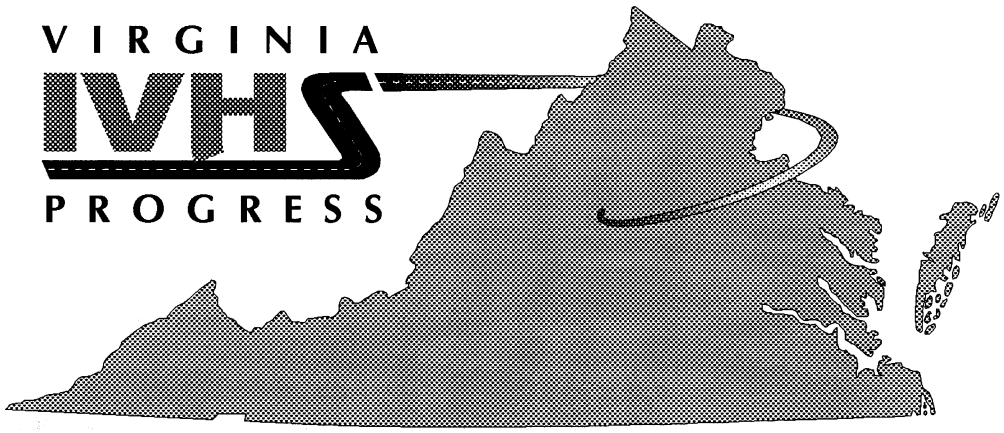
TECHNICAL ASSISTANCE
REPORT

INTELLIGENT VEHICLE-HIGHWAY SYSTEM (IVHS) ACTIVITIES IN THE VIRGINIA DEPARTMENT OF TRANSPORTATION

APRIL 1994 UPDATE



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TRANSPORTATION RESEARCH COUNCIL

VIRGINIA TRANSPORTATION RESEARCH COUNCIL

INTELLIGENT VEHICLE-HIGHWAY SYSTEMS (IVHS) ACTIVITIES IN THE VIRGINIA DEPARTMENT OF TRANSPORTATION

April 1994 Update

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Transportation and the University of Virginia)

Charlottesville, Virginia

April 1994
VTRC 94-TAR11

INTRODUCTION

The Virginia Department of Transportation (VDOT) is committed to the development and deployment of IVHS to improve the safety and efficiency of the Commonwealth's multi-modal transportation system. VDOT has developed and published a strategic plan to define Virginia PROGRESS, an ambitious statewide IVHS program.

Virginia PROGRESS is based on four areas critical to meeting VDOT's objective of providing safe, efficient, effective, and environmentally sound surface transportation systems.

- Advanced Traveler Information Systems (ATIS)
- Advanced Traffic Management Systems (ATMS)
- Automated Highway Systems (AHS)
- Commercial Vehicle Operations (CVO)

The Department has identified goals for each of these areas in the near-term (1992-1996), middle-term (1997-2001), and long-term (2002-2011) phases of Virginia PROGRESS.

Although Virginia PROGRESS is a relatively new initiative, VDOT has a history of utilizing technology to provide travelers in Virginia with traffic management and traveler information services. For example, the Department has operated a Traffic Management System (TMS) in Northern Virginia since 1985. This freeway system includes loop detectors, closed circuit television, and ramp metering. VDOT plans to expand this system, further develop its capabilities, and utilize it as a test-bed for ATMS research and development. In addition, VDOT is in the process of deploying a similar traffic management system in the Hampton Roads region. VDOT is also providing traveler information services in Hampton Roads through an innovative public-private partnership. The Department is participating in a privately operated telephone information line to allow travelers to obtain up-to-the-minute conditions at major bottlenecks in the region.

In addition to VDOT's traffic management and traveler information activities, the Department has been active in other areas of IVHS. For example, VDOT is currently deploying the FASTOLL system on the Dulles Toll Road. FASTOLL will utilize automatic vehicle identification (AVI) to automate toll collection. Finally, VDOT is actively pursuing the development of the "Smart Road," which will connect Blacksburg and Roanoke. This will be the first IVHS facility built from the ground up in the United States. VDOT expects that this facility will serve as an excellent national testbed for the development of AHS.

The Department has also been an active participant in the national IVHS development effort, working with organizations such as IVHS America and the I-95 Corridor Coalition. In addition, VDOT is an active participant in the U.S. Department of Transportation's IVHS

program, participating in a number of operational tests, including the Multi-jurisdictional Live Aerial Video Project, and the CAPITAL Operational Test.

VDOT's research arm, the Virginia Transportation Research Council (VTRC), is pursuing an active research program in the area of IVHS. This program, which includes both basic and applied research, is designed to support the Department's deployment of advanced IVHS technologies in the Commonwealth. VTRC is also working closely with state universities in the Commonwealth to coordinate research activities and assist in the implementation of recommendations.

VDOT's IVHS Steering Committee is the policy body responsible for Virginia PROGRESS. The program is administered by the Department's Traffic Engineering Division, with technical support from VTRC. The following individuals are suggested as contacts:

David R. Gehr
Commissioner
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This document, which is updated annually, presents a summary of all IVHS activities in which VDOT is currently involved. For each activity, the summary includes project descriptions, locations, contacts, and status. Furthermore, the activities are grouped according to the following classifications: (1) operational systems, (2) operational tests, (3) early deployment, (4) systems under development, (5) regional development, and (6) research.

IVHS OPERATIONAL SYSTEMS

PROJECT: I-66/I-95/I-395 Traffic Management System

LOCATION: Northern Virginia

CONTACT: Jimmy Chu
Traffic Management System Manager
Virginia Department of Transportation
1426 Columbia Pike
Arlington, VA 22204 Phone: (703) 521-5695

PROJECT DESCRIPTION:

The TMS monitors a 10-mile stretch of I-66 between the Capital Beltway (I-495) and the Roosevelt Bridge, an 11.5-mile segment of the Shirley Highway (I-395) between I-495 and the 14th Street Bridge, and 10 miles of the Capital Beltway (I-95) in the area of the Woodrow Wilson Bridge. The high-occupancy vehicle (HOV) facilities of these interstates are also controlled by the TMS. The TMS is staffed with 5 operators and 2 supervisors for 16 hours a day, 7 days a week, at the TMS operations center in Arlington.

Northern Virginia's TMS has many of the capabilities and features that define the IVHS functional area, ATMS. The primary responsibility of the TMS is incident management. Loop detectors are installed throughout the system at 1/2-mile spacings (550 total) to monitor traffic flow and detect incidents. CCTV is utilized to verify detected incidents and aid in incident management. A total of 48 CCTVs are installed in the TMS.

Another responsibility of the TMS is to provide congestion management. Twenty-six ramp meters are stationed throughout the network to regulate traffic flow onto the interstates during peak periods. In addition, 100 changeable message signs (CMSs) are used to provide travelers with information concerning network conditions. These signs provide information such as HOV restrictions, openings/closings of the reversible lanes on I-395, and freeway conditions (accidents, congestion, etc.).

An area that is given high priority in the TMS is one of the region's major bottlenecks, the Woodrow Wilson Bridge. Nine CCTVs are used to monitor traffic conditions in the area of the bridge, and 22 CMSs are used to provide information to the traveler. This bridge surveillance activity is coordinated with the state of Maryland.

There are plans to expand the TMS significantly in the near future. As the HOV facilities of I-95 and I-66 are extended, additional CCTV cameras, and CMSs will be added to the system. In addition, it is expected that a number of IVHS projects proposed for the region will depend upon integration with the TMS.

STATUS: The TMS was implemented in 1985 and is now fully operational. A computerized map has recently been added to the system to help operators identify problem locations and provide a means for information dissemination. Advertisement for the expansion of the system is scheduled for August 1994.

PROJECT: Suffolk District Tunnel Traffic Management Systems

LOCATION: Hampton Roads Region

CONTACT: Wayne White
District Tunnels & Toll Engineer
Virginia Department of Transportation
P.O. Box 3447
Hampton, VA 23663 Phone: (804) 727-4811

PROJECT DESCRIPTION:

Traffic control and surveillance systems are currently being used to manage traffic in three major tunnels in the Tidewater region: the Hampton Roads Bridge-Tunnel (I-64), the Downtown Tunnel (I-264), and the Monitor-Merrimac Memorial Bridge-Tunnel (I-664). These systems monitor traffic by CCTVs and vehicle detectors (inductive loops). Traffic information is relayed to a central computer, on which incident detection software is utilized. In addition, the systems use CMSs to communicate conditions to the traveler.

The Hampton Roads Bridge-Tunnel and the Monitor-Merrimac Memorial Bridge-Tunnel currently utilize a highway advisory radio (HAR) system to further inform travelers of traffic conditions. Six transmitters are situated around the area in advance of major route diversion points. The HAR advises motorists of possible delays and suggests alternate routing choices.

Finally, VDOT is currently in the process of integrating the three tunnel traffic management systems. Each system will be linked with a central computer. The central system will fuse this information, and provide a graphic display of traffic conditions in the Hampton Roads region. At this time, there are plans to provide up to 36 access ports that will allow local television stations and major activity centers (such as hotels and stadiums) the capability to provide traveler information services based on VDOT's monitoring systems.

STATUS: The surveillance systems and HAR are operational. The integrated graphic display system is expected to be operational by late Summer 1994.

PROJECT: Hampton Roads Traffic Information Hotline

LOCATION: Hampton Roads Region

CONTACT: Wayne White
District Tunnels & Toll Engineer
Virginia Department of Transportation
P.O. Box 3447
Hampton, VA 23663 Phone: (804) 727-4811

PROJECT DESCRIPTION:

VDOT is participating in INFOLINE, a telephone information service operated by a local newspaper, to provide current traffic information on major crossings in the region. Users can select the category 7874 (RUSH) to obtain up-to-date descriptions of traffic on the Hampton Roads Bridge-Tunnel, Monitor-Merrimac Memorial Bridge-Tunnel, Downtown Tunnel, Midtown Tunnel, Coleman Bridge, and James River Bridge. In addition, VDOT has acquired a dedicated line that will allow callers to directly access the RUSH category.

VDOT personnel at the six facilities update the traffic descriptions at 15 minute intervals (more often if necessary) during peak periods. At other times, the messages are updated when conditions warrant. The traffic description consists of a brief message such as "traffic is light/moderate/congested in both directions." This dissemination of real-time information gathered at traffic management systems is a step towards ATIS in the region.

STATUS: VDOT's RUSH category has been operational since mid-January, 1993.

PROJECT: I-66 Joint Operations Center

LOCATION: Northern Virginia

CONTACTS:

Captain Justin Murphy
Fairfax County Police Department
3911 Woodburn Road
Annandale, VA 22003 Phone: (703) 280-0550

Kenneth Wester
Assistant District Engineer - Maintenance
Virginia Department of Transportation
3975 Fair Ridge Drive
Fairfax, VA 22033 Phone: (703) 934-7317

PROJECT DESCRIPTION:

The I-66 Joint Operations Center is a cooperative effort between VDOT, Virginia State Police, Fairfax County Police, and Fairfax County Fire and Rescue. The Center, which was established to mitigate congestion problems caused by the expansion of I-66, serves as the focal point for the dissemination of traffic information to travelers in the I-66 corridor. The Center operates 6 hours a day during both morning and afternoon peak periods.

A unique feature of the I-66 Joint Operations Center is a HAR system, which utilizes two transmitters (650 AM) to communicate with motorists. It is expected that these transmitters represent the initial step towards regional HAR in Northern Virginia. The Center is also providing a #77 cellular service to motorists. Finally, the Joint Operations Center is coordinated with the Northern Virginia TMS, which allows both operation centers to fully utilize communication resources, such as CMSs and HAR, in Northern Virginia.

STATUS: The I-66 Joint Operations Center opened in March 1994.

PROJECT: Highway Surveillance Television Broadcast

LOCATION: Northern Virginia

CONTACTS:

Jimmy Chu
Traffic Management System Manager
Virginia Department of Transportation
1426 Columbia Pike
Arlington, VA 22204 Phone: (703) 521-5695

Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

This system allows local television stations to broadcast CCTV video from the Northern Virginia TMS. The stations utilize this video to supplement area traffic reports. For example, rather than simply stating the location of an incident, a station can present live transmission from the scene. This system serves to provide the traveler with up-to-the-minute, accurate information on the status of the transportation network.

It is anticipated that this system may be expanded to provide video feeds to information kiosks at major activity centers such as shopping malls. This will enable travelers to access up-to-date traffic information at the kiosk and plan an appropriate route.

STATUS: Channel 8, a Fairfax County cable news station, is currently using CCTV video in its traffic reports. VDOT is also working with other major stations in the Washington area to provide a similar service.

IVHS OPERATIONAL TESTS

PROJECT: Cellular Application to IVHS Tracking and Location (CAPITAL)

LOCATION: Washington Metropolitan Area

CONTACTS:

Bob Ewald
Program Manager
Engineering Research Associates, Inc.
1595 Springhill Road
Vienna, VA 22182 Phone: (703) 734-8858

Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

This operational test will evaluate the use of the Bell Atlantic cellular telephone infrastructure with passive statistical cellular and cellular geolocation technologies to estimate traffic congestion information and identify incidents. The project will test a full range of applications, from the collection and processing of wide area surveillance data to the dissemination of traffic data to remote users and in-vehicle equipment. In essence, the system will provide surveillance capabilities with minimal infrastructure requirements. The objectives of the study are:

- To determine if the use of cellular telephone technologies provides a cost-effective means of area-wide traffic surveillance.

- To determine if information from cellular telephone traffic can be effectively integrated into a real-time area-wide traffic control system, with specific applications for ATMS, ATIS, and Advanced Public Transportation Systems (APTS).

- To determine if the packet data transmissions over the cellular telephone communication network provide an effective means of disseminating real-time area-wide traffic information.

The test will be conducted in selected regions of the Washington Metropolitan area. VDOT is participating in this project with the FHWA, the Maryland State Highway Administration, Bell Atlantic Mobile Systems, Engineering Research Associates, and Farradyne Systems, Inc.

STATUS: This project is currently underway. Equipment is in the integration and installation phase and should be deployed on the Bell Atlantic Mobile towers in the Summer of 1994.

PROJECT: Airborne Video System

LOCATION: Northern Virginia

CONTACTS:

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Faculty Research Scientist
Virginia Transportation Research Council
530 Edgemont Road
Charlottesville, VA 22903 Phone: (804) 293-1942

Major Wally Baranyk
Fairfax County Police Department
3911 Woodburn Road
Annandale, VA 22003 Phone: (703) 280-0500

PROJECT DESCRIPTION:

The airborne video system utilizes a video camera mounted to a helicopter to provide a mobile video platform for use in traffic management. The system will supplement fixed surveillance CCTVs with real-time information concerning traffic incidents.

It is expected that the use of real-time airborne video will serve as a valuable component of an ATMS, particularly in incident management. The video will provide information on the type, location, severity, and impact of an incident to a control center. This project, an IVHS operational test, has three major objectives:

1. Determine the capabilities and limitations of a remotely controlled gyro-stabilized camera.
2. Establish the effectiveness and reliability of a video link between a helicopter and a ground station and between a ground station and a traffic management center.
3. Evaluate the effectiveness and applications of real-time video for an ATMS.

In addition to these objectives, the transfer of information between jurisdictions for regional ATMS applications will be examined. Many of the institutional issues that have been identified as key to the success of IVHS will be considered.

STATUS: The final report is currently being assembled and is due for publication in August 1994.

PROJECT: Automatic Truck Rollover Warning System

LOCATION: Northern Virginia

CONTACTS:

Bill Harrell
Transportation Engineer
Virginia Department of Transportation
3975 Fair Ridge Drive
Fairfax, VA 22033-2906 Phone: (703) 934-0500

Hugh W. McGee
Principal
Bellomo-McGee, Inc.
8330 Boone Blvd., Suite 700
Vienna, VA 22182 Phone: (703) 847-3071

PROJECT DESCRIPTION:

This project involves a feasibility study, design, and evaluation of a system that will detect trucks traveling at a speed that could cause rollover on curved exit ramps and activate a sign that warns the driver to reduce the truck's speed. The system includes: 1) two weigh-in-motion detectors, placed about 100 ft. apart along the deceleration lane, that can measure the truck's weight and speed; 2) a height detector; and 3) a fiber-optic warning sign positioned in advance of the curved ramp. A controller receives a signal from the two weigh-in-motion systems and the height detector, processes the information according to an algorithm that determines if the truck's speed may cause a rollover, and transmits a signal to activate the warning sign ("TRUCKS REDUCE SPEED") if the speed is above the estimated rollover threshold.

Systems have been installed at two exit ramps on the Capital Beltway. Over the next three years, these systems will be evaluated to determine their cost effectiveness. Factors being considered are accident prevention, speed reduction, annual cost, reliability, and maintenance requirements.

STATUS: The systems were installed in October 1993 and the evaluation will continue through 1996.

PROJECT: Effectiveness of Changeable Message Signs in Controlling Vehicle Speeds in Work Zones

LOCATION: Statewide

CONTACTS: Nicholas J. Garber, Ph.D.
Faculty Research Scientist
Virginia Transportation Research Council
530 Edgemont Road
Charlottesville, VA 22903 Phone: (804) 293-1908

PROJECT DESCRIPTION:

The purpose of this study is to evaluate the effectiveness of CMSs equipped with a radar unit in reducing speeds in work zones. By attaching the radar directly to the CMS, the speeds of individual vehicles in the traffic stream can be determined. Upon detecting a speed higher than a preset threshold limit, the CMS is programmed to display a personalized warning message to the driver. The dynamic nature of this method of speed control is believed to make it more effective than traditional static methods such as signing.

Four messages, designed to warn drivers that their speed exceeds the maximum safe speed, are being tested on the CMS at various locations throughout the state. Speed and volume data for the whole population traveling through the work zone are collected with automatic traffic counters. Vehicles that trigger the radar-activated display are videotaped as they progress through the work zone. These tapes are then analyzed to determine the speeds of the high-speeding vehicles at three locations along the length of the work zone.

STATUS: The first phase of this project is nearing completion. The use of the CMS in the work zone has been found to be an effective means of reducing the number of speeding vehicles, the average speeds, the speed variance, and the speeds of high-speeding vehicles over short periods of use and under the conditions studied. Subsequent phases of the project will determine the long term effectiveness as well as the effectiveness under differing conditions of CMSs in reducing speeds through work zones.

PROJECT: Advanced Ridesharing and Traveler Information System

LOCATION: Prince William County

CONTACTS: Leo Auger
Executive Director
Potomac Rappahannock Transportation Council
1519 Davis Ford Road, Suite 1
Woodbridge, VA 22192 Phone: (703) 490-4018

PROJECT DESCRIPTION:

The primary purpose of this operational test is to determine whether an IVHS-Based Advanced Ridesharing and Traveler Information System (ARTIS) can be a cost-effective way to reduce traffic congestion, gasoline consumption, air pollution, and mobility problems for residents of low-density suburban and rural areas. The ARTIS team represents a true public-private partnership. Its membership includes: the FHWA, the Federal Transit Administration (FTA), the Potomac and Rappahannock Transportation Commission (PRTC), the Northern Virginia Planning District Commission, the Virginia Department of Rail and Public Transportation, Gandalf Mobile Systems, Inc., UMA Engineering Ltd., Aegis Transportation Information System, Inc., and SG Associates.

ARTIS will make extensive use of computers and telecommunications to create new types of public transportation services and to integrate these new services with conventional transit, paratransit, and ridesharing modes.

The key element of the project is the development and field testing of a route-deviation minibus system. The Potomac and Rappahannock Transportation Commission will install computer terminals in up to 50 vehicles, establish a dispatching center, and train personnel in the use of the software package for both route deviation and fixed-route software. The ARTIS team will conduct an in-service evaluation of the system.

STATUS: The operational test was approved by the FHWA in January 1994. Work is expected to begin soon and last for a period of two and a half years.

IVHS EARLY DEPLOYMENT PROGRAM

PROJECT: Hampton Roads Early Deployment - COMPARE

LOCATION: Hampton Roads Region

CONTACTS: Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

VDOT is working with the cities of the Hampton Roads region and various regional transportation-oriented groups to examine opportunities to implement a comprehensive IVHS program in the region. The unique characteristics of the region, including the large number of tourists and a high concentration of military personnel, make Hampton Roads an ideal location to examine IVHS user services.

Congestion Management Plan: A Regional Effort (COMPARE), a planning effort for IVHS in Hampton Roads, has three major initiatives:

1. The development of a comprehensive concept plan for implementation of IVHS technologies in the Hampton Roads area.

2. The development and design of an inter-agency voice/data communication system that provides common access to all parties involved in traffic management in the region.

3. The development of an ATIS for the Hampton Roads area.

This project will also serve as a "pilot" application of the IVHS Planning and Project Deployment Process developed by the FHWA. The process will be utilized to develop the deployment plan for COMPARE.

STATUS: The project is expected to begin in June 1994.

PROJECT: Northern Virginia Early Deployment

LOCATION: Northern Virginia District

CONTACT: Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

The purpose of this study is to prepare the Northern Virginia region for the successful, near-term deployment of IVHS. This study, which will be conducted using FHWA's IVHS Planning and Project Deployment Process, will produce two important plans:

1. IVHS Strategic Deployment Plan

   This plan will provide a "road map" for wide-scale deployment of IVHS in the Northern Virginia region. The plan will include all modes of transportation, identifying opportunities to provide IVHS user services to the region.

2. ATMS Implementation Plan

   This plan will be developed in response to the need in the region to integrate a number of traffic management systems into a truly regional ATMS. In particular, the plan will identify a systems architecture that will allow the various systems, operated by a number of different agencies, to exchange information and to develop regional traffic management strategies.

While technology is an important aspect of this study, it will also look critically at institutional issues, funding opportunities, and operations and maintenance requirements.

STATUS: Advertisement for consultant services for this project is expected in Spring 1994.

PROJECT: Richmond Early Deployment

LOCATION: Richmond

CONTACT: Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

The purpose of the Richmond planning study is similar to those in Hampton Roads and Northern Virginia - to prepare the region for the successful, near-term deployment of IVHS. The Richmond region has deployed some selected components of IVHS, such as a sophisticated signal system in the City of Richmond, and there exists a need to plan for the further development and integration of IVHS in the region. The Richmond effort will be conducted using the FHWA's IVHS Planning and Project Deployment Process.

It is also expected that this study will provide an opportunity to examine the provision of inter-regional IVHS user services in Virginia. In particular, Richmond is the hub of Virginia's "urban crescent" (Northern Virginia, Richmond, Hampton Roads), and will play a critical role in integrating IVHS efforts in this area of the Commonwealth.

STATUS: Advertisement for consultant services for this project is expected in Summer 1994.

IVHS SYSTEMS UNDER DEVELOPMENT

PROJECT: FASTOLL

LOCATION: Dulles Toll Road - Northern Virginia

CONTACTS: Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

FASTOLL is an integrated toll collection system that has been designed to replace the existing manual system on the Dulles Toll Road. Although FASTOLL will continue to use both manual toll collection and automatic coin collection machines, it will also utilize a toll collection system based on automatic vehicle identification (AVI). The AVI system consists of three functional elements: a vehicle mounted transponder (or tag), a reader unit located beside the travel lanes, and a computer system for data processing. FASTOLL will allow drivers to pay their tolls by deducting them from prepaid accounts as their tags are read. AVI-equipped vehicles will not need to stop as their tags are read, thereby increasing the efficiency of the toll collection process.

There are a number of advantages expected from FASTOLL. First, the system will eliminate the delays caused by traditional toll booths, thereby increasing the utilization of highway capacity. Current toll collection equipment can handle only 600-800 vehicles per hour per lane. FASTOLL will improve this capacity to 1,400 vehicles per hour per lane. FASTOLL will also free personnel from the monotonous and hazardous task of collecting tolls. Finally, FASTOLL includes a new accounting system that should provide greater accuracy than the present system.

The experience gained with AVI through the FASTOLL system will be valuable in preparing for future applications of this technology. It is intended that the design of FASTOLL be adaptable for tolling applications throughout the Commonwealth. For example, the Dulles Greenway, a privately financed 14-mile extension of the toll road currently under construction, is expected to use an AVI system compatible with FASTOLL.

STATUS: VDOT awarded a contract for installation of FASTOLL in March 1994. It is expected that the system will be in operation in early 1995.

PROJECT: I-64 Traffic Management System

LOCATION: Hampton Roads Area

CONTACTS: Stephany Hanshaw
Traffic Management System Manager
Virginia Department of Transportation
1700 North Main Street
Suffolk, VA 23434 Phone: (804) 424-9907

PROJECT DESCRIPTION:

The I-64 TMS will consist of a complete traffic surveillance, control, and management system for I-64 between I-564 and I-264/VA-44, including the 8-mile reversible bus and HOV facility. In addition, this system will encompass I-64 concurrent flow HOV lanes on a 4-mile section from the I-264/VA-44 interchange to Indian River Road, and a 4-mile section on VA-44. The system will also accommodate upgrades to allow for management of the entire freeway system in the region.

In many ways, the I-64 TMS is similar to the Northern Virginia TMS. As in Northern Virginia, the I-64 TMS will utilize loop detectors, CCTVs, and CMSs. In addition, incident detection and management of the HOV facilities will be primary functions of the TMS. Finally, the system will serve as a foundation for regional IVHS development.

An interesting area of concentration of the I-64 TMS will be in traffic diversion. Given the often congested conditions of the tunnels and bridges in the region, strategies to divert travelers to other crossing points will be critical. A number of CMSs will serve as dedicated point diversion signs for the sole purpose of encouraging alternate routes.

The I-64 TMS will face a major challenge in interfacing with other management systems already in place in the region. Many cities in the area, as well as the major tunnels, have developed and implemented independent traffic control systems. In coordinating these various systems, a number of institutional problems need to be addressed.

STATUS: The system is currently under construction with completion anticipated in Summer 1995. Equipment to be used in the center and for data collection on the roadways is currently under review.

PROJECT: Northern Virginia Traffic Signal System

LOCATION: Northern Virginia

CONTACTS:

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Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

Tim Pagano
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Virginia Department of Transportation
3975 Fair Ridge Drive
Fairfax, VA 22033 Phone: (703) 934-0500

PROJECT DESCRIPTION:

The Northern Virginia traffic signal system will operate 700 signals with expansion capabilities to at least 2,000 signals. This state-of-the-art system will allow for signal adjustments necessitated by traffic conditions and for a central monitoring location to alter timing plans. Preliminary studies of the signal system suggest that it will reduce total delay between 14 and 27 percent, total stops between 21 and 23 percent, and total travel time between 8 and 13 percent. Furthermore, the system design will provide flexibility, allowing the system to incorporate advanced traffic control algorithms in the future.

The signal system is expected to play a significant role in future ATMS efforts in the Northern Virginia region. VDOT is currently considering strategies for integrating the new signal system with regional ATMS.

STATUS: Notice to proceed was given December 10, 1993. Several functional demonstrations have been conducted and the process of reviewing and approving material submissions is now underway. In addition, the contractor is conducting field surveys and will soon begin making loop repairs, and placing the cabinets. In preparation for personnel training, materials are being reviewed with input from the contractor and suppliers. Completion is anticipated in July 1996.

PROJECT: The University Road Connection - a "Smart Road"

LOCATION: Blacksburg/Roanoke, Virginia

CONTACTS:

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106 Faculty Street
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PROJECT DESCRIPTION:

VDOT has pledged to build a two-mile, two-lane highway facility in Montgomery County, Virginia, to serve as a test-bed for IVHS technology. It is envisioned that this facility will be part of a six-mile facility which will connect Blacksburg and Roanoke. The "smart road" will be the first IVHS facility built from the ground up in the United States. This is advantageous in that the various sensors and communications media (such as fiber optic cable) can be designed to function as an integral component of the system. In addition, this project will provide a unique opportunity to examine the application of IVHS in rural, intercity transportation.

VDOT is working closely with Virginia Tech to position the "smart road" to serve as a national test-bed for AHS technology. Virginia has joined a team led by General Motors to bid for a federal grant to serve as a national consortium for the development and demonstration of AHS. As a member of the consortium, Virginia will be in a position to participate actively in the development of this innovative technology.

STATUS: VDOT is working with Virginia Tech on preliminary plans for the Smart Road.

REGIONAL IVHS DEVELOPMENT

PROJECT: I-95 Corridor Coalition

LOCATION: I-95 Corridor: Virginia to Maine

CONTACTS: Charles Hall
Assistant State Traffic Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-6777

PROJECT DESCRIPTION:

The I-95 Corridor Coalition is a voluntary association that joins 12 State Departments of Transportation in the Northeast with 12 independent transportation and toll authorities and 3 cooperating Federal agencies. The Coalition is focusing on implementing effective communications and coordinated operations to achieve efficiencies in serving the travel needs of public and commercial users along the corridor. In particular, the Coalition advocates the widespread use of IVHS along the corridor in areas such as electronic toll collection, traffic and transit fleet management, and traveler information dissemination.

The Corridor Coalition's five-year business plan has defined a program of integrated IVHS projects in the Corridor. VDOT is actively participating in this program, serving on technical review committees and working groups and assisting with administrative matters. The projects in this program include: Information Exchange Network, Incident Management, Surveillance Requirements, Commercial Vehicle Operations, User Needs and Marketability, Traveler Information System, Coordinated CMS/HAR System, and Intermodal Outreach.

STATUS: VDOT is an active participant in the Coalition.

PROJECT: Commercial Vehicle Operations (CVO) Development

LOCATION: Statewide

CONTACT: Jim Robinson
Transportation Engineering Programs Supervisor
Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219 Phone: (804) 786-2878

PROJECT DESCRIPTION:

Virginia has been an active participant in CVO development in a number of ways. For example, VDOT is currently participating in a pooled-fund research project with other FHWA Region III states to examine institutional issues in implementing CVO in the region. This effort will analyze existing state practices for vehicle licensing, driver licensing, permitting, taxation, regulation, enforcement and safety inspections. Results will be used to identify beneficial CVO technology, such as state line beacons, electronic credentials, and mainline enforcement screening. The final product of this study will be an implementation plan for CVO in the region.

Virginia also participated in a similar CVO study in FHWA Region IV that is now completed. Therefore, it is evident that Virginia is playing a critical role as the "bridge" state for the East Coast. This consortium of Southeastern states has applied for a grant to fund the development of a model for data collection that would enable all necessary information to be collected at one time, thus eliminating the need for repetitive stops. This model would utilize electronic data interchange.

Another example of Virginia's activity in CVO is the Commonwealth's efforts in the research and development of Weigh-In-Motion (WIM) systems. The VTRC has conducted a study comparing a number of WIM systems. In addition, VDOT has installed permanent WIM sites throughout the Commonwealth to provide data for the Long-Term Pavement Performance Project as part of the Strategic Highway Research Program (SHRP).

STATUS: This is an ongoing activity within VDOT.

IVHS RESEARCH

PROJECT: Simulation Analysis of Traffic Diversion Strategies for Freeway Incidents

LOCATION: Research Project

CONTACTS:

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Catherine A. Cragg
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PROJECT DESCRIPTION:

A major focus of ATMS is incident management. While the detection component of incident management is receiving considerable attention, the recovery phase remains a rather weak element. Diversion is especially critical in incident recovery. Unfortunately, the routes chosen for diversion are not tested to determine their effectiveness in relieving incident induced congestion. This research project will utilize simulation to develop a methodology for analyzing diversion strategies and quantifying the effects of strategies on both the freeway and the arterials used for diversion. The case studies used in this project will involve the diversion strategies developed for the Northern Virginia area as a part of the Incident Management Plan. Once established, the methodology could be used to develop a database of diversion strategies that will serve as a useful tool to the traffic management team in the Northern Virginia TMS.

This project is a first step toward developing sophisticated user support systems for ATMS. For example, it is planned to utilize the database to develop an expert system that will guide traffic management personnel through the management of incidents. In addition, this research will pave the way for the utilization of real-time simulation within ATMS.

STATUS: This project is in the final stages and the final report should be complete by September 1994.

PROJECT: Development of an ATMS Software Support System Based on a Short-Term Traffic Condition Prediction Model

LOCATION: Research Project

CONTACTS:

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PROJECT DESCRIPTION:

Current traffic management systems function primarily to monitor freeway facilities. In order to upgrade these systems to ATMS status, it will be necessary to use surveillance information to actively manage the transportation network. This project will address this by examining ways to derive useful *information* from surveillance *data*.

The purpose of this research project is to develop a prototype ATMS software support system based on a short-term traffic condition prediction model. Predictive models have been identified as an essential component of ATMS in the *IVHS America Strategic Plan*. The following scenario illustrates the expected operation of such a system. At 4:30 pm, current raw surveillance data, along with other basic data (such as day-of-week, time-of-day, and weather classification) is input to the model. From 4:30 pm until 4:32 pm, the model calculations are executed by the computer. Upon completion of execution, the model output, i.e., the predicted traffic conditions at 4:45 pm and 5:00 pm, is displayed to the operator. The prototype system will be developed and evaluated based on data collected at the Northern Virginia TMS.

This project is designed to address the following key issues:

- The feasibility of developing short-term traffic condition prediction models for ATMS.
- The utility of short-term traffic condition prediction models in ATMS.

STATUS: This project was initiated in 1993 and will be completed in the Fall 1994.

PROJECT: Integration of Traffic Signal Systems and Traffic Management Systems

LOCATION: Research Project

CONTACTS: Catherine A. Cragg
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PROJECT DESCRIPTION:

The objective of this project is to determine the most effective means of integrating various traffic management systems. Traffic management systems have been developed in many urban areas in an effort to more closely monitor traffic conditions and be more responsive when adverse conditions are detected. These systems are most often concerned with traffic conditions on the freeway and have little control of conditions on the surrounding arterial network. For this reason, diversion strategies designed to alleviate congestion caused by incidents on the freeway often result in undesirable conditions on the arterials. Advances in signal control technologies allow for timings to be adjusted in response to differing levels of demand; however, in order to obtain maximum benefit from these technologies, communication must exist between those responsible for the two systems. Therefore, the aim of this project is to identify the appropriate hardware and software for integrating signal timing systems with large scale traffic management efforts and to determine an overall scheme for integrating the separate systems.

Tasks of this project include a review of the most current literature on both field hardware and system integration, evaluation of various hardware and software options, and determination of those most applicable for integration. It is expected that the results of these tasks will lead to a set of recommendations for system integration. As a final task, the benefits of system integration will be evaluated through a series of operational analyses.

STATUS: This project is scheduled to begin in August 1994.

PROJECT: Development of Guidelines for the Effective Use of Changeable Message Signs

LOCATION: Research Project

CONTACTS:

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PROJECT DESCRIPTION:

VDOT has made a significant investment in CMSs, a critical component of ATMS. At this time, however, VDOT does not have standards for the operation of CMSs. The purpose of this research project is to develop operational guidelines for CMSs, both portable and fixed, in the form of a user's manual for VDOT engineers and technicians. These guidelines will ensure that VDOT utilizes the CMSs consistently, providing travelers in Virginia with high quality traffic information.

The development of the guidelines will draw heavily upon the experience of VDOT personnel, as well as those from other state Departments of Transportation. Past research on CMS usage will also be synthesized. In addition, a focus group of motorists will be utilized in order to solicit the public's thoughts on traveler information, and test the application of the guidelines. The guidelines will assist operators with the following decisions:

- When should a CMS be used?
- Where should the CMS be located? (Where should a portable CMS be placed, or when should a fixed CMS be activated?)
- How much information can be presented?
- How should the information be presented? (Wording, graphics, number of displays)

STATUS: The project was initiated in November 1993, and will be completed by September 1994.

PROJECT: An Investigation of Operational Procedures for Highway Advisory Radio Systems

LOCATION: Research Project

CONTACTS:

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PROJECT DESCRIPTION:

While emerging technologies such as personal communication devices and in-vehicle navigation systems hold high potential for traveler information applications, a number of technologies currently exist that may be used to improve this important service. Particularly, HAR offers significant traveler information capabilities. HAR is especially attractive in that it employs equipment that is already standard in vehicles -- AM radios.

VDOT currently utilizes a HAR system as a component of the Hampton Roads tunnels' traffic management system. In addition, the Department is operating HAR systems in other regions of the state, such as Staunton and Fredericksburg. There are also plans to develop a regional HAR system in Northern Virginia to provide both local and regional information. Finally, other Virginia agencies are using HAR for applications such as airport traffic control and tourist messages. Clearly, HAR is a major component of traveler information services in Virginia.

The effectiveness of a HAR system is directly dependent upon how it is operated. For example, if messages are not updated to reflect current conditions, the public will quickly learn to ignore the system. This research effort will develop operating procedures for HAR systems. In doing so, it will examine HAR technology, personnel requirements, and message content. Finally, the effort will include a survey to gauge public reaction to the operating procedures and solicit ideas for improving the usefulness of HAR to travelers.

STATUS: The project will begin in the Summer 1994.

PROJECT: An Evaluation of the IVHS Planning and Project Deployment Process

LOCATION: Research Project

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PROJECT DESCRIPTION:

This project will evaluate the effectiveness of FHWA's IVHS Planning and Project Deployment Process. This process was developed to provide guidance for regional IVHS planning efforts. In particular, this project will take a critical look at the application of the process in the Hampton Road's IVHS Early Deployment study, COMPARE. The ultimate product of this project will be a report detailing the application of the process in Hampton Roads and describing recommended modifications to the process.

In order to develop the recommended modifications to the process, the project team (which consists of VTRC and Old Dominion University) will work closely with the consultant conducting the COMPARE study. In addition, the project team will interview stakeholders in the study, such as local officials in the Hampton Roads region. An important component of the project will be to compare the process to other large-scale planning processes. Furthermore, the team will look for opportunities to integrate IVHS planning into the traditional transportation planning process.

STATUS: This one-year project is expected to begin in June 1994.

PROJECT: FHWA IVHS-Research Center of Excellence at Virginia Tech

LOCATION: Research Program

CONTACTS: Antoine Hobeika
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Blacksburg, VA 24061 Phone: (703) 231-7740

PROJECT DESCRIPTION:

Virginia Tech, with support from VDOT and the VTRC, has been selected by FHWA as one of the three national IVHS Research Centers of Excellence (RCE). As an RCE, Virginia Tech will assess applicable IVHS technology, perform basic and applied research, and serve as partners in operational tests. In doing so, Virginia Tech's RCE will work closely with its public and private partners to accelerate the development of IVHS.

Specific projects included in the RCE's first year program include:

- IVHS Education and Training
- Computer-Based Training Tool for Traffic Control Center Operations
- IVHS Short Courses and Workshops
- Automated Incident Management
- Dynamic Network Optimization
- High-Speed Weigh-in-Motion Sensing
- In-Vehicle IVHS Display Modality Allocation for Commercial Trucks
- In-Vehicle IVHS Expert System
- Simulation Tool for Automatic Headway Control for Trucks
- SmartSonic Sensor for Traffic Application
- A Universal Digital Receiver for Autonomous Vehicle Monitoring Systems

STATUS: Virginia Tech is currently in the first year of the five-year RCE program.

PROJECT: Wide-Area Incident Management Expert-GIS System Development

LOCATION: Northern Virginia

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PROJECT DESCRIPTION:

The purpose of this project is to develop a wide-area incident management expert system to assist those persons responsible for responding to incidents that occur on and off the freeway system in Fairfax County, Virginia. The system is expected to provide for coordinated response, information about infrastructure elements, information about available resources, and motorist information. The expert system will provide personnel with information regarding the appropriate traffic diversion strategies, available alternate routes, signal timing for the alternate routes, and the effects of proposed strategies on both the freeway and arterial systems.

A Geographic Information System (GIS) will serve as the user interface and a database management system. The GIS will be used to input location-specific information such as geometric details and historic traffic volumes, as well as a means to input the location of the incident. The GIS will contain information regarding network characteristics such as gradient, curvature, ramps, elevated roadways, tunnels, bridges, overpasses, type and availability of shoulders, and any construction information which might influence the decision to divert traffic, and the selection of alternate routes.

STATUS: The project was initiated in January 1994 and is scheduled for completion September 1995.

PROJECT: Advanced Technologies for Improving Large Truck Safety on Two-Lane Secondary Roads

LOCATION: Statewide

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PROJECT DESCRIPTION:

The objectives of this study are to identify the characteristics of crashes involving large trucks on two-lane highways, determine the principal causal factors for these crashes and then identify existing or future IVHS and other advanced technologies that can be used to develop appropriate countermeasures to eliminate or reduce the detrimental effects of these causal factors in Virginia.

To accomplish these objectives, data on large-truck crashes were extracted from the computerized data files of crashes in Virginia from 1988 through 1990. Field data on the percentage of large trucks in the traffic stream were collected on a randomly selected sample of secondary roads. Crash rates were then computed and a detailed statistical analysis carried out to determine the crash characteristics of large trucks on two-lane secondary roads. Suitable technologies for eliminating or reducing the detrimental effects of the predominant causal factors were then identified.

Preliminary results indicate that on a statewide basis, large trucks have significantly higher crash rates on two-lane secondary roads than on primary roads and that large trucks are over-represented in crashes on two-lane secondary roads. Some technologies were identified as possible means of improving the safety of large trucks on secondary roads. Most of these technologies would apply to the vehicles rather than the roadway and would, therefore, require consideration by the trucking industry.

STATUS This project is complete with a final report expected in Summer 1994.