanced and emerging technologies.	The architecture includes descriptions of interconnections of systems with field and roadside equipment such as weather sensors and changeable message signs, lane control signals, and crosswalk indication lights.
Establish a unified, technology-based method of payment for all transit fares, public parking fees, and toll roads in the region.	The architecture addresses the status of electronic payment systems and provides a technical framework for future integration discussions.
Utilize public/private partnerships to provide travelers with comprehensive, timely, and accurate information on traffic and transit conditions and available alternatives.	The architecture describes and provides the framework for interconnections among transportation agencies and to private-sector information service providers (ISP), as well as to general public transportation systems users. Such connections could be used to provide timely and accurate information.
Use technology to manage and coordinate snow plowing, road salting operations, and other responses to extreme weather conditions, and to share with the public assessments of road conditions and how much time it will take to clear roadways.	The architecture addresses interconnections with transportation system management and operations centers and field equipment and vehicles, and to public safety agencies.
Use advanced communications and real-time scheduling methods to improve time transfers between transit services.	The architecture addresses interconnects to and among transit agencies which could facilitate sharing of schedules and current vehicle locations.
Develop operating strategies and supporting systems to smooth the flow of traffic and transit vehicles, reduce variances in traffic speed, and balance capacity and demand.	The architecture addresses interconnects with transportation management field devices and operations personnel as they address transportation system conditions.
Maintain international leadership in taking advantage of new technologies for transportation, such as automated highway systems and personal rapid transit.	The architecture addresses key components of these systems such as automated vehicle location systems and traffic signal prioritization systems.

Process of Updating the Regional ITS Architecture from the 2002 Draft

The 2002 draft Regional ITS Architecture mentioned above was the starting point for this update of the architecture. The 2002 draft had many of the key elements needed for this updated version. A number of changes, however, were needed, some to update elements of the 2002 architecture because of changes in the region's transportation systems or in the National ITS Architecture framework, other changes to develop components of the architecture which had not been addressed in the 2002 version.

The first step was to expand the inventory of and itemize the ITS center elements in the region as existing and planned for implementation. Each of the ITS element was mapped into entity(ies) within the Physical Architecture of the National ITS Architecture.

For each ITS element, an expected set of interconnections with other ITS elements in the region was developed, based upon what the National ITS Architecture identified as typical.

The entire process was performed with the advice and consent of the key stakeholders in the region. Once the interconnections were determined, the more detailed information exchanged between a pair of ITS elements was identified.

Beyond the interconnections, a high-level set of functional requirements was provided for each ITS element in the region. These were expanded into interagency operational concepts that described the roles and responsibilities in providing the ITS service in the region.

A list of agreements was compiled so that the agencies could verify the operation concepts and their agreements that these functions and interfaces are provided as described under this Regional ITS Architecture. Further, a list of ITS projects and action items were developed and confirmed by the stakeholders to established the basis of the ITS plan.

Next, the expected maintenance and update process was described. New ITS projects in the region may now be considered in the context and with the guidance of the Regional ITS Architecture. The process can also consider how emerging projects may necessitate updates to the Architecture on occasion to maintain the consistency and accuracy of the architecture.

The Regional ITS Architecture by its nature aims at a "moving target". Many details were not able to be addressed in the limited time frame of the current architecture, and many individual agency decisions are yet to be made on actions that will greatly impact the regional architecture. For such reasons, the Regional ITS Architecture ends with a "Next Steps and Future Needs" section which can provide a guide for future ITS integration and development by regional stakeholders.

[Note on attributions of quotes and text sources: Portions of the text in this draft report have been brought forward or adapted from the 2002 version of the architecture, developed by the team of Computer Sciences Corporation and PB Farradyne, Inc.; additional portions have been adapted from documentation of the National ITS Architecture, Version 5.0. Appropriate additional attributions for these and other sources of text or quotes utilized will be added to this document before finalization.]

1.0 Introduction

At present, all state and some local members of the Metropolitan Washington Council of Governments (MWCOG / NC RTPB) are utilizing ITS. The intent of these systems is to provide better information and services to the traveling public and to provide operations and management of special events, congestion, and incident response. Most of the work is proceeding independently and, to date, there are limited capabilities for sharing available information electronically across jurisdictions in the Washington area.

ITS refers to the electronic and communication systems that can be used for collecting, processing, disseminating, or acting on information in real time to improve the operation, safety, or convenience of the transportation system. An “architecture” is a concept from the field of system engineering that defines the framework within which a system can be built, the functionality of the pieces of the system and information that is exchanged between the components of the system. An architecture is functionally oriented and not technology specific. This feature allows architecture to remain effective over the time and not become obsolete as technology evolves.

The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems. It is a mature product that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.).

1.1 Purpose

The Metropolitan Washington Regional ITS Architecture was developed to address interagency coordination among transportation and public safety organizations in the region that provide transportation services. Information exchanged among transportation and public safety organizations must be timely, accurate, useful, and consistent to enable these organizations to fulfill their functions. As demand for related services increases and organizational responsibilities increase, existing systems owned and operated by these organizations will require enhancements. Transportation and communications technology is growing exponentially, providing multiple solutions to real or perceived system deficiencies.

In order to address these increased demands in a logical, efficient, and readily understandable manner, a common method of describing these systems and proposed enhancements is needed, readily available to all participating organizations. Any architecture shows the relationships established by interconnections among system elements. In an ITS regional architecture, these elements include transportation user services performed, actual subsystems owned or operated by each participating organization, and the information flows among them. Two important uses of the Architecture are to provide a comprehensive description of the existing transportation infrastructure in the region and to provide a baseline for future infrastructure and system development. The Architecture shows what regional transportation-related organizations are doing today, and the subsystems, information flows, and processes that make these activities possible. It does so in the language and grammar defined by the U.S. Department of Transportation (USDOT) National Architecture to satisfy federal regional architecture requirements.

Planned subsystems and information flows are also included and flagged in the architecture, to show the direction of transportation communications infrastructure evolution. Future transportation projects can be readily entered into the architecture, allowing the proposed informational connectivity to be compared with existing and planned conditions. This is expected to be the more important of the two uses, as regional ITS architectural compliance is and will remain a requirement for federal ITS project funding.

1.2 Project Background and History

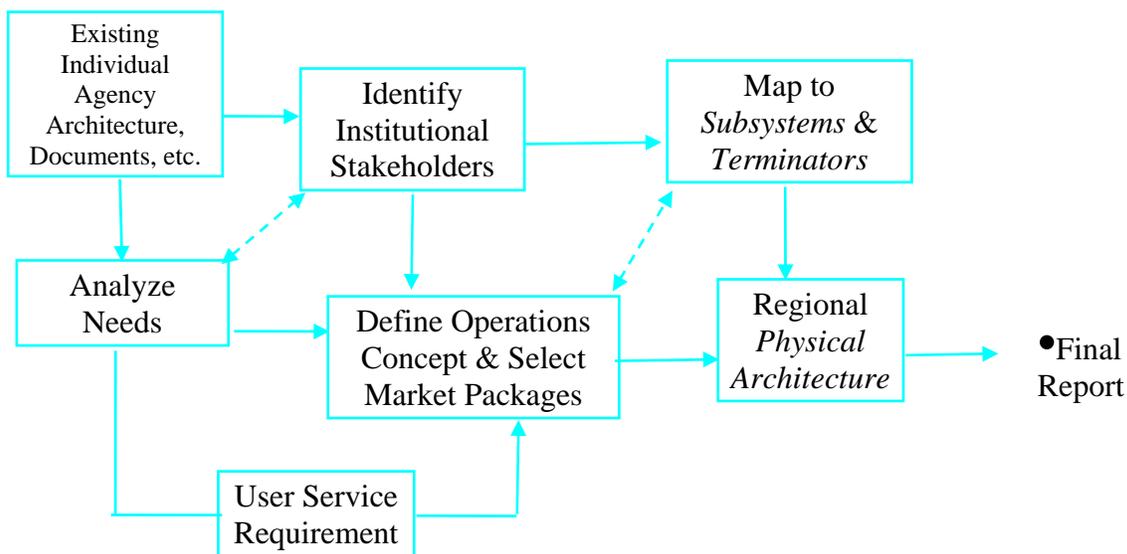
On June 11, 2002, the contractor team of Computer Sciences Corporation and PB Farradyne, Inc. completed the first draft version of the Metropolitan Washington Regional ITS Architecture on behalf of the region. The 2002 version was developed based upon the National ITS Architecture Version 3.0. Since then, new federal initiatives have placed increased requirements upon metropolitan regions to produce and maintain a regional ITS architecture. In addition, numerous changes in the region and the National ITS Architecture (the latest Version 5.0) have occurred. Therefore, the MOITS ITS Architecture Working Group was reconvened in 2004-2005 to advise an update of the regional ITS architecture to reflect the current situation of the region and to meet the new federal requirements.

1.2.1 Architecture Development Process

The development of the Metropolitan Washington Area ITS Architecture was closely coordinated with the on-going ITS architecture initiatives of the DDOT, of Maryland (Statewide), of the VDOT NOVA District, and of WMATA. The DDOT architecture was previously developed in conjunction with the development of the DDOT Integrated Transportation Management System (ITMS) project, and has been maintained on an ongoing basis. The Maryland Statewide ITS Architecture identifies interconnects and architecture flows between freeway, arterial, toll administration and transit management centers, information service providers, public safety centers, and archived data, emission and parking management systems between state, county and local agencies in Maryland. The VDOT NOVA District ITS Architecture is a VDOT-centric architecture, and as such, identifies interconnects and architecture flows between VDOT and county agencies, local jurisdictions, and other regional agencies that operate roadway and transit systems in the NOVA District. WMATA staff has undertaken maintenance activities of the agency's enterprise architecture which addresses WMATA's multiple systems: rail operations, bus operations, fare operations, security, and others.

Figure 1-1 is a diagram illustrates the process used in the development of the architecture.

Figure 1-1. Schematic process used in development of the Regional ITS Architecture.



1.3 Final Architecture Rule and Conformity

On January 8, 2001 the Final Rule on ITS Architecture and Standards Conformity (Final Rule) and the Final Policy on Architecture and Standards Conformity (Final Policy) were enacted by the FHWA and FTA respectively. The Final Rule/Final Policy ensures that Intelligent Transportation Systems (ITS) projects carried out using funds from the Highway Trust Fund including the Mass Transit Account conform to the National ITS Architecture and applicable ITS standards. This will be accomplished through the development of regional ITS architectures and using a systems engineering process for ITS project development.

The regional ITS Architecture shall include, at a minimum, the following :

1. A description of the region
2. Identification of the participating agencies and other stake holders
3. An operational concept that identifies the roles and responsibilities of participating agencies and other stakeholders
4. Any agreements (existing or new) required for the operation
5. systems functional requirements
6. Interface requirements and information exchanges with planned and existing systems and subsystems
7. Identification of ITS standards supporting regional and national interoperability
8. The sequence of the projects required for implementation
9. Maintenance procedures and responsibilities

Table E-3 summarizes how the Metropolitan Washington Area ITS Architecture meets the requirements of the Final Architecture Rule.

Table 1-1. Comparison of the Federal Architecture Rule on Architecture Conformity and Components of the Regional ITS Architecture.

Final Architecture Rule Conformity Requirements	Metropolitan Washington Area ITS Architecture Consistency
A description of the region	Included. Section 2.1 describes and maps the boundaries of the National Capital Region.
Identification of the participating agencies and other stakeholders	Included. Section 2.2 lists participating agencies and stakeholders.
Identification of the roles and responsibilities of the participating agencies and other stakeholders in the operation and implementation of the systems included in the regional ITS Architecture	Included. Section 3 describes an inventory of the major transportation technology systems addressed by the Regional ITS Architecture, and Section 4 describes operations concepts for those systems.
Identification of any agreements (existing or new) needed 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	Included. Section 7 identifies relevant agreements in the region.
Identification of system functional requirements	Included. Section 5 provides a detailed listing of function requirements for the region's major ITS systems.
Interface requirements and information exchanges with planned and existing systems and subsystems	Included. Section 6 provides descriptions and diagrams of regional interconnections and existing and potential information exchanges.
Identification of ITS standards supporting regional and national interoperability	Included. Section 8 describes standards in use or considered by the region.
The sequence of projects required for implementation	Included. Section 9 lists major ITS projects in the region that address issues in the Regional ITS Architecture, and characterizes their sequencing.
Identify any changes made in a project design that impact the regional ITS architecture along with the appropriate revisions made and agreed to	Included. Section 10 describes the process that allows for periodic update and supports conformity as set forth in the Final Architecture Rule.

2.0 Regional Boundaries

2.1 Regional Description

Figure 2-1. Map of the National Capital Region Transportation Planning Board Membership and Geographic Boundaries of the Regional ITS Architecture.



Note: the following description of the region is adapted from the Long-Range Transportation Plan for the National Capital Region, adopted by the TPB in October 2004.

Flanked by the Blue Ridge Mountains on the west and the Chesapeake Bay on the east, the Washington metropolitan area has grown from a small collection of communities along the Potomac River to a prominent international region of more than four million persons and two million jobs. In the earliest years of this nation's history, settlers sailed up the Potomac River from the lowlands of the Chesapeake Bay estuary to the area where the waters were no longer navigable. This section of the Potomac, known as Little Falls, marks the fall line, the geological feature where the rolling hills of the Piedmont yield to the sprawling flat lands of the tidal waters. It was here that the communities of Georgetown in Maryland (in present day District of Columbia) and Alexandria in Virginia were established and became ports and trading centers linking the inland settlements with communities along the Bay and other navigable waterways.

The Washington region consists of the District of Columbia and the jurisdictions of Suburban Maryland and Northern Virginia, and spans the spectrum of regional development: extending from the urbanized central core through the well-established suburbs and ending in the rural fringe. The federal government, based on the results of the 1990 Census, redefined the Washington area to include even more jurisdictions than before, including two counties in West Virginia. In addition, it combined the Washington and Baltimore regions into one "consolidated" metropolitan area. This combined region is the fourth largest in the nation in population terms.

The District of Columbia along with the City of Alexandria and Arlington County in Virginia are considered the regional core of the Washington area. The inner suburbs consist of Montgomery and Prince George's counties in Maryland and Fairfax County and the cities of Fairfax and Falls Church in Virginia. This group of jurisdictions is characterized by heavy growth that has taken place in the past few decades, and it is in this group that the majority of the region's residents live and work. Finally, the outer suburbs include Loudoun and Prince William counties, plus the cities of Manassas and Manassas Park in Virginia, and Frederick County in Maryland. While officially part of the Baltimore region, Howard and Anne Arundel counties in Maryland act very much like suburbs of the Washington region. A considerable number of the residents of these two counties commute to jobs in the Washington region, and consequently account for a significant level of travel on the area's transportation network.

The Washington region offers a rich array of options for both personal travel and goods movement. The major types of transportation facilities and transportation services in the area are described briefly in the sections that follow.

Highways

The road network is the foundation of the transportation system in the Washington region. This network consists of freeways, principal arterials, minor arterials, collectors, and local streets, each designed to provide a specific type of service. A large portion of the monies available for the transportation system are used to maintain and utilize this infrastructure as efficiently as possible.

The region has a designated portion of the National Highway System (NHS), illustrated in Figures 2-2 and 2-3. This system includes all of the interstate highways and other major roads in the region. The region's NHS is part of a nationwide system approved by Congress and the Federal Highway Administration (FHWA). The roadways designated on this system are eligible for NHS funds and transit facilities in NHS corridors may also be eligible for NHS funds.

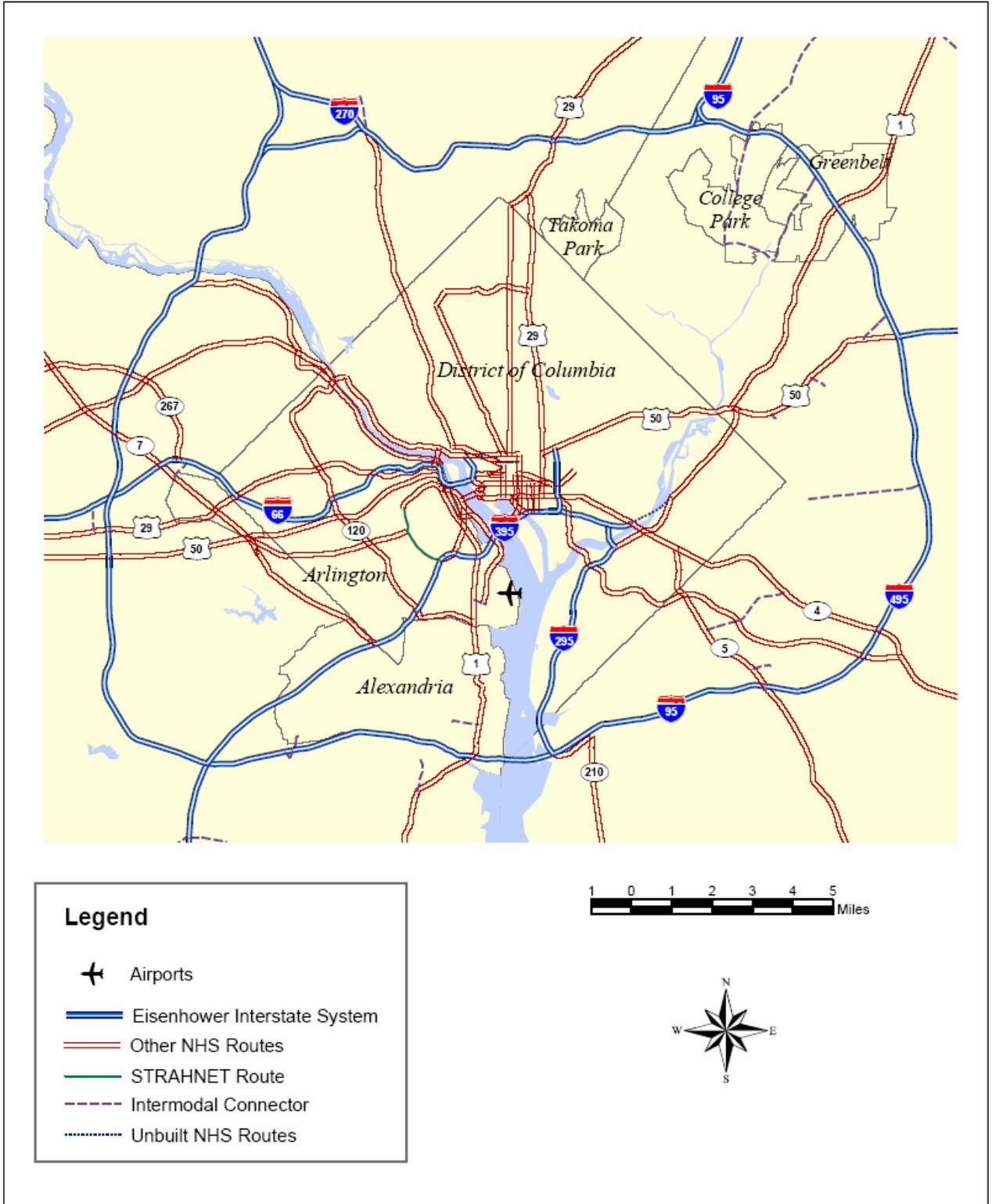


Figure 2-2 National Highway System Inside the Beltway

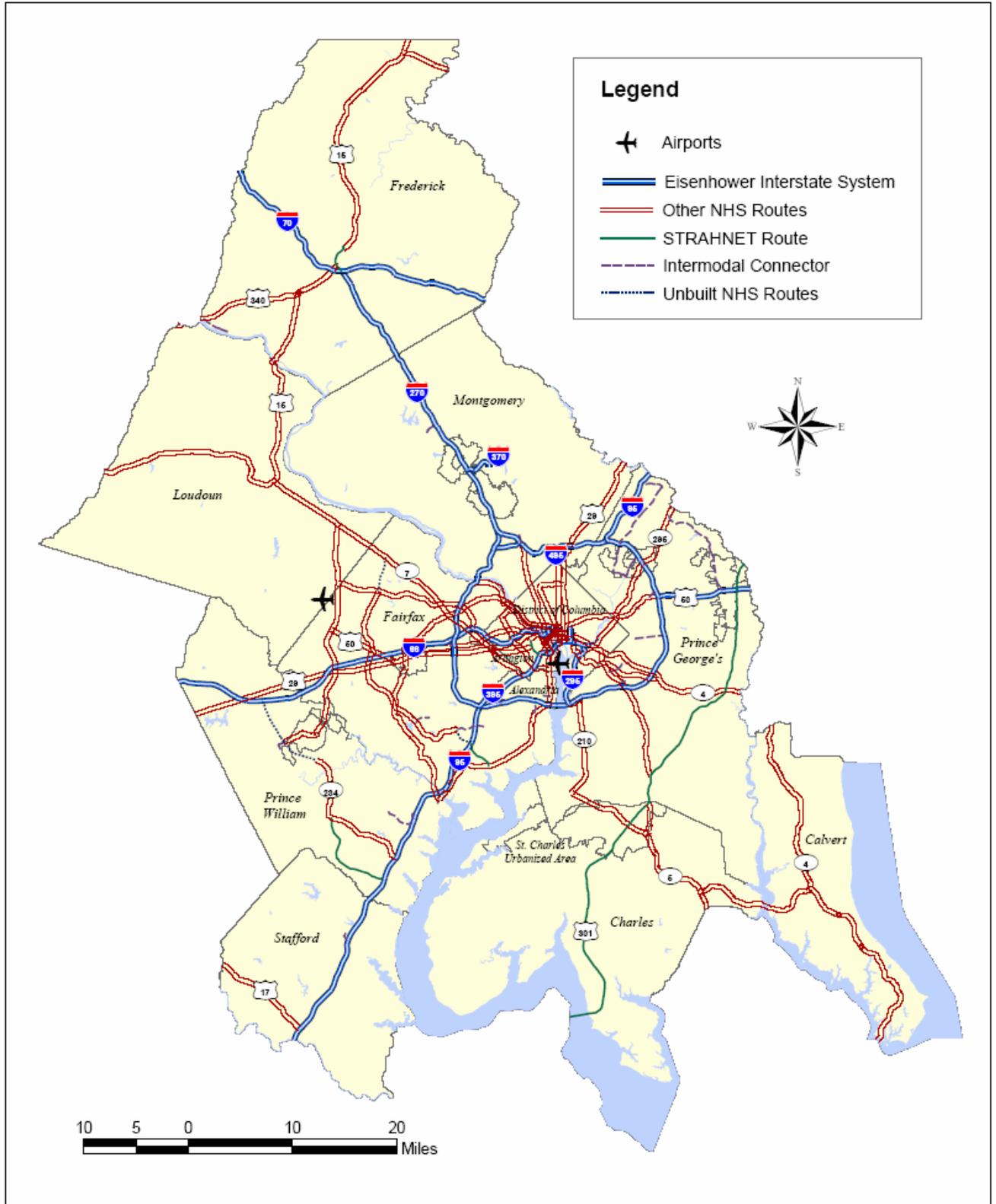


Figure 2-3 National Highway System Washington Region

HOV Facilities

The region's highway system includes a number of facilities that are reserved for high-occupancy vehicles (HOVs). The exclusive bus and carpool lanes on I-395 opened in the early 1970s and are among the most effective people moving facilities in the country. HOV lanes also can be found on I-66, I-270, US 1 and Washington Street in Alexandria, the Dulles Toll Road (VA 267), and I-95. HOV lanes increase the capacity of the highway network, moving more people in fewer cars.

Metrobus/Metrorail

The Washington Metropolitan Area Transit Authority (WMATA) operates the Metrorail and Metrobus service in the region. The Metrorail system radiates out from the downtown core, and Metrobuses feed into the Metrorail stations, creating a comprehensive mass transit network covering more than 1,500 square miles.

The originally planned 103-mile Metrorail with a total of 83 stations, shown in Figure 2-4, was completed in 2001. Metrorail's hundreds of daily heavy-rail trains operate with three- to six-minute intervals between trains during peak periods and with six- to sixteen-minute intervals during off-peak periods.

WMATA operates well over 1,000 Metrobuses with routes in the District of Columbia, Alexandria, and Arlington, Fairfax, Montgomery, and Prince George's counties. Since 1975, the Metrobus system has been transformed from a predominantly radial system serving the District of Columbia to a feeder network serving the Metrorail system. Metrobus also provides regional route service for trips not served by the rail system. Each time a new segment of the rail system has been opened, bus routes in the affected corridor or corridors have been modified either to serve or to turn back at the new stations.

Other Bus Services

In addition to Metrobus service, several jurisdictions have their own local bus service. These include Montgomery County's Ride-On, Alexandria's DASH, Prince George's County's The Bus, Fairfax County's Connector, Loudoun Transit, and the City of Fairfax's CUE systems. In addition, the CommuteRide system operates within Prince William County, Manassas, and Manassas Park. Several private commuter bus companies exist as well.

Commuter Rail

Two commuter rail services operate within and beyond the region's boundaries, Virginia Railway Express (VRE) and Maryland Rail Commuter (MARC). The Virginia Railway Express provides commuter rail service to Union Station in Washington, D.C. on two routes, the Manassas and Fredericksburg lines. VRE runs trains each weekday on lines reaching from Washington Union Station to Manassas and to Fredericksburg, Virginia.

MARC also provides commuter rail service to Union Station. Its service operates three routes, the Brunswick, Camden, and Penn lines. Trains on these three lines provide morning, midday, and evening service weekdays to points in Maryland and West Virginia.

Airports

Three major commercial airports are located in the Washington region. Washington National Airport, located in the central core of the region, serves domestic travel needs,

while Washington Dulles International Airport, located in Loudoun County, Virginia, serves both domestic and international routes. Baltimore/Washington International Airport, located in northern Anne Arundel County, Maryland, near the city of Baltimore, is also accessible to many area residents and provides access to domestic and international destinations. In addition to the major commercial airports, the region features a number of general aviation airports to serve non-commercial air activity such as corporate travel. The three major commercial airports also include general aviation facilities.

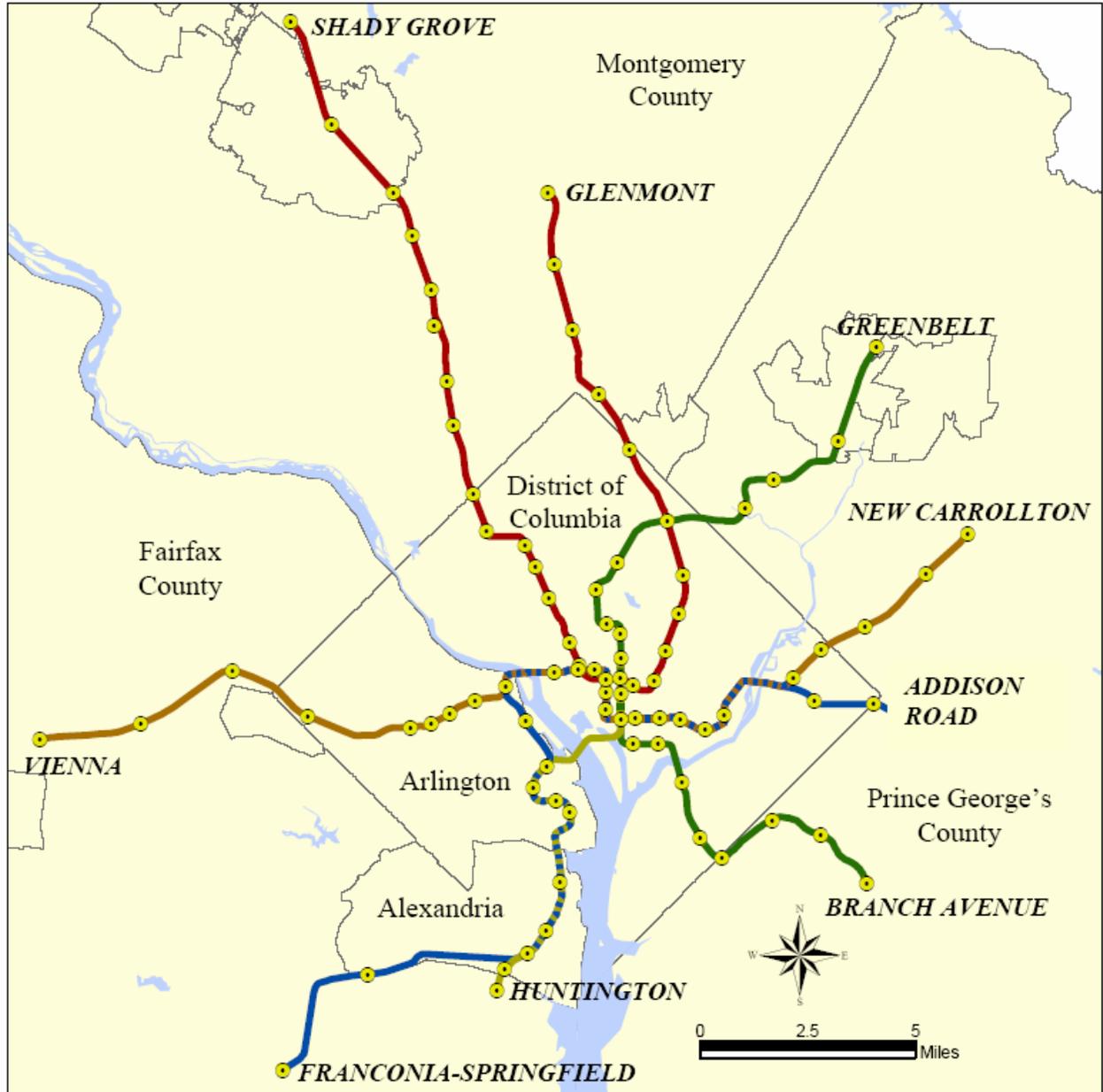


Figure 2-4 The Metrorail System

2.2 Stakeholder Descriptions

The success of the regional ITS architecture depends on participation by a diverse set of stakeholders. In this section, the Regional stakeholders are defined by the MOITS ITS Architecture work group for inclusion and participation in the Regional ITS Architecture effort. Stakeholders are defined as a core set of public and/or private agencies with transportation related responsibilities and /or duty in the region. Also there are numerous other entities, agencies that may have an interest in a project such as this. But according to the Federal Highway Administration(FHWA) guidelines, it is the best to start with a core stakeholder group and then add participants to the core group over time.

A list of stakeholder agencies for the Metropolitan Washington Area(MWA) Regional ITS Architecture is provided in appendix A.

3.0 ITS Systems Inventory

A regional ITS architecture inventory is a list of all existing and planned ITS system (This report uses Turbo Architecture terminology where each item in an inventory is an “element”) in a region as well as non-ITS systems that provide information to or get information from ITS systems. In general, the inventory should be managed so that it is as small as possible while still support the goal of identifying all key integration opportunities in the region.

3.1 Element Descriptions

Element descriptions are furnished below to document the groups that operate in the transportation environment as related to ITS. These elements are described in terms of their mission and relationship to the Regional ITS Architecture.

CAPWIN

CapWIN is a state-of-art wireless integrated mobile data communications network being Implemented to support federal, state, and local law enforcement, fire and emergency medical Services (EMS), transportation, and other public safety agencies primarily in the Washington, DC Metropolitan area. This element represents a communication network that allows several emergency agencies across multiple jurisdictions to communicate with one another. For example, various police agencies can access information regarding high intensity drug trafficking areas in multiple jurisdictions.

DC Field Equipment

These devices are typically located along the roadside and are controlled by operators in the DCDOT ITMS which aids them in monitoring and managing conditions. Examples include traffic controllers for the traffic signal system, CCTV, and vehicle detection.

DC Public Safety and Emergency Center

Protect life and property; prevent, detect, and investigate criminal acts; and enforce traffic regulations throughout a large complex of congressional buildings, parks, and thoroughfares. Additionally, Capitol Police are responsible for protecting Members of Congress, Officers of the United States Senate, United States House of Representatives, and their families.

DCDOT ITMS/TOC

This element represents the District of Columbia Department of Transportation that is responsible for controlling the Signal System in the District along with controlling DMS on the DC section of I-395. The ITMS is an appropriately automated system that provides effects management of roadway traffic on both freeways and surface street s throughout the DC for both recurring and non-recurring conditions.

Event Promoter

This element represents special event promoters in the VA/DC/MD areas. This events includes functions at stadiums or universities, and also includes activities such as parades or visiting the Smithsonian, etc.

Federal Installations

This element represents agencies that respond to major disasters that will impact the VA/DC/MD area. Examples of federal installations are GAO and Military. (Note the list is not inclusive but provides the reader with a general idea of the type of organizations).

Federal Law Enforcement

The Secret Service protects the President and Vice President, their families, heads of state, and other designated individuals; investigates threats against these protectees; protects the White House, Vice President's Residence, Foreign Missions, and other buildings within Washington, D.C.; and plans and implements security designs for designated National Special Security Events. The Secret Service also investigates violations of laws relating to counterfeiting of obligations and securities of the United States; financial crimes that include, but are not limited to, access device fraud, financial institution fraud, identity theft, computer fraud; and computer-based attacks on our nation's financial, banking, and telecommunications infrastructure.

FEMA

FEMA is part of the Department of Homeland Security's Emergency Preparedness and Response Directorate. FEMA has more than 2,600 full time employees. They work at FEMA headquarters in Washington D.C., at regional and area offices across the country, the Mount Weather Emergency Operations Center, and the National Emergency Training Center in Emmitsburg, Maryland. FEMA also has nearly 4,000 standby disaster assistance employees who are available for deployment after disasters. Often FEMA works in partnership with other organizations that are part of the nation's emergency management system. These partners include state and local emergency management agencies, 27 federal agencies and the American Red Cross.

General Public

Passengers and travelers.

Greenway Center

This center is responsible for the administration of the Greenway toll system. This center also reports incidents that occur on the Greenway Toll system to the VSP.

I-95 Corridor Coalition Information Exchange Network (IEN)

The IEN is a separate computer system from the traffic controller's workstation and allows traffic controllers to input incident information along I-95/395/495. This information is used by members of the I-95 corridor coalition to allow them to be informed of incidents from the state of Virginia to Maine. This station must be monitored and updated for accuracy.

Local Field Equipment

These signal control devices are typically located along the roadside and are controlled by operators in the local signal centers.

Local Public Safety and Emergency Management Centers

General description for a local county or city policy agency operations center

Local Signal Center

The element captures agencies that operate signal systems in the region with similar functionality. Examples of these agencies are the City of Alexandria, City of Fairfax, City of Falls Church, City of Manassas, City of Manassas Park, Arlington County, Town of Herndon, Town of Leesburg, and the Town of Vienna Montgomery County, Prince George's County, etc.

Local Transit Center

Basic transit service and paratransit service are provided by the following agencies in the region: Potomac and Rappahannock Transportation Commission (PRTC - services offered are fixed and paratransit), Washington Metropolitan Area Transit Authority (WMATA – Metro Access), City of Alexandria - DASH, City of Fairfax - CUE, Fairfax County - Fairfax Connector Transit, Arlington County - ART and STAR, Loudoun (LCTA and Express Bus), Springfield (TAGS Metro Springfield Circulator), and Falls Church Bus., Montgomery Ride on, etc.

Local Transit Vehicle

Provides bus transportation across the region.

MD Transit Management Centers

General description for transit centers operated by the Maryland Transit Authority including bus, light rail, commuter rail, and MARC.

MDSHA CHART

Generic name for Maryland State Highway Administration Traffic Operation Centers- Includes Statewide Operations Center and Regional Traffic Operation Centers.

Media Outlets

These centers are responsible for obtaining and sharing transportation information to the public via news, radio, and cable networks.

MEMA

Operations Centers associated with the Maryland Emergency Management Agency

Mobile Unified Command Center (DC)

This element represents a command structure that allows several agencies to coordinate their activities for major incidents (incidents that closed two or more lanes and/or last longer than two hours).

Mobile Unified Command Center (MD)

This element represents a command structure that allows several agencies to coordinate their activities for major incidents (incidents that closed two or more lanes and/or last longer than two hours).

Mobile Unified Command Center (VA)

This element represents a command structure that allows several agencies to coordinate their activities for major incidents (incidents that closed two or more lanes and/or last longer than two hours).

MWAA Center

This element represents the Metropolitan Washington Airport Authority that provides parking information and road congestion information at airports.

MWCOG Database

Washington MPO user of data for planning purposes

National Park Service

Responds to incidents and provide traffic management centers with incident data. Park police is also included here because they respond to incidents that occur on the BW parkway. The Park police in this element is also associated with CAPWIN.

NVTC Center

This center is responsible for collecting and using transit data for policy development and operational analysis.

Personal Traveler Information Devices

Personal electrical device such as PDA, personal computer, etc.

Private Sector ISP Centers

These centers provides value added transportation information to the public. Examples includes Mobility Technologies, Trichord, TrafficCast, and Tele Atlas.

Regional Toll Road

This system represent the regional toll road, such as Dulles Toll Road,, Greenway Toll road, etc.

Regional Transit Electronic Clearinghouse

This element represents a planned back office environment for housing electronic data of passenger usage information for the VA/DC/MD areas. An example agency is WMATA and also reflects the smart card clearinghouse for WMATA.

RITIS/CapCOM Center

The Regional Integrated Transportation Information System emphasizes data fusion and its relationship to data collection, regional transportation systems management, regional traveler information dissemination, and systems evaluation. RITIS takes data of regional interest and fuses that data into regional information that can be used to enhance regional traveler information and transportation management functions performed by member agencies. RITIS will be hold in the CapCOM center.

Smart Card

SmarTrip is a permanent, rechargeable farecard. It's plastic—like a credit card and is embedded with a special computer chip that keeps track of the value of the card.

Smart Tag Center

The center is responsible for the back office administration of Virginia's toll systems.

Smart Travel Lab

The Smart Travel Lab at UVA are responsible for research and provides archive data to the STC and STSS as stated in VDOT Policy along with NOVA sections, transit and COG clearinghouses. The Smart Travel Lab will also be users of archive data obtained by the NOVA Section and the Mobility Data Store.

Statewide 511 Virginia

The Statewide 511 Virginia system is planned and will evolve over a period of years. 511 Virginia will initially provide to the users via wireless and wireline telephone and the web site, exception information for Virginia's Interstate system using existing internal and external data sources and systems. Exception data includes reported incidents, work zones locations, special events and adverse weather conditions. This system will expand over time and more roadways and services will be added as additional data from other sources become available allowing 511 Virginia to provide comprehensive travel information on all major roadways.

VDOT Mobility Data Store

This element will be a central location for storing either ITS or non-ITS data at some point in the future.

VDOT NOVA CSC

VDOT Northern Virginia Traffic Communications Center is responsible for providing transportation information to the public once obtain from the STC.

VDOT NOVA Maintenance and Construction Operations/Snow Operations

Agencies that are associated with this element are VDOT local utility organizations and other construction agencies who's work activity will impact traffic operations. Also the electronic snow plow reporting systems aids VDOT in deploying snow operations. This is an AVL and website operation.

VDOT NOVA Safety Service Patrol

The safety service patrol is responsible for identifying and responding to incidents that occur on VDOT's roadway system.

VDOT NOVA Smart Traffic Center (STC)

VDOT Northern Virginia Smart Traffic Center is responsible for monitoring and managing traffic conditions on I-495, I-95/395, and I-66.

VDOT NOVA STSS

This element represents the VDOT Northern Virginia Smart Travel Signal System that is responsible for controlling signals in Fairfax, Prince William and Loudoun Counties. STSS installs, monitors, controls and maintains over 1000 traffic signals in the three counties. STSS is able to manage traffic flow continuously and monitor the real-time signal status, collect traffic flow information and adjust signal timing from a centralized traffic signal control system.

VDOT Public Affairs

This office is responsible for providing transportation information to the public once obtain from the STC.

VDOT Video Clearinghouse

This element represents VDOT video distribution system to share VDOT video with first responders in the region (e.g., VSP). This element also represents sharing DC and MD video into the video clearinghouse.

Virginia State Police Center

This center is responsible for providing public safety in the state of Virginia by responding to incidents that occur on VDOT's roadway system.

VRE Center

Virginia Railway Express - Rail transportation. AMTRAK is also part of this element since its functions are similar to VREs.

WMATA ADMS

Provides administration functions for WMATA, including HR, payroll, finance and accounting management. Enterprise system to manage archived data for hazmat, safety, assets, bus stops, routes.

WMATA Bus Operations Control Center (BOCC)

BOCC provides dispatch function, incident management and tracking for bus operators.

WMATA Customer Services Center (CSVs)/Trip Planning System/e-alerts/Elevator status report/Consumer Assistant Tracking System

Provides customer services including: trip planning, fare information, customer complaints, incident information. Provides bus and rail system maps, rail station information, parking information, bus & rail schedules (also downloadable to PDAs) and fares, trip planning, e-alerts and advisories (also subscription to same), accessibility, elevator/escalator status, Provides trip planning via web interface for entire jurisdiction including all carriers Provides trip planning via telephone interface for entire jurisdiction including all carriers.

WMATA Emergency Operations Center(Command Center)/Transit Police (MTPD) Operations Control Center

Provides for transit police dispatch, recording of calls, monitoring and recording of in-station video, incident reporting to federal, state and local agencies.

WMATA Fare Collection

On-bus fareboxes, garage and central fareprocessing equipment for fare collection and passenger counts.

WMATA Paratransit (Metro Access, MACS) Management Center

Provides for paratransit service for WMATA service area. Provides trip planning, run/operator/vehicle scheduling, operations, revenue generation, coordination of benefits, coordination with fixed route transit services.

WMATA Parking Management Center

Manages parking reservations, parking lot use and revenue collection for parking facilities.

WMATA Passenger Information Display System (PIDS-for Rail passengers)

In-Station electronic signs that display train arrival information, schedule delay, incident information and ADA required access information. Faregate, farecard vending machines, in-station and central facility fareprocessing equipment for rail system revenue collection and passenger counts.

WMATA Rail Operations Control Center(ROCC)/WMATA Passenger Operations (PassOPS)/Maintenance Operations Control (MOC)

ROCC provides train movement and wayside device monitoring and control, including third rail Power. Also provides incident management. PassOPS provide PIDS message programming, in-

station PA announcements, internal and external media communications/incident notification, incident management and coordination with medical, fire, police for rail transit passengers. MOC provides centralized maintenance control and dispatch center. 24x7 support and direction of maintenance activities.

WMATA Transit Bus (BTRA)

Provides bus transportation. Comprehensive Radio Communications System Provide means of communication with bus operators, rail operators, station managers, interlockers, depot personnel, dispatch personnel, public safety personnel, maintenance personnel. Bus Automatic Vehicle Location On-board bus equipment that provides automatic vehicle location information to Bus Operations Control Center for route and schedule adherence. Bus Automatic Passenger Counters On-board bus equipment that provides automatic passenger counts.

3.2 Systems Inventory

The system inventory provides a summary of systems that will be integrated in the MWA region and their associated connections to elements supported by the National architecture. Table 3-1 provides system characteristics including a status, and associated stakeholder.

The status of each system (existing or planned) is given to help determine if connections within the region stakeholders can be supported by existing systems or if new systems must be planned. The architecture mapping identifies the current or planned connections between systems and elements in the National ITS Architecture. Lastly, the associated stakeholder column identifies the agency that owns, and is responsible for maintenance and operation of the system.

Table 3-1 Systems Inventory

Element Name	Stakeholder Name	Entity Name	Status
CAPWIN	Mid-Atlantic Communications for Interoperability Partnership (MACIP)	Emergency Management	Existing
		Emergency Vehicle Subsystem	Existing
		Archived Data Management Subsystem	Existing
DC Field Equipment	DDOT	Roadway Subsystem	Existing
DC Public Safety and Emergency Center	District of Columbia Public Safety and Emergency Management	Emergency Management	Existing
		Traffic Management	Existing
DCDOT ITMS/TOC	DDOT	Archived Data Management Subsystem	Existing
		Information Service Provider	Existing
		Maintenance and Construction Management	Existing

		Traffic Management	Existing
Event Promoter	Event Promoters	Event Promoters	Existing
Federal Installations	Federal Agencies	Alerting and Advisory Systems	Existing
FEMA	Federal Agencies	Alerting and Advisory Systems	Planned
		Emergency Management	Planned
		Weather Service	Planned
General Public	General Public	Driver	Existing
		Traveler	Existing
Greenway Center	Regional Toll Administration Agency	Toll Administration	Existing
I-95 Corridor Coalition Information Exchange Network (IEN)	I-95 Corridor Coalition	Archived Data Management Subsystem	Existing
		Information Service Provider	Existing
Local Field Equipment	Local Signal Agencies	Roadway Subsystem	Existing
Local Public Safety and Emergency Management Centers	Local Public Safety and Emergency Management	Emergency Management	Existing
Local Signal Center	Local Signal Agencies	Archived Data Management Subsystem	Existing
		Emergency Management	Existing
		Information Service Provider	Existing
		Traffic Management	Existing
Local Transit Center	Local Transit Agencies	Information Service Provider	Existing
		Transit Management	Existing
		Transit Vehicle Subsystem	Existing
MD Transit Management Centers	MTA	Information Service Provider	Existing
		Parking Management	Existing
		Rail Operations	Existing
		Transit Management	Existing
MDSHA CHART	Maryland State Highway Administration (MDSHA)	Archived Data Management Subsystem	Existing
		Emergency Management	Existing
		Emissions Management	Existing

		Information Service Provider	Existing
		Maintenance and Construction Management	Existing
		Traffic Management	Existing
Media Outlets	Media	Media	Existing
MEMA	Maryland Public Safety and Emergency Management	Emergency Management	Existing
Mobile Unified Command Center (DC)	District of Columbia Public Safety and Emergency Management	Emergency Management	Existing
		Traffic Management	Existing
Mobile Unified Command Center (MD)	Maryland Public Safety and Emergency Management	Emergency Management	Existing
		Traffic Management	Existing
Mobile Unified Command Center (VA)	Virginia State Police	Emergency Management	Existing
		Traffic Management	Existing
MWAA Center	Metropolitan Washington Airports Authority(MWAA)	Emergency Management	Existing
		Fleet and Freight Management	Existing
		Information Service Provider	Existing
		Parking Management	Existing
		Transit Management	Existing
MWCOG Database	Metropolitan Washington Council of Governments(MWCOG)	Archived Data Management Subsystem	Existing
		Archived Data User Systems	Existing
National Park Service	National Park Service/United States Park Police (NPS/NSPP)	Traffic Management	Existing
		Emergency Management	Existing
		Emergency Telecommunications System	Existing
NVTC Center	Northern Virginia Transportation Commission (NVTC)	Archived Data Management Subsystem	Existing
Personal Traveler Information Devices	General Public	Personal Information Access	Existing
Private Sector ISP Centers	Regional ISP	Information Service Provider	Existing

Regional Toll Road	Regional Toll Administration Agency	Toll Collection	Existing
Regional Transit Electronic Clearinghouse	Regional Transit Electronic Clearinghouse	Transit Management	Planned
RITIS/CapCOM Center	CapCOM	Traffic Management	Planned
		Alerting and Advisory Systems	Planned
		Archived Data Management Subsystem	Planned
		Archived Data User Systems	Planned
		Emergency Management	Planned
		Information Service Provider	Planned
Smart Card	Washington Metropolitan Area Transit Authority (WMATA)	Traveler Card	Existing
Smart Tag Center	Regional Toll Administration Agency	Toll Administration	Existing
Smart Travel Lab	University of Virginia	Archived Data Management Subsystem	Existing
		Archived Data User Systems	Existing
		Information Service Provider	Existing
Statewide 511 Virginia	Virginia Department of Transportation (VDOT)	Telecommunications System for Traveler Information	Planned
VDOT Mobility Data Store	Virginia Department of Transportation (VDOT)	Archived Data Management Subsystem	Planned
VDOT NOVA CSC	VDOT NOVA District	Emergency Management	Existing
		Information Service Provider	Existing
VDOT NOVA Maintenance and Construction Operations/Snow Operations	VDOT NOVA District	Maintenance and Construction Management	Existing
		Emergency Management	Existing
		Emergency Vehicle Subsystem	Existing

		Information Service Provider	Existing
		Traffic Management	Existing
		Archived Data Management Subsystem	Existing
		Emergency Management	Existing
VDOT NOVA STSS	VDOT NOVA District	Emergency Management	Existing
		Traffic Management	Existing
VDOT Public Affairs	Virginia Department of Transportation (VDOT)	Information Service Provider	Existing
VDOT Video Clearinghouse	Virginia Department of Transportation (VDOT)	Information Service Provider	Existing
		Traffic Management	Existing
Virginia State Police Center	Virginia State Police	Emergency Management	Existing
VRE Center	Virginia Railway Express (VRE)	Multimodal Transportation Service Provider	Existing
		Rail Operations	Existing
		Transit Management	Existing
WMATA ADMS	Washington Metropolitan Area Transit Authority (WMATA)	Archived Data Management Subsystem	Existing
WMATA Bus Operations Control Center (BOCC)	Washington Metropolitan Area Transit Authority (WMATA)	Information Service Provider	Existing
		Transit Management	Existing
		Emergency Management	Existing
WMATA Customer Services Center (CSVs)/Trip Planning System/e-alerts/Elevator status report/Consumer Assistant Tracking System	Washington Metropolitan Area Transit Authority (WMATA)	Information Service Provider	Existing
WMATA Emergency Operations Center(Command Center)/Transit Police (MTPD) Operations Control Center	Washington Metropolitan Area Transit Authority (WMATA)	Emergency Management	Existing
		Information Service Provider	Existing
WMATA Fare Collection	Washington Metropolitan Area Transit Authority (WMATA)	Remote Traveler Support	Existing
WMATA Paratransit (Metro Access, MACS) Management Center	Washington Metropolitan Area	Information Service Provider	Existing

		Transit Management	Existing
WMATA Parking Management Center	Washington Metropolitan Area Transit Authority (WMATA)	Parking Management	Existing
WMATA Passenger Information Display System (PIDS-for Rail passengers)	Washington Metropolitan Area Transit Authority (WMATA)	Remote Traveler Support	Existing
WMATA Rail Operations Control Center(ROCC)/WMATA Passenger Operations(PassOPS)/Maintenance Operations Control(MOC)	Washington Metropolitan Area Transit Authority (WMATA)	Emergency Management	Existing
		Information Service Provider	Existing
		Maintenance and Construction Management	Existing
		Rail Operations	Existing
WMATA Rail Operations Control Center(ROCC)/WMATA Passenger Operations(PassOPS)/Maintenance Operations Control(MOC)	Washington Metropolitan Area Transit Authority (WMATA)	Transit Management	Existing
WMATA Transit Bus (BTRA)	Washington Metropolitan Area Transit Authority (WMATA)	Transit Vehicle Subsystem	Existing

4.0 OPERATIONAL CONCEPTS

4.1 Operational Concept Defined

In ITS architecture development, there are two terms that are often used: Operational Concept and Concept of Operations (COP). A COP defines in detail the specifics of how a system or project operates in different scenarios by combining user and system functions in a narrative fashion. An operational concept is based on principles of systems engineering and is a stakeholder-oriented document that describes system operational characteristics from the stakeholder's viewpoint. The use of these types of documents has proven valuable as a means to successfully communicate the information that stakeholders need and expect from system to system interconnect.

Applied to transportation management and operations, an operational concept is therefore a strategy for achieving a shared set of expectations of operations and delivery of services to be provided by a regional transportation system. These expectations are typically performed by system operators and system managers in response to local/regional needs. At an implementation level, ultimate build-out of the regional transportation system involves personal relationships, communications capabilities (verbal and non verbal/electronic), procedural protocols, information gathering and sharing arrangements, interagency mutual aid agreements both written and unwritten, and dissemination systems (the hardware and software of the various systems). An operational concept documents both existing and future stakeholder roles and responsibilities as identified by those stakeholders that are used to manage transportation facilities and services in the region. Future reports under this project will provide details on the functional requirements of the transportation systems and the agreements required to support these requirements. The benefits that result from the use of an operational concept include the following:

- Improved accountability and control for the various activities and functions that are undertaken in transportation management and operations
- Provision of faster, more coordinated responses to incidents, emergencies, and natural disasters.
- Avoidance of duplicative and/or conflicting efforts by various transportation and public safety jurisdictions, agencies, departments, and other entities
- Clarification of expectations and intent so that all stakeholders are aware of the consequences of their actions on other stakeholders
- Clarification of roles/responsibilities of all stakeholders so activities do not "fall through the cracks"
- Sharing of data and information across agency and jurisdictional boundaries to allow for seamless operations

4.2 Roles and Responsibilities

Operational concepts focus on a definition of each stakeholder's role in delivering transportation systems and services. The operational concept process develops and documents stakeholders' current and future roles and responsibilities in the implementation and operation of ITS and non-ITS activities based on a common regional architecture. Having clear operational roles and responsibilities allows the identification of each stakeholder's ITS role. The process also assists in identifying gaps and duplication of efforts for clarification. In later steps, these roles and responsibilities will form the basis for interagency agreements. In developing the list of

stakeholders, the intent was to encompass unique stakeholders individually and group certain stakeholders together who had similar roles and responsibilities. It was necessary to separate some large stakeholders from smaller stakeholders as the size predicated a wider range of services for even similar stakeholders.

The stakeholders include:

- CapCOM
- CapWIN
- I-95 Corridor Coalition
- Local Signal Agencies
- Maryland State Highway Administration (MDSHA)
- Maryland Transit Administration (MTA)
- MWAA
- MWCOG
- National Park Services
- Public Safety and Emergency Management (VA, MD, DC)
- Regional ISP
- Regional Local Transit Operators
- Regional Toll Operations (Include Smart-Tag Center, Greenway Center, and MdTA)
- Regional Transit Clearinghouse
- VDOT NOVA District /VDOT
- VRE Center
- WMATA

The operational concept documents these roles and responsibilities across a range of transportation services. The services covered are:

- Surface Street Management : provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. Additionally, general advisory and traffic control information can be provided to the driver while en route.
- Freeway Management : provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways, support freeway monitoring and adaptive strategies as an option. Includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment. Additionally, allows general advisory and traffic control information to be provided to the driver while en route.
- Incident Management: manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. Includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated to detect and verify incidents and implement an appropriate response.

- **Electronic Toll Collection** : provides toll operators with the ability to collect tolls electronically and detect and process violations. Vehicle tags of toll violators are read and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional, and ultimately national interoperability for these services.
- **Parking Management** : supports coordination between parking facilities to enable regional parking management strategies. Also provides enhanced monitoring and management of parking facilities. It assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees.
- **Transit Services** : manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, paratransit services, transit rail, and bus rapid transit (BRT) service.
- **Traveler Information**: collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions.
- **Emergency Management**: represents public safety, emergency management, and other allied agency systems that support incident management, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.
- **Maintenance and Construction**: monitors and manages roadway infrastructure construction and maintenance activities. Representing both public agencies and private contractors that provide these functions. Remotely monitors and manages ITS capabilities in work zones, gathering, storing, and disseminating work zone information to other systems
- **Archive Data system**: collects, archives, manages, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications.

Appendix B Table Matrix identifies the roles and responsibilities of key stakeholders for a range of transportation services.

5.0 Functional Requirements

A functional requirement is a description of WHAT a system must do to address a need , to provide a service, and/or to facilitate a stakeholder responsibilities. A functional requirement is characterized by naming the system, the stakeholder , and presenting a list of “shall” statement that constitute the function to be provided by the system. Note also that the use of “shall” statement is deliberate as it sets forth a declarative statement about what a system needs to do.

The list below (in alphabetical order by stakeholder)detail the primary functional requirement for the major ITS elements in Regional Area. These functional requirements were developed based on specific information provided by Stakeholders about their respective system(s).

Stakeholder : CapCOM

Element : RITIS/CapCOM Center

This system shall :

3 Basic Information Broadcast

- 3.1 collect, process, store, and disseminate traffic and highway condition information to travelers, including incident information, detours and road closures, event information, recommended routes, and current speeds on specific routes.
- 3.3 collect, process, store, and disseminate transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers.

133 Emergency Data Collection

- 133.3 receive and respond to requests from ITS Archives for either a catalog of the emergency management data or for the data itself.
- 133.4 be able to produce sample products of the data available.

15 Emergency Dispatch

- 15.1 dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- 15.3 relay location and incident details to the responding vehicles.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.

257 Emergency Early Warning System

- 257.1 monitor information from Alerting and Advisory Systems such as the Information Sharing and Analysis Centers (ISACs), the National Infrastructure Protection Center (NIPC), the Homeland Security Advisory System (HSAS), etc. The information may include assessments (general incident and vulnerability awareness information), advisories (identification of threats or recommendations to increase preparedness levels), or alerts (information on imminent or in-progress emergencies).
- 257.2 provide the capability to correlate alerts and advisories, incident information, and security sensor and surveillance data.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.2 develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.

- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.4 develop, coordinate with other agencies, and store emergency response plans.

122 Government Reporting Systems Support

- 122.1 provide data from an ITS archive to federal, state, or local government reporting systems.
- 122.2 provide the capability to select data from an ITS archive for use in government reports.
- 122.3 provide the capability to format data from an ITS archive suitable for input into government reports.
- 122.4 support requests for ITS archived data from Government Reporting Systems.
- 122.5 provide the applicable meta-data for any ITS archived data to satisfy government reporting system requests. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.

10 ITS Data Repository

- 10.1 collect data to be archived from one or more data sources.
- 10.3 store the archived data in a focused repository that is suited to a particular set of ITS data users.
- 10.6 include capabilities for archive to archive coordination.

254 TMC Evacuation Support

- 254.1 coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.

- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.6 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations
- 85.10 receive inputs from emergency management and transit management centers to develop an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.

89 TMC Regional Traffic Control

- 89.1 exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
- 89.2 exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.
- 128.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 128.3 receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.
- 128.4 be able to produce sample products of the data available.

Stakeholder : Mid-Atlantic Communications for Interoperability Partnership (MACIP)
Element : CAPWIN

This system shall :

133 Emergency Data Collection

- 133.1 collect emergency service data, emergency vehicle management data, emergency vehicle data, sensor and surveillance data, threat data, and incident data.
- 133.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 133.3 receive and respond to requests from ITS Archives for either a catalog of the emergency management data or for the data itself.
- 133.4 be able to produce sample products of the data available.

15 Emergency Dispatch

- 15.2 store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- 15.3 relay location and incident details to the responding vehicles.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.
- 15.5 track the location and status of emergency vehicles responding to an emergency and update the incident status based on information from the emergency vehicle.
- 15.6 receive status information from care facilities to determine the appropriate facility and its location.

- 15.7 store and maintain the emergency service responses in an action log.
- 15.8 receive asset restriction information from maintenance centers to support the dispatching of appropriate emergency resources.
- 15.9 receive traffic information, including closures, traffic conditions, etc. from traffic management centers.
- 15.11 receive road network conditions and traffic images to support dispatch of emergency vehicles.
- 15.12 coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.

257 Emergency Early Warning System

- 257.1 monitor information from Alerting and Advisory Systems such as the Information Sharing and Analysis Centers (ISACs), the National Infrastructure Protection Center (NIPC), the Homeland Security Advisory System (HSAS), etc. The information may include assessments (general incident and vulnerability awareness information), advisories (identification of threats or recommendations to increase preparedness levels), or alerts (information on imminent or in-progress emergencies).
- 257.2 provide the capability to correlate alerts and advisories, incident information, and security sensor and surveillance data.
- 257.3 broadcast wide-area alerts and advisories to traffic management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.4 broadcast wide-area alerts and advisories to transit management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.6 broadcast wide-area alerts and advisories to traveler information service providers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.
- 257.8 broadcast wide-area alerts and advisories to other emergency management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.
- 257.10 coordinate the broadcast of wide-area alerts and advisories with other emergency management centers.
- 257.11 receive incident information from other transportation management centers to support the early warning system.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.6 request resources from transit agencies as needed to support the evacuation.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.

- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.4 develop, coordinate with other agencies, and store emergency response plans.
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- 16.6 allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
- 16.8 receive hazardous materials incident information from commercial fleet operators.

251 Emergency Routing

- 251.1 collect current traffic and road condition information from traffic management centers for emergency vehicle route calculation.

252 Incident Command

- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.
- 252.4 share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.

10 ITS Data Repository

- 10.1 collect data to be archived from one or more data sources.
- 10.2 collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).
- 10.3 store the archived data in a focused repository that is suited to a particular set of ITS data users.
- 10.4 include capabilities for performing quality checks on the incoming archived data.
- 10.5 include capabilities for error notification on the incoming archived data.
- 10.6 include capabilities for archive to archive coordination.
- 10.7 support a broad range of archived data management implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a

131 Virtual Data Warehouse Services

- 131.1 provide capabilities to access "in-place" data from geographically dispersed archives. These capabilities may include analysis, data fusion, or data mining.
- 131.2 coordinate information exchange with a local data warehouse.
- 131.4 support the collection of archived data from other archives on an as-needed basis. (This minimizes the need to duplicate the comprehensive set of data from the remote archives in the local data warehouse.)
- 131.5 use data collected from different archives to build a set of global schema including the data archive definitions for the local archive plus any archives known to the local archive.

131.6 provide the local archived data schema to other archive systems.

Stakeholder : DDOT

Element : DCDOT ITMS/TOC

This system shall :

6 Collect Traffic Surveillance

- 6.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.
- 6.2 monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.
- 6.3 monitor, analyze, and store pedestrian sensor data collected from field elements under remote control of the center.
- 6.4 monitor, analyze, and distribute pedestrian images from CCTV systems under remote control of the center.
- 6.6 maintain a database of surveillance and sensors and the freeways, surface street and rural roadways, e.g. where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network.

23 HRI Traffic Management

- 23.1 remotely control highway-rail intersection (HRI) equipment located in the field.
- 23.4 provide the highway-rail intersection (HRI) equipment operational status to rail operations centers.

211 MCM Data Collection

- 211.1 collect maintenance and construction data (such as field equipment status, infrastructure status, maintenance and construction activity data) gathered from roadway, traffic, and other maintenance and construction sources.

212 MCM Environmental Information Collection

- 212.1 remotely control environmental sensors that measure road surface temperature, moisture, icing, salinity, and other measures.
- 212.3 remotely control environmental sensors on-board maintenance and construction vehicles that measure road and weather conditions including air and surface temperatures, wind speed, humidity, precipitation, visibility and other measures.
- 212.7 collect operational status for the roadside and vehicle-based environmental sensor equipment.

143 MCM Environmental Information Processing

- 143.1 respond to control data from center personnel regarding environmental sensor control and weather data collection and processing.

213 MCM Incident Management

- 213.1 receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.
- 213.2 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, etc.
- 213.3 exchange incident and threat information with emergency management centers as well as traffic management centers; including notification of existence of incident and expected severity, location, time and nature of incident.

- 213.4 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 213.5 respond to requests from emergency management to provide maintenance and construction resources to implement response plans, assist in clean up, verify an incident, etc. This may also involve coordination with traffic management centers and other maintenance centers.
- 213.8 receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.

142 MCM Maintenance Decision Support

- 142.1 provide the center personnel with tailored external information, including weather or road condition observations, forecasted weather information or road conditions, current usage of treatments and materials, available resources, equipment and vehicle availability, road network information, and source reliability information.
- 142.4 provide dispatch information to maintenance and construction vehicles based on the outputs of the decision support system, including recommended roadway treatment

214 MCM Roadway Maintenance and Construction

- 214.1 maintain an interface with asset management systems to track the inventory, restrictions, repair needs and status updates of transportation assets (pavement, bridges, signs, etc.) including location, installation and materials information, vendor/contractor, current maintenance status, standard height, width, and weight restrictions.
- 214.2 respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.
- 214.3 exchange information with administrative systems to support the planning and scheduling of maintenance activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract
- 214.6 collect the status and fault data from traffic management centers, including data for traffic, infrastructure, and environmental sensors, highway advisory radio and dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security sensors and surveillance equipment, etc., and provide a cohesive view of equipment repair

216 MCM Vehicle and Equipment Maintenance Management

- 216.2 exchange information with equipment repair facilities including status and history of repairs concerning maintenance and construction vehicles. This information includes vehicle status and diagnostic information, vehicle utilization, and coordination of when vehicles will be available for preventative and corrective maintenance.
- 216.3 schedule preventive and corrective vehicle maintenance with the equipment repair facility based on fleet health reports, maintenance records, vehicle utilization and vehicle availability schedules.

217 MCM Vehicle Tracking

- 217.1 monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.
- 217.2 present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.

218 MCM Winter Maintenance Management

- 218.1 respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.
- 218.2 exchange information with administrative systems to support the planning and scheduling of winter maintenance activities. This information includes: equipment and

- consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract
- 218.3 provide status information about scheduled winter maintenance activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.
- 218.4 receive equipment availability and materials storage status information from storage facilities to support the scheduling of winter maintenance activities.
- 218.6 collect current and forecast traffic and weather information from traffic management centers and weather service providers (such as the National Weather Service and value-added sector specific meteorological services).
- 218.7 dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion
- 218.8 determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.
- 218.11 assess the current status of all winter maintenance activities, including actual work activities performed, current locations and operational conditions of vehicles, materials and equipment inventories, field equipment status, environmental information, etc.

219 MCM Work Activity Coordination

- 219.1 provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.
- 219.5 exchange information with administrative systems to support the planning and scheduling of maintenance and construction activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract

220 MCM Work Zone Management

- 220.1 generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes.
- 220.2 control the collection of work zone status information including video images from cameras located in or near the work zone.
- 220.3 disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.

55 Rail Operations Coordination

- 55.1 exchange highway-rail intersection (HRI) information with rail operations centers. This information may include event schedules, requests for information from the Rail Operators, incident notification based on rail operations messages, and priority messages like notifications of a HAZMAT spill, equipment failure, or an intersection blockage.

254 TMC Evacuation Support

- 254.1 coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.
- 254.2 support requests from emergency management centers to preempt the current traffic

control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.

- 254.3 coordinate information and controls with other traffic management centers.
- 254.4 coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.

84 TMC Incident Detection

- 84.1 receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.
- 84.2 collect and store traffic flow and image data from the field equipment to detect and verify incidents.
- 84.3 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, and intermodal freight depots.
- 84.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 84.5 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field.
- 84.6 provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.
- 84.7 provide video and traffic sensor control commands to the field equipment to detect and verify incidents.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 85.5 respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.
- 85.6 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations
- 85.7 provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.
- 85.8 exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required

- closures, alternate routes, necessary restrictions, and time frame for repair and recovery.
- 85.9 coordinate information and controls with other traffic management centers.
- 85.10 receive inputs from emergency management and transit management centers to develop an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.
- 85.11 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic incident management.

87 TMC Multimodal Coordination

- 87.1 respond to requests from transit management centers for signal priority at one or more intersections along a particular transit route.
- 87.2 exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes.

249 TMC Multimodal Crossing Management

- 249.2 remotely control traffic signal controllers for use at major multimodal crossings.
- 249.3 remotely control driver information systems (such as dynamic messages signs, highway advisory radios (HAR), and equipment that controls warning lights and gates) to notify drivers of closure durations and times at multimodal crossings.

89 TMC Regional Traffic Control

- 89.1 exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
- 89.2 exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).

90 TMC Reversible Lane Management

- 90.1 remotely control devices to detect traffic in reversible lanes, including wrong-way
- 90.2 monitor the use of reversible lanes and detect wrong-way vehicles in reversible lanes using sensor and surveillance information, and the current lane control status (which direction the lane is currently operating). This may include identification of wrong-way
- 90.3 remotely control automated reversible lane equipment and driver information systems (such as lane control signals) that control traffic in reversible lanes on surface streets.
- 90.4 remotely control automated reversible lane equipment and driver information systems (such as lane control signals) that control traffic in reversible lanes on freeways.
- 90.5 collect operational status for the reversible lane field equipment.
- 90.6 collect fault data for the reversible lane field equipment and send to the maintenance center for repair.
- 90.7 provide the capability for center personnel to control access and management of reversible lane facilities, including the direction of traffic flow changes during the day, especially between the peak hours and dedication of more lanes to the congestion direction during special events.

92 TMC Signal Control

- 92.1 remotely control traffic signal controllers.
- 92.2 accept notifications of right-of-way requests from pedestrians.
- 92.3 collect traffic signal controller operational status and compare against the control information sent by the center.

- 92.4 collect traffic signal controller fault data from the field.
- 92.5 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.

238 TMC Speed Monitoring

- 238.2 collect operational status for the vehicle speed sensors; the status shall include logged information including measured speeds, warning messages displayed, and violation records.
- 238.3 provide the capability to notify an enforcement agency when vehicle speeds in the work zone are in excess of the posted speed limit or are creating an unsafe condition based upon the current environmental or traffic conditions.

94 TMC Traffic Information Dissemination

- 94.1 remotely control dynamic messages signs for dissemination of traffic and other information to drivers.
- 94.3 collect operational status for the driver information systems equipment (DMS, HAR, etc.).
- 94.4 collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.
- 94.5 retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.
- 94.6 distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.
- 94.7 distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.

95 TMC Traffic Network Performance Evaluation

- 95.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.
- 95.3 collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.
- 95.4 exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance.
- 95.5 exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.

239 TMC Work Zone Traffic Management

- 239.3 remotely control driver information systems (such as dynamic messages signs, highway advisory radios) to advise drivers of activity around a work zone.
- 239.6 receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback to the sending center.

135 Traffic and Roadside Data Archival

- 135.1 manage the collection of archive data directly from collection equipment located at the roadside.
- 135.2 collect traffic sensor information from roadside devices.
- 135.3 collect environmental sensor information that from roadside devices.

- 135.4 respond to requests from the Archive Data Administer to input the parameters that control the collection process.
- 135.5 send the request for data and control parameters to the field equipment where the information is collected and returned.
- 135.6 record the status about the imported traffic and roadside data.
- 135.7 use the status information to adjust the collection of traffic and roadside data.

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.

98 Traffic Maintenance

- 98.1 collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.
- 98.2 collect and store CCTV surveillance system (traffic, pedestrian) operational status.
- 98.3 collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.
- 98.4 collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.
- 98.5 collect environmental sensor operational status.
- 98.6 collect environmental sensor equipment fault data and send to the maintenance center for repair.
- 98.7 exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when the faults are cleared.
- 98.8 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic maintenance data.

Stakeholder : District of Columbia Public Safety and Emergency Management

Element : DC Public Safety and Emergency Center

This system shall :

278 Center Secure Area Alarm Support

- 278.3 After the alarm message has been received, the center shall generate an alarm acknowledgment to the sender.

265 Center Secure Area Sensor Management

- 265.1 remotely monitor and control security sensor data collected in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways). The types of security sensor data include environmental threat (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), infrastructure condition and integrity, intrusion and motion, and object detection sensors. The data may be raw or pre-processed in the field.
- 265.2 remotely monitor and control security sensor data collected in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers). The types of security sensor data include environmental threat (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), intrusion and motion, and object detection sensors. The data may be raw or pre-processed in the field.
- 265.4 exchange security sensor data with other emergency centers.
- 265.5 identify potential security threats based on collected security sensor data.

- 265.6 verify potential security threats by correlating security sensor data from multiple sources.
- 265.7 perform threat analysis based on correlations of security sensor and surveillance data.
- 265.8 exchange threat analysis data with Alerting and Advisory Systems and use that data in local threat analysis processing.
- 265.9 disseminate threat information to other agencies, including traffic, transit, maintenance, rail operations, and other emergency management centers.

247 Center Secure Area Surveillance

- 247.1 remotely monitor video images and audio surveillance data collected in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways). The data may be raw or pre-processed in the field.
- 247.2 remotely monitor video images and audio surveillance data collected in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers). The data may be raw or pre-processed in the field.
- 247.4 exchange surveillance data with other emergency centers.
- 247.5 identify potential security threats based on collected security surveillance data.
- 247.6 verify potential security threats by correlating security surveillance data from multiple sources.
- 247.7 remotely control security surveillance devices in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways).
- 247.8 remotely control security surveillance devices in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers).
- 247.12 respond to control data from center personnel regarding security surveillance data collection, processing, threat detection, and image matching.

14 Emergency Call-Taking

- 14.1 support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.
- 14.2 receive emergency call information from 911 services and present the possible incident information to the emergency system operator.

15 Emergency Dispatch

- 15.1 dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- 15.2 store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.

257 Emergency Early Warning System

- 257.2 provide the capability to correlate alerts and advisories, incident information, and security sensor and surveillance data.
- 257.3 broadcast wide-area alerts and advisories to traffic management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.4 broadcast wide-area alerts and advisories to transit management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER

- alert system), military activities, and other situations that pose a threat to life and
- 257.6 broadcast wide-area alerts and advisories to traveler information service providers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.
 - 257.10 coordinate the broadcast of wide-area alerts and advisories with other emergency management centers.
 - 257.12 present the alert and advisory information and the status of the actions taken in response to the alert by the other centers to the emergency system operator as received from other system inputs.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.2 develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.6 request resources from transit agencies as needed to support the evacuation.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.
- 253.9 monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.
- 253.10 monitor the progress of the reentry process.
- 253.11 submit evacuation information to toll administration centers along with requests for changes in the toll services or fee collection during an evacuation.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.

251 Emergency Routing

- 251.1 collect current traffic and road condition information from traffic management centers for emergency vehicle route calculation.
- 251.2 receive inputs from traffic management and maintenance centers on the location and status of traffic control equipment and work zones along potential emergency routes.

251.6 Once the route is calculated the route shall be provided to the dispatch function.

Stakeholder : Federal Agencies

Element : FEMA

This system shall :

133 Emergency Data Collection

- 133.1 collect emergency service data, emergency vehicle management data, emergency vehicle data, sensor and surveillance data, threat data, and incident data.
- 133.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 133.3 receive and respond to requests from ITS Archives for either a catalog of the emergency management data or for the data itself.
- 133.4 be able to produce sample products of the data available.

257 Emergency Early Warning System

- 257.1 monitor information from Alerting and Advisory Systems such as the Information Sharing and Analysis Centers (ISACs), the National Infrastructure Protection Center (NIPC), the Homeland Security Advisory System (HSAS), etc. The information may include assessments (general incident and vulnerability awareness information), advisories (identification of threats or recommendations to increase preparedness levels), or alerts (information on imminent or in-progress emergencies).
- 257.2 provide the capability to correlate alerts and advisories, incident information, and security sensor and surveillance data.
- 257.3 broadcast wide-area alerts and advisories to traffic management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.4 broadcast wide-area alerts and advisories to transit management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.5 broadcast wide-area alerts and advisories to toll administration centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.6 broadcast wide-area alerts and advisories to traveler information service providers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.
- 257.7 broadcast wide-area alerts and advisories to maintenance centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and
- 257.8 broadcast wide-area alerts and advisories to other emergency management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and property.
- 257.9 process status information from each of the centers that have been sent the wide-area
- 257.10 coordinate the broadcast of wide-area alerts and advisories with other emergency management centers.
- 257.11 receive incident information from other transportation management centers to support the early warning system.
- 257.12 present the alert and advisory information and the status of the actions taken in response

to the alert by the other centers to the emergency system operator as received from other system inputs.

- 257.13 support the entry of alert and advisory information directly from the emergency system operator.

241 Emergency Environmental Monitoring

- 241.1 collect current and forecast road and weather information from weather service providers (such as the National Weather Service and value-added sector specific meteorological services).
- 241.4 assimilate current and forecast road conditions and surface weather information to support incident management.
- 241.5 present the current and forecast road and weather information to the emergency system operator.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.2 develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.
- 253.9 monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.
- 253.10 monitor the progress of the reentry process.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.14 provide the capability for center personnel to provide inputs to the management of incidents, disasters and evacuations.

Stakeholder : Local Signal Agencies

Element : Local Signal Center

This system shall :

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.2 develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.6 request resources from transit agencies as needed to support the evacuation.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.4 develop, coordinate with other agencies, and store emergency response plans.
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- 16.7 receive event scheduling information from Event Promoters.
- 16.8 receive hazardous materials incident information from commercial fleet operators.
- 16.12 provide information to the media concerning the status of an emergency response.

23 HRI Traffic Management

- 23.1 remotely control highway-rail intersection (HRI) equipment located in the field.
- 23.2 accept collect highway-rail intersection (HRI) advisory or alert data from rail operations centers.
- 23.4 provide the highway-rail intersection (HRI) equipment operational status to rail operations centers.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.
- 252.4 share incident command information with other public safety agencies including

resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.

55 Rail Operations Coordination

- 55.1 exchange highway-rail intersection (HRI) information with rail operations centers. This information may include event schedules, requests for information from the Rail Operators, incident notification based on rail operations messages, and priority messages like notifications of a HAZMAT spill, equipment failure, or an intersection blockage.
- 55.2 receive highway-rail intersection (HRI) maintenance schedules, train schedules, and incident notifications from rail operations centers.
- 55.3 use the rail operations information to develop forecast HRI closure times and durations which may be applied in advanced traffic control strategies or delivered as enhanced traveler information.

84 TMC Incident Detection

- 84.2 collect and store traffic flow and image data from the field equipment to detect and verify incidents.
- 84.3 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, and intermodal freight depots.
- 84.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 84.5 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field.
- 84.6 provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.
- 84.7 provide video and traffic sensor control commands to the field equipment to detect and verify incidents.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 85.5 respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.
- 85.6 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations
- 85.7 provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.
- 85.8 exchange road network status assessment information with emergency management and

maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.

85.9 coordinate information and controls with other traffic management centers.

87 TMC Multimodal Coordination

87.1 respond to requests from transit management centers for signal priority at one or more intersections along a particular transit route.

87.2 exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes.

249 TMC Multimodal Crossing Management

249.2 remotely control traffic signal controllers for use at major multimodal crossings.

249.3 remotely control driver information systems (such as dynamic messages signs, highway advisory radios (HAR), and equipment that controls warning lights and gates) to notify drivers of closure durations and times at multimodal crossings.

249.6 receive and respond to requests for right-of-way at multimodal crossings.

92 TMC Signal Control

92.1 remotely control traffic signal controllers.

92.2 accept notifications of right-of-way requests from pedestrians.

92.3 collect traffic signal controller operational status and compare against the control information sent by the center.

92.4 collect traffic signal controller fault data from the field.

92.5 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.

94 TMC Traffic Information Dissemination

94.1 remotely control dynamic messages signs for dissemination of traffic and other information to drivers.

94.3 collect operational status for the driver information systems equipment (DMS, HAR, etc.).

94.4 collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.

94.5 retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.

94.6 distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.

94.7 distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.

94.8 provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.

239 TMC Work Zone Traffic Management

239.1 receive work zone images from a maintenance center.

239.3 remotely control driver information systems (such as dynamic messages signs, highway advisory radios) to advise drivers of activity around a work zone.

135 Traffic and Roadside Data Archival

- 135.1 manage the collection of archive data directly from collection equipment located at the roadside.
- 135.2 collect traffic sensor information from roadside devices.
- 135.3 collect environmental sensor information that from roadside devices.

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.
- 128.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 128.3 receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.
- 128.4 be able to produce sample products of the data available.

98 Traffic Maintenance

- 98.1 collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.
- 98.2 collect and store CCTV surveillance system (traffic, pedestrian) operational status.
- 98.3 collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.
- 98.4 collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.
- 98.5 collect environmental sensor operational status.
- 98.6 collect environmental sensor equipment fault data and send to the maintenance center for repair.
- 98.7 exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when the faults are cleared.
- 98.8 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic maintenance data.

Stakeholder : Local Transit Agencies

Element : Local Transit Center

This system shall :

99 Transit Center Fare and Load Management

- 99.1 manage the actual value of transit fares for each segment of each regular transit route, including the transmission of the information to transit vehicles and transit stops or
- 99.2 provide the capability for a system operator to manage the transit fares and control the exchange of transit fare information.
- 99.3 process the financial requests from the transit vehicles or roadside and manage an interface to a Financial Institution.
- 99.4 support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.
- 99.5 collect data on fare payment violations and send the data, including images of the violator, to the appropriate enforcement agency.
- 99.6 process requests for transit fares to be paid in advance.
- 99.7 process requests for the advanced payment of tolls and parking lot charges as well as

other non-transportation services, e.g. yellow-pages services.

- 99.8 be capable of establishing emergency fare structures to override all other fares during disasters, states of emergency, or evacuations.
- 99.10 collect passenger loading and fare statistics data to implement variable and flexible fare structures.
- 99.11 exchange fare and load information with other transit management centers, including potential Centralized Payments facilities.
- 99.12 provide transit fare information to other centers, including traveler information providers upon request.

100 Transit Center Fixed-Route Operations

- 100.1 generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, operational data on current routes and schedules, and digitized map data.
- 100.2 provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to initiate these processes
- 100.3 be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.
- 100.4 accept requests from traffic management to change routes and schedules as part of the implementation of demand management strategies.
- 100.5 collect transit operational data for use in the generation of routes and schedules.
- 100.6 assign transit vehicle operators based on factors such as eligibility, route preferences, seniority, and transit vehicle availability.
- 100.7 manage large deviations of individual transit vehicles, deviations in rural areas, and deviations of large numbers of vehicles.
- 100.8 generate the necessary corrective actions which may involve more than the vehicles concerned and more far reaching action, such as, the introduction of extra vehicles, wide area signal priority by traffic management, the premature termination of some services,
- 100.9 exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.
- 100.10 disseminate up-to-date schedules and route information to other centers for fixed and flexible route services.

101 Transit Center Information Services

- 101.1 provide travelers using public transportation with traffic and advisory information upon request. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.
- 101.2 provide transit information to the media including details of deviations from schedule of regular transit services.
- 101.3 exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems.
- 101.4 provide transit service information to traveler information service providers including routes, schedules, schedule adherence, and fare information as well as transit service information during evacuation.
- 101.6 broadcast transit advisory data, including alerts and advisories pertaining to major emergencies, or man made disasters.

102 Transit Center Multi-Modal Coordination

- 102.1 analyze transit vehicle schedule performance to determine the need for priority along

- 102.2 certain routes or at certain intersections.
send requests for priority along routes or at intersections to traffic management.
- 102.3 coordinate schedules and services between transit agencies, traffic management, maintenance and construction operations, parking management, and other surface or air transportation modes.
- 102.4 share transfer cluster and transfer point information with multimodal transportation service providers, other transit agencies, and traveler information service providers. A transfer cluster is a collection of stops, stations, or terminals where transfers can be made conveniently.

103 Transit Center Paratransit Operations

- 103.1 process trip requests for demand responsive transit services, i.e. paratransit. Sources of the requests may include traveler information service providers.
- 103.2 track the location and availability of transit vehicles for use in demand responsive transit (paratransit) operations.
- 103.3 generate demand responsive transit (paratransit) routes and schedules based on such factors as parameters input by the system operator, what other demand responsive transit schedules have been planned, the availability and location of vehicles, the relevance of any fixed transit routes and schedules, and road network information.
- 103.4 assign transit vehicle operators for confirmed demand responsive transit (paratransit) trips based on factors such as eligibility, route preferences, seniority, and transit vehicle availability.
- 103.5 exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.
- 103.6 disseminate up-to-date schedules and route information to other centers for demand responsive transit services (paratransit).

105 Transit Center Tracking and Dispatch

- 105.1 monitor the locations of all transit vehicles within its network.
- 105.2 determine adherence of transit vehicles to their assigned schedule.
- 105.3 collect trip monitoring data from on-board systems including transit vehicle mileage, fuel usage, passenger loading, availability, etc.
- 105.4 provide transit operational data to traveler information service providers.

256 Transit Evacuation Support

- 256.1 manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.
- 256.2 coordinate regional evacuation plans with Emergency Management - identifying the transit role in an evacuation and the transit resources that would be used.
- 256.3 coordinate the use of transit and school bus fleets during an evacuation, supporting evacuation of those with special needs and the general population.
- 256.4 adjust and update transit service and fare schedules and provide that information to other agencies as they coordinate evacuations.

Stakeholder : Maryland State Highway Administration (MDSHA)

Element : MDSHA CHART

This system shall :

6 Collect Traffic Surveillance

- 6.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.

- 6.2 monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.
- 6.3 monitor, analyze, and store pedestrian sensor data collected from field elements under remote control of the center.
- 6.4 monitor, analyze, and distribute pedestrian images from CCTV systems under remote control of the center.
- 6.6 maintain a database of surveillance and sensors and the freeways, surface street and rural roadways, e.g. where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network.
- 6.7 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.
- 6.8 distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.
- 6.9 respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.

15 Emergency Dispatch

- 15.1 dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- 15.2 store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- 15.3 relay location and incident details to the responding vehicles.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.
- 15.9 receive traffic information, including closures, traffic conditions, etc. from traffic management centers.
- 15.10 provide the capability for digitized map data to act as the background to the information presented to the emergency system operator.
- 15.11 receive road network conditions and traffic images to support dispatch of emergency vehicles.
- 15.12 coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.6 request resources from transit agencies as needed to support the evacuation.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.

16 Emergency Response Management

- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.4 develop, coordinate with other agencies, and store emergency response plans.
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- 16.8 receive hazardous materials incident information from commercial fleet operators.
- 16.10 provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.
- 16.12 provide information to the media concerning the status of an emergency response.

126 Emissions Data Collection

- 126.1 collect air quality and emissions management data from various sources, including emissions sensors distributed along the roadside and wide-area sensors detecting pollution over a larger geographical area.
- 126.3 receive and respond to requests from ITS Archives for either a catalog of the emissions management data or for the data itself.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.

125 ISP Data Collection

- 125.1 collect traveler information data, such as parking lot data, rideshare data, road network use data, vehicle probe data, and other data from traveler information system operations.

212 MCM Environmental Information Collection

- 212.1 remotely control environmental sensors that measure road surface temperature, moisture, icing, salinity, and other measures.
- 212.4 assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (such as the National Weather Service and value-added sector specific meteorological services), data from traffic, emergency, and transit management, traveler information providers, and environmental data collected from sensors deployed on and about the roadway as well as the fleet of maintenance and construction vehicles.

213 MCM Incident Management

- 213.7 provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.

142 MCM Maintenance Decision Support

- 142.1 provide the center personnel with tailored external information, including weather or road condition observations, forecasted weather information or road conditions, current usage of treatments and materials, available resources, equipment and vehicle availability, road network information, and source reliability information.

218 MCM Winter Maintenance Management

- 218.3 provide status information about scheduled winter maintenance activities including

anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.

220 MCM Work Zone Management

- 220.5 exchange information with administrative systems to support the planning and scheduling of work zone activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract

55 Rail Operations Coordination

- 55.1 exchange highway-rail intersection (HRI) information with rail operations centers. This information may include event schedules, requests for information from the Rail Operators, incident notification based on rail operations messages, and priority messages like notifications of a HAZMAT spill, equipment failure, or an intersection blockage.
- 55.2 receive highway-rail intersection (HRI) maintenance schedules, train schedules, and incident notifications from rail operations centers.

82 TMC Freeway Management

- 82.1 remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls.
- 82.2 collect operational status from ramp meters, mainline metering, and lane controls and compare against the control information sent by the center.
- 82.3 collect fault data from ramp meters, mainline metering, and lane controls.
- 82.4 implement control strategies, under control of center personnel, on some or all of the freeway network devices (e.g. ramp meters, mainline metering, and lane controls), based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the ramps themselves.

83 TMC HOV Lane Management

- 83.3 remotely control freeway control devices, such as ramp signals and mainline metering and other systems associated with freeway operations that control use of HOV lanes.
- 83.4 collect traffic flow measures and information regarding vehicle occupancy (i.e., lane usage) in HOV lanes.

84 TMC Incident Detection

- 84.1 receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.
- 84.2 collect and store traffic flow and image data from the field equipment to detect and verify incidents.
- 84.3 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, and intermodal freight depots.
- 84.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 84.5 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field.
- 84.6 provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.
- 84.7 provide video and traffic sensor control commands to the field equipment to detect and verify incidents.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 85.5 respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.
- 85.9 coordinate information and controls with other traffic management centers.
- 85.10 receive inputs from emergency management and transit management centers to develop an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.

87 TMC Multimodal Coordination

- 87.1 respond to requests from transit management centers for signal priority at one or more intersections along a particular transit route.
- 87.2 exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes.

89 TMC Regional Traffic Control

- 89.1 exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
- 89.2 exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).

92 TMC Signal Control

- 92.1 remotely control traffic signal controllers.
- 92.3 collect traffic signal controller operational status and compare against the control information sent by the center.
- 92.4 collect traffic signal controller fault data from the field.
- 92.5 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.

94 TMC Traffic Information Dissemination

- 94.1 remotely control dynamic messages signs for dissemination of traffic and other information to drivers.
- 94.2 remotely control driver information systems that communicate directly from a center to

the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.

- 94.3 collect operational status for the driver information systems equipment (DMS, HAR, etc.).
- 94.4 collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.
- 94.5 retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.
- 94.6 distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.
- 94.7 distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.
- 94.8 provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.

95 TMC Traffic Network Performance Evaluation

- 95.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.
- 95.5 exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.

239 TMC Work Zone Traffic Management

- 239.1 receive work zone images from a maintenance center.
- 239.3 remotely control driver information systems (such as dynamic messages signs, highway advisory radios) to advise drivers of activity around a work zone.
- 239.6 receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback to the sending center.

135 Traffic and Roadside Data Archival

- 135.1 manage the collection of archive data directly from collection equipment located at the roadside.
- 135.2 collect traffic sensor information from roadside devices.
- 135.3 collect environmental sensor information that from roadside devices.
- 135.4 respond to requests from the Archive Data Administer to input the parameters that control the collection process.
- 135.5 send the request for data and control parameters to the field equipment where the information is collected and returned.
- 135.6 record the status about the imported traffic and roadside data.
- 135.7 use the status information to adjust the collection of traffic and roadside data.

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.
- 128.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 128.3 receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.

98 Traffic Maintenance

- 98.1 collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.
- 98.2 collect and store CCTV surveillance system (traffic, pedestrian) operational status.
- 98.3 collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.
- 98.4 collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.
- 98.5 collect environmental sensor operational status.
- 98.6 collect environmental sensor equipment fault data and send to the maintenance center for repair.

131 Virtual Data Warehouse Services

- 131.2 coordinate information exchange with a local data warehouse.

Stakeholder : Metropolitan Washington Council of Governments(MWCOG)

Element : MWCOG Database

This system shall :

122 Government Reporting Systems Support

- 122.1 provide data from an ITS archive to federal, state, or local government reporting systems.
- 122.2 provide the capability to select data from an ITS archive for use in government reports.
- 122.3 provide the capability to format data from an ITS archive suitable for input into government reports.
- 122.4 support requests for ITS archived data from Government Reporting Systems.
- 122.5 provide the applicable meta-data for any ITS archived data to satisfy government reporting system requests. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.

10 ITS Data Repository

- 10.1 collect data to be archived from one or more data sources.
- 10.2 collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).
- 10.3 store the archived data in a focused repository that is suited to a particular set of ITS data users.
- 10.6 include capabilities for archive to archive coordination.
- 10.10 respond to requests from the administrator interface function to maintain the archive data.

131 Virtual Data Warehouse Services

- 131.2 coordinate information exchange with a local data warehouse.
- 131.3 provide the specialized publishing, directory services, and transaction management functions associated with coordinating remote archives.
- 131.4 support the collection of archived data from other archives on an as-needed basis. (This minimizes the need to duplicate the comprehensive set of data from the remote archives in the local data warehouse.)
- 131.5 use data collected from different archives to build a set of global schema including the data archive definitions for the local archive plus any archives known to the local archive.
- 131.6 provide the local archived data schema to other archive systems.

Stakeholder : Regional Toll Administration Agency

Element : Regional Toll Road

This system shall :

97 Toll Plaza Toll Collection

- 97.1 read data from vehicle toll tags to support toll payment transactions.
- 97.2 calculate the toll due based on the vehicle characteristics (vehicle size, weight, axle count, etc.), tag data, and stored toll prices.
- 97.3 update the toll tag value after debiting the toll amount and send a record of the transaction to a center.
- 97.4 read the credit identity on the toll tag and send that identity and the amount to be debited to a center.
- 97.5 support advanced toll payment by checking the vehicle's toll tag information against a stored list of advanced payments, and debiting the toll from the list in the case of a
- 97.6 In the case of closed toll systems, the field element shall update the toll tag with the system entry point, and upon toll system exit, used in the calculation of the toll.
- 97.7 control roadside displays indicating success or failure of the toll transaction to the driver.
- 97.8 control cameras, obtain images, and forward images of toll violators to a center.
- 97.9 respond to changes in tolls from the Toll Operator.
- 97.10 forward wide-area alert information to the Toll Operator.

Stakeholder : Regional Transit Electronic Clearinghouse

Element : Regional Transit Electronic Clearinghouse

This system shall :

96 Toll Administration

- 96.1 manage toll transactions, including maintaining a log of all transactions and toll pricing structure information.
- 96.3 For electronic toll payments requiring financial payment, the center shall process the financial information from toll plazas and manage an interface to a Financial Institution.
- 96.4 manage a local billing database for toll customers.
- 96.5 manage the details of toll payment violations based on tag information from the toll plaza, vehicle registration information from the Department of Motor Vehicles, invalid tag information from a Financial Institution, and previous violation information stored locally, and report such violations to appropriate law enforcement agencies.
- 96.8 exchange data with other toll agencies to coordinate toll transactions and pricing.
- 96.10 support wide-area alerts from emergency centers by passing on the information to its toll plazas and the Toll Administrator.
- 96.11 support toll transactions by commercial fleet operators.

129 Toll Data Collection

- 129.1 collect toll operational data and pricing data.
- 129.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 129.3 receive and respond to requests from ITS Archives for either a catalog of the toll data or

for the data itself.

129.4 be able to produce sample products of the data available.

99 Transit Center Fare and Load Management

- 99.1 manage the actual value of transit fares for each segment of each regular transit route, including the transmission of the information to transit vehicles and transit stops or
- 99.2 provide the capability for a system operator to manage the transit fares and control the exchange of transit fare information.
- 99.3 process the financial requests from the transit vehicles or roadside and manage an interface to a Financial Institution.
- 99.4 support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.
- 99.5 collect data on fare payment violations and send the data, including images of the violator, to the appropriate enforcement agency.
- 99.6 process requests for transit fares to be paid in advance.
- 99.7 process requests for the advanced payment of tolls and parking lot charges as well as other non-transportation services, e.g. yellow-pages services.
- 99.8 be capable of establishing emergency fare structures to override all other fares during disasters, states of emergency, or evacuations.
- 99.9 maintain a list of invalid traveler credit identities, or bad tag lists that can be forwarded to transit vehicles and transit stops or stations.
- 99.10 collect passenger loading and fare statistics data to implement variable and flexible fare structures.
- 99.11 exchange fare and load information with other transit management centers, including potential Centralized Payments facilities.
- 99.12 provide transit fare information to other centers, including traveler information providers upon request.

132 Transit Data Collection

- 132.1 collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.
- 132.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 132.3 receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.
- 132.4 be able to produce sample products of the data available.

Stakeholder : VDOT NOVA District

Element : VDOT NOVA Maintenance and Construction Operations/Snow Operations

This system shall :

211 MCM Data Collection

- 211.3 receive and respond to requests from ITS Archives for either a catalog of the maintenance and construction data or for the data itself.
- 211.4 be able to produce sample products of the data available.

212 MCM Environmental Information Collection

- 212.1 remotely control environmental sensors that measure road surface temperature, moisture, icing, salinity, and other measures.

- 212.5 provide weather and road condition information to weather service providers and center personnel.

143 MCM Environmental Information Processing

- 143.1 respond to control data from center personnel regarding environmental sensor control and weather data collection and processing.
- 143.2 assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (such as the National Weather Service and value-added sector specific meteorological services) and local environmental sensor data.

213 MCM Incident Management

- 213.1 receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.
- 213.2 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, etc.
- 213.3 exchange incident and threat information with emergency management centers as well as traffic management centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 213.4 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 213.6 exchange road network status assessment information with emergency management and traffic management centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.
- 213.7 provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.
- 213.8 receive information indicating the damage sustained by transportation assets, derived from aerial surveillance, field reports, inspections, tests, and analyses to support incident management.

142 MCM Maintenance Decision Support

- 142.3 provide an interface to the center personnel to input control parameters for the decision support process and receive decisions or information presentation.
- 142.4 provide dispatch information to maintenance and construction vehicles based on the outputs of the decision support system, including recommended roadway treatment

214 MCM Roadway Maintenance and Construction

- 214.1 maintain an interface with asset management systems to track the inventory, restrictions, repair needs and status updates of transportation assets (pavement, bridges, signs, etc.) including location, installation and materials information, vendor/contractor, current maintenance status, standard height, width, and weight restrictions.
- 214.2 respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other roadway maintenance.
- 214.3 exchange information with administrative systems to support the planning and scheduling of maintenance activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including

- 214.4 training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract provide emergency management and traffic management centers with information about scheduled maintenance and construction work activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and
- 214.5 collect the status and fault data from roadside equipment, such as traffic, infrastructure, and environmental sensors, highway advisory radio and dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security sensors and surveillance equipment, etc., and provide a cohesive view of equipment repair needs.
- 214.6 collect the status and fault data from traffic management centers, including data for traffic, infrastructure, and environmental sensors, highway advisory radio and dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security sensors and surveillance equipment, etc., and provide a cohesive view of equipment repair
- 214.7 remotely control and collect data from infrastructure monitoring sensors located along the roadway infrastructure or on maintenance and construction vehicles.
- 214.8 receive equipment availability and materials storage status information from storage facilities to support the scheduling of roadway maintenance and construction activities.

216 MCM Vehicle and Equipment Maintenance Management

- 216.1 collect and analyze vehicle diagnostics information from maintenance and construction vehicles. The information includes engine temperature, mileage, tire wear, brake wear, belt wear, and any warnings or alarms concerning the operational condition of the vehicle and ancillary equipment.
- 216.2 exchange information with equipment repair facilities including status and history of repairs concerning maintenance and construction vehicles. This information includes vehicle status and diagnostic information, vehicle utilization, and coordination of when vehicles will be available for preventative and corrective maintenance.
- 216.3 schedule preventive and corrective vehicle maintenance with the equipment repair facility based on fleet health reports, maintenance records, vehicle utilization and vehicle availability schedules.

217 MCM Vehicle Tracking

- 217.1 monitor the locations of all maintenance and construction vehicles and other equipment under its jurisdiction.
- 217.2 present location data to center personnel for the fleet of maintenance and construction vehicles and other equipment.
- 217.3 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for maintenance and construction vehicle tracking.

218 MCM Winter Maintenance Management

- 218.1 respond to requests from emergency management and traffic management centers for hazard removal, field equipment repair, and other winter roadway maintenance.
- 218.3 provide status information about scheduled winter maintenance activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, and the media.
- 218.4 receive equipment availability and materials storage status information from storage facilities to support the scheduling of winter maintenance activities.
- 218.7 dispatch and route winter maintenance vehicle drivers and support them with route-specific environmental, incident, advisory, threat, alert, and traffic congestion

-
- 218.8 determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies, and recommendations from the Maintenance Decision Support system, specifically under winter conditions. This supports winter maintenance such as plowing, treating, anti-icing, etc.
 - 218.9 provide dispatch instructions for vehicle operators based on input parameters from center personnel, specifically for winter conditions. This could include a treatment route, treatment application rates, start and end times, and other treatment instructions.
 - 218.10 support remote control of on-board maintenance and construction vehicle systems and field equipment that is remotely controlled by the vehicle such as adjusting material application rates and spread patterns.
 - 218.11 assess the current status of all winter maintenance activities, including actual work activities performed, current locations and operational conditions of vehicles, materials and equipment inventories, field equipment status, environmental information, etc.

219 MCM Work Activity Coordination

- 219.1 provide work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.
- 219.2 provide status information about scheduled maintenance and construction activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, multimodal transportation providers, rail operations, and the
- 219.3 collect and respond to feedback concerning scheduled maintenance and construction activities with other management centers such as traffic, emergency, transit, and rail operations.
- 219.4 collect and disseminate asset restriction information levied on transportation asset usage based on infrastructure design, surveys, tests, or analyses. This includes standard facility design height, width, and weight restrictions, special restrictions such as spring weight restrictions, and temporary facility restrictions that are imposed during maintenance and construction.
- 219.5 exchange information with administrative systems to support the planning and scheduling of maintenance and construction activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract
- 219.6 exchange rail schedules and work plans with rail operations centers.

220 MCM Work Zone Management

- 220.1 generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes.
- 220.2 control the collection of work zone status information including video images from cameras located in or near the work zone.
- 220.3 disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.
- 220.4 control traffic in work zones by providing remote control of dynamic message signs and highway advisory radio systems located in or near the work zone.
- 220.5 exchange information with administrative systems to support the planning and scheduling of work zone activities. This information includes: equipment and

consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract

Stakeholder : VDOT NOVA District

Element : VDOT NOVA Safety Service Patrol

This system shall :

14 Emergency Call-Taking

- 14.1 support the interface to the Emergency Telecommunications System (e.g. 911 or 7-digit call routing) to receive emergency notification information and provide it to the emergency system operator.
- 14.2 receive emergency call information from 911 services and present the possible incident information to the emergency system operator.
- 14.5 receive emergency notification information from other public safety agencies and present the possible incident information to the emergency system operator.
- 14.6 receive emergency notification information from public transit systems and present the possible incident information to the emergency system operator.

15 Emergency Dispatch

- 15.1 dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- 15.2 store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.
- 15.9 receive traffic information, including closures, traffic conditions, etc. from traffic management centers.
- 15.12 coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.

16 Emergency Response Management

- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.

251 Emergency Routing

- 251.5 provide the capability to request special traffic control measures from the traffic management center to facilitate emergency vehicle progress along the suggested route.
- 251.6 Once the route is calculated the route shall be provided to the dispatch function.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.4 share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.
- 252.5 assess the status of responding emergency vehicles as part of an incident command.

Stakeholder : VDOT NOVA District

Element : VDOT NOVA Smart Traffic Center (STC)

This system shall :

6 Collect Traffic Surveillance

- 6.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.
- 6.2 monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.
- 6.3 monitor, analyze, and store pedestrian sensor data collected from field elements under remote control of the center.
- 6.4 monitor, analyze, and distribute pedestrian images from CCTV systems under remote control of the center.
- 6.5 monitor, analyze, and store multimodal crossing and high occupancy vehicle (HOV) lane sensor data under remote control of the center.
- 6.6 maintain a database of surveillance and sensors and the freeways, surface street and rural roadways, e.g. where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network.
- 6.7 support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.
- 6.8 distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.
- 6.9 respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.
- 253.5 provide evacuation information to traffic, transit, maintenance and construction, rail operations, and other emergency management centers as needed.
- 253.6 request resources from transit agencies as needed to support the evacuation.
- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.
- 253.9 monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.
- 253.10 monitor the progress of the reentry process.
- 253.11 submit evacuation information to toll administration centers along with requests for changes in the toll services or fee collection during an evacuation.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.4 develop, coordinate with other agencies, and store emergency response plans.
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- 16.6 allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
- 16.7 receive event scheduling information from Event Promoters.
- 16.8 receive hazardous materials incident information from commercial fleet operators.
- 16.12 provide information to the media concerning the status of an emergency response.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.
- 252.4 share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.
- 252.5 assess the status of responding emergency vehicles as part of an incident command.

28 Interactive Infrastructure Information

- 28.1 collect, process, store, and disseminate customized traffic and highway condition information to travelers, including incident information, detours and road closures, recommended routes, and current speeds on specific routes upon request.
- 28.2 collect, process, store, and disseminate customized maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities upon request.
- 28.4 collect, process, store, and disseminate customized parking information to travelers, including location, availability, and fees upon request.
- 28.10 provide all traveler information based on the traveler's current location or a specific location identified by the traveler, and filter or customize the provided information
- 28.14 provide the capability to exchange information with another traveler information service provider current or predicted data for road links that are outside the area served by the local supplier.

82 TMC Freeway Management

- 82.1 remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls.
- 82.2 collect operational status from ramp meters, mainline metering, and lane controls and compare against the control information sent by the center.
- 82.3 collect fault data from ramp meters, mainline metering, and lane controls.

- 82.4 implement control strategies, under control of center personnel, on some or all of the freeway network devices (e.g. ramp meters, mainline metering, and lane controls), based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the ramps themselves.

83 TMC HOV Lane Management

- 83.3 remotely control freeway control devices, such as ramp signals and mainline metering and other systems associated with freeway operations that control use of HOV lanes.
- 83.4 collect traffic flow measures and information regarding vehicle occupancy (i.e., lane usage) in HOV lanes.

84 TMC Incident Detection

- 84.2 collect and store traffic flow and image data from the field equipment to detect and verify incidents.
- 84.3 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, and intermodal freight depots.
- 84.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 84.6 provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.
- 84.7 provide video and traffic sensor control commands to the field equipment to detect and verify incidents.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 85.5 respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.
- 85.6 receive inputs concerning upcoming events that would effect the traffic network from event promoters, traveler information service providers, media, and rail operations
- 85.7 provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.
- 85.8 exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.
- 85.9 coordinate information and controls with other traffic management centers.
- 85.10 receive inputs from emergency management and transit management centers to develop

an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.

89 TMC Regional Traffic Control

- 89.1 exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
- 89.2 exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).

94 TMC Traffic Information Dissemination

- 94.1 remotely control dynamic messages signs for dissemination of traffic and other information to drivers.
- 94.2 remotely control driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.
- 94.3 collect operational status for the driver information systems equipment (DMS, HAR, etc.).
- 94.4 collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.
- 94.5 retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.
- 94.6 distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.
- 94.7 distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.

95 TMC Traffic Network Performance Evaluation

- 95.1 monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.
- 95.2 collect wide-area pollution data from emissions management centers to support overall network performance evaluations.

239 TMC Work Zone Traffic Management

- 239.4 collect operational status for the driver information systems equipment in work zones.
- 239.6 receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback to the sending center.

135 Traffic and Roadside Data Archival

- 135.1 manage the collection of archive data directly from collection equipment located at the roadside.
- 135.2 collect traffic sensor information from roadside devices.
- 135.3 collect environmental sensor information that from roadside devices.
- 135.4 respond to requests from the Archive Data Administer to input the parameters that control the collection process.
- 135.5 send the request for data and control parameters to the field equipment where the information is collected and returned.
- 135.6 record the status about the imported traffic and roadside data.
- 135.7 use the status information to adjust the collection of traffic and roadside data.

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.
- 128.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 128.3 receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.
- 128.4 be able to produce sample products of the data available.

98 Traffic Maintenance

- 98.1 collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.
- 98.2 collect and store CCTV surveillance system (traffic, pedestrian) operational status.
- 98.3 collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.
- 98.4 collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.
- 98.7 exchange data with maintenance centers concerning the reporting of faulty equipment and the schedule/status of their repair. Information exchanged includes details of new equipment faults, and clearances when the faults are cleared.

Stakeholder : VDOT NOVA District

Element : VDOT NOVA STSS

This system shall :

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.4 develop, coordinate with other agencies, and store emergency response plans.
- 16.6 allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
- 16.10 provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.
- 16.11 assimilate the status of the transit, traffic, rail, maintenance, and other emergency center services and systems to create an overall transportation system status, and disseminate to each of these centers and the traveling public via traveler information providers.
- 16.12 provide information to the media concerning the status of an emergency response.

23 HRI Traffic Management

- 23.1 remotely control highway-rail intersection (HRI) equipment located in the field.
- 23.2 accept collect highway-rail intersection (HRI) advisory or alert data from rail operations centers.
- 23.5 collect incident information related to a highway-rail intersection (HRI), such as intersection blockages or crashes or equipment malfunctions.

- 23.6 implement control plans to coordinate signalized intersections around highway-rail intersections (HRI), under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, equipment faults, pedestrian crossings, etc.

252 Incident Command

- 252.1 provide tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders to support local management of an incident.
- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.
- 252.4 share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.
- 252.5 assess the status of responding emergency vehicles as part of an incident command.

55 Rail Operations Coordination

- 55.1 exchange highway-rail intersection (HRI) information with rail operations centers. This information may include event schedules, requests for information from the Rail Operators, incident notification based on rail operations messages, and priority messages like notifications of a HAZMAT spill, equipment failure, or an intersection blockage.
- 55.2 receive highway-rail intersection (HRI) maintenance schedules, train schedules, and incident notifications from rail operations centers.
- 55.3 use the rail operations information to develop forecast HRI closure times and durations which may be applied in advanced traffic control strategies or delivered as enhanced traveler information.

89 TMC Regional Traffic Control

- 89.1 exchange traffic information with other traffic management centers, includes incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.
- 89.2 exchange traffic control information with other traffic management centers, includes remote monitoring and control of traffic management devices (e.g. signs, sensors, signals, cameras, etc.).

92 TMC Signal Control

- 92.1 remotely control traffic signal controllers.
- 92.2 accept notifications of right-of-way requests from pedestrians.
- 92.3 collect traffic signal controller operational status and compare against the control information sent by the center.
- 92.4 collect traffic signal controller fault data from the field.
- 92.5 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.

94 TMC Traffic Information Dissemination

- 94.1 remotely control dynamic messages signs for dissemination of traffic and other information to drivers.
- 94.5 retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder

use, weight restrictions, width restrictions, HOV requirements), etc.

- 94.6 distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.
- 94.7 distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.
- 94.8 provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.

128 Traffic Data Collection

- 128.1 collect traffic management data such as operational data, event logs, etc.
- 128.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 128.3 receive and respond to requests from ITS Archives for either a catalog of the traffic data or for the data itself.
- 128.4 be able to produce sample products of the data available.

98 Traffic Maintenance

- 98.1 collect and store sensor (traffic, pedestrian, multimodal crossing) operational status.
- 98.2 collect and store CCTV surveillance system (traffic, pedestrian) operational status.
- 98.3 collect and store sensor (traffic, pedestrian, multimodal crossing) fault data and send to the maintenance center for repair.
- 98.4 collect and store CCTV surveillance system (traffic, pedestrian) fault data send to the maintenance center for repair.
- 98.5 collect environmental sensor operational status.

Stakeholder : Virginia Department of Transportation (VDOT)

Element : VDOT Mobility Data Store

This system shall :

122 Government Reporting Systems Support

- 122.1 provide data from an ITS archive to federal, state, or local government reporting systems.
- 122.2 provide the capability to select data from an ITS archive for use in government reports.
- 122.3 provide the capability to format data from an ITS archive suitable for input into government reports.
- 122.4 support requests for ITS archived data from Government Reporting Systems.
- 122.5 provide the applicable meta-data for any ITS archived data to satisfy government reporting system requests. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.

10 ITS Data Repository

- 10.1 collect data to be archived from one or more data sources.
- 10.4 include capabilities for performing quality checks on the incoming archived data.
- 10.6 include capabilities for archive to archive coordination.
- 10.7 support a broad range of archived data management implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a

123 On-Line Analysis and Mining

- 123.1 support the interface with Archive Data User Systems for requests for analysis of the archive data.
- 123.2 provide the capability to perform activities such as data mining, data fusion, summarizations, aggregations, and recreation from archive data. This may include multidimensional analysis, selective summarization and expansion of data details, and many other advanced analysis services.
- 123.3 receive the user's systems requests and develop the request to retrieve the data from the archive.

131 Virtual Data Warehouse Services

- 131.1 provide capabilities to access "in-place" data from geographically dispersed archives. These capabilities may include analysis, data fusion, or data mining.
- 131.2 coordinate information exchange with a local data warehouse.
- 131.4 support the collection of archived data from other archives on an as-needed basis. (This minimizes the need to duplicate the comprehensive set of data from the remote archives in the local data warehouse.)
- 131.5 use data collected from different archives to build a set of global schema including the data archive definitions for the local archive plus any archives known to the local archive.
- 131.6 provide the local archived data schema to other archive systems.

Stakeholder : Virginia State Police

Element : Mobile Unified Command Center (VA)

This system shall :

15 Emergency Dispatch

- 15.1 dispatch emergency vehicles to respond to verified emergencies and provide suggested routing under center personnel control.
- 15.2 store the current status of all emergency vehicles available for dispatch and those that have been dispatched.
- 15.3 relay location and incident details to the responding vehicles.
- 15.4 provide the capability to request traffic control measures from traffic management centers such as signal preemption, traffic barriers and road closures.
- 15.5 track the location and status of emergency vehicles responding to an emergency and update the incident status based on information from the emergency vehicle.
- 15.7 store and maintain the emergency service responses in an action log.
- 15.8 receive asset restriction information from maintenance centers to support the dispatching of appropriate emergency resources.
- 15.9 receive traffic information, including closures, traffic conditions, etc. from traffic management centers.
- 15.12 coordinate response to incidents with other Emergency Management centers to ensure appropriate resources are dispatched and utilized.

253 Emergency Evacuation Support

- 253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.
- 253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.
- 253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.

- 253.7 request traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes.
- 253.9 monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.
- 253.10 monitor the progress of the reentry process.

16 Emergency Response Management

- 16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.
- 16.2 manage coordinated inter-agency responses to and recovery from large-scale emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
- 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
- 16.6 allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
- 16.8 receive hazardous materials incident information from commercial fleet operators.
- 16.10 provide the capability to request transit resource availability from transit centers for use during disaster and evacuation operations.
- 16.11 assimilate the status of the transit, traffic, rail, maintenance, and other emergency center services and systems to create an overall transportation system status, and disseminate to each of these centers and the traveling public via traveler information providers.

251 Emergency Routing

- 251.1 collect current traffic and road condition information from traffic management centers for emergency vehicle route calculation.
- 251.3 calculate emergency vehicle routes based on information from traffic management and maintenance centers.
- 251.4 In special circumstances such as during disasters and evacuations when normal routes are not available, the center shall request a route from the traffic management center.
- 251.5 provide the capability to request special traffic control measures from the traffic management center to facilitate emergency vehicle progress along the suggested route.

252 Incident Command

- 252.2 provide incident command communications with public safety, emergency management, transportation, and other allied response agency centers.
- 252.3 track and maintain resource information and action plans pertaining to the incident command.
- 252.4 share incident command information with other public safety agencies including resource deployment status, hazardous material information, rail incident information, evacuation advice as well as traffic, road, and weather conditions.
- 252.5 assess the status of responding emergency vehicles as part of an incident command.

34 Mayday Support

- 34.6 support the activation of remote controlled functions requested by a vehicle, such as requests to unlock doors.
- 34.7 request additional emergency details from or issue commands to the vehicle's security systems or vehicle driver if needed.

236 Service Patrol Management

- 236.1 dispatch roadway service patrol vehicles to identified incident locations.
- 236.4 track the location and status of service patrol vehicles.

82 TMC Freeway Management

- 82.1 remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls.
- 82.4 implement control strategies, under control of center personnel, on some or all of the freeway network devices (e.g. ramp meters, mainline metering, and lane controls), based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the ramps themselves.

83 TMC HOV Lane Management

- 83.1 remotely control sensors to detect high-occupancy vehicle (HOV) lane usage.
- 83.2 remotely control driver information systems to notify users of lane status for lanes that become HOV or High Occupancy Toll (HOT) lanes during certain times of the day on freeways.
- 83.3 remotely control freeway control devices, such as ramp signals and mainline metering and other systems associated with freeway operations that control use of HOV lanes.
- 83.5 monitor the use of HOV lanes and detect vehicles that do not have the required number of occupants.

85 TMC Incident Dispatch Coordination/Communication

- 85.1 exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.
- 85.2 coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.
- 85.3 support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.
- 85.4 exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.
- 85.5 respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.
- 85.9 coordinate information and controls with other traffic management centers.

92 TMC Signal Control

- 92.1 remotely control traffic signal controllers.
- 92.2 accept notifications of right-of-way requests from pedestrians.
- 92.5 implement control plans to coordinate signalized intersections, under control of center personnel, based on data from sensors and surveillance monitoring traffic conditions, incidents, emergency vehicle preemptions, the passage of commercial vehicles with unusual loads, equipment faults, pedestrian crossings, etc.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA ADMS

This system shall :

10 ITS Data Repository

- 10.1 collect data to be archived from one or more data sources.
- 10.2 collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data; e.g., time range of entries, number of entries; or a sample of the data (e. g. a thumbnail).
- 10.3 store the archived data in a focused repository that is suited to a particular set of ITS data users.
- 10.4 include capabilities for performing quality checks on the incoming archived data.
- 10.6 include capabilities for archive to archive coordination.

131 Virtual Data Warehouse Services

- 131.2 coordinate information exchange with a local data warehouse.
- 131.4 support the collection of archived data from other archives on an as-needed basis. (This minimizes the need to duplicate the comprehensive set of data from the remote archives in the local data warehouse.)
- 131.6 provide the local archived data schema to other archive systems.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Bus Operations Control Center (BOCC)

This system shall :

99 Transit Center Fare and Load Management

- 99.1 manage the actual value of transit fares for each segment of each regular transit route, including the transmission of the information to transit vehicles and transit stops or
- 99.2 provide the capability for a system operator to manage the transit fares and control the exchange of transit fare information.
- 99.3 process the financial requests from the transit vehicles or roadside and manage an interface to a Financial Institution.
- 99.4 support the payment of transit fare transactions using data provided by the traveler cards / payment instruments.
- 99.5 collect data on fare payment violations and send the data, including images of the violator, to the appropriate enforcement agency.
- 99.6 process requests for transit fares to be paid in advance.
- 99.7 process requests for the advanced payment of tolls and parking lot charges as well as other non-transportation services, e.g. yellow-pages services.
- 99.8 be capable of establishing emergency fare structures to override all other fares during disasters, states of emergency, or evacuations.
- 99.9 maintain a list of invalid traveler credit identities, or bad tag lists that can be forwarded to transit vehicles and transit stops or stations.
- 99.10 collect passenger loading and fare statistics data to implement variable and flexible fare structures.
- 99.11 exchange fare and load information with other transit management centers, including potential Centralized Payments facilities.
- 99.12 provide transit fare information to other centers, including traveler information providers

upon request.

100 Transit Center Fixed-Route Operations

- 100.1 generate transit routes and schedules based on such factors as parameters input by the system operator, road network conditions, operational data on current routes and schedules, and digitized map data.
- 100.2 provide the interface to the system operator to control the generation of new routes and schedules (transit services) including the ability to review and update the parameters used by the routes and schedules generation processes and to initiate these processes
- 100.3 be able to generate special routes and schedules to support an incident, disaster, evacuation, or other emergency.
- 100.4 accept requests from traffic management to change routes and schedules as part of the implementation of demand management strategies.
- 100.5 collect transit operational data for use in the generation of routes and schedules.
- 100.6 assign transit vehicle operators based on factors such as eligibility, route preferences, seniority, and transit vehicle availability.
- 100.7 manage large deviations of individual transit vehicles, deviations in rural areas, and deviations of large numbers of vehicles.
- 100.8 generate the necessary corrective actions which may involve more than the vehicles concerned and more far reaching action, such as, the introduction of extra vehicles, wide area signal priority by traffic management, the premature termination of some services,
- 100.9 exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.
- 100.10 disseminate up-to-date schedules and route information to other centers for fixed and flexible route services.

101 Transit Center Information Services

- 101.1 provide travelers using public transportation with traffic and advisory information upon request. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.
- 101.2 provide transit information to the media including details of deviations from schedule of regular transit services.
- 101.3 exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems.
- 101.4 provide transit service information to traveler information service providers including routes, schedules, schedule adherence, and fare information as well as transit service information during evacuation.
- 101.5 enable yellow pages (including non-motorized transportation) information to be output to the traveler.
- 101.6 broadcast transit advisory data, including alerts and advisories pertaining to major emergencies, or man made disasters.

102 Transit Center Multi-Modal Coordination

- 102.1 analyze transit vehicle schedule performance to determine the need for priority along certain routes or at certain intersections.
- 102.2 send requests for priority along routes or at intersections to traffic management.
- 102.3 coordinate schedules and services between transit agencies, traffic management, maintenance and construction operations, parking management, and other surface or air transportation modes.
- 102.4 share transfer cluster and transfer point information with multimodal transportation

service providers, other transit agencies, and traveler information service providers. A transfer cluster is a collection of stops, stations, or terminals where transfers can be made conveniently.

103 Transit Center Paratransit Operations

- 103.1 process trip requests for demand responsive transit services, i.e. paratransit. Sources of the requests may include traveler information service providers.
- 103.2 track the location and availability of transit vehicles for use in demand responsive transit (paratransit) operations.
- 103.3 generate demand responsive transit (paratransit) routes and schedules based on such factors as parameters input by the system operator, what other demand responsive transit schedules have been planned, the availability and location of vehicles, the relevance of any fixed transit routes and schedules, and road network information.
- 103.4 assign transit vehicle operators for confirmed demand responsive transit (paratransit) trips based on factors such as eligibility, route preferences, seniority, and transit vehicle availability.
- 103.5 exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.
- 103.6 disseminate up-to-date schedules and route information to other centers for demand responsive transit services (paratransit).

104 Transit Center Security

- 104.1 monitor transit vehicle operational data to determine if the transit vehicle is off-route and assess whether a security incident is occurring.
- 104.2 receive reports of emergencies on-board transit vehicles entered directly by the transit vehicle operator or from a traveler through interfaces such as panic buttons or alarm switches.
- 104.3 support the back-office portion of functionality to authenticate transit vehicle operators.
- 104.4 exchange transit incident information along with other service data with other transit agencies.
- 104.6 send wide-area alert information to travelers (on-board transit vehicles or at stations/stops) and transit vehicle operators.
- 104.7 coordinate the response to security incidents involving transit with other agencies including Emergency Management, other transit agencies, media, traffic management, and traveler information service providers.
- 104.8 receive threat information and status on the integrity of the transit infrastructure.
- 104.9 provide support to remotely disable (or reset the disabling of) a transit vehicle in service.

105 Transit Center Tracking and Dispatch

- 105.1 monitor the locations of all transit vehicles within its network.
- 105.2 determine adherence of transit vehicles to their assigned schedule.
- 105.3 collect trip monitoring data from on-board systems including transit vehicle mileage, fuel usage, passenger loading, availability, etc.
- 105.4 provide transit operational data to traveler information service providers.

132 Transit Data Collection

- 132.1 collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.
- 132.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.

- 132.3 receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.
- 132.4 be able to produce sample products of the data available.

256 Transit Evacuation Support

- 256.1 manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.
- 256.2 coordinate regional evacuation plans with Emergency Management - identifying the transit role in an evacuation and the transit resources that would be used.
- 256.3 coordinate the use of transit and school bus fleets during an evacuation, supporting evacuation of those with special needs and the general population.
- 256.4 adjust and update transit service and fare schedules and provide that information to other agencies as they coordinate evacuations.

106 Transit Garage Maintenance

- 106.1 collect operational and maintenance data from transit vehicles.
- 106.2 monitor the condition of a transit vehicle to analyze brake, drive train, sensors, fuel, steering, tire, processor, communications equipment, and transit vehicle mileage to identify mileage based maintenance, out-of-specification or imminent failure conditions.
- 106.3 generate transit vehicle maintenance schedules, includes what and when the maintenance or repair is to be performed.
- 106.4 generate transit vehicle availability listings, current and forecast, to support transit vehicle assignment planning based, in part, on the transit vehicle maintenance
- 106.5 assign technicians to a transit vehicle maintenance schedule, based upon such factors as personnel eligibility, work assignments, preferences and seniority.
- 106.6 verify that the transit vehicle maintenance activities were performed correctly, using the transit vehicle's status, the maintenance personnel's work assignment, and the transit maintenance schedules.
- 106.7 generate a time-stamped maintenance log of all maintenance activities performed on a transit vehicle.
- 106.8 provide the transit system operator with the capability to update transit vehicle maintenance information and receive reports on all transit vehicle operations data.

107 Transit Garage Operations

- 107.1 maintain records of a transit vehicle operator's performance. This may be done utilizing standardized performance evaluation criteria set forth by governmental regulations and transit operating company policies, assessing the transit vehicle operator's driving history, and assessing comments from the transit vehicle operator's supervisor(s) as well as noting any moving violations or accidents, supervisor comments, government regulations, and company policies.
- 107.2 assess the transit vehicle operator's availability based on previous work assignments, accumulated hours, plus health and vacation commitments.
- 107.3 assign transit vehicle operators to transit schedules based on their eligibility, route preferences, seniority, and transit vehicle availability.
- 107.4 provide an interface through which the transit vehicle operator information can be maintained - either from the transit vehicle operator, a transit system operator (i.e. center personnel), or other functions.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Customer Services Center (CSVS)/Trip Planning System/e-alerts/Elevator status report/Consumer Assistant Tracking System

This system shall :**26 Infrastructure Provided Route Selection**

- 26.1 provide the capability to provide specific pre-trip and enroute directions to travelers (and drivers), including costs, arrival times, and transfer points.
- 26.2 include bicycle routes, walkways, skyways, and multi-use trails in the pre-trip and enroute directions it provides to travelers.
- 26.3 support on-line route guidance for travelers using personal devices (such as PDAs).
- 26.7 generate route plans based on transit services, including fares, schedules, and requirements for travelers with special needs.

28 Interactive Infrastructure Information

- 28.2 collect, process, store, and disseminate customized maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities upon request.
- 28.3 collect, process, store, and disseminate customized transit routes and schedules, transit transfer options, transit fares, and real-time schedule adherence information to travelers upon request.
- 28.4 collect, process, store, and disseminate customized parking information to travelers, including location, availability, and fees upon request.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Emergency Operations Center(Command Center)/Transit Police (MTPD) Operations Control Center

This system shall :**278 Center Secure Area Alarm Support**

- 278.1 collect silent and audible alarms received from travelers in secure areas (such as transit stops, rest areas, park and ride lots, modal interchange facilities).
- 278.2 collect silent and audible alarms received from transit vehicles, originated by the traveler or the transit vehicle operator.
- 278.3 After the alarm message has been received, the center shall generate an alarm acknowledgment to the sender.
- 278.4 After the alarm message becomes a verified incident, the center shall determine the appropriate response.
- 278.5 determine whether the alarm message indicates an emergency that requires the attention of public safety agencies, and forward alarm message data to the appropriate agency as necessary.
- 278.6 forward the alarm message to center personnel and respond to the traveler or transit vehicle operator as directed by the personnel.

265 Center Secure Area Sensor Management

- 265.1 remotely monitor and control security sensor data collected in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways). The types of security sensor data include environmental threat (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), infrastructure condition and integrity, intrusion and motion, and object detection sensors. The data may be raw or pre-processed in the field.
- 265.2 remotely monitor and control security sensor data collected in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers). The types of security sensor data include environmental threat (e.g. chemical agent,

- toxic industrial chemical, biological, explosives, and radiological sensors), intrusion and motion, and object detection sensors. The data may be raw or pre-processed in the field.
- 265.3 remotely monitor and control security sensor data collected on-board transit vehicles. The types of security sensor data include environmental threat (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors. The data may be raw or pre-processed in the field.
 - 265.4 exchange security sensor data with other emergency centers.
 - 265.5 identify potential security threats based on collected security sensor data.
 - 265.6 verify potential security threats by correlating security sensor data from multiple sources.
 - 265.7 perform threat analysis based on correlations of security sensor and surveillance data.
 - 265.8 exchange threat analysis data with Alerting and Advisory Systems and use that data in local threat analysis processing.
 - 265.9 disseminate threat information to other agencies, including traffic, transit, maintenance, rail operations, and other emergency management centers.
 - 265.10 respond to control data from center personnel regarding security sensor data collection, processing, threat detection, and threat analysis.

247 Center Secure Area Surveillance

- 247.1 remotely monitor video images and audio surveillance data collected in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways). The data may be raw or pre-processed in the field.
- 247.2 remotely monitor video images and audio surveillance data collected in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers). The data may be raw or pre-processed in the field.
- 247.3 remotely monitor video images and audio surveillance data collected on-board transit vehicles. The data may be raw or pre-processed in the field.
- 247.4 exchange surveillance data with other emergency centers.
- 247.5 identify potential security threats based on collected security surveillance data.
- 247.6 verify potential security threats by correlating security surveillance data from multiple sources.
- 247.7 remotely control security surveillance devices in secure areas including facilities (e.g. transit yards) and transportation infrastructure (e.g. bridges, tunnels, interchanges, roadway infrastructure, and transit railways or guideways).
- 247.8 remotely control security surveillance devices in traveler secure areas, which include transit stations, transit stops, rest areas, park and ride lots, and other fixed sites along travel routes (e.g., emergency pull-off areas and travel information centers).
- 247.9 remotely control security surveillance devices on-board transit vehicles.
- 247.11 exchange traveler images with other emergency management centers to support traveler image matching.

133 Emergency Data Collection

- 133.1 collect emergency service data, emergency vehicle management data, emergency vehicle data, sensor and surveillance data, threat data, and incident data.
- 133.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 133.3 receive and respond to requests from ITS Archives for either a catalog of the emergency

management data or for the data itself.

133.4 be able to produce sample products of the data available.

257 Emergency Early Warning System

257.1 monitor information from Alerting and Advisory Systems such as the Information Sharing and Analysis Centers (ISACs), the National Infrastructure Protection Center (NIPC), the Homeland Security Advisory System (HSAS), etc. The information may include assessments (general incident and vulnerability awareness information), advisories (identification of threats or recommendations to increase preparedness levels), or alerts (information on imminent or in-progress emergencies).

257.2 provide the capability to correlate alerts and advisories, incident information, and security sensor and surveillance data.

257.4 broadcast wide-area alerts and advisories to transit management centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and

257.7 broadcast wide-area alerts and advisories to maintenance centers for emergency situations such as severe weather events, civil emergencies, child abduction (AMBER alert system), military activities, and other situations that pose a threat to life and

257.9 process status information from each of the centers that have been sent the wide-area

257.11 receive incident information from other transportation management centers to support the early warning system.

257.13 support the entry of alert and advisory information directly from the emergency system operator.

241 Emergency Environmental Monitoring

241.1 collect current and forecast road and weather information from weather service providers (such as the National Weather Service and value-added sector specific meteorological services).

253 Emergency Evacuation Support

253.1 manage inter-agency coordination of evacuation operations, from initial planning through the evacuation process and reentry.

253.2 develop and exchange evacuation plans with allied agencies prior to the occurrence of a disaster.

253.3 provide an interface to the emergency system operator to enter evacuation plans and procedures and present the operator with other agencies' plans.

253.4 coordinate evacuation destinations and shelter needs with shelter providers (e.g., the American Red Cross) in the region.

253.6 request resources from transit agencies as needed to support the evacuation.

253.8 provide traveler information systems with evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary and when it is safe to return.

253.9 monitor the progress or status of the evacuation once it begins and exchange tactical plans, prepared during the incident, with allied agencies.

253.10 monitor the progress of the reentry process.

253.11 submit evacuation information to toll administration centers along with requests for changes in the toll services or fee collection during an evacuation.

16 Emergency Response Management

16.1 provide strategic emergency response capabilities such as that of an Emergency Operations Center for large-scale incidents and disasters.

16.2 manage coordinated inter-agency responses to and recovery from large-scale

- emergencies. Such agencies include traffic management, transit, maintenance and construction management, rail operations, and other emergency management agencies.
- 16.3 provide the capability to implement response plans and track progress through the incident by exchanging incident information and distributing response status to allied
 - 16.4 develop, coordinate with other agencies, and store emergency response plans.
 - 16.5 track the availability of resources (including vehicles, roadway cleanup?, etc.), request additional resources from traffic, maintenance, or other emergency centers if needed.
 - 16.6 allocate the appropriate emergency services, resources, and vehicle (s) to respond to incidents, and shall provide the capability to override the current allocation to suit the special needs of a current incident.
 - 16.11 assimilate the status of the transit, traffic, rail, maintenance, and other emergency center services and systems to create an overall transportation system status, and disseminate to each of these centers and the traveling public via traveler information providers.
 - 16.12 provide information to the media concerning the status of an emergency response.
 - 16.14 provide the capability for center personnel to provide inputs to the management of incidents, disasters and evacuations.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Fare Collection

This system shall :

59 Remote Transit Fare Management

- 59.1 accept and process current transit passenger fare collection information.
- 59.2 calculate a fare based on the origin and destination provided by the traveler, in conjunction with transit routing, transit fare category, and transit user history.
- 59.3 provide an interface to a transit user traveler card in support of payment for transit fares, tolls, and/or parking lot charges. The stored credit value data from the card shall be collected and updated based on the fare or other charges, or the credit identity shall be collected.
- 59.4 provide information to the center for financial authorization and transaction processing.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Paratransit (MetroAccess, MACS) Management Center

This system shall :

103 Transit Center Paratransit Operations

- 103.1 process trip requests for demand responsive transit services, i.e. paratransit. Sources of the requests may include traveler information service providers.
- 103.2 track the location and availability of transit vehicles for use in demand responsive transit (paratransit) operations.
- 103.3 generate demand responsive transit (paratransit) routes and schedules based on such factors as parameters input by the system operator, what other demand responsive transit schedules have been planned, the availability and location of vehicles, the relevance of any fixed transit routes and schedules, and road network information.
- 103.4 assign transit vehicle operators for confirmed demand responsive transit (paratransit) trips based on factors such as eligibility, route preferences, seniority, and transit vehicle availability.
- 103.5 exchange information with Maintenance and Construction Operations concerning work zones, roadway conditions, asset restrictions, work plans, etc.

- 103.6 disseminate up-to-date schedules and route information to other centers for demand responsive transit services (paratransit).

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Parking Management Center

This system shall :

138 Parking Coordination

- 138.1 The parking element shall exchange parking management data with other parking facilities including location, hours, availability, status, lot usage, operating strategies, and charging information.
- 138.2 The parking element shall provide parking management data to traffic management centers upon request as part of the implementation of demand management programs in the region. This could include changes to hours of operation or pricing.

134 Parking Data Collection

- 134.1 The parking element shall collect parking management data including lot usage and charging information.
- 134.2 The parking element shall assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 134.3 The parking element shall receive and respond to requests from ITS Archives for either a catalog of the parking management data or for the data itself.
- 134.4 The parking element shall be able to produce sample products of the data available.

136 Parking Electronic Payment

- 136.2 The parking element shall read data from the traveler card / payment instrument carried on-board the vehicle (tag) or by the traveler.
- 136.5 The parking element shall manage the parking lot charges, considering such factors as location, vehicle types, and times of day.
- 136.7 The parking element shall support the payment of parking lot transactions using data provided by the traveler cards / payment instruments.

49 Parking Management

- 49.1 The parking element shall maintain parking lot information including static information such as hours of operation, rates, location, entrance locations, capacity, type, and constraints; as well as dynamic information such as current state of the lot, occupancy, arrival rates, and departure rates.
- 49.2 The parking element shall distribute parking lot information upon request to traffic management centers, transit management centers for park and ride facilities, and to traveler information providers.
- 49.3 The parking element manage local dynamic message signs that display messages to travelers such as the parking lot state, number of spaces available, location of entrances, and current charges.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Passenger Information Display System (PIDS-for Rail passengers)

This system shall :

56 Remote Basic Information Reception

- 56.2 receive transit information from a center and present it to the traveler.
- 56.4 This public interface for travelers shall receive evacuation information from a center and present it to the traveler.

- 56.5 receive wide-area alerts and present it to the traveler.
- 56.7 support traveler input in audio or manual form.
- 56.8 present information to the traveler in audible or visual forms consistent with a kiosk, including those that are suitable for travelers with hearing or vision physical disabilities.

57 Remote Interactive Information Reception

- 57.2 receive transit information from a center and present it to the traveler upon request.
- 57.4 receive event information from a center and present it to the traveler upon request.
- 57.8 support payment for services, such as confirmed trip plans, confirmed yellow pages services, tolls, transit fares, parking lot charges, and advanced payment for tolls.
- 57.9 provide an interface through which credit identities and stored credit values may be collected from tags, traveler cards, or payment instruments used by travelers.
- 57.13 present information to the traveler in audible or visual forms consistent with a kiosk, including those that are suitable for travelers with hearing or vision physical disabilities.

59 Remote Transit Fare Management

- 59.1 accept and process current transit passenger fare collection information.
- 59.2 calculate a fare based on the origin and destination provided by the traveler, in conjunction with transit routing, transit fare category, and transit user history.
- 59.3 provide an interface to a transit user traveler card in support of payment for transit fares, tolls, and/or parking lot charges. The stored credit value data from the card shall be collected and updated based on the fare or other charges, or the credit identity shall be collected.
- 59.4 provide information to the center for financial authorization and transaction processing.
- 59.7 create passenger loading and fare statistics data based upon data collected at a transit stop.
- 59.8 present information to the traveler in a form suitable for travelers with physical disabilities.

60 Remote Transit Information Services

- 60.1 collect and provide real-time travel-related information at transit stops, multi-modal transfer points, and other public transportation areas.
- 60.2 collect and present to the transit traveler information on transit routes, schedules, and real-time schedule adherence.
- 60.3 provide support for general annunciation and/or display of imminent arrival information and other information of general interest to transit users.
- 60.4 present information to the traveler in a form suitable for travelers with physical disabilities.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Rail Operations Control Center(ROCC)/WMATA Passenger Operations(PassOPS)/Maintenance Operations Control(MOC)

This system shall :

142 MCM Maintenance Decision Support

- 142.3 provide an interface to the center personnel to input control parameters for the decision support process and receive decisions or information presentation.
- 142.4 provide dispatch information to maintenance and construction vehicles based on the outputs of the decision support system, including recommended roadway treatment

219 MCM Work Activity Coordination

- 219.2 provide status information about scheduled maintenance and construction activities including anticipated closures and impact to the roadway, alternate routes, anticipated delays, closure times, and durations. The information is provided to other management centers such as traffic, emergency, transit, traveler information providers, other maintenance centers, multimodal transportation providers, rail operations, and the
- 219.5 exchange information with administrative systems to support the planning and scheduling of maintenance and construction activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract
- 219.6 exchange rail schedules and work plans with rail operations centers.

220 MCM Work Zone Management

- 220.1 generate new work zone activity schedules for use by maintenance and construction vehicles, maintenance and construction operators, and for information coordination purposes.
- 220.2 control the collection of work zone status information including video images from cameras located in or near the work zone.
- 220.3 disseminate work zone information to other agencies and centers including traffic, transit, emergency management centers, other maintenance centers, traveler information providers, and the media.
- 220.4 control traffic in work zones by providing remote control of dynamic message signs and highway advisory radio systems located in or near the work zone.
- 220.5 exchange information with administrative systems to support the planning and scheduling of work zone activities. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract

101 Transit Center Information Services

- 101.2 provide transit information to the media including details of deviations from schedule of regular transit services.
- 101.3 exchange transit schedules, real-time arrival information, fare schedules, and general transit service information with other transit organizations to support transit traveler information systems.
- 101.4 provide transit service information to traveler information service providers including routes, schedules, schedule adherence, and fare information as well as transit service information during evacuation.
- 101.6 broadcast transit advisory data, including alerts and advisories pertaining to major emergencies, or man made disasters.

105 Transit Center Tracking and Dispatch

- 105.4 provide transit operational data to traveler information service providers.

132 Transit Data Collection

- 132.1 collect transit management data such as transit fares and passenger use, transit services, paratransit operations, transit vehicle maintenance data, etc.
- 132.2 assign quality control metrics and meta-data to be stored along with the data. Meta-data may include attributes that describe the source and quality of the data and the conditions surrounding the collection of the data.
- 132.3 receive and respond to requests from ITS Archives for either a catalog of the transit data or for the data itself.
- 132.4 be able to produce sample products of the data available.

256 Transit Evacuation Support

- 256.1 manage the use of transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency.
- 256.2 coordinate regional evacuation plans with Emergency Management - identifying the transit role in an evacuation and the transit resources that would be used.
- 256.3 coordinate the use of transit and school bus fleets during an evacuation, supporting evacuation of those with special needs and the general population.
- 256.4 adjust and update transit service and fare schedules and provide that information to other agencies as they coordinate evacuations.

Stakeholder : Washington Metropolitan Area Transit Authority (WMATA)

Element : WMATA Transit Bus (BTRA)

This system shall :

42 On-board Paratransit Operations

- 42.2 receive the status of demand responsive or flexible-route transit schedules and passenger loading from the transit vehicle operator.

43 On-board Transit Fare and Load Management

- 43.1 detect embarking travelers on-board a transit vehicle and read data from the traveler card / payment instrument that they are carrying.
- 43.2 provide an image of all travelers which shall be used for violation processing of those who do not have a traveler card / payment instrument or whose transit fare transaction
- 43.4 calculate the traveler's fare based on the origin and destination provided by the traveler as well as factors such as the transit routing, transit fare category, traveler history, and route-specific information.
- 43.6 provide a transit fare payment interface that is suitable for travelers with physical

44 On-board Transit Information Services

- 44.1 enable traffic and travel advisory information to be requested and output to the traveler. Such information may include transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, and special events.
- 44.3 broadcast advisories about the imminent arrival of the transit vehicle at the next stop via an on-board automated annunciation system.

45 On-board Transit Security

- 45.1 perform video and audio surveillance inside of transit vehicles and output raw video or audio data for either local monitoring (for processing or direct output to the transit vehicle operator), remote monitoring or for local storage (e.g., in an event recorder).
- 45.11 receive acknowledgments of the emergency request from the center and output this acknowledgment to the transit vehicle operator or to the travelers.

45.14 perform authentication of the transit vehicle operator.

46 On-board Transit Signal Priority

46.1 determine the schedule deviation and estimated times of arrival (ETA) at transit stops.

46.2 send priority requests to traffic signal controllers at intersections, pedestrian crossings, and multimodal crossings on the roads (surface streets) and freeway (ramp controls) network that enable a transit vehicle schedule deviation to be corrected.

46.3 send the schedule deviation data and status of priority requests to the transit vehicle operator.

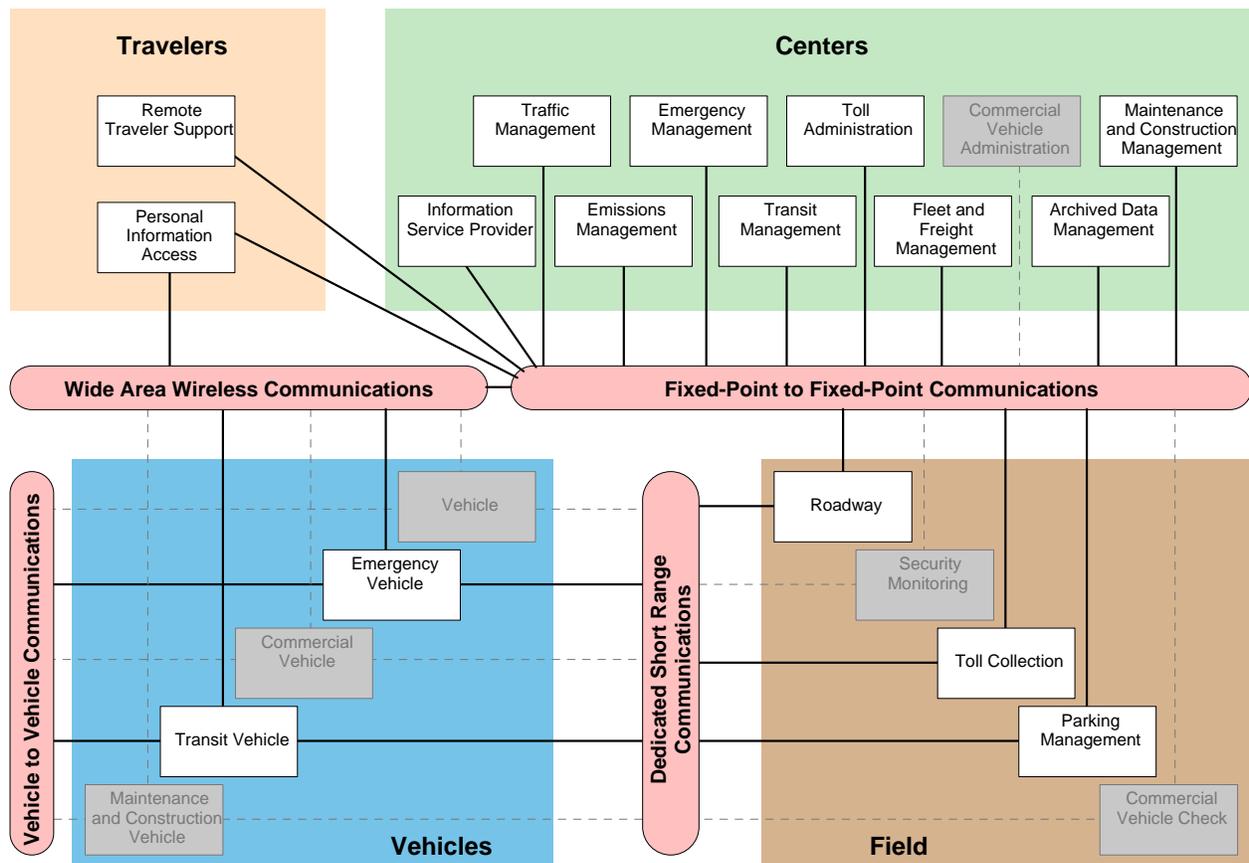
6.0 Regional Architecture

6.1 High Level Architecture

The ITS inventory, operational concept, and functional requirements lay the groundwork for evaluation of which ITS Systems should connect to each in the Metropolitan Washington Region (MWR). Based on this information and any documentation that may describe existing communications in the region, the interconnects and information flows were developed for the Metropolitan Washington region.

First of all, the MWR interconnects were mapped into the easy-to-understand National ITS “sausage diagram” format. The diagram depicts all of the ITS subsystems identified in the national ITS Architecture and the basic communication channel between them. Figure 6-1 shows the relevant subsystems identified in the MWR. The gray boxes are subsystems that are not part of the regions’ existing and planned deployment.

Figure 6-1. High-Level Architecture (“Sausage”) Diagram for the National Capital Region.



These subsystems include the major functional areas of Management Centers, Roadway Devices, Vehicles, and Personal Access. The data in these flows is carried by the architecture interconnects, or communications networks supporting ITS. These networks have been established as:

- **Fixed-Point-Fixed-Point Communication** : A communication link serving stationary entities. It may be implemented using a variety of public or private communication networks and technologies. It can include, but is not limited to, twisted pair, coaxial cable, fiber optic, microwave relay networks, spread spectrum, etc. In Fixed-Point to Fixed-Point (FP2FP) communication the important issue is that it serves stationary entities. Both dedicated and shared communication resources may be used.
- **Wide Area Wireless Communications** : A communications link that provides communications via a wireless device between a user and an infrastructure-based system. Both broadcast (one-way) and interactive (two-way) communications services are grouped into wide-area wireless communications in the National ITS Architecture. These links support a range of services in the National ITS Architecture including real-time traveler information and various forms of fleet communications.
- **Dedicated Short Range Communications** : A wireless communications channel used for close-proximity communications between vehicles and the immediate infrastructure. It supports location-specific communications for ITS capabilities such as toll collection, transit vehicle management, driver information, and automated commercial vehicle operations.
- **Vehicle To Vehicle Communications** : Dedicated wireless system handling high data rate, low probability of error, line of sight communications between vehicles. Advanced vehicle services may use this link in the future to support advanced collision avoidance implementations, road condition information sharing, and active coordination to advanced control systems.

6.2 Interconnect Matrix

A regional ITS architecture set of interconnects between ITS Systems in the region. Table 6-1 summarizes the regional ITS architecture interconnects.

6.3 Information Exchanges

Based on the interconnect , operational concept and functional requirements created in previous steps, the actual information content(information flow) exchanged on each interface were defined.

Detail interconnect and information interface requirement are provided in appendix C.

7.0 Agency Agreement

Agreements among the different stakeholder agencies and organizations are required to realize the integration proposed in the regional ITS architecture. Each connection between systems in the regional ITS architecture represents cooperation between stakeholders and potential requirement for an agreement. This doesn't mean that hundreds of connections in the architecture require hundreds of new agreements. One agreement may accomplish what is necessary to support many (or possible even all) of the interfaces identified in the architecture.

Typically, existing stakeholder agreements that support sharing of information, funding, or specific ITS projects can be extended to support include additional new requirements for corporation identified in the regional ITS architecture.

7.1 Types of Agreements

There is considerable variation between regions and among stakeholders regarding the type of agreements that are created to support ITS integration. Some common types of agreements as noted in table 7-1

Table 7-1 Agreement Type (from FHWA Regional ITS Architecture Guidance Document)

Type of Agreement	Description
Handshake Agreement	
	<ul style="list-style-type: none"> • Early agreement between one or more partners • Not recommended for long term operations.
Memorandum of Understanding	
	<ul style="list-style-type: none"> • Initial agreement used to provide minimal detail and usually demonstrating a general consensus.
	<ul style="list-style-type: none"> • Used to expand a more detailed agreement like a Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency.
	<ul style="list-style-type: none"> • May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement	
	<ul style="list-style-type: none"> • Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services or funding • Documents responsibility, functions and liability, at a minimum.

Type of Agreement	Description
Intergovernmental Agreement	<ul style="list-style-type: none"> • Between governmental agencies (<i>e.g., Agreements between universities and State DOT, MPOs and State DOT, etc.</i>)
Operational Agreement	<ul style="list-style-type: none"> • Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency. • Identifies respective responsibilities for all activities associated with shared systems being operated and/or maintained.
Funding Agreement	<ul style="list-style-type: none"> • Documents the funding arrangements for ITS projects (<i>and other projects</i>) • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	<ul style="list-style-type: none"> • Standard contract and/or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies. • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (<i>e.g., cities and counties</i>) to have one <i>Master Agreement</i> that uses smaller agreements (<i>e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.</i>) to modify or expand the boundaries of the larger agreement to include more specific language.

7.2 Agreement Focus

Rather than a focus on technology in early cooperative agreements, the focus should be on the scope-of-service and specific agency responsibilities for various components of the services. Describe the high-level information that each agency needs to exchange in order to meet the goals and expectations of other rather than defining how the delivery of that information will occur.

A simple handshake agreement may be enough for some Metropolitan Washington Region activities. However, once interconnections and integration of system begin, agencies may want to have some more substantial in place. A documented agreement will aid agencies in planning their operations costs, understanding their respective roles

and responsibilities, and build trust for future projects. Formal agreements are necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required.

7.3 List of Agreements Output

This output will be a list of required agreements, including both existing and planned agreements. Each list entry identifies the agreement title, the stakeholders involved, the type of agreement that is anticipated, high level status (existing or planned), and detailed and concise statement of the purpose of the agreement.

Table 7-2 summarizes agreement(s) in the region.

ITS Services	Involved Stakeholders	Type of Agreement	Status	Agreement Description
Traffic Operation	MDSHA, Montgomery County	N/A	Existing	MD SHA and Montgomery County executed a Management and Operations Coordination Agreement in June 2001. Additional agreements are anticipated to be made at the project level in the future.

Table 7-2 Agreements In the Region

8.0 ITS Standards to Consider

ITS standards are important for the following reasons:

- They have the potential to reduce capital and operating costs i.e. they can increase the benefit/cost ratio of technology;
- They increase flexibility i.e. offer plug and play capability;
- They allow for future expansion;
- They can help reduce technology deployment time;
- Allow evolutionary deployment to proceed smoothly;
- Reduce risk;
- Enable coordinated operations; and,
- Assist in meeting future funding eligibility requirements.

8.1 State of the National Standards

A total of 89 standards are currently identified by the National Standards development effort. Of these 89 standards, 19 are still under development, 10 are being balloted, 4 have been approved and are ready to publish, and 56 have been published and are currently available for purchase.

8.2 Standards Development Organizations (SDOs)

The following paragraphs describe the various SDOs that are currently involved in some aspect of ITS standards development. Each of the underlined headings is a link to that organization's web site where further background information and details can be found. The overall responsibility for the ITS standards development program rests with the U.S. Department of Transportation, ITS Joint Program Office. The maturity status of standards can be obtained from www.standards.its.dot.gov/standards.htm.

American Association of State Highway and Transportation Officials (AASHTO): AASHTO, teamed with the National Electrical Manufacturers Association (NEMA) and the Institute of Transportation Engineers (ITE), is the lead organization for the National Transportation Communications for ITS Protocol (NTCIP). (Also see the NTCIP SDO description below.)

American National Standards Institute (ANSI): The American National Standards Institute (ANSI), the U.S. administrator and coordinator of private sector voluntary standardization, does not itself develop standards. An ANSI committee [the Accredited Standards Committee (ASC) X12] was chartered to develop standards to facilitate electronic data interchange (EDI) for business transactions. This committee is in the process of developing ITS-related standards involving commercial vehicle operations (CVO).

American Society for Testing & Materials (ASTM): ASTM provides a forum for producers, users, consumers, and others who have interest in standard test methods,

specifications, practices, guides, classifications, and terminology. ASTM leads efforts in ITS standards concerning dedicated short-range communications (DSRC).

Commercial Vehicle Information Systems Network (CVISN – US DOT sponsored program): The scope of commercial vehicle operations, of which CVISN is a part, includes the operations and regulations associated with moving goods and passengers via commercial vehicles. It includes activities related to safety assurance, commercial vehicle credentials and tax administration, roadside operations, freight and fleet management, and vehicle operation.

Consumer Electronics Manufacturers Association (CEMA): CEMA is a sector of the Electronic Industries Alliance (EIA). Two ITS standards have been developed under the auspices of CEMA, both having to do with traveler information radio and FM subcarrier systems.

Data Interchange Standards Association (DISA): DISA was chartered by the American National Standards Institute (ANSI) to provide its Accredited Standards Committee (ASC) X12 with administrative support. Some commercial vehicle operations (CVO) related standards are available for purchase at this site.

Institute of Electrical and Electronics Engineers (IEEE): The IEEE develops and disseminates voluntary, consensus-based industry standards involving all types of electro technology. ITS-related standards being developed by IEEE include message sets and data dictionaries.

Institute of Transportation Engineers (ITE): The Institute of Transportation Engineers (ITE) is one of the largest professional transportation organizations in the world. ITE members include traffic engineers, transportation planners, and other professionals who are responsible for planning, designing, implementing, operating, and maintaining surface transportation systems worldwide. ITE is involved in the development of NTCIP, TCIP, and other ITS standards.

ITS America (ITSA): The Intelligent Transportation Society of America fosters public/private partnerships to increase the safety and efficiency of surface transportation through the application of advanced technologies. This site contains many excellent resources for basic information on ITS and related topics.

National Electrical Manufacturers Association (NEMA): NEMA is one of the largest standards development organizations (SDOs) in the nation and represents over 600 member organizations. NEMA is a member organization of NTCIP and acts as the publisher of NTCIP standards.

National Transportation Communications for ITS Protocol (NTCIP): The primary objective of the NTCIP is to provide communication standards that ensure the interoperability and interchangeability of traffic control and intelligent transportation systems (ITS) devices. The NTCIP is the first protocol for the transportation industry that provides a communications interface between disparate hardware and software products.

Oak Ridge National Laboratory (ORNL): Oak Ridge National Laboratory's Intelligent Transportation Systems (ITS) Research Program provides technical assistance and

program support to the FHWA in the following subject areas: traffic simulation, signal optimization, real-time control, human factors, automation and systems engineering, operations research, traffic models, and management information systems.

Security Industry Association (SIA): The SIA was formed in 1969 to promote growth and expansion in the access control, auto security, biometrics, burglar alarm, CCTV, lock hardware, monitoring, outdoor protection, perimeter protection, personal response systems, and personal security product industries. SIA has recently begun to investigate the need for ITS-related standards.

Society of Automotive Engineers (SAE): This organization is made up of more than 75,000 engineers, business executives, educators, and students who share information and exchange ideas for advancing the engineering of mobility systems. Information about SAE's ITS standards activities can be found within the "Technical Committee" section of this Web site. SAE has developed several ITS standards related to in-vehicle electronics architectures and advanced traveler information systems.

Telecommunications Industry Association (TIA): TIA is a national trade organization that provides communications and information technology products, materials, systems, distribution services and professional services. The association's member companies manufacture or supply most of the products used in global communication networks.

Transit Communications Interface Profiles (TCIP): The TCIP is a family of ITS standards for transit communications. These new standards provide the interfaces among transit applications that will allow data to be shared by transit departments and other operating entities such as emergency response services and regional traffic management centers.

Transit Standards Consortium (TSC): The Transit Standards Consortium is a public/private, non-profit organization that facilitates the development, testing, maintenance, education, and training related to transit standards. The organization includes transit agencies, standards bodies, vendors, and other interested parties.

Volpe National Transportation Systems Center: The John A. Volpe National Transportation Systems Center (Volpe Center), located in Cambridge, MA, is an organization of the Federal Government whose principal role is to serve as a national center of transportation and logistics expertise. As such, it provides research, analytic, management, and engineering support to the U.S. Department of Transportation, other Federal agencies, and state and local governments.

8.3 Standards Elements

A number of key elements make up a standard or set of standards. These include Data Dictionaries, Message Sets, Object Definitions, and Communications Protocol. Each of these is described in more detail below.

Data Dictionary

Data Dictionaries provide the definition and format of individual data elements that are then grouped into individual messages. In other words, messages are the sentences and data elements are the individual words.

Two good examples of data dictionaries are the Traffic Management Data Dictionary (TMDD) developed by the Institute of Transportation Engineers (ITE) and the Advanced Traveler Information Systems (ATIS) Data Dictionary developed by SAE.

Message Set

Message Sets (MS) are an essential component in the design and operation of modern computer based systems. They provide the basic information flows (generally described as messages) upon which communications between systems depend. Specifically, a message set provides the information definition (semantics) and format (syntax) to handle individual informational exchanges on specific topics. Thus, agreed upon message sets with unambiguous message definitions is one of the essential characteristics of standards required for information exchange between individual traffic management systems. Message sets are also important for communications between traffic management systems and other ITS users and/or suppliers of traffic related information. An example of a currently implemented Message Set is Location Reference Message Specification (LRMS). This specification standard was developed at Oak Ridge National Laboratory. The LRMS establishes standard formats for individual messages used within message sets to convey locations. The design of the LRMS is based on three fundamental concepts. First, the transfer of a location is a message in itself. Second, the use of multiple location message options (termed profiles) is used within an expandable framework. Finally, the use of a set of well-known ground control points (referred to as "datums") is used to permit registration of different map databases to one another so that locations transferred can be understood with minimal ambiguity. Message Sets work in hand-in-hand with Data Dictionaries and Communications Protocol.

Object Definitions

The analogy to message sets in the world of object oriented software is object definitions. Objects are intuitive in nature – for example bus objects, traffic signal objects, vehicle detector objects, incident objects, etc. Each defined object has attributes, or characteristics and methods that act upon it. For example, a bus object contains attributes of <driver ID>, <bus number>, <passenger capacity>, <wheelchair compatible>, and so on. A bus object can be created, removed, or stored – these are examples of its methods.

Communications Protocols

The communications interface standards provide guidance on the first four layers of the Open System Interconnect (OSI) reference model. The data dictionary, message set, and object definitions deal with the fifth through seventh layers of the OSI reference model. The applicable NTCIP communication interface standards describe communications at the physical, link, network, and transport layers of the model. The communications standards address items such as electrical levels, cabling, connectors, how fast data can be exchanged, contention management, error detection and resolution, as well as addressing. Defined standards accommodate different layers (or groups of layers) of the protocols. For example, many installations utilize NTCIP 2202 (Internet (TCP/IP and UDP/IP) Transport Profile for layers three and four. NTCIP 2104 (Ethernet Sub-network Profile) defines requirements for layers one and two including requirements for specific types of coaxial cable, twisted wire pairs, and fiber-optic media.

8.4 Decision Making Strategy for Standards

Making the best choices depends on multiple factors, including throughput (how much data must be transmitted or received on the interface), network topology (how the ITS systems are connected together), and infrastructure (fiber optic lines, leased land lines, etc.), among others. At this point in the process, educate the stakeholders sufficiently to identify the potential ITS Standards for each interface, but leave final technology choices to the communications experts during project implementation. Typically, these decisions are made as part of the Plans, Specifications and Estimates (PS&E) for each project.

Review the standards currently used by the stakeholders. It's possible that many industry standards are already in use in the region. Encourage stakeholders to examine their existing interfaces and determine whether this is indeed the case. Discuss options for converting these interfaces to ITS standards over time. In determining when and how to incorporate ITS standards for a given interface, it's critical to understand the relative maturity of the standards. For each potential standard, consider asking:

- Has the ITS standard been approved or published by the SDOs?
- Has the ITS standard been adopted by multiple vendors?
- Has the ITS standard been tested, whether informally by the vendor, or through the formal ITS Standards Testing Program funded by FHWA?
- Is there an amendment to the ITS standard currently in the works, and if so, how much of the standard will change as a result?

Although Metropolitan Washington Region should create a plan to migrate toward ITS standards conformance, stakeholders should reach consensus on an interim approach if the ITS standards applicable to the region's interfaces are not yet mature. The interim approach however should be supported to some extent by industry to avoid ending up with a proprietary standard only supported by a few manufacturers.

8.5 Standards To Consider

8.5.1 Common Standards

There are a series of standards that define terms, data elements and message sets, and foundation standards. These standards form the basis for interoperability among systems by defining a common set of terms and information elements. The several standards that should be adopted and used by regional jurisdictions in the development of ITS applications include:

- **Data Dictionary for Advanced Traveler Information System (ATIS):** A minimum set of media-independent data elements needed by potential information service providers to deploy ATIS services and provide the basis for future interoperability of ATIS devices.
- **Message Set for Advanced Traveler Information System (ATIS):** A basic message set using the data elements from the ATIS data dictionary needed by potential information service providers to deploy ATIS services and to provide the basis for future interoperability of ATIS devices.

- **Message Sets for External TMC Communication (MS/ETMCC):** A message set standard for communication between transportation system management centers and other ITS centers, including traffic and transit management systems, information service providers, emergency management systems, and emissions management systems.
- **National Location Referencing Information Report:** A basis for location referencing standardization activities by various application communities and SDOs.
- **Standard for Common Incident Management Message Sets (IMMS) for use by Emergency Management Centers (EMC):** Standards describing the form and content of the incident management message sets for emergency management systems to traffic management systems and from emergency management systems to the emergency telephone system or (E911).
- **Standard for Data Dictionaries for Intelligent Transportation Systems :** A set of meta-entities and meta-attributes for ITS data dictionaries, as well as associated conventions and schemas, that enable describing, standardizing, and managing all ITS data.
- **Standard for Functional Level Traffic Management Data Dictionary (TMDD):** This document includes data elements for traffic control, ramp metering, traffic modeling, video camera control traffic, parking management and weather forecasting, as well as data elements related to detectors, actuated signal controllers, vehicle probes, and dynamic message signs. It also contains data elements for roadway links, for incidents and traffic disruptive roadway events.
- **Standard for Traffic Incident Management Message Sets for Use by EMCs:** Enables consistent standardized communications among incident management centers, fleet and freight management centers, information service providers, emergency management centers, planning subsystems, traffic management centers and transit management centers.

These key baseline standards are critical for the deployment because they establish the common vocabulary of data elements and message structures that allow regional ITS systems to exchange data and information with each other.

8.5.2 NTCIP For Traffic Systems

NTCIP is a family of communications protocols and data definition standards that have been designed to accommodate the diverse needs of various subsystems and user services of the National ITS Architecture. NTCIP standards are intended to handle these needs in the two areas of C2F and C2C.

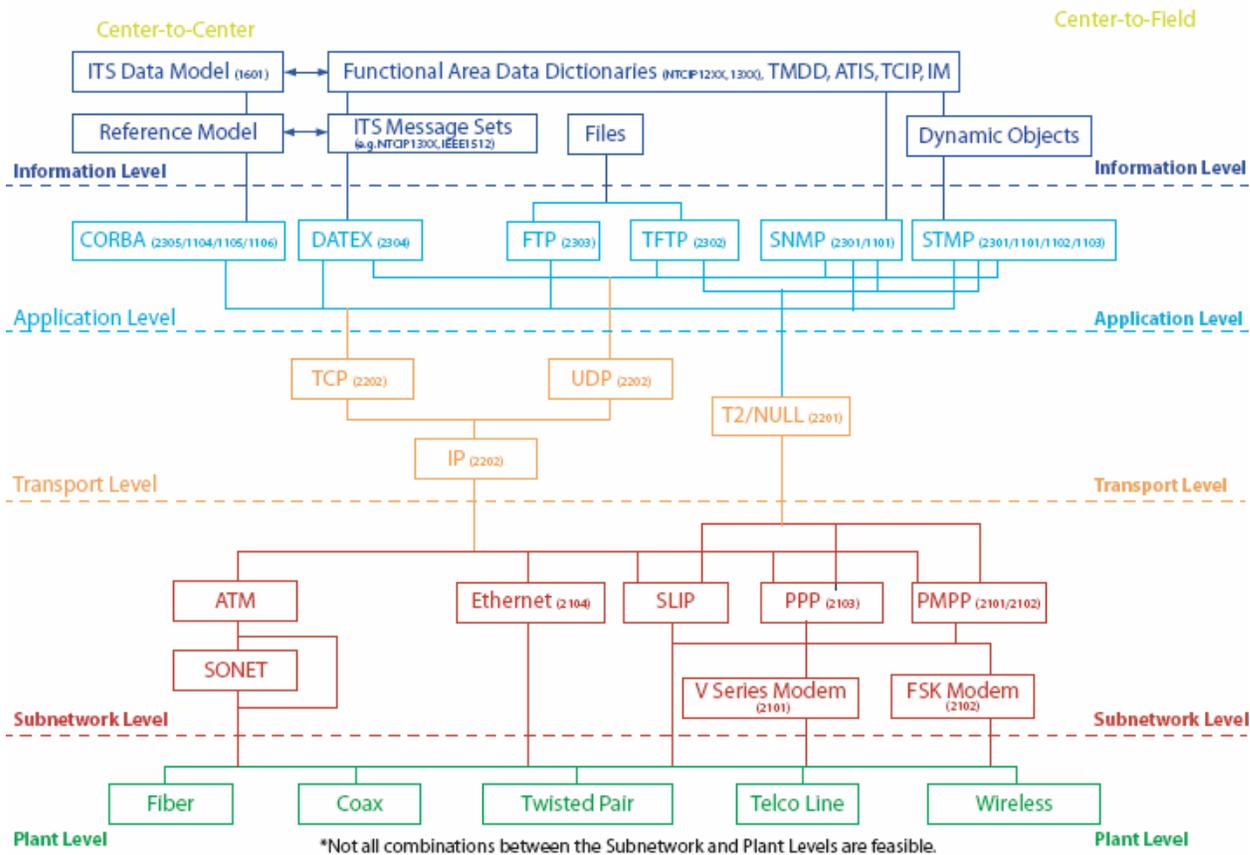
NTCIP uses a layered or modular approach to communications standards, similar to the layering approach adopted by the Internet and the International Organization of Standards (ISO). In general, data communications between two computers or other electronic devices can be considered to involve the following primary layers, called "levels" in NTCIP, to distinguish them from those defined by ISO and the Internet. The

NTCIP standards publication numbers are grouped in number ranges to indicate the standard type and the *level* where the standard goes.

- **Information Level** – This level contains standards for the data elements, objects and messages to be transmitted, for example, TCIP, NTCIP 1200 series Standards publications, MS/ETMCC.
- **Application Level** – This level contains standards for the data packet structure and session management., for example, SNMP, STMP, DATEXASN, CORBA, FTP.
- **Transport Level** – This level contains standards for data packet subdivision, packet reassembly and routing when needed, for example, TCP, UDP, IP.
- **Subnetwork Level** – This level contains standards for the physical interface, for example, modem, network interface card, CSU/DSU, and the data packet transmission method, for example, HDLC, PPP, Ethernet, ATM.
- **Plant Level** – This level consists of the physical transmission media used for communications, for example, copper wire, coaxial cable, fiber optic cable, wireless. It should be noted that the plant level is an infrastructure choice and not a standards selection choice. However, the plant level selection will have an impact on the subnetwork level selection to which it must interface.

Figure 8-1 illustrates the framework for NTCIP. The diagram shows the different protocols that can be chosen at each level (the boxes) and which ones are compatible (the lines connecting boxes).

Figure 8-1. NTCIP Framework.



Center-to-Center

NTCIP originally provided two alternative application level protocol choices for C2C communications, DATEX-ASN and CORBA. These two different protocols were found necessary to meet the variety of requirements for inter-system data exchanges. More recently, there has been increased interest in using XML and related technologies for C2C links due to its simplicity and the wide accessibility of tools to provide these services. However, it is feasible to use all of these protocols in the same network, with some centers acting as bridges, or translators, between the different protocols. The key is in determining where to deploy each protocol. DATEX was designed to provide simple, cost-effective solutions for basic needs. It is especially well suited for:

- Systems requiring real-time, fast data transfer, for example traffic signal status data;
- Systems with limited communications bandwidth but high data transfer load;
- Systems with infrequent event driven exchanges over dial-up links; and
- Non-object oriented systems.

Conversely, CORBA provides several features to support networks connecting object oriented systems, and assuming sufficient processing power and communications bandwidth are provided, could be used for all applications between such systems. Object oriented software can take full advantage of CORBA and implement it easily; this is much more difficult to achieve with traditional procedural software.

Its fundamental simplicity, the wide availability of XML tools and a large market of XML knowledgeable personnel have generated the interest in XML. It is especially well suited for systems requiring limited, simple data exchanges over communications links with sufficient bandwidth and processors with sufficient processing time available. However, there are no current transportation industry standards for the use of XML. The NTCIP effort continues to monitor the maturity of XML in an effort to determine its suitability for future use in the transportation industry.

C2C networks allow each system to request any available information from any or all other systems. Each system can be configured to either accept or reject any request. The “data” sent can be informational or can constitute a “command” to take some action. Consider a message sent from one traffic signal system to another and containing a signal timing pattern number. In DATEX, for example, depending on the message type, it could represent a command to implement that timing pattern at a particular traffic signal or group of signals, or it could represent a status report indicating that this timing pattern was just implemented at a particular traffic signal or group of signals.

The user can also establish standing subscriptions for data, if it wants the same data sent repeatedly. In DATEX, these subscriptions can specify that data be sent one-time-only, periodically, or repeatedly on occurrence of some event as defined in the subscription. Each subscription message has a corresponding publication message. Unless the subscription is a one-time request, the data will continue to be automatically “published” repeatedly until the subscription is cancelled, or until a predefined end date specified in the subscription.

Using CORBA, a system can automatically and dynamically “discover” data availability and shared control options available from other systems. These other systems use the CORBA framework to publish their capabilities and services offered, accept registration requests from authorized clients, and then deliver those capabilities and services to those clients on demand. For example, a CORBA traffic management system that owns a CCTV can offer to provide: (1) the images acquired as (a) snapshot, or (b) streaming video, and/or (2) allow remote control movement of that CCTV. The system owning the CCTV is the “server” and the system asking for the images, and/or control of the CCTV is the “client.” This example also serves to illustrate a typical use of a subscription such as “send me a new snapshot image from CCTV123 every minute” stated in the proper terms for that CORBA system— assuming the requester is authorized that service, the expected result is fairly obvious.

C2C communications require a peer-to-peer network connection between the involved computers. This is typically a local area network, a wide area network, or a dial-up connection. Local area networks typically use agency-owned twisted pair cable or fiber optic cable. Wide area networks typically use commercial telecommunications links such as frame-relay, fractional T1 leased lines, packet radio, or leased “virtual private networks”. Dial-up connections typically use ISDN, V.90 or similar modems over “plain-old telephone” lines. Any type of communication link can be used, as long as it enables use of the Internet transport and routing protocols (TCP/IP and UDP/IP) and has sufficient bandwidth for the planned communications load to achieve the desired operational performance (this is based upon frequency, size of messages to be exchanged, and latency issues encountered when using C2C systems).

While the NTCIP community recognizes these three solutions, it should be noted that at the time this guide was written, none of the three approaches provided complete solutions to C2C communications. For DATEX and CORBA, the base protocols have been defined, that is, how to exchange data, but the standards defining the data to be exchanged have not reached a state of maturity. The XML approach is even less mature in that the industry has not agreed on the exact rules on how to exchange the XML documents. Any near-term deployment should consider the impacts that this may have on the long-term maintainability of a system. The best solution is still likely to deploy one of the recognized standards, but the agency should realize that a future project would likely be required to upgrade the software to address any included features affected by revisions in order to achieve the final mature standard.

Center-To-Field

For C2F applications, NTCIP offers the potential for interchangeability and interoperability of equipment from different suppliers on the same system. This family of standards provides both the vocabulary (called objects) and the rules for communicating (called protocols) necessary to allow electronic traffic control equipment from different manufacturers and transportation management centers to operate with each other as a system.³¹ Key C2F standards that should be adopted and used by Metropolitan Washington Region are shown in Table 8-1 below.

Table 8-1 C2F Standards

NTCIP STANDARD	NAME	DESCRIPTION
NTCIP 1201	Global Object Definitions	Specification for those objects that are likely to be used in and for multiple device types
NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller Units	Specifications for objects that are specific to actuated signal controllers and definitions of standardized object groups that can be used for conformance statements.
NTCIP 1203	Object Definitions for Dynamic Message Signs	Defines data that is specific to dynamic message signs including all types of signs that can change state, such as blank- out signs, changeable signs, and variable signs
NTCIP 1204	Object Definitions for Environmental Sensor Stations & Roadside Weather Information System	Definitions of objects that are specific to environmental sensor stations (ESS) and object groups, which can be used for conformance statements.

NTCIP STANDARD	NAME	DESCRIPTION
NTCIP 1205	Data Dictionary for Closed Circuit Television (CCTV)	A database for Closed Circuit Television systems. The format of the database is identical to other NTCIP devices and uses ASN. 1 representation. Targeted devices include cameras, lenses, video switches, and positioning controls for aiming and identification, such as videotext overlays.
NTCIP 1206	Data Collection and Monitoring Devices	Specifies object definitions that may be supported by data collection and monitoring devices, such as roadway loop detectors.
NTCIP 1207	Ramp Meter Controller Objects	Specifications for objects that are specific to ramp metering controller operations.
NTCIP 1208	Object Definitions for Video Switches	Deals with the data needed to control a video switch enabling multiple monitors to view multiple video feeds.
NTCIP 1209	Transportation System Sensor Objects	Object definitions that are specific to and guide the data exchange content between advanced sensors and other devices in an NTCIP network. Advanced sensors
		include video- based detection sensors, inductive loop detectors, sonic detectors, infrared detectors, and microwave/ radar detectors
NTCIP 1210	Objects for Field Management Stations	This standard will define the objects necessary to manage a field master.
NTCIP 1211	Objects for Signal Control Priority	Object definitions for the application of signal prioritization by transit vehicles, rail, emergency vehicles and trucks.

8.5.3 NTCIP For Transit - TCIP

TCIP is a suite of data interface standards for the transit industry (<http://www.tcip.org/>). This suite of standards includes the wide range of transit ITS applications. A summary of the TCIP standards is found in the Following Table -8-2.

Table 8-2 Transit Standards

TCIP STANDARD	NAME	DESCRIPTION
1400	Framework Document	Defines how the various TCIP standards work together
1401	Common Public Transportation (CPT) Business Area Standard	Defines those data elements and data frames that are generic to multiple TCIP Business areas
1402	Incident Management (IM) Business Area Standard	Defines the data elements and messages used for exchanging information on incident management operations
1403	Passenger Information (PI) Business Area Standard	Defines the data elements and messages used for passenger information data exchange
1404	Scheduling/Runcutting (SCH) Business Area Standard	Defines the data elements and messages used for exchanging information about transit schedules and runcutting information
1405	Spatial Representation (SP) Business Area Standard	Defines the data elements and messages used for exchange of location and spatial concepts
1406	Onboard (OB) Business Area Standard.	Defines the data elements and messages used for exchanging information about devices and operations aboard the transit vehicle
1407	Control Center (CC) Business Area Standard	Defines the data elements and messages used for exchanges between control centers
1408	Fare Collection (FC) Business Area Standard	Defines the data elements and messages used for exchanging information about fare collection operations

9.0 Sequencing of Projects

The Metropolitan Washington Region is rich in ITS deployment. Many of these systems, such as CHART, DCDOT ITMS, WMATA SmartTrip, NOVA STSS, to name just a few – exist or underway. The regional ITS architecture is “implemented” with many individual ITS projects and private sector initiatives that occur over years, or even decades. A sequence, or ordering, of ITS projects that will contribute to the integrated regional transportation system depicted in the regional ITS architecture is defined.

The general sequencing relationship true for the region’s ITS systems is shown in Figure 9-1 Below. The field infrastructure (loops, cameras, etc.) with the associated communications is essential to the operation of any system. Each regional modal system operates independently with its own internal system communications. These internal communications usually serve to link multiple dispatch locations to the modal system. Finally, the intermodal management systems bring together the functionality and information of the various modal systems, both in terms of software applications and system-to-system communications. A breakdown or missing link in a lower Stage of this dependency pyramid will impact the next Stages up, and each piece of the picture is interrelated.

Institutional issues are mitigated with the understanding that Stage 1 and 2 projects should proceed according to their expected schedule. Stage 3 integration should be developed in conjunction with the establishment of the regional network and standards of the Regional Integration of ITS project.

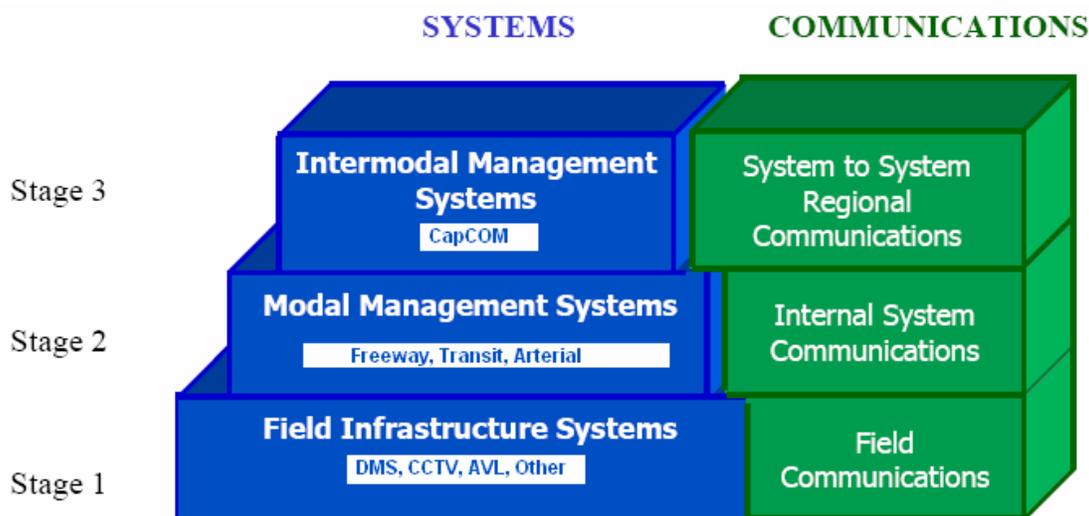


Figure 9-1 General Sequencing Relationship

Table 9-1 displays the regional project sequencing. These timelines should be seen as estimates and schedules are likely to change over time. Some of the planned projects have estimated dates for deployment, while some agencies have not yet established a deployment date.

Table 9-1 Project List

Agency	Planned System/Data	Projected Date
MDSHA	CHART II	Near Term
VDOT	Statewide 511	On-Going
WMATA	Transit Bus Priority	On-Going
CapCOM	CapCOM Center/RITIS	Near Term
DCDOT	Anacostia Gateway TMC Design	Near Term
	Fiber Optics Communication Network	N/A
	Transportation Management Center Improvements	N/A
	Traveler Information System	N/A
	Regional Integration and Coordination Interfaces	N/A
	Signal Preemption and Priority	N/A

10.0 Use and Maintenance of the Architecture

10.1 Use of Regional Architecture

The success of the Metropolitan Washington Regional ITS Architecture is dependent upon the effective use of the architecture. The architecture should be mainstreamed into the traditional planning and deployment process for the region and should be a tool for stakeholders to use in planning their projects to support regional goals.

10.1.1 Support Planning Process

The planning process has as its overall output two primary planning and programming documents: the Transportation Plan and the Transportation Improvement Program. Numerous transportation planning activities on a regional and local level feed information to the development of the Transportation Plan and TIP.

- Long-Range Transportation Plan for the National Capital Region ([financially] Constrained or CLRP): identifies and describes all regional significant transportation projects and programs that are planned in the Washington metropolitan area within 25 years.
- Transportation Improvement Program (TIP): describes specific projects that will be deployed and or/operated over the next several years. ITS projects need to be included in this document to receive Federal funds.

The transportation plan is one of the principal products of the planning process. It is the expression of a state or metropolitan area's long-range approach to constructing, operating, and maintaining the multimodal transportation system. It is the policy forum for balancing transportation investments among modes, geographic areas, and institutions.. The Federal regulation Metropolitan Transportation Planning (23 CFR, part 450) specifies requirements for transportation plans. Following table 10-1 indicate those requirements and highlight some of the associated considerations for using the regional ITS architecture to support the Metropolitan Transportation Plan.

Table 10-1. Relationship of Transportation Plan and Architecture (from FHWA Regional Architecture Guidance Document)

Metropolitan Transportation Plan Requirements	Considerations for Regional ITS Architecture
Include both long-range and short-range strategies/actions that lead to the development of an integrated intermodal transportation system that facilitates the efficient movement of people and goods.	The regional ITS architecture considers both short-range and long-range services/ projects and takes a multi-modal view.
Identify the projected transportation demand of persons and goods in the metropolitan planning area over the period of the plan	This is an evaluation effort that does not relate to the regional ITS architecture
Identify pedestrian walkway and bicycle transportation facilities	Regional ITS architecture doesn't have much coverage related to this requirement.

Reflect the consideration given to the results of the management systems	Archive data and other ITS provide important support to management systems.
Assess capital investment and other measures necessary to preserve existing transportation system and make the most efficient use of existing transportation facilities to relieve vehicular congestion and enhance the mobility of people and goods.	Systems/Services described by the regional ITS architecture have as their key goal and attribute improving the efficiency of the existing transportation network.
Include design concept and scope descriptions of all existing and proposed transportation facilities in sufficient detail in nonattainment and maintenance areas to permit (air quality) conformity determinations.	Information from the Project Sequencing can be used to address some of this requirement.
Reflect a multimodal evaluation of the transportation, socioeconomic, environmental, and financial impact of the overall plan, including all major transportation investments.	This is an evaluation effort that does not relate to the regional ITS architecture
Include a financial plan that demonstrates the consistency of proposed transportation investments with already available and projected sources of revenue.	Information from the Project Sequencing in the regional ITS architecture can be used to address some of this requirement.

The TIP is a staged, multiyear, intermodal program of transportation projects that is consistent with the Metropolitan Transportation Plan. The TIP must include a prioritized list of specific projects to be constructed over a several-year (often three) period after its approval.

As part of the TIP preparation, a project prioritization and selection process is conducted. Some of the factors that are typically used in developing project priorities include:

- Urgency of need for the project
- Project effectiveness versus cost
- Sequencing as related to other projects
- Type of funds available and their applicability
-

Metropolitan Washington Regional ITS architecture can play a key role in the project prioritization and selection process. The Project Sequencing output from the regional ITS architecture effort can be a major input to prioritization. In addition, integration opportunities identified in the regional ITS architecture can be used to better define the full benefits of ITS projects.

10.1.2 Support Project Development

Metropolitan Washington Area Regional ITS Architecture assists in defining high-level requirements in ITS design for specific project development.

During project development, stakeholders should incorporate regional ITS architecture elements such as operational concepts, standards, and functions in their detailed design documents. This method of defining ITS projects for future deployment is consistent with the National ITS Architecture, it lends credibility to new projects, it limits duplicate efforts by transportation stakeholders, and it supports uniform regional approach to both the planning and deployment process.

If the project has not been previously identified in the Regional Architecture, then a system engineering process should be executed to develop the items that modify the regional architecture, such as operational concepts, functional requirements, system interconnects, agreements and information flows.

10.2 Maintenance of the Regional Architecture

The regional ITS architecture is not a static set of outputs. It must change as plans change, ITS projects are implemented, and the ITS needs and services evolve in the region.

What is the process by which the architecture is modified/changes? Some of the Key aspects of the process, which are defined in this section are:

- Who is responsible?
- What has to be modified?
- When (how often) does this occur?
- How are changes identified?

10.2.1 Responsibility for Maintaining the Regional ITS Architecture

Because changes can arise from many sources (see discussion below), and very likely will arise from some sources outside the technical expertise of a single champion, it is a good idea for a group of people from different stakeholder areas to be involved in architecture maintenance. Representatives from traffic, transit, public safety, traveler information, and any other key stakeholders from the team that developed the architecture are good candidates for the architecture maintenance team. Ultimate responsibility may reside with MWCOG, but the team of representatives from the different stakeholder groups should assist in the effort.

10.2.2 Items To Be Maintained in the Architecture

The Metropolitan Washington Regional ITS Architecture is stored in Microsoft Access database and is represented through a set of output including reports and diagrams. To aid the Metropolitan Washington Area with architecture version document control, the filename of the database should contain the date on which the architecture was updated. This allows the most current version to be easily identified.

Outputs such as interconnect and information flow diagrams, systems inventory, stakeholder list and other diagrams and reports can be produced from Turbo outputs as by-products of architecture database. These outputs can be updated as necessary for meetings or outreach

activities. The Following are the components of regional ITS Architecture that should be maintained.

- Description of the Region
- List of Stakeholders
- Inventory of existing and planned ITS systems in the region
- Operational Concepts
- System functional requirements
- Documentation of existing and planned interconnects and information flows for the region
- Documentation of project sequencing
- List of Agency Agreements
- Documentation of applicable, in use, or planned ITS Standards.

10.2.3 Frequency of Updating the Architecture

Because of the nature of technology systems, the Regional ITS Architecture will always be in a state of flux. The frequency of updates will follow a tiered format according to technical complexity and policy significance. Small technical changes will be identified through the MOITS Task Forces ITS Architecture Working Group and made on an as-needed basis, anticipated to occur approximately quarterly. Once a year, an official update would be anticipated, covering major technical changes, to be approved by the MOITS Policy Task Force. Once every three years, a complete update is anticipated to occur, reexamining both policy and technical issues, policy sections being forwarded for endorsement by the TPB.

10.2.4 Update Process

The actual change management process could be handled with varying degrees of formality depending upon the complexity (both technical and institutional) of the regional ITS architecture. In general, the more complex the architecture, the greater the need for formality in the handling of changes.

The general steps in the process are:

1. Define changes. In developing the process a key question to answer is- who can create changes? Can anyone suggest a change to the regional ITS architecture baseline, or must suggested changes go through certain specified channels or organizations? Does any paperwork need to accompany a change request? Here the process might be formal, with change request forms, or informal, with requests taking the form of emails or other non standardized inputs.
2. Assess the impact of the change. Someone needs to evaluate the change and determine what impact it has upon the architecture baseline. This evaluation could be required of the person proposing the change, or it could be performed by someone else (possibly the person, or group of people responsible for maintaining the architecture).
3. Provide a recommendation to the MOITS ITS Architecture Working Group designated as what is referred to in the National ITS Architecture as a Change Control Group or Configuration Control Board. For proper change control some group (or individual in less complex cases) should be assigned responsibility for reviewing and approving changes

to the baseline. The job of the Group is to decide what changes go into the architecture baseline. The level of formality (and the size of the Group) will depend upon the size and complexity of the architecture. On one end of the spectrum a single person may perform the entire function for very simple architectures. On the other end of the spectrum a committee of key representatives from each stakeholder area or key stakeholder may be involved.

4. The Change Control Group makes a decision. Either it accepts the change, rejects it, asks for additional evaluation, or, forwards the information to the MOITS Policy Task Force in cases that may have policy implications or are otherwise deemed necessary. Decisions with major policy implications will further be forwarded to the National Capital Region Transportation Planning Board for its action. At no time will policy be set within the framework of the Regional ITS Architecture; rather, policy will be encompassed only in the TPB approval of the Long-Range Transportation Plan for the National Capital Region (CLRP), and the architecture will follow from the policy direction encapsulated in the CLRP. Though rare, policy issues may arise for TPB consideration and action from evolving or emerging technology, or other opportunities identified in the systems engineering process.
5. The decision is implemented. If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated and an updated architecture baseline is defined.

11.0 Next Steps and Future Needs

- Maintain the architecture as described in Section 10.
- Revisit the ITS inventory for additional information and detail.
- Reexamine and update information according to ongoing updates of individual agency enterprise architectures.
- Review the systems and interconnects described in the architecture on an ongoing basis for needs and opportunities.
- Stakeholders may convene to consider project or program development implications of what is described in the architecture.
- Revisit and expand consideration of standards.
- Revisit the sequencing of projects for additional information and detail.
- Keep track of changes of the National ITS Architecture that have implications for the regional architecture