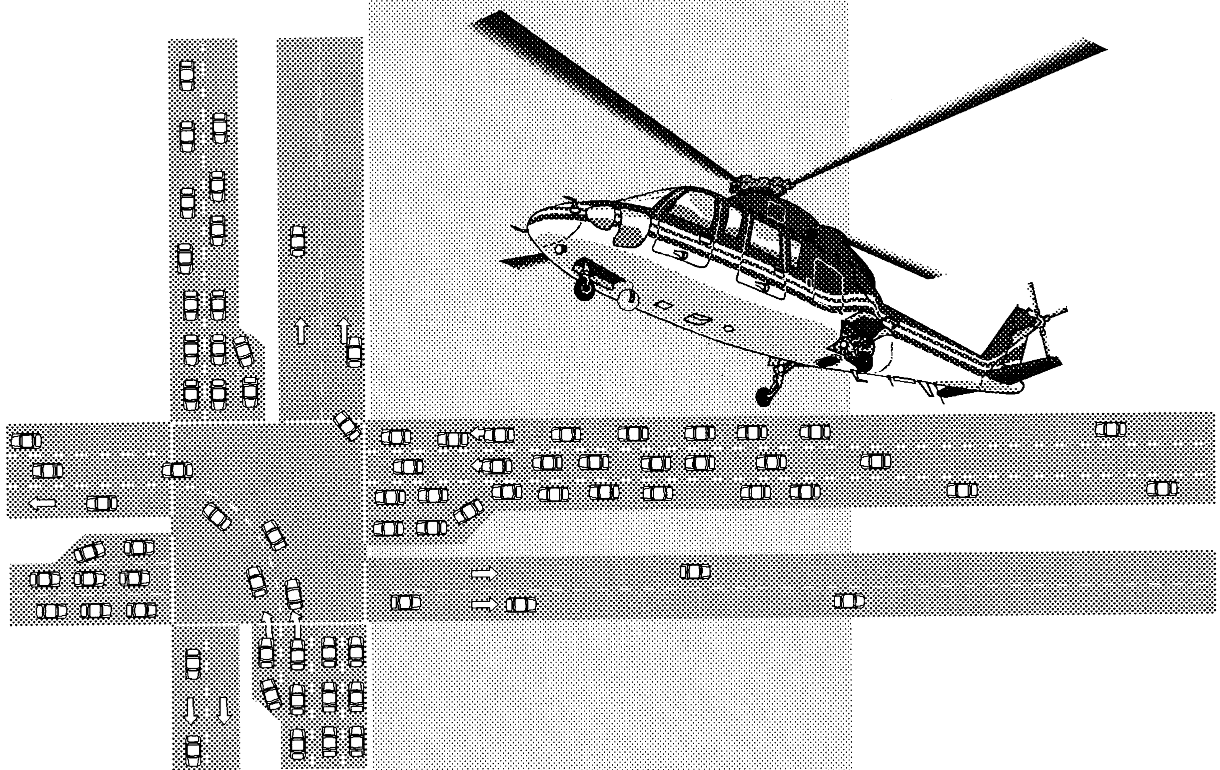
FINAL REPORT

EVALUATION OF THE USE OF LIVE AERIAL VIDEO FOR TRAFFIC MANAGEMENT



MICHAEL J. DEMETSKY
Faculty Research Scientist
Professor of Civil Engineering

FRANK D. SHEPARD
Research Scientist

JOHN S. MILLER
Research Scientist

STEVE R. BLACKWELL
Data Analyst Specialist

VIRGINIA
VTRC
TRANSPORTATION RESEARCH COUNCIL

VIRGINIA TRANSPORTATION RESEARCH COUNCIL

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
VTRC94-R14		

4. Title and Subtitle	5. Report Date
Evaluation of the Use of Live Aerial Video for Traffic Management	January 1995
	6. Performing Organization Code
7. Author(s) Michael J. Demetsky, Frank D. Shepard, John S. Miller, and Steve R. Blackwell	8. Performing Organization Report No. VTRC 94-R14
9. Performing Organization Name and Address Virginia Transportation Research Council 530 Edgemont Road Charlottesville, Virginia 23219	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address Federal Highway Administration The Dale Building 1504 Santa Rosa Road, Richmond, VA 23229	13. Type of Report and Period Covered Final Report: July 1993-April 1994
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report describes the evaluation of an intelligent transportation system (ITS) demonstration project in which live aerial video of traffic conditions was captured by a rotary wing aircraft operated by the Fairfax County (Virginia) Police Department. The video was transmitted to ground stations for use by Fairfax County and the Virginia Department of Transportation for incident and congestion management.

The evaluation had three foci: (1) the capture and transmission of the video picture, (2) related institutional issues, and (3) the utility of the video information in incident management and traffic control. The evaluation covered a 10-month demonstration period from July 1993 to April 1994.

The demonstration showed that aerial video can capture and transmit pictures of traffic flow and incidents to aid in decision making by traffic management. Throughout the evaluation period, the reliability of the system was greatly improved, resulting in a continuous daily operation (except for emergency interruptions). The aerial video has enhanced incident management in the application area and has potentially unlimited on-line applications for traffic surveillance in conjunction with various traffic management systems. Examples of off-line applications are training, planning, operational improvements, and before and after studies.

17. Key Words	18. Distribution Statement
Airborne, Video, Helicopter, Traffic, Surveillance, Incidents, Congestion	No restrictions. This document is available to the public through NTIS, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	37	

FINAL REPORT

EVALUATION OF THE USE OF LIVE AERIAL VIDEO FOR TRAFFIC MANAGEMENT

Michael J. Demetsky
Faculty Research Scientist
Professor of Civil Engineering

Frank D. Shepard
Research Scientist

John S. Miller
Research Scientist

Steve R. Blackwell
Data Analyst Specialist

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

In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

January 1995
VTRC 94-R14

ACKNOWLEDGMENTS

This research was sponsored by the Federal Highway Administration; Fairfax County, Virginia; and the Virginia Department of Transportation. The demonstration was performed by the Fairfax County Police Department, and the evaluation was conducted by the Virginia Transportation Research Council. Ron Minor (now of VDOT), Sandy Gideonse, and Mike Uram of Fairfax County provided technical and procedural information about the aerial video operation and its application to incident management. Jimmy Chu and Joe Wallace of VDOT were the primary sources on utilization of the aerial video for traffic management. Various individuals from the local media in Washington, D.C., and Charlottesville, Virginia, provided information on the institutional issues.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

ABSTRACT

This report describes the evaluation of an intelligent transportation system (ITS) demonstration project in which live aerial video of traffic conditions was captured by a rotary wing aircraft operated by the Fairfax County (Virginia) Police Department. The video was transmitted to ground stations for use by Fairfax County and the Virginia Department of Transportation for incident and congestion management.

The evaluation had three foci: (1) the capture and transmission of the video picture, (2) related institutional issues, and (3) the utility of the video information in incident management and traffic control. The evaluation covered a 10-month demonstration period from July 1993 to April 1994.

The demonstration showed that aerial video can capture and transmit pictures of traffic flow and incidents to aid in decision making by traffic management. Throughout the evaluation period, the reliability of the system was greatly improved, resulting in a continuous daily operation (except for emergency interruptions). The aerial video has enhanced incident management in the application area and has potentially unlimited on-line applications for traffic surveillance in conjunction with various traffic management systems. Examples of off-line applications are training, planning, operational improvements, and before and after studies.

FINAL REPORT

EVALUATION OF THE USE OF LIVE AERIAL VIDEO FOR TRAFFIC MANAGEMENT

Michael J. Demetsky
Faculty Research Scientist
Professor of Civil Engineering

Frank D. Shepard
Research Scientist

John S. Miller
Research Scientist

Steve R. Blackwell
Data Analyst Specialist

INTRODUCTION

The prompt and proper identification and evaluation of an incident that affects the normal movement of traffic are essential if the incident's cumulative adverse effects are to be reduced. The appropriate, coordinated response to an incident is essential in an urban environment where the interstate and arterial roadway networks normally operate at capacity for most of the day. In addition, the governmental agencies responsible for traffic management need traffic information to assist in making decisions associated with real-time traffic control.

This report describes an evaluation of an intelligent transportation system (ITS) demonstration project in which live aerial video of traffic conditions was recorded by a rotary wing aircraft. For approximately 11 years, the Fairfax County Police Department has been operating a fleet of three turbine-powered, rotary wing aircraft for the purpose of public safety, including the monitoring of rush hour traffic over existing highways. The cost of the fleet was $4 million. This situation provided an opportunity to evaluate the use of aerial video in traffic management without incurring the additional expense of the aircraft.

In conjunction with the Virginia Department of Transportation (VDOT) and the Federal Highway Administration (FHWA), an effort was launched to provide aerial video of traffic conditions. Approximately $500,000 was allocated by Fairfax County as an in-kind expenditure for operating costs for the demonstration, and another $319,000 was supplied by FHWA to VDOT for video equipment and evaluation. The equipment became the property of Fairfax County after the demonstration. The video picture was transmitted to ground stations for use by Fairfax County and VDOT for incident and congestion management.

PURPOSE AND SCOPE

The scope of the demonstration included the use of existing technology to provide aerial video to enhance existing traffic management capabilities. The utility of the video for incident management and use by VDOT's traffic management center (TMC) in Arlington, Virginia, was evaluated.

Overall, this evaluation had three foci: (1) the capture and transmission of the video picture, (2) related institutional issues, and (3) the utility of the information for incident management and traffic control. The evaluation covered a 10-month demonstration period from July 1993 to April 1994.

A parallel demonstration was conducted in Montgomery County, Maryland, using fixed wing aircraft, but only the Fairfax County system is addressed here.

METHODS

An existing Fairfax County police helicopter was retrofitted with the desired video capabilities. Since the helicopter had a multimission role that could not be compromised and it was already heavily outfitted for medical and police missions, space, weight, and aircraft balance were at a premium. It became apparent that the use of the existing system had to be maximized, which meant converting the existing forward looking infrared (FLIR) system to a combination FLIR and video camera system. The equipment and method used to capture and transmit the live aerial video for traffic management are described. Solutions to problems that arose with the equipment and method were identified.

Important considerations in the development of a video information system are the necessary arrangements among institutions involved in delivering and using the information. Accordingly, partnerships among agencies, ownership of the aircraft, and the potential role of private traffic information services were addressed.

In order to evaluate the utility of the video information in traffic management, several areas were investigated: flight scheduling, adequacy of coverage area, incident management, recommendations by the staff of VDOT's Northern Virginia TMC based on their experience during the demonstration, and potential off-line applications. These areas were investigated through the use of interviews, user surveys, and meetings with the involved parties.

OVERVIEW OF EQUIPMENT AND GROUND TRANSMISSION

Aircraft

The Bell 206 helicopter used in the demonstration is shown in Figure 1, and a schematic of the aircraft is shown in Figure 2. The helicopter is a light, single-engine helicopter (1,810 kg [4,000 lb] gross weight) that can be airborne for a maximum of 3 hours with the amount of fuel carried. The aircraft is staffed by a two-person crew: a pilot who sits on the right-hand side and a flight officer, who is also a paramedic, who sits on the left. The flight officer operates the hand controller for the video.

The video system weighs less than 45 kg (100 lb) and has a 3-watt power output with a maximum effective range of 32 km (20 mi). As a basis for comparison, most helicopters used by commercial TV stations are of medium size (4,500 to 9,100 kg [10,000 to 20,000 lb] gross weight) or, at the very least, are twin-engine ships at the top end of the light helicopter scale.

Figure 1 Side View of Bell 206 Helicopter

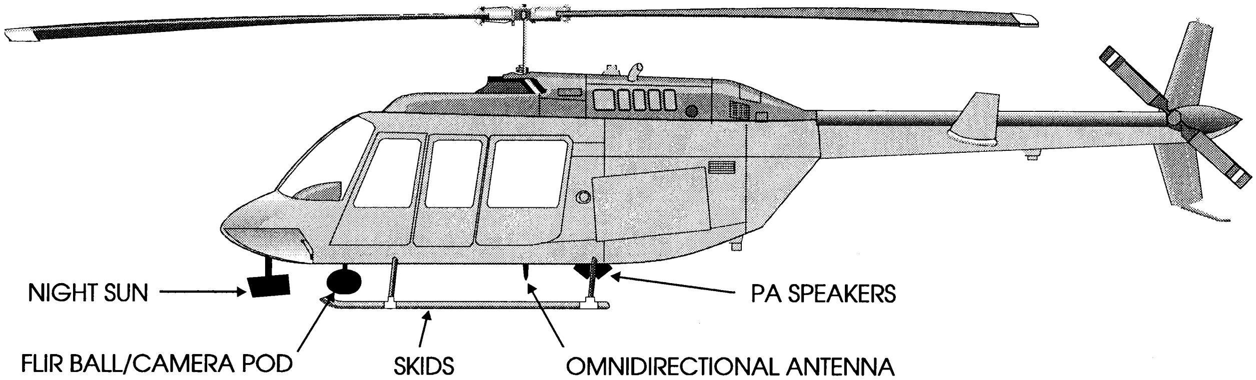


Figure 2 Schematic of Helicopter

The video system in these aircraft weighs in excess of 228 kg (500 lb), costs about $1.2 million, has a power output of 30 watts, and has an airborne transmitter-to-ground receiver range of about 320 km (200 miles).

Video System

A schematic of the airborne video system is shown in Figure 3. The system consists of the helicopter equipped with the video equipment, from which information is sent to the ground station and a police traffic van at the site of an incident. From the ground station, the video is transmitted to selected locations via cable. The single most important element of the system is a gyro-stabilized color video camera in the helicopter, which can be installed or removed in about 1 minute. It is also the single most expensive part of the system, costing $110,000 for the camera itself and the supporting elements on each of the three aircraft. The camera is co-located with a thermal imaging device in a portable ball/pod, as shown in Figure 4, which is attached to the underside of the aircraft's fuselage. The helicopter has a rail mount and two quick-disconnect cannon plugs for easy installation and removal of the ball/pod. It also has the necessary internal wiring, a video monitor on the instrument panel, and an electronic control unit and hand-held controller to operate the pod and its inclusive systems.

The six-power CCD camera sends its images to three places in the helicopter: (1) the video monitor, where the operator actually sees what he or she is doing through the camera's perspective; (2) the 8-mm video cassette recorder (VCR), which records the entire flight for the camera and FLIR; and (3) the microwave transmitter, which sends the signal via an omnidirectional antenna to the ground stations, which is shown in Figure 5.

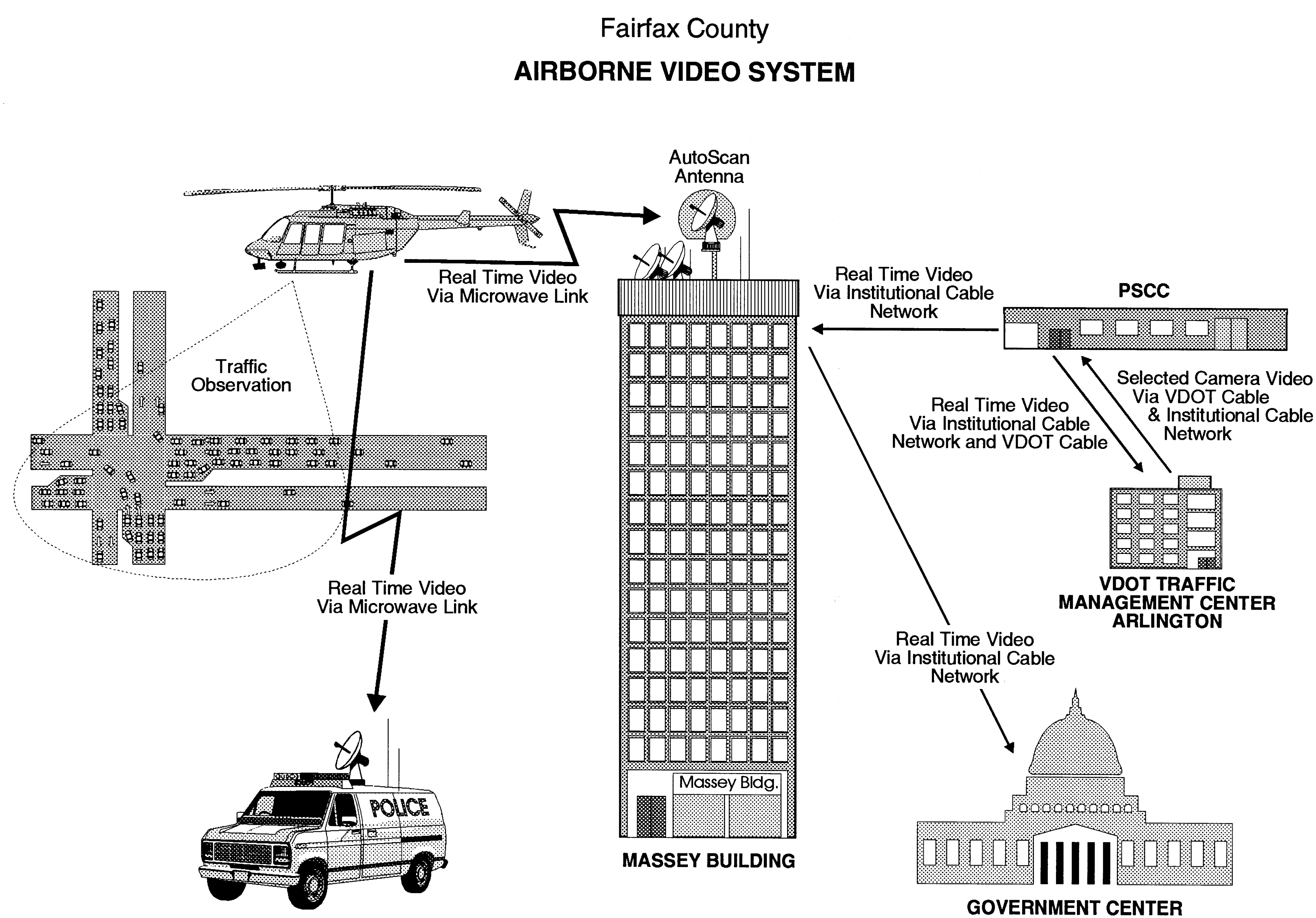


Figure 3 Schematic of the Airborne Video System

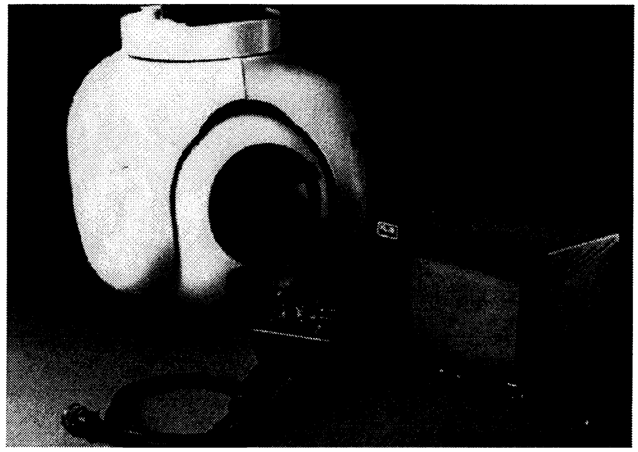


Figure 4 Portable Ball/Pod

Figure 5 Omnidirectional Antenna

Ground Transmission

The main ground station is the Massey Building, which is centrally located in Fairfax County and houses the headquarters of the police and fire departments. The top of the building is about 202 m (660 ft) mean sea level (MSL), making it the tallest (64 m [210 ft]) in the county. Most of the traffic missions with the camera are flown at about 305 m (1,000 ft) MSL, roughly

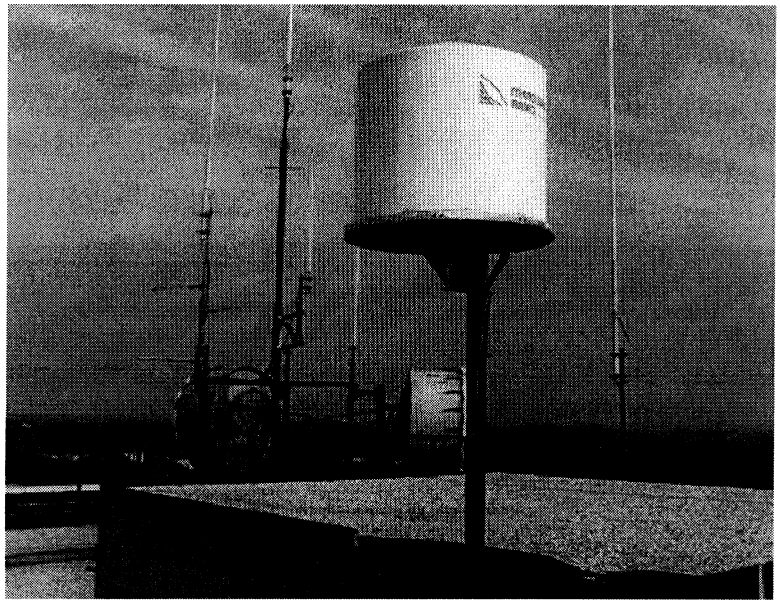


Figure 6 Rotating Antenna Encased in Radome

152 m (500 ft) above ground level (AGL). Flying much higher would put the aircraft in the terminal control area (TCA) for Washington National and Dulles airports, the base of which starts at 400 m (1,300 ft) MSL.

The microwave signal is received on the roof of the Massey Building by a rotating antenna, which is pole-mounted and encased in a radome, as shown in Figure 6. A schematic of the mounting is shown in Figure 7. The antenna filters and sends the signal to the receiver, which outputs the RF signal to a modulator unit. There, it enters the cable television (CATV) network in the penthouse of the Massey Building. The penthouse houses a controller for the automatic tracking system and a computer software program that uses a signal from the aircraft's LORAN C navigational system. The signal indicates where the aircraft is located in relation to the Massey Building. The data include magnetic bearing, distance, and altitude. Based on this information, the controller tells the antenna which way to face in order to receive the microwave signal best.

The CATV distribution system is fairly comprehensive because it includes three cable systems: Fairfax County's cable service, Media General Cable, provides the county with free lines; VDOT provides cable from Falls Church across I-66; and the Arlington cable service provides Arlington County with lines for public use in that jurisdiction. Information is sent through CATV, as shown in Figure 3, first to Fairfax County's Public Safety Communications Center (PSCC) and the Massey Building. From PSCC it is further sent to VDOT's TMC in Arlington.

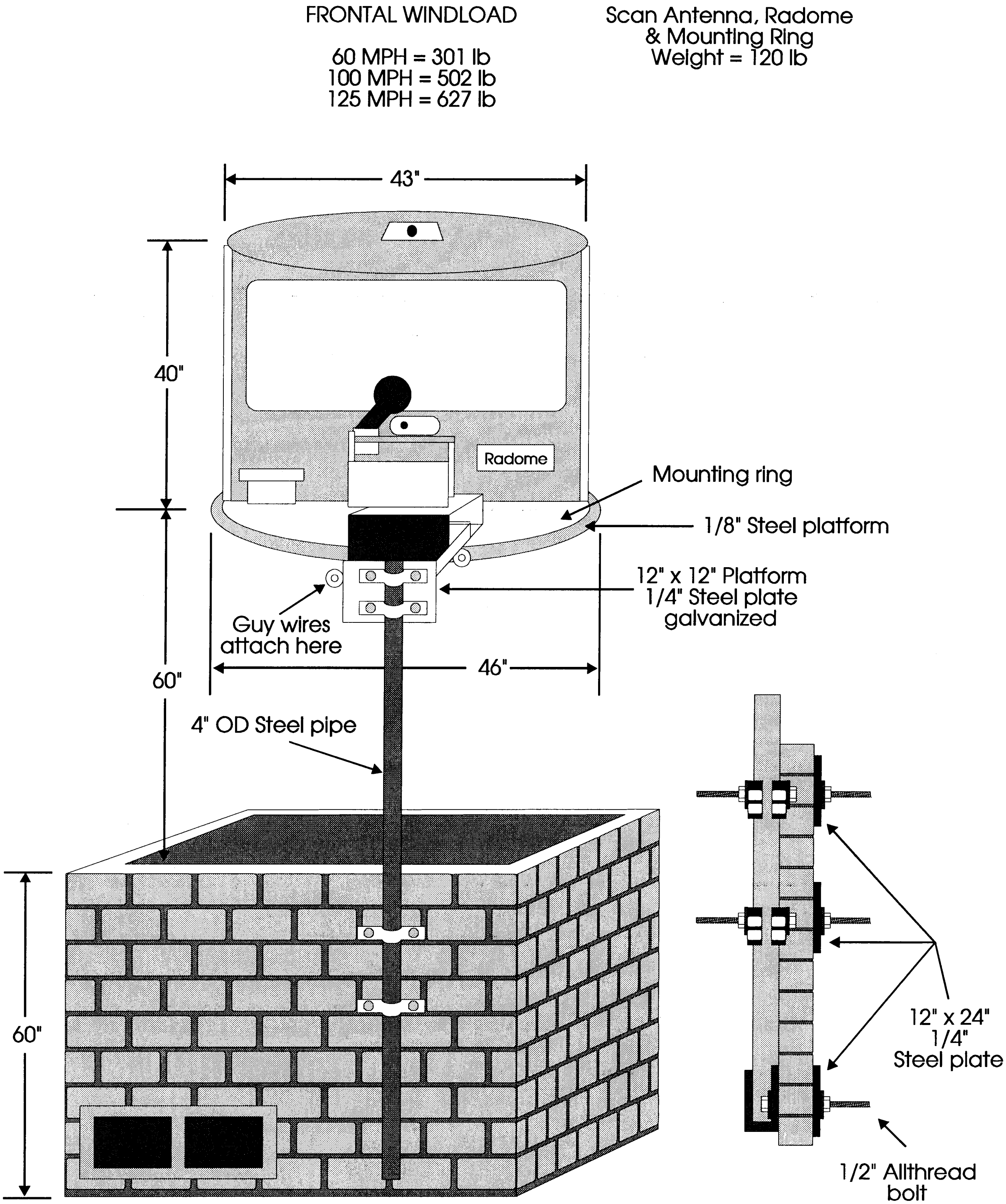


Figure 7 Schematic of Rotating Antenna Mounting

The principal recipient of the system is the PSCC, which dispatches both police and fire units in response to emergency calls. Within the PSCC is a Disaster Operations Center (DOC), which is activated in time of need. The DOC has two modulators, two demodulators, and the primary color monitor at the end of the airborne video downlink. In addition, it has a two-way command radio used for communications with the helicopter. It also has a Macintosh Classic II computer, which connects to the automatic tracking system in the Massey penthouse. The usual start-up procedure is to align the antenna manually through the modem and then shift to automatic tracking with the mouse. The receiving antenna atop the Massey Building has a physical limit stop at about 300 degrees magnetic heading. This feature prohibits the antenna from twisting off the cable that connects it to the receiver in the penthouse. When the helicopter passes through the 300-degree radial, the most expeditious means of reacquisition is to reverse the antenna to the opposite side of the stop manually and then re-engage the automatic tracking system. This can all be accomplished through the computer in the DOC.

The TMC also has a monitor, a demodulator, and a modulator. It sends video to the PSCC/DOC from the 48 VDOT ground cameras located on the interstate highway system. Pictures sent from the DOC to the TMC pass through two switching stations enroute: Media General's in Merrifield and Fire Station 76 in Falls Church, Virginia. Likewise, pictures from the TMC to the DOC travel the reverse route. The distribution network also includes the new Fairfax County Government Center in the Fair Oaks area, as well as four drop points within the Massey Building itself—two for the Police Department and two for the Fire Department.

A police van is separate from the cable distribution system but is nonetheless a key part of the overall program. It has a roof-mounted antenna, pedestal driver, manual controller, and microwave receiver. It also has a manual tracking system to keep the antenna facing the helicopter and a monitor that assists the system operator. The van usually works in conjunction with the Police Command Bus, which responds to the scene of major incidents of all kinds. The van can be parked next to the bus and hooked by portable cable to a monitor in the bus, or it can be co-located in the general area of the bus and send RF signals to the bus through multiplex/demultiplex (MUX/DEMUX) units with transmitters/receivers using the 900 MHz band. The van also has a 12-volt DC to 110-volt AC power converter to implement the video system. The van/bus combination offers the Police Department on-scene command and control at an incident site.

CAPTURE AND TRANSMISSION OF PICTURE

The reliability of the system improved throughout the evaluation period as various problems associated with the video transmission were resolved. This is a qualitative judgment based on the perceived availability of the video helicopter to the Fairfax County Police for the purpose of traffic surveillance. Actual data on flight hours per month would be misleading because factors other than technical problems can affect the utilization of the helicopter for the traffic mission on a given day. These factors include weather, police and emergency uses, and scheduled maintenance.

Problems

Specific problems that were addressed included the following:

- There were problems with the ground station antenna tracking and reception that were resolved by hardware modification, software revision, and operational attention. Further interruptions of telemetry data were resolved by pilot training.

- The antenna on the Massey Building was not receiving signals of adequate strength because it was masked by other dishes/antennae on the roof. The antenna platform was raised, and the problem was solved.

- Ground-based interference was encountered when the receiver site antenna was turned in certain directions. The numerous signal sources on top of the Massey Building necessitated the installation of a high-quality bandpass filter and a low-noise amplifier beneath the antenna. Once accomplished, the problem was corrected.

- Intervals of blanking out occurred when the helicopter changed heading during flight. The aircraft's skids, antenna, night sun, and other equipment were found to be shielding the system's omnidirectional antenna. The antenna was extended below the belly and mounted amidship, and most of the blanking sources were circumvented. Pilots were also alerted to this problem.

- Initially, there was considerable camera vibration, leading to a blurry picture. The camera's mounting pad and the associated aircraft spars/ribs/stringers and skin were strengthened to solve the problem.

- In some instances, there was loss of color because of unintentional mixing of signals in TV-type monitors. This was solved by inserting filters to isolate the aural carrier of the TV signal from the video input.

- Camera overexposure and washout are still evident, particularly on bright sunny days. Although this does not impair function, it does reduce image and color quality. Efforts are now being made to adjust the camera aperture and shutter control.

- The ball/pod did not maintain environmental integrity, and as a result, moisture entered and clouded the camera lens. The camera housing was modified and returned to service. The lens of the camera initially took in moisture, but a new sealing system eliminated the problem.

Many of the problems with the camera were corrected by the manufacturer in later models. However, the color camera does not work well at night, but the black and white FLIR system improves night visibility. The current camera has a 6X zoom capability.

There are also limitations to the system. The distance from the airborne transmitter to the ground receiver is limited to about 32 km (20 mi). This includes both horizontal distance on the ground as well as vertical distance (in terms of altitude) above the ground. This is because of the system's 3-watt power output, which is weak compared to, say, the 30-watt amplifier used by commercial TV stations. A significant limitation is the weather. Precipitation of any kind diminishes the picture. Other obstructions to visibility, such as haze, smoke, fog, etc., also negatively affect the system. Anything (dirt, grease, oil, insects, etc.) on the external glass plate of the pod decreases the effectiveness of the system.

The airspeed of the helicopter can be a factor. The faster the aircraft travels, the less likely the ground observer is to focus on details, particularly at low altitude and high zoom settings. Therefore, when the helicopter arrives on a scene, it necessarily slows to 50 to 60 knots (58 to 69 mph), circles, and turns the camera directly on the event below.

Since traffic patrols are not the primary objective for the Fairfax County Police fleet, three aircraft must be operational for the peak period traffic surveillance function to be maintained because two must be reserved for police and hospital transport at all times. Experience during the demonstration indicated that when an aircraft is down, traffic surveillance is cut back. However, the on-call aircraft could be used in the case of an incident.

A backup camera would be beneficial in case of a malfunction. Further, a second camera in an additional helicopter would provide the opportunity for coverage of multiple incidents or expanded viewing of a large incident.

Implementation Costs

The costs and vendors of the components used to make the air video operational are given in Appendix A. Further technical information on the system can be obtained from the Fairfax County Police Department Operations Support Bureau at the address given in Appendix A.

INSTITUTIONAL ISSUES

The use of aerial video for traffic management requires the cooperation of various public and private parties in order to collect, distribute, and use the information. This section explores the important ways institutional cooperation makes possible and can enhance the effectiveness of the air video traffic information system.

Partnerships Among Agencies

Examination of the partnership arrangements for implementation of this aerial video revealed several key players: Fairfax County Police, Fairfax County Traffic Information Center (TIC), VDOT (TMC), VDOT Safety Service Patrol, Virginia State Police, and Fairfax Fire and Rescue. Currently, when an incident is spotted by the Fairfax County police helicopter, the TIC is notified, and it, in turn, notifies the Virginia State Police, the TMC, the Safety Service Patrol, and the Camp 30 Area Headquarters of VDOT's Fairfax Residency. If the TIC is notified of an incident by someone other than the helicopter crew, the helicopter is sent to the scene and the further notifications follow.

Ownership of Aircraft

The helicopter is completely funded through the Fairfax County Police Department and is used for many aspects of police work in addition to monitoring traffic. The fact that it is neither operated nor financed by VDOT presents both advantages and challenges that necessitate a unique degree of coordination among public sector agencies.

Currently, the Fairfax County Police also use the helicopter for medical evacuation, inter-hospital transport, and law enforcement. The Commonwealth, therefore, receives use of the helicopter as well as the expertise of the pilots and the Fairfax County ground crew at no cost. However, there is a price to be paid: about 20% of the time *during peak periods,* the helicopter is not available for traffic surveillance because it must be used for other police work. During nonpeak hours, if the helicopter is available and an incident occurs, VDOT receives the benefits.

To determine if this situation is satisfactory, one must ask if having the helicopter available for traffic use 100% rather than only 80% of the time would justify a $2.8 million expenditure in the first year of use as well as subsequent operating expenditures of $0.4 million annually. This cost was computed as follows: $2.4 million capital cost plus $0.4 million annual operating cost (15 hours per week at $500 per hour). If the answer is yes, one option to reduce costs would be to rotate the helicopter over different places in the state. For example, the same helicopter could be shared by several jurisdictions, such as Richmond, Norfolk, and Northern Virginia, for periodic traffic surveillance and operational studies. It could also be on call for emergencies and special events, but it would not be generally available for any specific area. However, ground support equipment would be required in all areas served. The costs of such additions would need to be determined and added to the operating costs.

Potential for Private Operation

The possibility of government agencies purchasing aerial video coverage from a private traffic provider was also considered. VDOT could pay a provider to operate, maintain, and provide aerial video coverage. However, VDOT's bottom line is *mission*: its purpose is to give accurate information to the public and provide assistance during incidents. The private sector's objective is to maximize profit. Therefore, the amount of competition among private traffic information providers plays a key role in determining the performance incentive for the private sector. For example, in order to cut costs, a monopolistic private organization might limit the amount of time its aircraft is operational, whereas a public agency could afford to stay in the air longer should conditions justify additional airtime. However, a private organization in competition with other traffic information providers might strive to stay in the air longer to obtain better coverage and, consequently, win a greater share of the market.

The method in which such a contract is specified would naturally influence the success or failure of hiring a private sector firm. The contract should account for incentives and disincentives that a private firm would face in the task of providing aerial video information. For example, paying a provider a flat fee could encourage the provider to stay in the air as little as possible to minimize operating costs. Paying a provider on an hourly basis might induce the provider to stay in the air longer than necessary. A solution could be to use a performance-based contract where the amount paid would reflect the accuracy and completeness of the aerial video information. Finally, the contract should specify what equipment will be used. For example, private organizations would have a choice between fixed wing aircraft and a helicopter, but certain conditions might dictate the option to be used. (The hourly cost of a helicopter is between $300 and $500 whereas that of a fixed wing aircraft is between $100 and $125.)

USE FOR INCIDENT MANAGEMENT AND TRAFFIC CONTROL

Flight Scheduling

The Fairfax County helicopter currently flies twice each day (1.5 hours during the morning rush hour and 1.5 hours during the afternoon rush hour), 5 days per week, provided it is available. The flight path over the interstate highways is set in advance but can be easily changed upon request. If an incident occurs at a time other than when the aircraft is deployed, the craft is ready to go on standby status.

Normally, it takes the helicopter about 1 hour to complete this trajectory, leaving it with another half hour to examine selected sites. The helicopter does occasionally deviate from the flight path at VDOT's request. VDOT could request more airtime, but if it were needed on a regular basis, cost could become a factor.

Adequacy of Coverage Area

The helicopter route is centered on Fairfax County, which is a significant portion of VDOT's Northern Virginia jurisdiction. However, other geographical locations near Fairfax

County that are of interest to VDOT, such as Arlington County and the City of Alexandria, are not covered by the helicopter's path.

As with many major metropolitan areas, the height the helicopter can reach, and hence the range of the aerial video, is restricted by FAA regulations. In this case, National Airport restricts the maximum altitude of the helicopter as it flies closer to Washington, D.C. For example, at the Cabin John Bridge, the helicopter may be no higher than 328 m (1,000 ft); at Tysons Corner, the maximum is 214 m (700 ft); and at Memorial Bridge, the maximum is 92 m (300 ft). Although the helicopter can fly below these heights, pilots often fly at 152 m (500 ft) to avoid hitting tall buildings or towers: one pilot from the Virginia State Police stated that, in his opinion, it was not safe to fly below 328 m (1,000 ft) without an observer to watch for obstructions.

The current trajectory of the aircraft was designed to cover all of Fairfax County; however, other trajectories can be considered to monitor the traffic situation better. For example, Fairfax County may find it more feasible to identify areas of congestion and then continuously monitor them while receiving feedback from traffic officials. Further, it appears that rather than using a fixed flight path, it would be more beneficial to receive constant direction from a group of traffic controllers (composed of State Police, local police, and VDOT personnel). The controllers could work with the pilot to provide a flight path that changed in response to rush hour traffic congestion. The concept of a VDOT control center with direct communication with the aircraft is being investigated.

Incident Management

It was planned that data for this part of the evaluation would come from investigations involving major incidents. Sources were to include interviews, questionnaires, and meetings with involved parties to determine the effectiveness of using aerial video for incident detection, assessment, removal, and traffic control. Specific sources were to include Fairfax County and Virginia State Police, VDOT personnel (TMC, Safety Patrol, district staff), and helicopter pilots. However, because few major incidents occurred during the evaluation period, a compila-tion of statistics on the effectiveness of using aerial video was not possible. Accordingly, only one incident was investigated.

The incident involved an accident on the Capital Beltway (I-95/495) in which a flat-bed tractor trailer with a sewage storage tank went under a bridge, causing the tank to fall off. The incident occurred at 2:57 P.M. on Tuesday September 28, 1993, and blocked the road for 66 minutes. The maximum traffic backup was approximately 64 km (4 mi). The helicopter was on the ground when the incident occurred and reached the scene in 20 minutes.

Interviews with Helicopter and Ground Personnel

These interviews revealed several benefits from using aerial video. First, it quickly scanned the overall incident scene, allowing for assessment of congestion on alternate routes and continued reevaluation of traffic control strategies to fine tune alternate route guidance and minimize congestion. For example, a decision was made to close the I-95/I-395 ramp, which was not a part of the basic incident management plan. Aerial video allowed identification of obstructions along the alternate routes, such as road maintenance or utility work, and their quick removal. The aerial video also quickly detected secondary incidents and accelerated their efficient removal, which reduced their cumulative effect. In this case, there were two other incidents as a result of the original: a dump truck turned over and a fender bender occurred. The aerial video facilitated the realization that police motorcycles should be used to get to the accident scene since larger vehicles would have to sit in traffic.

Advantages of having aerial video at the Fairfax TIC and the Command Bus were evident. Personnel were able to observe the scene and make real-time decisions in cooperation with other team members. Team members were able to request additional, real-time information (including zooming to observe names, numbers, materials, etc.) for continuous updating of decisions. The state police typically require an officer to be on the scene to make a decision concerning closing the road and putting the incident management plan into effect. The aerial video accelerated this decision-making process and made it possible for the police officer to make a decision from a remote location.

User Survey Responses

Questionnaires designed to evaluate the incident removal strategy were given to Fairfax County and VDOT personnel; each organization completed three questionnaires (see Appendix B). Three of the six respondents felt the incident was verified faster, and two thought that use of the aerial video allowed the police to reach the scene faster. All respondents believed that a key advantage was the ability to observe the overall scene more efficiently. Other respondents commented that the command post was able to utilize the resources effectively and make critical decisions concerning traffic re-routing and that the extent of the congestion and the effectiveness of the alternate route could be examined.

Effects of Using Aerial Video Over the Demonstration Period

Personnel from VDOT and Fairfax County were also asked to describe the effects of the aerial video over the period of the demonstration. They provided the following comments:

- The aerial video can facilitate effective management of special events such as the Marine Corps Marathon. Extensive traffic control was required during this 37-km (26 mi), 7-hour race, and the aerial video allowed continuous viewing of the entire scene. The video was received at the command post, thereby allowing cooperative real-time decisions to be made by the management team. In the past, there had been problems due to traffic control breaking down, which resulted in the slowest runners not having protection as originally planned.

- Observations of the scene from the aerial video allow more effective deployment of response resources.

- Speedier traffic control adjustments are possible because of real-time pictures of traffic patterns and congestion.

- Minor accidents, which often occur in the backups resulting from major incidents, are quickly revealed.

- In the event of natural disasters, such as snow, floods, or tornados, multidisciplinary personnel can communicate, coordinate, and cooperate in monitoring conditions, establishing priorities, and making decisions. Zoom capabilities allow more specific information to be obtained.

Recommendations From the TMC

The Northern Virginia TMC was supportive of using the aerial video to supplement their traffic surveillance procedures. However, after the aerial video was received for the test period through April 1994, it was concluded that the transmission needed to be better coordinated with the TMC's operation in order to maximize its benefits for traffic management. For example, TMC personnel need to be trained to observe the aerial video and use it to supplement the information they receive from the ground cameras. Many times, they did not immediately know the location of the scene the video was showing. Overall, for the demonstration period, the aerial video was not of much use to the TMC except for major incidents and events.

Accordingly, for the aerial video to be used to enhance the TMC's operation, the following changes were recommended:

- *Increase the flying hours.* The present time is just enough to cover the major interstate highways once. It does not provide enough traffic information to the controllers to make sound decisions.

- *Reduce the coverage areas.* Two or three helicopters may be required to cover the Northern Virginia Area successfully. As it is now, it takes 1 hour for the helicopter to complete one run. In a real-time operation, this is unacceptable. By reducing the coverage area, a helicopter may fly over the same area within 15 minutes, which would greatly improve the surveillance capability of the aerial video.

- *Improve communication between the pilots and the traffic controllers.* There was no such communication link set up for this demonstration. When information from the pilot was required, the Fairfax County Police Center was contacted. By having direct communication, information on the aircraft's location and requests to fly to a particular area would be possible.

Finally, the aerial video may enhance the capabilities of a TMC by providing an extra set of eyes that extend beyond the scope of its cameras. This dynamic capability allows a transportation agency to monitor congested routes as they develop, even if the planners of the TMC did not foresee the need to monitor such routes.

Operational Studies and Potential Operational Uses

Three operational studies were conducted, and discussions with Fairfax County and VDOT personnel yielded other possible operational uses.

Operational Studies

The first study was requested by a citizen in Northern Virginia to install overhead lane use control signals on Route 1 from the Occoquan River to the southern intersection of Mount Vernon Parkway and Route 1 (approximately 10.2 km [6.3 mi]). A traditional approach would involve gathering data relative to the study section, which would include signal operations, utility plans, and traffic counts. After collecting the necessary data, one would conduct field investigations of the subject location. Multiple ground videotaping sessions involving as many as four vehicles and two persons per vehicle to traverse the Route 1 corridor and its surrounding areas would have been required.

VDOT personnel obtained the same data by videotaping the study site for 30 minutes during the morning peak period. Further, the aerial video provided a view of the entire network rather than an isolated ground perspective. The aerial video also identified traffic operation deficiencies and their cause, as well as locations where lane use control signals could not be used because of design deficiencies.

Another study involved the Dulles Toll Road (DTR) in Fairfax County. After VDOT instituted HOV lane use on the DTR, the facility began to fail operationally. The aerial video showed heavy platoons and decreased headways, which prevented vehicles from merging onto the DTR from entrance ramps. Simple lane changes were also shown to be difficult. With the aerial observation, problem areas were identified, necessary modifications were made, and by using before and after comparisons of videotapes, VDOT was able to see that the modifications proved to be successful. VDOT felt that without the use of aerial video, problems could not have been identified and remedied as quickly.

A third study demonstrated the public relations capabilities of the use of aerial video. Because of concern about snow removal after a large storm, the Beltway was videotaped to provide snow removal information to local officials. This presentation refuted allegations that VDOT had not sufficiently cleared the Beltway of snow.

Potential Operational Uses

VDOT personnel suggested other possible uses as follows:

- *Improved traffic control for special events.* Aerial video could be used to observe traffic flow at congestion-causing events such as football games, concerts, and fairs. Traffic control devices such as variable message signs could be remotely controlled from the TMC in real time in order to improve traffic flow.

- *Observations of the effects of problem intersections, interchanges, and channelizations on areawide traffic patterns.* One example is the comparison of congestion levels on a toll road and adjacent roads.

- *Identification of safety or congestion-reduction countermeasures.* This usage is especially applicable in work zones due to the associated congestion.

- *Identification and evaluation of secondary road cut-throughs.* Major arterials in Northern Virginia are often clogged with traffic, which prompts some motorists to use residential streets in order to bypass these arterials. The use of these cut-throughs has prompted a public outcry on behalf of the local residents, who cite problems such as heavier traffic, higher speeds, and a failure to yield to pedestrians, many of whom are elderly persons or young children. Potential cut-throughs and their expected level of use may be readily examined through the use of the aerial video.

- *Improved work zone traffic management.* Traffic delays and bottlenecks in work areas can be detected, and solutions developed and monitored. The progress of construction and its effects on traffic in surrounding areas can also be monitored.

- *Verification of problems identified by the public.* Reported problems can be verified quickly with the aerial video, and appropriate action taken.

Off-Line Planning and Training

Examination of tapes of the aerial video revealed that aerial video can potentially be used for planning and training purposes including incident management planning, transportation planning, and traffic management. Examples are using the tapes as an incident management training tool or as an evaluation tool for studying traveler responses after a major change in the transportation system. Video can be used to show contrasting results of effective and ineffective incident management strategies. This could enable trainees to have a better understanding of their role in incident management by allowing them to see queues and bottlenecks form and dissipate as a result of various actions.

Another possible use is validation of simulation models. A substantial amount of public and private resources has been devoted to developing, improving, and verifying microscopic and macroscopic traffic simulation models. These models range in scope and application: some are designed to analyze a single transportation entity, such as an intersection or a freeway merge area, and others are designed to analyze an entire network of minor and major traffic routes. Thus, as aerial video becomes readily available on a daily basis, a broad range of traffic, training, and planning applications will become plausible.

DISCUSSION AND CONCLUSIONS

This demonstration showed that aerial video can effectively capture and transmit pictures of traffic flow and incidents to designated user stations, thus accelerating decision making. The technique provided adequate coverage for incident management for the targeted area, but the area served is too large to allow general traffic surveillance. For this demonstration, the system was built using components, which created problems because of incompatabilities among them. However, as the use of traffic aerial video becomes a common practice, proven package systems of compatible components should become available.

The use of aerial video by a transportation agency offers distinct benefits for both real-time traffic operations and long-term analysis. The key purpose is effective communication of traffic conditions to the traffic management agency, which can then provide timely and accurate information to motorists. Real-time benefits resulting from this enhanced communication during an incident include effective selection of an alternate route, rapid identification of secondary accidents, and efficient deployment of response resources. Clearly, the aerial video enhanced the capabilities of the Northern Virginia Incident Management Team in Fairfax County.

For traffic surveillance and management purposes, the time period of the demonstration was not sufficient for TMC to integrate the new information into the traffic monitoring process. For the aerial video to enhance TMC's capability, control over the coverage area, time of flight, and communication with the pilot would be required.

In a similar vein, off-line capabilities provide for operational analysis of current and future traffic conditions. The air video reduces the time and personnel needed to acquire data from the field. An example is a visual examination of the effects of emerging bottlenecks on regional traffic patterns. Further, aerial video may facilitate an objective evaluation of a jurisdiction's incident response procedures. By using the video for incident management training seminars and as a tool for demonstrating positive and negative impacts of various actions, a multiagency incident response team might increase its effectiveness. Finally, aerial video may allow a transportation agency to adopt a proactive approach to traffic management by identifying and evaluating potential problems before they occur. Specific problems include the use of residential neighborhoods to bypass congested arterials and heavily used facilities needing snow removal.

RECOMMENDATIONS

1. *Continue to monitor and learn from the use of aerial video for incident management, and develop more effective congestion and incident management strategies through documented experiences.*

2. *Enhance real-time communication between the pilot and the agencies on the ground.* Two specific measures should be implemented: first, place electronic ribbons at the bottom of the monitor screen in order for the TMC and other agencies to know the pilot's location, and second, establish formal channels of communication such that TMC personnel could provide input into where the helicopter should travel. One result might be that TMC officers would direct the pilot to fly over congested areas or other hot spots rather than follow a fixed flight path.

3. *Consider using aerial video for off-line planning, training, and other applications.* A number of potential applications were identified in this study. Future research could be directed toward demonstrating how the aerial video can be used for such purposes.

4. *Establish regular meetings among private and public interests to discuss what is being done and what can be done better.* For example, a meeting among key users of the aerial video would allow them to provide input as to how the helicopter is used, including the flight path and the transmission of information between the helicopter and the ground stations.

5. *Make the aerial video footage available to private traffic information providers.* Benefits may be obtained by cooperating with private traffic information providers. The private sector can be helpful in the task of information dissemination once such information has been verified and made available. Therefore, an effective method of disseminating traffic information would be for VDOT to provide aerial video to the private sector.

6. *Establish one point of contact to represent the public sector.* Currently, private organizations must contact both VDOT and Fairfax County Police; having one source of information and authority could simplify administrative matters for both the public and private sector.

7. *Study the feasibility of alternative agency ownership arrangements and use of aerial video in other areas of the state.* Cost-benefit analyses should be used to determine the benefits of different strategies for implementing the use of aerial video.

8. *Compare the effectiveness of using a helicopter versus a fixed wing aircraft.* Data from the Virginia and Maryland experiences could be used.

9. *Investigate the potential advantages of obtaining a backup video camera.* Expected increases in reliability and multiple coverage benefits should be assessed.

Appendix A

COST AND VENDOR INFORMATION

Project Title: Intelligent Vehicle Highway System
Federal Project Number: IVH-9151(002)
Federal Catalog Number: 20.205
State Project Number: IVH-029-101, C501
Approved Amount: $300,000
Approval Date: February 10, 1992
Expiration Date: September 26, 1991 - January 25, 1993
Reimbersement Vouchers Due:

State Contact: Charles D. Hall
(Traffic Engineering Division)
The Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219
TEL: (804) 786-6777

REQUISITION DOC #	REQUISITION DATE	PURCHASE ORDER DOC #	PURCHASE ORDER DATE	QTY	DESCRIPTION	INDEX	SUB OBJ	EXPENDITURE AMOUNT ($)	ITEM RECEIVED	CHECK #	DATE	VENDOR
BP61512		VA83315	01/22/93		N204FC, RELOCATE FLIR	009019	3828 *	2,486.49	10/10/92	145-908523	10/21/92	AVIONICS TECHNOLOGY CORP
BP61512		VA83315	01/22/93		N204FC, INSTALLATION, TEST	009019	3828 *	4,073.86	10/10/92	145-908523	10/21/92	AVIONICS TECHNOLOGY CORP
BP61512		VA83315	01/22/93		N204FC, INSTALLATION, VCR	009019	3828 *	1,987.47	12/15/92	145-955307	12/23/93	AVIONICS TECHNOLOGY CORP
LP02974	09/04/92	PA96789	09/09/92		ALUMINUM BAR & SHEET, etc...	009019	3250 *	396.78	08/26/92	145-884309	09/16/92	DILLSBURG AEROPLAN
LP90946	10/06/92	PB03493	10/21/92		ALUMINUM SHEET, GROMET, RIVNUT	009019	3250 *	96.11	10/09/92	145-910812	10/22/92	DILLSBURG AEROPLANE WORKS
LP92912	12/18/92	LP92912	12/18/92	2	SONY VOLTAGE CONVERTOR, DCP-80	009019	3250	61.60				LOSS PREVENTION
PR05681	07/31/92	P004668	08/18/92	2	VIDEO DISTRIBUTION AMPLIFIED S/EQ	009019	3594 *	520.00	09/15/92	145-897615	10/05/92	PIERCE PHELPS
PR05681	07/31/92	P004668	08/18/92	2	RACK & POWER SUPPLY, #8500	009019	6549 *	1,140.10	09/15/92	145-897615	10/15/92	PIERCE PHELPS
PR05681	07/31/92	P004668	08/18/92	1	10 x 1 VIDEO SWITCH "THE PERFORMER"	009019	6549 *	1,129.90	10/27/92	145-920393	11/06/92	PIERCE PHELPS
PR05681	07/31/92	P004668	08/18/92	1	COLOR BAR & TEST PATTERNS	009019	6549 *	1,170.00	09/15/92	145-897615	10/15/92	PIERCE PHELPS
PR05677	07/31/92	P004669	08/18/92	11	CARD CAGE & POWER SUPPLY	009019	6549 *	11,968.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	6	5.5 Mhz AUDIO SUB-CARRIER DEMODULATOR	009019	3594 *	2,220.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	5	5.5 Mhz AUDIO SUB-CARRIER MODULATOR	009019	3594 *	2,000.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	6	12 Mhz FM VIDEO DEMODULATOR	009019	6549 *	5,874.00	12/11/92	145-956954	01/04/93	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	5	12 Mhz FM VIDEO MODULATOR	009019	6549 *	4,240.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	8	AGILE INPUT CONVERTER, #3246	009019	6549 *	5,744.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	7	AGILE INPUT CONVERTER, #3146	009019	6549 *	5,481.00	12/14/92	145-951917	12/24/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	1	CABLE, 1000FT	009019	6549 *	1,020.00	09/26/92	145-903792	10/13/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	30	CRIMP STYLE BNC CONNECTORS	009019	3594 *	42.90	11/02/92	145-921860	11/10/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	1	CRIMP TOOL, CT-2460	009019	3594 *	54.00	09/26/92	145-903792	10/13/92	MIDWEST CORP CATV DIV
PR05677	07/31/92	P004669	08/18/92	2	FILTER, 270 Mhz CENTER	009019	6514 *	4,078.00	10/13/92	145-914212	10/28/92	MIDWEST CORP CATV DIV
PR05679	08/11/92	P004670	08/18/92	2	AGILE MODULATOR, 11-02	009019	6549 *	2,500.00	09/29/92	145-918959	11/04/92	I S S ENGINEERING
PR05679	08/11/92	P004670	08/18/92	2	AGILE MODULATOR, 11-02	009019	6549 *	2,500.00	10/22/92	145-918959	11/04/92	I S S ENGINEERING
PR05679	08/11/92	P004670	08/18/92	1	AGILE DEMODULATOR, GL1000A-02	009019	6549 *	921.00	09/29/92	145-918959	11/04/92	I S S ENGINEERING
PR05679	08/11/92	P004670	08/18/92	1	AGILE DEMODULATOR, GL1000A-02	009019	6549 *	921.00	10/22/92	145-918959	11/04/92	I S S ENGINEERING
PR05679	08/11/92	P004670	08/18/92	1	AGILE DEMODULATOR, GL1000A-02	009019	6549 *	0.00				I S S ENGINEERING
PR06251	08/27/92	P005625	09/04/92	1	SONY VIDEO 8 RECORDER/PLAYER	009019	6549 *	631.00	09/26/92	145-907084	10/20/92	A V WASHINGTON
PR06251	08/27/92	P005625	09/04/92	1	AC PACK BATTERY CHARGER	009019	3594 *	115.00	09/26/92	145-907084	10/20/92	A V WASHINGTON
PR06064	08/18/92	P006898	10/16/92	1	MONITOR, VIDEO, COLOR, 13"	009019	3594 *	500.00	11/10/92	145-929680	11/20/92	CTL COMMUNICATIONS CORP
PR06064	08/18/92	P006898	10/16/92	2	MONITOR, VIDEO, COLOR, 13"	009019	3594 *	250.00	01/04/93	145-962533	01/13/93	CTL COMMUNICATIONS CORP
PR06064	08/18/92	P006898	10/16/92	1	RECEIVER/MONITOR, COMB VCR, 20"	009019	3594 *	485.00	11/10/92	145-929680	11/20/92	CTL COMMUNICATIONS CORP
PR06065	08/18/92	P007169	10/06/92	1	MONITOR, VIDEO, 19"	009019	3594 *	358.70	10/27/92	145-920349	11/06/92	LEE HARTMAN & SONS INC
PR07411	10/24/92	P008243	11/11/92	3	PORTABLE TRANSMITTER, 2T2WB	009019	6514	25,650.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	3	OMNI-DIRECTIONAL ANTENNA	009019	6514	5,250.00	01/06/93			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	3	NAVTRACK SYSTEM, #NTK-OMI	009019	6514	34,200.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	CENTRAL ENG RECEIVER, DUAL CONV.	009019	6514	11,250.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	CENTRAL ENG REVEIVE ANTENNA	009019	6514 *	9,900.00	12/16/92	145-976971	01/28/93	MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	TOUCHSTAR SLAVE CONTROLLER	009019	6514	4,455.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	MAIN CONTRAL CABLE ASSEMBLY	009019	6549 *	706.00	12/16/92	145-976971	01/28/93	MICROWAVE RADIO CORP

Project Title: Intelligent Vehicle Highway System
Federal Program Number: IVH-9151(002)
Federal Contract Number: IVH029-101-C501
Federal Catalog Number: 20.205
Approved Amount: $300,000
Approval Date: February 10, 1992
Expiration Date: September 26, 1991 - January 25, 1993
Reimbersement Vouchers Due:

State Contact: Charles D. Hall
(Traffic Engineering Division)
The Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219
TEL: (804) 786-6777

REQUISITION DOC #	REQUISITION DATE	PURCHASE ORDER DOC #	PURCHASE ORDER DATE	QTY	DESCRIPTION	INDEX	SUB OBJ	EXPENDITURE AMOUNT ($)	ITEM RECEIVED	CHECK #	DATE	VENDOR
PR07411	10/24/92	P008243	11/11/92	1	RECEIVE SITE ANTENNA	009019	6514	1,795.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11Y92	1	MISC ACCESSORIES	009019	3250	300.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	SILO RADOME for MICROSCAN II	009019	6514	2,600.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	DUAL CONV PORTABLE RECEIVER	009019	6514	11,250.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	OFFSET FED ANTENNA	009019	6514	2,655.00	12/04/92	145-966500	01/21/93	MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	PAN/TILT PEDESTAL	009019	6514	2,022.00	12/04/92	145-966500	01/21/93	MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	QUIKSET QPT 90 LOCAL CONTROL	009019	6549	783.00	12/04/92	145-966500	01/21/93	MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	3	TECHNICAL SUPPORT, MASSEY	009019	3010	2,550.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	TRAVEL EXPENSES	009019	3010	500.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	VAN INSTALLATION	009019	3010	2,500.00	12/22/92			MICROWAVE RADIO CORP
PR07411	10/24/92	P008243	11/11/92	1	TECHNICAL SUPPORT, HELICOPTER	009019	3010	2,000.00	12/22/92			MICROWAVE RADIO CORP
PR08293	12/18/92	P010685	01/06/93	3	SONY 8MM VCR, MDL EVO-210	009019	6549	1,650.00				LEE HARTMAN & SONS INC
PR08293	12/18/92	P010685	01/06/93	2	SONY REMOTE CONTROLS, MDL RM-94	009019	3250	136.00				LEE HARTMAN & SONS INC
PR07946	11/20/92	P010686	01/06/93	1	AGILE DEMODULATOR, MODEL GL1000A	009019	6549	650.00				WESTCHESTER ASSOCIATES
PR71985	02/18/92	P067625	02/21/92		AIRBORNE VIDEO SYSTEM	009019	6514	110,147.93	07/02/92	145-858013	08/06/92	FLIR SYSTEMS INC

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

YTD: $298,588.84 BALANCE: $1,411.16

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

SUBOBJECT CODE

Services - Professional Consultant	3010	$7,550.00
Suplies - Other Operating	3250	$990.49
Communication Equipment - Operating	3594	$6,545.60
Repair and Maintenance of Operating Equipment	3828	$8,547.82
Assigned Agency Vehicle	4191	$0.00
Capitalized Communications Equipment	6514	$225,252.93
Non-Capitalized Communications Equipment	6549	$49,702.00
	TOTAL:	$298,588.84

For information on the airborne video system contact:

Sandy Gideonse
Operations Support Bureau
Fairfax County Police
Fairfax County Helicopter Division
3911 Woodburne Road
Annandale, Virginia 22003

Phone: 703/246-4489
Fax: 703/246-0648

Appendix B

AERIAL VIDEO USER QUESTIONNAIRE

AERIAL VIDEO QUESTIONNAIRE: INCIDENTS

FAIRFAX COUNTY

DATE: ____________ TIME: ____________ EVENT #: ______

INCIDENT INFORMATION USED BY:

☐ ***TRAFFIC INFORMATION CENTER (TIC)***

☐ ***POLICE*** ☐ ***FIRE/RESCUE***

☐ ***OTHER (SPECIFY)*** ____________

☐ ***TRAFFIC MANAGEMENT SYSTEM***

☐ ***VDOT***

☐ ***VIRGINIA STATE POLICE***

☐ ***OTHER (SPECIFY)*** ______________________

INCIDENT REPORTED: ***FROM THE SCENE BY:***

☐ ***MOTORIST/CITIZEN*** ☐ ***VDOT***

☐ ***POLICE*** ☐ ***OTHER (SPECIFY)*** ___________

☐ ***AERIAL VIDEO***

☐ ***TRAFFIC MANAGEMENT SYSTEM***

ENVIRONMENTAL CONDITIONS:

☐ ***CLEAR*** ☐ ***CLOUDY*** ☐ ***OTHER:*** ____________

ROADWAY GEOMETRICS:

☐ ***INTERSECTION*** ☐ ***RAMP*** ☐ ***OTHER:*** _________

AREA BLOCKED:

☐ ***LANES (# ____)*** ☐ ***SHOULDER*** ☐ ***ROADWAY***

ESTIMATED TIME:

HELICOPTER TO REACH SCENE: _______ ***DURATION OF INCIDENT:*** ______

TASKS OF AERIAL VIDEO:

☐ ***DISPATCH*** ☐ ***POLICE*** ☐ ***FIRE/RESCUE***

☐ ***CLARIFY SCENE*** ☐ ***OTHER:*** ____________

AERIAL VIDEO QUESTIONNAIRE: INCIDENTS

SECTION NAME FILLING IN FORM:

____

ADVANTAGES OF AERIAL VIDEO:

- [ ] *INCIDENT DETECTION QUICKER-ESTIMATED TIME SAVING:* ____________
- [ ] *POLICE FIRE OTHER ON SCENE QUICKER THAN ESTIMATED:*
  TIME SAVING: ______ *EXPLAIN: (USE COMMENT AREA)*
- [ ] *ABILITY TO OBSERVE SCENE. EXPLAIN (USE COMMENT AREA)*
- [ ] *OTHER SPECIAL USES OF VIDEO (USE COMMENT AREA)*

COMMENTS: ______________________________

____

____

____

____

____

____

____

____

____

IMPROVEMENTS TO AERIAL VIDEO

- [ ] *ADDITIONAL INFORMATION NEEDED. EXPLAIN:*

____

____

____

- [ ] *VIDEO QUALITY SHOULD BE IMPROVED. EXPLAIN:*

____

____

____

- [ ] *OTHER PROBLEMS. EXPLAIN:*

____

____

____

____

____

____

____