Strategic Plan

Northern Virginia District (NOVA)
Smart Travel Program

Virginia Department of Transportation

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PREFACE

This Virginia Department of Transportation Northern Virginia Smart Travel Strategic Plan is the product of the collaboration among the VDOT Northern Virginia District Staff and the VDOT Central Office. It provides a foundation for the Northern Virginia Smart Travel Program by documenting system conceptualization using a top-down approach that describes the vision, goals, objectives, and functions that support a successful implementation of Smart Travel.

Virginia's Smart Travel Program was established to enhance awareness of the state's Intelligent Transportation Systems (ITS) program. Smart Travel conveys to VDOT's customers that VDOT actively applies technology to transportation operations to improve service delivery. Smart Travel deployments enhance VDOT's capabilities, providing better traffic operations, reducing travel delays, improving VDOT's efficiency, and enhancing the safe operations of the Commonwealth's surface transportation network.

The Smart Travel Program is an umbrella for all the transportation technology efforts of Virginia's state and local government agencies, as well as the efforts of the private sector. As the lead agency, the Virginia Department of Transportation has developed a statewide ten-year Smart Travel Business Plan to guide and focus the use of ITS.

The VDOT Northern Virginia Smart Travel Strategic Plan will provide guidance to the deployment of Smart Travel services. Additionally, this living document will contribute to the establishment of an integrated Smart Travel system in the Northern Virginia region.

1. INTRODUCTION

1.1 Background

The Northern Virginia District of the Virginia Department of Transportation (VDOT) is comprised of VDOT owned and operated facilities located within the jurisdictions of Arlington, Fairfax, Loudoun and Prince William Counties; the Cities of Alexandria, Fairfax, Falls Church, Manassas, Manassas Park; and the Towns of Herndon, Clifton, Dumfries, Middleburg and Leesburg. The Northern Virginia Region considered for Smart Travel deployment planning includes the VDOT Northern Virginia District, Interstate 66 (I-66) west to Interstate 81 (I-81) and Interstate 95 (I-95) south to the Fredricksburg City Limit. Figure 1 illustrates the geographic boundary of the Northern Virginia Region.

VDOT maintains the freeways and primary roadways within the district and operates traffic signals throughout Fairfax, Loudoun and Prince Williams Counties. Many jurisdictions located within the boundaries of the VDOT Northern Virginia (NOVA) District are responsible for operating and maintaining the secondary roadways and for providing emergency services within their borders. Additionally, numerous federal, state and local transportation stakeholders, including transit, police, emergency medical, and other agencies, all have a role in operating and managing the roadways and other regional transportation systems.

Virginia's Smart Travel Program was established to communicate to its customers that Intelligent Transportation Systems (ITS) is more than just the application of technology as it may have been implied from the term "Intelligent Transportation System." Smart Travel is a program that serves as an "umbrella", unifying all modal agencies and the efforts of various transportation stakeholders as networked components that provide transportation services to the public. The success of Smart Travel largely depends on institutional coordination.

Because each of the stakeholders has specific responsibilities, VDOT's Northern Virginia District is defining their Smart Travel operations role, including an understanding of what the region expects from VDOT NOVA, and what VDOT NOVA can offer the region.

This Strategic Plan is a step towards defining VDOT NOVA District's role in providing ITS in the region. In May 1996, the ITS Strategic Deployment Plan for Northern Virginia was completed using a federal Early Deployment Study grant.[1] That Strategic Deployment Plan incorporated input from various stakeholders including local emergency services, local city and county DOT's, regional planning entities, transit and airport authorities, the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and state governments in the Washington Metropolitan area. That document and the companion Advanced Traffic Management System Implementation Plan[2] completed under the same effort, provide a foundation for the integration of Smart Travel applications within the transportation infrastructure in the district.

[1] DeLeuw, Cather & Company of Virginia, Northern Virginia Intelligent Transportation System (ITS) Early Deployment Study, Strategic Deployment Plan, May 1996.

[2] DeLeuw, Cather & Company of Virginia, Northern Virginia Intelligent Transportation System (ITS) Early Deployment Study, Advanced Traffic Management System (ATMS) Implementation Plan, April 1996.

The continued deployment of Smart Travel in the NOVA District will play a key role in improving the efficiency and safety of the surface transportation network operated by VDOT, and enable more efficient service delivery in the region. As in ITS applications, a core communications network, traffic and conditions monitoring, and advanced information processing capability will provide the data and analysis for managing the roadways to improve the quality of life for the region's travelers. Applied technology will help VDOT optimize its services to support a multimodal transportation system. This system improves the quality of life and customer satisfaction by establishing safer roads than what may have been achieved without the application of technology.

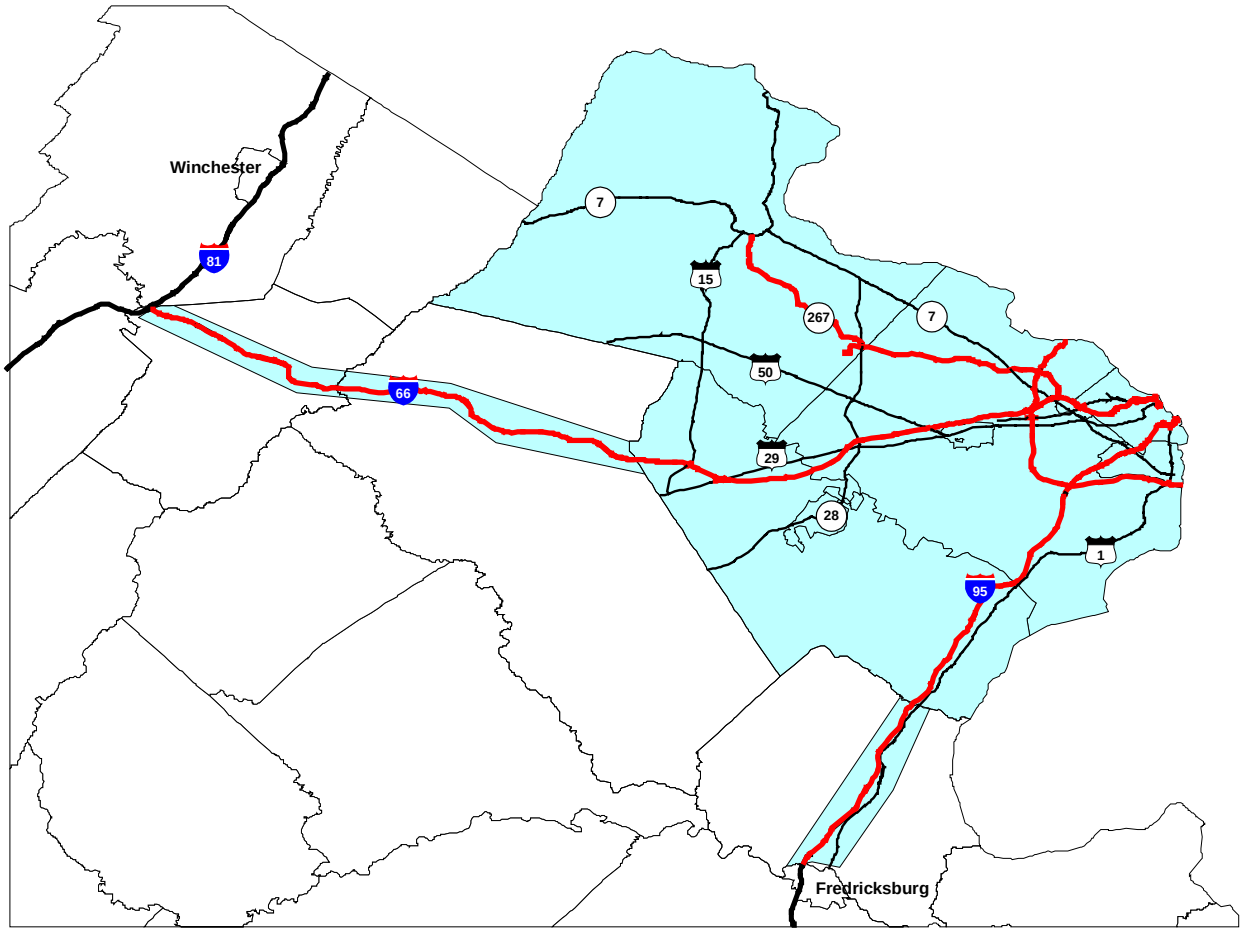

Figure 1: Geographic Boundary of the Northern Virginia Region for Smart Travel Deployment

Using the previous Northern Virginia Intelligent Transportation System Early Deployment Study and Smart Travel Business Plan [3] as a starting point and incorporating other regional studies, [4,5]

[3] Virginia Department of Transportation, Smart Travel Business Plan 1997-2006, 1998 Update.

[4] National Capital Region Transportation Planning Board, Vision, Goals, Objectives and Strategies, Adopted on October 21, 1998.

the VDOT NOVA District Smart Travel Framework provides implementation guidance for the next ten years. The following three documents will be produced as part of the Northern Virginia Smart Travel Framework:

- Smart Travel Program for VDOT Northern Virginia - Strategic Plan
- Smart Travel Program for VDOT Northern Virginia - Summary of 1999 Activities
- Smart Travel Program for VDOT Northern Virginia - Comprehensive Project List and Program Plan

1.2 Purpose

The purpose of this framework is to document where Northern Virginia stands today and to define how Smart Travel will enhance the Northern Virginia regional transportation system. This framework will help establish an integration plan to bring these systems together into a coordinated regional system. This will also avoid the risk of "stovepipe" solutions in which different systems produce redundant information instead of maximizing system utility through efficient information exchange.

In addition to advancing the District's Smart Travel program, this framework will be a resource to regional planning efforts, such as the Northern Virginia 2020 Transportation Plan.

The first component of the Smart Travel framework is a Strategic Plan. The purpose of this Strategic Plan is to identify future operations in the VDOT Northern Virginia District and how they will be supported through systems implementation.

The second component of the framework is a summary of current and planned activities in Northern Virginia. The purpose is to identify where Northern Virginia stands on the Smart Travel program.

By sketching out future operations with their anticipated functionality and understanding existing operations, a list of potential projects is developed as the third component of the framework. When implemented, these projects will advance the VDOT NOVA District towards enhanced and more efficient operations. The Program Plan distinguishes the critical projects that can be deployed in the near-term to improve VDOT's service value more quickly. The plan will provide guidance on how the Northern Virginia District should appropriate funding for these critical projects.

Each element of the Northern Virginia District Smart Travel framework provides specific benefits as described below:

The VDOT Northern Virginia Smart Travel Strategic Plan documents the system conceptualization using a top-down approach that describes the vision, goals, objectives and

[5] Maryland Department of Transportation, Maryland State Highway Administration, Virginia Department of Transportation, District of Columbia Department of Public Works, Federal Highway Administration, Metropolitan Washington Council of Governments ITS Task Force, A Proposal for a Metropolitan Washington Area Intelligent Transportation System (ITS) Transportation Management System Showcase, February 20, 1997.

functions for the Northern Virginia District. The Strategic Plan helps the District to visualize the future Smart Travel Program that will help the District to improve safety and mobility of the transportation network and possible ways to reach that vision.

Specific benefits of the Strategic Plan include the following:

- Support Policy: The plan is built on statewide policy and programs, so any activities based on the plan will be consistent with statewide policy and programs.

  To receive this benefit, any Smart Travel project or program should be traceable to one or more objectives identified in the Strategic Plan.

- Save Resources: This plan lays out an operational scheme that describes which operational entity should perform what functions. This will avoid stovepipe solutions.

  To receive this benefit, institutional operations related to Smart Travel should be consistent with the operational scheme.

- Build Consensus and Coordination: This Strategic Plan is built on input from the District staff and input of various stakeholders as documented in the Northern Virginia ITS Early Deployment Study. This increases the likeliness for successful systems design and implementation.

  To receive this benefit, the District staff should provide comments on the Plan if their priority or objectives differ from the Plan, so that the Plan can be updated accordingly.

- Support evaluation: The Strategic Plan maps functions to objectives. When a project is developed to perform a number of functions, these functions can be mapped to one or more objectives. The District can perform a before-after evaluation of these projects based on the objectives.

  To receive this benefit, the District should map each project to the functions and objectives defined in the Plan.

The Summary of Smart Travel Activities **includes** an inventory of Smart Travel systems that are currently operational or planned in the Northern Virginia region. The inventory helps the District to comprehend and communicate where it stands on the Smart Travel program, so that it can expand and/or improve on the current program.

Specific benefits of the Inventory of existing and planned Smart Travel projects and activities include the following:

- Support State Programs and Planning: This inventory will provide input for Northern Virginia to the 1999 VDOT Smart Travel Program Activities Update.

(The Inventory will be used in the development of a Program Plan and a District Architecture.)

- Identify Projects: The District will be able to identify projects by recognizing missing functions from existing projects.

  To receive this benefit, the District should review the functionality in the existing projects and the list of functions described in the Strategic Plan.

- Track Progress: After a predetermined interval the District can evaluate what was planned and what was actually deployed in the timeframe. This will enable the District to revise its deployment plan.

  To receive this benefit, the District should track and evaluate deployment periodically in relation to the Program Plan.

The Smart Travel Program Plan provides a comprehensive project list that compares what functions are envisioned in the Strategic Plan and what functions are accommodated by current and planned systems as compiled in the Summary of Activities. A Program Plan is developed for critical projects that describes potential projects by concept of operations, functional requirements, estimated cost, benefits and expertise requirements for implementing these projects. This program plan helps to identify activities to move the District Smart Travel program forward so that it can reach the vision.

Specific benefits of this Program Plan include the following:

- Allocate Resources Efficiently: By documenting the critical projects and why they are critical, the District will be able to allocate resources efficiently.

  To receive this benefit, the District may use resource allocation methods that optimally distribute available resources between projects based on their criticality.

- Track Progress: After a predetermined interval the District can evaluate what was planned and what was actually deployed in the timeframe. This will enable the District to revise its deployment plan.

  To receive this benefit, the District should track and evaluate deployment periodically in relation to the Program Plan.

1.3 Methodology

The VDOT NOVA District framework consists of a Smart Travel Strategic Plan, Summary of 1999 Activities and Program Plan. Figure 2 shows the elements of the framework including the tasks (shown in the second column), input to these tasks (shown in the first column), output from these tasks (shown in the third column) and the expected benefits from the outcomes (shown in the forth column).

The Strategic Plan was developed by identifying the Smart Travel vision, goals, objectives and functions for the VDOT NOVA District. The vision portrays the services Smart Travel can offer to the District's transportation network. The vision was initially identified based on several regional studies, the Statewide Smart Travel Business Plan, Northern Virginia Early Deployment Plan and VDOT's Strategic Plan for the 21st Century. Goals, which are derived from the vision, provide initial direction on how to proceed to the vision. Objectives further clarify goals and provide a more specific direction and are used to define the functions that will ultimately lead to the vision. Selected functions are aggregated to define a project. The hierarchy of action planning enables a traceability of any project to the vision, thus enabling realization of the vision through project deployment.

The Strategic Plan allocates functions to the existing institutional framework of the VDOT NOVA District. The institutional framework will identify "who does what and where." The understanding of "who does what and where" will help develop the logical and physical architecture for the District. The logical architecture provides detail on the behavior of the system that is to be deployed. The physical architecture details the data that must be exchanged between physical entities, the means of exchanging data among them and interface requirements between the physical entities. Appendix A provides guidelines to develop a NOVA District Smart Travel architecture using the Strategic Plan and other appropriate resources. The VDOT NOVA District Architecture will demonstrate interfaces and integration requirements within VDOT and with other agencies.

The tasks produce the following outcome or products: Strategic Plan, Institutional Operational Scheme, Program Activities Summary, a comprehensive project list and a Program Plan for critical projects. These products are expected to impact the District transportation programs as well as regional programs.

The regional planning efforts will benefit from the VDOT NOVA District Strategic plan by integrating, in their planning process, the anticipated Smart Travel functions that may impact the regional transportation network. It is anticipated that the Strategic Plan will be a resource to the Northern Virginia 2020 Transportation Plan, 2000 Constrained Long-Range Plan and Dulles Corridor Task Force Plan.

The Summary of 1999 Activities compiled a list of existing and planned Smart Travel systems in the Northern Virginia region. A workshop was conducted with the leadership and staff of the VDOT Northern Virginia District to receive input on the inventory of these existing systems regarding responsibilities for deploying and operating/maintaining these systems. Appendix B includes a summary of this workshop. Input from this workshop has been incorporated into this

plan and will be used to identify potential projects. The product of this task will be an input to the Smart Travel Program Activities in the Virginia Department of Transportation 1999 Update.

By identifying the differences between what functions are offered by the existing systems and what functions are envisioned in the Strategic Plan, new projects are identified. Detailed programmatic information such as functional requirements and cost are developed for critical projects (which can be developed in the short term). The product of this task, a list of projects and a program plan, can be used as supporting documents to the funding request process for the Six Year Improvement Program and Federal Earmark, and as a resource to the Northern Virginia 2020 Transportation Plan.

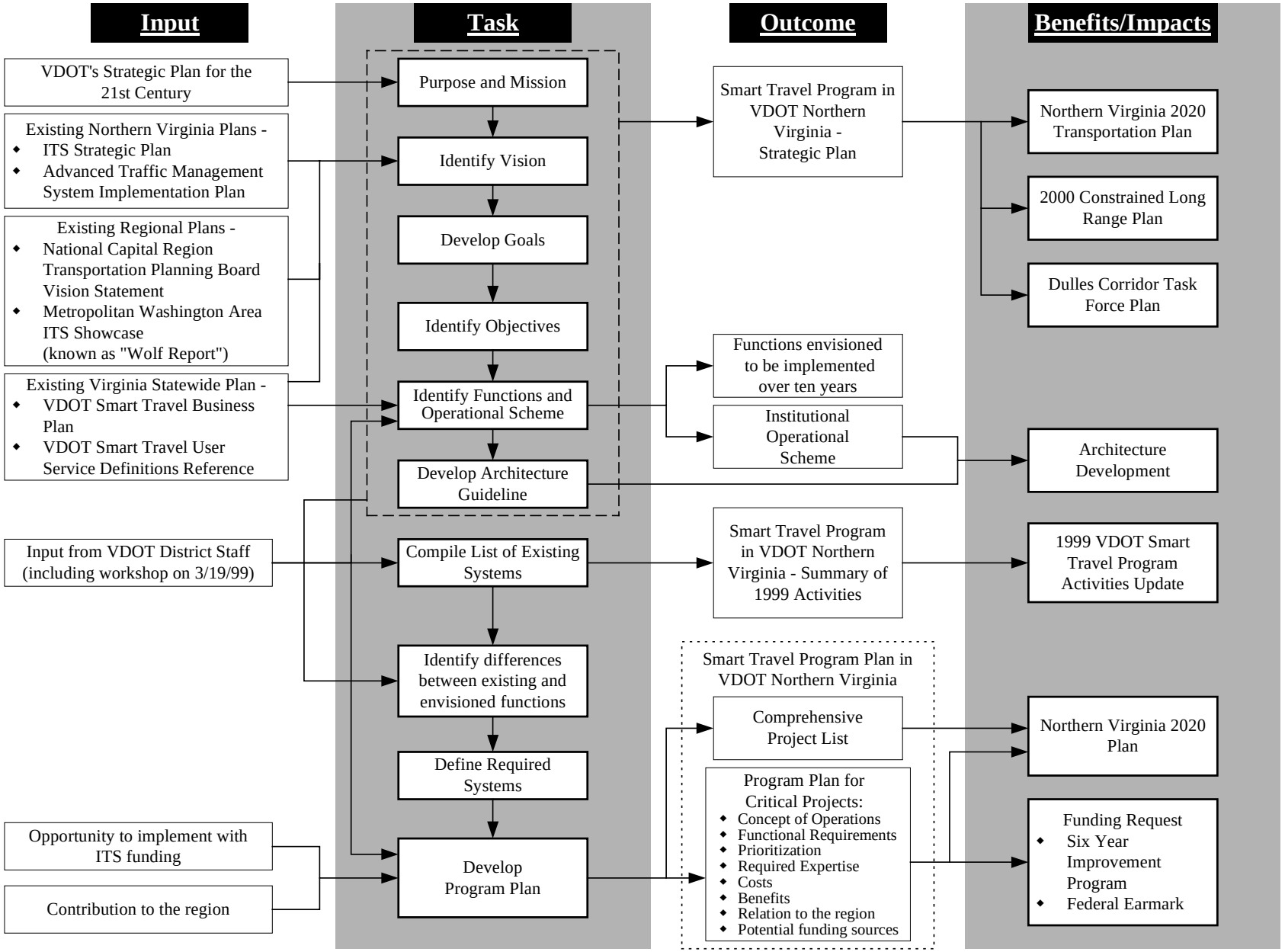

Figure 2: VDOT Northern Virginia District Smart Travel Framework Elements

2. VISION AND VISION STATEMENTS

2.1 Vision

The VDOT NOVA District Smart Travel vision is consistent with VDOT's purpose as stated in the Strategic Plan for the 21st Century[6] to "keep Virginia moving" as it promotes improved capacity and safety. Additionally, the Smart Travel vision has been motivated by VDOT's mission to "Become the most effective customer oriented public agency in Virginia by the year 2000." Smart Travel envisions a transportation system that revolves around providing better services to its customers, by improving the quality of their commute and by responding promptly to their issues.

The Smart Travel Vision for the VDOT NOVA District, which is motivated by VDOT's Purpose and Mission Statements, is defined as follows:

"APPLIED TRANSPORTATION TECHNOLOGY WILL HELP VDOT OPTIMIZE ITS SERVICES, SUPPORTING A MULTIMODAL TRANSPORTATION SYSTEM THAT IMPROVES QUALITY OF LIFE AND CUSTOMER SATISFACTION BY ENSURING SAFER AND LESS CONGESTED ROADS."

2.2 Vision Statements

This section presents a series of vision statements, derived from the Smart Travel Vision, which portray the systems that may be realized in the next ten years. These vision statements are organized in the following two key operational areas:

- System Management
- Personal Travel

These two operational areas encompass the broad services that Smart Travel delivers to enhance agency operations, to manage resources more effectively, and to improve service value to the Smart Travel system users. The term "users" applies to more than those who simply receive a benefit from these operational areas. Users are those groups who have a stake in the success of the transportation system. This includes motorists, transit agencies, emergency services, trucking companies, and the VDOT NOVA District, to name a few.

2.2.1 Vision Statements for System Management

The principal "users" of the System Management group are the public agencies and authorities that construct, maintain, enforce, operate and/or own surface transportation facilities. These users benefit from the System Management services through the increased efficiency and effectiveness of their operations. The users of the transportation system benefit from the improved delivery of transportation services at an equal or lower cost.

[6] Virginia Department of Transportation, Strategic Plan for the 21st Century, 1999.

The System Management vision statements apply mainly to the services necessary for VDOT to manage the roadway network. The System Management vision supports the interdependency between VDOT and the motorists: if VDOT operates more efficiently, the motorists will receive better transportation service.

VDOT and Smart Travel customers will receive numerous benefits by implementing Systems Management. With the knowledge of real time traffic conditions, VDOT will be able to make timely decisions for any actions needed to improve the traffic flow. VDOT will be able to make the best use of its resources through the capability of improved monitoring of resources. Additionally, this service will reduce crashes, encourage increased transit ridership, improve air quality, reduce congestion, improve motorist safety, and provide greater convenience for the users.

A pictorial interpretation of the vision for System Management is shown as Figure 3. Each of the circled letters on the figure corresponds to the narrative provided below.

A. VDOT will improve the safety of travelers by providing advance warning, by implementing crash countermeasures, and by contributing to the security of transportation facilities.

Advance warnings of approaching vehicles at the intersection can be conveyed to motorists on the cross-streets through dynamic message signs, special roadside signs or in-pavement crosswalk warnings. These systems will rely on real-time data collection and processing to take place in the field so that the approaching motorists and pedestrians may receive appropriate warning messages.

VDOT will support the law enforcement agency in improving safety at transportation facilities by establishing automated mechanisms to detect activities and/or motorists/pedestrian's distress at park and ride facilities and rest areas. Detected traveler distress will be communicated directly to the Virginia State Police and/or other emergency service providers.

B. VDOT will contribute to the prevention of secondary crashes by supporting prompt reporting and quick response to incidents.

VDOT will enhance the Safety Service Patrol's ability to remove small incidents from the roadway in the shortest time possible. The patrol will facilitate the identification of localized trouble spots that need to be addressed through better management or through physical improvement. In addition, police will use an automated crash reporting system, which includes an automatic location identification technology, to improve incident reporting. The travelers themselves can continue to report incidents through cellular telephones. VDOT will facilitate Emergency Services' response to incidents by providing signal priority to their en-route vehicles and by sharing route congestion data so their vehicles encounter the minimal possible traffic.

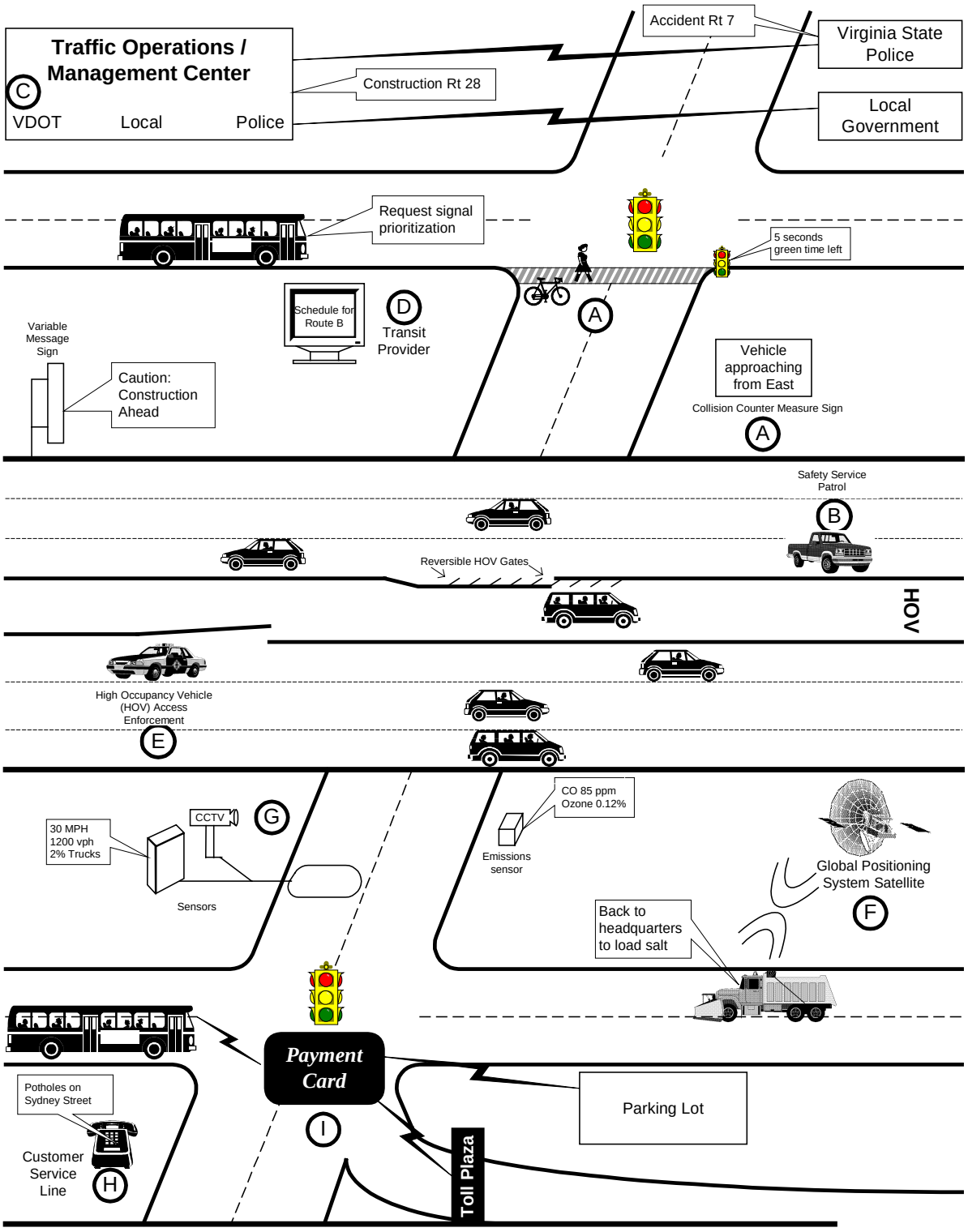

Figure 3: Vision for System Management

C. VDOT will achieve more effective operations through planning and real-time traffic surveillance/management.

Real-time surveillance equipment will be placed on the interstate roadways. The information will be sent to a transportation management center where software systems and staff will process it and automatically identify problems in the limited-access network. When a problem is detected, personnel from VDOT, local agencies, and police will work together to provide immediate and coordinated response.

Arterial roadways will be more actively managed through planning and deployment of transportation technology for traffic surveillance and traffic control. Real-time roadway status will be available to motorists through the use of the Information Service Providers and through VDOT's customer service activities. Additionally, VDOT will share the data on roadway status with other public sector agencies and the private sector.

D. VDOT will support transit operators to improve transit services through real-time transit information and improved schedule adherence.

VDOT will support the efforts of transit operators to improve transit travel times so that more riders are attracted to transit services. VDOT will work with transit agencies to provide signal priority where appropriate. VDOT will also explore the means to provide traffic information to the transit providers so they can assess their schedule reliability and reduce travel time. This traffic information may also be relayed to the public who are considering travel via transit.

E. VDOT will enhance the access control to the High Occupancy Vehicle (HOV) lanes and use systems to help prevent crashes on reversible HOV lanes

VDOT will provide gates at the entry of reversible HOV lanes that can be used in both directions. The gates are critical to ensuring motorist safety by preventing vehicles from entering an HOV lane operating in the opposite flow direction. The appropriate use of the HOV lanes will be enforced.

F. VDOT will optimize its operations by adopting automated processes to manage personnel, equipment and resources.

Automatic Vehicle Location technologies and database management systems will improve the deployment of equipment (trucks, vehicles, tractors, etc.) needed to maintain the transportation system. Supervisors will know exactly what maintenance equipment is available and where it is located, thus improving dispatch efficiency. Fleet management capabilities coupled with weather and pavement-monitoring capabilities will enhance the roadway management during adverse weather conditions.

G. VDOT will share field data within the Department and with other agencies to maximize the utility of the data.

Traffic operations data such as speed, classification, and volume that are used for traffic management and evaluation, will be used for other activities, such as transportation planning. Such data may be provided to transit operators, planning organizations, and local governments to enhance their operations.

H. VDOT will provide enhanced customer service through prompt response and follow through to customer comments and issues.

VDOT will establish a system to track the activities that are initiated by a customer request or inquiry. VDOT will provide a 24-hour customer service telephone number to promote public access.

I. VDOT will support a simplified method of payment for transportation services

VDOT will implement a toll tag that will be usable throughout Virginia and the member states of the I-95 Corridor Coalition. Similarly, electronic toll tags used by the I-95 Corridor Coalition states will be usable throughout Virginia. Additionally, VDOT will support the implementation of a simplified method of payment that is particularly beneficial to those who travel using a combination of car, bus, or train. Fare and fee collection for travel will be automated; thus reducing the time spent making the fare/fee payment.

2.2.2 Vision Statements for Personal Travel

The principal "users" of the Personal Travel group are the users of surface transportation services. These users benefit from the Personal Travel services because of fewer and less severe crashes, improved emergency response, greater personal security, timely and accurate travel information and improved route guidance.

Ultimately, the private sector will be responsible for the delivery of most of the Personal Travel services. Initially, however, VDOT will play a significant role until the market potential of these services is better established. Both in the short- and long-term, many of the System Management services will provide the basic data required for Personal Travel services, which will lead to public-private "partnerships."

The Personal Travel vision statements reflect the traveler's need for information to make informed decisions about available choices. An educated traveler is aware of the obstacles he or she will encounter, and will elect to divert themselves away if necessary. In addition to the need for information, travelers need to communicate if they are in need of assistance. The Personal Travel vision provides for the needs of travelers by promoting communication tools.

The Personal Travel services will improve customer satisfaction and reduce delay by providing updated information on travel conditions, traveler services, and route guidance to destinations. Additionally, VDOT supports the private sector provision of systems that automatically transmit requests for help from a distressed vehicle.

Information Service Providers will provide on-demand traveler services information including descriptions of destinations and services, route guidance, and accurate traffic and weather conditions tailored specifically to the need of their customers. The availability of these services will serve to enhance the quality of travel and will promote tourism in the region. The Information Service Providers will provide packaged information through in-vehicle devices, dial-up services, personal digital assistance, the Internet, television and radio stations. Figure 4 portrays the vision for Personal Travel.

A. VDOT will provide timely and accurate information on roadway conditions.

   Real-time information, such as traffic conditions, status of Park and Ride lots, and construction activities, will be provided to motorists by VDOT through the use of highway advisory radio, variable message signs, highway helpline and the Internet. Special transit information may be conveyed to motorists at strategic locations through variable message signs and highway advisory radio. VDOT also will share data with the information service providers. The Information Service Providers will provide packaged information through in-vehicle devices, dial-up services, personal digital assistance, the Internet, television and radio stations.

B. Information Service Providers will support motorists equipped with an automated in-vehicle emergency reporting system.

   In-vehicle "Mayday" systems will allow quick and automated identification of disabled vehicles and serious accidents in remote areas. When triggered by a serious crash, or

activated by the driver, the location of the event will be communicated to an Information Service Provider who will then forward the information to local emergency services and VDOT. The local emergency service will send appropriate help to the affected vehicle and VDOT will support the effort by managing the traffic at the location of the incident.

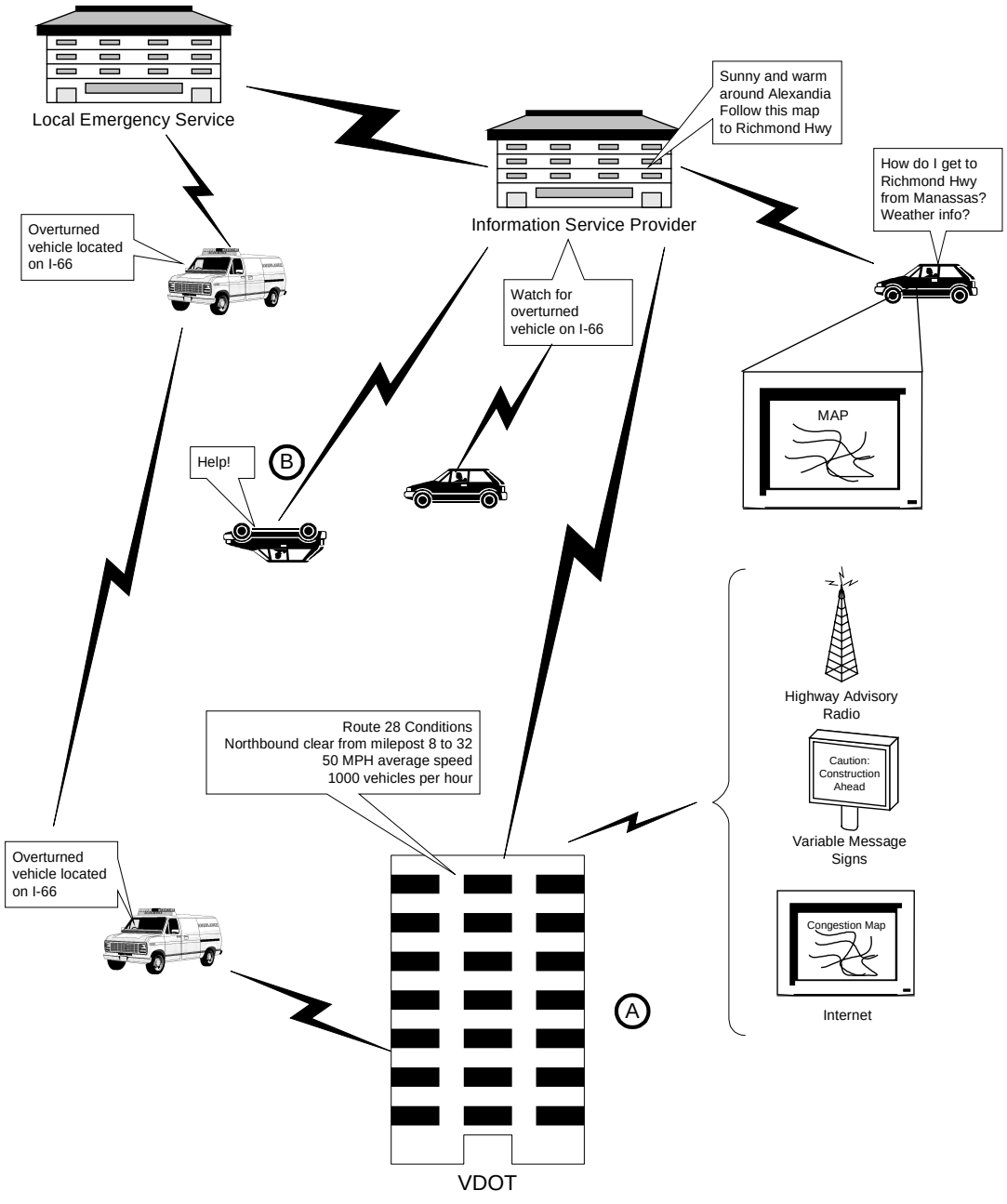

Figure 4: Vision for Personal Travel

3. GOALS AND OBJECTIVES

Goals are derived from the vision in order to categorize the vision statements to provide clear direction for planning the system. The system objectives further clarify the intent of the broader goals. The VDOT NOVA District developed the following goals to satisfy the vision identified in Section 2 of this Plan. These goals are as follows:

- Enhance public safety
- Operate the transportation system effectively and efficiently
- Enhance mobility (using technology)
- Enhance agency operations and maximize the effectiveness and efficiency of personnel, equipment and resources
- Make the transportation system user-friendly
- Support private-sector provision of traveler information services

This section provides a brief description of the goals and objectives that will help VDOT NOVA District reach the goals. The functions are described in Section 4.

Goal: Enhance public safety

VDOT has invested significant resources in improving the safety of its roadways and roadside facilities. VDOT is committed to making its roads safer by implementing measures to reduce the frequency and severity of crashes. VDOT is also actively implementing measures to secure the safety of pedestrians, bicyclists, park and ride patrons, and rest area patrons. Additionally, VDOT supports law enforcement agencies in ensuring public safety at roadside facilities.

Objectives:

1. *Promote safety of transportation facilities:* VDOT will promote safety at public facilities along the roadway network so that travelers feel comfortable and confident about the safety of the facility.
2. *Reduce crashes on freeways and surface streets:* VDOT will implement safety improvement projects that promote a higher quality of life for the residents and visitors of Virginia.

Goal: Operate the transportation system effectively and efficiently

Land use and funding issues constrain VDOT's ability to meet the demand for more capacity and mobility by adding lanes and/or building more roads. VDOT will operate the existing system and new capacity as it is added to maximize effectiveness and efficiency.

Objectives:

1. *Improve communication and coordination of agency activities:* Maintaining the roadway network operation requires the concerted effort of many offices in the Department and other agencies. VDOT will share information on and coordinate with planned and on-going activities within the agency and with other agencies.

2. *Improve and maintain flow of traffic on freeways:* Detailed traffic and roadway conditions data is vital for the Department to assess the performance of the roadway network. This will enable VDOT to be more proactive in managing the roadways for the public.

3 *Improve and maintain flow of traffic on surface streets:* Traffic flow is managed through the signal system that controls the surface streets. VDOT will ensure that the signal control is operating to promote safety and to provide a means for managing traffic to alleviate congestion.

4. *Increase involvement in identifying new concepts and technologies:* The technological institutions in Virginia (Universities, the Transportation Research Council, the Center for Transportation Research, etc.) will be supported by VDOT to create and promote new technologies that benefit all modes of transportation.

5. *Improve process for outcome-based project planning and implementation:* Measurement of project development will help VDOT gauge the deployment of its programs and track the successful operation of working systems. This information can be used to replicate successes elsewhere in Virginia.

Goal: Enhance Mobility

Enhanced mobility will ensure that a comprehensive range of choices are available that would meet the transportation demand of various types of users. These choices should be accessible in a convenient and safe manner by various types of users, including bicyclists, pedestrians and high occupancy vehicle drivers.

Objectives:

1. *Reduce travel time and improve schedule reliability for buses and HOV carpool and vanpool users:* VDOT supports the use of multi-occupant vehicles to increase the number of people traveling, and will maximize operations of HOV facilities

2. *Reduce demand on the roadway network:* VDOT will work towards promoting other modes of travel, and spreading demand so that the use of single occupancy vehicles is reduced, and peak congestion is reduced.

3. *Improve access to the region's major activity centers, recreation areas and places with strategic national interests:* VDOT will ensure that the mobility of the residents and visitors of Virginia is as efficient and accessible as reasonably possible.

4. *Reduce air pollution:* VDOT will work to help improve the quality of life by supporting projects that minimize the emission of harmful pollutants.

Goal: Enhance district operations and maximize effectiveness and the efficiency of personnel, equipment and resources

The services provided by VDOT will be improved when its divisions function at their best. The district can function optimally by utilizing its staff to their maximum potential and managing and operating its assets in a manner that reduces operational cost and improves effectiveness.

Objectives:

1. *Improve intra-agency cooperation:* The complex operations of the VDOT NOVA District require close coordination among the offices within VDOT. Information sharing is crucial for maintaining the coordinated operation of disparate work groups.

2. *Improve inter-agency cooperation:* The Department is a public organization with a significant influence on the operation of other local and state agencies. VDOT will support the forums through which the Department and other agencies share information.

3. *Improve efficiency in tracking of resources:* The enormous inventory that VDOT works with must be effectively managed so that resources can be shared when needed, requisitions can be filed based on need, and the maintenance of all VDOT resources can be tracked.

Goal: Make the transportation system user-friendly

VDOT's primary theme for operations is to satisfy the customers who use its transportation system. By making the transportation system easier to access and use, and providing timely response to customer comments/issues, VDOT will satisfy its primary theme.

Objectives:

1. *Improve customer service:* VDOT will ensure that its customers receive the services they request promptly and to their satisfaction.

2. *Simplify payment for transportation services:* VDOT will support a common payment system for transportation services, so that it is easier for customers who use various modes of transportation in their commute.

Goal: Support traveler information services

Informed travelers are able to make objective choices regarding their travel routes, mode, and time of travel to a particular destination. VDOT can use this opportunity to help balance the travel demand more smoothly across the multimodal transportation roadway network.

Objectives:

1. *Improve roadway network information dissemination:* Identifying the appropriate media for providing information to travelers will ensure that the right message gets to the right audience. VDOT will share roadway network condition data with public and private enterprise. In many instances, private enterprise will be more capable of packaging information that the public will desire.

2. *Support traveler services information by coordinating with other agencies:* VDOT will support dissemination of traveler information, such as parking and tourists activities information through coordination with other agencies. Transit information will be provided to travelers considering alternate modes. This will include providing traveler information through VDOT's Highway Advisory Radio.

3. *Support emergency notification by coordinating with other agencies*: VDOT will support emergency notification function that provides for the faster notification of travelers involved in an accident. This system will enable emergency services to reach the scene of an incident more quickly with appropriate support equipment, thus reducing response time.

4. FUNCTIONS

The objectives that were identified in Section 3 are used to define the Smart Travel functions to be provided by the VDOT NOVA District. Functions are descriptions of a specific service that can be part of a Smart Travel deployment such as "detect traffic volumes." Selected functions are aggregated to define projects that VDOT can implement as part of the Six-Year Improvement Program or through other means. Figures 5,6,7, 8, 9 and 10 show the hierarchy and traceability of projects to vision for each goal. As shown in these figures, the vision statements were mapped to a goal and the objectives that help reach the goal. A set of functions was identified for each stated objective.

The Section 4.1 describes the functions that are associated with each objective. VDOT NOVA District is already performing many Smart Travel functions through its various organizational sections. These organizational sections are termed as institutional entities in this document. The Section 4.2 associated these functions to VDOT NOVA District's existing institutional framework.

4.1 Functional Scheme

Each objective identified in Section 3 may be satisfied with certain actions or functions by the VDOT NOVA District. This section lists an ideal set of functions that would help reach each VDOT NOVA District Smart Travel objective. VDOT NOVA District would be able to identify potential projects by aggregating appropriate functions that are not accommodated by existing or planned activities.

Initially, VDOT NOVA District Smart Travel functions were identified by mapping the statewide functions identified in the VDOT Smart Travel User Service Reference[7] to the VDOT NOVA District business practices. This User Service Reference shows the links of VDOT user services requirements to the National ITS Architecture User Service Requirements and those functions that are unique to VDOT and are not reflected in the National ITS Architecture. The functions that were suitable to represent the VDOT NOVA District can be traced to the statewide user services requirements and therefore can be traced to the National ITS Architecture.

Appendix C presents the traceability of each VDOT NOVA District functions to the statewide user service requirements as defined in the VDOT Smart Travel User Service Reference. VDOT Northern Virginia District Staff also provided input to these functions through a workshop held on March 19, 1999 (See Appendix B).

[7] Virginia Department of Transportation, Virginia Smart Travel User Service Reference, July 15, 1998.

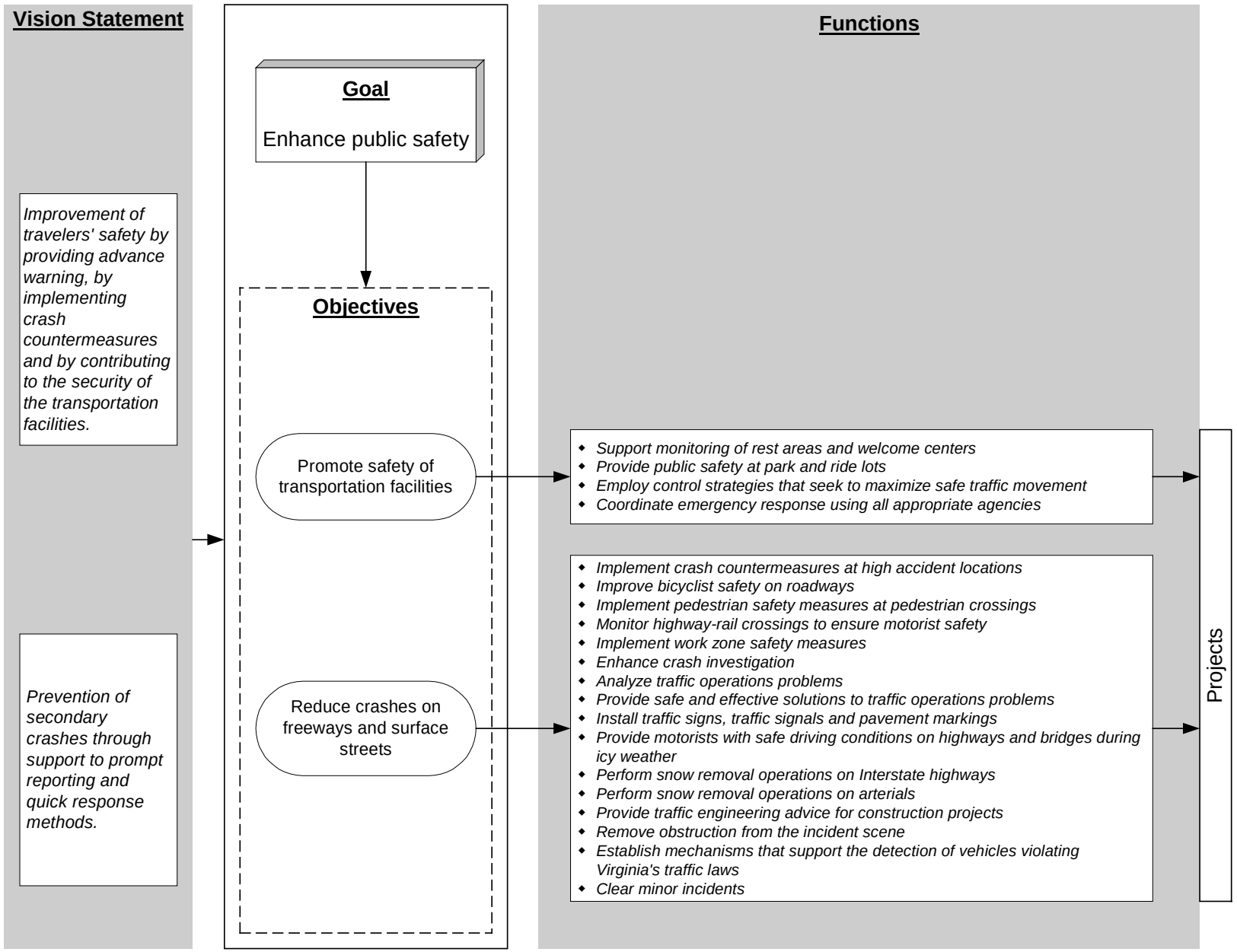

Figure 5: Mapping of the Goal – Enhance Public Safety

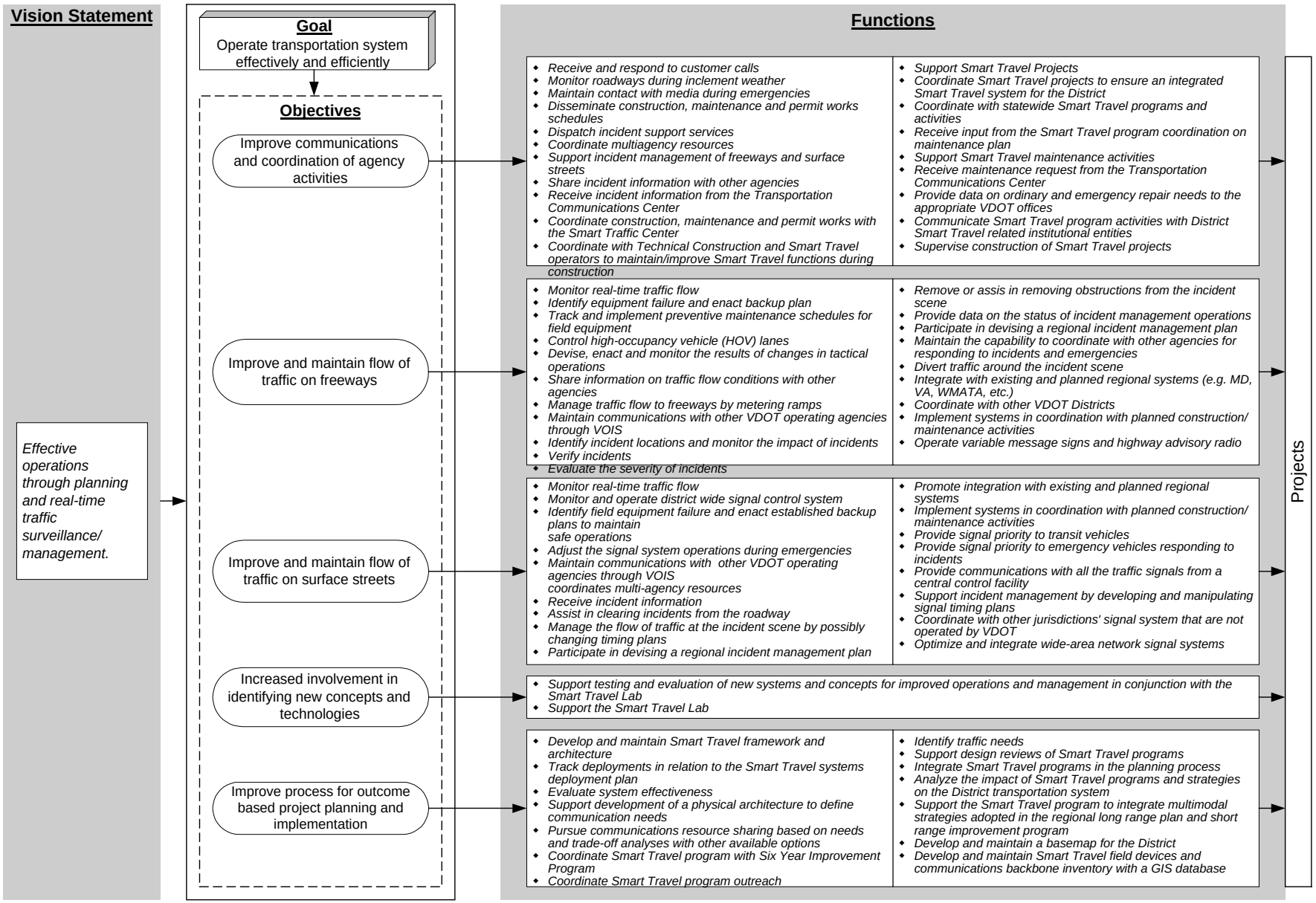

Figure 6: Mapping of the Goal – Operate Transportation System Effectively and Efficiently

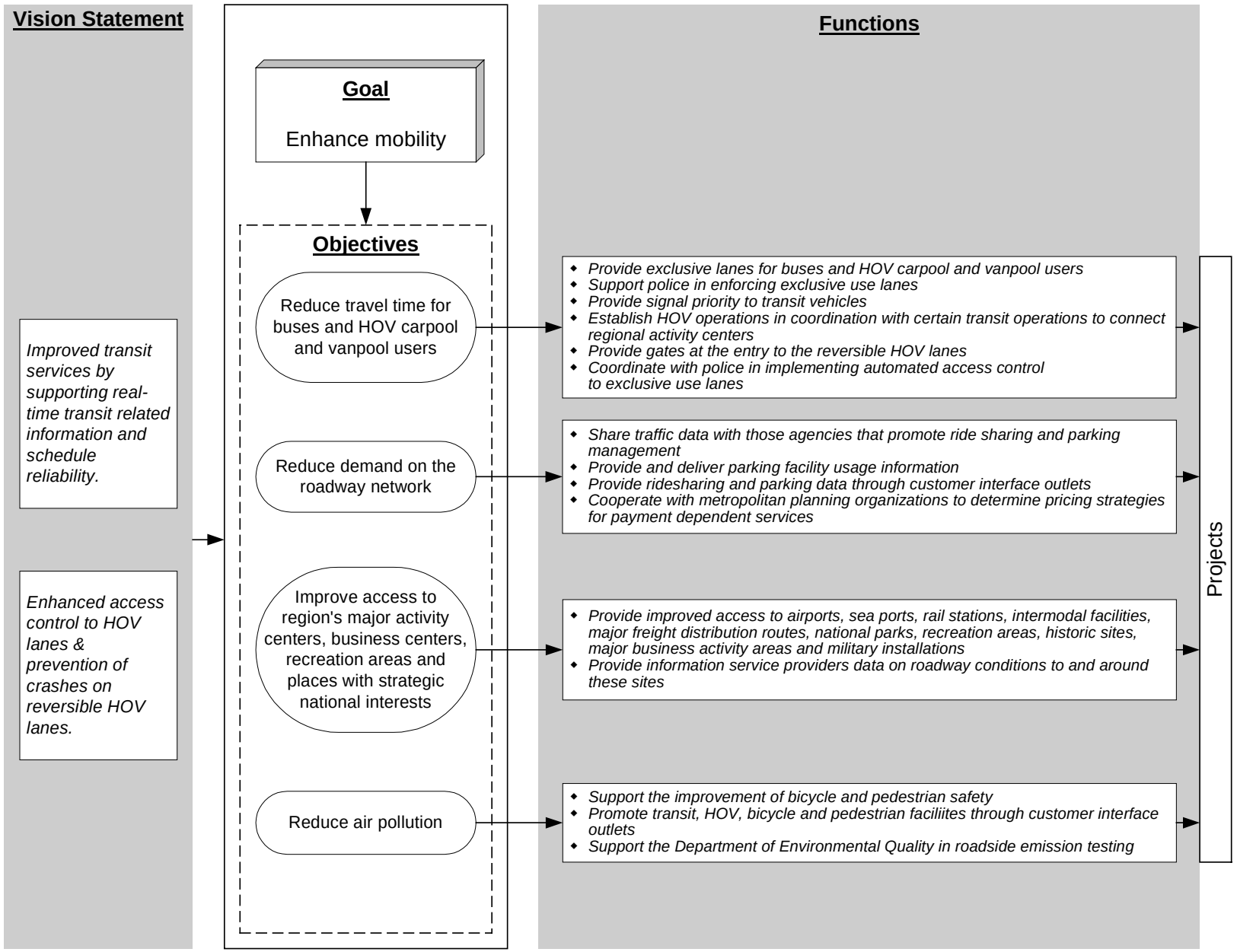

Figure 7: Mapping of the Goal – Enhance Mobility

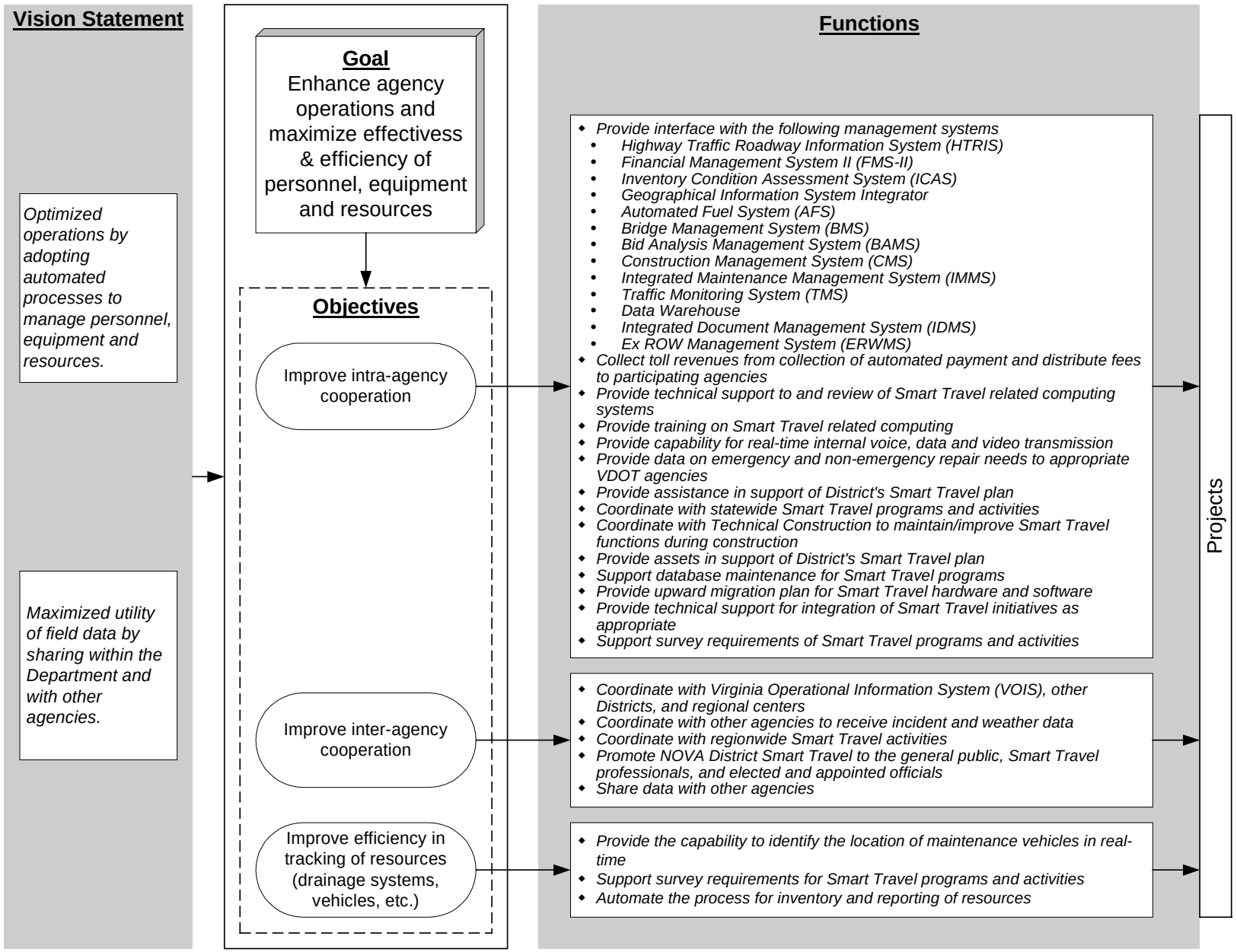

Figure 8: Mapping of the Goal – Enhance Agency Operations

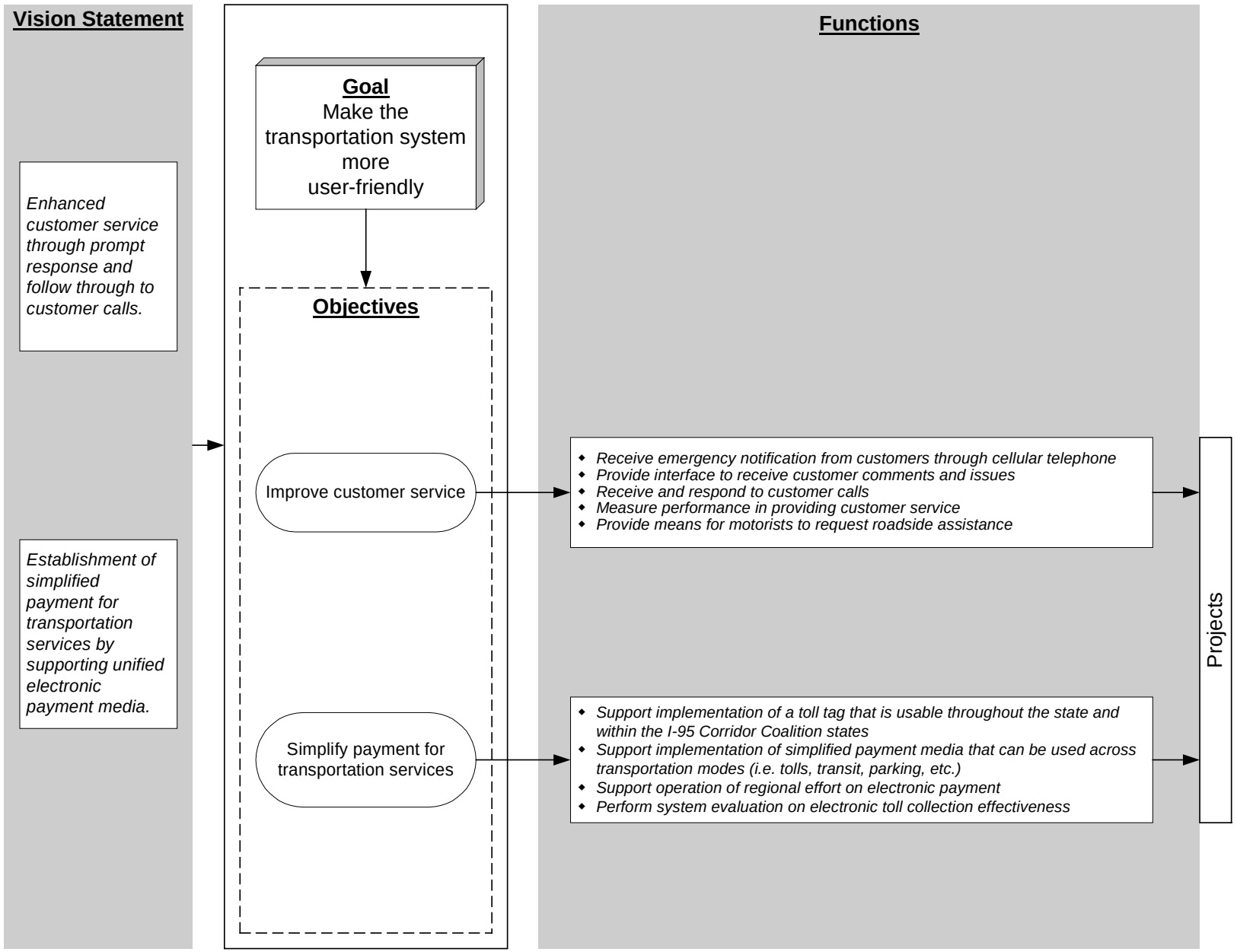

Figure 9: Mapping of the Goal – Make the Transportation System More User-Friendly

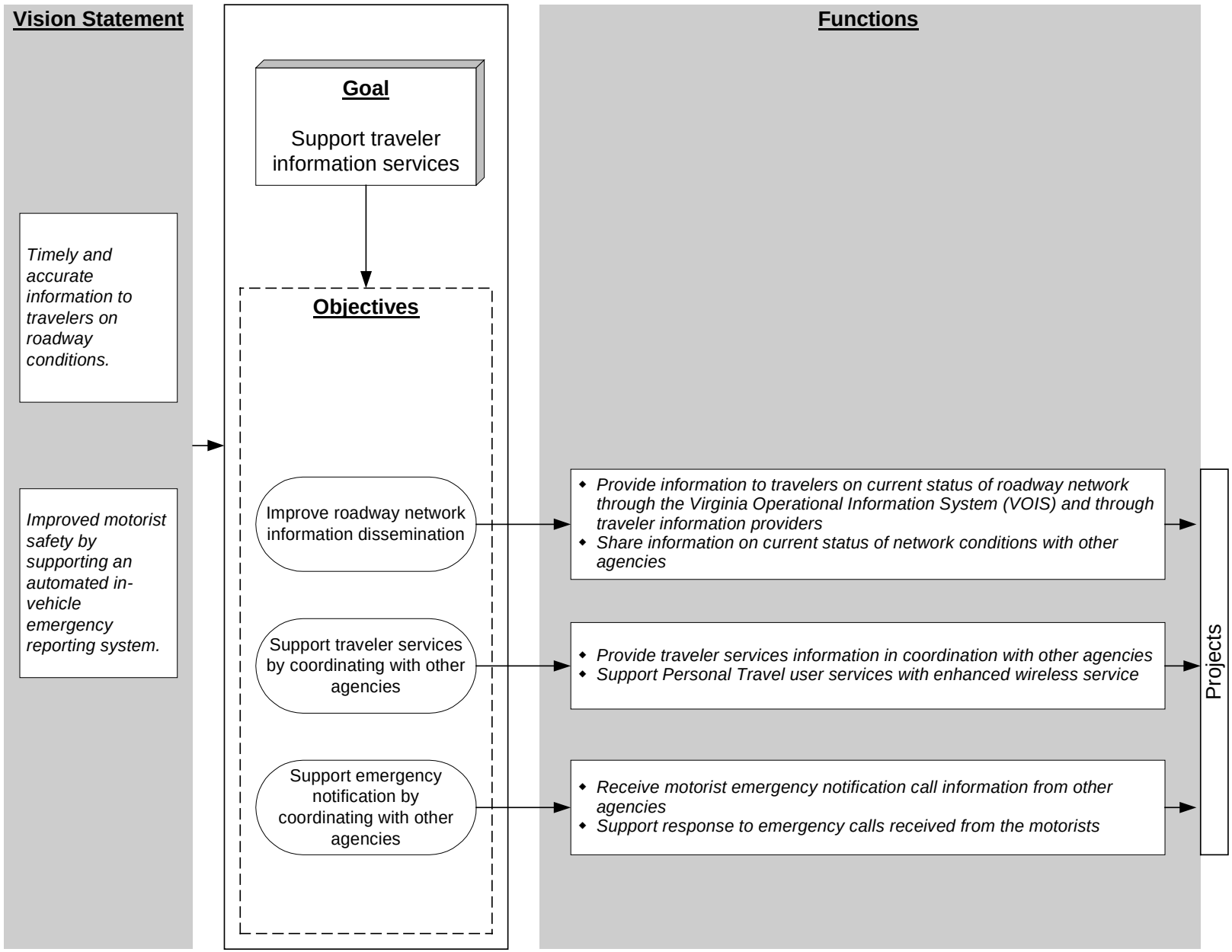

Figure 10: Mapping of the Goal – Support Traveler Information Services

The following section lists the functions associated with each VDOT NOVA District Smart Travel objective.

Objective: Promote safety of transportation facilities

The following functions help to reach this objective:

- Support monitoring of rest areas and welcome centers
- Provide public safety at park and ride lots
- Employ control strategies that seek to maximize safe traffic movement
- Coordinate emergency response using all appropriate agencies

Objective: Reduce crashes on freeways and surface streets

The following functions help to reach this objective:

- Implement crash countermeasures at high accident locations
- Improve bicyclist safety on roadways
- Implement pedestrian safety measures at pedestrian crossings
- Monitor highway-rail crossings to ensure motorist safety
- Implement work zone safety measures
- Enhance crash investigation
- Analyze traffic operations problems
- Provide safe and effective solutions to traffic operations problems
- Install traffic signs, traffic signals and pavement markings
- Provide motorists with safe driving conditions on highways and bridges during icy weather
- Perform snow removal operations on Interstate highways
- Perform snow removal operations on arterials
- Provide traffic engineering advice for construction projects
- Remove obstruction from the incident scene
- Establish mechanisms that support the detection of vehicles violating Virginia's traffic laws
- Clear minor incidents

Objective: Improve communications and coordination of agency activities

The following functions help to reach this objective:

- Receive and respond to customer calls
- Monitor roadways during inclement weather
- Maintain contact with media during emergencies
- Disseminate construction, maintenance and permit works schedules
- Dispatch incident support services
- Coordinate multiagency resources

- Support incident management of freeways and surface streets
- Share incident information with other agencies
- Receive incident information from the Transportation Communications Center
- Coordinate construction, maintenance and permit works with the Smart Traffic Center
- Coordinate with Technical Construction and Smart Travel operators to maintain/improve Smart Travel functions during construction
- Support Smart Travel Projects
- Coordinate Smart Travel project to ensure an integrated Smart Travel system for the District
- Coordinate with statewide Smart Travel programs and activities
- Receive input from the Smart Travel program coordination on maintenance plan
- Support Smart Travel maintenance activities
- Receive maintenance request from the Transportation Communications Center
- Provide data on ordinary and emergency repair needs to the appropriate VDOT offices
- Communicate Smart Travel program activities with District Smart Travel related institutional entities
- Supervise construction of Smart Travel projects

Objective: Improve and maintain flow of traffic on freeways

The following functions help to reach this objective:

- Monitor real-time traffic flow
- Identify equipment failure and enact backup plan
- Track and implement preventive maintenance schedules for field equipment
- Control high-occupancy vehicle (HOV) lanes
- Devise, enact and monitor the results of changes in tactical operations
- Share information on traffic flow conditions with other agencies
- Manage traffic flow to freeways by metering ramps
- Maintain communications with VDOT operating agencies through VOIS
- Identify incident locations and monitor the impact of incidents
- Verify incidents
- Evaluate the severity of incidents
- Remove or assist in removing obstructions from the incident scene
- Provide data on the status of incident management operations
- Participate in devising a regional incident management plan
- Maintain the capability to coordinate with other agencies for responding to incidents and emergencies
- Divert traffic around the incident scene
- Integrate with existing and planned regional systems (e.g. MD, VA, WMATA, etc.)
- Coordinate with other VDOT Districts

- Implement systems in coordination with planned construction/maintenance activities
- Operate variable message signs and highway advisory radio

Objective: Improve and maintain flow of traffic on surface streets

The following functions help to reach this objective:

- Monitor real-time traffic flow
- Monitor and operate district wide signal control system
- Identify field equipment failure and enact established backup plans to maintain safe operations
- Adjust the signal system operations during emergencies
- Maintain communications with an operations facility that communicates and coordinates multi-agency resources
- Receive incident information
- Assist in clearing incidents from the roadway
- Manage the flow of traffic at the incident scene by possibly changing timing plans
- Participate in devising a regional incident management plan
- Promote integration with existing and planned regional systems
- Implement systems in coordination with planned construction/maintenance activities
- Provide signal priority to transit vehicles
- Provide signal priority to emergency vehicles responding to incidents
- Provide communications with all the traffic signals from a central control facility
- Support incident management by developing and manipulating signal timing plans
- Coordinate with other jurisdictions' signal system that are not operated by VDOT
- Optimize and integrate wide-area network signal systems

Objective: Increased involvement in identifying new concepts and technologies

The following functions help to reach this objective:

- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Support the Smart Travel Lab

Objective: Improve process for outcome-based project planning and implementation

The following functions help to reach this objective:

- Develop and maintain Smart Travel framework and architecture
- Track deployments in relation to the Smart Travel systems deployment plan
- Evaluate system effectiveness

- Support development of a physical architecture to define communication needs
- Pursue communications resource sharing based on needs and trade-off analyses with other available options
- Coordinate Smart Travel program with Six Year Improvement Program
- Coordinate Smart Travel program outreach
- Identify traffic needs
- Support design reviews of Smart Travel programs
- Integrate Smart Travel programs in the planning process
- Analyze the impact of Smart Travel programs and strategies on the District transportation system
- Support the Smart Travel program to integrate multimodal strategies adopted in the regional long range plan and short range improvement program
- Develop and maintain a basemap for the District
- Develop and maintain Smart Travel field devices and communications backbone inventory with a GIS database

Objective: Reduce travel time for buses and HOV carpool and vanpool users

The following functions help to reach this objective:

- Provide exclusive lanes for buses and HOV carpool and vanpool users
- Support police in enforcing exclusive use lanes
- Provide signal priority to transit vehicles
- Establish HOV operations in coordination with certain transit operations to connect regional activity centers
- Provide gates at the entry to the reversible HOV lanes
- Coordinate with police in implementing automated access control to exclusive use lanes

Objective: Reduce demand on the roadway network

The following functions help to reach this objective:

- Share traffic data with those agencies that promote ride sharing and parking management
- Provide and deliver parking facility usage information
- Provide ridesharing and parking data through customer interface outlets
- Cooperate with metropolitan planning organizations to determine pricing strategies for payment dependent services

Objective: Improve access to region's major activity centers, business centers, recreation areas and places with strategic national interests

The following functions help to reach this objective:

- Provide improved access to airports, sea ports, rail stations, intermodal facilities, major freight distribution routes, national parks, recreation areas, historic sites, major business activity areas and military installations
- Provide information service providers data on roadway conditions to and around these sites

Objective: Reduce air pollution

The following functions help to reach this objective:

- Support the improvement of bicycle and pedestrian safety
- Promote transit, HOV, bicycle and pedestrian faciliites through customer interface outlets
- Support the Department of Environmental Quality in roadside emission testing

Objective: Improve intra-agency cooperation

The following functions help to reach this objective:

- Provide interface with the following management systems
    - Highway Traffic Roadway Information System (HTRIS)
    - Financial Management System II (FMS-II)
    - Inventory Condition Assessment System (ICAS)
    - Geographical Information System Integrator
    - Automated Fuel System (AFS)
    - Bridge Management System (BMS)
    - Bid Analysis Management System (BAMS)
    - Construction Management System (CMS)
    - Integrated Maintenance Management System (IMMS)
    - Traffic Monitoring System (TMS)
    - Data Warehouse
    - Integrated Document Management System (IDMS)
    - Ex ROW Management System (ERWMS)
- Collect toll revenues from collection of automated payment and distribute fees to participating agencies
- Provide technical support to and review of Smart Travel related computing systems
- Provide training on Smart Travel related computing
- Provide capability for real-time internal voice, data and video transmission

- Provide data on emergency and non-emergency repair needs to appropriate VDOT agencies
- Provide assistance in support of District's Smart Travel plan
- Coordinate with statewide Smart Travel programs and activities
- Coordinate with Technical Construction to maintain/improve Smart Travel functions during construction
- Provide assets in support of District's Smart Travel plan
- Support database maintenance for Smart Travel programs
- Provide upward migration plan for Smart Travel hardware and software
- Provide technical support for integration of Smart Travel initiatives as appropriate

Objective: Improve inter-agency cooperation

The following functions help to reach this objective:

- Coordinate with Virginia Operational Information System (VOIS), other Districts, and regional centers
- Coordinate with other agencies to receive incident and weather data
- Coordinate with regionwide Smart Travel activities
- Promote NOVA District Smart Travel to the general public, Smart Travel professionals, and elected and appointed officials
- Share data with other agencies

Objective: Improve efficiency in tracking of resources (drainage systems, vehicles, etc)

The following functions help to reach this objective:

- Provide the capability to identify the location of maintenance vehicles in real-time
- Support survey requirements for Smart Travel programs and activities
- Automate the process for inventory and reporting of resources

Objective: Improve customer service

The following functions help to reach this objective:

- Receive emergency notification from customer through cellular telephone
- Provide interface to receive customer comments and issues
- Receive and respond to customer calls
- Measure performance in providing customer service
- Provide means for motorists to request roadside assistance

Objective: Simplify payment for transportation services

The following functions help to reach this objective:

- Support implementation of a toll tag that is usable throughout the state and within the I-95 Corridor Coalition states
- Support implementation of simplified payment media that can be used across transportation modes (i.e. tolls, transit, parking, etc.)
- Support operation of regional effort on electronic payment
- Perform system evaluation on electronic toll collection effectiveness

Objective: Improve roadway network information dissemination

The following functions help to reach this objective:

- Provide information to travelers on current status of roadway network through the Virginia Operational Information System (VOIS) and through traveler information providers
- Share information on current status of network conditions with other agencies

Objective: Support traveler services information by coordinating with other agencies

The following function help to reach this objective:

- Provide traveler services information in coordination with other agencies
- Support Personal Travel user services with enhanced wireless service

Objective: Support emergency notification by coordinating with other agencies

The following function help to reach this objective:

- Receive motorist emergency notification call information from other agencies
- Support response to emergency calls received from the motorists

4.2 Institutional Operational Scheme

The District Administrator heads VDOT NOVA District. The Assistant District Administrator supports the District Administrator in the management of four major operational areas: Maintenance/Operations, Administration, Planning & Technology and Preliminary Engineering/Construction. Figure 11 shows the existing (April 1999) institutional framework of the VDOT NOVA District.

Under each operational area, the Smart Travel related institutional entities are shown that support the Northern Virginia District Smart Travel Program through various functions identified in Section 4.1. The institutional operational scheme allocates these functions to various institutional entities in an effort to organize the institutional functions that would support any future Smart Travel activities that demands defined institutional functions, such as the development of the VDOT NOVA District Smart Travel architecture. Some new functions were introduced in the institutional operational scheme that could not be directly associated with any objectives, such as Contract Administration's function "Issue Request for Proposal for Smart Travel projects".

The institutional operational scheme provides important input in developing the District Smart Travel Architecture. This scheme will be revised if institutional framework were to be changed in order to accurately reflect "who does what and where." Knowing "who does what and where" will help develop the logical and physical architecture for the District. The logical architecture will provide detailed requirements for these functions that will be useful for system procurement and design. The physical architecture will show what data must be exchanged between each institutional unit to support the Smart Travel program. The institutional operational scheme must be verified and updated before using it for developing the District Smart Travel architecture.

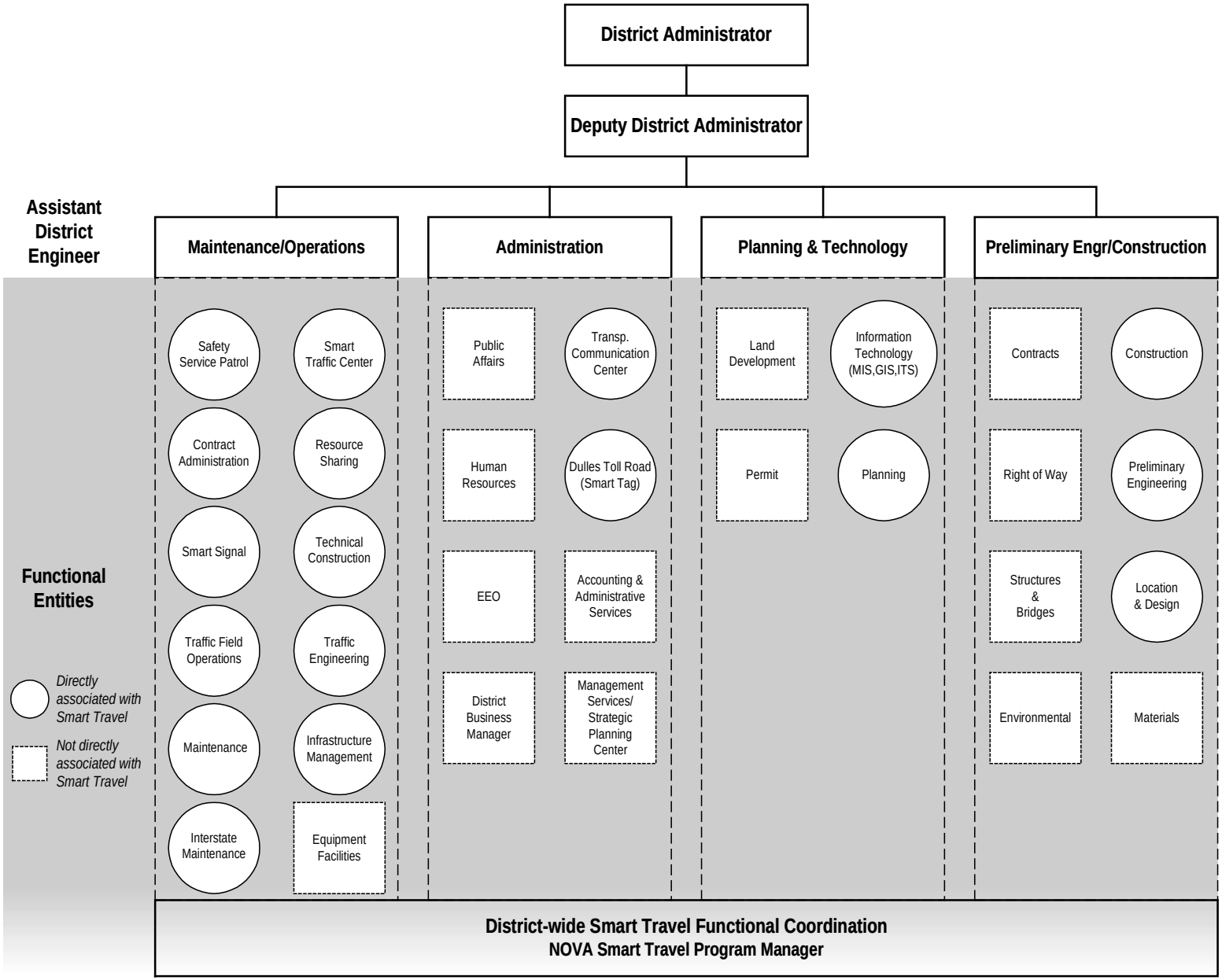

Figure 11: Existing Institutional Framework of the Northern Virginia District

The following list presents a proposed operational scheme for the Northern Virginia District Smart Travel program. This scheme was developed by allocating functions identified in Section 4.1 to the existing institutional framework.

Smart Traffic Center

For freeways:

- Monitor real-time traffic flow
- Identify equipment failure and enact backup plan
- Track and implement preventive maintenance schedules for field equipment
- Control high-occupancy vehicle (HOV) lanes
- Employ control strategies that seek to maximize safe traffic movement
- Devise, enact and monitor the results of changes in tactical operations
- Share information on traffic flow conditions with other agencies
- Provide information to travelers on current status of roadway network through the Virginia Operational Information System (VOIS) and through traveler information providers
- Establish mechanisms that support the detection of vehicles violating Virginia's traffic laws
- Manage traffic flow to freeways by metering ramps
- Maintain communications with other VDOT operating agencies through VOIS
- Identify incident locations and monitor the impact of incidents
- Evaluate the severity of incidents
- Provide data on the status of incident management operations
- Participate in devising a regional incident management plan
- Maintain the capability to coordinate with other agencies for responding to incidents and emergencies
- Operate variable message signs and highway advisory radio
- Support the Department of Environmental Quality in roadside emission testing
- Share traffic data with those agencies that promote ride sharing and parking management
- Evaluate system effectiveness
- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Integrate with existing and planned regional systems (e.g. MD, VA, WMATA, etc.)
- Implement systems in coordination with planned construction/maintenance activities
- Provide motorists with safe driving conditions on highways and bridges during icy weather
- Support the Smart Travel Lab
- Coordinate with other VDOT Districts (Fredricksburg, Culpeper, and Staunton)

Safety Service Patrol

- Receive emergency notification from customers through cellular telephone
- Identify incident locations and monitor the impact of incidents
- Verify incidents
- Share incident information with other agencies
- Remove or assist in removing obstructions from the incident scene

Resource Sharing

- Support development of a physical architecture to define communication needs
- Pursue communications resource sharing based on needs and trade-off analyses with other available options
- Provide assets in support of District's Smart Travel plan
- Support Personal Travel user services with enhanced wireless service

Contract Administration

- Issue Request for Proposal for Smart Travel projects
- Award contracts for Smart Travel projects
- Prepare, coordinate and manage the development of contract documents for the Smart Travel programs
- Monitor the Smart Travel budget for the District
- Forecast the budget for the Smart Travel projects
- Administer contracts for Smart Travel projects and activities

Technical Construction

- Supervise construction of Smart Travel projects
- Coordinate construction, maintenance and permit works with the Smart Traffic Center
- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Implement work zone safety measures

Smart Signal

For surface streets:

- Monitor real-time traffic flow
- Monitor and operate district wide signal control system
- Identify field equipment failure and enact established backup plans to maintain safe operations
- Adjust the signal system operations during emergencies
- Maintain communications with an operations facility that communicates and coordinates multi-agency resources
- Share information on current status of network conditions with other agencies

- Receive incident information
- Manage the flow of traffic at the incident scene by possibly changing timing plans
- Participate in devising a regional incident management plan
- Share traffic data with those agencies that promote ride sharing and parking management
- Provide signal priority to transit vehicles
- Provide signal priority to emergency vehicles responding to incidents
- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Provide communications with all the traffic signals from a central control facility
- Evaluate system effectiveness
- Support incident management by developing and manipulating signal timing plans
- Coordinate with other jurisdictions' signal system that are not operated by VDOT
- Support Smart Travel Lab
- Provide assistance in support of District's Smart Travel plan
- Improve bicyclist safety on roadways
- Implement pedestrian safety measures at pedestrian crossings

Traffic Engineering

- Analyze traffic operations problem
- Provide safe and effective solutions to traffic operations problems
- Provide traffic engineering advice for construction projects
- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Implement crash countermeasures at high accident locations

Traffic Field Operations

- Install traffic signs, traffic signals and pavement markings
- Support Smart Travel projects

Infrastructure Management

- Receive input from the Smart Travel program coordination on maintenance plan
- Support Smart Travel maintenance activities

Maintenance

- Perform snow removal operations on arterials
- Receive maintenance request from the Transportation Communications Center
- Provide the capability to identify the location of maintenance vehicles in real-time
- Automate the process for inventory and reporting of resources
- Provide data on emergency and non-emergency repair needs to the appropriate VDOT agencies

Interstate Maintenance

- Support snow removal on Interstate highways
- Receive maintenance request from the Transportation Communications Center
- Provide the capability to identify the location of maintenance vehicles in real-time
- Automate the process for inventory and reporting of resources
- Provide motorists with the safest driving conditions on highways and bridges during icy weather

Transportation Communications Center

- Receive and respond to customer calls
- Monitor roadways during inclement weather
- Maintain contact with media during emergencies
- Disseminate construction, maintenance and permit work schedules
- Coordinate emergency response using all appropriate agencies
- Support incident management on freeways and surface streets
- Receive motorist emergency notification call information from other agencies

Dulles Toll Road (Smart Tag)

- Support implementation of a toll tag that is usable throughout the state and within the I-95 Corridor Coalition states
- Support implementation of simplified payment media that can be used across transportation modes (i.e. tolls, transit, parking, etc.)
- Collect toll revenues from collection of automated payment and distribute fees to participating agencies
- Support operation of regional effort on electronic payment

Information Technology (MIS, GIS, ITS)

- Provide technical support to and review of Smart Travel related computing systems
- Develop and maintain a base map for the District
- Provide training on Smart Travel related computing
- Support database maintenance for Smart Travel programs
- Develop and maintain an Smart Travel field equipment inventory with a GIS database
- Provide upward migration plan for Smart Travel hardware and software
- Provide technical support for integration of Smart Travel initiatives as appropriate

Planning

- Integrate Smart Travel programs in the planning process
- Analyze the impact of Smart Travel programs and strategies on the District transportation system
- Integrate Smart Travel in the multimodal strategies adopted for the regional long range plan and short range improvement program

Construction

- Identify traffic needs
- Coordinate road construction, maintenance, and permit works with the Smart Traffic Center
- Implement work zone safety measures
- Provide information to travelers on current status of roadway network through the Virginia Operational Information System (VOIS) and through traveler information providers
- Coordinate with Technical Construction and Smart Travel operators to maintain/improve Smart Travel functions during construction

Preliminary Engineering

- Coordinate Smart Travel program with the Six Year Improvement Program

Location and Design

- Support survey requirements for Smart Travel programs and activities
- Support design reviews of Smart Travel programs

Smart Travel Program Coordination

- Develop and maintain Smart Travel framework and architecture
- Coordinate Smart Travel project to ensure an integrated Smart Travel system for the District
- Communicate Smart Travel program activities with District Smart Travel related institutional entities
- Coordinate with statewide Smart Travel programs and activities
- Coordinate with regionwide Smart Travel activities
- Support testing and evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab
- Promote NOVA District Smart Travel to the general public, Smart Travel professionals, and elected and appointed local officials
- Develop and maintain Smart Travel field devices and communications backbone inventory with a GIS database
- Coordinate with the Virginia Operational Information System, other Districts, and regional centers

All above proposed Smart Travel functions for existing institutional framework should be updated if the institutional framework were to be changed. The accurate allocation of functions guarantee a beneficial and practical Smart Travel architecture and therefore the accurate allocation of functions would guarantee a beneficial and practical Smart Travel architecture. This would help to avoid stovepipe solutions in which different systems produce redundant information instead of maximizing its utility through efficient information exchange.

5. SUMMARY

The VDOT Northern Virginia District Smart Travel Framework identifies anticipated future scenarios that will improve safety and reduce congestion and defines ways to reach these scenarios. The Smart Travel framework promotes the delivery of services 24 hours a day, 7 days a week and 365 days a year. This is a departure from the traditional planning process in which items are planned to affect transportation performance during critical peak hour periods.

The NOVA District Smart Travel Framework should help the NOVA District in developing and evaluating projects. Table 1 summarizes the anticipated benefits of the Strategic Plan, Summary of 1999 Activities and the Program Plan on the VDOT NOVA District Smart Travel program.

	Support Project Evaluation	Support Policy	Allocate Resource Efficiently	Save Resources	Build Consensus and Coordination	Support State Programs and Planning	Track Progress	Identify Projects
Smart Travel Strategic Plan								
Smart Travel Summary of Activities								
Smart Travel Program Plan								

Table 1: Anticipated benefits of Smart Travel Framework

This NOVA Smart Travel Strategic Plan presents the vision that are consistent with the VDOT's purpose and mission for the 21st century. This vision led to identifying goals, objectives and functions for the Plan. Initially, the vision was used to define goals. Objectives to reach the goals were subsequently identified. The objectives were then used to define functions to be undertaken by the Northern Virginia District. The Comprehensive Smart Travel Project List will aggregate functions that are not mapped to any existing or planned Smart Travel projects into new projects. This hierarchy of action planning enables a traceability of any project to the vision, thus, enabling realization of the vision through project deployment.

Additionally, this plan provides guidelines to develop a District Smart Travel Architecture that will articulate the District's operations and needs in a systematic way so that VDOT can deploy systems in an integrated fashion. These guidelines include the definition of a District Smart Travel Architecture, and justification for and scope of the Smart Travel architecture (see Appendix A).

This Strategic Plan is meant to be the foundation for the VDOT NOVA District Smart Travel Program Plan, providing support to develop potential projects that would forward the District's Smart Travel program. This document should help the District to focus their Smart Travel program to a common vision and help them identify how to reach the vision.

APPENDIX A
GUIDELINES FOR DEVELOPING A DISTRICT SMART TRAVEL ARCHITECTURE

These guidelines are provided to help District develop a Smart Travel architecture that connects all the Smart Travel components within the District and in the state to achieve optimal functionality. By having a District Architecture, VDOT will have a detailed understanding of the needs of the systems and how the communication layer supports the system. This detailed understanding of VDOT NOVA systems will assist VDOT interface and integrate with other agencies in and adjacent to the District.

A reverse engineering path based "communications first, architecture later" will not be satisfactory. This may add constraints in adding new functionality because the communications infrastructure is not capable of adapting to new system needs or incapable of supporting legacy systems.

The following section defines the District Smart Travel architecture and how it related to other Smart Travel Planning efforts. Additionally, this section provides justification for and scope of District Smart Travel architecture, and immediate actions needed to initiate the process of developing the architecture.

What is a District Smart Travel Architecture?

A Smart Travel architecture is a plan that articulates the District's operations and needs into systems engineering context so that VDOT can deploy Smart Travel systems in an integrated fashion. Each activity performed by the Northern Virginia District will depend on a system as a tool for improving efficiency. The architecture will accurately reflect the operations of the Department so that the systems are readily accepted and correctly used by the NOVA District personnel, and can be easily integrated into the NOVA District operations.

There are two distinct elements of a District Architecture. The Logical Architecture describes the system in terms of the functions it performs. The Physical Architecture provides a physical description of the system in terms of the relationships among system components and end users. These elements are described in the following section.

<u>Logical Architecture (Planning Level)</u>

The Logical Architecture provides great detail on the behavior of the system. The detailed description of the functions includes the input data received by the function, the processing or manipulation of the data performed by the function and the output data or information produced by the function.

The detail of the Logical Architecture can be very specific without having to identify a particular technology. Indeed, the description of the system function behavior and requirements enable the system developer to identify the specifications for system devices as part of the design phase.

The Logical Architecture does not dictate a particular design; it provides a description of what the NOVA District needs the system(s) to perform.

The Logical Architecture enables a description of the desired system to perform under many scenarios. First, there is the interaction between system functions. An example of this scenario is when traffic surveillance detectors identify congestion and automatically call the nearest Safety Service Patrol via alphanumeric pager. Second, there is the interaction among end users (personnel) and the system functions. An example of this scenario is when a traffic engineer changes a signal controller-timing plan from a remote office. Third, there is the interaction between system functions and existing (legacy) systems. An example is when event planning automatically calls upon the Pavement Management System to retrieve a schedule of upcoming pavement improvement projects.

Physical Architecture

The Physical Architecture builds upon the Logical Architecture by defining the physical subsystems and other items that provide the system functions. The system functions from the Logical Architecture are grouped into subsystems according to the commonality of purpose. For instance, a traffic management subsystem may contain the traffic surveillance, fault detection, and device control functions. The subsystems categorize the functions so that a physical entity can be developed that delivers the functions.

The Physical Architecture also describes the types of interfaces that will exist between subsystem to other subsystems, between subsystems and users, and between subsystems and field devices. The interface description includes the details on the data that is exchanged, the total amount of data that is exchanged, and the speed in which the data must be exchanged.

Aside from these characteristics, it is important to characterize the criticality of the interface should the interface fail. This enables the developer to design a system that is appropriately robust because the failure of one part of the system will not deactivate the remainder of the system. The criticality may include the dependency of the subsystem on the failing interface and the ability of the subsystem to perform under a variety of conditions.

Any interface is subject to the conformance of standards such as the National Transportation Communications for ITS Protocol (NTCIP). The need for these standards is drawn from the need to achieve certain system commonality so that no system developer must rely on propriety technology from a manufacturer. The standards conformity for interfaces is an important issue because new standards are identified, as the industry becomes more sophisticated.

The communications network, which serves as the conduit for system data interchange, must be robust to support the system's needs plus the interface standards and protocols that guide the system implementation. As an example, the traffic management subsystem and the incident management subsystem may require live video transmission to be supported at each subsystem. The interface for each subsystem must support the volume of data of the video. The interface that is provided at the originating subsystem must be consistent with the receiving subsystem to enable the transmission of the video data.

The establishment of the Physical Architecture will provide developers with tools to gauge the effectiveness of their designs. The architecture is valuable for the Department to create testing procedures and acceptance criteria for designs prepared for systems. Aside from individual device testing (unit testing), the Department can direct the developers to perform module testing of parts of the system in a controlled environment. If the system modules are performing acceptably according to the acceptance criteria, the developers can perform a fully integrated systems test. The value of testing is in the identification of faulty design and correction before the system's full implementation. The more testing that is performed along a system's development life cycle, the more likely the resulting system will be successful.

Why is a District Smart Travel Architecture Important?

The development of a District Architecture will yield many benefits to the Northern Virginia District as it develops and acquires systems. Following the architecture development, the District will be able to perform critical evaluations of proposed designs. The District architecture allows a system to be clearly defined. The following discusses the benefits of establishing a District Architecture:

Interoperability of Systems

The architecture will eliminate the risk of stovepipe solutions. The deployed systems will share as much data that is practical and necessary.

Design Reliability

The architecture provides a logical implementation path, whereas without the architecture there is a risk of "patch work" of unrelated systems that must be modified. The architecture, coupled with testing requirements and criteria, will ensure a successful design and implementation of the systems because flaws are identified before the full implementation is completed. This removes the possibility that a design improvement "patch" is quickly created to resolve the design issue, but instead promotes good design practices that remove error early in the development life cycle.

Support to Resource Sharing Initiative

The preferred approach to the resource sharing process is first to define the district's telecommunication needs and to develop potential network architecture. This prepares the NOVA District to negotiate with the private industry. By having the architecture before going to a resource sharing agreement with private enterprises, the NOVA District will have better understanding of needs for negotiating.

Reduced Development Cost

The architecture provides a Concept of Operations and Functional Requirements, which enables less effort in system design as the higher level needs are already defined in the architecture. This also eliminates the misinterpretation of high-level system needs in design.

User Acceptance of Systems

Personnel will use systems already agreed on that enhance their activities without adding more activities to their workload. This is valuable because the continued success of the Smart Travel systems depends on the use of the systems by the organization's personnel.

Greater Interaction among District offices

The various units of the Northern Virginia District will each interact with the deployed systems to suit their individual needs. Yet, the sharing of the systems among the variety of business units will engineer a greater sense of unity because the access to vital information will be provided to everyone on an equal basis.

Greater Interaction with Other Institutions

The NOVA District Smart Travel architecture will assist in identifying institutional interdependencies that exist in the region, and how agencies can benefit from each other's activities.

What are the Available Resources for Developing the NOVA District Smart Travel Architecture?

The NOVA District Architecture builds upon previous state, federal and local efforts. It relies more upon the VDOT Northern Virginia Smart Travel Framework, which is based on the Virginia Smart Travel Business Plan. This basis enables the NOVA District Architecture to promote the vision of Smart Travel systems for Virginia and also will enable the consistency with the National ITS Architecture.

The following table summarizes the tools that are available for creating the NOVA District Architecture. It lists a description of the contents and uses of each resource. The assumptions for the availability of the resource are provided for those items, which have not been released yet. These resources can be used as tools in developing the NOVA District Architecture.

RESOURCE	CONTENTS OF RESOURCE	USE OF RESOURCE
Smart Travel User Services Reference (Published by VDOT)	Describes the standard Smart Travel User Services and Functions that are provided throughout Virginia.	This document serves as the foundation for District and local area system development. The high level requirements describe the Department's operations in terms of Smart Travel functions. These functions are described in more detail throughout the design process.
NOVA Smart Travel Strategic Plan (Pending the release of the Northern Virginia District Smart Travel Framework)	Includes VDOT Northern Virginia District functions that support the District's Smart Travel goals and objectives.	The Strategic Plan allocates functions to the existing institutional framework of the VDOT NOVA District. The institutional framework will identify "who does what and where." The understanding of "who does what and where" will help develop the logical and physical architecture for the NOVA District.

RESOURCE	CONTENTS OF RESOURCE	USE OF RESOURCE
VDOT Northern Virginia Program Plan (Pending the release of the Northern Virginia District Smart Travel Framework)	Describes the behavior of critical projects	The functional requirements for specific project implementation are an aid to develop other system-wide functional requirements. These project-specific requirements demonstrate the detail of the requirements that is adequate and meaningful to a systems developer.
National ITS Architecture (Published by USDOT)	Provides a reference for the planning, design and implementation of ITS systems for a broad range of transportation providers.	The volume of data provided in this package is adequate to support system development of any scale. The National ITS Architecture can be used as the foundation for establishing functional requirements and for defining the interfaces among the subsystems.
Interim Guidance on Conformity with the National ITS Architecture* (Published by USDOT) See notes after this table	Provides guidance on the use of the National ITS Architecture to develop a regional architecture.	This document is broad in scope and provides little detail on the specific uses of the National ITS Architecture. It does advocate consensus from a variety of transportation stakeholders for creating a regional architecture –—a different approach compared to the NOVA District, single-agency architecture.
Critical Standards (Published by USDOT)	Provides a list of the interface standards under development and categorizes them as 'national', ensuring interoperability, and 'foundation', promoting the development of other standards.	This document is under review and will likely change in the future. The 'national' standards to date apply to roadside-to-vehicle communications, which is outside the goals of the VDOT Smart Travel Business Plan. The 'foundation' standards govern the data passing through interfaces and may impact the NOVA District Architecture.

*The USDOT published the following as the Interim Guidance for ensuring National ITS Architecture conformity (paragraph IV.A.1):

"Recipients of funds from the Highway Trust Fund for ITS projects that affect regional integration shall evaluate those projects for institutional and technical integration with transportation systems and services within the region, and consistency with the applicable regional ITS architecture or the National ITS Architecture. Based upon this evaluation of the projects(s), Highway Trust Fund recipients shall take the appropriate actions to ensure that development of the project(s): (a) engages a wide range of stakeholders, (b) enables the appropriate electronic information sharing between shareholders, (c) facilitates future ITS expansion, and (d) considers the use of applicable ITS standards."

The USDOT provides the following as considerations in transportation planning (paragraph IV.B):"Statewide and metropolitan planning activities should include consideration of the efficient management and operation of the transportation system."

What is the Scope of the NOVA District Smart Travel Architecture?

The NOVA District Smart Travel Architecture should follow a systems engineering approach to better reflect regional and statewide needs and to promote consistency with the National ITS Architecture (when Consistency Policy with the *National ITS Architecture* is implemented). The architecture focuses on the Department's business practices. Interfaces to outside agencies are identified but not developed. The NOVA District Smart Travel Architecture should be developed through a systematic development of the following elements:

Concept of Operations

The Concept of Operations will be developed based on the Functional Scheme identified in the *VDOT Northern Virginia District Strategic Plan*. The Concept of Operations will enable an architecture that is suitable for the NOVA District's needs by summarizing all the relevant operations that will be affected by the deployment of Smart Travel systems.

User Service Requirements

Based on the broad system functions identified in the Concept of Operations, VDOT will create detailed user service requirements that articulate the institutional needs. The developer will add or delete requirements from the *VDOT Smart Travel User Service Reference* to meet the needs of the NOVA District.

Logical Architecture

The Logical Architecture will provide detail on the behavior of the system that is to be deployed. The detailed description of the functions will include the identification of input data received by the functions, the processing or manipulation of the data performed by the functions, and the output data or information produced by the functions.

Documenting the Logical Architecture will require the development of diagrams that reflect the function's characteristics, and that define data that are received, processed or sent by the functions and functional requirements.

Physical Architecture

The functions that are defined in the Logical Architecture will be organized into subsystems and will be consistent with the Institutional Operational Scheme described in the *VDOT Northern Virginia District Smart Travel Strategic Plan*. The subsystems are the physical entities that deliver the functions to the system users. The organization of the subsystems will depend on a prioritization of functions that considers the critical need for implementation, the function's relationship with other functions, and the data flow characteristics among certain functions and existing systems/activities in the region; all of which will be based on the existing and planned Smart Travel project/activities in the region (refer to the *Smart Travel Program in the Virginia Department of Transportation Northern Virginia District –Summary of 1999 Activities*).

The Physical Architecture will also document intra-agency interface requirements. This mutual exchange of information within VDOT will identify the potential interfaces within the Northern Virginia District systems and to other statewide VDOT systems.

Documenting the Physical Architecture will require the development of figures that demonstrate the subsystems, the means of exchanging data among them, and the documentation of institutional interface requirements. Additionally, the documentation will also demonstrate that the applicable standards are supported by the interfaces.

Physical Architecture Testing

VDOT will establish acceptance criteria for testing of the Physical Architecture, so that it meets the functional requirements and the integrated system works as planned and interface requirements support existing and upcoming ITS standards activities.

Consistency Process Documentation

VDOT will develop and implement a process to determine the consistency of the proposed projects with (1) the adopted *NOVA District Smart Travel Architecture*, (2) *the Statewide Smart Travel Framework* and (3) the *National ITS Architecture*. This process will provide a mapping of project design and terminology to the NOVA District Smart Travel Architecture and will identify potential interfaces and show use of ITS standards, where applicable. This process should also document how these projects can also be mapped to *the Statewide Smart Travel Framework* and the National ITS Architecture through the NOVA District Smart Travel Architecture.

What are the Immediate Actions Needed?

Establish a Group within VDOT that will Advocate the NOVA District Architecture Development

An established group of VDOT personnel will facilitate the identification and resolution of institutional issues and the technical challenges they pose. The establishment of a core group at the earliest stages of development will provide the members with the sense of the development process. Such a group is likely to ensure that systems are budgeted, programmed, and acquired without adverse impacts to their other activities.

Such a core group will require the participation of staff from all the VDOT District offices that will derive a benefit from the implementation of systems. These include the District Construction Engineer, the District Maintenance Engineer, the District Traffic Engineer, the District Administrator, and other key staff.

Identify Scope of the District Architecture

The core group will evaluate the scope identified in the previous section and recommend the final scope. The architecture development can start immediately after the scope is finalized.

APPENDIX B

VDOT NORTHERN VIRGINIA SMART TRAVEL FRAMEWORK WORKSHOP MARCH 19, 1999

WORKSHOP SUMMARY

The VDOT NOVA District Smart Travel Framework Workshop was held on March 19, 1999 from 9:00 AM to 2:30 PM. Attachment A illustrates the Workshop Agenda.

Ms. Amy Tang, the VDOT Northern Virginia Smart Travel Program manager, hosted the workshop with technical guidance from Mr. J.R. Robinson of the VDOT Central Office ITS Division. Ms. Tang is the Project Manager from VDOT for developing the Northern Virginia Smart Travel Framework; an effort that is funded by the VDOT ITS Division. Odetics ITS is providing technical support to Ms. Tang as part of the On-Call Technical Support Services Contract.

The workshop included a breakout session that was divided into two groups. These group sessions ran concurrently, where Ms. Erin Bard of PB Farradyne facilitated one group and Dr. Shahram Malek of Odetics ITS facilitated the other group. Dr. Ronnie Chowdhury of Odetics ITS supported Ms. Bard, while Mr. Matt Miller of Dewberry & Davis supported Dr. Malek in the other breakout session group.

The workshop objective was to gather input on potential Smart Travel projects that should be considered as part of NOVA's Smart Travel Program Plan. These projects must also be consistent with VDOT's overall mission and goals. Longer-term projects were also discussed, particularly those that would impact short-term efforts. This information will be used to design the financially constrained program plan, to support funding requests for maintenance and operations including staff, and to guide the long-term NOVA Smart Travel program.

The workshop consisted of the following three elements:

- Introductory and Overview Presentations
- Breakout Sessions
- Breakout Group Presentations

INTRODUCTORY AND OVERVIEW PRESENTATIONS
(9:00 AM – 10:10 AM)

Ms. Tang commenced the meeting by providing an overview of the workshop that included a broad description of the VDOT NOVA District Smart Travel Framework, along with the objectives and format of the workshop.

The elements of the Northern Virginia District Smart Travel Framework are an updated Smart Travel Strategic Plan, an inventory of existing and planned Smart Travel projects/activities and a

Smart Travel Program Plan. When completed, the framework will be presented to the District Administrator and Assistant District Engineers, and shared with VDOT staff and other Smart Travel professionals.

Ms. Tang presented the NOVA District Smart Travel vision, which portrays the future system in action.

The Smart Travel vision is the first element in a hierarchy of action planning for NOVA. The vision guides the program as goals are mapped to visions. Objectives to reach the goals are subsequently identified. The objectives are used to define functions (the term "activities" was used in the workshop for functions) to be undertaken by NOVA and selected functions are aggregated to define a project. This hierarchy of action planning enables a traceability of any project to the vision, thus ensuring the realization of the Smart Travel vision through project deployment.

Following Ms. Tang's presentation, Mr. J.R. Robinson of the VDOT Central Office ITS Division presented how the Northern Virginia Framework fits together with the Statewide Smart Travel vision.

Mr. Robinson's presentation included the driving forces for developing a district-wide Smart Travel framework. He also discussed the envisioned Statewide Smart Travel Framework, which is currently planned to include statewide, regional, district and residency/area headquarters responsibilities. In addition, the Statewide Smart Travel vision calls for the implementation of nine district operations centers and four regional operations centers (two are in place today including one at NOVA) enabled by the statewide fiber optic network.

BREAKOUT SESSIONS
(10:20 AM – 2:00 PM)

The breakout sessions were divided into two groups. VDOT Northern Virginia executives and staff representing planning, maintenance, technical construction, construction, signals, Smart Traffic Center, Dulles Toll Road, traffic engineering, land development, and transit attended the workshop.

Each participant received a workshop package that included a copy of the following documents:

- Workshop Agenda
- VDOT Smart Travel Business Plan 1997-2006 (1998 Update)
- Northern Virginia District Smart Travel Vision (Draft)
- Northern Virginia District Vision, Goals Objectives and Activities (Functions) Figures (Draft)
- Tables with list of existing projects and related sample activities (these tables were handed to the participants during the breakout session) (See Attachment B)

Facilitators assisted participants working on the distributed Tables to accomplish the following:

- Provide comments on the activities that are mapped to existing projects.
- Identify additional projects.
- Identify responsible parties in systems deployment, system operation/maintenance and system upgrade for existing and new projects.

In detail, participants reviewed the projects to identify whether the activities accurately described the project, and whether any projects were missing and should be added to the program. In addition, participants needed to identify responsible parties for deployment, operation, and future upgrade. The attached tables (Attachment B) depict input received from the participants on Smart Travel projects (shown in underlined and letters "A" and "B" correspond to the breakout group designation in the workshop).

In addition, the participants discussed other Smart Travel program-related topics, as described below. A good part of the discussion focused on how NOVA could better plan, manage and operate Smart Travel investments. Those comments are summarized in the following four categories:

SYSTEM COVERAGE

- Area of Influence: Some systems including highway advisory radio and motorist call boxes may be deployed in systems that extend beyond the existing boundary of the Northern Virginia region. For example, the motorist call box system should extend beyond the Prince William County line. Currently, NOVA's Smart Travel maintenance efforts extend past the Prince William County line.

- Geographical Coverage: Many planning activities conducted for the Northern Virginia District rely on land use and population information that includes Fauquier County and Fredricksburg. The major arterials such as US-29 are also considered very important for planning in the Northern Virginia District.

- Freeway Management Vision: The vision for the geographical coverage of the freeway management system in the Northern Virginia Region includes the following:
  - The complete Dulles Corridor
  - All of I-495 within Virginia
  - All of I-66 from I-495 to I-81
  - I-395/I-95 from DC to Fredricksburg

1. SYSTEM PLANNING AND DESIGN CONSIDERATIONS

- Virtual Regional System: Because NOVA's Smart Travel systems are currently housed in more than one location, NOVA should understand the advantages and disadvantages of a Virtual Regional System as opposed to a "real" system, or one that is housed in a single location.

- Wireline and wireless Resource Sharing: The following items are needed:
  - Strategic Plan

- Funds for administrative work and design
- Tracking of funds through general funds
- Operations and maintenance cost of goods and services placed as a part of the program needs to be considered.
- Evaluate whether VDOT is receiving adequate value in the resource sharing agreements.
- Plan that hooks up Smart Travel devices that are existing to the fiber optic backbone provided through the wireline resource sharing.

- Usage of in-Vehicle Tags: To date, there has been only a limited evaluation performed on the ability to use tags for origin-destination studies, or other probe data for evaluating system operations. VDOT should explore the opportunity to estimate real travel time and delay by using data from tags.

- Coordination of Smart Travel planning with Construction Projects: Smart Travel planning should consider existing and planned construction projects, so that, whenever possible, certain elements of Smart Travel projects can be integrated into the programmed construction project.

2. Smart Travel PROGRAM AWARENESS

- Internal Communications within VDOT on Smart Travel Programs and Services: The workshop itself was very informative for the majority of the participants. Few are aware of the complete scope of the current and planned Smart Travel projects and needs. With Smart Travel staff located in more than 7 different VDOT groups in NOVA, this internal communication activity must be thoughtfully designed and implemented.

- Public Awareness of Available Services and Programs: VDOT should improve the communication with the public on the services that are available to the motorists. For example, the "One Call Number" for traveler information is not well publicized. VDOT staff was also unaware of the One Call Number. The extent of any benefits of Smart Travel Program in NOVA is not widely known either by the public or by VDOT staff. Public information specific to Smart Travel systems, including the One Call Number, should be developed.

3. MAJOR CONSTRUCTION ACTIVITIES IMPACT ON NOVA Smart Travel

- Regional Affects of Construction: With upcoming, long-term construction of the Springfield Interchange, Woodrow Wilson Bridge, I-66, and several other smaller projects, the operation of the Smart Travel systems in NOVA will need to be continually adjusted to respond to the continual change in traffic patterns and volumes due to construction. Currently, VDOT's practice is to review construction project traffic impacts only within the project limits. However, these projects will have affects far outside the project limits, and will have cumulative effects on each other.

- Traffic Operational Plan to include Regional Affects of Construction: A comprehensive traffic operations review and plan needs to be developed that considers the regional affects of construction so that the resources can be applied to Smart Travel system operations to manage traffic during the construction period. For example, traffic back-ups and diversions on the above projects will affect the signal timing in Northern Virginia. However, there has been no work done to identify the corridors that would likely be affected, the possible extent of that effect, and the resource needs to maintain optimal timing. There has been no review of the construction impacts regionally, nor has there been a review of the need for freeway systems beyond the construction project limits to manage traffic, or allow drivers to avoid construction.

BREAKOUT GROUP PRESENTATIONS
(2:00 PM – 2:30 PM)

The presentation by each group was divided into three subjects, and they are summarized as follows:

1. Today's Accomplishment

- The workshop helped the participants to understand the elements and scope of the Northern Virginia Smart Travel framework and the importance of information sharing between sections.

- The workshop was constructive. Participants communicated with each other on issues that are related to the deployment of Smart Travel systems in the Northern Virginia region. There was much agreement among the participants on the opportunities and constraints to the deployment of Smart Travel systems in the region. One issue everybody agreed on was that Smart Travel operations should be synchronized with planning and construction activities.

- This workshop was proactive where the participants volunteered information and input on the NOVA District wide Smart Travel framework.

2. Major Issues/Conflicts

- Smart Travel deployment should fit into VDOT's business practices. It is a part of the VDOT organization and how Smart Travel fits into the organizational concept of operations must be defined.

- Communication within the agency and with the public is important for successful Smart Travel deployment. There should be an improved mechanism to communicate within the agency regarding on going and planned Smart Travel activities. Additionally, public awareness on these systems must be developed to utilize its maximum potential.

- There must be a forum that can easily communicate the infrastructure and systems that are existing, so that future projects can fully utilize these resources. For example, a base

map that graphically identifies the Resource Sharing fiber optic network will help to plan for projects that can benefit from this resource.

- The Northern Virginia regional Smart Travel boundaries should be defined and approved by the appropriate authority. Additionally, the geographical scope of each operating entity within VDOT must be identified.

- Questions were raised with the physical or virtual operational center. Specifically, what are the differences between them and what are the advantages/disadvantages associated with them?

- Issues were raised on VDOT's role in enforcement/security and emissions monitoring. It was suggested that VDOT should not have any direct role in enforcement/security, although it will support these activities. The responsibility of interfacing among various management systems was discussed. The participants have not identified who would be the appropriate person to take this responsibility.

- Participants felt that guidance for Smart Travel program is important because it would avoid programmatic changes due to changes in personnel.

3. RECOMMENDED FUTURE ACTIONS

- The participants felt that this type of workshop should be repeated in about six months. The next workshop should be more focused so that participants will be able to complete the tasks assigned to them.

- The NOVA District Smart Travel Framework must be approved by the management within VDOT, so that they can make any changes early in the development life cycle so that the systems are designed to perform to suit the institutional needs.

- Participants recommended that the ITS framework will be able to provide a list of key projects that can be added to the next *Six Year Plan* that will be released in July 2000.

- Because of rapidly changing technology and user expectations, the Smart Travel program should be revised yearly. The yearly update will accommodate what has been achieved and what has been lagging from the previous year.

Attachment A

VDOT Northern Virginia Smart Travel Framework Workshop
March 19, 1999
9:00 AM – 2:35 PM

AGENDA ITEM	WHO	TIME
Welcome, Introduction and Workshop Overview	Amy Tang	9:00 AM – 9:05 AM
What, Why, How, and When	Amy Tang	9:05 AM – 9:25 AM
Northern Virginia ITS Vision	Amy Tang	9:25 AM – 9:40 AM
How the Northern Virginia ITS Framework Fits into the Statewide ITS Program	J. R. Robinson	9:40 AM –10:10 AM
BREAK		10:10 AM –10:15 AM
Breakout Session Strategies Overview	Amy Tang	10:15 AM—10:20 AM
Breakout Sessions Two groups divided and work with facilitators on: • Any missing projects? • Responsibilities?	Everyone	10:20 AM— Noon
LUNCH		Noon – 1:00 PM
Breakout Sessions – Continue	Everyone	1:00 PM— 2:00 PM
Summary of Breakout Sessions – 10-15 minutes presentation by each group	Representatives from each group	2:00 PM – 2:30 PM
Action Items • Deadline for Additional Comments (in writing) from Participants • Next Step - Incorporate Comments and Refine the Strategic Plan	Amy Tang	2:30 PM – 2:35 PM
WORKSHOP ADJOURNED		2:35 PM

Workshop Tables

These tables were presented to the workshop participants. They list functions (called "activities" during the workshop) under each Smart Travel project. They also list functions that the VDOT NOVA District is currently not performing. The workshop participants were divided in two groups (designated as Groups A and B). "A" and "B" in the responsible parties column refer the comments from these groups, respectively. The following is a list of abbreviations used in these tables.

List of Abbreviations used in the following Workshop Tables:

Const	*Construction*
DTR	Dulles Toll Road
Maint.	Maintenance
MWCO	*Metropolitan Washington Council of Governments*
STC	*Smart Traffic Center*
TCC	*Transportation Communications Center*
TE	*Traffic Engineering*
Traffic Field Ops	*Traffic Field Operations*
Tech Const	*Technical Construction*
VDRPT	Virginia Department of Rail and Public Transportation

Project	Sample Activities The Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Northern Virginia Traffic Signal System	• Monitor real-time traffic flow on surface streets • Monitor and operate district wide signal control system • Identify field equipment failure and enact established backup plans to maintain safe operations • Adjust the signal system operations during emergencies • Maintain communications with the transportation communications center that communicate and coordinate multiple agency resources • Receive incident information • Assist in clearing incidents from the roadway • Manage the flow of traffic at the incident scene • Participate in devising a regional incident management plan • Share traffic data with those agencies that promote ride sharing and parking management • Provide priority to transit vehicles at signals • Provide signal priority to emergency vehicles responding to incidents • Provide travelers information on current status of roadway network • Share information on current status of network conditions with other agencies	A. Traffic Field Ops A. Tech Const	B. Traffic Field Ops A. Tech Const	B. Traffic Field Ops A. Tech Const
Real-Time Adaptive Control System (RT-TRACS)	• Identify field equipment failure and enact established backup plans to maintain safe operations • Adjust the signal system operations during emergencies • Adjust signal timing based on real-time traffic demand • Provide priority to transit vehicles at signals • Provide signal priority to emergency vehicles responding to incidents	A. Phase 2 is ongoing		
Regional Signal Preemption and Prioritization Study	• Adjust the signal system operations during emergencies • Assist in clearing incidents from the roadway • Manage the flow of traffic at the incident scene • Provide priority to transit vehicles at signals • Provide signal priority to emergency vehicles responding to incidents	A. MWCOG ITS Task Force		
Traffic Signal Timing Optimization and General Signal System Operation	• Monitor and operate district wide signal control system • Identify field equipment failure and enact established backup plans to maintain safe operations • Adjust the signal system operations during emergencies • Maintain communications with the transportation communications center that communicate and coordinate multiple agency resources • Receive incident information • Assist in clearing incidents from the roadway • Manage the flow of traffic at the incident scene			

Tysons ITS Support	• Establish HOV operations in coordination with transit operations to connect strategic activity centers • Provide improved access to strategic activity centers			

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Smart Tag- Dulles Toll Road	• Implement a toll tag that is usable throughout the state and with the member states of the I-95 Corridor Coalition • Implement additional toll collection capacity • Limited Evaluation @ Deployment	B. DTR	B. DTR	B. DTR
Regional Effort on Electronic Payment	• Support implementation of simplified payment media that can be used across transportation modes (i.e. tolls, transit, parking, etc.)	B. DTR, VDOT & ITS	B. Various facilities	B. DTR / Fiscal
Smart Tag Store	• Collect toll revenues from collection of automated payment and distribute fees to participating agencies • Support Operation of regional effort on electronic payment	B. VDOT / Fiscal	B. VDOT / fiscal	B. DTR / fiscal

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Smart Traffic Center	• Establish a centralized traffic management facility for freeways to - Monitor real-time traffic flow - Identify equipment failure and enact backup plan - Track preventive maintenance schedules for field equipment - Control high-occupancy vehicle (HOV) lanes - Device, enact and monitor the results of changes in tactical operations - Share information on traffic flow conditions with other agencies - Establish mechanisms that support the detection of vehicles violating Virginia's traffic laws - Collect data regarding vehicle emissions - Manage traffic flow to freeways - Maintain communications with an operations facility that communicates and coordinates multi-agency resources - Evaluate the severity of incidents - Provide traveler with information on roadway network - Provide data on the status of incident management operations - Participate in devising a regional incident management plan - Establish mechanism to automatically detect vehicles in violation of traffic laws - Collect emission data to devise mitigation strategies - Share traffic data with those agencies that promote ride sharing and parking management - Use data obtained from other agencies to evaluate systems effectiveness	B. STC, VDOT-ITS Division, VDOT-NOVA ITS	B. STC	B. STC, Smart Travel lab
Enhanced Smart Traffic Software	• Support evaluation of new systems and concepts for improved operations and management • Implement new systems and functionality for improved operations and management • Upgrade existing systems for improved operations and management • Provide data to other stakeholders • Provide connectivity to function	B. STC VDOT-ITS Division, NOVA ITS	B. STC	B. STC, Smart Travel lab
Test Field Subsystems for Smart Traffic Center	• Test effectiveness of system components	B. Tech const	B. STC	B. STC, Smart Travel Lab

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Automatic Truck Rollover Warning System	• Support the evaluation of innovative concepts for improved operations and resource management	B. STC, TE	B. STC	B. STC
Woodrow Wilson Bridge (WWB) ITS Design	• Promote integration with existing and planned regional systems • Coordinate construction with operations	A. Technical Const, STC B. VDOT-ITS, NOVA-ITS, STC Signal	A. Const, STC B. STC, Traffic Field Ops	A. Technical Const, STC B. STC Signal
Virginia Beltway Detection	• Upgrade existing systems for improved operations and management	B. VDOT-ITS, NOVA-ITS, STC	B. STC	B. STC
Springfield Fiber-optic By-Pass	• Implement systems in coordination with planned construction/maintenance activities • Almost complete	B. VDOT-const	B. STC, Tech const	B. Signal, STC, Tech Const
Fiber-optic Resource Sharing	• Expand infrastructure to support system implementation	B. VDOT-Tech Const	B. Tech Const	B. NOVA ITS
Partners in Motion (Washington Metropolitan Area Traveler Information System)	• Provide information to travelers on current status of roadway network • Provide ridesharing and parking data through customer interface outlets • Maintain contact with media during emergencies	B. VDOT-ITS Division	B. STC	B. STC, VDOT-ITS Division, NOVA ITS

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Wireless Communica-tion Resource Sharing Program	• Expand infrastructure to support system implementation	A. STC, Tech Const	A. STC, Tech Const	A. STC, Tech Const
Highway Advisory Radio	• Provide information to travelers on current status of roadway network	A. Regional interstate only A. STC, tech const	A. STC	
Call Box Program	• Provide assistance to motorists for roadside emergencies	A. Cell comm to STC pilot – will decide position later A. Tech const	A. STC & Private maintenance	

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Automatic Vehicle Location (AVL) Demonstration	• Provide the capability to identify the location of maintenance vehicles in real-time • Automate the process for inventory and reporting of resources July 99 final evaluation report	A. District Maint	A. District Maint	A. District Maint
Automatic Vehicle Location (AVL) System for Safety Service Patrol	• Provide assistance to motorists statewide for roadside emergencies			
Transportation Communica-tions Center	• Receive and respond to ~~customer~~ citizen calls • Monitor roadway during inclement weather • Maintain contact with media during emergencies • Coordinate construction, maintenance and permit works • ~~Dispatch Safety Service Patrols~~ • Coordinate multi-agency resources	A. TCC	A. TCC	
Computer-Aided Dispatch System??	~~• Provide the capability to identify the location of maintenance vehicles in real-time~~ ~~• Automate the process for inventory and reporting of resources~~ • ~~Dispatch safety service patrols~~			
Closed-Circuit Television between Smart Traffic Center and Transportation Communica-tions Center	• Support incident management on freeways and surface streets • Monitor roadways during inclement weather • 4CCTV images ?camera control?		A. TCC	
Airborne Video Project (Phase II)	• Support incident management on freeways and surface streets • VSP Fairfax Co.			

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Advanced Law Enforcement and Response Technology (ALERT)	• Support the evaluation of innovative concepts for improved operations and resource management • Support police response to incidents • Support police in enforcing traffic laws • Accident investigation	A. FHWA	A. Traffic Field Ops, STC	
I-95/395/495 Interchange Congestion Management Program (Springfield)	• Support incident management • Coordinate road construction, maintenance, and permit work • Provide information to travelers on current status of roadway network • CCTV	A. Const Traffic, Field Ops	A. STC & Const	
Springfield Park and Ride Lot Guidance Information	• Share traffic data with those agencies that promote ride sharing and parking management • Provide ridesharing and parking data through customer service outlets			

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Collision Counter-measures for Unsignalized Intersections	• Support the evaluation of innovative concepts for improved operations and resource management • Implement crash countermeasures at high accident locations			
District-wide Telecommunications System	• Provide interface with VDOT's management systems • Provide capability for real-time voice, data and video transmission • Provide interface to receive customer comments and issues • Measure performance in providing customer service			
Dulles Task Force Corridor Technology Task Group	• Provide improved access to airports and major business activity areas • Share traffic data with those agencies that promote ride sharing and parking management • Provide ridesharing and parking data through customer interface outlets • Provide priority to transit vehicles at signals if appropriate • Provide priority to emergency vehicles responding to incidents	A. VDRPT		
Demonstration of Wireless Location Technology	• Monitor real-time traffic flow • Provide capability to identify the location of maintenance vehicles in real-time			

Project	Sample Activities the Project Will Support	Responsible Parties		
		System Deployment	System Operations/ Maintenance	System Upgrade
Development of Northern Virginia ITS Framework	• Develop updated Strategic Plan • Develop inventory of existing and planned systems • Develop a two-year program plan	B. VDOT-ITS Division B. VDOT-NOVA ITS		B. VDOT-ITS Division B. VDOT-NOVA ITS
Development of Northern Virginia Resource Sharing Strategic Plan	• Develop updated Strategic Plan • Develop Guidance to service/goods allocation • Develop tracking system	B. VDOT-NOVA ITS B. VDOT-ITS Tech const		B. VDOT-NOVA ITS B. VDOT-ITS Tech const
	• Support improvement of bicycle and pedestrian safety	B. NOVA-Traffic Engineering B. NOVA-Planning		
	• Monitor highway-rail crossings to ensure motorist safety	B. NOVA-TE; VDRPT		
	• Support ~~monitoring of~~ rest areas and welcome centers • Kiosk (STC) (VOIS)	B. VDOT-CO operation		
	• Support roadside emission testing • COG (existing) for monitoring	B. VDOT-Enviro. Trans. Planning. DMV	B. DMV	B. DMV
	• Provide interface with the following management systems: – Highway Traffic Roadway Information System (HTRIS) – Financial Management System –2 (FMS-2) – Inventory Condition Assessment System (ICAS) – Geographical Information System Integrator – Bid Analysis Management System (BAMS) – Construction Management System (CMS) – Traffic Monitoring System (TMS) – Data Warehouse – Automated Fuel System (AFS) – Bridge Management System (BMS) – Integrated Maintenance Management System (IMMS) – Integrated Document Management System (IDMS) – Ex ROW Management System (ERWMS)	B. VOIS	B. VOIS	B. VOIS

APPENDIX C

TRACEABILITY OF VDOT NOVA DISTRICT FUNCTIONS TO THE STATEWIDE USER SERVICE REQUIREMENTS

VDOT has documented Smart Travel user services based on VDOT's business practices in Virginia Smart Travel User Service Definitions Reference. Functions in each user service are also identified and mapped to National ITS Architecture user service requirements. Some user service requirements are modified to fit VDOT's business practice. For those VDOT functions that are unique to VDOT and are not reflected in the National ITS Architecture, new requirements are defined.

NOVA Smart Travel functions that are defined under each Smart Travel objective are mapped to the VDOT Smart Travel user service requirements. In the following tables, the numerical designation corresponds to the user service requirements depicted in the VDOT Smart Travel User Service Definitions Reference. No numerical designation is placed after a function when there is no suitable requirements are found in the statewide requirements list. The "VA" follows numerical designation (i.e. 1.7.7-VA) represents user service that are unique to Virginia and cannot be directly correlated to the National ITS Architecture user service requirement.

Objective: Promote safety of transportation facilities

Function	Corresponding User Service Requirement
Support monitoring of rest areas and welcome centers	1.7.7 – VA
Provide public safety at park and ride lots	2.4.1.1 (b), 2.4.1.1 (d)
Employ control strategies that seek to maximize safe traffic movement	1.6.1.1
Coordinate emergency response using all appropriate agencies	7.0.3 – VA

Objective: Reduce crashes on freeways and surface streets

Function	Corresponding User Service Requirement
Implement crash countermeasures at high accident locations	1.6.1.7
Improve bicyclist safety on roadways	1.6.1.1.7-VA
Implement pedestrian safety measures at pedestrian crossings	1.6.1.1.6-VA
Monitor highway-rail crossings to ensure motorist safety	1.10
Implement work zone safety measures	1.7.6.2-VA, 1.7.6.3 - VA
Enhance crash investigation	7.0.1 VA
Analyze traffic operations problem	1.6.1.1, 1.6.1.7, 1.6.2.1.2-VA
Provide safe and effective solutions to traffic operations problems	1.6.2.3
Install traffic signs, traffic signals and pavement markings	***1.6.1.1.9 - NOVA***
Provide motorists with safe driving conditions on highways and bridges during icy weather	1.6.2.1.4-VA, 7.0.4-VA
Perform snow removal operations on Interstate highways	7.0.2.3 – VA
Perform snow removal operations on arterials	7.0.2.3 – VA
Provide traffic engineering advice for construction projects	1.7.2.1
Remove obstruction from the incident scene	1.7.5.1
Establish mechanisms that support the detection of vehicles violating Virginia's traffic laws	7.2.2.1 – VA, 7.2.2.2 – VA
Clear minor incidents	1.7.3.2

Objective: Improve communications and coordination of agency activities

Function	Corresponding User Service Requirement
Receive and respond to customer calls	7.1.3-VA
Monitor roadways during inclement weather	1.6.2
Maintain contact with media during emergencies	1.1.2.1.1
Disseminate construction, maintenance and permit works schedules	1.7.6 – VA
Dispatch incident support services	1.7.2.2
Coordinate multiagency resources	1.7.2.2, 1.7.2.3
Support incident management of freeways and surface streets	1.7.2, 1.7.3, 1.7.5-VA, 1.7.6-VA
Share incident information with other agencies	7.0.3-VA, 1.7.3
Receive incident information from the Transportation Communications Center	***1.7.3.3-NOVA***
Coordinate construction, maintenance and permit works with the Smart Traffic Center	***1.7.2.1-NOVA***
Coordinate with Technical Construction and Smart Travel operators to maintain/improve Smart Travel functions during construction	***1.7.2.1.a-NOVA***
Support Smart Travel projects	1.6.1
Coordinate Smart Travel project to ensure an integrated Smart Travel system for the District	***7.1.4-NOVA***
Coordinate with statewide Smart Travel programs and activities	***7.1.4-NOVA***
Receive input from the Smart Travel program coordination on maintenance plan	***7.1.4.2-NOVA***
Support Smart Travel maintenance activities	***7.1.4-NOVA***
Receive maintenance request from the Transportation Communications Center	***7.1.4.1-NOVA***
Provide data on ordinary and emergency repair needs to the appropriate VDOT offices	1.6.5-VA
Communicate Smart Travel program activities with District Smart Travel related institutional entities	***7.1.4-NOVA***
Supervise construction of Smart Travel projects	***7.1.4-NOVA***

Objective: Improve and maintain flow of traffic on freeways

Function	Corresponding User Service Requirement
Monitor real-time traffic flow	1.6.2, 1.8.1.5, 1.8.2.3
Identify equipment failure and enact backup plan	1.6.5-VA
Track and implement preventive maintenance schedules for field equipment	1.6.5-VA
Control high-occupancy vehicle (HOV) lanes	1.6.3
Devise, enact and monitor the results of changes in tactical operations	1.6.3, 1.8.3.1
Share information on traffic flow conditions with other agencies	1.6.4, 1.8.1.5, 1.8.2.3
Manage traffic flow to freeways by metering ramps	1.6.3.3
Maintain communications with other VDOT operations agencies through Virginia Operations Information System (VOIS)	1.8.1.5, 1.8.2.3
Identify incident locations and monitor the impact of incidents	1.7.1
Verify incidents	***1.7.1.2-NOVA***
Evaluate the severity of incidents	1.7.1.2.2
Remove or assist in removing obstructions from the incident scene	1.7.3
Provide data on the status of incident management operations	1.7.3.4 – VA, 1.7.3.2, 1.7.3.3
Participate in devising a regional incident management plan	1.7.2.1, 1.7.2.2, 1.7.2.3, 1.7.2.4
Maintain the capability to coordinate with other agencies for responding to incidents and emergencies	4.5.2.3
Divert traffic around the incident scene	1.7.5-VA
Integrate with existing and planned regional systems (e.g. MD, VA, WMATA, etc.)	***7.1.5-NOVA***
Coordinate with other VDOT Districts	***7.1.4-NOVA***
Implement systems in coordination with planned construction/maintenance activities	***7.1.4.3-NOVA***
Operate variable message signs and highway advisory radio	1.2.2.1

Objective: Improve and maintain flow of traffic on surface streets

Function	Corresponding User Service Requirement
Monitor real-time traffic flow	1.6.2, 1.8.1.5, 1.8.2.3
Monitor and operate district wide signal control system	1.6.1, 1.8.2.3
Identify field equipment failure and enact established backup plans to maintain safe operations	1.6.5 – VA
Adjust the signal system operations during emergencies	1.6.3.3.1
Maintain communications with an operations facility that communicates and coordinates multi-agency resources	1.8.1.5, 1.8.2.3
Receive incident information	1.7.1.2.1
Assist in clearing incidents from the roadway	1.7.3
Manage the flow of traffic at the incident scene by possibly changing timing plans	1.7.5 – VA
Participate in devising a regional incident management plan	1.7.2.1, 17.2.2, 1.7.2.4, 1.7.2.5
Promote integration with existing and planned regional systems	7.1.4-VA
Implement systems in coordination with planned construction/maintenance activities	7.1.4-VA
Provide signal priority to transit vehicles	1.6.3.2.2, 1.6.1.2.2
Provide signal priority to emergency vehicles responding to incidents	1.6.3.2.2
Provide communications with all the traffic signals from a central control facility	1.6.1.2, 1.6.1.4, 1.6.1.5, 1.6.1.6, 1.6.1.7, 1.6.1.8-VA
Support incident management by developing and manipulating signal timing plans	1.6.3.3
Coordinate with other jurisdictions' signal systems that are not operated by VDOT	1.6.1.2
Optimize and integrate wide-area network signal systems	1.6.1.2, 1.6.1.2.1

Objective: Increased involvement in identifying new concepts and technologies

Function	Corresponding User Service Requirement
Support evaluation of new systems and concepts for improved operations and management in conjunction with the Smart Travel Lab	***1.6.3.3-NOVA***
Support the Smart Travel Lab	***1.6.3.3-NOVA***

Objective: Improve process for outcome-based project planning and implementation

Function	Corresponding User Service Requirement
Develop and maintain Smart Travel framework and architecture	***7.1.4-NOVA***
Track deployments in relation to the Smart Travel systems deployment plan	***7.1.4.2-NOVA***
Evaluate system effectiveness	1.6.3, ***1.6.3.3-NOVA***
Support development of a physical architecture to define communication needs	***7.1.6-NOVA, 7.1.6.1-NOVA***
Pursue communications resource sharing based on needs and trade-off analyses with other available options	***7.1.6.1-NOVA***
Coordinate Smart Travel program with Six Year Improvement Program	***7.1.4.3-NOVA***
Coordinate Smart Travel program outreach	***7.1.4.5-NOVA***
Identify traffic needs	***7.1.5-NOVA***
Support design reviews of Smart Travel programs	***7.1.4-NOVA***
Integrate Smart Travel programs in the planning process	***7.1.4.3-NOVA***
Analyze the impact of Smart Travel programs and strategies on the District transportation system	***7.1.5.1-NOVA***
Support the Smart Travel program to integrate multimodal strategies adopted in the regional long range plan and short range improvement program	***7.1.4.3-NOVA***
Develop and maintain a base map for the District	***7.1.4.4-NOVA***
Develop and maintain all Smart Travel field devices and communications backbone inventory with a GIS database	***7.1.4.4-NOVA***

Objective: Reduce travel time for buses and HOV carpool and vanpool users

Function	Corresponding User Service Requirement
Provide exclusive lanes for buses and HOV carpool and vanpool users	***7.1.7-NOVA***
Support police in enforcing exclusive use lanes	7.2.2 – VA
Provide signal priority to transit vehicles	1.6.3.2.2
Establish HOV operations in coordination with certain transit operations to connect regional activity centers	2.1.1
Provide gates at the entry to the reversible HOV lanes	***1.6.1.1.9-NOVA***
Coordinate with police in implementing automated access control to exclusive use lanes	7.2.2 – VA

Objective: Reduce demand on the roadway network

Function	Corresponding User Service Requirement
Share traffic data with those agencies that promote ride sharing and parking management	1.8.1.5
Provide and deliver parking facility usage information	1.6.2.1.6 – VA, 2.1.5 - VA
Provide ridesharing and parking data through customer interface outlets	1.1.2
Cooperate with metropolitan planning organizations to determine pricing strategies for payment dependent services	3.1.5

Objective: Improve access to region's major activity centers, business centers, recreation areas and places with strategic national interests

Function	Corresponding User Service Requirement
Provide improved access to airports, sea ports, rail stations, intermodal facilities, major freight distribution routes, national parks, recreation areas, historic sites, major business activity areas and military installations	1.6.2.4, 1.6.3.3.1, 1.6.3.3.2, 1.6.3.3.3, 1.6.3.3.4
Provide information service providers data on roadway conditions to and around these sites	1.1.2

Objective: Reduce air pollution

Function	Corresponding User Service Requirement
Support the improvement of bicycle and pedestrian safety	1.6.1.1.6 - VA, 1.6.1.1.7 - VA
Promote transit, HOV, bicycle and pedestrian facilities through customer interface outlets	***7.1.3.1-NOVA***
Support the Department of Environmental Quality in roadside emission testing	7.2.1 – VA

Objective: Improve intra-agency cooperation

Function	Corresponding User Service Requirement
Provide interface with the following management systems: • Highway Traffic Roadway Information System (HTRIS) • Financial Management System II (FMS-II) • Inventory Condition Assessment System (ICAS) • Geographical Information System Integrator • Automated Fuel System (AFS) • Bridge Management System (BMS) • Bid Analysis Management System (BAMS) • Construction Management System (CMS) • Integrated Maintenance Management System (IMMS) • Traffic Monitoring System (TMS) • Data Warehouse • Integrated Document Management System (IDMS) • Ex ROW Management System (ERWMS)	7.1.4 – VA
Collect toll revenues from collection of automated payment and distribute fees to participating agencies	7.1.2 – VA
Provide technical support to and review of Smart Travel related computing systems	***7.1.4.5-NOVA***
Provide training on Smart Travel related computing	***7.1.4.5-NOVA***
Provide capability for real-time internal voice, data and video transmission	1.6.2.5.1, 1.6.2.5.2
Provide data on emergency and non-emergency repair needs to the appropriate VDOT agencies	1.6.5-VA
Provide assistance in support of District's Smart Travel plan	***7.1.4-NOVA***
Coordinate with statewide Smart Travel programs and activities	***7.1.4-NOVA***
Coordinate with Technical Construction and Smart Travel operators to maintain/improve Smart Travel functions during construction	***1.7.7.1.a-NOVA***
Provide assets in support of District's Smart Travel plan	***7.1.5-NOVA***
Support database maintenance for Smart Travel programs	***7.1.4-NOVA***
Provide upward migration plan for Smart Travel hardware and software	***7.1.6-NOVA***
Provide technical support for integration of Smart Travel initiatives as appropriate	***7.1.6-NOVA***
Support survey requirements of Smart Travel programs and activities	***7.1.4.2-NOVA***

Objective: Improve inter-agency cooperation

Function	Corresponding User Service Requirement
Coordinate with Virginia Operational Information System (VOIS), other Districts, and regional centers	***7.1.5-NOVA***
Coordinate with other agencies to receive incident and weather data	1.7.1.2.1 (b), 1.7.1.2.1 (c), 1.7.1.2.1 (d), 1.7.1.2.1 (e), 1.7.1.2.1 (f), 1.7.1.2.1 (g)
Coordinate with regionwide Smart Travel activities	***7.1.4-NOVA***
Promote NOVA District Smart Travel to the general public, Smart Travel professionals, and elected and appointed local officials	***7.1.4.5-NOVA***
Share data with other agencies	1.6.4

Objective: Improve efficiency in tracking of resources (drainage systems, vehicles, etc)

Function	Corresponding User Service Requirement
Provide the capability to identify the location of maintenance vehicles in real-time	5.2.2
Support survey requirements for Smart Travel programs and activities	***7.1.4.2-NOVA***
Automate the process for inventory and reporting of resources	1.6.5-VA

Objective: Improve customer service

Function	Corresponding User Service Requirement
Receive emergency notification from customers through cellular telephone	7.1.3.1-VA
Provide interface to receive customer comments and issues	7.1.3 – VA
Receive and respond to customer calls	7.1.3.2-VA
Measure performance in providing customer service	7.1.3.4-VA
Provide means for motorists to request roadside assistance	7.1.3 – VA

Objective: Simplify payment for transportation services

Function	Corresponding User Service Requirement
Support implementation of a toll tag that is usable throughout the state and within the I-95 Corridor Coalition states	7.1.2 - VA, 3.1.1, 7.1.1 - VA
Support implementation of simplified payment media that can be used across transportation modes (i.e. tolls, transit, parking, etc.)	7.1.2 - VA, 3.1.4
Support operation of regional effort on electronic payment	7.1.2 - VA, 3.1.4
Perform system evaluation on electronic toll collection effectiveness	7.1.2.3-VA

Objective: Improve roadway network information dissemination

Function	Corresponding User Service Requirement
Provide information to travelers and travelers information providers on current status of roadway network through Virginia Operational Information System (VOIS) and through traveler information providers	1.1.2, 1.2.2.1
Share information on current status of network conditions with other agencies	1.1.2.1.1, 1.1.2.1.2, 1.1.2.1.3, 1.1.2.1.4, 1.1.2.1.5, 1.1.2.1.6, 1.1.2.1.7, 1.5.2.2 (c), 1.5.2.2 (f), 1.5.2.5 (a), 1.5.2.5 (f), 1.5.2.6 (a)

Objective: Support traveler services by coordinating with other agencies

Function	Corresponding User Service Requirement
Provide traveler services information in coordination with other agencies	1.5.2.5, 1.5.2.6
Support Personal Travel user services with enhanced wireless service	1.1.2

Objective: Support emergency notification by coordinating with other agencies

Function	Corresponding User Service Requirement
Receive motorist emergency notification call information from other agencies	5.1.3-VA
Support response to emergency calls received from the motorists	1.7.3

New User Service Requirements identified for the Northern Virginia District

NOVA Requirement Number	Requirement
1.6.1.1.9-NOVA	Traffic movement control shall include traffic signs, traffic signals, control devices, and pavement markings to guide and control motorist behavior.
1.6.3.3-NOVA	The Device Control function shall support the testing and evaluation of new systems and technologies.
1.7.2.1-NOVA	The response formulation function shall coordinate permits for construction, maintenance, and utility work through the Transportation Communications Center.
1.7.2.1.a-NOVA	The response formulation shall coordinate with Technical Construction and Smart Travel operators to maintain and/or improve Smart Travel functions during construction.
1.7.3.3-NOVA	The response implementation function shall provide the capability to disseminate information through the Transportation Communications Center.
1.7.1.2-NOVA	Incident Management shall include the capability to verify incidents
1.7.5.1-NOVA	Incident Management shall include the capability to remove roadway obstructions as quickly as feasible.
7.1.3.1-NOVA	Customer Interface shall promote travel methods that reduce the number of single-occupancy vehicles on roadways.
7.1.4-NOVA	Administrative Functions and Asset Management shall include a Manage Smart Travel (MST) function to coordinate Smart Travel projects and activities within the NOVA District and Statewide and to support Smart Travel maintenance activities.
7.1.4.1-NOVA	MST shall receive Smart Travel maintenance requests from the Transportation Communications Center.
7.1.4.2-NOVA	MST shall receive input regarding the Smart Travel program coordination.
7.1.4.3-NOVA	MST shall coordinate system implementation with planned construction and maintenance activities and with other planning activities.
7.1.4.4-NOVA	MST shall provide the capability to geographically document all elements of Smart Travel implementations and their supporting infrastructure.
7.1.4.5-NOVA	MST shall promote Smart Travel outreach, training, and education programs.
7.1.5-NOVA	Administrative Functions and Asset Management shall include an Integration Management (IM) function to promote the integration of Smart Travel in Northern Virginia with other existing and planned regional systems.
7.1.5.1-NOVA	IM shall provide the capability to evaluate the effectiveness of deployed systems.
7.1.6-NOVA	Administrative Functions and Asset Management shall include a Manage Architecture (MA) function to develop and maintain a NOVA District Architecture.
7.1.6.1-NOVA	MA shall provide the means to determine communications requirements to support Smart Travel implementation.
7.1.7-NOVA	Administrative Functions and Asset Management shall provide exclusive use facilities for high occupancy vehicles.

Virginia User Service Requirements

1.1	**PRE-TRIP TRAVEL INFORMATION**
1.1.2	PTTI shall provide the capability for users to access information on the current condition of transportation systems.
1.1.2.1	PTTI transportation services current situation information shall be provided in real-time.
1.1.2.1.1	Real-time information provided by PTTI shall include the current condition of any incidents.
1.1.2.1.2	Real-time information provided by PTTI shall include the current status of any accidents or incidents.
1.1.2.1.3	Real-time information provided by PTTI shall include the current condition of any road construction.
1.1.2.1.4	Real-time information provided by PTTI shall include any currently recommended alternate routes.
1.1.2.1.5	Real-time information provided by PTTI shall include the current speeds on specific routes.
1.1.2.1.6	Real-time information provided by PTTI shall include current parking conditions in key areas.
1.1.2.1.7	Real-time information provided by PTTI shall include the schedules for any current or soon to start events.
1.1.2.1.8	Real-time information provided by PTTI shall include the current weather situation.
1.2	**EN-ROUTE DRIVER INFORMATION**
1.2.2	Driver advisory shall be implemented in two phases with first a short term capability and later a long term capability.
1.2.2.1	The short term DI driver information capability shall include the ability to provide information to travelers within the limited area of deployment.
1.2.2.1.1	DI shall include the capability to provide travelers with accurate information concerning available travel options and their state of operational availability.
1.2.2.1.2	DI shall provide that information to travelers required for them to avoid areas of congestion.
1.2.2.1.2.1	DI shall provide that information needed for travelers to select those transportation modes that allow them to avoid congestion.
1.2.2.1.3	DI shall provide the capability for users to receive travel information in their vehicles.
1.2.2.1.4	In the short-term DI shall be deployed in those limited areas where the need and associated benefits are more immediate.
1.2.2.2	The long term DI driver information capability shall include the ability to provide information to travelers within all geographic areas of the IVHS deployment.
1.3	**ROUTE GUIDANCE**
1.3.1	RG shall include the capability to Provide Directions to travelers.
1.3.1.2.1	Current transportation system conditions upon which directions to travelers is based shall include, but not be limited to, the following:
1.3.1.2.1(a)	Current traffic conditions.
1.3.1.2.1(d)	Events taking place that influence travel routes.
1.3.1.2.1(d).1	Street closures.
1.3.1.2.1(d).2	Pedestrian events.
1.3.1.2.1(d).3	No pedestrian zones.
1.3.3.1	The Real-Time Mode shall utilize current travel condition information to provide performance that is enhanced over the Static Mode performance, to include, but not be limited to, the following:
1.3.3.1(a)	Traffic conditions information.
1.5	**TRAVELER SERVICES INFORMATION**

1.5.2.2	Information Access shall provide the capability for travelers to request and receive information about specific services in an area to include but, not be limited to, the following:
1.5.2.2(c)	Parking information.
1.5.2.2(f)	Daily or special events information.
1.5.2.5	Information Access shall provide the capability for travelers to access the TSI information via any of, but not limited to, the following methods:
1.5.2.5(a)	Highway advisory radio.
1.5.2.5(f)	Public area kiosks.
1.5.2.6	Information Access shall provide the capability for travelers to access TSI information from public kiosk locations which include, but are not limited to:
1.5.2.6(a)	Rest areas.
1.6	**TRAFFIC CONTROL**
1.6.1	Traffic Control shall include a Flow Optimize function to provide the capability to optimize traffic flow.
1.6.1.1	The Flow Optimize function shall employ control strategies that seek to maximize *safe* traffic-movement efficiency.
1.6.1.1.1	Traffic-movement control shall manage *safe* movement of traffic on *surface* streets.
1.6.1.1.2	Traffic-movement control shall manage *safe* movement of traffic on ~~highways~~ *freeways*.
1.6.1.1.3	Traffic-movement control shall include the goal of minimizing delay times.
1.6.1.1.4	Traffic-movement control shall include the goal of minimizing energy use.
1.6.1.1.5	Traffic-movement control shall include the goal of minimizing air quality impacts due to traffic.
1.6.1.1.6 – VA	*Traffic movement control shall include the goal of maximizing pedestrian safety on surface streets.*
1.6.1.1.7 – VA	*Traffic movement control shall include the goal of maximizing bicycle safety on surface streets.*
1.6.1.1.8 – VA	*Traffic movement control shall include the goal of maximizing vehicle safety.*
1.6.1.2	The Flow Optimize function shall include a Wide Area optimization capability, to include several jurisdictions.
1.6.1.2.1	Wide area optimization shall integrate the control of network signal systems with the control of freeways.
1.6.1.2.2	Wide area optimization shall include features that provide preferential treatment for transit vehicles.
1.6.1.2.3	Wide area optimization shall include features that provide preferential treatment for HOV.
1.6.1.4	*The* Flow optimize *function* shall *be* ~~include a Control function that is~~ responsive to both the current demand as well as the expected demand.
1.6.1.4.1	*The Flow Optimize function* ~~Control~~ shall include the capability to *determine the strategy for* ~~facilitate~~ the dissipation of traffic congestion *based on current demand*.
1.6.1.5	*The* Flow Optimize *function* shall provide the capability to predict travel patterns.
1.6.1.6	The *Flow Optimize* ~~Control~~ Function shall include the use of data acquired from traffic surveillance as feedback to the control strategies.
1.6.1.7	Implementation of the *Flow Optimize* ~~Control~~ Function shall include strategies that account for at least the following:
1.6.1.7(a)	Human factors.
1.6.1.7(b)	Driver/traveler behavior and expectancies.
1.6.1.8 – VA	*Traffic Control shall provide near real-time warning in advance of frequently recurring hazardous weather events.*
1.6.2	Traffic Control shall include a Traffic Surveillance function *and a Weather Surveillance function*.
1.6.2.1	~~Traffic~~ Surveillance shall include a *Traffic/*Vehicle Detection function with the capability of accurately detecting vehicles in a real-time fashion.
1.6.2.1.1	Vehicle Detection shall include the capability to determine those vehicles that are HOVs.
1.6.2.1.2 – VA	*Vehicle Detection shall be able to monitor through automated means the presence and*

	extent of congestion which recurs weekly.
1.6.2.1.3 – VA	*Vehicle Detection shall be able to monitor the presence of congestion which recurs seasonally.*
1.6.2.1.4 – VA	*Weather Surveillance shall monitor and detect the presence of frequently recurring weather hazards such as fog and ice.*
1.6.2.1.5 – VA	*Vehicle Detection shall detect the presence of overheight vehicles at height restricted facilities.*
1.6.2.1.6 – VA	*Vehicle Detection shall detect the presence of vehicles in parking facilities.*
1.6.2.2	Traffic Surveillance shall include a Data Collect function to provide the capability to collect data that are needed for determining traffic flow and prediction.
1.6.2.3	Traffic Surveillance shall include an area wide surveillance capability to include several jurisdictions.
1.6.2.3.1	The area wide surveillance shall gather speed and flow information.
1.6.2.3.2	The area wide surveillance shall cover a large number of roadway segments.
1.6.2.4	Traffic *Surveillance* ~~Control~~ shall provide the capability to acquire detailed traffic measurements at specific locations.
1.6.2.4.1	Traffic Surveillance shall include a Data Process function to process the traffic data which are acquired.
1.6.2.4.2 – VA	*Traffic Surveillance shall estimate and continuously monitor the current and expected traffic flow impact of each existing incident.*
1.6.2.4.3 – VA	*Traffic Surveillance shall include an incident identification capability.*
1.6.2.5	*Traffic Surveillance* ~~The wide area surveillance~~ shall acquire sufficient data to provide the system with the knowledge of the existing conditions.
1.6.2.5.1	Data Process shall combine and process traffic data from multiple sources and times in order to improve the accuracy of the view of the current traffic condition.
1.6.2.5.2	Data Process shall process traffic data to generate near term predictions of traffic conditions.
1.6.3	Traffic Control shall include a *Device* Control Function.
1.6.3.1	The Device Control Function shall include a "real-time" traffic-adaptive control capability.
1.6.3.2	The real-time traffic-adaptive control portion of the Control Function shall be an area wide control to include several jurisdictions.
1.6.3.2.1	The area wide control shall be implemented in an integrated and consistent manner that avoids the issuance of conflicting controls.
1.6.3.2.2	The area wide control shall be implemented in a manner that permits the following types of vehicles to have preference over other vehicles being controlled.
1.6.3.2.2(a)	Transit.
1.6.3.2.2(b)	HOV.
1.6.3.2.2(c)	Emergency Medical Service Vehicles.
1.6.3.3	The Device Control Function shall provide the capability to exercise control over those devices utilized for traffic control.
1.6.3.3.1	Device Control shall include the capability to control traffic signalization, including rapid modification of signalization parameters to respond to traffic requirements.
1.6.3.3.2	Device Control shall include the capability to control dynamically traffic signing.
1.6.3.3.3	Device Control shall include the capability to control freeway ramp metering.
1.6.3.3.4	Device Control shall include the capability to exercise dynamic control over the infrastructure (such as reversible-lanes, turning restrictions, etc.).
1.6.3.5	Device Control shall provide the operator with the capability to manually override the system's automatic controls.
1.6.3.6	Device Control shall provide the operator the capability to adaptively change system response in order to provide a coordinated support of other TMCs that are responding to incidents.
1.6.4	The Control Function shall provide traffic control information to other elements of the IVHS.

***1.6.5** – VA*	*Traffic Control shall include a Malfunction Management function.*
1.6.5.1 – VA	*Malfunction Management shall include the capability to detect controller equipment failure.*
1.6.5.2 – VA	*Malfunction Management shall include the capability to detect failure of controller detection devices.*
1.6.5.3 – VA	*Malfunction Management shall include the capability to detect a power failure.*
1.6.5.4 – VA	*Malfunction Management shall include the capability to communicate an alarm regarding any failure of controller or detection devices to Traffic Control.*
1.6.5.5 – VA	*Malfunction Management shall include the capability to identify the type of fault that causes controller or detector devices to malfunction*
1.7	**INCIDENT MANAGEMENT**
1.7.0	IVHS shall include an Incident Management (IM) function. Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Six major functions are provided which are (1) Scheduled Planned Incidents, (2) Identify Incidents, (3) Formulate response Actions, (4) Support Coordinated Implementation of Response Actions, (5) Support Initialization of Response to Actions, and (6) Predict Hazardous Conditions.
1.7.1	Incident Management shall provide an incident identification function to identify incidents.
1.7.1.2	The incident identification function shall include the capability to identify existing (both planned and unplanned) incidents.
1.7.1.2.1	The incident identification function shall use information from the following types of sources, where available, to identify existing incidents:
1.7.1.2.1(a)	Traffic flow sensors.
1.7.1.2.1(b)	Environmental sensors.
1.7.1.2.1(c)	Public safety sources.
1.7.1.2.1(d)	Media sources.
1.7.1.2.1(e)	Weather information sources.
1.7.1.2.1(f)	Transportation providers.
1.7.1.2.1(g)	Travelers.
1.7.1.2.2	The incident identification function shall determine and continuously monitor at least the following characteristics of each existing incident:
1.7.1.2.2(a)	Type.
1.7.1.2.2(b)	Extent.
1.7.1.2.2(c)	Severity.
1.7.1.2.2(d)	Location.
1.7.1.2.2(e)	Expected duration.
1.7.1.2.3	The incident identification function shall determine and continuously monitor the current and expected traffic flow impact of each existing incident.
1.7.2	Incident Management shall provide a response formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary.
1.7.2.1	The response formulation function shall propose and facilitate the appropriate scheduling of *construction, maintenance, and utility work activities* ~~those predicted incidents that can be scheduled~~ to minimize *impacts on traffic* ~~incident potential, incident impacts, and/or the resources required for incident management~~.
1.7.2.2	The response formulation function shall propose and facilitate the appropriate dispatch of emergency response vehicles to an incident.
1.7.2.3	The response formulation function shall propose and facilitate the appropriate dispatch of service vehicles to an incident.
1.7.2.4	The response formulation function shall propose and facilitate the appropriate dissemination of incident related information to travelers and potential travelers.
1.7.2.5	The response formulation function shall propose and facilitate the appropriate control of traffic signals and other traffic control to reduce the traffic flow impact of an incident.

1.7.3	Incident Management shall include a response implementation function to provide those services needed to implement a coordinated incident response using all appropriate agencies.
1.7.3.1	The response implementation function shall provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions:
1.7.3.1(a)	Response implementation shall allow coordinated selection/determination of the procedures needed for resolution of each incident and provide the procedures to those agencies responding to the incident.
1.7.3.1(b)	Response implementation shall provide the status of all resources needed for incident resolution to those agencies responding to the incident.
1.7.3.2	The response implementation function shall provide a link between Incident Management and all other user services necessary to implement incident response actions.
1.7.3.3	The response implementation function shall provide the capability to disseminate information relating to response status to other agencies. ~~and user services.~~
1.7.3.4 – VA	*The response implementation function shall provide the capability to disseminate information relating to response status to other user services.*
1.7.5 – VA	*Incident Management shall provide the capability to manage traffic at the incident location and its vicinity.*
1.7.6 – VA	*Incident Management shall provide the capability to disseminate information on planned events.*
1.7.6.1 – VA	*Incident Management shall include the capability to provide information on planned special events.*
1.7.6.2 – VA	*Incident Management shall include the capability to provide information on construction activities.*
1.7.6.3 – VA	*Incident Management shall include the capability to provide information on maintenance activities.*
1.7.7 – VA	*Incident Management shall include the capability to monitor the following incidents at rest areas:*
1.7.7(a) – VA	*Crime.*
1.7.7(b) – VA	*Traveler distress.*
1.8	**TRAVEL DEMAND MANAGEMENT**
1.8.1.5	The communications function shall provide the capability to receive information and data from transportation operators and/or users that delineates their:
1.8.1.5(a)	Current status.
1.8.1.5(b)	Needs.
1.8.1.5(c)	Level of activity.
1.8.2.3	Strategies developed by the processing function shall include the guidance for the operation of physical systems that:
1.8.2.3(a)	Monitor traffic.
1.8.2.3(b)	Inform travelers.
1.8.2.3(c)	Collect fees.
1.8.2.3(d)	Detect traffic.
1.8.3.1	The sensors/control function shall provide the capability to gather information needed for the generation of management and control strategies to include, but not be limited to the, following:
1.8.3.1(a)	Parking availability.
1.8.3.1(b)	Usage levels.
1.8.3.1(c)	Vehicle occupancy.
1.8.3.1(d)	Vehicle pollution levels.
1.10	**HIGHWAY-RAIL INTERSECTION**
1.10.0	Highway-Rail Intersection. ITS shall include a Highway-Rail Intersection (HRI) function to control highway and rail traffic in at-grade HRIs. Two sub-services are supported: Standard Speed Rail Subservice which is applicable to light rail transit, commuter rail and

	heavy rail trains with operational speeds up to 79 miles per hour (MPH); and High Speed Rail Subservice which is applicable to all passenger and freighttrains with operational speeds from 80 to 125 MPH.
1.10.1	The Highway-Rail Intersection (HRI) shall be applicable to operational, at-grade highway-rail intersections with train operational speeds up to 125 MPH.
1.10.1.1	HRI users shall include light rail transit and rapid rail transit approaching and crossing HRIs.
1.10.1.2	HRI users shall include commuter rail trains approaching and crossing HRIs.
1.10.1.3	HRI users shall include freight and intercity passenger trains approaching and crossing HRIs.
1.10.1.4	HRI users shall include highway vehicles approaching and crossing HRIs.
1.10.1.5	HRI users shall include motor vehicle operators, bicyclists and pedestrians approaching and crossing HRIs.
1.10.1.6	HRI users shall include train crews operating rail traffic while approaching and crossing HRIs.
1.10.1.7	HRI users shall include rail maintenance and inspection vehicles approaching and crossing HRIs.
1.10.2	HRI shall provide interfaces between highway and rail management functions.
1.10.2.1	HRI shall provide information management interfaces between highway and rail to coordinate traffic, demand and schedules.
1.10.2.1.1	HRI shall be capable of acquiring current train schedules from rail operations functions, and shall determine projected HRI closure times and duration.
1.10.2.1.2	HRI shall be capable of interacting with traffic management functions.
1.10.2.1.3	HRI shall provide closure data to traffic management for in-vehicle traveler advisory messages.
1.10.2.1.4 – VA	*HRI shall provide closure data to traffic management for dynamic signing messages.*
1.10.2.2	HRI shall provide the capability for interactive real-time interfaces.
1.10.2.2.1	HRI shall provide the capability to interface with rail operations functions for rail traffic control information.
1.10.2.2.2	HRI shall provide the capability to interface with traffic management functions for highway traffic coordination.
1.10.2.2.3	HRI shall provide the capability interface with trains approaching and crossing the HRI for traffic coordination.
1.10.2.2.4	HRI shall provide the capability interface with highway vehicles approaching and crossing HRIs for traffic control information.
1.10.3	At all HRIs with active railroad warning systems, HRI shall manage the traffic in the intersection.
1.10.3.1	HRI shall be capable of augmenting the intersection with standard highway traffic signal devices.
1.10.3.2	HRI shall include an automated collision avoidance function for highway vehicles approaching HRIs.
1.10.3.3	HRI shall provide an Intelligent Intersection Controller (IIC) function to manage highway and rail traffic in the intersection.
1.10.3.3.1	IIC shall control active highway traffic signal devices at HRIs to manage highway traffic.
1.10.3.3.2	IIC function shall control active railway warning devices, including flashing lights and physical barriers for highway and walkway lanes at HRIs.
1.10.3.3.3	IIC function shall provide an intersection surveillance system to derive the real-time status of traffic in the intersection.
1.10.3.3.4	IIC function shall report real-time HRI equipment status.
1.10.3.3.5	IIC function shall report real-time HRI traffic status as advisories or alerts.
1.10.4	HRI shall include a Standard Speed Rail (SSR) Subservice to manage highway and rail traffic at HRIs for rail lines with operational speeds less than 80 MPH.
1.10.4.1	SSR shall include active railroad warning systems at designated HRIs.
1.10.4.2	SSR shall include passive HRIs with non-active warning systems.

1.10.4.2.1	SSR shall augment passive warning signs with additional highway traffic control devices at passive HRIs.
1.10.5	HRI shall provide a High Speed Rail (HSR) Subservice for HRIs on rail lines with operational speeds between 80 and 125 MPH.
1.10.5.1	HSR shall include active roadside message devices to provide highway closure information at HSR HRIs.
1.10.5.2	HSR shall provide special safety features to enhance safety.
1.10.5.2.1	HSR shall close the HRI to highway traffic at a predetermined time (up to three minutes) before train arrival or when directed by train operations.
1.10.5.2.2	HSR shall include a positive barrier function(e.g. four quadrant gates) to close the intersection to highway traffic for rail lines operating at speeds over 110 MPH.
1.10.5.2.3	HSR HRIs shall verify the intersections status as either "OPEN" or "BLOCKED" for rail traffic by an immobile obstacle.
1.10.5.2.4	HSR shall provide HRI status to rail operations functions as either a "PROCEED": or "STOP" indication.
1.10.5.2.5	HSR shall provide HRI status to the train as either a "PROCEED": or "STOP" indication.
1.10.5.2.6	HSR shall provide HRI status to highway vehicles as either a "STOP FOR TRAIN" or "PROCEED" indication.
1.10.6	At HRIs with active railroad warning systems, HRI shall provide the capability for automatic collision notification to rail operations and traffic management.
2.1	**PUBLIC TRANSPORTATION MANAGEMENT**
2.1.1	PTM shall include an Operation of Vehicles and Facilities (OVF) function that provides computer assisted control of the operation of vehicles and their associated facilities.
2.1.1.2.2	When CC detects a vehicle(s) has deviated from schedule it shall provide the capability to automatically determine the optimum scenario for returning the vehicle or fleet to schedule.
2.1.1.2.3	CC shall include an integrated traffic control capability that provides traffic signal preemption when required for schedule adjustment to Transit Vehicles at traffic signals (i.e., centralized or distributed).
2.1.5 - VA	*PTM shall have the capability to advise travelers of the parking availability at park and ride lots.*
2.1.5.1 - VA	*PTM shall include the capability to monitor the parking availability at park and ride lots.*
2.1.5.2 - VA	*PTM shall include the capability to disseminate information regarding parking availability at park and ride lots.*
2.2	**EN-ROUTE TRANSIT INFORMATION**
2.2.3	TI shall include an Information Processing function for processing that data used for generation of the En-Route Transit Information.
2.2.3.1	Information Processing shall include an information collection feature.
2.2.3.1.1	Information Collection shall acquire transit operations information to include, but not be limited to, the following type:
2.2.3.1.1(a)	Schedule.
2.2.3.1.1(b)	Actual service provided.
2.2.3.1.1(c)	Next available vehicle; based on actual operating conditions.
2.2.3.1.1(d)	Transfer options describing available services and their associate schedules.
2.2.3.1.2	Information Collection shall acquire transit situation conditions to include, but not be limited to, the following type:
2.2.3.1.2(a)	Actual road data.
2.2.3.1.2(b)	Traffic data.
2.4	**PUBLIC TRAVEL SECURITY**
2.4.1	PTS shall include specific Secure Areas.
2.4.1.1	The Secure Areas shall encompass all physical areas related to public transit travel including the following:
2.4.1.1(a)	Bus stop areas.
2.4.1.1(b)	Park and Ride areas.

2.4.1.1(c)	Riding on transit vehicles.
2.4.1.1(d)	Kiosks.
2.4.1.1(e)	Transit transfer locations.
2.4.1.2	All Secure Areas shall have traveler activated alarms.
2.4.2	PTS shall include a Security Sensors (SS) function.
2.4.2.2	SS shall include both video and audio systems at key locations to monitor activities.
2.4.4	PTS shall include a Security Management and Control (SMC) function.
2.4.4.4	SMC shall include the capability to generate coordinated preplanned responses for incidents.
2.4.4.5	SMC shall include the capability to support coordinated multiple agency responses to incidents.
3.0	**ELECTRONIC PAYMENT**
3.1	**ELECTRONIC PAYMENT SERVICES**
3.1.1	Electronic Payment shall provide an Electronic Toll Collection (ETC) capability.
3.1.1.1	ETC shall provide the capability for vehicle operators to pay toll without stopping their vehicles.
3.1.1.2	ETC shall provide the capability to implement pricing structures for locally determined needs.
3.1.1.3	ETC shall provide confirmation of the transaction to each customer.
3.1.1.4	ETC shall include the capability to identify those vehicles and/or operators that violate its toll collection process.
3.1.1.5	ETC shall accommodate single billing to commercial carriers.
3.1.1.6	ETC shall provide the capability to automatically access and process each commercial vehicle's required documentation.
3.1.1.7	ETC shall be implemented in a manner that reduces the cost of toll collection.
3.1.1.8	ETC shall be implemented in a manner that seeks to minimize the opportunities for fraud.
3.1.4	IVHS shall include an Electronic Payment Services Integration (EPSI) feature.
3.1.4.1	EPSI shall provide the capability to combine electronic payments made for use of various transportation modes into a single integrated system.
3.1.4.2	EPSI shall provide the capability to integrate fare and toll pricing structures of multiple agencies.
3.1.4.3	EPSI shall collect and provide that usage data needed to develop pricing strategies that favor certain transportation modes or routes.
3.1.4.4	EPSI shall be implemented in a manner that ensures that it may be deployed across multiple agency political boundaries without degrading the services it provides.
3.1.5	IVHS shall provide a Roadway Pricing (RP) capability.
3.1.5.1	RP shall provide the capability to implement various road pricing policies.
3.1.5.1.1	Road pricing policies capable of being implemented by RP shall include variable pricing.
3.1.5.2	RP shall provide the capability to implement roadway pricing strategies, developed by other services, that alleviate congestion.
3.1.5.3	RP shall provide the capability to implement roadway pricing, developed by other services, that can be used to influence mode selection.
4.5	**HAZARDOUS MATERIAL INCIDENT RESPONSE**
4.5.2	HIR shall provide an Operation Focal Point (OFP) for initiating appropriate responses.
4.5.2.1	OFP shall be capable of being implemented as either a centralized dispatch or several de-centralized dispatch units or vehicles.
4.5.2.2	OFP shall provide the capability for existing dispatch centers to receive the calls, determine response requirements, and route distress calls to predesignated responding agencies.
4.5.2.3	OFP shall provide the capability for operators to coordinate with other agencies and response services to include, but not be limited to, the following:
4.5.2.3(a)	State and/or local transportation officials.
4.5.2.3(b)	Police departments.
4.5.2.3(c)	Highway patrol.

4.5.2.3(e)	Emergency medical services.
4.5.2.3(f)	Environmental protection agencies.
4.5.2.3(g)	HAZMAT teams.
4.5.2.3(h)	Towing and other "courtesy" services.
5.0	**EMERGENCY MANAGEMENT**
5.1	**EMERGENCY NOTIFICATION AND PERSONAL SECURITY**
5.1.3 - VA	*ENPS shall include an information sharing function.*
5.1.3.1 - VA	*ENPS function shall include the capability to share information on received emergency calls.*
5.1.3.2 - VA	*ENPS function shall include the capability to clear the scene of the emergency to avoid possible incidents.*
5.2	**EMERGENCY VEHICLE MANAGEMENT**
5.2.2	Emergency Vehicle Management ~~Service~~ shall *include* ~~be provided by~~ a Route Guidance System.
5.2.2.1	Route Guidance System shall maintain real-time information on traffic conditions, emergency response vehicle locations, and emergency response vehicle destinations.
5.2.2.2	Route Guidance System shall advise emergency response vehicles of appropriate routes.
5.2.3	Emergency Vehicle Management ~~Service~~ shall *include* ~~be provided by~~ a Signal Priority System.
5.2.3.1	Signal Priority System shall maintain real-time information on signal timing, emergency vehicle locations and emergency vehicle routing.
5.2.3.2	Signal Priority System shall determine signal *priority* ~~prioritize~~ timing sequences for relevant signals.
7.0 – VA	**EMERGENCY MANAGEMENT**
7.0.0 – VA	IVHS shall include an Emergency Management function. Emergency Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Six major functions are provided which are (1) Situation assessment analysis for decision maker, (2) Maintenance of current status of information exchange with federal, state and local agencies involved with Emergency Management, (3) Coordinated response with state and federal agencies to natural and manmade disasters, (4) Maintenance of current resource availability status to deal with disasters.
7.0.1 – VA	Emergency Management shall provide an incident identification function to identify emergencies.
7.0.1.1 – VA	The emergency identification function shall include the capability to identify predicted emergencies.
7.0.1.1.1 – VA	The emergency identification function shall use information from the following types of sources, where available, to identify predicted emergencies:
7.0.1.1.1(a) – VA	Traffic flow sensors.
7.0.1.1.1(b) – VA	Environmental sensors.
7.0.1.1.1(c) - VA	Public safety sources.
7.0.1.1.1(d) – VA	Media sources.
7.0.1.1.1(e) – VA	Weather information sources.
7.0.1.1.1(f) – VA	Transportation providers.
7.0.1.1.1(g) – VA	Sponsors of special events.
7.0.1.1.1(h) – VA	Hazardous condition prediction algorithms.
7.0.1.1.2 – VA	The emergency identification function shall determine at least the following characteristics of each predicted emergency:
7.0.1.1.2(a) – VA	Type.
7.0.1.1.2(b) – VA	Extent.
7.0.1.1.2(c) – VA	Severity.
7.0.1.1.2(d) – VA	Location.
7.0.1.1.2(e) – VA	Expected duration.
7.0.1.1.3 – VA	The emergency identification function shall determine the expected traffic flow impact of

	each predicted emergency.
7.0.1.1.4 – VA	The emergency identification function include the following capabilities:
7.0.1.1.4(a) – VA	Catastrophic events monitoring.
7.0.1.1.4(b) – VA	Data analysis.
7.0.1.1.4(c) – VA	Data dissemination.
7.0.2 – VA	Emergency Management shall provide a response formulation function to formulate appropriate response actions to each identified emergency and revise those actions when necessary.
7.0.2.1 – VA	The response formulation function shall propose and facilitate the appropriate scheduling of those predicted emergencies that can be scheduled to minimize emergency potential, incident emergency, and/or the resources required for emergency management.
7.0.2.2 – VA	The response formulation function shall propose and facilitate the appropriate dispatch of emergency response vehicles to an emergency.
7.0.2.3 – VA	The response formulation function shall propose and facilitate the appropriate dispatch of service vehicles to an emergency.
7.0.2.4 –VA	The response formulation function shall propose and facilitate the appropriate dissemination of emergency related information to travelers and potential travelers.
7.0.2.5 –VA	The response formulation function shall propose and facilitate the appropriate control of traffic signals and other traffic control to reduce the traffic flow impact of an emergency.
7.0.3 – VA	Emergency Management shall include a response implementation function to provide those services needed to implement a coordinated emergency response using all appropriate agencies.
7.0.3.1	The response implementation function shall provide at least the following decision support capabilities needed to implement coordinated emergency response actions by all participating institutions:
7.0.3.1(a) –VA	Response implementation shall allow coordinated selection/determination of the procedures needed for resolution of each emergency and provide the procedures to those agencies responding to the emergency.
7.0.3.1(b) – VA	Response implementation shall provide the status of all resources needed for emergency resolution to those agencies responding to the emergency.
7.0.3.1(c) – VA	Response implementation shall allow for continuous assessment of VDOT's response preparedness.
7.0.3.2 – VA	The response implementation function shall provide a link between Emergency Management and all other user services necessary to implement emergency response actions.
7.0.3.3 –VA	The response implementation function shall provide the capability to disseminate information relating to response status to other agencies and user services.
7.0.4 – VA	Emergency Management shall provide the capability to predict the time and location of hazardous conditions that may cause an emergency.
7.1 – VA	**ADMINISTRATIVE FUNCTIONS AND ASSET MANAGEMENT**
7.1.0 – VA	IVHS shall include an Administrative Functions and Asset Management capability. Three functions are provided which are (1) Support Electronic Payment Services, (2) Customer Interface and, (3) Interface with other VDOT Systems.
7.1.1 – VA	Administrative Functions and Asset Management shall provide an Electronic Toll Collection (ETC) capability.
7.1.1.1 – VA	ETC shall provide the capability for vehicle operators to pay toll without stopping their vehicles.
7.1.1.2 – VA	ETC shall provide the capability to implement pricing structures for locally determined needs.
7.1.1.3 – VA	ETC shall provide confirmation of the transaction to each customer.

7.1.1.4 – VA	ETC shall include the capability to identify those vehicles and/or operators that violate its toll collection process.
7.1.1.5 – VA	ETC shall accommodate single billing to commercial carriers.
7.1.1.6 – VA	ETC shall provide the capability to automatically access and process each commercial vehicle's required documentation.
7.1.1.7 – VA	ETC shall be implemented in a manner that reduces the cost of toll collection.
7.1.1.8 – VA	ETC shall be implemented in a manner that seeks to minimize the opportunities for fraud.
7.1.2 – VA	IVHS shall include an Electronic Payment Services Integration (EPSI) feature.
7.1.2.1 – VA	EPSI shall provide the capability to combine electronic payments made for use of various transportation modes into a single integrated system.
7.1.2.2 – VA	EPSI shall provide the capability to integrate fare and toll pricing structures of multiple agencies.
7.1.2.3 – VA	EPSI shall collect and provide that usage data needed to develop pricing strategies that favor certain transportation modes or routes.
7.1.2.4 – VA	EPSI shall be implemented in a manner that ensures that it may be deployed across multiple agency political boundaries without degrading the services it provides.
7.1.3 – VA	Administrative Functions and Asset Management shall include a Customer Interface capability.
7.1.3.1 – VA	Customer Interface shall include the capability to respond to customer questions regarding:
7.1.3.1(a) – VA	Roadway conditions.
7.1.3.1(b) – VA	Snow removal.
7.1.3.1(c) – VA	Traffic conditions.
7.1.3.1(d) – VA	Construction activity.
7.1.3.1(e) – VA	Maintenance activity.
7.1.3.2 – VA	Customer Interface shall include the capability to respond to customer complaints.
7.1.3.3 – VA	Customer Interface shall include the capability to forward customer complaints to appropriate VDOT personnel.
7.1.3.4 – VA	Customer Interface shall maintain a log of received questions and complaints and a log of activities performed in response to those questions and complaints.
7.1.4 – VA	Administrative Functions and Asset Management shall include an interface capability with the following VDOT systems:
7.1.4(a) – VA	HTRIS
7.1.4(b) – VA	Financial Management System (FMS)
7.1.4(c) – VA	Inventory Condition Assessment System (ICAS)
7.1.4(d) – VA	GIS Integrator
7.1.4(e) – VA	Automated Fuel System (AFS)
7.1.4(f) – VA	Bridge Management System (BMS)
7.1.4(g) – VA	Bid Analysis Management System (BAMS)
7.1.4(h) – VA	Construction Management System (CMS)
7.1.4(i) – VA	Integrated Maintenance Management System (IMMS)
7.1.4(j) – VA	Traffic Monitoring System (TMS)
7.1.4(k) – VA	Data Warehouse
7.1.4(l) – VA	Integrated Document Management System (IDMS)
7.1.4(m) – VA	Ex ROW Management System (ERWMS)
7.2 - VA	REGULATORY FUNCTIONS
7.2.0 - VA	IVHS shall include a Regulatory Functions function. The Regulatory Function will include two major activities: (1) Emissions Testing and Mitigation and (2) Traffic Law Enforcement.
7.2.1 - VA	ETAM shall include roadside pollution assessment (RPA) capabilities.
7.2.1.1 - VA	RPA shall be capable of detecting the level of emission of ozone precursors with a high degree of accuracy.

7.2.1.1.1 - VA	RPA shall be capable of detecting moving vehicles, within its monitored area, whose emissions violate the emission standard.
7.2.1.1.2 - VA	RPA shall be capable of determining suspected vehicle's registration data either by license plate or via automatic vehicle identification.
7.2.1.1.3 - VA	RPA shall be capable of determining which suspected vehicles are not in compliance with emission standards for that vehicle from the vehicle's registration data.
7.2.1.2 - VA	RPA shall be capable of providing air quality statistical data to the TMC.
7.2.1.2.1 - VA	RPA shall be capable of providing the air quality data on the monitored values of pollution.
7.2.2 – VA	Regulatory Functions shall include Traffic Law Enforcement capabilities.
7.2.2.1 – VA	Traffic Law Enforcement capabilities shall include detection of vehicles violating traffic laws including, but not limited to:
7.2.2.1(a) – VA	Intersection control.
7.2.2.1(b) – VA	HOV lanes.
7.2.2.1(c) – VA	Speed.
7.2.2.1(d) – VA	Work zone control.
7.2.2.2 – VA	Traffic Law Enforcement capabilities shall include identification of vehicles violating traffic laws including, but not limited to:
7.2.2.2(a) – VA	Intersection control.
7.2.2.2(b) – VA	HOV lanes.
7.2.2.2(c) – VA	Speed.
7.2.2.2(d) – VA	Work zone control