Metropolitan Washington Area ITS Architecture

Version 1.0 Report

for

Maryland State Highway Administration

and

Metropolitan Washington Council of Governments

June 11, 2002

Submitted by:
Advanced Networked Systems
Computer Sciences Corporation
7471 Candlewood Road
Hanover, MD 21076

Computer Sciences Corporation

PB Farradyne

Table of Contents

Acknowledgements

Executive Summary

Transportation Operating Agencies in the Metropolitan Washington Council of Governments / National Capital Region Transportation Planning Board (MWCOG / NCRTPB / NCRTPB) region are moving towards a consensus that regional ITS operations and cooperation are both necessary and possible. This change has been evident through the efforts of the National Capital Region Transportation Planning Board and the MWCOG / NCRTPB Management and Operations Task Force. Furthermore, this change is documented in many reports, including the Multi-Jurisdictional Transportation Telecommunications Study that was finalized for the Maryland State Highway Administration (MD SHA) and the MWCOG / NCRTPB. That study finds 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."

Computer Sciences Corporation (CSC) and its partner, PB Farradyne (PBF), were contracted in August, 2000 to perform an analysis of potential electronic voice, data, and video information exchange for and between regional Intelligent Transportation System (ITS) applications throughout the MWCOG / NCRTPB region. The goal of the study is to examine the regional ITS application interface alternatives and recommend specific actions that could facilitate electronic exchange on National ITS Architecture data elements among MWCOG / NCRTPB member ITS agencies. Originally, the project work plan called for developing a Proof of Concept to demonstrate the validity of the regional architecture. However, the MWCOG / NCRTPB ITS Architecture Working Group chose to focus on the development of the regional architecture, and has scaled back the Proof of Concept task. The current scope of this project is to:

- Develop a regional ITS architecture. The architecture provides an opportunity to examine and look at potential interconnects – it does not commit stakeholders and agencies to implementation.

- Examine regional ITS application interface alternatives

This report documents the processes and provides for a regional ITS architecture. Section 1 provides details regarding the project's goals, objectives, project area and jurisdictions, and a project work flow chart. Section 2 describes the comprehensive regional coordination efforts undertaken in developing the regional architecture, operations, participating stakeholders and conformity to the January 8, 2001 Federal Highway Administration (FHWA) Final Architecture Rule and Federal Transit Agency (FTA) Policy. In summary:

- The regional architecture has been closely coordinated and developed with the on-going development of the Maryland Statewide and VDOT NOVA District ITS Architectures

- The regional architecture demonstrates how it conforms to the final FHWA rule and FTA policy. Full compliance is mandated by January 8, 2005. The MWCOG / NCRTPB ITS

Architecture Working Group is working to place the regional architecture into a regional transportation planning practice. Furthermore, as the regional architecture is a "living document", the MWCOG / NCRTPB ITS Architecture Working Group is working to develop processes that will result in on-going maintenance of the regional architecture and conformance to the national ITS Architecture.

Section 3 documents the process followed in developing the regional architecture. A number of reports and documents were reviewed to identify existing and planned ITS for the purpose of identifying ITS subsystems that capture the basic functions and services of each stakeholder. ITS Market Packages were then identified that support the subsystems. Based upon these efforts, a Strawman Architecture (i.e., DRAFT Architecture) was developed to identify interconnects and architecture flows required to facilitate the electronic exchange of information among the various stakeholders. The Strawman Architecture was reviewed and validated by reaching out to targeted stakeholders and working closely with the Maryland Statewide and VDOT NOVA District ITS Architecture teams. Section 3 also contains tables that trace the numerous subsystems, market packages, and interconnects to the stakeholders and a table tracing architecture flows to the subsystems.

Section 4 summarizes the regional architecture interconnects for each of the stakeholders. A section describing how the stakeholders can use the regional architecture is also provided. A large printout of the architecture is also enclosed in the notebook binder cover. Furthermore, the entire regional architecture, interconnects and architecture flows for all stakeholders, is included in Appendix D.

The Metropolitan Washington Area ITS Architecture provides the framework to enable the following list:

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

- Expanding of the regions freeway emergency / incident management functions onto the arterial roadway network

- Improving 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

- Emergency vehicle to emergency vehicle voice communications

Traveler Information

- Disseminating 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

- Enhancing regional traffic management by coordinating traffic information and control strategies in neighboring jurisdictions

Transit Management

- Enhancing 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

- Supporting WMATA's on-going regional transit electronic toll clearinghouse initiative

- Enhancing 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

The findings of the two remaining project tasks – examining regional ITS application interface alternatives and identifying concepts that could be advanced to demonstrate a Proof of Concept -- will be documented in separate forthcoming reports.

1.0 Introduction

At present, all state and some local members of the Metropolitan Washington Council of Governments (MWCOG / NCRTPB) 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.

1.1 Project Goals

The goal of this project is to examine regional ITS application interface alternatives and provide specific actions that could facilitate electronic exchange on National ITS Architecture data elements among MWCOG / NCRTPB member ITS applications. To that end, an ITS architecture that is in conformance with the United States Department of Transportation's National ITS Architecture has been developed to advance the status of electronic exchange of regional ITS information in this area. This Report documents the processes and provides for a Metropolitan Washington Area ITS Architecture as developed by the Computer Sciences Corporation / PB Farradyne (CSC / PBF) Team.

1.2 Project Objectives

Project objectives include the development of a regional architecture, examination of regional ITS application interface alternatives, and the development of alternatives and concepts that lead to up to three Proof of Concept proposals.

- <u>ITS Regional Architecture</u> – The regional architecture defines interconnects and data flows required to facilitate operations and management issues in the MWCOG / NCRTPB region.

- <u>Examination of regional ITS application interface alternatives</u> - National ITS Architecture provides a framework of standards and approaches for electronic information exchange. The standards requirements of the National Architecture will provide a starting point in defining the standards to be used in the Washington Regional Architecture. As the architecture is defined, the standards based electronic information exchange will be applied to ensure that all participants are aware of the targeted framework for planning, defining and integrating their individual applications.

1.3 Project Area and Jurisdictions

As shown in Figure 1, the regional architecture focus has been on larger agencies with known ITS programs and on-going initiatives. The project area focus is the MWCOG / NCRTPB region. Participating jurisdictions involved in the development of the regional architecture include:
- State of Maryland
- Frederick County
- Montgomery County
- Prince George's County
- Commonwealth of Virginia
- Arlington County
- Fairfax County
- Loudoun County
- Prince William County
- City of Alexandria
- City of Fairfax

- City of Falls Church
- City of Manassas
- District of Columbia
- Washington Metropolitan Area Transit Authority

1.4 Project Workflow Chart

Figure 2 sets forth a high-level approach followed by the CSC / PBF Team to complete the project with a particular emphasis on the efforts involved to develop the regional architecture.

Figure 1 - Project Area

TASK 1 -
Project Kick-Off Meeting

TASK 2 -
Inventory Existing and Planned ITS

TASK 3 -
Develop ITS Regional Architecture

TASK 4 -
Identify Approaches for Electronic Exchange of Data Information Elements

- "The Wolf Report", February 24, 1997
- National Capital Area "Umbrella" ITS Early Deployment Study, April 25, 1997
- MD SHA CHART Regional Operations Coordination (ROC), November 1998
- Commercial Vehicle Information Systems and Network, Ten-Year Implementation and Maintenance Plan, June 30, 1999
- National Capital Regional TPB Vision Document, 1999
- VDOT NOVA District Smart Travel Strategic Plan, 1999
- Regional Payment Systems Partnership, September 2000
- Arlington County Telecommunications Upgrade - Draft Technical Memorandum No. 2: ITS Architecture Needs, November 6, 2000
- WMATA Draft ITS Strategic Plan, December 4, 2000
- Multi-Jurisdictional Transportation Telecommunications Study, 2000
- U.S. DOT ITS Deployment Database, 2000
- MD SHA CHART Functional Vision, January 18, 2001
- MD SHA CHART Draft Business Plan, January 2001

Selected Regional ITS Initatives

On-Going Projects

MWCOG Regional ITS Strategic Plan

VDOT NOVA ITS Architecture

Maryland Statewide Architecture

Expanded WMATA ITS Strategic Plan

Key Milestones

Validation of Strawman Architecture

Validation of Strawman Architecture in MWCOG Region

Draft ITS Architecture

On-Going Regional ITS Initiatives

3.1 - Strawman Regional Architecture

3.2 - Refinement and Consistency Check - Targeted Validation Meetings:
- DC DPW
- Prince George's County
- Northern Virginia Local Safety Providers
- Northern Virginia Traffic Management Operations
- Northern Virginia Local Transit Providers
- Regional Electronic Fare Payment Providers
- MWCOG Stakeholder Workshops

3.3 - Validate Strawman Regional Architecture

OK!

4.1 - Identify National ITS Architecture and Technical Standards-Based Approaches for Electronic Information Exchange
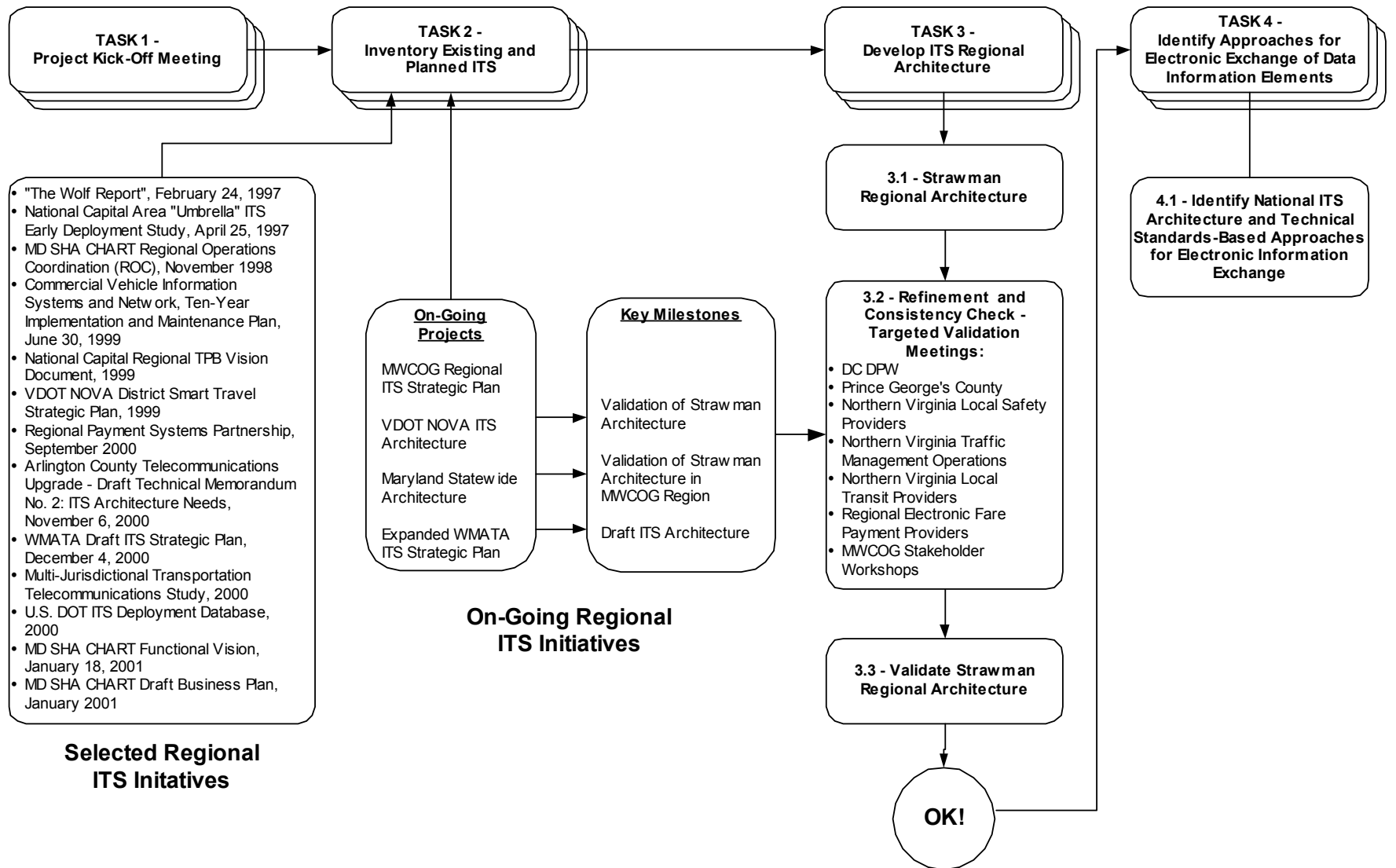
Figure 2 - Project Workflow Chart

2.0 Background

Regional coordination efforts, operations, a list of stakeholders represented in the regional architecture, and the role of the MWCOG / NCRTPB ITS Architecture Working Group is discussed in this section.

2.1 Regional Coordination Efforts

The development of the Metropolitan Washington Area ITS Architecture was closely coordinated with the on-going Maryland Statewide and VDOT NOVA District ITS architecture initiatives. 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, commercial vehicle operations (CVO) systems, 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. The CSC / PBF Team coordinated the development of the Metropolitan Washington Area ITS Architecture with these two architectures as follows:

- November 8, 2000 – Agreed to coordinate the development of the regional architecture and developed a framework for doing so.

- December 13, 2000 – Agreed to common stakeholders and naming conventions for use in the Turbo Architecture software package. Stakeholder and naming conventions continued to be closely coordinated during the development and updates of all three architectures.

- April 6, 2001 – Reviewed and coordinated common interconnects among the various stakeholders included in all three architectures.

- May / June 2001 – Coordinated targeted validation meetings with VDOT NOVA District ITS Architecture local public safety, transit, and traffic management operators, and regional electronic fare payment providers. (See Section 3.5 for additional details).

- June 2, 2001 – Coordinated updated common interconnects with the Maryland Statewide Architecture.

- August 2001 – Coordinated updates with the on-going validation of the VDOT NOVA District ITS Architecture.

The Metropolitan Washington Area ITS Architecture is anticipated to be coordinated with the on-going MWCOG / NCRTPB Management, Operations, and ITS Strategic Plan. The strategic plan is currently under development by MWCOG / NCRTPB staff. Common areas for collaboration include regional traveler information, freeway and arterial management, incident management, electronic fare and toll payment, transit management, emergency response management, and data archiving.

2.2 Operations

The regional architecture is an operations-based architecture and is centered around roadway operations centers, transit dispatch centers and police / fire dispatch centers – locations where operational functions are performed and / or where data becomes information. Architecture flows that are internal to specific agencies (e.g., in-vehicle systems that support improved vehicle maintenance, architecture flows between agency operations centers and their field devices such as CCTV cameras and variable message signs, etc.) are assumed to be set forth

within an individual agency's architecture and are not included in the regional architecture. There are exceptions -- transit and emergency vehicle priority pre-emption along signalized arterials require exchanges of data in the field between vehicles and roadside devices. The regional architecture provides for these pre-emption functions.

2.3 Stakeholders

Table 1 summarizes and provides a brief description of the stakeholders represented in the Metropolitan Washington Area ITS Architecture. In addition, common stakeholders with the Maryland Statewide and VDOT NOVA District ITS Architectures are also noted on the table, Such commonality reflects the extensive coordination efforts conducted by the three architecture efforts as noted in Section 2.1.

2.4 Final Architecture Rule and Conformity

On January 8, 2001, the FWHA rule and FTA policy on ITS Architecture and Standards were published to implement section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21). The final rule/policy requires that:

- Regions currently implementing ITS projects must have a regional ITS architecture in place in four years.

- ITS projects funded by the Highway Trust Fund and the Mass Transit Account must conform to a regional ITS architecture.

- Major ITS projects should move forward based on a project level architecture that clearly reflects consistency with the National ITS architecture. A major ITS Project is any ITS project that impacts regional integration or national interoperability.

- Projects must use USDOT adopted ITS standards as appropriate. To date, the USDOT has not adopted any ITS standards, and a formal rulemaking process will precede any USDOT ITS standard adoption. The proposed rule does not require replacement of existing systems or equipment. Applicable ITS standards would be used as new features and system upgrades are planned with the use of the National ITS Architecture.

The final rule on the ITS Architecture and Standards requires the development of a local implementation of the National ITS Architecture referred to as a regional ITS Architecture. The regional ITS architecture should be tailored to meet local needs, meaning that it does not need to address the entire National ITS Architecture.

The regional ITS architecture shall contain a description of the region; identification of the participating agencies and other stakeholders; the roles and responsibilities of the participating agencies and other stakeholders; any agreements (existing or new) needed for operations, including at a minimum those affecting ITS project interoperability; system functional requirements; interface requirements and information exchanges with planned and existing systems; identification of applicable standards; and the sequence of projects necessary for implementation. Any changes made in a project design that impact the regional ITS architecture shall be identified and the appropriate revisions made and agreed to in the regional ITS architecture.

Any region that is currently implementing ITS projects shall have a regional ITS architecture by April 8, 2005. In this context, a region is a geographic area that is based on local needs for sharing information and coordinating operational strategies among multiple projects. A region

Metropolitan Washington Area ITS Architecture Stakeholders	Metropolitan Washington Area ITS Architecture Stakeholder Description	Common Stakeholders	
		Maryland Statewide ITS Architecture Stakeholders	VDOT NOVA ITS Architecture Stakeholders
Baltimore-Wasington HIDTA	Gateway / message switch for local incident management providers.	Public Safety Center	CAPWIN
CHART / Freeway Traffic Management Center (TMC)	MD SHA CHART Statewide Operations Center, Traffic Operations Center 3 in College Park, and Emergency Traffic Patrol / Emergency Response Unit vehicles	Freeway Traffic Management Center (TMC)	CHART
DC Regional Electronic Transit Clearinghouse	Regional Electronic Fare system for WMATA, Fairfax County Connector, City of Fairfax CUE, Montgomery County Ride On, Arlington County ART, Maryland MARC, Alexandria DASH, VRE PRTC, Maryland MTA		DC Regional Electronic Transit Clearinghouse
Other Regional Electronic Toll Clearinghouses	EZ-Pass Member Agencies		Other Regional Electronic Toll Clearinghouses
DC DDOT Center	Future Integrated Traffic Management Center of DC DPW. The center is assumed to be located at DC DPW offices on 14th Street.		DC DPW Center
DC Public Safety Centers	DC Police and Fire Departments - Includes DC Emergency Management Agency (DEMA), DC Office of Emergency Preparedness, Naval District of Washington (NDW) Fire Emergency Service, US Secret Service, US Park Police, US Marshall Office, and US Capital Police operations / dispatch centers and their vehicles		DC Public Safety Centers
Federal Installations	Pentagon and other large Federal operations in the region that affect transportation	Public Safety Center	Federal Installations
Greenway Center	Private Road Operations in Loudoun County		Greenway Center
MC TMC / Arterial Management Center (TMC)	Montgomery County TMC and Montgomery County Ride-On vehicles.	Arterial Management Center (TMC)	
MD CVISN / Commercial Vehicle Operation Systems	Commercial Vehicle Administration	Commercial Vehicle Operations (CVO) Systems	
MD Public Safety Centers / Public Safety Center	Maryland State Police and County E-911Centers	Public Safety Center	MD Public Safety Centers
MD MTA/Transit Management Center	Maryland Mass Transit Adminstration	Transit Management Center	
Metropolitan Washington COG Center	Regional metropolitan planning organization		Metropolitan Washington COG Center
MNCPPC DASH	Maryland - National Capital Park and Planning Commission - Data acquisition software and hardware	Archived Data Management System	
MWAA Center	Reagan National & Dulles International Airports		MWAA Center
National Park Service	Responsible for Operating B/W & G/W Parkways	Public Safety Center	
NOVA Local Planning Centers	Arlington, Fairfax, Loudoun, and Prince William Counties		NOVA Local Planning Centers
NOVA Local Public Safety Centers	Local Police and Fire - Includes Arlington County, Fairfax County, Loudoun County, Prince William County and City of Alexandria and their field vehicles		NOVA Local Public Safety Centers
NOVA Local Signal Centers	Traffic Signal Systems for Arlington County, Cities of Alexandria, Fairfax, Manassas and Manassas Park and Towns of Herndon, Leesburg and Vienna		NOVA Local Signal Centers
NOVA Local Transit Centers	Local Bus Services: Metrobus, Fairfax Connector, Arlington Trolley, Alexandria DASH, City of Fairfax CUE, Loudoun Transport Association, PRTC Omnilink, and Springfield TAGS METRO & Circulator operations / dispatch centers and their vehicles Commuter Bus Services: Loudoun County Commuter Service and PRTC OmniRide operations / dispatch centers and their vehicles Para-Transit: WMATA Metro Access, Fairfax County Fastran, Alexandria DOT, Arlington STAR, City Wheels (City of Fairfax), and Fare Wheels (City of Falls Church) operations / dispatch centers and their vehicles		NOVA Local Transit Centers
NVTC Center	Northern Virginia Transportation Commission		NVTC Center
Other NOVA Local Planning Centers			
Other NOVA Local Public Safety Centers			
Other NOVA Local Signal Centers			
Other NOVA Local Transit Centers			
Partners In Motion / Information Service Provider (ISP) Centers / Media	Regional Traveler Information provider under the brand name Partners In Motion	Information Service Provider (ISP) Centers / Media	ISP Centers
Prince George's County - The Bus / Transit Management Center	Prince George's County "The Bus" operations / dispatch center and their vehicles	Transit Management Center	
FedEx Field TMC / Arterial Management Center (TMC)	Part-time Operations Center for Fed Ex Field	Arterial Management Center (TMC)	

Stakeholder	Description	Element Type	Element Name
SHA Signals / Arterial Management Center (TMC)	MD SHA OOTS	Arterial Management Center (TMC)	
Smart Tag Center	VDOT Smart Tag Customer Service Center - Includes administration for Dulles Toll Road, Greenway and other toll facilities in VA		Smart Tag Center
TRIP / Arterial Management Center (TMC)	Prince George's County TRIP Center	Arterial Management Center (TMC)	
VDOT Mobility Data Store	Data archiving for VDOT statewide and NOVA District		VDOT Mobility Data Store
VDOT Dulles Toll Road Center	Dulles Toll Road Operations Center		VDOT Dulles Toll Road Center
VDOT NOVA Safety Service Patrol	Safety service patrols operated by VDOT NOVA		VDOT NOVA Safety Service Patrol
VDOT NOVA Smart Traffic Center	VDOT NOVA Freeway Management Center		VDOT NOVA Smart Traffic Center
VDOT NOVA STSS	VDOT NOVA SMART TRAFFIC Signal System		VDOT NOVA STSS
VDOT NOVA TCC	VDOT NOVA Transportation Communication Center		VDOT NOVA TCC
Virginia State Police Center	State Law Enforcement operations / dispatch center and their vehicles		Virginia State Police Center
Virginia Truck Weigh Stations	A component of the Commercial Vehicle ITS Program in Virginia, administered by the Virginia Department of Motor Vehicles		Virginia Truck Weigh Stations
VRE Center	Commuter Rail and Amtrak operations / dispatch center		
WMATA	Regional Transit Agency operations / dispatch center and their vehicles	Transit Management Center	NOVA Local Transit Centers

Table 1: Metropolitan Washington Area ITS Architecture Stakeholders

can be specified at a metropolitan, statewide, multi-state, or corridor level. Within a metropolitan area, the metropolitan planning area should be the minimum area that is considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture.

Table 2 summarizes how the Metropolitan Washington Area ITS Architecture meets the requirements of the Final Architecture Rule.

Final Architecture Rule Conformity Requirements	Metropolitan Washington Area ITS Architecture Consistency
A description of the region	Conforms. See Section 1.3
Identification of the participating agencies and other stakeholders	Conforms. See Section 2.3
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	Conforms. See Section 2.3
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	Conforms. 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.
Identification of system functional requirements	Conforms. See Table 3 and Appendices B and C.
Interface requirements and information exchanges with planned and existing systems and subsystems	Conformity will be achieved upon the successful completion of Task 4 set forth in Figure 2: Project Workflow Chart.
Identification of ITS standards supporting regional and national interoperability	Conformity will be achieved upon the successful completion of Task 4 set forth in Figure 2: Project Workflow Chart.
The sequence of projects required for implementation	The MWCOG / NCRTPB ITS Architecture Working Group is developing a high-level sequencing of projects that could be set forth in the on-going development of the MWCOG / NCRTPB Management, Operations and ITS Strategic Plan.
Identify any changes made in a project design that impact the regional ITS architecture along with the appropriate revisions made and agreed to	The MWCOG / NCRTPB ITS Architecture Working Group is developing a process that allows for periodic update and supports conformity as set forth in the Final Architecture Rule.

Table 2: Summary of Final Architecture Rule and Conformity Requirements

2.5 Role of the MWCOG / NCRTPB ITS Architecture Working Group

The MWCOG / NCRTPB ITS Architecture Working Group contains members from MWCOG / NCRTPB jurisdictions actively involved in advancing ITS. The Subcommittee advises the MWCOG / NCRTPB ITS Technical Task Force on architecture issues. As such, the Subcommittee has been tasked with overseeing the development of the Metropolitan Washington Area ITS Architecture.

The Subcommittee provided critical guidance and direction in the development of the regional architecture, and reviewed and approved deliverables and content that went into the

development of the architecture. Seven meetings were held with the Subcommittee between January 4, 2001 and July 25, 2001. Key issues discussed and agreed upon at these meetings include:

- Turbo Architecture, a software package that supports development of regional and project ITS architectures using the National ITS Architecture as a starting point, was used in developing the Metropolitan Washington Area ITS Architecture. Use of the Turbo Architecture will also facilitate consistency with the current development of the Maryland Statewide and VDOT NOVA ITS Architecture efforts.

- Expanded the review of on-going reports and project development efforts as appropriate. The 2001 MD SHA CHART Business Plan and the MD SHA CHART Functional Visioning Plan, MD SHA efforts that were completed in January 2001, and coordinating with MWCOG / NCRTPB's ITS as a Data Resource Consultant Team to work through data archiving issues, were conducted.

- Interviews were re-instituted as identified in the original work plan and conducted with targeted agencies / stakeholder groups to obtain additional information, priorities, and input for use in validating the regional architecture

- The Metropolitan Washington Area ITS Architecture must be coordinated with the on-going development of the WMATA ITS Strategic Plan that is being conducted by WMATA's Office of Systems. Subsystems, market packages, interfaces and architecture flows for WMATA as set forth in the regional architecture are based on initial drafts (December 4, 2000) of the Strategic Plan.

- The regional architecture will be a "living document" requiring on-going update and maintenance. Furthermore, a sequence of projects required for implementation and a process whereby changes made in a project's design that impacts the regional architecture must be identified by January 8, 2005 in order to achieve full conformity with the Final Architecture Rule.

- New market packages currently under development for inclusion into the National ITS Architecture were not included at this time in the Metropolitan Washington Area ITS Architecture. They will be included in future update efforts.

- Reviewed and commented upon proposed subsystems, market packages, interconnects and data flows in the regional architecture

- The regional architecture will reflect current and planned architecture flows defined by stakeholders

- Conformity to the Final Architecture Rule will be will be reviewed

3.0 Development of the Architecture

The Metropolitan Washington Area ITS Architecture was developed as shown in Tasks 1-3 of Figure 2: Project Workflow Chart. Specifically:

- A number of reports and documents were reviewed to identify existing and planned ITS for the purpose of identifying ITS subsystems

- ITS Market Packages were identified that support the subsystems

- Subsystems and market packages were programmed into the Turbo Architecture software package to develop a Strawman Architecture. The Strawman Architecture represents an initial draft of the regional architecture and identifies interconnects and architecture flows required to facilitate the subsystem processes among stakeholders.

- The Strawman Architecture was reviewed and validated by reaching out to targeted stakeholders and working closely with the Maryland Statewide and VDOT NOVA District ITS Architecture teams

3.1 Identification of Subsystems

In the context of the National ITS Architecture, the physical architecture provides stakeholders with a physical representation via a high-level structure (though not a detailed design) of important ITS interfaces and major system components.
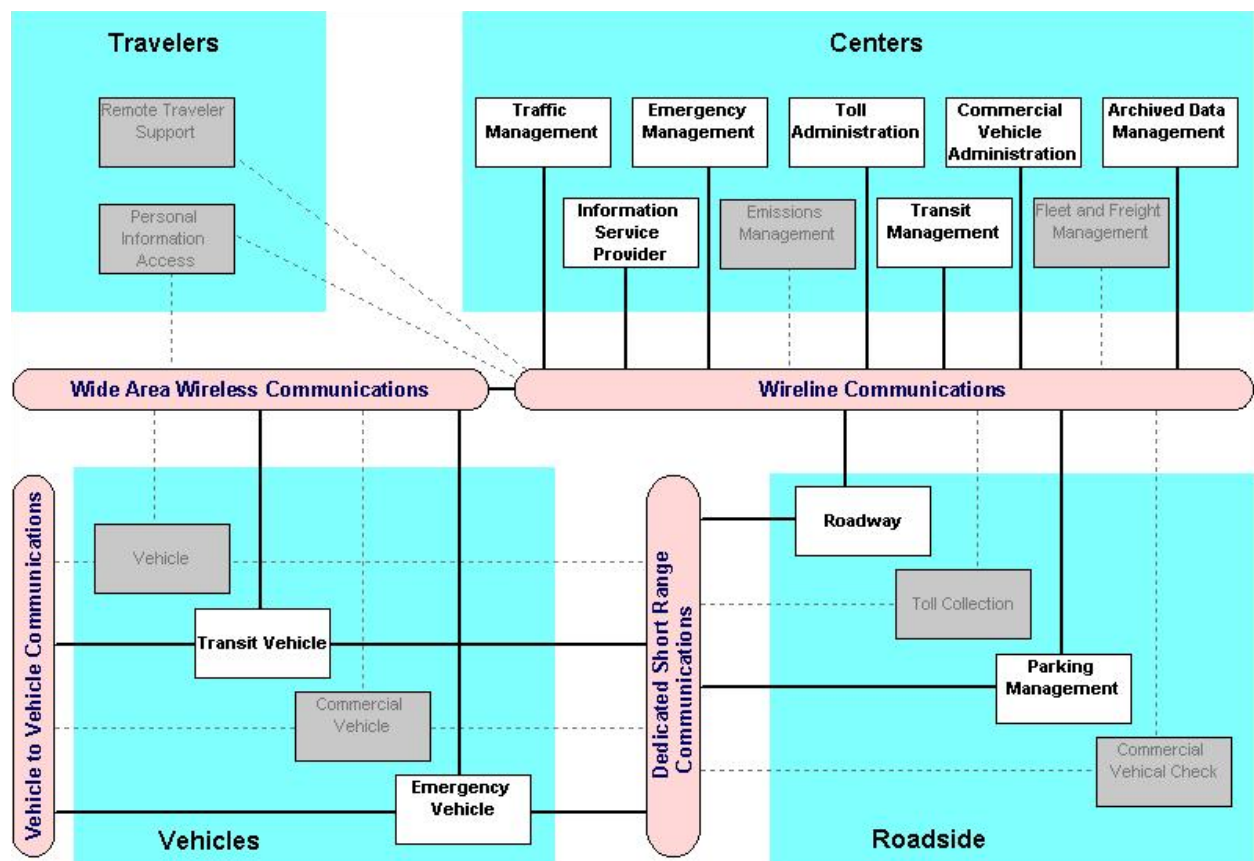

Figure 3: Metropolitan Washington Area ITS Architecture Subsystems

As shown in Figure 3, the principal elements in the physical architecture are the 19 subsystems and architecture flows that connect these subsystems, as well as external terminators, into an overall structure. The 11 subsystems contained in the Metropolitan Washington ITS Architecture

15

are highlighted for reference. As previously discussed in Section 2.2 Operations, the remaining seven subsystems are not required by the regional stakeholders.

Table 3 assigns these 11 subsystems to each of the Metropolitan Washington Area ITS Architecture stakeholders. Note that each subsystem is traced to one of the following reports or a recommendation of the CSC / PBF Team approved by the MWCOG / NCRTPB ITS Architecture Working Group. Definitions of the 11 subsystems are set forth in Appendix A.

- "The Wolf Report": February 24, 1997 – The report focuses on five areas or visions for the MWCOG / NCRTPB Region including 1) Simplifying the method of payment for transportation services; 2) Reducing congestion related crashes on the Capital Beltway, other Interstate highways and on major arterials; 3) Improving the reliability and predictability of operating conditions on the region's interstate system; 4) Providing accurate and timely transportation service information; and 5) Improving customer services related to natural and man-made emergencies.

- National Capital Area "Umbrella" ITS Early Deployment Study: April 25, 1997 – The "Umbrella" study is a region-wide ITS early deployment study focusing on ITS initiatives and opportunities for ITS applications. The study addressed freeway and incident management systems, traffic control, traveler information, electronic payment, public transit systems, and commercial vehicle operations.

- MD SHA CHART Regional Operations Coordination, November 1998 – This study developed a feasible framework for MD SHA, Prince George's County and Montgomery County agencies to conduct coordinated transportation management at the regional level.

- Commercial Vehicle Information Systems and Network, Ten-Year Implementation and Maintenance Plan, June 30, 1999 – This report provides site survey information, cost estimates, and schedules for the implementation and ten-year maintenance of Maryland's Commercial Vehicle Information Systems and Networks (CVISN) Program. The study describes three broad "groupings" of CVISN systems to include Roadside Operations Computer (ROC) and Screening Systems; the International Registration Plan (IRP) System; and the International Fuel Tax Agreement (IFTA) System.

- National Capital Regional TPB Vision Document, 1999 – The vision document sets forth eight Policy Goals developed by the TPB for the MWCOG / NCRTPB region's transportation system. Policy goals whose objectives required the implementation of advanced technologies were reviewed for their regional implication.

- VDOT NOVA District Smart Travel Strategic Plan, 1999 – This report presents the short-term recommended list of Smart Travel projects for the VDOT NOVA District. It is a living document that will contribute to the establishment of an integrated Smart Travel system in Northern Virginia.

- Regional Payment Systems Partnership, September 2000 – This study identifies a longer-term vision for a multi-modal and multi-agency electronic payment system. It also sets forth a practical action plan that builds on current programs and accomplishments.

Table 3 Insert

- Arlington County Telecommunications Upgrade - DRAFT Technical Memorandum No. 2: ITS Architecture Needs, November 6, 2000 – This document sets forth a high-level ITS architecture for Arlington County's Department of Public Works.

- WMATA DRAFT ITS Strategic Plan: December 4, 2000 – This document sets forth WMATA ITS needs and solutions that have been selected for further detailed analysis as well as a high-level systems architecture.

- Multi-Jurisdictional Transportation Telecommunications Study, 2000 – This report documents specific interconnections of fiber assets that could facilitate data sharing activities in the MWCOG / NCRTPB region. Furthermore, it recommends future opportunities to support a long-term vision of ITS data sharing, immediate opportunities for the interconnection of fiber assets, and a proposed regional fiber backbone network. The report also contains an appendix documenting interviews of many MWCOG / NCRTPB member jurisdictions regarding their current and future ITS plans.

- USDOT ITS Deployment Database, 2000: http://itsdeployment.ed.ornl.gov - The database contains findings on freeway, arterial, transit, emergency and incident management, and electronic toll collection information on operations centers, deployment, standards, data archiving, and integration from a comprehensive survey of the Washington area's transportation agencies.

- MD SHA CHART Functional Vision, January 18, 2001 – The CHART Functional Vision expands the CHART Business Plan process by documenting a broader vision of future CHART functionality for traffic and roadway monitoring, traveler information, traffic management and incident management.

- MD SHA CHART Draft Business Plan, January 2001 – The CHART Business Plan presents a 6-year plan for the continued development and implementation of ITS by the MD SHA.

3.2 Identification of Market Packages

Market Packages provide an accessible, deployment oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real world transportation problems and needs. Market packages collect together one or more subsystem processes that must work together to deliver a given transportation service and the architecture flows that connect them and other important external systems. In short, market packages identify the pieces of the physical architecture that are required to implement subsystems.

Forty-two (42) of the 63 market packages set forth in the National ITS Architecture have been included in the Metropolitan Washington Area ITS Architecture. (The remaining 21 market packages support and facilitate the other seven subsystems not included in the regional architecture, or they support internal subsystem processes that are not part of the regional architecture). Appendix B traces each of the 42 market packages to the 11 subsystems and Metropolitan Washington Area ITS stakeholders. Based upon the review of the aforementioned reports and documents in Section 3.1, market packages have been further broken out to reflect their existing, planned or future nature. Definitions of the 423 market packages are also set forth in Appendix B.

3.3 Identification of Interconnects

In the context of the National ITS Architecture, interconnects represent communication transfers between stakeholders required to implement one or more subsystem processes. To that end, the Turbo Architecture software package is an ideal tool to quickly identify the various combinations of interconnects between the 11 subsystems and 41 stakeholders in the Metropolitan Washington Area ITS Architecture as it automatically identifies the desired interconnects based upon the programmed subsystems and market packages.

The software, however, also automatically assumes many things. For example, the Metropolitan Washington Area ITS Architecture contains 13 stakeholders that support the traffic management subsystem and as such, the Turbo Architecture assumes 125 interconnects (each stakeholder is assumed to be connected to the other 12 stakeholders). In reality, however, an interconnect between the Montgomery County, Maryland Traffic Management Center and the VDOT NOVA Smart Traffic Signal System is not required by either stakeholder. As such, the interconnects have been customized to reflect the realities of the region.

Appendix C summarizes Metropolitan Washington Area ITS Architecture interconnects for each of the 41 stakeholders. The Appendix also notes which of the 11 subsystems are facilitated by the interconnects. Whereas Table 3 (See Section 3.1) and Appendix B summarized requisite information needed to develop the regional architecture, Appendix C presents a tabular framework of the regional architecture at a high-level (excluding architecture flows).

3.4 Identification of Architecture Flows

In the context of the National ITS Architecture, architecture flows represent information that is exchanged between subsystems and terminators in the physical architecture. The architecture flows and their communication requirements define the interfaces which form the basis for much of the ongoing standards work in the ITS program. More importantly, identification of the Metropolitan Washington Area ITS Architecture flows is an essential element to successfully fulfilling the last two objectives of this project -- examination of regional ITS application interfaces alternatives and the development of a proof of concept.
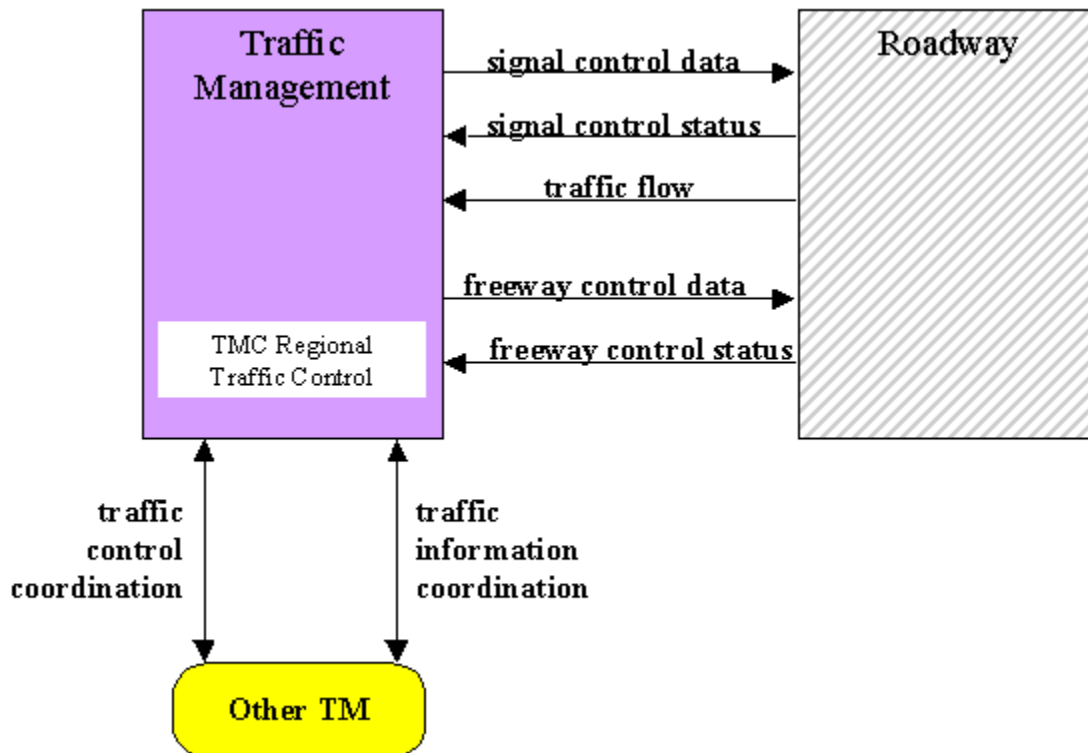

Figure 4: Regional Traffic Control Market Package Diagram

The Regional Traffic Control market package is mapped in Figure 4. The figure shows the relevant portions of the National ITS Architecture for this market package, including relevant architecture subsystems (Traffic Management and Roadway), equipment packages (TMC Regional Traffic Control), system terminators (Other Traffic Management Centers) and architecture flows (signal control data, traffic control information, etc.) that are the most important to the operation of the market package. The figure clearly shows that the traffic control coordination and traffic information coordination architecture flows are required to facilitate regional traffic control between two traffic management centers. As such, these two architecture flows are included in the regional architecture as they support the Traffic Management Subsystem function that many stakeholders require.

As the regional architecture is centered around roadway operations centers, transit dispatch centers and police / fire dispatch centers – locations where operational functions are performed and / or where data becomes regional information – architecture flows between the Traffic Management and Roadway Subsystems are not included in the regional architecture. 87 of the 168 architecture flows in the National ITS Architecture are contained in the Metropolitan Washington Area ITS Architecture. (The remaining 81 architecture flows support and facilitate the subsystems not included in the regional architecture, or they do not reflect the realities of the region). Appendix D traces each of the 87 architecture flows to the 11 subsystems contained in the Metropolitan Washington Area ITS stakeholders. Definitions of the 87 architecture flows are also set forth in Appendix D.

3.5 Validation of the Architecture

Development of the Metropolitan Washington Area ITS Architecture was accomplished by working closely with the MWCOG / NCRTPB ITS Architecture Working Group, the VDOT NOVA ITS Architecture effort and the Maryland Statewide ITS Architecture effort. Through the MWCOG / NCRTPB ITS Architecture Working Group and review of reports summarized in Section 3.1, much was known on the state of ITS in the region prior to developing the regional architecture and commencing with validation efforts, particularly at the state level and with other agencies who have legacy systems (e.g., Montgomery County).

Validation of the architecture was achieved by 1) continued coordination with the Maryland Statewide and VDOT NOVA District ITS initiatives, 2) continued review and guidance from the MWCOG / NCRTPB ITS Architecture Working Group, and 3) holding meetings with targeted stakeholders at the county and local levels. VDOT NOVA District ITS validation meetings (referenced below) were geared towards validating the VDOT NOVA ITS Architecture, however, many participating stakeholders were able to comment on both the regional and VDOT NOVA Architecture development efforts.

Comments from these three efforts were reviewed and incorporated into the architecture. In addition, a Final DRAFT of the regional architecture that has been reviewed and approved by the MWCOG / NCRTPB ITS Architecture Working Group, will be forwarded to all MWCOG / NCRTPB agencies for their review prior to final approval and acceptance of the MWCOG / NCRTPB ITS Architecture Working Group. Targeted validation meetings were held as follows:

- Prince George's County – The county has funding to design and develop an operations center. Revisions to the regional architecture included adding an interconnect between CAPWIN and the TRIP Center as the County anticipates participating in the CAPWIN project during later stages, and deleting interconnects with the DC Public Safety Center and the MD MTA / Transit Management Center. Any information exchange / coordination is expected to occur via CHART SOC and/or TOC3. Furthermore, the interconnect with the MWCOG / NCRTPB Center was deleted as data for archiving will go thru the Maryland National Capital Park and Planning Commission (MNCPPC) who will forward to the MWCOG / NCRTPB Center. In the future, its is anticipated that the TRIP Center

20

will have relatively limited interaction with the National Park Service, PG County "The Bus" / Transit Management Center, MD SHA Signals, and the DC DPW Center. Such interconnects are to be included in the regional architecture.

- District of Columbia Department of Public Works (DC DPW) – The DC DPW will be upgrading their traffic signal system. The project commenced in July 2001. Interconnects with Virginia State Police, NOVA Local Public Safety Providers, and Maryland Local Public Safety Providers were deleted, and architecture flows were curtailed to reflect DC DPW's interests in only monitoring the status of current activities.

- Northern Virginia Local Public Safety Centers - VDOT NOVA Safety Service Patrol, Arlington County Police, Fire and Emergency Communications Center, Fairfax County Police and Fire, and Prince William County Police and Public Safety Communications Center representatives participated. This meeting was coordinated with outreach and validation efforts of the VDOT NOVA ITS Architecture. The interconnect with the VDOT NOVA TCC was eliminated. Direct coordination is not required. Coordination and/or information, if required, would occur from NOVA Local Public Safety Centers to VDOT NOVA TCC via the VDOT NOVA STC.

- Northern Virginia Traffic Management Operations – The Cities of Fairfax and of Falls Church, VDOT NOVA Smart Traffic Signal System (STSS), Greenway, VDOT Dulles Toll Road, VDOT NOVA Smart Traffic Center, City of Alexandria and MD SHA CHART representatives participated. This meeting was coordinated with outreach and validation efforts of the VDOT NOVA ITS Architecture. Revisions included adding the towns of Herndon and Vienna to the description of NOVA Local Signal Centers, and adding interconnects with the VDOT NOVA STSS and DC DPW to coordinate corridor arterial operations. Furthermore, the regional architecture is to reflect the continued stand-alone operations of the VDOT NOVA STC and VDOT NOVA STSS operations over the upcoming 5-10 years.

- Northern Virginia Local Transit Providers – Washington Metropolitan Area Transit Authority (WMATA), Virginia Railway Express (VRE), Potomac and Rappahannock Transportation Commission (PRTC), Virginia Department of Rail and Public transportation (VDRPT) Northern Virginia Transportation Commission (NVTC), Fairfax County Connector, Fairfax FastTran, City of Fairfax CUE, Arlington ART, and Alexandria DASH representatives participated. This meeting was coordinated with outreach and validation efforts of the VDOT NOVA ITS Architecture. Revisions included adding Fairfax FASTRAN, Arlington STAR, PRTC FlexRoute, Alexandria DOT, and Loudoun County Express to the description for NOVA Local Transit Providers, and revising the architecture to accommodate future bus priority via roadside communications.

- Regional Electronic Fare Payment Providers - VDOT, VDRPT, WMATA, PRTC, VDOT Dulles Toll Road, Greenway, and I-95 Corridor Coalition representatives participated. This meeting was coordinated with outreach and validation efforts of the VDOT NOVA ITS Architecture. There was no consensus at this meeting that on-going regional and VDOT NOVA ITS Architecture efforts should reflect a common electronic fare payment system for vehicular, bus and rail travel.

- Washington Metropolitan Area Transit Authority – Office of Systems and Office of Business Planning and Development were in attendance. Interconnects were requested that would allow MD SHA and VDOT CCTV camera images to be forwarded to their bus operations center, bus Automatic Vehicle Location (AVL) data to be to be exchanged among regional transit providers to refine schedule adherence and operations, and WMATA police vehicles to have emergency vehicle priority along signalized arterials. The regional architecture is consistent with the current DRAFT WMATA ITS Strategic Plan at a high-level. The DRAFT plan is anticipated to be completed and accepted by the WMATA Board by the end of 2001.

- Three architecture workshops were held in March 2002. Representatives of all 41 stakeholders were invited to provide comments on a Final Draft Architecture Report and to review in detail the process and proceedings on how the architecture was developed. Comments from VDOT, DC DOT, Montgomery County, Prince George's County and the City of Alexandria were addressed and incorporated in Version 1.0 of the regional ITS architecture.

4.0 Metropolitan Washington Area ITS Architecture

The Metropolitan Washington Area ITS Architecture is presented as follows:

- A printout of all existing and planned interconnects between all 41 stakeholders is included in the notebook binder cover. Existing interconnects assume fiber optic cable or advanced wireless communications media, and exclude the ad hoc use of the telephone, two-way radio, e-mail, facsimile and pagers. Planned interconnects represent potential interconnects between stakeholders that would support the electronic exchange of information. Furthermore, planned interconnects do not imply that resources and funding have been allocated to deploy the interconnect.

- In Appendix E, diagrams illustrating existing and planned interconnects for each of the 41 stakeholders are provided. A listing of all existing and planned architecture flows between all 41 stakeholders is also provided in Appendix E.

4.1 Using the Architecture

Architecture is a term used by systems engineers to describe and set forth planned interconnects between diverse stakeholders and their computerized systems. Interconnects are defined by the data that flows between the systems. In addition, standards required to ensure that each computerized system can understand and communicate data in a uniform fashion are also included in an ITS architecture.

ITS architectures are important when ITS elements/systems are implemented in an incremental fashion by multiple lead agencies. Computer systems are very difficult to modify once they have been implemented. Extraction of data from a system that is not designed for that purpose can be very costly. It is often less costly to replace an entire system than it is to reconfigure it for specific data extraction. An architecture allows systems to be designed up front to accommodate future connections to other computer systems.

The Metropolitan Washington Area ITS Architecture is simply a plan that describes how regional stakeholders can connect their computerized systems, and what types of data will flow across those connections to facilitate functions such as traffic management, transit management, etc. The architecture can be used by stakeholders as follows:

- It allows stakeholders to review and understand what other regional stakeholders have implemented and have planned.

- Stakeholders can refine, prioritize, or re-prioritize their ITS program goals, objectives, and projects as needed.

- The regional architecture provides a guideline and framework for stakeholders who plan to implement ITS regionally

- Identify existing, planned, or new architecture flows required to support specific projects and/or subsystems

Appendix A – Summary of Subsystems

Archived Data Management Subsystem (adms)

The Archived Data Management Subsystem 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. The data received is formatted, tagged with attributes that define the data source, conditions under which it was collected, data transformations, and other information (i.e. meta data) necessary to interpret the data. The subsystem can fuse ITS generated data with data from non-ITS sources and other archives to generate information products utilizing data from multiple functional areas, modes, and jurisdictions. The subsystem prepares data products that can serve as inputs to Federal, State, and local data reporting systems. This subsystem may be implemented in many different ways. It may reside within an operational center and provide focused access to a particular agency's data archives. Alternatively, it may operate as a distinct center that collects data from multiple agencies and sources and provides a general data warehouse service for a region.

Commercial Vehicle Administration Subsystem (cvas)

The Commercial Vehicle Administration Subsystem will operate at one or more fixed locations within a region. This subsystem performs administrative functions supporting credentials, tax, and safety regulations. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. This subsystem communicates with the Fleet Management Subsystems associated with the motor carriers to process credentials applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. The subsystem also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with other cognizant authorities. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (in other states/regions) to support nationwide access to credentials and safety information for administration and enforcement functions. This subsystem supports communications with Commercial Vehicle Check Subsystems operating at the roadside to enable credential checking and safety information collection. The collected safety information is processed, stored, and made available to qualified stakeholders to identify carriers and drivers that operate unsafely.

Emergency Management Subsystem (em)

The Emergency Management Subsystem operates in various emergency centers supporting public safety including police and fire stations, search and rescue special detachments, and HAZMAT response teams. This subsystem interfaces with other Emergency Management Subsystems to support coordinated emergency response involving multiple agencies. The subsystem creates, stores, and utilizes emergency response plans to facilitate coordinated response. The subsystem tracks and manages emergency vehicle fleets using automated vehicle location technology and two-way communications with the vehicle fleet. Real-time traffic information received from the other center subsystems is used to further aide the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the timeliest response. Interface with the Traffic Management Subsystem allows strategic coordination in tailoring traffic control to support en-route emergency vehicles. Interface with the Transit Management Subsystem allows coordinated use of transit vehicles to facilitate response to major emergencies.

Information Service Provider Subsystem (isp)

This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The subsystem can play several different roles in an integrated ITS. In one role, the ISP provides a general data warehousing function, collecting

information from transportation system operators and redistributing this information to other system operators in the region and other ISPs. In this information redistribution role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information. The second role of an ISP is focused on delivery of traveler information to subscribers and the public at large. Information provided includes basic advisories, real time traffic condition and transit schedule information, yellow pages information, ridematching information, and parking information. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. The information is provided to the traveler through the Personal Information Access Subsystem, Remote Traveler Support Subsystem, and various Vehicle Subsystems through available communications links. Both basic one-way (broadcast) and personalized two-way information provision is supported. The subsystem provides the capability for an informational infrastructure to connect providers and consumers, and gather that market information needed to assist in the planning of service improvements and in maintenance of operations.

Traffic Management Subsystem (tms)

The Traffic Management Subsystem operates within a traffic management center or other fixed location. This subsystem communicates with the Roadway Subsystem to monitor and manage traffic flow. Incidents are detected and verified and incident information is provided to the Emergency Management Subsystem, travelers (through Roadway Subsystem Highway Advisory Radio and Dynamic Message Signs), and to third party providers. The subsystem supports HOV lane management and coordination, road pricing, and other demand management policies that can alleviate congestion and influence mode selection. The subsystem monitors and manages maintenance work and disseminates maintenance work schedules and road closures. The subsystem also manages reversible lane facilities, and processes probe vehicle information. The subsystem communicates with other Traffic Management Subsystems to coordinate traffic information and control strategies in neighboring jurisdictions. It also coordinates with rail operations to support safer and more efficient highway traffic management at highway-rail intersections. Finally, the Traffic Management Subsystem provides the capabilities to exercise control over those devices utilized for AHS traffic and vehicle control.

Transit Management Subsystem (trms)

The transit management subsystem 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, and paratransit services. The subsystem's interfaces allow for communication between transit departments and with other operating entities such as emergency response services and traffic management systems. This subsystem receives special event and real-time incident data from the traffic management subsystem. It provides current transit operations data to other center subsystems. The Transit Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from transit vehicles, manages vehicle service histories, and assigns drivers and maintenance personnel to vehicles and routes. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations. It furnishes travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the monitoring of key

transit locations with both video and audio systems is provided with automatic alerting of operators and police of potential incidents including support for traveler activated alarms.

Toll Administration Subsystem (tas)

The Toll Administration Subsystem provides general payment administration capabilities and supports the electronic transfer of authenticated funds from the customer to the transportation system operator. This subsystem supports traveler enrollment and collection of both pre-payment and post-payment transportation fees in coordination with the existing, and evolving financial infrastructure supporting electronic payment transactions. The system may establish and administer escrow accounts depending on the clearinghouse scheme and the type of payments involved. This subsystem posts a transaction to the customer account and generates a bill (for post-payment accounts), debits an escrow account, or interfaces to the financial infrastructure to debit a customer designated account. It supports communications with the Toll Collection Subsystem to support fee collection operations. The subsystem also sets and administers the pricing structures and includes the capability to implement road pricing policies in coordination with the Traffic Management Subsystem. The electronic financial transactions in which this subsystem is an intermediary between the customer and the financial infrastructure shall be cryptographically protected and authenticated to preserve privacy and ensure authenticity and audit ability.

Parking Management Subsystem (pms)

The Parking Management Subsystem provides electronic monitoring and management of parking facilities. It supports a DSRC communications link to the Vehicle Subsystem that allows electronic collection of parking fees. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also interfaces with the financial infrastructure and broadly disseminates parking information to other operational centers in the region. Note that the latter functionality may be located in a back office, remote from the parking facility.

Roadway Subsystem (rs)

This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic. Equipment includes highway advisory radios, dynamic message signs, cellular call boxes, CCTV cameras and video image processing systems for incident detection and verification, vehicle detectors, traffic signals, grade crossing warning systems, and freeway ramp metering systems. This subsystem also provides the capability for emissions and environmental condition monitoring including weather sensors, pavement icing sensors, fog etc. HOV lane management and reversible lane management functions are also available. In advanced implementations, this subsystem supports automated vehicle safety systems by safely controlling access to and egress from an Automated Highway System through monitoring of, and communications with, AHS vehicles. Intersection collision avoidance functions are provided by determining the probability of a collision in the intersection and sending appropriate warnings and/or control actions to the approaching vehicles.

Emergency Vehicle Subsystem (evs)

This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response. The Emergency Vehicle Subsystem includes two-way communications to support coordinated response to emergencies in accordance with an associated Emergency Management Subsystem. Emergency vehicles are equipped with automated vehicle location capability for monitoring by vehicle tracking and fleet management functions in the Emergency Management Subsystem. Using these capabilities, the appropriate emergency vehicle to respond to each

emergency is determined. Route guidance capabilities within the vehicle enable safe and efficient routing to the emergency. In addition, the emergency vehicle may be equipped to support signal preemption through communications with the roadside subsystem.

Transit Vehicle Subsystem (trvs)

This subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The Transit Vehicle Subsystem collects accurate ridership levels and supports electronic fare collection. An optional traffic signal prioritization function communicates with the roadside subsystem to improve on-schedule performance. Automated vehicle location functions enhance the information available to the Transit Management Subsystem enabling more efficient operations. On-board sensors support transit vehicle maintenance. The Transit Vehicle Subsystem also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.

Appendix B – Summary of Market Packages

Market Package table Insert

ITS Data Mart (ad1)

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

ITS Data Warehouse (ad2)

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

ITS Virtual Data Warehouse (ad3)

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

Transit Vehicle Tracking (apts1)

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

Transit fixed-route Operations (apts2)

This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data, and is implemented through data processing and information display at the transit management subsystem. This data is exchanged using the existing wireline link to the information service provider where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.

Demand Response Transit Operations (apts3)

This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services. This package uses the existing

AVL database to monitor current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. The Information Service Provider Subsystem may be either be operated by transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines the paratransit service is a viable means of satisfying a traveler request and uses wireline communications to make a reservation for the traveler.

Transit Passenger and Fare Management (apts4)

This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card. This package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem using existing wireless infrastructure.

Multi-modal Coordination (apts7)

This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Intermodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.

Transit Traveler Information (apts8)

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

Broadcast Traveler Information (atis1)

This market package provides the user with a basic set of ATIS services; its objective is early acceptance. It involves the collection of traffic conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). Different from the market package ATMS6--Traffic Information Dissemination--which provides the more basic HAR and DMS information capabilities, ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

Interactive Traveler Information (atis2)

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler

can obtain current information regarding traffic conditions, transit services, ride share/ride match, parking management, and pricing information. A range of two-way wide-area wireless and wireline communications systems may be used to support the required digital communications between traveler and the information service provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route to include phone, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

Dynamic Route Guidance (atis4)

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

ISP Based Route Guidance (atis5)

This market package offers the user advanced route planning and guidance that is responsive to current conditions. Different than the Dynamic Route Guidance Market Package, this market package moves the route planning function from the user device to the information service provider. This approach simplifies the user equipment requirements and can provide the infrastructure better information on which to predict future traffic and appropriate control strategies to support basic route planning with minimal user equipment. The package includes both turn-by-turn route guidance as might be used in a vehicle, as well as pre-trip routes. The package includes two-way data communications and optionally also equips the vehicle with the databases, location determination capability, and display technology to support turn-by-turn route guidance.

Integrated Transportation Management/Route Guidance (atis6)

This market package allows a traffic management center to continuously optimize the traffic control strategy based on near-real time information on intended routes for a proportion of the vehicles within their network while offering the user advanced route planning and guidance which is responsive to current conditions. It would utilize the individual and ISP route planning information to optimize signal timing while at the same time providing updated signal timing information to allow optimized route plans. The use of predictive link times for this market package are possible through utilizing the market package ATMS9--Traffic forecast and Demand Management--at the traffic management center.

Yellow Pages and Reservation (atis7)

This market package enhances the Interactive Traveler Information package by making infrastructure provided yellow pages and reservation services available to the user. The same basic user equipment is included. This market package provides multiple ways for accessing information either while en-route in a vehicle using wide-area wireless communications or pre-trip via wireline connections.

Dynamic Ridesharing (atis8)

This market package enhances the Interactive Traveler Information package by adding an infrastructure provided dynamic ridesharing/ride matching capability. In terms of equipment requirements, ATIS8 is similar to ATIS7.

In Vehicle Signing (atis9)

This market package supports distribution of traffic and travel advisory information to drivers through in-vehicle devices. It includes short-range communications between roadside

equipment and the vehicle and wireline connections to the Traffic Management Subsystem for coordination and control. This market package also informs the driver of both highway-highway and highway-rail intersection status.

Network Surveillance (atms01)

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

Probe Surveillance (atms02)

This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and Information Service Provider is used to communicate current vehicle location and status, and 2) dedicated short range communications between the vehicle and roadside is used to provide equivalent information back to the Traffic Management Subsystem. The first approach leverages wide area communications equipment that may already be in the vehicle to support personal safety and advanced traveler information services. The second approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short range communications applications identified within the architecture. The market package enables traffic managers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users and private information providers. It requires one of the communications options identified above, roadside beacons and wireline communications for the short range communications option, data reduction software, and utilizes wireline links between the Traffic Management Subsystem and Information Service Provider Subsystem to share the collected information. Both "Opt out" and "Opt in" strategies are available to ensure the user has the ability to turn off the probe functions to ensure individual privacy. Due to the large volume of data collected by probes, data reduction techniques are required in this market package which include the ability to identify and filter out-of-bounds or extreme data reports.

Surface Street Control (atms03)

This market package 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. A range of traffic signal control systems are represented by this market package ranging from static pre-timed control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. Additionally, general advisory and traffic control information can be provided to the driver while en-route. This market package is generally an intra-jurisdictional package that does not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.

Freeway Control (atms04)

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of

ramp meters are included as part of this market package. This package is consistent with typical urban traffic freeway control systems. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also 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. For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en-route.

HOV Lane Management (atms05)

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

Traffic Information Dissemination (atms06)

This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), transit management center, emergency management center, and information service provider.

Regional Traffic Control (atms07)

This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated Interjurisdictional traffic control. This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

Incident Management System (atms08)

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the freeway control market package and through the regional coordination with other traffic management and emergency management centers, weather service entities, and event promoters supported by this market package. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package provides Traffic Management Subsystem equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information

Dissemination market package. The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel.

Traffic Forecast and Demand Management (atms09)

This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of the roadway network performance. This includes the prediction of travel demand patterns to support better link travel time forecasts. The source data would come from the Traffic Management Subsystem itself as well as other traffic management centers and forecasted traffic loads derived from route plans supplied by the Information Service Provider Subsystem. In addition to short-term forecasts, this market package provides longer-range forecasts that can be used in transportation planning. This market package provides data that supports the implementation of TDM programs, and policies managing both traffic and the environment. Information on vehicle pollution levels, parking availability, usage levels, and vehicle occupancy are collected by monitoring sensors to support these functions. Demand management requests can also be made to Toll Administration, Transit Management, and Parking Management Subsystems.

Electronic Toll Collection (atms10)

This market package provides toll operators with the ability to collect tolls electronically and detect and process violators. Variations in the fees that are collected enables implementation of demand management strategies. Dedicated short-range communication between the roadway equipment and the vehicle is required as well as wireline interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. 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. The population of toll tags and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.

Emissions Monitoring and Management (atms11)

This market package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the emissions management subsystem for processing. Both individual detection and identification of vehicles that exceed emissions standards and general area-wide monitoring of air quality are supported by this market package. For area wide monitoring, this market package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this market package measures tail pipe emissions and identifies vehicles that exceed emissions standards. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

Virtual TMC and Smart Probe Data (atms12)

This market package provides for special requirements of rural road systems. Instead of a central TMC, the traffic management is distributed over a very wide area (e.g., a whole state or collection of states). Each locality has the capability of accessing available information for assessment of road conditions. The package uses vehicles as smart probes that are capable of measuring road conditions and providing this information to the roadway for relay to the Traffic Management Subsystem and potentially direct relay to following vehicles (i.e., the automated road signing equipment is capable of autonomous operation). In-vehicle signing is used to inform drivers of detected road conditions.

Standard Railroad Grade Crossing (atms13)

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

Advanced Railroad Grade Crossing (atms14)

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

Parking Facility Management (atms16)

This market package provides enhanced monitoring and management of parking facilities. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This is performed by sensing and collecting current parking facilities status, sharing the data with information service providers and traffic operations, and automatic fee collection using short-range communications with the same in-vehicle equipment utilized for electronic toll collection.

Reversible Lane Management (atms17)

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

Road Weather Information System (atms18)

This market package monitors current and forecast road and weather conditions using a combination of weather service information and data collected from environmental sensors

deployed on and about the roadway. The collected road weather information is monitored and analyzed to detect and forecast environmental hazards such as icy road conditions, dense fog, and approaching severe weather fronts. This information can be used to more effectively deploy road maintenance resources, issue general traveler advisories, and support location specific warnings to drivers using the Traffic Information Dissemination Market Package.

Regional Parking Management (atms19)

This market package supports coordination between parking facilities to enable regional parking management strategies.

Electronic Clearance (cvo03)

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem over wireline to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This package allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short-range communications to the roadside. The roadside check facility may be equipped with AVI, weighing sensors, transponder read/write devices, computer workstation processing hardware, software, and databases.

CV Administrative Processes (cvo04)

This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in the electronic clearance program provided by a separate market package that allows commercial vehicles to be screened at mainline speeds at commercial vehicle check points. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Subsystem and snapshots of this database are made available to the commercial vehicle check facilities at the roadside to support the electronic clearance process.

Roadside CVO Safety (cvo07)

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

HAZMAT Management (cvo10)

This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight

Management Subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

Emergency Response (em1)

This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the Emergency Management Subsystem and an Emergency Vehicle to enable an incident command system to be established and supported at the emergency location. The Emergency Management Subsystem would include hardware and software for tracking the emergency vehicles. Public safety, traffic management, and many other allied agencies may each participate in the coordinated response managed by this package.

Emergency Routing (em2)

This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s). The Information Service Provider Subsystem supports routing for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles. In this market package, the Information Service Provider Subsystem would typically be integrated with the Emergency Management Subsystem in a public safety communications center. The Emergency Vehicle would also optionally be equipped with dedicated short-range communications for local signal preemption.

Mayday Support (em3)

This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user and determine the appropriate response. The Emergency Management Subsystem may be operated by the public sector or by a private sector provider. The request from the traveler needing assistance may be manually initiated or automated and linked to vehicle sensors. The data is sent to the Emergency Management subsystem using wide area wireless communications with voice as an option. Providing user location implies either a location technology within the user device or location determination within the communications infrastructure.

Appendix C – Summary of Interconnects

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
Baltimore - Washington HIDTA	CHART/ Freeway Traffic Management Center (TMC)			X					X				
	DC DDOT Center			X					X				
	DC Public Safety Centers			X					X				
	Federal Installations			X									
	Greenway Center			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X					X				
	MD Local Public Safety Centers / Public Safety Center			X					X				
	MWAA Center			X									
	National Park Service			X									
	NOVA Local Public Safety Centers			X					X				
	TRIP / Arterial Traffic Management Center (TMC)			X					X				
	VDOT NOVA Safety Service Patrol			X					X				
	VDOT NOVA Smart Traffic Center			X					X				
	Virginia State Police Center			X					X				
CHART/ Freeway Traffic Management Center (TMC)	Baltimore - Washington HIDTA			X					X				
	DC DDOT Center			X								X	
	DC Public Safety Centers			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X								X	
	MD CVISN / Commercial Vehicle Operations (CVO) Systems		X										
	MD Local Public Safety Centers / Public Safety Center			X									
	MD MTA / Transit Management Center			X	X								
	Metropolitan Washington COG Center	X											
	MWAA Center			X									
	National Park Service			X								X	
	NOVA Local Public Safety Centers			X									
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	FedEx Field TMC / Arterial Traffic Management Center (TMC)			X	X							X	
	SHA Signals / Arterial Traffic Management Center (TMC)			X								X	
	TRIP / Arterial Traffic Management Center (TMC)			X								X	
	VDOT NOVA Smart Traffic Center			X								X	
	Virginia State Police Center			X									
	WMATA			X	X							X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
DC DDOT Center	Baltimore - Washington HIDTA			X					X				
	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	DC Public Safety Centers			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X								X	
	MD MTA / Transit Management Center							X					
	Metropolitan Washington COG Center	X											
	National Park Service			X								X	
	NOVA Local Signal Centers			X								X	
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	SHA Signals / Arterial Traffic Management Center (TMC)			X								X	
	TRIP / Arterial Traffic Management Center (TMC)			X								X	
	VDOT NOVA Smart Traffic Center			X								X	
	WMATA			X				X				X	
DC Public Safety Centers	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X									
	DC DDOT Center			X					X				
	MC TMC / Arterial Traffic Management Center (TMC)			X									
	MD MTA / Transit Management Center			X									
	NOVA Local Signal Centers			X					X				
	SHA Signals / Arterial Traffic Management Center (TMC)			X									
	VDOT NOVA Smart Traffic Center			X									
	WMATA			X									
Regional Transit Electronic Clearinghouse	MC TMC / Arterial Traffic Management Center (TMC)									X			
	MD MTA / Transit Management Center									X			
	NOVA Local Transit Centers									X			
	Prince George's County - The Bus / Transit Management Center									X			
	VDOT Mobility Data Store	X											
	VRE Center									X			
	WMATA									X			
Federal Installations	VDOT NOVA Smart Traffic Center			X								X	
	Virginia State Police Center			X									
	WMATA												
	MD Local Public Safety Centers / Public Safety Center			X									
	MD MTA / Transit Management Center												
	NOVA Local Public Safety Centers			X									
	NOVA Local Transit Centers												
	DC Public Safety Centers			X									

Stakeholder A	Stakeholder B	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
Greenway Center	Baltimore - Washington HIDTA												
	Metropolitan Washington COG Center	X											
	NOVA Local Public Safety Centers			X									
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	Smart Tag Center									X			
	VDOT Dulles Toll Road Center			X								X	
	VDOT Mobility Data Store												
	VDOT NOVA Smart Traffic Center			X								X	
	Virginia State Police Center			X									
MC TMC / Arterial Traffic Management Center (TMC)	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	DC DDOT Center			X								X	
	DC Public Safety Centers			X									
	Regional Transit Electronic Clearinghouse									X			
	MD Local Public Safety Centers / Public Safety Center			X			X						
	MD MTA / Transit Management Center						X	X					
	MNCPPC DASH	X											
	NOVA Local Public Safety Centers			X									
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	SHA Signals / Arterial Traffic Management Center (TMC)			X								X	
	TRIP / Arterial Traffic Management Center (TMC)			X								X	
	Virginia State Police Center			X									
	WMATA			X		X	X	X				X	X
MD CVISN / Commercial Vehicle Operations (CVO) Systems	CHART/ Freeway Traffic Management Center (TMC)		X										
	Metropolitan Washington COG Center	X											
	Virginia Truck Weigh Stations		X										

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
MD Local Public Safety Centers / Public Safety Center	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X									
	DC DDOT Center							X					
	Federal Installations			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X					X				
	MD MTA / Transit Management Center			X									
	National Park Service			X									
	Prince George's County - The Bus / Transit Management Center			X									
	FedEx Field TMC / Arterial Traffic Management Center (TMC)			X									
	SHA Signals / Arterial Traffic Management Center (TMC)			X					X				
	TRIP / Arterial Traffic Management Center (TMC)			X					X				
	WMATA			X									
MD MTA / Transit Management Center	CHART/ Freeway Traffic Management Center (TMC)			X	X								
	DC Public Safety Centers			X									
	Regional Transit Electronic Clearinghouse									X			
	MC TMC / Arterial Traffic Management Center (TMC)							X					
	MD Local Public Safety Centers / Public Safety Center			X									
	Metropolitan Washington COG Center	X											
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	SHA Signals / Arterial Traffic Management Center (TMC)			X				X				X	
	VRE Center												X
	WMATA												X

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
Metropolitan Washington COG Center	CHART/ Freeway Traffic Management Center (TMC)	X											
	DC DDOT Center	X											
	MC TMC / Arterial Traffic Management Center (TMC)	X											
	MD CVISN / Commercial Vehicle Operations (CVO) Systems	X											
	MD MTA / Transit Management Center	X											
	MNCPPC DASH	X											
	National Park Service	X											
	NOVA Local Planning Centers	X											
	NOVA Local Signal Centers	X											
	NOVA Local Transit Centers	X											
	NVTC Center	X											
	Partners In Motion / Information Service Provider (ISP) Center / Media	X			X								
	Prince George's County - The Bus / Transit Management Center	X											
	SHA Signals / Arterial Traffic Management Center (TMC)	X											
	VDOT Mobility Data Store	X											
	WMATA	X											
MNCPPC DASH	MC TMC / Arterial Traffic Management Center (TMC)	X											
	Metropolitan Washington COG Center	X											
	TRIP / Arterial Traffic Management Center (TMC)	X											
MWAA Center	Baltimore - Washington HIDTA												
	CHART/ Freeway Traffic Management Center (TMC)												
	Federal Installations												
	NOVA Local Public Safety Centers			X									
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT Dulles Toll Road Center					X							
	VDOT NOVA Smart Traffic Center					X							
	Virginia State Police Center			X									
National Park Service	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	Federal Installations			X									
	MD Local Public Safety Centers / Public Safety Center			X									
	Metropolitan Washington COG Center	X											
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	FedEx Field TMC / Arterial Traffic Management Center (TMC)											X	
	TRIP / Arterial Traffic Management Center (TMC)											X	
	VDOT NOVA Smart Traffic Center			X								X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
NOVA Local Planning Centers	Metropolitan Washington COG Center	X											
	NOVA Local Public Safety Centers	X											
	NOVA Local Signal Centers	X											
	NOVA Local Transit Centers	X											
	NVTC Center	X											
	VDOT Mobility Data Store	X											
	VDOT NOVA Smart Traffic Center	X											
	VDOT NOVA STSS	X											
NOVA Local Public Safety Centers	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X									
	Federal Installations												
	Greenway Center			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X									
	MWAA Center			X									
	NOVA Local Planning Centers												
	NOVA Local Signal Centers								X				
	NOVA Local Transit Centers			X									
	VDOT Dulles Toll Road Center			X									
	VDOT Mobility Data Store												
	VDOT NOVA Safety Service Patrol			X					X				
	VDOT NOVA Smart Traffic Center			X									
	VDOT NOVA STSS			X					X				
	WMATA			X									
NOVA Local Signal Centers	DC DDOT Center			X								X	
	DC Public Safety Centers			X									
	Regional Transit Electronic Clearinghouse									X			
	NOVA Local Planning Centers												
	NOVA Local Public Safety Centers			X			X						
	NOVA Local Transit Centers			X			X					X	
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT Mobility Data Store	X											
	VDOT NOVA Smart Traffic Center			X								X	
	VDOT NOVA STSS			X								X	
	Virginia State Police Center			X			X						
	WMATA			X			X					X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
NOVA Local Transit Centers	DC DDOT Center												
	Federal Installations												
	Metropolitan Washington COG Center	X											
	NOVA Local Public Safety Centers												
	NOVA Local Signal Centers			X								X	
	NVTC Center							X					
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT Mobility Data Store												
	VDOT NOVA Smart Traffic Center												
	VDOT NOVA STSS							X				X	
	Virginia State Police Center			X									
	VRE Center												X
	WMATA											X	X
NVTC Center	Metropolitan Washington COG Center	X											
	NOVA Local Planning Centers	X											
	NOVA Local Transit Centers	X											
	VDOT Mobility Data Store	X											
Other NOVA Local Planning Centers	NOVA Local Planning Centers	X											
Other NOVA Local Public Safety Centers	NOVA Local Public Safety Centers			X									
Other NOVA Local Signal Centers	NOVA Local Signal Centers											X	
Other NOVA Local Transit Centers	NOVA Local Transit Centers												X
Other Regional Electronic Toll Clearinghouses	Smart Tag Center									X	X		

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
Partners In Motion / Information Service Provider (ISP) Center / Media	CHART/ Freeway Traffic Management Center (TMC)				X								
	DC DDOT Center				X								
	Greenway Center				X								
	MC TMC / Arterial Traffic Management Center (TMC)				X								
	MD MTA / Transit Management Center				X								
	Metropolitan Washington COG Center				X								
	MWAA Center				X								
	National Park Service				X								
	NOVA Local Signal Centers				X								
	NOVA Local Transit Centers				X								
	Prince George's County - The Bus / Transit Management Center				X								
	SHA Signals / Arterial Traffic Management Center (TMC)				X								
	VDOT Dulles Toll Road Center				X								
	VDOT NOVA Smart Traffic Center				X								
	VDOT NOVA STSS				X								
	VDOT NOVA TCC				X								
	VRE Center				X								
	WMATA				X								
Prince George's County The Bus / Transit Management Center	Regional Transit Electronic Clearinghouse										X		
	MD Local Public Safety Centers / Public Safety Center			X									
	Metropolitan Washington COG Center	X											
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	SHA Signals / Arterial Traffic Management Center (TMC)							X					
	TRIP / Arterial Traffic Management Center (TMC)							X					
	WMATA												X
FedEx Field TMC / Arterial Traffic Management Center (TMC)	CHART/ Freeway Traffic Management Center (TMC)			X		X						X	
	MD Local Public Safety Centers / Public Safety Center			X									
	National Park Service			X								X	
	SHA Signals / Arterial Traffic Management Center (TMC)			X								X	
	TRIP / Arterial Traffic Management Center (TMC)			X		X						X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
SHA Signals / Arterial Traffic Management Center (TMC)	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	DC DDOT Center			X								X	
	DC Public Safety Centers			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X								X	
	MD Local Public Safety Centers / Public Safety Center			X									
	MD MTA / Transit Management Center			X			X						
	Metropolitan Washington COG Center	X											
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	Prince George's County - The Bus / Transit Management Center						X						
	FedEx Field TMC / Arterial Traffic Management Center (TMC)			X								X	
	TRIP / Arterial Traffic Management Center (TMC)			X								X	
	WMATA			X			X						
Smart Tag Center	Other Regional Electronic Toll Clearinghouse									X	X		
	Greenway Center									X			
	VDOT Dulles Toll Road Center									X			
TRIP / Arterial Traffic Management Center (TMC)	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	DC DDOT Center			X								X	
	MC TMC / Arterial Traffic Management Center (TMC)			X								X	
	MD Local Public Safety Centers / Public Safety Center			X			X						
	MNCPPC DASH	X											
	National Park Service			X								X	
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	Prince George's County - The Bus / Transit Management Center			X			X						
	FedEx Field TMC / Arterial Traffic Management Center (TMC)			X	X							X	X
	SHA Signals / Arterial Traffic Management Center (TMC)			X								X	
	WMATA			X		X	X						
VDOT Dulles Toll Road Center	Greenway Center			X								X	
	MWAA Center				X								
	NOVA Local Public Safety Centers			X									
	Partners In Motion / Information Service Provider (ISP) Center / Media												
	Smart Tag Center									X			
	VDOT NOVA Smart Traffic Center			X								X	
	Virginia State Police Center			X									
	WMATA			X								X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
VDOT Mobility Data Store	Metropolitan Washington COG Center	X											
	NOVA Local Planning Centers	X											
	NOVA Local Public Safety Centers	X											
	NOVA Local Signal Centers	X											
	NOVA Local Transit Centers	X											
	NVTC Center	X											
	Regional Transit Electronic Clearinghouse									X			
	VDOT NOVA Safety Service Patrol	X											
	VDOT NOVA Smart Traffic Center	X											
	VDOT NOVA STSS	X											
VDOT NOVA Safety Service Patrol	Baltimore - Washington HIDTA			X		X							
	Greenway Center												
	NOVA Local Signal Centers								X				
	VDOT Mobility Data Store	X											
	NOVA Local Public Safety Centers			X					X				
	VDOT NOVA STSS								X				
	VDOT NOVA Smart Traffic Center			X									
	Virginia State Police Center			X					X				
VDOT NOVA Smart Traffic Center	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X								X	
	DC DDOT Center			X								X	
	DC Public Safety Centers			X									
	Federal Installations			X									
	Greenway Center			X								X	
	MWAA Center				X								
	National Park Service			X								X	
	NOVA Local Public Safety Centers			X									
	NOVA Local Signal Centers											X	
	NOVA Local Transit Centers											X	
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT Mobility Data Store	X											
	VDOT Dulles Toll Road Center			X								X	
	VDOT NOVA Safety Service Patrol			X									
	VDOT NOVA STSS			X								X	
	VDOT NOVA TCC				X								
	Virginia State Police Center			X									
	VRE Center			X									
	WMATA			X		X						X	

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
VDOT NOVA STSS	NOVA Local Planning Centers	X											
	NOVA Local Public Safety Centers			X									
	NOVA Local Signal Centers						X					X	
	NOVA Local Transit Centers							X					X
	Partners In Motion / Information Service Provider (ISP) Center / Media				X		X						
	VDOT Mobility Data Store	X											
	VDOT NOVA Smart Traffic Center			X								X	
	VDOT NOVA Safety Service Patrol												
	Virginia State Police Center			X			X						
	WMATA			X			X						
VDOT NOVA TCC	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT NOVA Smart Traffic Center				X								
	Virginia State Police Center			X									
Virginia State Police Center	Baltimore - Washington HIDTA			X									
	CHART/ Freeway Traffic Management Center (TMC)			X									
	Federal Installations			X									
	Greenway Center			X									
	MC TMC / Arterial Traffic Management Center (TMC)			X									
	MWAA Center			X									
	NOVA Local Signal Centers			X					X				
	NOVA Local Transit Centers			X									
	VDOT Dulles Toll Road Center			X									
	VDOT NOVA Safety Service Patrol			X					X				
	VDOT NOVA Smart Traffic Center			X									
	VDOT NOVA STSS			X					X				
	VDOT NOVA TCC				X								
	WMATA			X									
Virginia Truck Weigh Stations	MD CVISN / Commercial Vehicle Operations (CVO) Systems		X										
	VDOT Mobility Data Store	X											
	VDOT NOVA Smart Traffic Center		X										
VRE Center	Regional Transit Electronic Clearinghouse									X			
	MD MTA / Transit Management Center												X
	NOVA Local Transit Centers												X
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	VDOT NOVA Smart Traffic Center												
	WMATA												X

Stakeholder A	Stakeholder B	Subsystems / Interconnects Traceability											
		Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
WMATA	CHART/ Freeway Traffic Management Center (TMC)					X							
	DC DDOT Center							X	X				
	DC Public Safety Centers			X									
	Regional Transit Electronic Clearinghouse									X			
	Federal Installations												
	MC TMC / Arterial Traffic Management Center (TMC)					X		X	X				X
	MD Local Public Safety Centers / Public Safety Center			X									
	MD MTA / Transit Management Center												X
	Metropolitan Washington COG Center	X											
	NOVA Local Public Safety Centers			X									
	NOVA Local Signal Centers							X	X				
	NOVA Local Transit Centers												X
	Partners In Motion / Information Service Provider (ISP) Center / Media				X								
	Prince George's County - The Bus / Transit Management Center												X
	SHA Signals / Arterial Traffic Management Center (TMC)							X	X				
	TRIP / Arterial Traffic Management Center (TMC)							X	X				
	VDOT Dulles Toll Road Center												
	VDOT Smart Traffic Center					X							
	VDOT NOVA STSS							X	X				
	Virginia State Police Center			X									
	VRE Center												X

Appendix D – Summary of Architecture Flows

Architecture Flows	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
					Subsystems							
activity reports		X										
archive analysis requests	X											
archive analysis results	X											
archive coordination	X											
archive request confirmation	X											
archive requests	X	X	X	X	X				X			X
archive status	X	X	X	X	X				X		X	X
archived data product requests	X											
archived data products	X											
bad tag list							X					X
broadcast information				X								
commercial vehicle archive data	X	X										
compliance review report		X										
credential application		X										
credentials and safety information request		X										
credentials and safety information response		X										
current network conditions			X								X	
demand responsive transit plan				X								X
demand responsive transit request				X								X
electronic credentials		X										
emergency acknowledge			X				X					X
emergency archive data	X		X									
emergency data request			X									
emergency dispatch requests			X					X				
emergency dispatch response			X					X				

53

Architecture Flows	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
emergency notification			X									X
emergency operations request			X									
emergency operations status			X									
emergency traffic control request			X								X	
emergency traffic control response			X								X	
emergency vehicle tracking data			X					X				
external reports				X							X	
fare and payment status							X					X
fare and price information				X							X	
fare management information							X					X
freeway control status						X					X	
HAZMAT information			X									
HAZMAT information request			X									
hov data						X					X	
incident command information			X					X				
incident command request			X					X				
incident data						X					X	
incident information			X	X							X	
incident information for media			X									
incident information request			X	X							X	
incident notification			X									
incident notification response			X									
incident report			X									
incident response coordination			X									
incident response status			X								X	

Architecture Flows	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
											Subsystems	
incident status			X					X				
information request		X										
ISP coordination				X								
local signal priority request						X	X					
logged special vehicle route				X							X	
media information request			X	X							X	X
parking archive data	X				X							
parking availability					X						X	
parking demand management request					X						X	
parking demand management response					X						X	
parking information				X	X							
parking instructions					X						X	
parking lot data request				X	X							
parking lot reservation confirmation				X	X							
parking reservations request				X	X							
payment							X					
remote surveillance control			X								X	
request fare and price information				X							X	
request for bad tag list							X					X
request for payment							X					
request for right-of-way						X					X	
request for traffic information				X							X	
request transit information											X	X
resource deployment status			X								X	
resource request			X								X	

Architecture Flows	Subsystems											
	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
reversible lane status						X					X	
road network use				X							X	
route plan				X								
route request				X								
selected routes				X								X
signal control data						X					X	
signal control status						X					X	
suggested route			X					X				
toll archive data	X								X			
toll data				X					X			
toll data request				X					X			
toll demand management request									X		X	
toll demand management response									X		X	
toll instructions									X	X		
toll transactions									X	X		
traffic archive data	X										X	
traffic control coordination											X	
traffic control priority request											X	X
traffic control priority status											X	X
traffic flow						X					X	
traffic images						X					X	
traffic information				X							X	
traffic information coordination											X	
traffic information for media											X	
traffic information for transit											X	X

Architecture Flows	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
transaction status	X	X		X	X				X			X
transit and fare schedules				X								X
transit archive data	X											X
transit demand management request											X	X
transit demand management response											X	X
transit emergency coordination data			X									X
transit emergency data			X									X
transit incident information				X								X
transit incidents for media												X
transit information for media												X
transit information request				X								X
transit parking coordination					X							X
transit parking lot response					X							X
transit request confirmation				X								X
transit schedule information							X					X
transit system data											X	X
transit traveler information							X					X
transit traveler request							X					X
transit vehicle location data							X					X
transit vehicle passenger and use data							X					X
transit vehicle schedule performance							X					X
traveler advisory request							X					
traveler archive data	X			X								
traveler information				X								
traveler information for media				X								

Architecture Flows	Subsystems											
	Archived Data Management Subsystem	Commercial Vehicle Administration	Emergency Management	Information Service Provider	Parking Management	Roadway Subsystem	Transit Vehicle Subsystem	Emergency Vehicle Subsystem	Toll Administration	Toll Collection	Traffic Management	Transit Management
trip confirmation				X								
trip plan				X								
trip request				X								
TRMS coord												X
vehicle location							X	X				

activity reports
Activity reports containing records of citations, accidents, inspections, etc.

archive analysis requests
A user request that initiates data mining, analytical processing, aggregation or summarization, report formulation, or other advanced processing and analysis of archived data. The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.

archive analysis results
Processed information products, supporting meta data, and any associated transaction information resulting from data mining, analytical processing, aggregation or summarization, report formulation, or other on-line processing and analysis of archived data.

archive coordination
Catalog data, meta data, published data, and other information exchanged between archives to support data synchronization and satisfy user data requests.

archive requests
A request to a data source for information on available data (i.e. "catalog") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.

archive request confirmation
Confirmation that an archive request has been received and processed with information on the disposition of the request

archive status

Notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified.

archived data product requests
A user-specified request for archived data products (i.e. data, meta data, or data catalogs). The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.

archived data products
Raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information.

bad tag list
List of invalid transit user tags which may have previously failed a fare payment transaction.

broadcast information
General broadcast information that contains link travel times, incidents, advisories, transit services and a myriad of other traveler information.

commercial vehicle archive data
Information describing commercial vehicle travel and commodity flow characteristics. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

compliance review report
Report containing data from facility activity logs from various roadside facilities.

credential application
Application for commercial vehicle credentials for a particular route/trip.

credentials and safety information request
Request for additional credentials and safety information.

credentials and safety information response
Instructions to commercial vehicle managing and/or information systems indicating which vehicles are to be allowed to pass and which are out of service or have not been credentialed.

current network conditions
Current traffic information, road conditions, and camera images that can be used to locate and verify reported incidents, and plan and implement an appropriate response.

demand responsive transit plan
Plan regarding overall demand responsive transit schedules and deployment.

demand responsive transit request
Request for paratransit support.

electronic credentials
Authenticated credentials including route enrollment and payment confirmation.

emergency acknowledge
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

emergency data request
A request for additional information or a control command issued by the emergency response agency in response to an emergency request for assistance from a traveler.

emergency dispatch requests
Emergency vehicle dispatch instructions including incident location and available information concerning the incident.

emergency dispatch response
Request for additional emergency dispatch information (e.g., a suggested route) and provision of en-route status.

emergency notification
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

emergency archive data
Logged incident information that characterizes the identified incidents and provides a record of the corresponding incident response. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

emergency operations request
Emergency operator inputs supporting call taking, dispatch, and other operations and communications center operator functions.

emergency operations status
Emergency operations data supporting a range of emergency operating positions including call taker, dispatch, and various other operations and communications center operator positions.

emergency traffic control request
Special request to preempt the current traffic control strategy in effect at one or more signalized intersections or highway segments. For example, this flow can request all signals to red-flash, request a progression of traffic control preemptions along an emergency vehicle route, or request another special traffic control plan.

emergency traffic control response
Status of the special traffic signal control strategy implemented in response to the emergency traffic control request.

emergency vehicle tracking data
The current location and operating status of the emergency vehicle.

external reports
Traffic and incident information that is collected by the media through a variety of mechanisms (e.g., radio station call-in programs, air surveillance).

fare and payment status
Current fare collection information including the operational status of the fare collection equipment and financial payment transaction data.

fare and price information
Current transit, parking, and toll fee schedule information.

fare management information
Transit fare information and transaction data used to manage transit fare processing on the transit vehicle.

freeway control status
Current operational status and operating parameters for ramp meters, dynamic message signs, mainline metering/lane controls and other control equipment associated with freeway operations.

HAZMAT information
Information about a particular hazmat load including nature of the load and unloading instructions. May also include HAZMAT vehicle route and route update information

HAZMAT information request
Request for information about a particular hazmat load.

hov data
Current HOV lane information including both standard traffic flow measures and information regarding vehicle occupancy in HOV lanes.

incident command information
Information that supports local management of an incident. It includes resource deployment status, hazardous material information, traffic, road, and weather conditions, evacuation advice, and other information that enables emergency personnel in the field to implement an effective, safe incident response.

incident command request
Request for resources, commands for relay to other allied response agencies, and other requests that reflect local command of an evolving incident response.

incident data
Data and imagery from the roadside supporting incident detection and verification.

incident information
Notification of existence of incident and expected severity, location, time and nature of incident.

incident information for media
Report of current desensitized incident information prepared for public dissemination through the media.

incident information request
Request for incident information, clearing time, severity.   The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

incident notification
The notification of an incident including its nature, severity, and location.

incident notification response
Interactive acknowledgement and verification of the incident information received, requests for additional information, and general information on incident response status.

incident report
Report of an identified incident including incident location, type, severity and other information necessary to initiate an appropriate incident response.

incident response coordination
Incident response procedures, resource coordination, and current incident response status that are shared between allied response agencies to support a coordinated response to incidents. This flow also coordinates a positive hand off of responsibility for all or part of an incident response between agencies.

incident response status
Status of the current incident response including traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides).

incident status
Information gathered at the incident site that more completely characterizes the incident and provides current incident response status.

information request
General purpose information request for data stored within the commercial vehicle operations information exchange network.

ISP coordination
Coordination and exchange of transportation information between centers. This flow allows a broad range of transportation information collected by one ISP to be redistributed to many other ISPs and their clients.

local signal priority request
Request from a vehicle to a signalized intersection for priority at that intersection.

logged special vehicle route
Anticipated route information for special vehicles (e.g., oversize vehicles) or groups of vehicles (e.g., governor's motorcade) that may require changes in traffic control strategy.

media information request
Request from the media for current transportation information.

parking availability
Current parking lot occupancy, parking availability, and cost information.

parking information
General parking information and current parking availability.

parking demand management request
Request to change the demand for parking facility use through pricing or other mechanisms.

parking demand management response
Response to parking demand management change requests indicating level of compliance with request.

parking instructions
Information that allows local parking facilities to be managed to support regional traffic management objectives.

parking lot data request
Request for parking lot occupancy, fares, and availability. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

parking lot reservation confirmation
Confirmation for parking lot reservation.

parking archive data
Data used to analyze and monitor trends in parking demand, pricing, and operational actions. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

parking reservations request
Reservation request for parking lot.

payment
Payment of some kind (e.g., toll, parking, fare) by traveler which in most cases can be related to a credit account.

remote surveillance control
The control commands used to remotely operate another center's sensors or surveillance equipment so that roadside surveillance assets can be shared by more than one agency.

request fare and price information
Requests for current fare and price information from a service provider that can be used to augment the traffic manager's overall view of current transportation network status.

request for bad tag list
Request for list of bad vehicle tag IDs.

request for payment
Request to deduct cost of service from user's payment account.

request for right-of-way
Forwarded request from signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.

request for traffic information
Request for traffic information that specifies the region/route of interest, the desired effective time period, and other parameters that allow preparation of a tailored response.   The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

request tag data
Request for tag information including credit identity, stored value card cash, etc.

request transit information
Request for transit service information and current transit status.

resource deployment status
Status of traffic management center resource deployment identifying the resources available and their current deployment status.

resource request
A request for traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc.

reversible lane status
Current reversible lane status including traffic sensor and surveillance data and the operational status and mode of the reversible lane control equipment.

road network use
Aggregated route usage and associated travel data from clients for planning and analysis.

route plan
Tailored route provided by ISP in response to a specific request.

route request
Request for a tailored route based on given constraints.

selected routes
Routes selected based on route request criteria.

signal control data
Information used to configure and control traffic signal systems.

signal control status
Status of surface street signal controls.

suggested route
Suggested route for a dispatched emergency vehicle that may reflect current network conditions and the additional routing options available to en-route emergency vehicles that are not available to the general public.

tag data
Unique tag ID and related vehicle information for the purposes of payment for services.

toll data
Current toll schedules for different types of vehicles as well as advanced toll payment information.

toll data request
Request made to obtain toll schedule information or pay a toll in advance. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.

toll demand management request
Request to change the demand for toll road facility use through pricing or other mechanisms.

toll demand management response
Response to toll demand management change requests indicating level of compliance with request.

toll instructions
Demand management toll pricing information based on current congestion.

toll archive data
Data indicating toll facility usage and pricing schedules. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

Toll Transactions
Detailed list of transactions from a toll station.

traffic control coordination
Information transfers that enable remote monitoring and control of traffic management devices. This flow is intended to allow cooperative access to, and control of, field equipment during incidents and special events and during day-to-day operations. This flow also allows 24-hour centers to monitor and control assets of other centers during off-hours, allows system redundancies and fail-over capabilities to be established, and otherwise enables integrated traffic control strategies in a region.

traffic control priority request
Request for signal priority at one or more intersections along a particular route.

traffic control priority status
Status of signal priority request functions at the roadside (e.g. enabled or disabled).

traffic flow
Raw and/or processed traffic detector information which allows derivation of traffic flow variables (e.g., speed, volume and density measures).

traffic images
High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications.

traffic information
Current and forecasted traffic information, road and weather conditions, incident information, and pricing data. Either raw data, processed data, or some combination of both may be provided by this architecture flow.

traffic information coordination
Traffic information exchanged between TMC's. Normally would include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.

traffic information for media
Report of current traffic conditions, incidents, maintenance activities and other traffic-related information prepared for public dissemination through the media.

traffic information for transit
Current and forecasted traffic information and incident information.

traffic archive data
Information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

transaction status
Response to transaction request. Normally dealing with a request for payment.

transit and fare schedules
Specific transit and fare schedule information including schedule adherence.

transit demand management request
Request to change the demand for transit facility use through pricing or other mechanisms.

transit demand management response
Response to transit demand management change requests indicating level of compliance with request.

transit emergency coordination data
Data exchanged between centers dealing with a transit-related incident.

transit emergency data
Initial notification of transit emergency at a transit stop or on transit vehicles and further coordination as additional details become available and the response is coordinated.

transit incident information
Information on transit incidents that impact transit services for public dissemination.

transit incidents for media
Report of an incident impacting transit operations for public dissemination through the media.

transit information for media
Report of transit schedule deviations for public dissemination through the media.

transit archive data
Data used to describe and monitor transit demand, fares, operations, and system performance. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

transit parking coordination
Request for coordinated fare payment and parking lot price data.

transit parking lot response
Response to transit occupancy inquiries and coordination with parking lots.

transit request confirmation
Confirmation of a request for transit information or service.

transit schedule information
Current and projected transit schedule adherence.

transit system data
Current transit system operations information indicating 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.

transit traveler information
Transit information prepared to support transit users and other travelers. It contains transit schedules, real-time arrival information, fare schedules, and general transit service information.

transit traveler request
Request by a Transit traveler to summon assistance, request transit information, or request any other transit services.

transit vehicle location data
Current transit vehicle location and related operational conditions data provided by a transit vehicle.

transit vehicle passenger and use data
Data collected on board the transit vehicle pertaining to availability and/or passenger count.

transit vehicle schedule performance
Estimated times of arrival and anticipated schedule deviations reported by a transit vehicle.

traveler advisory request
In vehicle communication between transit and vehicle systems includes advisories and advance payment deductions.

traveler archive data
Data associated with traveler information services including service requests, facility usage, rideshare, routing, and traveler payment transaction data. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.

traveler information
Traveler information comprised of traffic status, advisories, incidents, payment information and many other travel-related data updates and confirmations.

traveler information for media
General traveler information regarding incidents, unusual traffic conditions, transit issues, or other advisory information that has been desensitized and provided to the media.

trip confirmation
Acknowledgement by the driver/traveler of acceptance of a route.

trip plan
A sequence of links and special instructions comprising of a trip plan indicating efficient routes for navigating the links. Normally coordinated with traffic conditions, other incidents, preemption and prioritization plans.

trip request
Request by a driver/traveler for special routing.

TRMS coord
Coordination information between local/regional transit organizations including schedule, on-time information and ridership.

vehicle location
Location of vehicle and other vehicle characteristics which are exchanged between vehicle subsystems.

Appendix E – Stakeholder Interconnects and Architecture Flows

Appendix F – Architecture Flow Packages