Executive Summary

Northern Virginia District (NOVA)
Smart Travel Program

Virginia Department of Transportation

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Executive Summary

Technology applications that improve the delivery of transportation services are known as Intelligent Transportation Systems (ITS). The Virginia Department of Transportation's (VDOT) Smart Travel Program unifies the ITS applications of all transportation modes and levels of government under one umbrella concept—Smart Travel. VDOT recognizes that ITS cannot be developed in isolation; ITS is systems, and systems require a high degree of coordination for effective development. The Smart Travel Program provides the needed coordination.

Purpose of this Summary Report

This report presents the short-term recommended list of Smart Travel projects for the Northern Virginia District (NOVA.) NOVA's Smart Travel planning process is an ongoing effort that includes reviews by staff and stakeholders to refine the strategic plan for the development of the region's ITS. The planning process is summarized by the following reports, which can be referred to for more detailed information:

- The *Strategic Plan* identifies future operations in NOVA and outlines the systems necessary for their support;
- The *Summary of 1999 Activities* identifies the current status of the district's Smart Travel Program;
- The *Mapping of Ten Smart Travel Systems to Vision* flows from the *Strategic Plan* and includes a recommended set of long-range ITS projects.

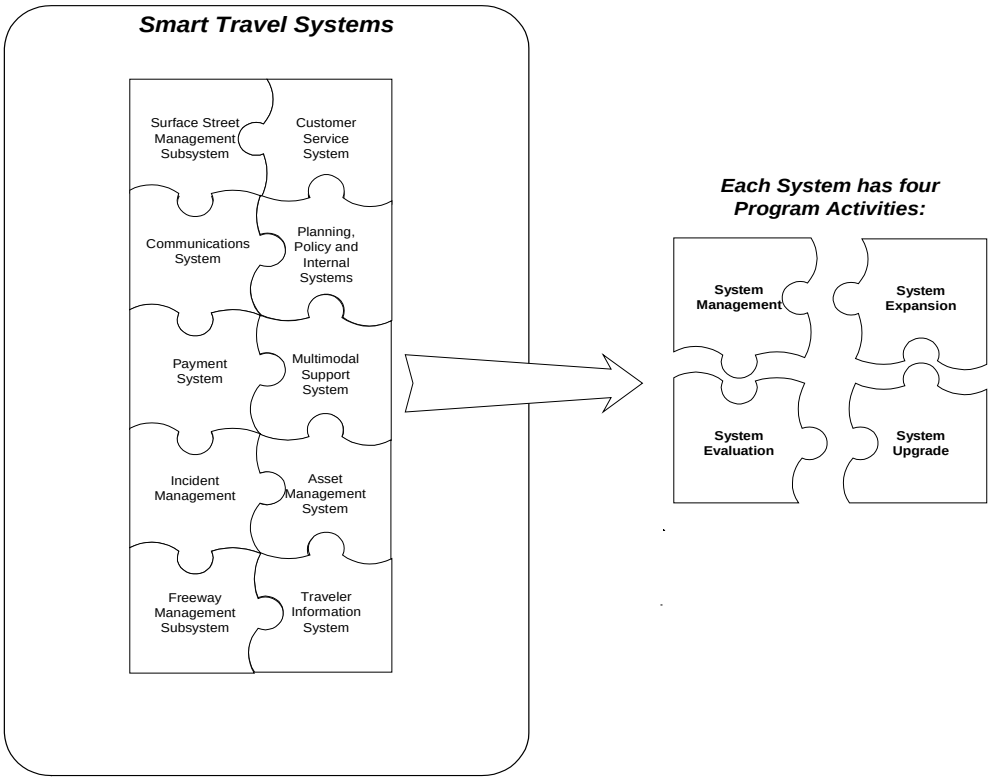
This Summary Report integrates the findings of all of these activities and reports into a single document. It presents both a long-range set of actions and a short-range (two-year) set of projects, and describes the strategic planning process used in their development.

Planning for ITS - Building Systems

Planning for ITS is somewhat different from planning for typical transportation infrastructure. Computers, communications and software are complex and their underlying technology is rapidly advancing. Also, they are notoriously difficult to change or modify once in place. Because it is so difficult to modify technology systems, ITS planning must be sufficiently detailed to ensure that the ITS installed today has the capability designed into the original systems for future expansion. NOVA's Smart Travel Program does just that. It envisions the future transportation service needs, including the geographic and functional needs, and envisions complete ITS systems to meet those needs. The NOVA Smart Travel Program can be described as ten inter-related systems that work together. Like pieces in a puzzle, the ten systems are related and form the complete picture of Smart Travel in NOVA. The following table and graphic summarize the concepts of the ten Smart Travel systems.

NOVA Smart Travel Systems	
System	**Purpose**
Planning and Policy	The planning and policy system is largely made up of internal policy and planning processes to ensure the consideration of all ITS alternatives, and that proposed systems are consistent with the overall local, regional and statewide transportation framework. Smart Travel planning and policy projects are continuous activities that respond to changes in technology, strategic priorities, or business practices. Further, the planning and policy system evaluates deployments to determine their effectiveness and contribution to the strategic planning initiatives.
Surface Street Management	The surface street management system enables comprehensive management of critical arterial roads within NOVA. While NOVA maintains signals on the primary routes in the region, other jurisdictions operate and maintain some secondary roadways. Projects in this system ensure regional coordination to optimize traffic flow during peak periods, incidents, and special events.
Freeway Management	The freeway management system monitors and operates the freeway system at its optimal level. Effective freeway management will provide raw data to improve traveler information while allowing real-time operational adjustments as traffic conditions demand.
Incident Management	The incident management system enables VDOT to identify the occurrence and nature of roadway or roadside incidents, initiate an appropriate response, and clear the incident in a timely manner.
Multi-modal Support	The multi-modal support system provides travelers with information on alternate modes of transportation. The intent of this system is to distribute a broad range of modal information, allowing travelers to choose the most appropriate mode available and decreasing travel demand on the highway system.
Customer Service	The customer service system provides a direct link between travelers and VDOT services. The system provides VDOT with feedback on customer satisfaction and allows management to target resources in response to customer demands.
Communications	All Smart Travel systems that transfer information require wireline and/or wireless communication. This system establishes the required communications infrastructure that enables the other systems to inter-operate, taking into account service requirements and implications on cost, performance and user acceptance.
Traveler Information	The traveler information system encompasses the broad range of services that provide traveler information to the public, with the goal of improved travel choices, reduced delay, and improved customer satisfaction.
Asset Management	The asset management system coordinates routine VDOT maintenance and operations activities in a way that minimizes travel disruptions.
Payment System	The payment system involves electronic toll collection, transaction confirmation, and payment violation. In addition, this system enables the integration of toll collection with other electronic payment systems in the region.

THE TEN SMART TRAVEL SYSTEMS



The Smart Travel program directly addresses the need for planning and coordination in system development. VDOT does not deploy Smart Travel projects as a set of unrelated technologies; the value of ITS is greatly increased when data from various systems is shared between them to enable a variety of different applications – improving the delivery of transportation services.

Inter-Regional Operations

Smart Travel provides the intelligent link between travelers, vehicles, and infrastructure and enables people and goods to move more safely and efficiently through a state-of-the-art, inter-modal transportation system—regardless of whom operates the transportation infrastructure. For example, Advanced Traveler Information Systems (ATIS) can provide seamless information for an entire region, regardless of the agency or entity operating individual elements of the system.

Smart Travel envisions an interconnected, statewide ITS to meet the state's travel needs. This statewide network will be built on a foundation of local (district and residency) ITS. ITS, just like other traffic operations, are delivered at the local level. The statewide vision builds on the local ITS deployments to create a statewide network. Four multi-regional/district Smart Travel centers

are planned statewide, with NOVA's existing center planned as one of these multi-regional centers. Each district will be directly connected to one of the four centers. Residencies can choose to connect or not, based on their needs. Districts will be connected to the statewide network through their connections with their Smart Travel center.

Traffic problems ignore departmental boundaries, and Smart Travel facilitates address inter-district operations. NOVA's Smart Travel program includes operations across district boundaries, specifically I-66 west to I-81 and I-95 south to the city of Fredricksburg. Operating these roadways from the NOVA Smart Travel Center makes sense in terms of both finance and logistics. Financially, it is more efficient to operate these roadways from NOVA than to invest in additional control centers. These roadways are also of critical importance for traffic through and connecting with the Capital region from Maryland and Virginia, and NOVA is the logical jurisdiction to manage these interconnections.

National ITS Architecture Consistency

The NOVA Smart Travel Program planning process will also help ensure VDOT NOVA maintains their eligibility for federal ITS funds. The recent TEA-21 federal transportation bill included a requirement that agencies demonstrate "consistency" with the National ITS Architecture to be eligible for federal funds for ITS. The Federal Highway Administration (FHWA) defines ITS as any project with advanced technology such as telecommunications, computers, sensors, etc. The National ITS Architecture is a system engineering tool that describes computer systems. It helps ensure that ITS is deployed across the nation using a common framework and that future ITS can be linked and integrated to maximize the ITS investment.

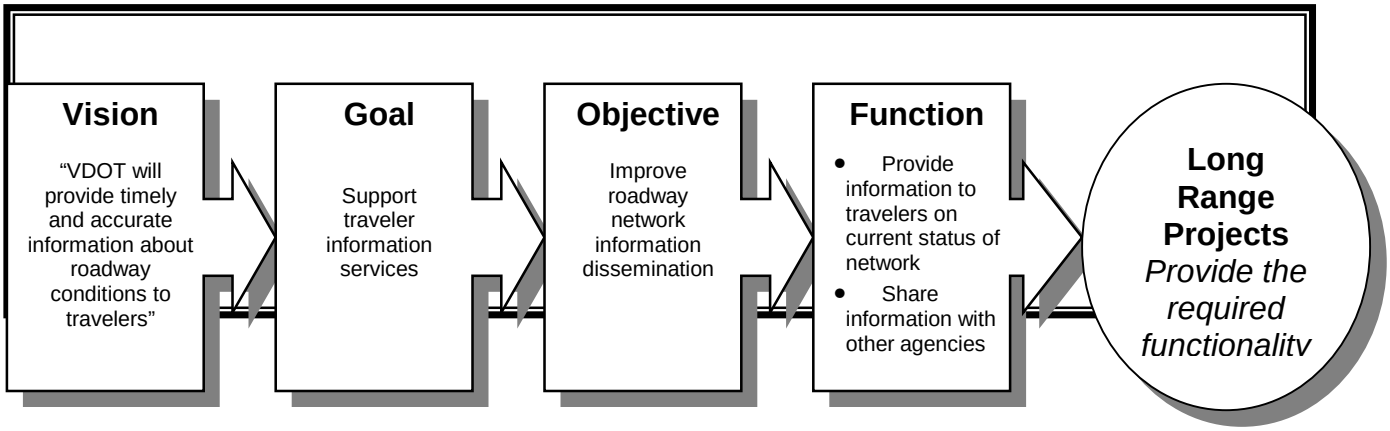
Strategic Planning and Project Selection Process

NOVA's Smart Travel program was developed using a system engineering process that mirrored the strategic process for the statewide Smart Travel program. This top-down approach describes the vision, goals, objectives and functions that support holistic systems development.

The vision portrays the services Smart Travel can provide to enhance the efficiency of the transportation network. The vision was developed based on several regional studies, the statewide Smart Travel Business Plan, the Northern Virginia Early Deployment Plan and VDOT's Strategic Plan for the 21st Century. Also, the vision is consistent with two Washington, DC area plans: the National Capital Region Transportation Planning Board's *Vision, Goals, Objectives and Strategies*, and the Washington Council of Governments' *Proposal for a Metropolitan Washington Area ITS Transportation Management System Showcase.* Goals are then derived, which provide initial direction on how to proceed toward the vision. Many goals are directly connected to on-street safety and operations needs. Objectives further clarify goals and provide a more specific direction that is used to define functions. Selected functions are

aggregated to define projects. This logical hierarchy allows any project to be traced back to the goals and objectives, ensuring consistency with the state Smart Travel program, as well as other long-range planning documents.

Importantly, the "functions" of the Smart Travel program are equivalent to the user service requirements of the National ITS Architecture. Thus, the Smart Travel planning process that defines the required functionality of the regional system relates directly to the user services of the National ITS Architecture. This relationship ensures consistency with the National ITS Architecture, as required for federal-aid eligibility.



AN EXAMPLE FROM THE NOVA SMART TRAVEL STRATEGIC PLANNING PROCESS

Defining the Long Range Program

The long-range program recommends projects by comparing the functions revealed by the strategic planning process to the functions accommodated by the current systems in Northern Virginia. Identification of the "gap" between current deployment and the functions envisioned by the Strategic Plan provides the long-range project list. Like pieces of a puzzle, the district can identify and implement projects that complete the desired functionality of the system.

Ranking Projects for the Short Range Program

This report summarizes the results of a criteria-based process to develop a recommended list of short-range projects. The process considered:

- Smart Travel elements of road and highway projects identified in the regional transportation plan.
- Maintaining and operating the existing Smart Travel systems.
- Planning and evaluation projects in support of Smart Travel.
- Safety projects.
- Projects on a critical path that enables further system development.
- In addition, placeholders were included for two reasons:
    - The regional planning process can produce projects in the short-term program; the placeholders consider ITS elements that emerge from the short-term program.
    - Accommodate opportunities or to meet unique needs that arise.

Smart Travel Program – Long-Range and Short-Range Projects

The following table lists the long-range and short-range program of projects. The projects noted in **bold** are recommended for implementation in the short-term. Each project is classified based on which of the ten Smart Travel systems it supports, and each is further classified as System Management, System Expansion, System Upgrade, and/or System Evaluation based on the following definitions:

- System Management refers to the task of operating, maintaining and managing the system's functionality.
- System Expansion refers to projects that increase the geographic coverage of a system.
- System Upgrade refers to the task of adding functionality to a system.
- The Smart Travel program also includes a periodic System Evaluation of each project. This work will help guide future implementation strategies for new system elements.

The table on the following page lists the entire program of projects, with the short-range projects in **bold** typeface. Primary system contributions are denoted by a solid symbol (●), and secondary system contributions are denoted by a hollow symbol (○).

SMART TRAVEL PROGRAM PLAN LONG RANGE AND SHORT-RANGE PROJECTS														
	Smart Travel System										Project Type			
Projects	Planning/Policy	Surface Street Mgt.	Freeway Mgt.	Incident Mgt.	Multi-modal	Customer Service	Communications	Traveler Info.	Asset Mgt.	Payment	System Mgt.	System Expansion	System Upgrade	System Evaluation
Smart Travel Integration and Standards Guidelines	●	○	○	○	○	○	○	○	○	○	●	○		
Congestion Mapping System	●	○	○	○							○		●	
Operations and Management Planning	●	○	○	○	○	○	○	○	○	○	●			○
Decision Support System for Resource Sharing Initiatives	●						○				●			○
Smart Travel (GIS) Inventory System	●										○		●	
Professional Capacity Building	●	○	○	○	○	○	○	○	○	○	●			○
Traffic Data Archiving System	●	○	○								○		●	
Smart Travel Program Outreach	●										●	○		
Decision Support for Smart Travel Implementations	●											●	○	
Smart Travel Strategic Planning	●										●		○	
Coordination with Six-Year Improvement Program	●										○	●		
Deployment Tracking	●										○			●
Smart Travel Spot Safety Project Ranking Criteria	●	○	○	○	○	○	○	○	○	○	●			○
Technical Support to Dulles Toll Road Technology Task Group	●		○		○						●		○	
Regional Signal Coordination		●									●	○		
Signal Priority for Transit/Emergency Vehicles		●			○						○		●	
Traffic Signal System Field Maintenance		●									●			○

Bold type indicates that the project is recommended for inclusion in the Short-Range Plan.

● - Indicates a principal function for the project.
○ - Indicates a supportive function for the project.

SMART TRAVEL PROGRAM PLAN
LONG RANGE AND SHORT-RANGE PROJECTS

Projects	Smart Travel System										Project Type			
	Planning/Policy	Surface Street Mgt.	Freeway Mgt.	Incident Mgt.	Multi-modal	Customer Service	Communications	Traveler Info.	Asset Mgt.	Payment	System Mgt.	System Expansion	System Upgrade	System Evaluation
Traffic Control Software Maintenance		●									●		○	
Traffic Control Software/ Hardware Upgrade		●									○		●	
Real-Time Traffic Adaptive Control System (RT-TRACS) Implementation		●										●		○
Signal System Evaluation	○	●											○	●
Traffic Control Communication Study	○	●					○					○		●
Integration of Developer-installed Signals with Smart Travel		●									○	●		
Red Light Running Cameras		●									○	●		
Head-on Traffic Warning System and Evaluation	●	●									○	●		○
De-icing System Evaluation		●									○	●		○
Automated Pedestrian Safety System		●									○	●		
Bicyclist Safety Enhancement		●									○	●		
Grade Crossing Safety Enhancement		●									○	●		
Spot Safety Project Placeholder		●									○	●		
Freeway Access Control System		○	●								●		○	
Integrated Traffic Management		○	●								●		○	
Integration of Signal, Freeway and Safety Service Patrol (SSP) Operations		○	●	○								○	●	
Analysis of Traffic Management Needs	○		●								●			○
Evaluation of Cellular Call Locating System	○		●	○			○	○			○			●
Transponders as Probes			●	○			○	○		○		○	●	
Smart Traffic Center Software and Hardware Maintenance			●								●			○

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Co-locate Smart Traffic Center, Smart Signal Control Center, and SSP Operations Control		○	●	○							●		○	
Freeway Management System Evaluation	○		●										○	●
Freeway System Completion Projects			●	○			○	○			○	●		
Road and Highway Projects in the Regional Long-Range Plan			●	○			○	○			○	●		
Interstate System Completion Project Placeholder			●	○			○	○			○	●		
Roadway Maintenance Operations Link to TCC		○		●					○		●		○	
AVL for Safety Service Patrol			○	●								○	●	
Workzone Safety System				●							●			○
Uniform Incident Response Protocol Implementation				●							●			○
Low Cost Route Diversion Study	○	○		●							●			○
Mayday System				●							●			○
Uniform Incident Response and Dispatch Protocol Update				●									●	○
Lessons Learned From Construction Impact Mitigation Strategies	○			●							○			●
Springfield Interchange Smart Travel Implementation				●		○		○				●	○	
Woodrow Wilson Bridge Smart Travel Implementation				●		○		○				●	○	
Transportation Demand Management Support	○				●						○		●	
Evaluation of Support to Transit Operations	○				●							○		●
Customer Service Enhancement						●					○		●	

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Transportation Communications Center Operations Upgrade		○	○	○		●					●		○	
Emergency Call Services Upgrade						●							●	○
Customer Satisfaction Survey	○					●					○			●
Inventory of Communications Infrastructure	○						●						○	●
Fiber-Optic Link between I-66 and the Northern Virginia District Headquarters							●					●	○	
Procedures for Maintaining the Communication Infrastructure	○						●				●			○
Districtwide Communications System Evaluation	○						●					○		●
Parking Information System					○			●					●	○
Enhanced Traveler Information System					○			●					●	○
Regional Traveler Information System Recompete					○			●			●	○		
Evaluation of the Regional Traveler Information System	○							●			○			●
Enhanced AVL for Snow Plows									●		○		●	
Regionwide Coordination with Construction/Road Closures	○								●		●	○		
AVL for Fleet Management									●			●		○
Evaluation of AVL for Fleet Management	○								●		○			●
Integrated Payment System					○					●		○	●	
Toll Operations Improvements			○							●		○	●	
Evaluation of Integrated Payment System	○									●			○	●
Project Placeholder—Unforeseen Opportunities														

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Program Cost Overview

The implementation cost of Smart Travel projects is more than $38 million, with annual operating and maintenance costs exceeding $5.9 million. While these numbers might first appear to be substantial, they are a fraction of the $1.5 billion for infrastructure construction in Northern Virginia budgeted for the next ten years (the Northern Virginia 2020 Transportation Plan identified a need for more than $10 billion in projects over the next 20 years). Moreover, the benefits of efficient system management provide a more than an adequate return on investment, while contributing to social goals such as safety and quality of life. Finally, the vast majority the funding for these projects will come as part of larger construction/reconstruction of existing infrastructure, such as the Woodrow Wilson Bridge and Springfield Interchange reconstruction projects.

Smart Travel System	Capital or Implementation Cost*	Annual Operation/Maintenance or Personal Services Cost**
Planning and Policy	$ 910,000	$ 0
Surface Street Management	$ 2,320,000	$ 1,152,000
Freeway Management	$ 23,300,000	$ 3,664,000
Incident Management	$ 11,000,000	$ 1,110,000
Multi-modal		
Customer Service		
Communications	$ 1,100,000	
Traveler Information		
Asset Management		
Payment	$ 250,000	
Total:	**$ 38,880,000**	**$ 5,926,000**

* *Capital or Implementation Cost* includes the one-time cost of implementing or executing a project.
** *Annual Operation/Maintenance or Personal Services Cost* is the yearly cost to maintain and operate the system, including hardware, software and personal services expenses. Where exact data was unavailable, it was assumed that these annual expenses would be 10% of the system's implementation cost.

Next Steps

This document will now be circulated as a draft to undergo review by executive staff. Once approved for consistency with VDOT strategic direction and policies, the document will be used to guide short-term funding decisions. Smart Travel planning is a continuous process, and the document will undergo updates to reflect new developments in technology, funding and deployment.

ACRONYMS

ATIS	Advanced Traveler Information System
AVL	Automated Vehicle Location, as commonly enabled by global positioning systems.
CCTV	Closed Circuit Television
CMAQ	Congestion Mitigation and Air Quality Improvement Program, a federal surface transportation funding program
FCC	Federal Communications Commission
GIS	Geographic Information System
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle lanes
ITS	Intelligent Transportation System or Systems
NHS	National Highway System, a designated system of federal highways, and an associated federal surface transportation funding program
NOVA	Northern Virginia District of the Virginia Department of Transportation
NTCIP	National Transportation Communications for ITS Protocol
STC	Smart Traffic Center, operated by VDOT
STP	Surface Transportation Program, a federal surface transportation funding program
TEA-21	Transportation Equity Act for the 21st Century, the federal authorizing legislation for surface transportation.
VDOT	Virginia Department of Transportation
VMS	Variable Message Signs
WWB	Woodrow Wilson Bridge