U.S. Department of Transportation's

IMPLEMENTATION of the NATIONAL INTELLIGENT VEHICLE HIGHWAY SYSTEMS (IVHS) PROGRAM PLAN

Report to Congress

June 1994

THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

June 23, 1994

The Honorable Albert Gore, Jr.
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

In accordance with the requirements of section 6054(c) of the Intermodal Surface Transportation Efficiency Act of 1991, Public Law 102-240, enclosed is the "Department of Transportation's Implementation Report to Congress on the National IVHS Program Plan." It describes the Department's accomplishments to date in advancing the national Intelligent Vehicle Highway Systems (IVHS) program.

We have already made significant progress towards achieving the goals of IVHS to improve the safety of our surface transportation system, reduce congestion, enhance mobility, mitigate environmental problems, save energy, and promote economic growth and productivity. We believe that this dynamic program, with its extraordinary cooperation among the public and private sectors, will be a cornerstone of our 21st century transportation system.

An identical letter has been sent to the Speaker of the House of Representatives.

Sincerely,

Federico Pena

Enclosure

THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

June 23, 1994

The Honorable Thomas S. Foley
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

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REPORT TO CONGRESS

U. S. DEPARTMENT OF TRANSPORTATION'S

IMPLEMENTATION

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NATIONAL

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PROGRAM PLAN

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I. FOREWORD

This report is being forwarded to Congress pursuant to Section 6054(c) of the *Intermodal Surface Transportation Efficiency Act* of *2991* (ISTEA). To obtain the Department of Transportation's (DOT) assessment of implementation progress to date, that section of ISTEA requested the Secretary to:

> *(a) analyze the possible and actual accomplishments of Intelligent Vehicle Highway Systems (IVHS) projects in achieving congestion, safety, environmental, and energy conservation goals and objectives of the program; (b) specify cost-sharing arrangements made, including the scope and nature of Federal investment, in any research, development, or implementation project under the program: (c) assess nontechnical problems and constraints identified as a result of each such implementation project; and (d) include, if appropriate, recommendations of the Secretary for legislation or modifications to the IVHS Strategic Plan.*

The *IVHS Strategic Plan,* transmitted to Congress in December 1992, presented the goals and objectives of the national IVHS program and described the program delivery process. This report builds on the Strategic Plan and describes the achievements of DOT in the IVHS arena, including early activities predating official establishment of the IVHS program in 1991. Future implementation reports to Congress will describe DOT's progress in implementation of the National IVHS Program Plan.

The Strategic Plan also called for the formulation of a tactical program plan to assure coordination and integration of IVHS activities in the public and private sectors. The DOT is presently formulating such a tactical plan, called the National IVHS Program Plan. This is a dynamic document being developed and implemented in a cooperative effort by DOT, with advice from IVHS AMERICA and interested members of the public. A first draft of the Plan has been completed describing the research, development, and testing activities needed to achieve deployment of a full range of inter-related IVHS user services that will make highway and public transportation more efficient, safe, and environmentally sound. Activities to ensure national compatibility of IVHS systems, including development of an open nationwide IVHS architecture, are important elements of the Plan. The Plan has undergone a broad review throughout the IVHS community, a second draft has been developed, and it is also being widely reviewed.

II. EXECUTIVE SUMMARY

America's economic future depends on the Nation's capacity to invent and master new technologies. It depends upon moving ideas to the marketplace to spur growth, create new jobs, and strengthen our industrial performance. Vice President Gore has identified broad initiatives that together will restore America's technological leadership and reinvigorate our economy. The Vice President's technology initiative emphasizes that investing in infrastructure means more than building and repairing bridges, harbors, and highways. Today the United States faces a new series of communications, transportation, and environmental needs for the 21st century.

The Department of Transportation's (DOT) Intelligent Vehicle Highway Systems (IVHS) program is a key component in this national technology initiative. IVHS will harness emerging communications. computer, and surveillance technologies to address our most challenging surface transportation problems. Early indications are that IVHS applications can improve traffic flow in congested urban corridors, provide safer and more secure travel, reduce the harmful environmental impacts of traffic congestion, and help American travelers and businesses achieve new levels of productivity.

DOT has acted swiftly to adopt the changes that will encourage development of IVHS and foster its widespread deployment. Policy direction for IVHS comes directly from the the Office of the Secretary and the highest levels of the Department's modal administrations. IVHS program management has been streamlined to coordinate the efforts of the Federal Highway Administration, the Federal Transit Administration, and the National Highway Traffic Safety Administration. The experience and skills of the private sector, national laboratories, the academic community, and the public at large are aggressively sought to steer the program towards the vision of a thriving American IVHS industry.

The development of IVHS is advanced by an ambitious array of planning efforts; research and development projects; operational tests: institutional, policy, and legal studies; early deployment planning, and the development of a national architecture and standards. Examples of projects that demonstrate accomplishments in reaching program goals through the development of IVHS user services are outlined below. These are only a few examples from the nearly 150 activities that are currently underway to advance the national IVHS program.

Short and Long Range Tactical Planning

The first draft of the National IVHS Program Plan has been developed in a cooperative effort by DOT, with advice from IVHS AMERICA and input from interested members of the public. Development of this far-reaching Plan represents a major accomplishment in fostering public/private cooperation and promoting a consensus view on how IVHS will be advanced in the United States.

The National IVHS Program Plan is focused on the development and deployment of a collection of interrelated transportation user services. These user services are defined, not

along lines of common technologies, but upon the services or benefits that users might receive. The Program Plan defines the specific research, development, testing, and other activities necessary to achieve and support deployment of these IVHS user services in a nationally compatible, intermodal system. The Plan also addresses investment tradeoffs and activities necessary to foster the best possible legal and institutional environment for the deployment of IVHS.

The National Program Plan is a dynamic document that will reflect evolving changes in Government policy, technology, market conditions, and program successes and failures. Thus, ongoing program assessment is a major element of the IVHS program planning process and will serve as a feedback mechanism for evaluating the performance of the program in achieving key IVHS goals and objectives.

Encouraging Development of Critical Technologies

Developing and commercializing new technologies is critical to regaining U.S. industrial leadership. Though competitiveness ultimately rests with the private sector, Government has a role in encouraging precompetitive technology development and making the most of technological advances to support important public safety, mobility, and environmental goals.

In 1993, DOT managed almost 100 IVHS research and development (R&D) projects to develop the basic tools and knowledge bases needed to guide future activities.

- "Detection Technology for IVHS" evaluated the performance of existing commercially available electronic surveillance systems for use with IVHS applications.

- "Crash Avoidance and the Older Driver" analyzed the traffic crash experience of older drivers, assessing their capabilities and limitations as drivers, and identifying and evaluating advanced vehicle design features that will ensure their driving safety while accommodating their mobility needs.

- "Human Factors Considerations for In-Vehicle Crash Avoidance Warning Systems" has developed preliminary guidelines for crash warning devices that are general enough to permit the use of various display technologies.

Partnering with the Public and Private Sectors to Test IVHS Systems

IVHS operational tests bridge the gap between R&D and full scale deployment of IVHS systems by evaluating advanced technologies and systems in a real world environment. Operational tests are conducted as cooperative arrangements between the public and private sectors, with the participants sharing in the technical, administrative, and financial responsibilities. The 43 operational tests in which DOT is participating demonstrate the effectiveness and commitment to public and private cooperation that is critical to the IVHS program.

• The TravTek project was a partnership between DOT, General Motors, the American Automobile Association (AAA), the City of Orlando. and the State of Florida. Among other results, TravTek demonstrated that in-vehicle navigation and route guidance systems reduced driver's travel times without compromising safety.

- The HELP/Crescent commercial vehicle project--a partnership of states, industry, and DOT--integrated and tested technologies that are helpmg to reduce the regulatory burden on motor carriers and provided significant time and economic savings by allowing properly equipped trucks to be "electronically cleared" past weigh stations.

• The Denver Smart Bus project, a partnership between the Federal Transit Administration (FTA) and the Denver Regional Transportation District, is demonstrating the use of Global Positioning System (GPS) technologies to improve the management of the transit fleet and to ensure on-time service and quick response to incidents.

- Four locations with serious air quality problems were designated as "priority corridors" by DOT in March 1993 using specific criteria contained in Section 6056(b) of ISTEA. Operational tests will be conducted at these sites, which will become national test beds for IVHS and will often be where the public is first introduced to IVHS products and services.

• After passage of ISTEA, basic procedures for implementation of operational tests were developed, ensuring the opportunity for participation by all interested parties through a program of open solicitations.

Establishing an Intelligent Infrastructure

The creation of a modem, efficient 21st century transportation infrastructure will bring major advances in safety, mobility and environmental quality. while stimulating new national and international markets. To achieve these goals, IVHS products and services must be successfully developed and marketed by the private sector. DOT is pursuing activities to inform the public about the benefits of IVHS. and to assess user acceptance, perceived value and willingness to pay for IVHS products and services.

The success of IVHS will also depend in large measure upon investment decisions of state and local governments. The IVHS Early Deployment Program provides assistance to local agencies in the development of multiyear strategic plans for the deployment of IVHS user services. DOT's goal is to offer this assistance to the 75 largest U.S. metropolitan areas and 30 major intercity corridors by the end of 1997. So far, 35 IVHS early deployment planning studies are underway or already completed, and 11 areas have been conditionally approved for funding in fiscal year (FY) 1994.

While some IVHS systems will require considerable development and testing before they are readily available, others are already being deployed and showing results.

- Prior to the January 1994 earthquake. the IVHS system operating in the Smart Corridor in Los Angeles was producing significant savings in travel times, signal delays. and vehicle

stops, leading to reductions in fuel consumption and vehicle emissions. Following the earthquake, the system components on the arterial streets facilitated the diversion of traffic from the badly damaged Santa Monica freeway.

- The INFORM project on Long Island is operational and has demonstrated that drivers will divert to less congested routes if presented with reliable and credible information, creating significant travel time savings for local commuters.

Ensuring National Compatibility of IVHS Systems

National compatibility will permit a full range of diverse but interchangeable IVHS systems to flourish nationwide, while preserving the capability for future expansion, innovation, and modernization. This will increase the appeal of IVHS services and products to the consumer and help nurture a U.S. IVHS industry.

- In September 1993, four contractor teams began parallel efforts to define an initial open nationwide IVHS system architecture. Alternatives developed by these teams will be evaluated against technical, nontechnical, and cost criteria. A broad consensus-building effort will ensure that the views of those who will be developing or ultimately purchasing and using IVHS systems will be reflected in the national architecture development process.

- Development of IVHS standards and protocols will allow components to be interchangeable and help ensure that systems are reliable, available, and maintainable. DOT is supporting early establishment of standards and protocols in electronic map data bases and automatic vehicle identification.

Leveraging the Federal Investment in Technology

By tapping the expertise of the national Waboratoties and encouraging significant cost sharing by both the public and private sector participants, the IVHS program achieves maximum leverage of Federal investments. The total contribution from DOT's public and private sector partners in the IVHS program already exceeds $150 million.

- In the Advantage I-75 operational test of commercial vehicle technologies, it is estimated that 68 percent of the total project cost will come from the participating states and motor carriers.

- In the TravTek project, an estimated 75 percent of the total project cost for operationally testing and evaluating the in-vehicle navigation and route guidance system came from the non-Federal partners.

Fostering Institutional Cooperation

Legal processes and institutional arrangements founded in the era of interstate highway construction must stretch and adapt in a new era of technological change. Specialized training. innovative contracting procedures, and new forums for communication will develop

to support heightened cooperation of the public and private sectors to test and deploy new technologies. Coordinating traffic and traveler information across jurisdictional boundaries will require new skills and procedures to reconcile varying legal and operational practices.

- In 1992, DOT established a Legal and Institutional Issues Program to advance dialogue, research, and innovative projects that will overcome nontechnical hurdles to IVHS deployment.

- The Volpe National Transportation Systems Center has completed a lessons learned report on institutional issues encountered in major operational tests across the country.

- The development of an initial, qualitative study on the potential emission impacts of IVHS has been completed, a first step in ensuring deployment of IVHS has a beneficial, or at least neutral,, impact on the environment.

Many of these nontechnical and institutional issues are being examined and will be addressed in detail in a forthcoming report to Congress on Nontechnical Constraints to Implementation of Intelligent Vehicle Highway Systems.

Looking to the Future

Although still young, the IVHS program has made significant progress in achieving the goals set forth by Congress and the program's public and private sector participants. The continued advancement of the IVHS program, guided by the National Program Plan, will result in technical, economic, safety, institutional, and environmental improvements that will reduce or eliminate the surface transportation problems that impact our safety, economy, environment, and quality of life.

III. ACTUAL AND ANTICIPATED ACCOMPLISHMENTS

Managing the National IVHS Program

PROVIDING OVERSIGHT & ACCOUNTABILITY

An important set of early accomplishments by DOT has been the establishment of the management approach, organizational structures. and relationships among the diverse public and private entities that are necessary to successfully discharge and implement the IVHS program.

For example, with the involvement of DOT, IVHS AMERICA was created in 1990 to represent the many public and private sector organizations and individuals that are working with the Department to advance the national IVHS program. Established by the Highway Users Federation for Safety and Mobility, the American Association of State Highway and Transportation Officials, and Mobility 2000, IVHS AMERICA is a nonprofit scientific and educational society that represents a broad based coalition of over 500 public and private sector members. IVHS AMERICA is chartered as a utilized FederaI advisory committee to DOT to help plan, promote, and coordinate the development and deployment of IVHS in the United States.

Within the Department, DOT has established a Joint IVHS Program Office to coordinate intermodal policy in the implementation of the IVHS program. This new office, located within the Federal Highway Administration (FHWA), serves as the Department's Executive Agent for overall management and oversight of the IVHS program, including the IVHS activities of FHWA, FTA, the National Highway Traffic Safety Administration (NHTSA). and the Research and Special Programs Administration (RSPA). Policy direction comes directly from the Secretary and the highest levels of the Department's modal administrations.

PLANNING THE NATIONAL PROGRAM

The National IVHS Program Plan, the tactical complement to the *IVHS* Strategic Plan, is being developed cooperatively by DOT, with advice from IVHS AMERICA and the involvement of interested members of the general public and public interest groups. The Plan is guided by the goals and objectives established for the national program, and seeks a consensus view of how highway and public transportation operational problems will be addressed through the development and deployment of IVHS user services. The cooperative development and ongoing management of the Program Plan, by DOT and its partners, represents a major accomplishment in fostering the extraordinary cooperation required by the national IVHS program.

The Program Plan identifies the research, development, testing, and other activities necessary to achieve and support deployment of a range of IVHS user services within the framework of a nationally compatible, intermodal

system. The Plan includes schedules. inter-project dependencies. specific milestones, and key decision points for each user service to ensure their systematic development. The Plan also addresses investment tradeoffs and cross-cutting studies such as institutional and legal issues and the development of an open, national IVHS systems architecture.

The first draft of the Program Plan was completed in October 1993, and underwent an extensive review throughout the IVHS community. The second draft of the Plan is now undergoing a similar broad review, and the First Edition of the National IVHS Program Plan is scheduled to be completed in the fall of 1994.

ASSESSING PROGRESS

The National Program Planning Process recognizes that changes in Government policy, technology, market conditions, and program successes and failures should be reflected in future program activities. Thus, ongoing program assessment is a major element of the Program Plan, and will serve as a feedback mechanism for evaluating the performance of the national program relative to achieving key IVHS goals and objectives. The assessment process will identify needed changes in the Plan, and provide a common reference for the public and private sectors to contribute to and utilize assessment data as they develop and deploy IVHS products and services. Results from the program assessment will also assist State and local agencies in their decision-making as they begin to deploy IVHS user services. The assessment process will also provide data to assist in preparing future Implementation Reports to Congress.

Many of the projects described in the following sections are in the first stages of their evaluation. Thus the list of accomplishments is expected to grow as evaluations are completed. This section highlights accomplishments in user service developments in the following areas: research and development activities, operational tests, national compatibility pIanning, and early deployment support

Developing and Testing IVHS User Services

FOCUSING ON THE USER

The National IVHS program is focused on a collection of interrelated transportation services, with the user as the focal point. This approach begins with an assessment of user needs and proceeds through the required research, development, and testing activities needed to reach deployment of the service. Twenty-seven user services were identified in the initial draft of the Plan, and more are being considered. User services fall within the broad categories of travel and traffic management, public transportation management, commercial vehicle operations, emergency management, electronic payment, and advanced vehicle safety systems. Deployment of these user services will help to attain the goals defined in the *IVHS Strategic Plan* by creating a future of safer and

better informed travelers. improved traffic control systems. and more efficient transit and commercial vehicle operations.

Research and Development

DOT's IVHS research and development (R&D) program, sponsored by FHWA, FTA, and NHTSA. is presently focused on developing and assessing alternative system concepts for providing user services.

PROVIDING INNOVATIVE AND EFFECTIVE R&D

The R&D portion of the IVHS program is being carried out primarily through the Federal contracts and procurement process, and through innovative procedures such as cooperative agreements and contracts with public/private partnerships, often with a 20-percent cost sharing contribution. The national laboratories are also participating where appropriate.

Early IVHS research and development projects were designed to obtain fundamental information, learn more about a particular technology or system concept, or develop needed tools which will be used to guide future efforts. Results of projects completed to date provide advancements in the technical, economic, safety, institutional, legal, and environmental areas.

Almost 100 IVHS R&D projects are underway. Highlights of R&D accomplishments to date include:

ENHANCING MOBILITY

- Traffic management user services are being advanced by contracts such as "Detection Technologies for IVHS" and "Real Time Traffic Adaptive Signal Control Systems," that are investigating deployment issues of traffic surveillance systems and developing and evaluating network-wide traffic signal control systems. Research in these areas will result in operational tests scheduled for 1997.

- "Analysis of Complex Corridor Locations" assessed relative costs, benefits and effectiveness of potential alternative solutions for improving traffic flow in congested freeway locations.

- Improved traveler information services will result from tests and evaluations of potential communication alternatives for the transfer of IVHS information among traffic management centers, transit dispatch centers, the roadside, and individual vehicles. For example, the Subcarrier Traffic Information Channel (STIC) prototype was developed and successfully demonstrated the use of the subcanier of the commercial FM broadcast band to transmit digital traffic information.

- Research and testing of various advanced transit fare technologies is underway in southern California. Some of these systems use "contactless" cards, which read and write to an electronic fare card without physically

touching it. Also being examined are multiuse card systems. where several operators are linked through a common fare medium.

- A joint study by FHWA and FTA is identifying. analyzing and evaluating candidate real-time multimodal strategies and scenarios to implement IVHS user services.

IMPROVING SAFETY

- A study called "Commercial Vehicle Information System" is examming the the feasibility of using advanced IVHS technologies and systems to link a motor carrier's safety fitness with its commercial vehicle registration.

- The "Carrier Safety Fitness System" will provide national truck and bus safety information to 100 roadside safety inspection sites, as well as to other governmental and private users. This safety information will be one of many tools for enforcement personnel to use in screening and targeting carriers. vehicles, and drivers for inspection.

- To foster the development and early deployment of collision avoidance systems, DOT is establishing performance requirements for such systems. This early development of performance specifications will lessen the risk of negative side effects and help ensure that safety enhancement goals are achieved

- Vehicle-based and/or cooperative collision avoidance systems must be available to, and purchased by, the motoring public to achieve the safety goals of the IVHS program. To accelerate development of these products, DOT has entered into cooperative agreements with industry to support these initiatives.

- The "user-friendliness" of a system, e.g., the match between the characteristics of the system and the capabilities and limitations of the drivers who must use them, will determine the ultimate effectiveness and acceptance of IVHS systems. Significant progress has been made in numerous projects to ensure that basic human factors/human performance data are available to guide product designers.

INCREASING EFFICIENCY

- ISTEA stipulates that DOT will develop an Automated Highway System (AHS) with the goal of demonstration on a test track by 1997. The AHS is a major initiative to achieve the long term goal of instrumented vehicles and highways that will provide fully automated, "hands-off, " operation at better levels of performance, in terms of safety, efficiency. and comfort. The program for development of an AHS has been structured into three phases of activity: analysis, demonstration, and operational test and evaluation.

Phase I of the AHS program is the analysis stage, examining requirements. issues, and risks in the areas of AHS applications, technology, design, deployment, operation, and practicality. This set of analyses are collectively

referred to as "Precursor Systems Analyses." Fifteen contracts of one-year duration each were awarded in late FY 1993 through an FHWA Broad Agency Announcement. In addition, in September 1992. a contract was awarded by FHWA to a team led by Honeywell. Inc., to conduct initial AHS human factors studies. This effort is expected to be completed in 1994 and will result in a Human Factors Handbook for AHS designers to support AHS system development.

A Request for Applications to form a cooperative partnership with a consortia for phase II, the AHS demonstration, was issued in December 1993 and applications were received in March 1994. This phase will extend through the AHS program's first major milestone, the 1997 demonstration requested by Congress. Assuming successful demonstration of concept feasibility in phase II, the test and evaluation phase will begin in 1997.

Operational Tests

Operational tests bridge the gap between R&D and full scale deployment of IVHS services and products. These tests are used to evaluate advanced systems in real world situations to ensure public benefits, determine whether the expected benefits can be achieved at the expected cost, and to heighten awareness and educate the public about the potential of IVHS. Operational tests are conducted as cooperative arrangements between the public and private sectors, with the participants sharing the technical, administrative, and financial responsibilities of the project.

ESTABLISHING PARTNERSHIPS TO OPERATIONALLY TEST IVHS USER SERVICES

Prior to the passage of ISTEA, several highly visible operational tests were initiated as partnerships with the public and private sectors. These included PathFinder in California, TravTek in Florida, and ADVANCE in Illinois, which are testing user services that provide improved traveler information, navigation, and route guidance. The HELP/Crescent and Advantage I-75 tests were also initiated to test IVHS user services related to commercial vehicle operations. The SmartTraveler project in Boston was undertaken to assess market acceptance and travelers' willingness to pay for roadway and other travel information.

With passage of ISTEA, a conceptual approach and the basic procedures for further implementing the operational test program were developed. A key consideration was to ensure the opportunity for participation by all interested parties. To foster this wide participation, a program of open solicitations through Federal Register announcements has been implemented.

Solicitations for IVHS operational test proposals were published in July 1992 and September 1993. The solicitations explained the partnership nature of the program, identified specific user service areas in which DOT was interested, and provided the criteria to be used in evaluating the proposals. Project

agreements were negotiated with the partners of the selected projects to reach mutually agreeable terms on funding levels and contribution sources. detailed partnership responsibilities. and the development of a sound evaluation work plan to ensure that each project is evaluated in an unbiased and nationally consistent manner.

Through the solicitation process, 16 projects were identified in FY 1993. To date, DOT is participating as a partner in 43 operational test projects.

The following operational tests highlight accomplishments in the development of the IVHS user services defined in the National Program Plan:

ENHANCING MOBILITY

- The TravTek project in Orlando. Florida, was the first major exposure of the general public to in-vehicle navigation and route guidance, and one of the two operational tests completed as planned for these user services. TravTek was the result of a successful public/private/academic partnership between General Motors, the Florida Department of Transportation, the City of Orlando, the American Automobile Association (AAA), and FHWA.

As part of the TravTek project, sophisticated in-vehicle computers, along with Global Positioning System (GPS) satellite receivers, monitored the location of 100 TravTek cars rented through AVIS, providing the drivers with navigation and dynamic route guidance information based on real-time traffic conditions in the area. The preliminary results revealed that those who used TravTek planned their trips 80 percent faster than those who did not use TravTek, and those with TravTek reached their destinations 20 percent faster than those without. TravTek also achieved significant progress by demonstrating that IVHS routing instructions can be presented to drivers in their vehicles without compromising safety.

- The Pathfinder Project was conducted in the Smart Corridor in Los Angeles. Like TravTek, Pathfinder is a completed project that evaluated different strategies for providing route guidance and in-vehicle navigation to drivers. Pathfinder demonstrated that real-time information on traffic conditions could be successfully transmitted to vehicles and presented to drivers through in-vehicle devices. The Pathfinder project also demonstrated that equipped vehicles could act as roving "traffic probes," and send travel time information back to a traffic information center. In addition, nearly 80 percent of drivers reported that their trips were faster with Pathfinder and 70 percent rated the map and voice instructions easy to use.

IMPROVING COMMERCIAL PRODUCTIVITY

- The HELP/Crescent Project, a public/private partnership with the motor carrier industry, is testing the use of advanced technologies to improve the efficiency of commercial vehicle operations. HELP/Crescent is using automatic vehicle identification, automatic vehicle location and weigh-in-motion technology along I-5 from British Columbia to California and then

eastward along I-IO into Texas. These technologies contribute to allowing states to electronically clear safe trucks with legal weights and credentials so that they can drive through the entire corridor with minimal stopping at weigh stations or ports-of-entry. Electronic clearance should result in significant time savings and economic benefit to the trucking industry, and increased effectiveness and efficiency of state enforcement.

- The ADVANTAGE I-75 Project is a partnership of public and private sector interests along the I-75 corridor from Ontario, Canada, to Florida that is also operationally testing electronic clearance of motor carriers. The project is facilitating safe motor carrier operations by allowing transponder-equipped and properly documented trucks to travel any segment along the entire length of I-75 at freeway speeds with minimal stopping at weigh or inspection stations. Advantage I-75 uses off-the-shelf technology and decentralized information, with each state retaining its constitutional and statutory authority relative to motor carriers and their operations.

REDUCING ENERGY & ENVIRONMENTAL IMPACTS

- The Bellevue. Washington Smart Traveler is a partnership with FTA and state, local and academic entities to use mobile communications, such as cellular phones, to make ride sharing more attractive. The project is also installing and testing traveler information kiosks in downtown office buildings. Early results of the evaluation show that 42 percent of single occupancy drivers reported increased flexibility to carpool as a result of the ride sharing program, and van and car poolers felt safer and less stressed with access to real-time traffic information.

- The Denver Smart Bus Project is installing a Fleet Management and Control System as part of an upgraded communications capability. Using vehicle location inputs from a GPS system, the Denver Smart Bus Project identifies off-schedule buses and automatically determines an optimal strategy to get them back on schedule. The system is installed on all 788 Denver Regional Transportation District buses, and on 28 supervisory vehicles. The project also uses the information to inform passengers of schedule adherence and delays so they can better plan their travel.

- In the Smart Corridor, a portion of the Santa Monica Freeway in Los Angeles, data from control systems on both freeways and arterial streets are combined to produce useful, integrated information for travelers in the corridor. Prior to the January 1994 earthquake, the advanced traffic management system installed in the Smart Corridor reduced travel times by 18 percent, traffic signal delays by 44 percent, vehicle stops by 41 percent, emissions by 14 percent, and fuel consumption by 13 percent. Following the earthquake, the system facilitated the rerouting of traffic from the damaged Santa Monica freeway on to the arterial street system.

PROVIDING RELIABLE INFORMATION

● The INFORM Project in Long Island, New York, demonstrated that drivers will divert to less congested routes if presented with reliable and credible information on traffic congestion. In this project, changeable message signs present traffic flow and alternate routing information to drivers. The project demonstrated that 5 to 10 percent of the freeway traffic can be diverted to appropriate off-ramps. Because of the incident-related messages displayed on the signs, there is an estimated annual savings of 300,000 vehicle hours of travel in the corridor. The ramp metering system implemented with INFORM also resulted in a 3- to g-percent increase in freeway speeds for the morning peak period.

FOSTERING COOPERATION

● The Transportation Operations Coordinating Committee (TRANSCOM) Congestion Management Program, involves a consortium of 15 transportation and public safety agencies in New York, New Jersey, and Connecticut that is successfully demonstrating the value of cooperative traffic management efforts using IVHS in a large metropolitan area. The project is designed to test incident detection tools such as the use of electronic toll tags to gather traffic flow information and the coordinated applications of variable message signing, advisory radio, and closed-circuit television monitoring of traffic conditions across multiple jurisdictions to improve interagency response to traffic incidents.

Priority Corridors

In addition to individual operational tests like those described above, four locations were designated as "priority corridors" by DOT in March 1993 using specific criteria contained in Section 6056(b) of ISTEA. These corridors are: the Northeast corridor centered along I-95 and stretching through six states from Maryland to Connecticut; a Midwest Corridor centered around the Chicago metropolitan area and stretching from Gary, Indiana, to Milwaukee. Wisconsin; the Houston, Texas, metropolitan area: and a southern California Corridor centered around I-5/1-10 from Los Angeles to San Diego. These sites will become national test beds for IVHS and, in many ways, will be where the public is first introduced to IVHS services and technologies.

ESTABLISHING AN IVHS **INFRASTRUCTURE**

Over the long term, funds spent at each corridor site, along with funds that this money leverages. will result in the establishment of an IVHS infrastructure that will support continuing deployment of IVHS user services.

The jurisdictions in the priority corridors have joined together and are producing business plans for each Corridor that define the intermodal IVHS efforts planned to address a set of identified needs. Operational test projects will be negotiated each year with the Corridors, based on the plans of the region as well as the national interest in advancing the IVHS program. In this way, the Priority Corridors will help to support the comprehensive IVHS operational test program as these areas move towards deployment of integrated IVHS applications.

Ensuring National Compatibility

CREATING A U.S. IVHS INDUSTRY

National compatibility will provide for interchangeable products and a full range of IVHS user services nationwide. while preserving the capability for future expansion and modernization. Planning and achieving an integrated. compatible national IVHS includes the development of an open, nationwide IVHS system architecture and the evolution and promulgation of IVHS standards that bring together user service needs. These efforts will enhance the market for IVHS products. and reduce the risk for product developers, thus helping to nurture an IVHS product and service industry in the United States.

Accomplishments in planning for national compatibility are described below.

System Architecture

GUIDING THE IMPLEMENTATION 0F AN INTEGRATED IVHS ACROSS THE U.S.

DOT is overseeing and guiding the development of a nationwide IVHS system architecture that will provide a framework for deployment of a nationally compatible system and stimulate development of products to reduce the problems associated with surface transportation. The IVHS architecture will describe how IVHS subsystems interact and communicate with each other, what information is shared among subsystems? and how the provision of user services are integrated. The system architecture will accommodate the needs of the public and private sectors as well as state and local transportation agencies, while supporting congestion relief, improved public safety, environmental improvements, more effective intermodal transportation, and the provision of a cost effective mix of services.

The development process for a nationwide IVHS architecture is underway and represents a major accomplishment in ensuring that a nationally compatible set of IVHS user services will emerge. Development of the architecture will be conducted in two phases. In Phase I. four architecture contractor teams are conducting parallel efforts to define an initial, open nationwide IVHS architecture. The four teams are lead by Rockwell International Corporation, Westinghouse Electric Corporation, Hughes Aircraft Company. and Loral/IBM. Alternatives developed by these teams will be evaluated against a set of criteria that reflect technical. nontechnical, and cost considerations. This phase began on September 15, 1993, and is scheduled for completion in December 1994.

As part of the broad based architecture development effort, FHWA has also contracted with Johns Hopkins University's Applied Physics Laboratory to define a national commercial vehicle system design. In addition, FTA has commissioned the Sandia National Laboratory in Albuquerque, New Mexico, to define the information flows between the central dispatcher, transit vehicles,

computers and other electronic components, and the users. Both efforts will feed directly into the national system architecture development process.

At the conclusion of the Phase I review and evaluation, DOT will select the contractor teams with the most promising concepts to proceed to Phase II. Phase II will conduct the detailed analyses and system modeling required for a comprehensive evaluation of the architectures emerging from Phase I.

ENSURING CONSENSUS

In parallel with the architecture development contracts, DOT and IVHS AMERICA are working together to involve all organizations and individuals potentially affected by, **or** having an effect on, the establishment of the IVHS architecture. This group, collectively known as "stakeholders," consists of product developers (e.g., private industry). system implementors (e.g., state and local authorities), users (e.g., consumers), policy advocates (e.g., public interest groups), and standard setting organizations (e.g., Society of Automotive Engineers (SAE), Institute of Electrical and Electronic Engineers (IEEE)), among others.

The consensus process will involve an extensive outreach effort to educate and inform the stakeholders on the system architecture efforts continuously throughout the development cycle. In addition, the process will allow stakeholder feedback to DOT which will influence the development process and ensure that the best architecture emerges.

The system architecture development program will conclude in 1996 and will result in a single open architecture as the National Architecture for IVHS. This architecture will be selected by DOT based on the contract efforts and the recommendations that emerge from a consensus of IVHS stakeholders.

Standards and Protocols

FACILITATING AND STIMULATING PRODUCT DEVELOPMENT

The results produced by the development of the National Architecture over the next three years will guide the development of many needed safety, communication, vehicle, and infrastructure standards. Appropriate standards enhance the marketplace for both producers and consumers. Standards will allow system components to be interchangeable, and eliminate unnecessary product development costs caused by changes in the way products interconnect. Standards will also help to foster nationwide deployment., increasing the utility of IVHS systems to the user.

DOT is supporting the work of the IVHS AMERICA Standards and Protocols Committee, which is collaborating with established standards-making bodies through the IVHS AMERICA Center for Standards and Protocol. The Center

serves as a liaison with the standard-setting organizations to ensure that adopted standards reflect the needs of the IVHS community.

CREATING OPPORTUNITIES FOR EARLY MARKETS

Initial activity has been focused on developing U.S. standards. There are multiple independent standards-setting and industry organizations (e.g., the American National Standards Institute (ANSI) and SAE) that represent a wide range of disciplines currently involved in initial IVHS standards activities. Activity is also underway to coordinate the development of standards internationally through the International Standards Organization (ISO).

Early efforts in the establishment of standards and protocols include activity in the areas of electronic map data bases and automatic vehicle identification (AVI). Both of these areas are being supported by DOT-funded studies. For example, DOT is funding work at the Lawrence Livermore National Laboratory and the National Institute of Standards and Technology (MST) to support the development of an AVI standard that will facilitate the nonstop movement of commercial vehicles across the country.

Early accomplishments in the area of standards include:

- FTA sponsored the development of a standard called Vehicle Area Network. The standard defines recommended practices and an open architecture for interfacing of interchangeable transit vehicle components, and is expected to minimize costs while providing for expansions as technology advances. The standard is expected to be officially adopted by SBE in FY 1994, but is already being used by transit agencies in communication system procurements.

- A preliminary draft for an International Traveler Information Interchange Standard (ITIIS) has been prepared by the SAE ITIIS Working Group.

- Several national and international workshops and conferences on IVHS standards and protocols have been held.

- Discussions are underway and by mid-1994. DOT and MST will establish cooperative R&D agreements or memorandums of understanding to address issues involved in IVHS Software Safety.

Supporting Early IVHS Deployment

FOSTERING DEPLOYMENT OF IVHS USER SERVICES

Systematic planning for early deployment of IVHS systems and services is the first step in establishing a favorable environment to foster and encourage deployment of IVHS. DOT has initiated specific planning efforts and support activities to foster, encourage, and coordinate public and private sector involvement in early IVHS deployment. To ensure successful deployment of IVHS, efforts are also underway to assess the public's understanding and acceptance of IVHS services. These activities and accomplishments to date are described below.

Metropolitan Area and Corridor Planning Studies

The IVHS Early Deployment Program implements the planning grants section of ISTEA [section 6055(b)] by aiding local agencies in the development of multiyear strategic plans for the deployment of IVHS user services in both the short and long term.

PLANNING FOR EARLY IVHS DEPLOYMENT

Deployment planning projects have been funded since the passage of ISTEA to conduct studies which will help metropolitan areas and intercity corridors plan for the deployment of IVHS user services. To date, FHWA has awarded 35 IVHS early deployment planning grants and has conditionally approved 11 areas for such grants in FY 1994. Like other elements of the IVHS program, participants are required to contribute at least 20 percent of the cost of the planning study. Throughout the life of ISTEA, FHWA intends to offer this assistance to the 75 largest U.S. metropolitan areas and 30 of the major intercity corridors linking metropolitan areas.

Several early deployment planning projects are nearing completion. The areas participating in these studies have reported the following early accomplishments:

- The various jurisdictions and agencies responsible for transportation services within these communities are reporting increased cooperation and communication. This is an essential first step toward the successful deployment of integrated IVHS user services.

- Local agencies have adopted new incident management techniques to improve the operation and safety of existing facilities, and have established traffic operations centers as the focal point for transportation information.

- Local officials have acquired an increased level of understanding of the potential for IVHS to impact transportation services within their community.

Results from specific projects include:

SETTING THE STAGE WITH ADVANCED TRAFFIC MANAGEMENT SYSTEMS

- Integrated System Project, Anaheim, California. This project is operational and features an integrated, inter-jurisdictional traffic management approach for special events occurring in the city and in Orange County. Technologies such as computerized traffic signal systems, highway advisory radio, closed circuit television, and changeable message signs are used to monitor and coordinate traffic. This system is integrated electronically with the California Department of Transportation's traffic operation center, and is investigating methods for linking electronically with the Orange County Transit Dispatch Center.

- Incident Management, Minneaoolis-St. Paul, Minnesota. Two efforts are included in this project. The Metro Area Highway Advisory Radio is providing information to motorists so that they can assess current driving conditions and take alternative routes when major incidents occur. Broadcasts are being aired over a Minneapolis public radio station, KBEM-88.5 FM. A Heavy Truck Incident Management effort has developed strategies to reduce and respond to heavy **truck** incidents.

Assessing Public Understanding and Acceptance

While many IVHS user services will be developed and marketed by the private sector, the successful deployment of these services will also require participation from Federal, state and local governments to ensure that the services meet the needs of the users, and have their support.

UNDERSTANDING USER NEEDS

DOT is pursuing research into user needs, requirements, and uncertainties with regard to specific user services. Issues being addressed include user acceptance, perceived value, and willingness to pay for a particular IVHS user service.

Numerous public education and outreach activities are also underway to explain the benefits and potential uses of IVHS services. Many of these activities are being conducted with other groups, such as IVHS AMERICA. To date. these activities have included "road shows," conferences, seminars, workshops, and published material.

In 1994. the Public Education and Outreach Program will focus on developing a consumer and news media climate conducive to the development and

deployment of IVHS user services in the United States. Specific planned activities include:

- conducting 10 regional meetings for state and local government officials and others across the country;

- producing a new, 15-minute videotape to make IVHS issues and benefits understandable and accessible to general and interdisciplinary audiences;

REACHING OUT TO THE PUBLIC

- producing a series of columns regarding IVHS for publication in community newspapers; and

- conducting an extensive media relations campaign in the United States.

DOT is also planning to hold public forums to facilitate the direct participation of the public in the development of the National IVHS Program Plan. As part of a Federal Register notice requesting public comment on the Plan, DOT requested suggestions on the most effective method for conducting these public forums. Also requested were suggestions on additional outreach activities which could improve the content and comprehensiveness of the National Program Plan, thus enhancing its usefulness and chances for success.

IV. LEVERAGING THE FEDERAL INVESTMENT

Through the IVHS program, contributions to the Nation's industrial performance, economic growth, and international competitiveness are being maximized by leveraging the Federal investment. Federal funds are being leveraged through significant cost-sharing by various partners. making public and private partnerships a key feature of the IVHS program.

This section highlights accomplishments in public/private partnerships, innovative cost-sharing arrangements. and the conversion of defense technologies to IVHS applications. The section also discusses the funding issues associated with the long term deployment of IVHS user services.

Public/Private Partnerships

The principal private sector responsibility in IVHS. as stated in the *IVHS Strategic Plan,* is to develop the technology and market the products that will bring IVHS to reality. There are a multitude of opportunities for America's businesses, both small and large, to participate as partners in today's IVHS program, for example, as members of R&D consortia and as operational test partners" In fact, many players are already involved, including major defense and aerospace firms, the national labs, communications and electronics companies, and the automotive industry. All are sharing in the cost of these projects, helping to maximize the Federal investment in the program.

ENCOURAGING INNOVATIVE FINANCING

While ISTEA requires at least a 20-percent match, larger contributions are encouraged, with the goal that Federal IVHS funds not exceed 50 percent of the total project cost. Contributions from states, local agencies and the private sector can make up the remaining cost of the project. In addition to direct cash contributions, equipment contributions, in-kind labor, and the value of regular Federal-aid projects directly associated with the IVHS project are allowed. To date, the contribution to the Federal IVHS program from these partnerships arrangements exceeds $150 million.

This significant commitment of resources represents a major accomplishment in leveraging the Federal investment in the IVHS program. The table on the next page more specifically illustrates the contributions of DOT's public and private sector partners. The table shows the amount of Federal IVHS funding, versus estimated funding from other sources, for 20 ongoing or recently completed IVHS operational test projects.

Examples of Federal IVHS Funding and Estimated Non-IVHS Funding in the Operational Test Program

IVHS OPERATIONAL TEST PROJECT	FEDERAL IVHS FUNDING	NON-IVHS FUNDING	TOTAL FUNDING	PERCENT NON-IVHS FUNDING
ADVANCE (Chicago, Illinois)	$ 35,375,000	$ 16,647,000	$ 52,022,000	32%
Advantage I-75 (multi-state)	3,500,000	7,458,000	10,958,000	68%
Boston SmartTraveler	1,515,000	1,535,000	3,050,000	50%
California Smart Traveler	355,000	1,000,000	1.355,000	74%
Connecticut Freeway Advanced Traffic Management System	600,000	775,000	1.375,000	56%
CTA Smart Bus (Chicago, Illinois)	490,000	3,150,000	3,640,000	87%
Detroit Transportation Center Transit Information	50,000	50,000	100,000	50%
DIRECT (Michigan)	2,500,000	2,500,000	5,000,000	50%
Fast-Trac (Michigan)	40,500,000	11,500,000	52,000,000	22%
Guidestar (Minnesota)	11,000,000	2,750,000	13,750,000	20%
HELP/Crescent (multi-state)	5,850,000	15.150,000	21,000,000	72%
Houston Smart Traveler	2,500,000	2,500,000	5,000,000	50%
PASS (Oregon)	350,000	222,000	572,000	39%
Pathfinder (California)	1,000,000	1,500,000	2,500,000	60%
Roadway Powered Electric Vehicle (Phase II) (California)	1,500,000	6,150,000	7,650,000	80%
Satellite Communications Feasibility (Philadelphia)	2,200,000	2,200,000	4,400,000	50%
SMART Corridor (California)	1,100,000	45,900,000	47,000,000	98%
TRANSCOM (NY/NJ/CT)	11,400,000	2,975,000	14,375,000	21%
Travel-Aid (Washington State)	1,828,525	3,157,766	4,986,291	63%
TravTek (Florida)	3,000,000	9,000,000	12,000,000	75%
TOTAL	$126,613,525	$136,119,766	$262,733,291	52%

FOSTERING A NEW WAY OF DOING BUSINESS

Fostering the long-term commitment and participation of the private sector, however, represents a new way of doing business for everyone involved. The number of businesses already participating in the IVHS program represents a major accomplishment in establishing a new institutional structure that facilitates the cooperation between the public and private sectors that most IVHS user services require.

Below are examples of large and small business organizations that are actively involved in the IVHS program:

- Hughes Electronics Corporation has developed extensive capabilities in video imaging systems for vehicle detection, satellite communications, and AVI devices.

● American Telegraph and Telephone (AT&T) has initiated work in several areas, including "smart card" technology for electronic toll and traffic management (ETTM) applications.

- Navigation Technologies and ETAK are two California-based firms which have focused on electronic mapping needs for route analysis and display.

- IBM has initiated work on several aspects of IVHS. and is cooperating with J.B. Hunt, a large commercial trucking firm based in Arkansas, in developing an "on-board computer" product for use by trucking management and drivers for all aspects of company activities.

EARLY LEADERS IN THE IVHS MARKETPLACE

- Westinghouse has been active in development of automated vehicle location (AVL) systems, particularly for the transit industry.

- A number of private sector firms. for example, Mark IV IVHS Corporation, AMTECH Corporation and ATIComm, have developed vehicle identification technologies and are designing and selling ETTM systems.

- Motorola is developing the in-vehicle navigation and route guidance device for the ADVANCE project in the Chicago area. This system handles all aspects of the driver interface, map and route display, and communications between the vehicle and the traffic information center.

● Similarly, General Motors (GM) contributed substantial resources to the development of the in-vehicle device for the TravTek project in Orlando. In addition, GM recently announced that it will begin offering an on-board navigation device as a factory option in its Oldsmobile Eighty-Eight LSS model this spring. The device uses GPS satellites and dead reckoning

techniques to determine the vehicle's location. An on-board computer then calculates the most convenient route to a destination requested by the driver.

- The American Automobile Association is a major partner in the TravTek project. In addition, they will be testing the marketability of kiosks. These are video monitors which will provide information and routing recommendations to travelers in hotel lobbies and other public places.

• ECONOLITE, a relatively small firm specializing in roadside traffic control hardware/software devices, is marketing a video image detection system for vehicle surveillance which was developed at the University of Minnesota.

• Based on a competitive solicitation, three IVHS Research Centers of Excellence were established at the University of Michigan, Texas A&M University, and Virginia Polytechnic University. The Centers are modeled after DOT's successful University Transportation Centers Program, and are assessing IVHS technology needs, performing basic and applied research, and where feasible, serving as partners in IVHS operational tests. The Centers are also expected to leverage Federal funds by building partnerships with the private sector, non-DOT Government agencies, and/or other academic institutions.

Defense Technology Conversion

DRAWING ON DOMESTIC SOURCES OF TECHNOLOGY

The United States is the world leader in many technologies applicable to IVHS, and numerous efforts are currently underway to assess the feasibility of converting existing aerospace and defense technologies to IVHS. For example, DOT and the Department of Energy (DOE) entered mto a Memorandum of Understanding on August 6, 1993, that will promote the use of the defense technology expertise of DOE's national laboratories in DOT's IVHS program.

Discussions have also taken place between DOT and various elements of the Department of Defense (DOD) and the Advanced Research Projects Agency (ARPA) to convert applicable defense technologies to IVHS. Potentially applicable technologies include: high-definition imaging and displays, advanced sensors (e.g., infrared, microwave, acoustic), radar/lidar technologies, simulation modeling, telecommunications, advanced software (e.g., systems control, image processing, and data infusion), artificial intelligence technologtes, and vehicle robotics and location systems.

The GPS system. with its network of satellites, IS already a component of many IVHS systems. DOT has been identified to work closely with DOD to

facilitate the proper implementation of GPS for civilian use, and to ensure the long-term availability of GPS as a U.S. national asset that would be available to civilian users worldwtde.

The defense industry already recognizes the potential of the IVHS program, and some 50 defense organizations are members of IVHS AMERICA, including ARPA, the U.S. Tank and Automotive Command (TACOM), Martin Marietta, and Hughes Aircraft, In addition, over 20 defense community contractors are participating in the AI-IS Precursor Systems Analyses studies and ten defense contractors are involved in the development of the national IVHS system architecture. Continued utilization of the resources represented by the defense and aerospace industry will be instrumental in advancing the national IVHS program and bringing IVHS systems to deployment.

Funding IVHS Deployment

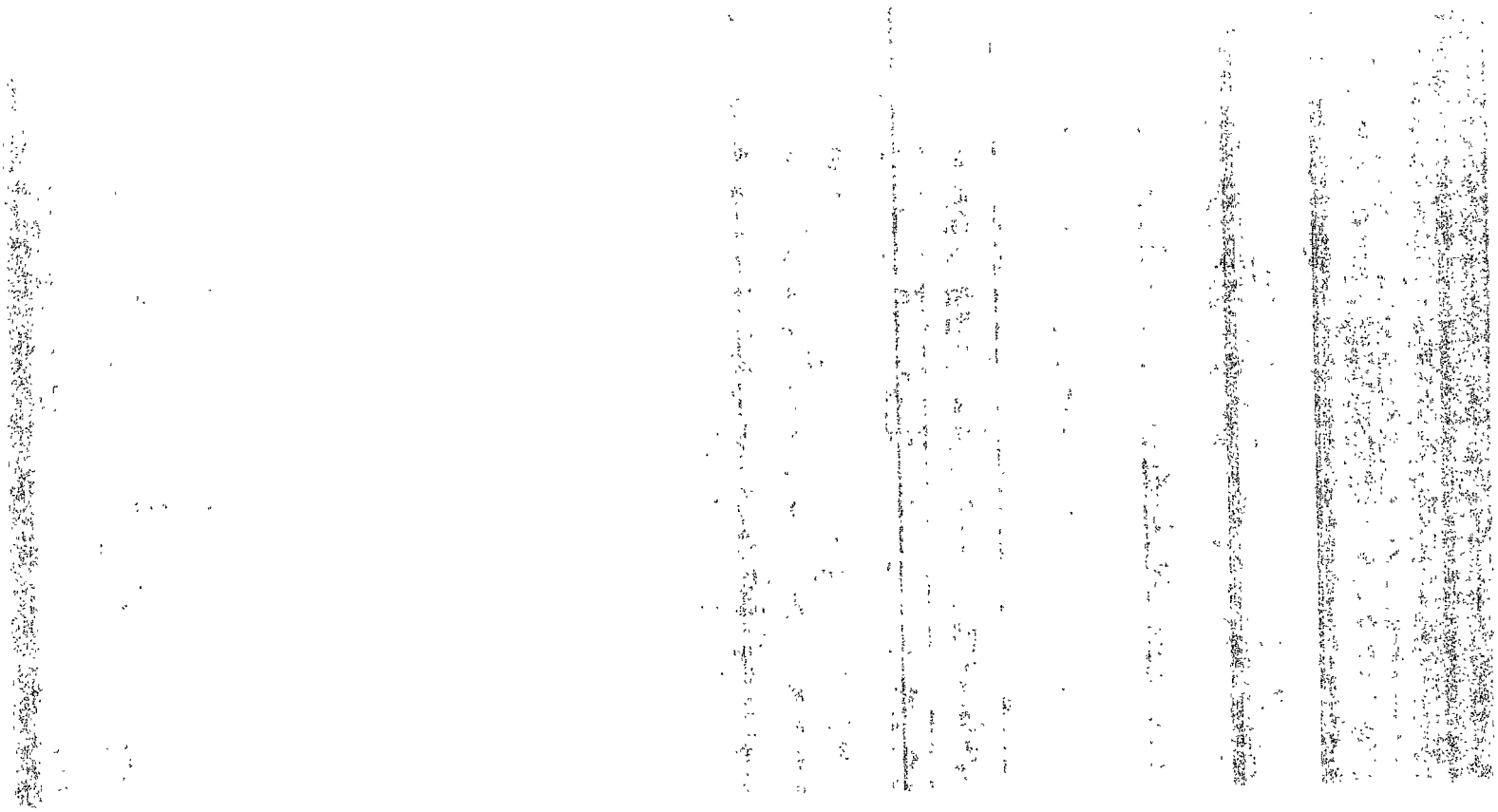
Long term deployment of IVHS will require a large investment of money from both Federal and non-Federal sources. Federal IVHS funds have been devoted to the development and operational testing of specific user services and technologies, but are not currently available for the general deployment of IVHS infrastructure. Infrastructure deployment is currently progressing with funding through Federal-Aid programs such as the National Highway System. the Surface Transportation Program and, in some cases, the Congestion Mitigation and Air Quality Program.

RE-EVALUATING TRADITIONAL FUNDING PROCEDURES

As user services mature, DOT will begin to establish eligibility requirements for the use of Federal-aid funding if there is a public sector role in deployment. Although the specifics will vary from one user service to another, performance, interoperability, and/or other standards or guidelines will need to be developed to establish these eligibility requirements. In many cases, the Federal requirements will likely be based upon IVHS standards developed by recognized standards-making bodies, such as SAE. Some of this standard setting activity, however, cannot be finalized until the national IVHS architecture has been established.

DOT is also pursuing innovative financing and partnership activities through the IVHS funding provided by ISTEA. For example, entities other than states can participate in a project and can both receive funds and contribute their own funds to the effort. These entities include local governments, universities, the private sector, and many others. Traditional Federal-aid procedures will need to be reevaluated to ensure that flexibility is available to allow these innovative approaches to proceed unimpeded. Several efforts are underway, by both DOT and IVHS AMERICA, to examine innovative procurement and financing methods in the context of the national IVHS program.

It IS clear, though, that IVHS will not reach full deployment using only Federal-aid funds. Substantial investments will also be required by state and local governments, automobile manufacturers, other private industries, and the general public. Fortunately, many IVHS user services lend themselves to a pay-for-use deployment, fostering an equitable distribution of costs. Early deployment of IVHS services must be carefully monitored to assess user acceptance and willingness to pay, and to identify other barriers to deployment and develop solutions for removing or lowering these barriers.



V. NONTECHNICAL PROBLEMS AND CONSTRAINTS

Since the beginning of the IVHS program and the establishment of DOT's Legal and Institutional Issues Program, significant progress has been made in the identification of nontechnical challenges which will most directly affect the success of eventual IVHS deployment.

CHALLENGES TO DEPLOYMENT

Early barriers to IVHS deployment have been identified using several approaches, including case studies of IVHS operational tests. Drawing on comments from the public and private sectors on the Nontechnical Constraints report to Congress, first stage project evaluations, and independent studies of IVHS legal and institutional issues. the issues most frequently encountered to date are:

- barriers to private sector participation in the development and deployment of IVHS products and services:

- institutional impediments to metropolitan traffic management coordination;

- intellectual property rights in the procurement of IVHS products and services;

- the role of design and performance standards in the IVHS program;

- staffing and education needs;

- liability and privacy issues;

- environmental issues;

- the need to increase awareness and understanding of IVHS user services, including user acceptance and willingness to pay, and public outreach and education: and

0 understanding the availability and sources of funding for IVHS deployment.

Many of these anticipated and actual issues have been examined and will be addressed in the upcoming report to Congress on Nontechnical Constraints to the Implementation and Use of Intelligent Vehicle-Highway Systems.

Examples of accomplishments in identifying and addressing nontechnical issues mclude:

- A series of workshops are under way to assist organizations in addressing the challenging issues associated with innovative public/private partnerships. "Public/Private Partnerships: Managing the Legal Issues," was the first in the series, held m January 1993 in Dallas, Texas. The proceedings from this workshop have been widely distributed through out the IVHS community.

- A second workshop, "IVHS and Intellectual Property," was held m January 1994 in Washington, D.C This workshop addressed private sector concerns about the retention of intellectual property rights when contracting or entering into partnership arrangements with the public sector.

- The development of an initial, qualitative study on the potential emission impacts of IVHS has been completed. This report is a first step in ensuring that deployment of IVHS user services has either a positive or neutral impact on the environment.

- "Commercial Vehicle Operations (CVO) Institutional Issues Studies" are identifying non-technical barriers in current State motor carrier regulatory functions that may hinder the deployment of IVHS/CVO technologies nationally.

- "IVHS/CVO Detroit and St. Clair Rivers International Border Crossing Study" has proven quite effective in opening up international communications and identifying technical and institutional changes that would enhance the efficiency of border operations.

- Looking ahead to the implementation of the North American Free Trade Agreement, FHWA has awarded a grant to the International Association of Chiefs of Police (IACP) to study the effectiveness of motor carrier safety and size-and-weight enforcement in the states on the United States-Mexican border As part of this effort, the IACP will explore how to best use the latest IVHS commercial vehicle technologies for international electronic clearance and to facilitate enforcement.

VI. RECOMMENDATIONS FOR LEGISLATION OR MODIFICATION TO THE STRATEGIC PLAN

The Secretary of Transportation has no recommendations for legislation or modification to the *IVHS Strategic Plan* at this time.

VII. CONCLUSION

Each project supported and managed by DOT and identified in this report was designed to advance the development and deployment of one or more of the IVHS user services described in the first draft of National Program Plan.

Although still very young, the IVHS program, through early accomplishments focused on acquiring fundamental information and developing needed tools to guide other or future efforts, has demonstrated significant progress toward making our highways and public transportation more efficient, safer, and more environmentally sound.

The accomplishments highlighted throughout this report exemplify DOT's commitment to encourage and coordinate the development of IVHS user services and to ensure nationwide compatibility. These accomplishments demonstrate how DOT has stimulated private sector and state and local government efforts through investments in research and development, operational tests, addressing nontechnical barriers, and supporting early deployment planning.

The continued advancement of the IVHS program, guided by the National Program Plan, will result in technical, economic, safety, institutional, and environmental accomplishments that will reduce or eliminate highway and public transportation operational problems that impact our safety, economy, and quality of life.

US GOVERNMENT PRINTING OFFICE 1994 — 615385 18145

Publication No. FHWA-SA-94-082
HTV-10/10-94(10M)QE