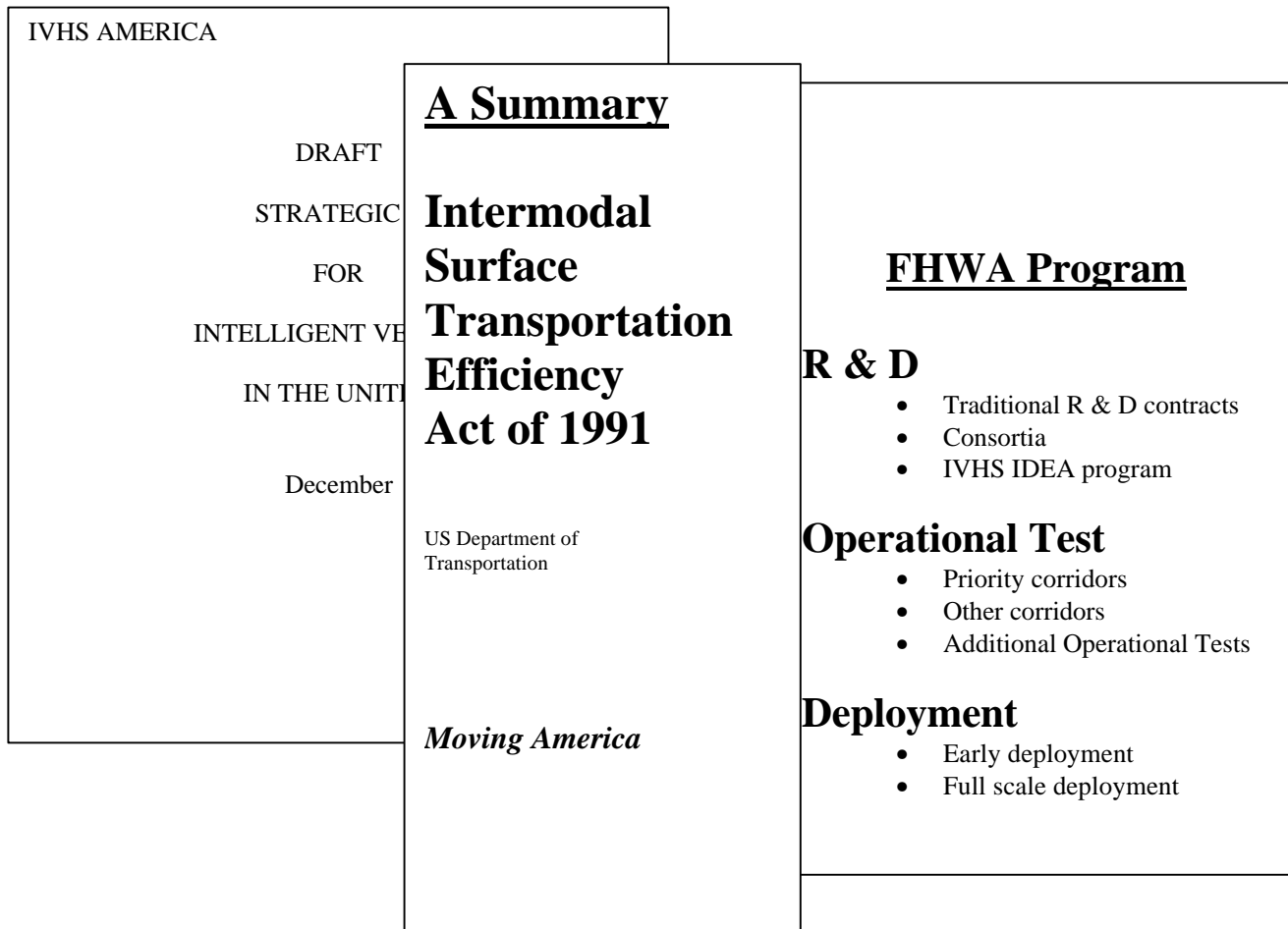


An Overview of IVHS Program Implementation Plans in FHWA



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Federal Highway Administration
Office of Traffic Operations and
Intelligent Vehicle Highway Systems

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Introduction

This pamphlet discusses program implementation plans in the Federal Highway Administration (FHWA) for Intelligent Vehicle Highway Systems (IVHS) provisions in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. It addresses:

- The National IVHS Program
- The Corridors Program
- Additional Operational Tests
- Technical Assistance, Planning, and Early Deployment
- Research and Development
- The Automated Highway System
- Other Provisions
- Funding

Background

The U.S. Department of Transportation (DOT), through FHWA, the National Highway Traffic Safety Administration (NHTSA), the Federal Transit Administration (FTA), and the Research and Special Projects Administration (RSPA), is managing a National

IVHS Program. The aim of IVHS is to apply advanced concepts and technology in the areas of communications, navigation, and information systems to improve highway safety, provide solutions to traffic congestion problems, and to reduce the harm that automobile traffic does to the environment. This involves a substantial commitment to a program that will span 20 years or more. The IVHS program will be developed through the participation of government, industry, and academic institutions and international automotive and electronics standards-setting organizations, acting independently and in concert.

DOT has major technical responsibilities for the underlying research, concept development, technology demonstration, testing and evaluation, and support of deployment for IVHS. These elements are coordinated in the National IVHS Strategic Plan being cooperatively developed by DOT and the Intelligent Vehicle Highway Systems Society of America (IVHS AMERICA). DOT is also sponsoring and conducting basic research, field operational tests, systems engineering, and standardization efforts to support the successful implementation of IVHS.

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, signed into law by President Bush in December, 1991, provides the framework for the delivery of IVHS. FHWA continues as the lead modal administration within DOT for IVHS.

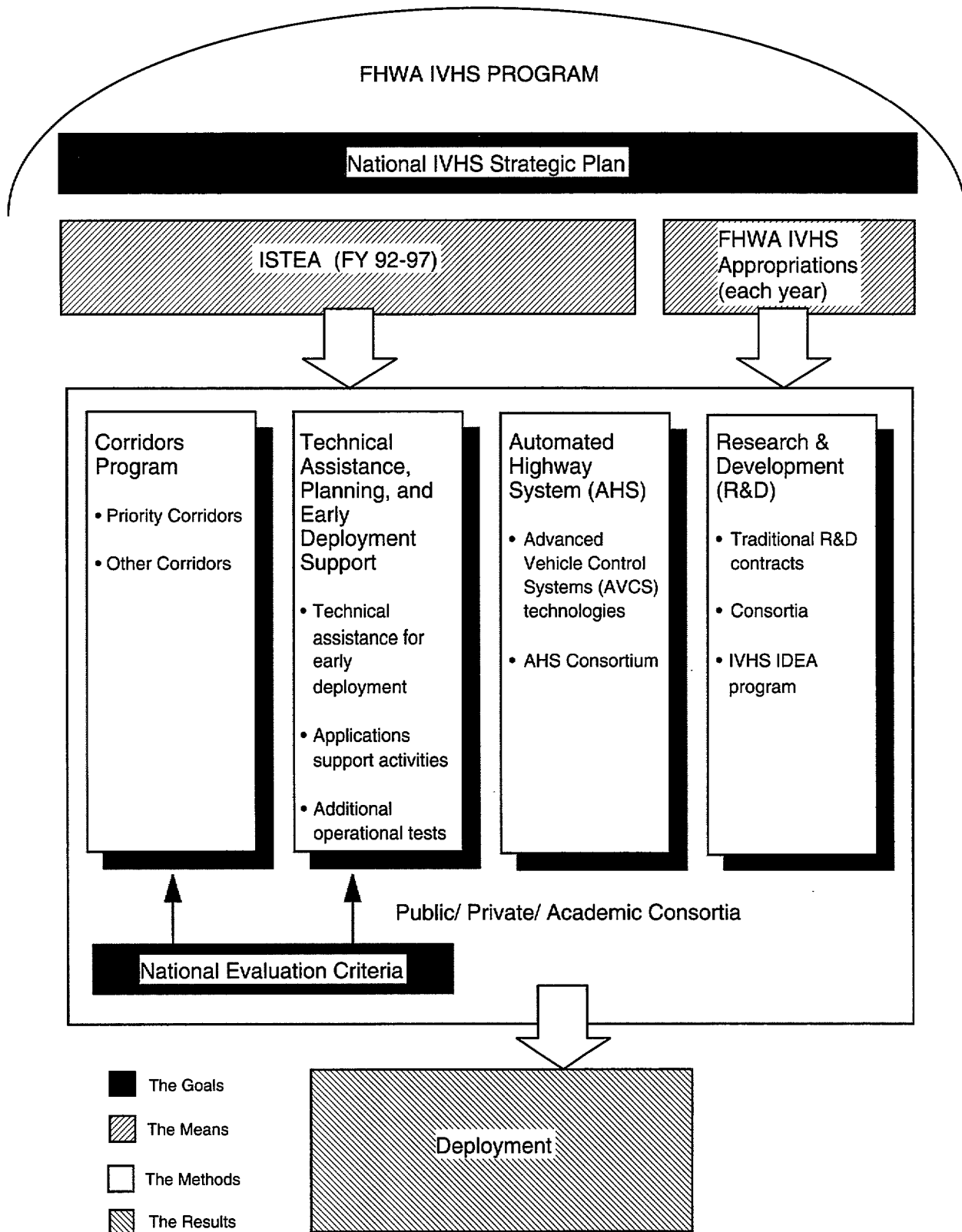
National IVHS Program

The primary goal of a national IVHS program is a balanced transportation system that includes:

- A system of travel-support technology that operates consistently and efficiently across the United States to promote the safe, expeditious, and economic movement of people and goods
- An efficient public transportation system that interacts smoothly with improved highway operations
- A vigorous U.S. IVHS industry supplying both domestic and international needs

IVHS AMERICA

The major participants in the IVHS program include the U.S. DOT, state and local transportation agencies, universities, and private industry. IVHS AMERICA, with membership from all of these areas, serves as the focal point for IVHS activities. As a Utilized Federal Advisory Committee, IVHS AMERICA provides advice to DOT agencies on IVHS matters through its Technical Committees, Coordinating Council, and Executive Committee. IVHS AMERICA provides a national public/private forum for communication, consensus building, national program coordination, and related national and international activities.



The National IVHS Strategic Plan outlines the goals, objectives, methods, and means necessary for implementation of IVHS technologies in the United States. IVHS AMERICA will also support DOT with on-going input and advice concerning program priorities on an annual basis.

Program Management and Support

FHWA has developed a Management Plan to define the functions, organization, and management processes by which it will advance its part of the national IVHS program. To meet this plan, FHWA will be supported by IVHS AMERICA and a number of other organizations to provide on-going program and systems engineering support services.

Public/Private Partnerships

By its very nature, IVHS forces a marriage of public (the highway) and private (the vehicle) sector interests. While providing many benefits to the traveling public, it will also serve to stimulate U.S. industry and provide business opportunities. The public/private partnerships that will be formed will be new and different to all involved. Adversarial relationships between the public and private sectors must be replaced by a spirit of cooperation.

Some current examples of successful public/private partnerships include those working on the TravTek and ADVANCE operational test projects. The TravTek partnership consists of the city of Orlando, Florida, Florida DOT, PI-IWA, General Motors (GM), and the American Automobile Association (AAA). The partnership working on the ADVANCE project consists of Illinois DOT, Motorola, Inc., the Illinois Universities Transportation Research Consortium (Northwestern University and the University of Illinois at Chicago), and PI-IWA.

IVHS Act of 1991 Overview

The Intelligent Vehicle Highway Systems Act of 1991, as an element of the ISTEA, is tied to a coherent program of initiatives in highway construction, highway safety, regulation of motor carriers, and other research projects. Additionally, support for the concept of multimodalism in the ISTEA encourages a system view of IVHS, to help ensure that the advantages of individual transportation modalities combine and contribute to an overall transportation solution. The IVHS Act

establishes an IVHS program with approximately \$660 million authorized over a 6-year period.

- An IVHS Corridors program is established to provide for operational tests under “real world” conditions. Corridors will serve as showcases and testbeds for implementation of IVHS technologies.
- Other provisions relating to IVHS include authority to use advisory committees, such as IVHS AMERICA, for carrying out the IVHS program and the availability of planning grants to State and local governments for studying the feasibility for development and deployment of IVHS.
- The Act also requires demonstration of a completely automated highway and vehicle system which will serve as the prototype for future fully automated IVHS systems. The DOT goal is to demonstrate an automated roadway or test track in operation by the end of 1997. A consortium currently being formed to address the problem of developing this prototype will most likely include a variety of public and private members with an interest in automated highways.
- A strategic plan must be submitted to Congress no later than 1 year after this act became effective on December 18, 1991. The plan must include the goals, milestones, and objectives of the IVHS program.
- The Act requires the development of compatible standards and protocols to promote widespread use of IVHS technologies, the establishment of evaluation guidelines for IVHS operational tests, and the establishment of an information clearinghouse.

Deployment

The ultimate goal of the IVHS program is full deployment of proven IVHS technologies throughout the United States. Deployment of IVHS also represents the area of greatest business opportunity.

The funds provided through the IVHS program will be used only for IVHS research and development, operational testing (which may include very limited deployment), and program support activities. The installation and maintenance of fully deployed systems will need to be supported from different sources, including other federal and state funding.

Corridors Program

The primary funding category established by the ISTEA is the “Corridors Program.” The ISTEA specifies that DOT is to designate corridors that would especially benefit from IVHS. The systems which are built within these corridors will be both showcases and testbeds for advanced technology in transportation, providing benefits to the traveling public, commercial carriers, and operating agencies as well. These corridors will provide long-term sites for multiple operational tests. As showcases and testbeds, it is envisioned that these sites will be visited by officials from other areas interested in deploying IVHS technologies. Many travelers will first be exposed to the benefits of the advanced technology being developed through these corridors. This public education and marketing potential will be an important aspect of corridor development.

The ISTEA states that at least 50 percent of the funds for the Corridors Program must be spent on 3 to 10 priority urban corridors. The remaining funds may be spent on “other” corridors and areas.

Priority Corridors

The ISTEA includes very specific criteria to be used in the designation of priority corridors. This criteria include:

- Traffic density at 1.5 times national average
- Severe or extreme ozone non-attainment
- Variety of transportation facilities
- No/limited expansion of system feasible
- Mix of passenger, transit, Commercial Vehicle Operations (CVO)
- Complexity of traffic patterns
- Contribute to *National IVHS Strategic Plan*

The priority corridors will be predominantly intercity and intraurban corridors. Considered in the final designation of the priority corridors will be discussions and correspondence with DOT field offices, visits to potential sites, and Congressional priorities.

Preliminary priority corridors have been identified, including major Northeast, Midwest, and West intercity corridors, and five intraurban corridors. Meetings with state and local agencies representing these potential corridors have been held to discuss the goals of the priority corridors program. Proposals will be prepared which fully define how these projects will be implemented. The current IVHS operational test projects in these areas will likely be incorporated in the program.

Other Corridors

In addition to the priority corridors component, Congress established a second category of projects which will be funded for other corridors and areas. These other corridors may be in either urban or rural environments. “Other” corridors in urban areas will possess many of the same characteristics as the priority urban corridors. “Other” corridors will also contribute to advancement of the national IVHS program by addressing goals such as improving safety, improving operational efficiency, reducing regulatory burden, improving commercial productivity, and enhancing performance of travelers.

Several current IVHS operational test projects will be candidates for the “other” corridors portion of the Corridors Program. After these current operational tests are transitioned into the “other” corridors portion, there will be a limited amount of funds available to add new sites to the program. FHWA will solicit these through a Federal Register notice.

Candidate Priority Corridors

Intercity Corridors

1. Northeast Corridor
Formation of a coalition among 10 States (VA to MA along I-95) is being discussed. A contiguous segment of this area (portions of MD to CT) meets priority corridor criteria, including severe ozone.
2. Midwest Corridor
Chicago to Gary
3. West Corridor
Regional Los Angeles to San Diego

Intraurban Corridors

1. Anaheim
2. Chicago ADVANCE Project
3. Houston
4. Los Angeles Smart Corridors
5. Milwaukee
6. Northern New Jersey/New York/Connecticut
7. San Diego

Additional Operational Tests

Beyond the operational test projects identified in the Corridors Program, additional operational test projects will also be supported. The purpose of these tests is to evaluate unique technologies and institutional/financial arrangements that hold the promise of enhancing safety, reducing congestion, and improving mobility on the Nation's highways. These projects will be much narrower in scope than the corridors projects. Typically, an additional operational test will focus on one specific user service and may be conducted over a relatively short period of time (e.g., two years). Such a test may be conducted within the framework of an existing

corridor but will probably require a separate environment in order to isolate the effects of the system being tested.

Funding restrictions may severely limit the number of new additional operational tests each year. Interest in participating in these tests will be solicited through Federal Register notice. Specific technical areas will be identified as priority areas for funding support and interested parties will be invited to prepare and submit proposals. These proposals will be evaluated using the published National Selection Criteria.

Technical Assistance, Planning, and Early Deployment Support

Technical assistance and planning support is another part of the IVHS program that is identified in the ISTEA. The focus of technical assistance and planning support is on implementation and deployment studies. The implementation and deployment stages of the IVI-IS program will be crucial in ensuring that the technology and technology products will integrate successfully into our transportation systems. The two major program

areas that encompass technical assistance and planning support are technical assistance for early deployment and applications support activities.

Technical Assistance for Early Deployment

This effort will support planning and preliminary engineering projects aimed at implementation of state-

of-the-art traffic control and management systems in a number of metropolitan areas. The goal is to prepare a large number of areas for deployment of current IVHS technologies and evolving technologies as they are developed and proven. These studies should aid in the development of traffic management control centers, guide in establishing and implementing these systems, and plan for the necessary infrastructure for these systems.

The projects should focus on deployment of area-wide systems in major metropolitan areas and on intercity urban/rural corridors. The projects will generally consist of planning, feasibility, and preliminary engineering activities. An overall systems-level analysis of existing freeway and arterial operations within the metropolitan area or intercity corridor should be part of these efforts. Review of physical capacity, travel patterns and characteristics, existing control techniques, and institutional relationships will define the physical and jurisdictional structure which would receive IVHS technologies. Knowledge of developing advances in IVHS is necessary to help define the functions and technologies which should be considered for deployment in the study area. Items to be included as a long-range view of IVHS in the study area would include:

- An operational concept
- Institutional arrangements
- A preliminary estimate of funding needs and sources, including continuing operational and maintenance demands

Pilot studies funded in FY91 were initiated in Denver, Colorado, and in Portland, Oregon to study the issues necessary for IVHS deployment in those areas. For FY 92, early deployment studies will be designated in coordination-with FHWA Regional Administrators and

the FTA, and will include approximately 10 to 12 additional metropolitan areas. Potential future studies for early deployment in FY 93-97 will be announced in an annual *Federal Register* solicitation. It is intended that the 75 largest metropolitan areas will be supported under this portion of the ISTEA.

These funds for long-range, comprehensive planning and design will help to provide orderly, efficient deployment of emerging IVHS technologies. This seed money should not be used to prepare concepts and proposals for IVHS operational test funding consideration. In addition to the 75 areawide projects, IVHS technical assistance funds will be available to begin the process of linking these major cities together, via Interstate highway intercity corridors. IVHS technology can improve the operations, efficiency, and safety of motorists travelling between major metropolitan areas. Funds are available to conduct intercity corridor studies to determine the appropriate level of Advanced Traffic Management Systems (ATIS)/Advanced Traveler Information Systems (ATIS) technology. It is intended that five Interstate intercity corridors be supported during each of the six years of the ISTEA.

Applications Support Activities

The purpose of Applications Support Activities is to support activities which accelerate the sharing of IVHS technologies (i.e., technology transfer). This support will focus on upgrading state-of-the-practice transportation operations/management techniques, including improvement of tools for assessing their benefits; and expediting deployment of proven IVHS technologies. Initially, this area will focus on four topics: incident management, congestion management/traffic performance, advanced traffic control system management, and national marketing of IVHS development.

Early Deployment Studies Timeline

- 1991: Pilot studies in Denver, Colorado, and Portland, Oregon
- 1992: 10-12 additional metropolitan areas
- 1993-1997: Over 60 additional metropolitan areas (over 500,000 population)

Research and Development

The FHWA IVHS research and development (R&D) program will provide the insight into new technology developments which will be used as building blocks for future IVHS applications. The many integration and implementation issues involved with IVHS lead to many areas for R&D that are not strictly technical in nature. Some of the major areas for R&D include:

- System analysis and systems architecture
- Transportation systems analysis
- Modeling and simulation
- Databases and database management
- Communications
- Software
- Safety and human factors
- Institutional and legal issues
- Socioeconomic issues
- Privacy as a design issue

In order to satisfy the needs of IVHS R&D, FHWA is employing several approaches for conducting research. These approaches include the use of traditional R&D contracts, public/private/academic consortia, research institutes and universities, and the IVHS Innovations Deserving Exploratory Analysis (IDEA) program.

Traditional R&D Contracts

FHWA will continue to award traditional R&D contracts to individual organizations or consultants. These types

of contracts have been the major thrust for past FHWA R&D contracts and will continue to play an important role in the PI-IWA IVHS program. One current example of this approach is the In-Vehicle Safety and Warning System (IVSAWS) contract to develop concepts and designs for in-vehicle safety and warning systems.

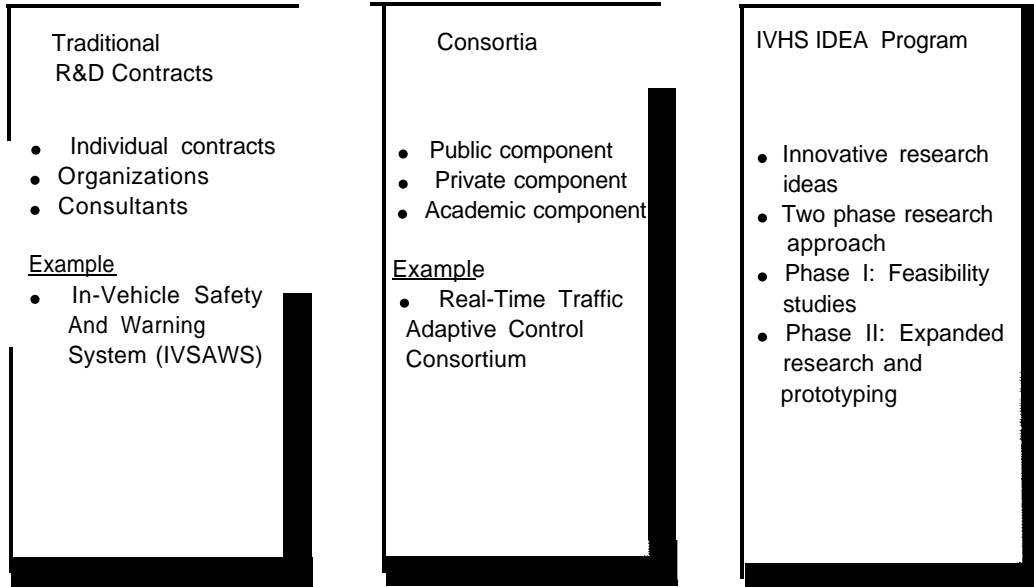
Consortia

In addition to contracts with individual entities, a major focus for conducting R&D projects will be through public/private/academic consortia. These consortia provide the necessary array of skills and resources needed to achieve successful completion of major IVHS R&D projects. These projects will typically be much larger in scope than past FHWA R&D contracts. An example of one of these initiatives is the “Real-Time Traffic Adaptive Control for IVHS” project, the objective of which is to develop and evaluate a traffic control system that can operate in an IVHS environment and rapidly respond to changing traffic conditions.

IVHS IDEA Program

The IVHS IDEA Program will be used to support research of innovative ideas with potential applications to IVHS. The IVHS IDEA Program is modeled after the Strategic Highway Research Program (SHRP) IDEA Program in that the research is conducted in a two-phase approach. The first phase of the program will fund several small feasibility studies of innovative concepts. The second phase of the program is designed to fund a select number of the initial feasibility studies which will lead to a prototype system or product. There will be an annual solicitation for the IVHS IDEA Program. The IVHS IDEA Program is designed so that the entrepreneur can get involved in the IVHS program.

RESEARCH AND DEVELOPMENT



Automated Highway System

The Automated Highway System (AHS) is a component of Advanced Vehicle Control Systems (AVCS) and represents the later stage of deployment of AVCS. AHS deals primarily with the evaluation, testing, and deployment of AVCS technologies and the integration of AVCS with the other IVHS technology areas to eventually realize a fully automated roadway. Congress has stated, as part of the ISTEA, "the goal of this program is to have the first fully automated roadway or an automated test track be in operation by 1997." This requirement is one of the major milestones driving the AHS program. The National Highway Traffic Safety Administration (NHTSA) will also play a key role consistent with its primary responsibility concerning vehicle safety issues. Funding for the AHS program may include the 5 percent of the Corridors Program funds that are reserved for innovative, high risk projects.

AVCS uses vehicle- and/or roadway-based electro-mechanical and communications devices that enhance the control of vehicles. AVCS features such as automatic braking and collision avoidance have the potential for significantly improving safety. Specific safety issues include inspection requirements for AHS equipment, isolation and testing of safety-critical software, failure mode analysis and specification of safeguards,

operational parameters which include safety margins (e.g., minimum allowable headway), and required safety standards. In sum, AHS builds on the above to provide a fully automated vehicle highway system. Projected benefits include substantial accident and congestion reduction through longitudinal and lateral control of vehicles.

Following are the goals of the AHS program:

- Establish a program plan which guides AHS implementation from research and development through operational testing to deployment
- Ensure that AHS technology developments fit within the framework of an overall IVHS architecture and that standards are developed which ensure interoperability between commercially available AHS systems
- Establish and maintain a capability for testing and evaluating AHS technological developments
- Ensure that AHS implementations increase public safety and that appropriate system safeguards exist

targeted on the prevention of injury, loss of life, or damage to property due to failure of AI-IS in-vehicle or infrastructure equipment

- Establish design and performance standards and procedures for maintaining, operating, and calibrating AHS equipment and systems

Other Provisions

Other provisions of the ISTEA include the completion of the *National IVHS Strategic Plan*; submission of a report to Congress on institutional, policy, and legal barriers to IVHS; use of national laboratories; and development of IVHS standards, protocols, and architectures.

National IVHS Strategic Plan

The DOT is required to submit a final version of the *National IVHS Strategic Plan* to Congress within a year of the enactment of the ISTEA. The purpose of the *National IVHS Strategic Plan* is to:

- Establish goals and objectives of the national IVHS Program
- Outline a course of action to develop and deploy the technology
- Determine the magnitude and sources of funding required
- Specify roles of public, private, and academic participants
- Identify key challenges to IVHS deployment.

In addition to the *National IVHS Strategic Plan*, a report on implementation of the *National IVHS Strategic Plan* is due to Congress within two years of the ISTEA enactment.

Institutional, Policy, and Legal Barriers

A report on *Non-Technical Barriers* to IVHS implementation is due to Congress within two years of the ISTEA enactment. This report will identify the institutional, policy, and legal barriers to implementation of IVHS in the United States. Some institutional and policy issues affecting IVHS implementation include intergovernmental/interagency coordination, new missions and added technical capabilities for existing organizations, public/private cooperation, impacts on users, and funding. Legal

issues include tort liability, antitrust, intellectual property, privacy, procurement, regulatory structure, and jurisdictional authority to delegate traffic management. In conducting the study on barriers to IVHS, DOT will consult with other appropriate Federal agencies including the Commerce Department, the Environmental Protection Agency, and the Department of Justice.

The FHWA is sponsoring two series of studies related to institutional, policy, and legal barriers to IVHS. The first series is the *IVHS Deployment and Public/Private Sector Issues* policy studies. FHWA is sponsoring a symposium on the different public/private sector models detailed in the policy studies for the management of ATIS and ATMS technologies. Currently, the most prominent IVHS application for private sector management is the traffic management center (TMC). The policy studies examine a number of public/private deployment options for TMCs including a “traditional contract” model between the public and private sectors and a “franchise” model similar to that in the cable television industry. The second series of studies will focus on CVO-related deployment and institutional issues. For this series, up to \$50,000 would be provided to each State which prepares an acceptable proposal to identify institutional issues that would impede or prevent the achievement of national CVO goals. Working Groups will facilitate discussions and a report will be prepared detailing findings.

National Laboratories

The use of national laboratories to study IVHS technologies is strongly encouraged in the ISTEA. These laboratories serve several agencies with IVHS interests and have substantial skills which could be effectively used. The DOT is developing an umbrella agreement with the Department of Energy (DOE) whereby the DOT can have DOE national laboratories develop specific IVHS applications. Examples of national laboratories are the Sandia National Laboratories and the Los Alamos National Laboratory, both in New Mexico, and the Oak Ridge National Laboratory in Tennessee.

Standards, Protocols, and Architectures

The ISTEA specifically mentions the need for IVHS standards and protocols. Standards and protocols, which will help assure compatibility among IVHS technologies, are required. DOT will be looking to IVHS AMERICA, and in particular, the Standards and Protocols Technical Committee, to be the leader in developing this area. Existing standards-setting groups such as the American National Standards Institute (ANSI) and the International Standards Organization (ISO) will be used in the development of the IVHS standards and protocols.

Work is currently underway to define a national IVHS system architecture. The IVHS system architecture identifies functions that are needed to provide IVHS services, and allocates them to subsystems. Some of

these subsystems may be in the vehicle, some at the roadside, and others in one or more traffic management centers. In addition, the information flows and interfaces between functions are defined. An architecture and common interface standards are needed in order to obtain economies of scale for production, and to eliminate the need for consumers to buy multiple systems. A common, modular architecture with standard interfaces will simplify system design and maintenance, and support a mobile population.

FHWA is funding initial studies of alternative IVHS system architectures, coordinating with other public and private sector entities through frequent briefings to the IVHS AMERICA Systems Architecture Committee. FHWA is also planning a major procurement activity related to defining potential IVHS system architectures.

Funding

Funding for the FHWA IVHS program is made up of two components: IVHS Appropriations Bill [General Operating Expenses (GOE)] funding and ISTEA funding. Allocations of federal funds to particular types of projects are identified in both the IVHS Appropriations Bill and in the ISTEA. In addition, except for FHWA-designated high risk projects, the ISTEA limits the contribution of Federal funds to 80 percent of the total cost of a project.

Federal Fund Goals

In order to maximize available Federal dollars, the FHWA will continue to encourage that no more than 50 percent of the total project cost comes from Federal IVHS funds. FHWA will work with their partners to achieve the 50/50 goal where possible. Supporting the FHWA goal of a 50/50 split, the ISTEA imposes a strict limit of 80 percent Federal IVHS funds to the total cost of a project. This limit applies to both the ISTEA funded projects and the projects identified in the FY 92 Appropriations Bill. The matching 20 percent must be made from non-Federal-aid sources, i.e., private sector contribution, State or local funds, etc.

Funding Summary

Programs and plans for use of IVHS funds have developed rapidly based on the existing IVHS program, the *National IVHS Strategic Plan*, and the requirements of the ISTEA. The following points illustrate that a

significant portion of the available funds must be reserved for current obligation plans through 1997:

- With the exception of FY 92, essentially all of the GOE funds provided will be used to support contracted (or consortia) research and development efforts, program support needs, and technology transfer activities. For FY 92, a large amount (\$109 million) of the GOE funds has been identified with specific projects.
- At least \$250 million must be reserved for the designated priority corridors meeting the strict ISTEA criteria.
- The funding needs for innovative, high-risk projects, including demonstration of the Automated Highway System and other efforts, will require a minimum of \$75 million.
- Funding of the planning and preliminary engineering studies leading to early deployment will require approximately \$40 million.
- Support of previous commitments for completion of existing additional operational tests will require funding resources.

Analysis of the above shows that \$30 million may be available each year to fund other corridors. In addition, approximately \$10 million per year would remain for additional operational tests.

FHWA IVHS Funding (all amounts in \$ millions)			
	N 92	<u>FY s 93-97</u>	Total
<u>Annromiations Bill (GOE Funds)</u> (R&D, Program Support, Technology Transfer)	140	30 (FY 93 request only)	170
<u>ISTEA</u>			
• Corridors Program; Priority and Others	71	430	501
• Technical Assistance, Planning, & Additional Operational Tests	23	135	158
	<hr/> 234	<hr/> 595	<hr/> 829

For Further Inforamtion

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