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Public and Private Sector Roles in Intelligent Vehicle – Highway Systems (IVHS) Deployment



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SEARCHING FOR SOLUTIONS
A Policy Discussion Series
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Public and Private Sector Roles in Intelligent Vehicle – Highway Systems (IVHS) Deployment

Final Report

*Summary of Seminar Proceedings:
Prepared by Walcoff & Associates*

Sponsored by the Office of Policy Development
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Foreword

This report summarizes a Federal Highway Administration (FHWA) workshop on key issues in public/private roles for deployment of IVHS technologies and services.

To develop a more comprehensive view of the potential institutional issues and roles for IVHS implementation, the FHWA Office of Policy Development and the Office of Traffic Management and IVHS held a 2-day workshop in cooperation with IVHS AMERICA. The workshop was intended to develop research recommendations, provide guidance for operational tests and particularly develop recommendations on public/private deployment roles and responsibilities.

The workshop was based on the recognition that focusing on the relationship between the public and private sectors is essential to realizing the promise of IVHS. While there is a great deal of technology deployment involved, IVHS is not really just *about* technology, but also *about* changing institutional relationships so that information can be used to improve transportation.

Therefore, it is clear that as we begin to focus our attention beyond operational testing for proof of technical concepts to real world deployment, a new set of issues must be addressed.

- Which IVHS concepts are “technology-driven/infrastructure-based public services” (and tax supported) versus “market-driven/service-oriented businesses” (based on user charges)?
- What are the demands of customers for various IVHS services, the appropriate service delivery concepts, markets, and prices?
- How will very large amounts of capital be raised to deploy IVHS without substantial private investment?

- How are the 39,000 units of State and local government going to support the capacity required for IVHS deployment and operation?
- Will choices of technologies or system architecture unintentionally bias institutional roles?

Virtually all of the key implementation issues center on public sector capacities and private sector opportunities. Neither the public nor private sector can successfully deploy IVHS alone. Furthermore, it is important to recognize that there are *several* private sectors: technology vendors, providers, vehicle platform producers, investors, and customer/users. New forms of public/private partnership can be explored within the context of operational testing and deployment.

This report is the third in a series entitled *Searching for Solutions: A Policy Discussion Series*. The series deals with key highway transportation issues such as congestion pricing, public/private partnerships, transportation and air quality, and transportation and economic productivity. Issue papers emanate from policy seminars and workshops sponsored by the FHWA, or from FHWA policy research. We look forward to generating a wide-ranging dialogue on these and other important challenges facing transportation policy development.

Stephen C. Lockwood
Associate Administrator for Policy
Federal Highway Administration

Dennis C. Judycki
Associate Administrator for Safety
and System Applications
Federal Highway Administration

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Introduction

The Federal Highway Administration (FHWA) conducted a workshop on the roles of the public and private sectors in the deployment of Intelligent Vehicle-Highway Systems (IVHS) on April 8 and 9, 1992, at the Holiday Inn-Crowne Plaza of Rockville, Maryland. The objective of the workshop was to develop specific recommendations concerning: (1) needed research related to the issues of public/private sector involvement in IVHS deployment; (2) methods of evaluating institutional issues in IVHS operational tests; and (3) public/private roles and strategies to promote greater near-term IVHS deployment. The focus of the workshop was primarily on Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS). The more than 80 conference participants (see Appendix A) included Federal, State, and local highway officials and representatives of universities and private enterprise concerned with the deployment of IVHS technologies on America's highways.

In preparation for the workshop, FHWA solicited proposals for white paper topics on

public/private sector roles in IVHS deployment and the institutional factors that may affect private sector participation. Twelve topics were selected, and papers were prepared prior to the workshop. Summaries were presented by the authors, or coauthors in the three panels conducted during the plenary sessions (see Agenda in Appendix B). The panels included one or two discussants who responded to the issues raised by the authors or introduced other issues that might warrant discussion. The session concluded with open discussion among all the participants.

In addition to the panel presentations, workshop participants were divided into three groups to attend breakout sessions in which they discussed assigned issues and formulated recommendations to be presented at the closing session of the workshop. After the presentation of the participants' recommendations, Workshop Moderator Tom Humphrey, from Massachusetts Institute of Technology (MIT), summarized the workshop.

Opening Remarks

Welcome

Dennis Judycki, Associate Administrator for Safety and System Applications at FHWA, welcomed the participants and described the rapid expansion of the IVHS program at FHWA. The expansion started with an increase from \$4 million to \$20 million only 18 months ago and has resulted in today's program of nearly \$800 million over the next 6 years. Of this \$800 million, \$234 million will be available this year, primarily for research, development, and operational testing for IVHS.

The IVHS program has been ahead of the legislation in two regards: (1) the formation of an advisory group or national forum, IVHS AMERICA, to develop partnerships and advance the program nationally; and (2) the development of a draft strategic plan, which will be considered in May by IVHS AMERICA. However, according to Mr. Judycki, program delivery will be judged by the deployment of IVHS systems; the deadline for deploying a prototype automated highway system is 1997.

Mr. Judycki maintained that successful IVHS deployment will require revolutionary rather than evolutionary change from the traditional approaches used in highway technologies. Coming to grips with the institutional issues will affect not only the ultimate deployment of IVHS but also the types of technologies developed and marketed. Mr. Judycki challenged the participants to be agents of change, using unconventional thinking to provide focus and priority in dealing with institutional issues. He charged them to develop strategies and recommendations (i.e., an action plan) to facilitate the transition from deployment issues to deployment opportunities.

Charge to the Participants

Stephen Lockwood, Associate Administrator for Policy at FHWA, pointed out that, unlike other conferences, this workshop contained no

real experts because a state of the art has not been developed to deal with the institutional issues associated with IVHS development and deployment. He listed several issues that he said were "unknown territory:" market demand, investment and financing, costs and pricing, bundling of transportation-related information with consumer information, alternative system architectures, and the location of "smartness."

Mr. Lockwood expressed a sense of urgency, as the IVHS program moves into the operational test phase, about defining and identifying the players and sources of ideas, expertise, and capital. Neither the public sector nor the private sector can successfully deploy IVHS alone.

Mr. Lockwood urged the participants to advance the dialogue and convert their insights into products that will lead to research activity. Specifically, he asked them to identify (1) research needs, with the priorities among those that relate to institutional barriers to IVHS deployment; and (2) methods of evaluating institutional issues within the operational tests that are currently being conducted or are soon to begin.

Welcome from IVHS AMERICA

According to Craig Roberts, Director for Institutional and Legal Issues for IVHS AMERICA, although everyone involved in IVHS development and deployment agrees that resolving the institutional issues is critical, the technical issues are, in many ways, easier to grasp. The challenging objective of this program is to develop and deploy a uniform—or at least compatible—system of technologies across the country in a decentralized, multi-faceted environment for both the public and the private sectors.

IVHS AMERICA was created to deal with this very complex area of policy and politics. It embodies the public/private partnership on a national basis and attempts to bring all the concerned parties together under one umbrella. However, because the number of players is increasing, IVHS is experimenting with various mechanisms of public/private partnerships and developing a process of multiple iterations so that deployment can progress. Many of the models of public/private partnerships contradict the cultural tradition of strong separation of the public and private sectors.

Mr. Roberts acknowledged that the development of the IVHS AMERICA strategic plan generated heated deliberations on the institutional issues. However, he asserted that the strategic plan was merely the first step in resolving these issues. According to Mr. Roberts, this workshop was the second step. The workshop will strongly influence the research and policy agendas of the U.S. Department of Transportation (DOT); its significance cannot be overemphasized.

Panel 1: Current U.S. and Foreign Experience with Public/Private Sector Deployment of IVHS

A Sociotechnological Perspective on Public/Private Partnership for IVHS Infrastructures

The paper coauthored by Kan Chen, Professor of Electrical Engineering and Computer Science at the University of Michigan, and his colleague, Frank Stafford, Professor of Economics, focused on the IVHS infrastructure—i.e., the physical components of IVHS systems that are outside the vehicles. The paper emphasized the unconventional involvement of the private sector in the development of the infrastructure. Although infrastructure has traditionally been owned and operated by the public sector, private sector involvement is warranted for two reasons: the development of infrastructure is a prerequisite for deploying IVHS, and the public sector may need private sector assistance in this role.

Mr. Chen presented several motivations for private sector involvement in infrastructure development. First, in a public/private partnership, the private sector can work more efficiently as a result of its electronics expertise; its experience in handling large-scale projects such as those in the defense industry; possible cross-fertilization of concepts among different IVHS functions; and its political neutrality, which may allow it to achieve cooperation among public agencies. Second, public funds for IVHS infrastructure are limited, especially at local levels. Finally, the private sector is positioned to provide different levels of services so that the benefits of IVHS can be realized more fully.

Mr. Chen presented several examples of possible public/private partnerships in infrastructure:

(1) An Automatic Vehicle Location (AVL) and Fleet Management system designed, installed, and operated through a private organization to serve multiple agencies in the same city, which would monitor the private firm's performance through a policy board;

(2) An electronic toll collection and road pricing system using Electronic Toll and Traffic Management (ETTM) and Heavy Vehicle Electronic License Plate (HELP) technologies (and a single transponder) to serve a particular corridor, with funding provided by and profits shared with the private sector;

(3) A traffic information collection, analysis, and dissemination system that would be privately funded but publicly regulated and would use advanced sensors and communications systems, bundling IVHS functions with other communications needs to reduce costs and increase market penetration;

(4) A beacon-based route guidance system, primarily privately funded, to extend traffic control, with the "smart" function on the roadway (raising the cost of infrastructure) and the use of wireless communications to reduce costs;

(5) A cellular-based route guidance system, primarily privately funded but with public financial involvement to reduce costs, with the "smarts" on the vehicle and using probes for traffic data; and

(6) Private toll roads, which would be owned, built, and operated totally by the private sector (with ownership reverting to the public sector after 35 to 40 years) to establish an environment conducive to the implementation of IVHS.

Mr. Chen also described barriers to implementing IVHS: procurement procedures for the public sector; regulatory policies that may

affect the private sector's motivation for and risks in becoming involved in IVHS; multi-jurisdictional issues; legal liability issues; a possible mismatch in costs and benefits; and a lack of commitment by the auto industry, which affects the commitment of the electronics industry. To overcome these barriers, Mr. Chen recommended taking the following steps:

- learn from public/private partnerships in other industries and other nations,
- hold more workshops and meetings,
- conduct field tests implementing technical and institutional innovation simultaneously, and
- plan specifically for full deployment by developing scenarios that define roles of public and private partners, and identify barriers and solutions.

An Analysis of Public/Private Cooperation in European, Japanese, and North American IVHS Efforts

The objective of the paper by Neil Emmott, Senior Associate and IVHS Technical Manager for Castle Rock Consultants, was to examine the European and Japanese efforts in implementing IVHS and to consider how that experience might apply in the United States. He focused on two European programs, Dedicated Road Infrastructures for Vehicle Safety in Europe (DRIVE) and Program for European Traffic with Highest Efficiency and Unprecedented Safety (PROMETHEUS); compared two activities in the United Kingdom, Autoguide and Trafficmaster; and described the approach used in the Japanese Road Automobile Communication System (RACS), Advanced Mobile Traffic Information and Communication System (AMTICS), and Vehicle Information and Communication System (VICS) initiatives.

The DRIVE program was divided into two phases: the research and development phase, or DRIVE, and the follow-up effort, DRIVE II, which involves field trials and system evaluations. DRIVE involved a great deal of private sector involvement at the preproposal, or program definition, stage. Suggestions for

DRIVE II were requested within 6 months after DRIVE began, an approach that provided a good platform for later private sector involvement. In addition, the DRIVE office solicited proposals through a broad task list; companies could respond to a specific task or a combination of tasks, or they could propose a totally new approach if it fit the broad DRIVE goals. Private sector firms are reimbursed for only 50 percent of their costs, but this approach has been successful because participation in DRIVE gave firms extensive opportunities for market development across Europe. DRIVE also allowed firms to retain intellectual property rights.

One criticism of DRIVE has been that its management and coordination structures are unwieldy and overly bureaucratic. However, considering that it linked public, private, and academic players with different languages and cultures from across the Continent, DRIVE's management structure had to be fairly controlled. This structure has been relaxed for DRIVE II.

PROMETHEUS is considered a private sector equivalent of DRIVE, although it is actually partially funded by the public sector. PROMETHEUS uses a sliding funding mechanism whereby private firms can obtain up to 50 percent funding for research and development and reduced funding as products are developed. The PROMETHEUS organization has recently expressed its needs for continued success: confirmation of support from the European ministries of transportation for the program and for field trials, including resolution of institutional issues; resolution of legal issues, including adaptation of traffic laws; and tax reductions that would support the introduction of IVHS technologies.

In comparing the Autoguide and Trafficmaster ATIS systems of the United Kingdom, Mr. Emmott contended that the failure of Autoguide to achieve implementation to date is the result of two factors. First, the government and the selected contractor appeared to be in disagreement over the system's communication element. Second, the contractor was uncertain of the system's profit potential under the government-specified functionality. In contrast, Trafficmaster was designed and developed by the private sector, which then approached the government for an operating license. As a result of recent IVHS advances, the British government is considering the develop-

ment of a code of practice for in-vehicle displays, which may provide protection against liability concerns.

The Japanese have involved a large number of private sector firms in IVHS programs, such as RACS, AMTICS, and VICS. This approach has resulted in a sort of standardization as the firms worked together rather than developing separate, proprietary products. Investment in Japanese programs has also put the private sector in a better position to market its in-vehicle navigation systems.

Mr. Emmott contended that the U.S. IVHS program could benefit from borrowing some approaches from the Europeans and Japanese. These approaches include:

- formation of larger consortia of private sector participants;
- use of sliding public/private funding in IVHS projects, with retention of intellectual property rights by private sector firms;
- solicitation of ideas from the private sector for development of projects;
- broad solicitations that allow firms to respond to several areas of interest;
- infrastructure studies by the public sector that provide a platform for private sector activities; and
- the use of codes of practice to address liability concerns and stimulate product development.

Opportunities for Private Sector Involvement in the Deployment and Operation of Advanced Traveler Information Systems

Ken Orski, President of Urban Mobility Corporation, and his coauthor, Robert Owen of Metro Traffic Control, contended that the role of the private sector has been secured in the areas of research and development, manufacture, and marketing of IVHS equipment. However, the private sector's role in the deployment and operation of IVHS is not clear because the traditional view is that, as an enhancement of conventional traffic management, IVHS deployment and operation should be a public responsibility. The authors challenged this

point of view, particularly as it concerns the Advanced Traveller Information Systems (ATIS).

Presently, two parallel traffic information systems exist: those operated for State and local traffic departments, which monitor traffic for purposes of traffic control and management, and commercial traffic information services, which disseminate traffic information to the public and, increasingly, to private subscribers. The public systems collect data through passive detection devices and disseminate it through mechanisms such as changeable message signs, highway advisory radio stations, and police radio frequencies. Commercial traffic advisory services rely on visual observation and disseminate the information over commercial radio and television stations. Commercial traffic information services stress interpretation and presentation of their data to the public.

The authors contended that the public sector would be ignoring a vast reservoir of expertise in this arena if it tries to assume control over ATIS systems. Mr. Orski and Mr. Owen offered five possible scenarios of public/private partnerships for the demonstration, deployment, and operation of ATIS systems. The first scenario, the functional division of responsibilities, is modeled after the weather information systems, in which the public sector collects information both for its own use and for sale to private firms.

The second scenario, franchised operations, has two variations: the exclusive franchise, similar to the cable television franchise, and the nonexclusive franchise, modeled after cellular telephone networks. In this scenario, the public still collects data, but then awards an exclusive or nonexclusive franchise to one or two companies. The franchise would then disseminate the data while the public maintains regulatory controls.

The third scenario, the completely private model, in which the entire system is privately operated, is highly unlikely to gain the acceptance of State and local governments, according to Mr. Orski.

Scenario four is a publicly owned system operated by private contractors. State and local governments would finance and deploy the ATIS system and specify the performance standards for operation. The contractor would determine the hardware and software needed to meet these requirements. This option allows

the public sector to take advantage of the specialized engineering, marketing, and management skills of the private sector.

The last scenario is a unified public/private partnership in which both parties collect information, which is then funneled to a central traveler information center for dissemination to clients, using both public and private transmission facilities.

Finally, Mr. Orski described the barriers that would hinder implementation of any public/private partnership scenario:

- unwillingness by the public sector to share traffic management responsibilities with the private sector;
- jurisdictional fragmentation;
- legal constraints regarding the use of public right of way;
- procurement and contracting regulations; and
- uncertainty of the market for IVHS technology.

The California Department of Transportation (CalTrans) Experience with Public/Private Arrangements

In his paper, Wesley Lum, Chief of the Office of Advanced Systems Integration and Implementation for CalTrans, shared California's experiences in public/private partnerships for the IVHS program, evaluated the California experience in determining program needs, and solicited ideas from others for improving the program. CalTrans has been involved in IVHS for approximately 20 years, but contracting with the private sector in IVHS is relatively new, having begun about 10 years ago and increased since then. Now, CalTrans contracts for a variety of IVHS services.

Mr. Lum listed a variety of IVHS projects and presented the issues associated with those projects. First, in the area of ATMS, Mr. Lum has observed a continued resistance to contracting. The procurement process is lengthy and difficult. CalTrans officials also don't understand the needs of the private partners. Issues related to ATIS include funding and charging for information, the integrity of the

information that is disseminated, liability questions, the difficult procurement process, and the distrust of the motor carrier industry toward the government. In Advanced Vehicle Control Systems (AVCS) projects, the issues are the procurement process (again), the need for the public to understand private sector incentives, and the "buy American" philosophy.

To tackle these issues, Mr. Lum recommended a national program to coordinate the identification, clarification, and resolution of public/private issues. The functions of this program would be to divide responsibilities among the Federal, State, and local levels; provide funding; and share information among all participants in IVHS programs.

Critique of Panel 1

William Hyman, Director of the Transportation Studies Program of The Urban Institute, used Mr. Orski's framework of public/private partnerships to comment on each of the presentations. He admitted that all these forms of partnerships probably exist in the United States, and the deployment of IVHS would benefit from a more detailed examination of the circumstances under which each of them is effective. Guidelines for implementing the various forms of partnerships would also be helpful.

Mr. Hyman found the examination (by Kan Chen and Frank Stafford) of franchise operations in other industries to be highly productive. He recommended the electric power industry as an example of interaction among independent power producers and franchise electric utilities and of ways to foster innovation in this type of environment.

Mr. Hyman agreed with Mr. Orski that purely private models will not be pervasive, but contended that market opportunities exist. The key questions he raised in this area concerned the posture toward these providers that the government should assume and actions that can be taken to foster purely private activities.

Mr. Hyman warned that, in the area of contracting and procurement, the government should not use the same practices used for paving and road building. These procedures rely on materials and methods; IVHS procurement should focus on performance specifications. Mr. Hyman cautioned against the overspecification of programs such as the Autoguide program described by Neil

Emmott. Although standards are crucial, if taken to extreme, the standardization process could hamper innovation and rapid deployment of IVHS systems.

Mr. Hyman advised considering some of the examples of public/private coventures described by Mr. Emmott, particularly the sliding funding mechanism and the protection of intellectual property rights for the private sector.

Open Discussion

Procurement Procedures

Scott Wainwright of the Montgomery County (Maryland) DOT expressed his agency's confusion about procurement issues and the decision whether to issue requests for proposals (RFPs). Mr. Lum commented that the California legal staff needs explicit examples or contracts to determine their legality. Mr. Hyman commented that the Transportation Research Board conducted a study on innovative contracting in the highway paving industry. He suggested a similar study for IVHS. Mr. Judycki pointed out that not all procurements must take the traditional approach. Mr. Roberts agreed, suggesting that legal counsel and contracting officers should be brought into the process very early to resolve the issues and have creative contracting.

Charges for ATIS Services

Mr. Wainwright also commented that ATIS seems ripe for private sector involvement, but the concern is whether the public will be willing to pay for services that are now provided for free. Mr. Orski responded that ATIS will offer service far superior to current traffic information systems. Value-added features would include easier access, customized information tailored to specific commuters or corridors, more comprehensive coverage, and more versatile and user-friendly service. Operational tests are extremely important in establishing the public's willingness to pay. Mr. Lum commented that these results may vary from region to region, particularly for the individual motorist. Mr. Roberts pointed out that the private sector is especially effective in identifying niche markets. Mr. Chen asserted that the key question is the accuracy and timeliness of the information.

Robert Owen of Metro Traffic Control explained that commercial traffic reporting services depend on the needs of the broadcasting industry; therefore, only about 30 percent of the information gathered is broadcast on radio or television. Mr. Owen predicted that the broadcast industry will not provide as much traffic information in the future, and the public's willingness to pay will increase as the free services decrease.

Don Savitt of Hughes Aircraft Company commented that ATIS needs to be not just user-friendly but user-useful. Mr. Orski replied that the industry could learn a great deal about the presentation of information from the weather forecasting industry. Sadler Bridges from the Texas Transportation Institute pointed out that markets exist for information about specific routes (pretrip route planning or pretrip motorist information, for instance), in addition to the type of general information given on the radio.

Mr. Lockwood asserted that the discussion illustrated a degree of ignorance in the field about who should provide the information, what type of information should be provided, who will pay for the information, and how payment should be made. Mr. Hyman added that extensive market research is needed in this area by both the public and the private sectors. Mr. Orski contended that the market for ATIS would be segmented much like that of the weather-forecasting industry, which provides specialized reports to clients in addition to the information provided to radio and television. This type of segmentation will require price elasticity.

Burt Stephens of FHWA outlined the following factors that will influence willingness to pay: initial cost, reliability of information, fulfillment of expectations, and flexibility and ease of use.

The participants discussed the weather forecasting model and how it might be applied to IVHS. In addition, Mr. Lum shared that, although CalTrans has considered selling traffic information, the agency currently gives it away because its main objective is to disseminate the information, not to raise money.

Mr. Lum also raised the issue of equity—i.e., should those who can afford it have the advantage of in-vehicle traffic information systems that cost thousands of dollars. Mr. Lum maintained that equity should not be an issue.

Furthermore, the solution to a particular traffic problem may require that only a few vehicles be diverted, so these systems may help from a traffic management viewpoint.

Role of Traffic Management in ATIS

Gene Donaldson of the Montgomery County DOT expressed concern that, with ATIS, everyone will be able to determine what routes to take, hindering traffic management officials from controlling traffic. He therefore maintained that data analysis and interpretation should be placed with traffic control. The public sector would then give the information to private sector partners to disseminate as they wished.

This viewpoint drew a great deal of discussion. Mr. Chen commented that, in his examples, the beacon-based system provides route guidance through a traffic management system; in contrast, the cellular-based system allows the individual driver to determine the route. Some private companies think the cellular model will sell in this country. Mr. Chen asserted that the resolution of this fundamental issue affects the system architecture and the public/private relationship.

Harley Radin maintained that private firms would hesitate to invest in such a system if the government decides what information could be transmitted. This arrangement would not be viable from a business standpoint. Mr. Lum also pointed out that private firms want a guarantee that they won't face future competition from the government or other changes in regulation that may affect profits.

Effect of ATIS on Driver Behavior

In response to the question of what effect traffic information has on driver behavior, Mr. Orski responded that four out of five drivers do not change their routes on the basis of the information. Jack Brown of the Florida DOT agreed, stating that drivers change their routes only when a specific and significant incident occurs. Rick Weiland commented that these discussions did not account for the increased reliability of information from on-board digital ATIS, which would encourage people to make decisions on the basis of the information provided. Sigmund Silber recommended viewing this issue in light of varying levels of segmentation of the market.

Panel 2: Public/Private Roles in IVHS Deployment

Economic Issues Associated with the Definition of Public/Private Roles in the Deployment of IVHS

Philip Tarnoff, President of Farradyne Systems, Inc., observed that, over the last several years, the IVHS community has been gravitating toward traditional roles in public/private partnerships, with the public sector responsible for the infrastructure and the private sector contracting to supply whatever the public sector can't provide. The objective of his paper was to examine the issues associated with these relationships before the IVHS community decides to standardize these relationships.

Mr. Tarnoff's analysis focused on the surveillance infrastructure because it is the foundation on which all aspects of IVHS will be built; and on a typical corridor, the Baltimore-Washington corridor, because of its proximity. The analysis considered both freeways and arterial roadways and three types of models: the public sector model, the franchise model, and the laissez-faire model. The public sector model examined the public sector's economic capability of installing and maintaining a surveillance system. The franchise model examined the feasibility of granting a franchise to one firm or a group of private sector firms and allowing them to use the right of way under regulatory control. In the laissez-faire model, the right of way would be open, with no regulations, to anyone who wanted to install a surveillance system. Mr. Tarnoff did not believe this model was very realistic.

The conclusion of Mr. Tarnoff's analysis was that about \$24 billion is needed to install a comprehensive surveillance system on the nation's freeways and major urban arterials. The implementation would take more than 5 years from the time at which public/private

sector responsibilities are decided. Therefore, the national surveillance system would be completed by the year 2000.

Mr. Tarnoff was skeptical about the availability of such funding through the public sector. This figure represents a substantial portion of the total Federal aid program; the usual amount used for surveillance is only about 0.05 percent of the total. Furthermore, the cost of \$24 billion includes only the detectors; it does not include new signals or such freeway controls as ramp metering and variable message signs.

In examining the franchise model, Mr. Tarnoff assumed that motorists could be charged \$25 per month, which is comparable to the charge for Trafficmaster. Analysis showed that two firms sharing the market and charging this fee could break even with a market share of about 2 percent. For comparison, the cellular telephone market is now about 9 percent.

This analysis, according to Mr. Tarnoff, represents a "light at the end of the tunnel." It shows that the private sector could assume more of the public sector's role in supplying infrastructure with a reasonable expectation of recovering its investment and showing a profit.

IVHS Deployment and Public/Private Sector Issues

Edwin Rowe, General Manager of the Los Angeles DOT, also used the traditional model and the laissez-faire model, but in different contexts. He assumed that the traditional model would be used for ATMS and the laissez-faire model would be used for ATIS, including the provision of equipment and data fusion, but under regulatory control.

In Mr. Rowe's deployment model, data from the publicly operated ATMS and the privately operated ATIS would be transmitted

to a regional transportation management center run by a public agency or to a network of such centers. Data fusion would take place at the main regional center. The center would disseminate the information to the traditional public sector distribution agents, such as highway advisory radio and changeable message signs, and to additional users, such as municipal access channels on cable television. In addition, the regional center would send the information (either in a packaged format or as raw data) to private sector distributors, who would repackage it to suit their specific needs.

Primary among the private sector distributors would be commercial traffic data centers and frequency modulated (FM) digital broadcasts. Mr. Rowe contended that FM digital broadcasts will offer the primary early opportunities for the private sector in the IVHS market. Entrepreneurs have developed various devices for receiving the data, from inexpensive hand-held devices to costly programmable devices; however, they need a way to acquire the data from the public sector.

Mr. Rowe listed several advantages of his deployment model. First, it offers continuity by placing the responsibility for ATMS with the public sector, where it has been traditionally and in which 25 years of research has been invested. It is consistent with current ATMS deployments in various programs. Mr. Rowe believes that the public sector can collect and distribute traveler information more economically. This model also ensures the control over traffic patterns that the public sector needs. Finally, because the model employs an open architecture, it allows for extensive private sector competition for equipment for distributing the information.

Ways to Improve Traditional Opportunities for IVHS Development and Deployment

Stephen Crosby, Chairman of SmartRoute Systems, began by saying that FHWA is undertaking an unusual, challenging, threatening, and difficult task in its assessment of public/private sector roles in IVHS deployment. To admit that the traditional way of doing business may not work in the IVHS arena challenges the agency, its personnel, and its potential funding. Therefore, Mr. Crosby views the objective of

this assessment as twofold: to reduce the big conceptual issues into researchable components without losing sight of those broad issues.

Both the IVHS AMERICA Strategic Plan and the RFP assume that the private sector will take on a changed role in IVHS deployment, but the reasons for this changed role are not clear. Mr. Crosby contended that meeting the policy objectives would be difficult if the reasons for this changed role—i.e., the problems that will be solved as a result—are not explicitly stated. He also noted that the continuum of models from the traditional to the purely private is limiting because it considers only models that have been used in the past. IVHS is charting unknown territory in terms of technology, organizational structures, and funding; the options for innovative models should be kept open, not only to allow FHWA a greater range of functions but also to attract involvement by smaller, more innovative private sector firms.

Mr. Crosby listed three distinct types of barriers to IVHS development and deployment:

- the technological barrier, which is the most easily resolved;
- the institutional barriers, which are the subject of this workshop; and
- the barrier of market development and behavior modification that will be necessary for IVHS to succeed.

For example, Mr. Crosby pointed out that automatic teller machines were available for 5 to 10 years before people began to make full use of them. Failure to develop the IVHS market will create a substantial barrier, according to Mr. Crosby. He recommended that the strategic plan and operational tests focus on this barrier in addition to their other components.

In relation to these barriers, Mr. Crosby raised some specific issues. First, in the past, FHWA and the State and local agencies have enjoyed a partnership with a common commitment to building and maintaining the interstate highway system and adjunct roads. However, in the area of IVHS, FHWA has indicated much greater forethought about roles, innovation, and strategies than its State and local partners. As a result, Mr. Crosby believes that, for successful deployment of IVHS, FHWA must assume a more aggressive role by tying allocation

of Federal dollars to the State and local agencies' activities toward IVHS deployment. He contended that FHWA should offer direction in matters such as alternative routing by at least requiring that the local agencies resolve the problem among themselves.

Ultimately, Mr. Crosby asserted, the motorist, or the consumer, pays for IVHS (even if the public sector funds the infrastructure) through gas taxes or user fees. However, only those who can afford to buy the in-vehicle receiver offered by the private sector will receive the full benefit of IVHS. Mr. Crosby maintained that this issue of equity also warrants attention.

IVHS Deployment and Public/Private Sector Issues

Sigmund Silber, an independent management consultant, focused on ways to encourage more private sector involvement in IVHS, viewing the program from the perspective of a telecommunications firm. In reviewing a number of

issues, Mr. Silber's conclusion was that private sector firms must understand the investment decision they are making before they become involved. They need to be able to determine their initial and operating costs and their revenues.

The private sector may assume several different roles in IVHS: consulting, supplying software, integrating IVHS systems (designing and deploying the infrastructure), operating and managing the system as the ultimate service provider, or providing additional services to either the facilities managers or the traveling public.

In making their investment decisions, private sector firms must consider benefits, match benefits to costs, and determine how to recover the costs of supplying those benefits. Mr. Silber presented a benefits matrix (Table 1), with benefits listed on the left side and recipients of the benefits shown across the top. The percentages show who receives benefits in each category.

Table 1. Intelligent Vehicle-Highway Systems Benefits Matrix

	Individual Travelers	Fleet Operators	Businesses	Government Agencies	Society at Large
Safety	40%	20%			40%
Congestion	30%	20%		20%	30%
Environmental Benefits					100%
Energy Conservation	30%	10%			60%
Universal Mobility and Accessibility	70%	10%		20%	
Public Transportation	60%			20%	20%
Economic Activity	40%		40%		20%
Law Enforcement				30%	70%

Source: Sigmund Silber.

The costs of supplying benefits to society at large cannot be recovered from the private sector viewpoint. However, the costs of certain categories of benefits can be more easily recovered, such as the costs of providing benefits to fleet operators, which are the most easily recovered on the matrix. A close analysis of the benefits would further segment the recipients into different types of fleet operators (e.g., long-distance and intracity), individual travelers (e.g., those with young children or with disabilities), etc. Various factors preclude capturing 100 percent of the value of benefits, so the next consideration is what Mr. Silber called the “payability index”; i.e., how much the recipients of benefits are willing to pay for them. These steps help the private sector determine their market.

In conclusion, Mr. Silber offered several recommendations:

- (1) include an example of each possible private sector role in operational tests;
- (2) determine methods of estimating alternate routing and incorporate them into operational tests;
- (3) to develop the industry, examine the benefits and share the information with private industry in a precompetitive stage of the IVHS program;
- (4) develop an outreach program to categories of companies in the private sector who are not involved in IVHS; and
- (5) understand the technologies that drive these companies and show them how IVHS fits with these technologies.

IVHS Deployment and Public/Private Issues: A Purely Private Model

From his background in electronic transaction processing in the banking industry, Richard Darwin, Business Development Manager for the Information Systems Business Group at Battelle Memorial Institute, defined ATIS as a service for individual travelers. The definition of a business opportunity, he contended, is critical. To grow and be profitable, the business must have a certain environment and must be packaged in such a way that consumers will use the service it provides.

In the deployment of IVHS, Mr. Darwin chose to examine the franchising model,

making several recommendations for implementation. The environment must first be set: public agencies should organize themselves into a businesslike public corporation so that private firms know who the “authority” is. The public agencies should then develop a business plan that would define the public sector’s commitment to IVHS technology and would include the following elements of that commitment:

- (1) pursuing marketing strategies that maximize the use of ATIS products and services;
- (2) operating an ATIS that minimizes safety risks;
- (3) acquiring an ATIS that minimizes the risk of technical obsolescence;
- (4) implementing procurement policies that reward cost-effective solutions on the basis of value pricing; and
- (5) engaging in business arrangements that return revenue to the “authority” treasury. In other words, the public authority would operate with the same incentives as the private franchise. According to Mr. Darwin, the type of public authority that he proposed does not exist.

Mr. Darwin offered an ATIS deployment scenario with two paths: Path 1 involves developing a proof-of-concept model, using FHWA funding; and Path 2 involves using the RFP process with financial incentives to stimulate private sector interest. In either case, Mr. Darwin maintained, successful IVHS deployment must be viewed as a process from which the private sector can profit.

Critique of Panel 2

From the perspective of his experience as general manager of TRANSCOM, an entrepreneurial organization in a government setting, Matthew Edelman expressed sympathy with the panelists. TRANSCOM has the job of breaking down bureaucratic boundaries. One current IVHS project involves seven agencies. The multi-jurisdictional issues do not arise in working with engineering and operations staff; however, hidden under those seven agencies are also seven sets of purchasing, accounting, and administrative staff whose requirements often conflict. Mr. Edelman suggested that not only government but also private businesses are not geared for the revolution of IVHS deployment. One step in

addressing these problems, he suggested, is to have contracts lawyers join the IVHS Legal Affairs Committee.

Mr. Edelman maintained that there is no right or wrong in the determination of fees. He cited as an example the Port Authority Bus Terminal in Manhattan, one of the busiest bus facilities in the country. A large portion of its commuters are from Rockefeller Center. With IVHS in place, the employers at Rockefeller Center could be notified of any breaks in bus service for whatever reason; the employers could advise their employees to remain at Rockefeller Center until the problem is resolved. Sensitivity analysis has shown that this service could return a profit, but only three employers would become involved in it.

Mr. Edelman agreed with Steve Crosby that creative iterative approaches are necessary in the deployment of IVHS and that the parties involved must be flexible in using public resources as efficiently as possible. He cited another example involving traffic services. TRANSCOM has a large network whose main linkages include speed dialing and an alphanumeric pager that receives messages from a variety of sources, including transit police, traffic agencies, and traffic services. The information is transmitted to all affected parties, including the traffic services. The question in this situation was, who charges whom? The arrangement decided upon was for the traffic services to supply TRANSCOM with information when appropriate and TRANSCOM to give the traffic services access to all information received on the TRANSCOM network.

Open Discussion

Private Sector Interest in IVHS

Hans Klein of MIT asked why so few private sector organizations participated in the workshop. Sigmund Silber replied that the bulk of the private sector is not willing to invest in developing models and that the Federal Government and IVHS AMERICA must supply the leadership to help the private sector see the value of models. Phil Tarnoff disagreed with the contention that interest is lacking in the private sector, with the possible exception of the telecommunications industry. He contended that the problem is the lack of fully defined roles that, if defined, would allow the government to advise private sector parties where to invest. Ed Rowe added that the prob-

lem is lack of policies, not lack of interest from private firms; the firms seem willing to invest in various types of equipment and techniques for distributing the information.

Don Savitt commented that, to encourage private involvement, the existence of the market must be proved and price sensitivity must be determined. He noted some disagreement among the participants about who should conduct market analyses, commenting that Hughes Aircraft is doing it because the company is concerned about whether or not there is a market. Mr. Crosby commented that investment dollars are difficult to acquire; large companies hesitate to invest unless they can foresee \$50 to \$100 million in business opportunities, and small companies have difficulty just raising the money. He maintained that, if FHWA desires private sector involvement, it must increase sensitivity to proving, demonstrating, and developing a market. Data that can be used in producing a business plan must be developed. Mr. Silber added that, as he pointed out in his presentation, different investment models are needed for different private sector roles—e.g., the investment criteria for systems integrators are different from those of hardware suppliers.

Matthew Edelman contended, however, that this need for market research presents a dilemma for government agencies who must show progress in the deployment of IVHS regardless of the commercial market. Government agencies cannot tell a Senate or House of Representatives oversight committee that they have not started the design work because they lack a rigorous basis for determining private sector interest.

Philip Tarnoff asserted that the question is a matter of economic analysis; i.e., can the private sector make money? To determine the answer, Mr. Tarnoff maintained that the market must be segmented and the price that users are willing to pay must be determined. Steve Lockwood asserted, however, that the end users and the market (i.e., those who pay) may not be the same. On the other hand, determining whether individual users, employers, or cities will be willing to pay for the benefits of IVHS is crucial to inducing private sector involvement.

Multiple Jurisdictions

Gary Ritter of U.S. DOT commented that panel members have stated that the private sector is

well suited to working across jurisdictional boundaries, whereas others have indicated a desire for government agencies to unify under some sort of authority. Mr. Darwin replied that developing an authority would solve problems of who makes decisions, who supplies the funding and how it works, and the possibility that one of the parties could disrupt the revenue stream. He characterized the problem of balkanization as a critical barrier. On the other hand, Matthew Edelman feared that this type of authority, which would not represent any specific agency, would meet with more mistrust than the various agencies themselves. He agreed that government must change its way of doing business so that these divisions appear seamless to the outside world, but was skeptical that the answer lay in forming an authority.

Ed Rowe suggested dealing with balkanization in a phased manner, working first with the State agencies that control the major highways and then building upon that relationship. "Sometimes," he said, "you have to make the smaller agencies that seem to be more parochial offers they cannot refuse."

Steve Crosby maintained that, as the agency which provides much of the funding, FHWA is in a position to facilitate breaking down jurisdictional barriers by properly leveraging its resources. Bill Hyman maintained that the metropolitan planning organizations (MPOs) may be the key organizations to solve many of the coordination problems because the problems are primarily at the local level. Matthew Edelman offered examples of situations in which MPOs had played such a role. In contrast, Steve Lockwood pointed out that the track record of local governments in implementing or operating such a system is weak at best and that examples of one or two cities or counties should not suggest that the problem is solved.

Ed Rowe agreed that the public sector has indeed had problems in fulfilling their responsibilities in managing their systems. He contended that a simple management concept is needed and that the owners of systems must have the ultimate responsibility. They may delegate that responsibility through contractual mechanisms, but they must maintain their responsibility. In doing so, they will collect traffic information, and the issue is how to maximize distribution of that information to

the private sector. Mr. Rowe contended that this task goes beyond the public sector's capability.

Phil Tarnoff defended the local agencies, reminding the participants that they are not performing operations and maintenance as they should because they lack funding and staff to do it properly. Furthermore, this situation is not likely to change. In addition, the capabilities of local jurisdictions are uneven. In the Washington, D.C. metropolitan area, for instance, Montgomery County, Maryland, is considered advanced in the area of IVHS. Its neighbor, Prince George's County, has no advanced traffic control systems. Fairfax County, Virginia, one of the wealthiest counties in the country, has no traffic control system. The Alexandria and Arlington systems are 10 years old and should probably be replaced. The city of Washington just spent \$30 million on a traffic control system containing 150 detectors for 1,200 intersections, and it is doubtful whether any of them are working. Mr. Tarnoff further maintained that, unless these problems are addressed and a different approach is adopted, IVHS implementation will not be realized for 30 to 40 years.

Panel moderator Bob Ervin used a viewgraph to illustrate this point. It showed metropolitan Detroit, with 106 municipalities, 3 counties, and the State DOT. The State is pouring money into freeway detectors. However, the communities are experiencing tremendous financial distress. Furthermore, the communities lack incentives to put in surveillance. Their logic is that, if they have no surveillance system and therefore no data to offer to a central data collection facility, those who are guiding traffic will assume that their roads are clogged and not divert traffic there; Mr. Ervin called this logic the "islands-of-darkness" mentality. Communities also lack any tradition in the technology. For these reasons, Mr. Ervin maintained that IVHS will not be implemented through local levels, regardless of how much sense it makes or how well it works.

These problems led to the question of probes. Mr. Ervin outlined four ways to seed a probe fleet: (1) hardwiring the expressway system to produce a skeleton fleet; (2) using the limited data to attract users, who then become probes; (3) detecting signals propagated by cellular telephones; and (4) using the toll tag fleet.

In conclusion, Mr. Ervin maintained that the basic issue is twofold: private models do not provide adequate traffic management, so public control should remain on the traffic management side; on the other hand, the public

sector represents a very weak link. If the IVHS community relies too heavily on that weak link for broad deployment, a generation may pass before it is realized.

Panel 3: Procurement Issues, Operational Tests, Design and Deployment Issues, and Other Topics

Design and Deployment Alternatives for ATMS and ATIS Components of IVHS

Jack Kay, President of JHK & Associates, began his presentation with a series of “if, then” statements to establish some assumptions upon which his viewpoint is based. First, if one believes in a strong need to implement IVHS, then a major task lies ahead. Second, if one holds that this implementation must be carried out in the same fashion that freeway management has been carried out, then implementation will not occur. However, both the public and the private sectors play significant roles in this implementation.

Mr. Kay considered three approaches to implementing IVHS: the classic, or engineer-contractor, approach; the program-manager approach; and the design-build approach. Although the first approach fits the institutional model, guarantees the low bid, and is easily managed, it has some disadvantages that, according to Mr. Kay, constitute fatal flaws. The engineer-contractor approach takes longer to deploy because tasks are carried out sequentially, sometimes with long gaps of inactivity. During those gaps in time, specifications for equipment may become obsolete. The contract may also be the wrong type: the selection of the prime contractor is particularly important, for instance, because that organization will solicit the component parts, and it must consider the quality and maintainability of those components.

The program-manager approach uses a single person—whether a staff member or a consultant—who is selected on the basis of technical qualifications and who serves as the point of control. This approach avoids the low-bid mentality and the problems associated with choosing the wrong prime contractor. The contract would be a cost-plus-fixed-fee contract, which is easier to modify and may reduce costs because procurements are broken up into appropriate packages. The program-manager approach would require reduced public-agency staff, and it should offer faster deployment because the program manager can use alternate procurement techniques. This approach is also somewhat consistent with institutional practice. A disadvantage is that some agencies may want to use traditional award-cycle procurements.

The design-build approach deviates further from the classic approach in the IVHS industry, but is not unusual in such other government arenas as the Department of Defense (DOD). This approach should significantly reduce delivery time, reduce demands on the public agency, and reduce costs through procurement efficiency. Again, selection of the designer and builder should be on the basis of qualifications. The design-build approach has some disadvantages, primarily institutional, such as the task of convincing those involved that it is a reasonable approach and does not preclude the traditional bid procedures. Assessing costs with this approach is difficult, and it may require either additional staff to monitor work or an independent contractor review agency.

Enhanced Procurement Procedures and Other Solutions to Maximize Private Sector Involvement in IVHS

According to Donald Savitt, Business Development Manager for Advanced Traffic Management at Hughes Aircraft Company, his company's interests in IVHS lie in the areas of ATMS and toll roads, which he said differ only in the collection of tolls in addition to ATMS on toll systems. Hughes is interested in several areas of involvement with these systems: financing of systems, a design-build approach to deploying systems, operations and maintenance, and franchising. Hughes can offer the following services or products in the IVHS arena: program management, system design, top-down system design, advanced technology subsystems, installation, and integration.

Mr. Savitt explained that the traditional procurement approach—what was called the design-contractor approach—creates problems for a company such as Hughes. If Hughes participates in the design under this approach, the company is excluded from providing hardware. However, the design alone does not generate enough business to interest the company, so their strategy must then be to convince the design firm to include the types of products Hughes supplies in the design; then Hughes can submit proposals to supply subsystems. According to Mr. Savitt, this scenario is “the only game in town.”

On the other hand, toll road projects follow a model to which Hughes is more accustomed: the DOD model. Using the DOD model, an agency would hire a technical advisor to write a functional and performance specification; the agency would then issue an RFP. With the advice of their technical advisor, the agency would award the contract and provide technical oversight of the program. Program oversight includes regular reviews in which the contractor must show compliance with the performance specifications before the project can progress. The contractor “goes out on a limb,” agreeing to complete the work for a specified price and within a specified time before the work begins.

Mr. Savitt also raised other issues that hinder private sector participation in IVHS.

Each State has its own qualification requirements, so every product must be qualified in all 50 States. Standards must be set at the appropriate time. The company takes an investment risk in developing or purchasing products. The public agency must also realize that, although a company will install its products for free to demonstrate them and complete development, at some point the company must make a profit. Finally, State and local agencies should assess the value of a franchise arrangement for IVHS deployment.

Evaluating Institutional Effectiveness: Development of Concepts and Methods for Incorporation into IVHS Operational Field Tests

Jonathan Gifford, Assistant Professor in the Department of Public Affairs at George Mason University, and his coauthors, Brien Benson, Roger Stough, and Kingsley Haynes, examined technological development literature in IVHS and other technologies to determine how the institutional environment influences technological implementation. The institutional influence affects a technology's character, use, and the manner in which it reaches the market. In the IVHS arena, understanding the nature of that influence is extremely important. Therefore, in implementation analysis, the context in which technologies are implemented in the operational field test must be understood. For example, the analysis should answer the following questions:

- What is the institutional setting, and how does it influence the dissemination of the technology in these tests?
- Was the technology itself really tested, or did institutional problems hinder observation of the technology's full capabilities?
- How did the institutional setting facilitate or inhibit the dissemination of the technology?
- How did any institutional innovations perform?

Mr. Gifford and his coauthors classified the institutional influences into three categories: institutional relationships (relationships between organizations), organizational issues

(relationships within organizations), and behavioral influences (the impacts of program activities on the end users of the technology). In addition to these institutional influences, the nature of the technology itself may affect its implementation.

Mr. Gifford and his colleagues recommended that operational field tests review implementation on two levels: first, every evaluation should document implementation conditions to establish the institutional setting; second, certain evaluations should be chosen for in-depth case studies to identify and evaluate specific institutional arrangements. The categories to be evaluated and questions to be answered in each category are shown in Table 2.

According to Mr. Gifford, this in-depth case study would show, among other things, the significance of private sector versus public sector implementation strategies; areas in which training or other management techniques are needed to successfully implement IVHS; other field tests that are needed; the public response or lack of response to the information that IVHS supplies; and the price that the consumer is willing to pay for the information.

In closing, Mr. Gifford cautioned the participants that failure is an important part of the process of implementation. The IVHS community must be able to allow failures to occur; to learn from those failures; and, at the same time, to encourage, recognize, and endorse success.

Critique of Panel 3

Joseph Ligas, IVHS Program Manager for the Illinois DOT, cautioned the participants against becoming enamored with model institutional arrangements to the point of trying to fit a specific model to every situation. The models should be used as guides only. In reference to Mr. Kay's presentation, Mr. Ligas stated that IVHS must move toward the design-build and program manager concepts.

Mr. Ligas found Mr. Savitt's remarks very intriguing. He found Hughes' interest in IVHS to be extremely positive because it represents new players in the IVHS arena who have not traditionally been involved in surface transportation systems. He cautioned that the public sector must keep in mind that these players have different goals (which Mr. Savitt spelled out well) and a different corporate culture.

Table 2. Evaluation of Institutional Effectiveness: Areas and Questions

Evaluation Area	Evaluation Questions
Technology issues	1. Stage of development 2. Appropriateness 3. Distribution of benefits a. Public versus private b. Over time
Institutional issues	1. Established institutional arrangements? 2. Resources in the public versus the private sector 3. Cooperative arrangements
Organizational issues	1. Experience/in-house knowledge/expertise 2. Accordance with current rules/procedures?
Behavioral issues	1. Market demand, willingness to pay 2. Human factors

Source: J.L. Gifford, B.G. Benson, K.E. Haynes, and R.R. Stough. "Evaluating Institutional Effectiveness: Development of Concepts and Methods for Incorporation into IVHS Operational Field Tests." Prepared for the U.S. Federal Highway Administration, February 1992.

Mr. Ligas also agreed with Mr. Gifford's remarks. However, he believed that the paper dwells too much on institutional conflicts, negotiations, and problems that are not unique to IVHS but that occur in many types of partnerships. He advised that parties must be flexible and willing to change if IVHS implementation is to succeed. He concluded that operational tests must also allow the flexibility to change technology in midcourse if necessary.

Mel Cheslow, a consultant with the MITRE Corporation, based his comments on his review of Mr. Gifford's presentation and on his personal work experience. He stated that he views the private sector primarily as a service provider. Mr. Cheslow maintained that the IVHS community needs to understand what kinds of markets, fee structures, and cost recovery are possible.

Fees can be charged by a number of providers, whether from the public or the private sector: the collector of the information, the processor of the information, the communications service that carries the information, and the manufacturer of in-vehicle equipment. Disagreement may also arise over how fees are set; the public sector may want to set the fees and keep them low to encourage use of the information, whereas the private sector may want to set lower fees initially and then raise them over time to recover costs or make a profit. Therefore, fees could become a major issue.

Mr. Cheslow also warned that current operational tests may not offer the best setting for evaluating institutional issues because they are set up primarily as technical proof-of-concept evaluations. The organizational arrangements in these tests are not stable, long-term relationships. He suggested that participants of operational tests should be the partners who would also work together in a real operation. He further recommended that operational tests be run in two phases, with fees charged in the second phase.

Mr. Cheslow maintained that, in starting up a large ATMS or ATIS service, three questions must be considered: Should surveillance sensors or probes be used to gather sufficient traffic data for users to recognize its value? If a route is selected for route guidance, should user or system optimization be used to determine the alternate route? Will a startup service that does not provide route guidance be viable and attractive to users?

Mr. Cheslow advised FHWA to examine the experience of their sister agency, the Federal Aviation Administration (FAA), in regard to design-build contracts. According to Mr. Cheslow, FAA has experienced cost overruns, schedule slippages, and extreme criticism from the Government Accounting Office in its oversight role.

Open Discussion

Comparison of Toll-Road Projects with IVHS

Gary Maring from FHWA opened the discussion by asking Mr. Savitt why Hughes finds toll-road projects more attractive than ATMS or other IVHS applications. Mr. Savitt responded that, currently, toll-road procurements are designed in a way that favors Hughes. However, he believes that ATMS will eventually be a much bigger share of the market, particularly if the procurement rules change. He also commented that agencies procuring toll roads must satisfy an investor and make a profit, two requirements that give them a totally different point of view from that of an agency concerned with moving traffic and serving the public good. Mr. Savitt continued that, unlike several speakers, he believes that opportunities exist for franchising in ATMS projects as well as in ATIS.

Comparison of Models

Mr. Tarnoff questioned whether the DOD model is a good approach to follow. Mr. Savitt replied that DOD programs certainly are not always successful, but their approach is better for a larger company because the company must be able to design a system and make sufficient profit in product development to make the project worth their investment. He pointed out that confidence in a firm's ability to do the job should be higher in the IVHS arena because the technology is not as advanced as that in the defense industry.

Mr. Kay suggested that the architectural model, which is also a type of design-build model, might be more applicable. In this model, the first stage would be open competition, with significant proposals. At the preliminary engineering stage, the contract could then be negotiated to a fixed-price contract because, at that point, the components have been selected and the technical decisions have been made.

Evaluating Institutional Issues in Operational Tests

Mr. Chen raised questions about evaluating institutional issues in operational tests when some of the organizations are merely involved on an ad hoc basis. In reply, Mr. Gifford stated that some organizations will be involved in service delivery and that operational tests can therefore be used to evaluate institutional issues. He maintained that it is also important to determine what issues are unique to IVHS and to consider those issues in an institutional evaluation setting.

Mr. Savitt disagreed that institutional issues can or should be evaluated in operational tests. Hughes is involved in operational tests because they offer an opportunity to learn how to carry out a project, not because they might make a profit. He said that a company's approach to doing business is an open book. Regardless of the type of firm—whether design, engineering, etc.—each knows how it must operate to make profits. FHWA could have each potential player write a paper about the topic and would then know what each player needs for active participation.

Evaluating Willingness to Pay in Operational Tests

Mr. Chen's question also raised the issue of whether the public's response could be evaluated in operational tests. Mr. Gifford replied that some of the end users in operational tests will be the same as those in deployed systems; simulations can be built into case studies to evaluate willingness to pay.

Mr. Cheslow suggested that FHWA attempt to evaluate willingness to pay by having a university representative set up alternative fee structures and test them with different users. The fees should represent the potential costs of a system in 10 or 15 years. Mr. Cheslow contended that, however the evaluation is done, the topic warrants attention.

Steve Lockwood suggested that two types of operational tests may be needed: the technical proof-of-concept test and a proof-of-service-value test. The latter could use simple technology, be deployed in several metropolitan areas, and use various levels of information. The evaluation could take place over a period of years. Because the focuses of the two types of tests are so different, Mr. Lockwood suggested, integrating the two would be a mistake.

Mr. Cheslow agreed that the IVHS community can learn from the operational tests but expressed concern that, both in the public and in the private sector, those whose programs fail operational tests must somehow be protected. He countered, however, that successful implementations have been achieved in the trucking industry, with several activities continuing as firms rise and fall, and services being offered and eliminated as the industry attempts to determine the best package of services for trucking and fleet management. Mr. Cheslow suggested that this arena is a good environment for testing willingness to pay because the trucking industry represents a true end user with an economic stake in the future of IVHS.

Daniel Brand of Charles River Associates cautioned that evaluating institutional issues and evaluating consumer issues require different levels of analysis. Sigmund Silber agreed, adding that the process is threefold: at the beginning of the process is the technology, and at the end are the service alternatives and willingness to pay; in between is the impact on behavior. Before consumers are willing to pay, the service must have some impact on their behavior.

Mr. Savitt and Ed Mierzejewski, from the University of South Florida, both recommended TravTek as a good example of testing the consumer's willingness to pay.

State of the Art

As the session was ending, Gene Donaldson of the Montgomery County DOT challenged the perception that transportation agencies are "in the Stone Age." His jurisdiction is dealing with a defense firm as a single contractor in developing an advanced system, and other local agencies are ready to move forward. Mr. Kay countered that several good examples exist in which transportation agencies have used the engineer-contractor approach successfully; however, most agencies do not have the resources that Montgomery County has. Mr. Savitt added that his comments about agencies acquiring technical support apply only if the agency needs that support. Mr. Donaldson contended that the technology should be placed in jurisdictions that know how to use it properly.

Breakout Sessions

The participants were divided into three groups for each of the two time periods set aside for small-group discussion in the breakout sessions. The topic for all three groups during the first time period was Issues Affecting Public/Private Sector Roles in IVHS Deployment. Participants were asked merely to identify the issues during these discussions. On the second day, the groups discussed the following topics: Future Research Needs, Evaluating Institutional Issues in Operational Tests, and Public/Private Sector Roles in IVHS Deployment. The participants were charged not only to identify the issues in each of these areas but also to develop innovative strategies and specific recommendations and to establish some priorities in dealing with the issues to ensure the timely and successful deployment of IVHS.

Breakout Session 1

Facilitator Eva Lerner-Lam of the Palisades Group began by establishing a structure for the discussion. Participants were to raise either general issues or specific barriers related to IVHS deployment, specifying the category into which their comments would fall. At a specified time, the discussion ended so that the issues and barriers could be prioritized. Ms. Lam informed the group that they were not to offer solutions, although they could hint at them. However, offering solutions was to be reserved for the next day's discussion. The participants elaborated on some issues and merely restated other issues that had been raised during the panel presentations.

General Issues

Ms. Lam opened the discussion by listing the high cost of infrastructure as a general issue. One participant stated that, as discussed earlier, multiple agency involvement is definitely an issue. Another issue raised by the group was the degree of government control.

Another participant listed public benefits versus private benefits as an issue. He elaborated that, in the creation of Mobility 2000 and IVHS AMERICA, the concept was a closed-loop total systems approach and implied that the purpose of IVHS is for the public good. However, the discussions to date have dealt with open-loop systems and individual benefits. This participant maintained that a contradiction and a challenge exist in the viewpoints. The challenge will be to achieve system optimization through a bottom-up, open-loop type of approach. Tied to this issue is the contradiction in the philosophical approaches of the public and private sectors: the public sector is interested in service delivery, whereas the private sector is interested in profit.

Group members asserted that the public sector needs to understand what kinds of incentives are needed to encourage the private sector to invest in IVHS and what business risks the private sector is taking when it makes that investment. Introducing new products is difficult, and entering the market with advanced technology is even more difficult. How can the public sector "prime the pump" to encourage private sector investment, and what rewards should be offered for the risks that the private sector is taking? Another person countered that private sector incentives are fairly straightforward, but the multiple government agencies involved in IVHS often have different motivations and incentives.

Another participant maintained that the issue is more than just "priming the pump." The issue really concerns establishing an environment for public/private sector partnerships in IVHS. The private sector needs assurance of a long-term public commitment to IVHS, not only in philosophy but also in funding. A foundation of rules and regulations governing the public/private partnerships must be laid. The rules and regulations that establish the working environment should answer the following questions: What will the public sec-

tor allow the private sector to do? What markets and products will the government allow the private sector to have, or—viewing the question from the opposite end of the spectrum—what products will the public sector encourage, or possibly even pay, the private sector to produce? What does the public sector want in regard to IVHS? One participant asserted that the environment must be such that private sector firms can conduct market research and define the products for IVHS deployment in their local areas. Another person contended that definition of the products should be a cooperative process, with input from both the public and the private sectors.

One member of the group maintained that both sides tend to generalize about the parties on the other side: public agencies lump all private sector companies into a single category, and private sector firms lump all public agencies into a single category. For instance, many public agencies view all companies as having a product to sell and therefore being able to invest 50 percent because they can recover their costs and make a profit on the product. He pointed out that design firms, for instance, cannot invest 50 percent because they cannot recover that kind of investment.

Accountability was also discussed. The public sector may have an obligation to continue supplying a service that private sector no longer wants to support. One participant maintained that continued support should be built into the contract; for instance, in military contracts, the period of support may be as long as 25 years. This person also maintained that the project must be profitable to both parties; if it is not, the issue must be addressed.

Another area of concern was that the technology will become obsolete in a short time. The converse problem is the fear of advanced technology and trying to keep up with it, particularly for local municipalities.

In addition to technological instability, political instability emerged as a concern. A new administration may decide to exert greater public control over certain aspects of IVHS than the preceding administration exerted.

The need to integrate IVHS activities with advancements in other fields was also seen as an issue. For instance, FCC's redevelopment of the spectrum could eliminate some potential IVHS activities. However, communications among the various fields is extremely limited.

Finally, participants observed that the public sector's lack of technical expertise and the private sector's lack of transportation expertise affect successful public/private partnerships in IVHS.

Specific Barriers

To stimulate thought about specific barriers to successful public/private partnerships in IVHS, Ms. Lam listed government procurement procedures as the first barrier. This topic received a great deal of attention in earlier panel discussions.

Referring to the discussion of the environment for public/private partnerships in IVHS, one participant stated that the private sector does not understand the rules for these partnerships. This barrier may be the result of the number of public sector agencies involved. Private sector firms want to know who their business partners are and who is responsible for which specific duties under the partnership.

A related issue is the lack of a public sector "business plan" for IVHS. One participant suggested that IVHS AMERICA is a first step in developing the business plan, but others disagreed.

Another barrier related to the need for establishing an environment for IVHS is the current feeling of isolation between the public and private sectors. One participant expressed a feeling of "us versus them" as opposed to "us together as a team."

One group member observed that the lack of standards and protocols is a barrier to IVHS development. Another person commented that IVHS does not have a standard systems architecture. However, someone pointed out that development of standards too early could hinder development; thus, the issue is a "two-edged sword."

Liability issues also constitute a barrier to IVHS deployment. Many products will not enter the market unless liability issues are addressed. In addition, fear of antitrust actions hinders development; companies need to be able to work together.

Referring to the "islands-of-darkness" phenomenon described in an earlier panel presentation, one participant asserted that local public agencies have no incentives to become involved in IVHS. Another person com-

mented that this problem is prevalent, particularly in home-rule States.

Another participant stated that the absence of intellectual property rights for the private sector is also a barrier. If a company designs a product for a public agency, can that agency give the drawings to another company? In the military environment, private firms bear all the investment in the products and can then sell them to a broad market to recover their investment. Is the same true for IVHS? The answer to this question is not clear. If projects are jointly funded, who owns the product?

Finally, a specific barrier to IVHS deployment is the “buy local” mentality in many areas of the country.

Prioritization

As the final step, each participant assigned a priority rating (high, medium, or low) to each topic. The votes were then tallied, and topics were prioritized according to the rank each received from the majority of participants. The results of this procedure are shown in the Table 3.

Table 3. Prioritization of Intelligent Vehicle-Highway Systems Issues and Barriers

Priority	Issues and Barriers
High	<ul style="list-style-type: none"> • Need for assurance of long-term public commitment • Public benefits versus private benefits • Understanding private sector investment incentives • Understanding public sector incentives • Business risk to private industry • Procurement procedures
Medium to High	<ul style="list-style-type: none"> • What will the public sector allow the private sector to do? What markets and products will it have? What does the public sector really want? • Lack of technical expertise in the public sector and lack of transportation expertise in the private sector • Lack of a public sector business plan • Lack of standards and protocols • Disincentives for local agency participation (the “islands-of-darkness” phenomenon) • Liability issues • Intellectual property rights
Medium	<ul style="list-style-type: none"> • High cost of infrastructure • Multiple agency involvement • Degree of government control • Technological obsolescence • Fear of advanced technologies • Political instability • Lack of understanding of the rules of the partnership
Medium to Low	<ul style="list-style-type: none"> • Tendency to generalize all public agencies into a single category and all companies into a single category • Public sector accountability • Need to integrate IVHS activities with advancements in other fields • Feeling of “us versus them” instead of “us together as a team”
Low	<ul style="list-style-type: none"> • Fear of antitrust actions • “Buy local”

Breakout Session 2

Facilitator Tom Urbanik, Texas Transportation Institute, explained that the goal of this breakout session was to examine the public/private sector cooperation in IVHS.

Public/Private Boundaries

The discussion began with the question of whether the boundaries were clear in the public/private mix in Commercial Vehicle Operations (CVO), AVCS, ATMS, and ATIS. The general consensus was that there were not as many opportunities for public/private collaboration in CVO as there were in ATIS because the CVO market was not as big as the ATIS market.

One participant said that the boundaries of participation between ATIS and ATMS were not clear mainly because of how each of those designations was set up (technical committees). Another participant said that, from a private sector point of view, if travel information is provided on a sign, then it is free and is classified as ATMS; however, if the information is provided directly to the vehicle, charges for the equipment needed to maintain the system can then be made.

Markets

One participant urged that a distinction between the market and the user be made because sometimes the entity paying for the service is not the end user. As an example, he cited a hotel that paid for an advertisement in an in-vehicle information system in which the end user is clearly the driver. This distinction must be made because the public sector needs to know whom to approach to market IVHS. The usual view taken by entrepreneurs—that the entity that pays for the service is the end user—cannot apply to ATIS. Another participant said that ATIS could be expanded to use in such other areas as regional telephone companies, cable companies, and weather services. ATIS would enhance each of those service areas by providing valuable information to the end user. This expansion would be very easy to finance. A workshop participant added that employers who had trip reduction requirements would be willing to pay for ATIS, although the ultimate beneficiary would be the actual worker making the trips. The plan for the next few months should be to sell employers on the market value of ATIS.

Absence of the Private Sector at the Workshop

The group listed the following reasons why the private sector did not attend this conference:

- **Lack of private sector awareness.** For the most part, the private sector is not aware of the total picture for IVHS. Most private sector industries are interested only in their specialties.
- **Private sector segmentation.** Different private sector firms would have interests in the various parts of ATIS. For example, as a result of antitrust actions, telecommunications companies—such as the Regional Bell Operating Companies (RBOCs)—have certain legal restrictions placed on them. Within these RBOCs are two divisions (cellular and wireless) that have particular interests in ATIS. The cellular communications division is interested in communicating to people on the move. The completely separate wireless division is a corporate planning activity. These two elements within the same company constitute a prime example of how private sector companies can have varied interests in ATIS.
- **Private sector hostility.** Many private sector organizations have reservations about the public sector, viewing it as inefficient or incapable of managing IVHS.
- **Insufficient public sector capabilities.** The public sector does not have the mechanisms to deal with the franchise model, which is a crucial private sector interest. The private sector also wants exclusivity, which the public sector cannot provide.

Investment

The participants discussed whether the private sector should profit from the public sector's investments in IVHS. The group agreed that the private sector could profit from the public sector investment. They said that some of the money expended is "sunk," and some of the money invested clearly yields public benefits. For example, much of the data needed for ATIS is already being collected. The participants also mentioned that the commonality of interests between the public and the private sectors in a partnership overrides this concern. However,

one participant said that sometimes the private sector is reluctant to enter into joint ventures with the public sector because the public sector cannot give any guarantees to its private sector partners (e.g., the public sector cannot give exclusive access).

Cooperation Between the Public and Private Sectors

The group discussed various factors that enhance or hinder cooperation between the public and private sectors. One participant said that the existing informal cooperation efforts between the public and private sectors need to be less institutionalized. The public sector's inability to grant exclusivity causes a private sector reluctance to enter into public/private partnerships. One participant said that with franchise fees and up-front public sector funding, the private sector would be more comfortable with the relationship. Another participant said that legal issues impede public/private cooperation. Each State has different regulations for the parameters for public/private cooperation. He added that public/private cooperation would benefit from removal of those legal barriers. The participants also discussed whether the public or the private sector should take the lead in implementing IVHS. The group agreed that the cellular telephone industry or other private sector areas may be able to move ahead and draw in the public sector. Finally, the group agreed that both the public and the private sectors should know more about their markets and profitability to enhance opportunities for cooperation.

Conclusion

The consensus on IVHS was that the private sector's major role with respect to being an investor and ultimate service provider should be in ATIS, and the public sector's concentration area should be in ATMS. Surveillance, the participants agreed, was a common aspect. However, there was no consensus on route guidance.

Breakout Session 3

Facilitator Dave Gehr, Assistant Commissioner for Operations at Virginia DOT, opened the session by asking participants whether they wanted to begin with any of the sample questions that had been distributed in advance. Although no one in the group chose to address the questions directly, several people com-

mented on the wording of particular questions or on their implications.

Arrangements versus Elements

The group generally agreed with one member's comment that the local context must be taken into account for successful IVHS deployment to take place; several people said that the best partnership structure would be the one that best fit the situation. The group agreed that IVHS deployment activities must be tailored or customized to fit a community's needs. Some people felt that using *arrangements* as models is not as helpful as evaluating the successful *elements* within arrangements. These participants argued that successful elements are simpler to replicate than are whole programs; there are no standard solutions. One participant noted that "what's successful in one place won't necessarily work someplace else."

One member of the group said that discussing partnership arrangements or what kinds of standards should be applied to IVHS deployment arrangements is "premature." He felt that time would be better spent cataloging the successes and failures of ongoing programs. This process would show what tactics work best in various situations.

Feasibility of Public/Private Partnerships

Models of successful public/private partnerships were discussed, including the cellular phone industry and public utilities. The group felt that the public sector's concerns (the public good, safety, etc.) and the private sector's concerns (profit, government regulation) must be balanced.

One individual took issue with the idea of public sector control of IVHS deployment as the default option; he said that neither sector "owns" IVHS. Several participants pointed out that the private sector's willingness to take a leadership role in product development, research and development, and new applications for technology is tempered by its reluctance to invest in an uncertain regulatory climate.

Several people talked about incentives for the private sector to invest in IVHS. The two incentives that were mentioned most often were: (1) profit; and (2) consistency of government regulations. According to several members of this group, assurances that "the rules [i.e., government regulations] won't change" are necessary to spur private sector investment.

The group seemed to concur that any investment is a “leap of faith” to some degree, but that the private sector is entitled to some amount of certainty, if not to guarantees. The group agreed that the public and private sectors both need to learn about each other’s decision-making criteria and processes. The private sector has already made substantial investments in IVHS, but private investment will diminish until the incentives to invest outweigh the risks.

It was noted that lack of coordination within the public and private sectors further clouds the issues in public/private partnerships. Many agencies within the public sector (including FHWA, the Environmental Protection Agency (EPA), and agencies responsible for enforcing the new Americans with Disabilities Act requirements) will have a stake in IVHS deployment. The private sector is not monolithic; moreover, private sector entities are generally focused on competing rather than cooperating with one another.

The participants expressed some confusion about what the private sector would provide to IVHS deployment. Three possible roles for private sector entities were identified: (1) contractors responding to public RFPs; (2) product developers responsible for conducting research and development activities; and (3) service providers. Because the technology of the future cannot be predicted at this point, the group was unable to reach a clear definition of what the service-provider role might entail. A few members of the group stated that they did not understand what the private sector could be relied upon to provide to IVHS deployment.

Someone proposed the weather information system as a model, but the group did not feel that an “open loop” (i.e., a program that allows totally open participation, with no reporting requirements and little regulation) could be applied to IVHS. It was stressed that IVHS must remain connected to the fundamental goal of the public good.

The Trafficmaster System in England was also discussed as a possible model. Trafficmaster, which is 100 percent privately funded, was founded with venture capital. The company’s decision to enter the market was probably based on the availability of the technology, its relatively low cost, and ease of production as well as a belief that the product would sell. Trafficmaster applied to the British government traffic authority to obtain a license

and permission to install sensors on the public right of way.

Some regulation is necessary, according to the group, for safety if for nothing else. For example, there must be requirements regarding proper installation, integrity testing, and maintenance work on any hardware installed on public roads. The group agreed that central to the public/private partnership debate is the question that one participant posed, How do we meet all parties’ goals concurrently? It was suggested that decision modeling or analysis may be helpful in determining a mutually acceptable course.

Identification of IVHS Users

Two groups of users were identified: (1) Federal, State, and local authorities responsible for implementing and coordinating systems; and (2) travelers. Several people thought that talking about IVHS deployment at this point is “putting the cart before the horse,” because so little is known about what kinds of technology will be available and how great the demand will be.

Some of the breakout participants said that the true “end user” is the traveler. These people were quick to point out that the evidence collected to date shows that IVHS may have little impact on the way people choose to travel. Studies have shown that even if travelers are provided with information on upcoming congestion and alternate routes, they will not necessarily change their route accordingly. People are, as one participant put it, “not 100 percent rational decisionmakers.” Their route choices may depend on a wide range of variable factors that studies cannot identify. In some locations, there is only one way to get from Point A to Point B, so travelers cannot choose a route. Several people in the breakout group warned of “information overload”; i.e., giving people more information than they can absorb. According to the group, more studies on traveler behavior are needed to further clarify the kind of information travelers will use and why they will use it.

The Market for IVHS Technology

A related topic was the market for IVHS: if consumers are unfamiliar with the product and do not understand how it would be useful to them, then demand for the product will be limited. The consensus was that applicable market research on IVHS and its niche is still

lacking. The participants had several questions, such as who the market is, whether the market can be expanded, how the market can be expanded, and whether the marketing focus should be on consumers or on regional authorities.

The group unanimously said that the initial market will almost certainly be commercial. Companies such as Federal Express, United Parcel Service (UPS), and courier and messenger services, that focus on deadline deliveries are the most obvious market for in-travel information. To develop a broad public market, consumer education is necessary. The cellular telephone market was discussed as a model in connection with this topic. According to one member of the group, when cellular telephones were first available, no obvious market for them existed; however, as consumers grew more familiar with cellular telephones and came to value their convenience, the market grew. Another member of the group pointed out that in the case of cellular telephones, the Federal Communications Commission (FCC) played an enabling or facilitating role by defining the market. Automated teller machines (ATMs) were discussed as another product that created its own market. Once people used ATMs, they liked the convenient service—and now they are even willing to pay to use ATMs. The overriding question regarding the subject of consumer education was who ought to pay to fund the

learning curve—an investment that may not pay off.

Again and again the group stressed that the volumes of data generated by IVHS will be valuable. The public sector could sell this information, one person said; another person quickly noted that if the information is available to everyone free of charge, no one will pay for it. However, one group member maintained that the weather service model, which is similar (in data collection and dissemination) to IVHS, indicates that consumers will pay for the information. Other participants said that the situations are not comparable because the public good is the primary justification for the weather service system. Some of the group felt that IVHS deployment could be a win-win situation, but others thought that other parties with a stake in IVHS could lose. One example was EPA and its concerns about air quality.

Breakout Session 4: Future Research Needs

Facilitator Mike Meyer of the Georgia Institute of Technology opened the session with a brief description of the breakout format the group would use. First, he presented a diagram of the possible public/private partnerships that could be used in IVHS deployment (Figure 1).

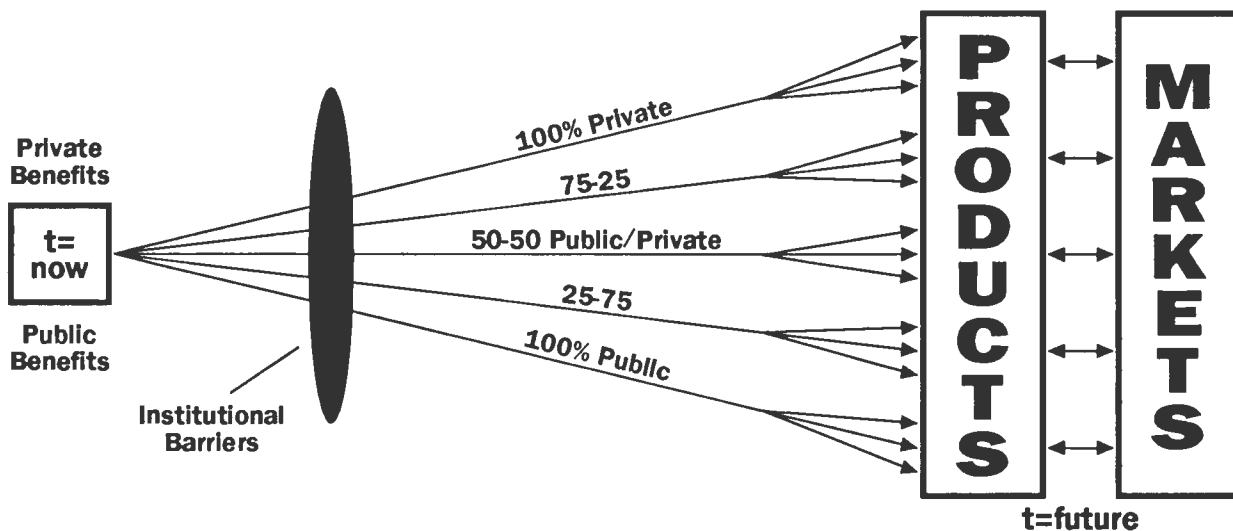


Figure 1. Possible Methods for IVHS Deployment

Next, Mr. Meyer presented the five working hypotheses that guided the discussion in the earlier sessions of the workshop:

- The partnerships and the general processes involved in IVHS deployment will be market-driven.
- The benefits of IVHS will be perceived as value added to other goods.
- Institutional structures are not expected to change drastically for the sake of IVHS.
- IVHS deployment must be flexible enough to be tailored to local needs.
- The public and private sectors will share the costs of IVHS deployment.

These hypotheses were examined, discussed, and commented upon by the breakout participants.

Mr. Meyer encouraged the group to spend its time wisely by concentrating on topics that could be discussed profitably. Questions that could not be addressed satisfactorily, such as those concerning future technology and institutional change, were to be avoided. He stressed that the group's charge was to present recommendations for the top-priority research needs that would pave the way for successful IVHS deployment. Mr. Meyer told the group that the session would end with a comparison of the breakout group's priorities and those set forth in the Strategic Plan for IVHS in the United States.

The group began the discussion by listing various concerns, discussing them, grouping them into general categories where possible, and then ranking them in order of importance. Following, in priority order, are the group's major topics.

Motivation, Benefits, and Resources

The group agreed that the motivations for all players involved in or affected by IVHS deployment—governing authorities, providers, and consumers—must be carefully examined. For the public sector, this examination of motivation means understanding what the “public good” means in IVHS terms. In cases involving a desired public benefit but no obvious opportunity for profit, how can the private sector be induced to invest? What kinds of incentives are necessary? What assurances or incentives (e.g., changes in the tax code, a set-aside IVHS account, etc.) are needed and

can be given to the private sector to increase investment in IVHS? How can these be harmonized with Congressional concerns? How must partnerships be constructed to maximize public benefits?

For the private sector, this examination of motivation means achieving a clear definition of what kinds of assurances are sufficient to balance the risk of investment; defining the roles the private sector can and should play in IVHS deployment; and assessing the profitability and market potential of IVHS endeavors.

The motivations of the end users, the traveling public, also need to be better understood. Market research can help to define the utility of IVHS capabilities to consumers. Travel behavior must be researched, as must the techniques for and costs of developing the market.

Models of Public/Private Partnerships

The group disagreed about whether the focus should be on successful partnership arrangements per se or on the elements that make particular arrangements successful. Some people maintained that Ken Orski's analysis of the five possible types of arrangements should be used as a starting point for further research; others believed that each of the five models could vary greatly depending upon its internal structure, and so the elements—rather than the models in their entirety—should be the unit of analysis.

Partnership models that were mentioned included franchises and contractors. For services provided by the private sector, the group suggested that the public sector contract work to the private sector or retain private sector consultants. Procurement procedures were also discussed as a facet of partnership models.

Here again, the local context was of paramount importance to the group. Members stressed that the most successful systems are those that are custom tailored to meet local needs.

Pilot Studies

The group differentiated operational field testing (for technology and hardware) from what they called pilot studies, which would be designed to account for the system's actual use and utility once implemented. For example, pilot studies would include gathering data on consumer response and on institutional issues.

Risk assessment research, including the concerns of environmental groups and others, could also be incorporated. These areas are not currently included in most field tests; they could be conducted separately from or as part of planned field tests.

Technology transfer, using techniques or models that have been successful in other settings, was mentioned as an important subtopic. Non-U.S. models, such as Trafficmaster in the United Kingdom, would be a good starting point for this research. Decision modeling or gaming is another possibility for this research.

Procurement Procedures

The group acknowledged that the private sector needs to better understand Federal Acquisition Regulations (FARs). However, the utility of FARs in this application should be evaluated. If current procurement procedures hinder private sector investment, perhaps other arrangements should be considered.

On the basis of FHWA experience, what options to encourage private investment have been most successful? Would easing Federal procurement requirements encourage investment? What alternative systems can be used at each level of government? Appropriate procurement procedures must take legal issues and Congressional requirements into account as well.

Two types of procurement are relevant to IVHS: one is for research and development activities, and the other is for actual deployment of systems (involving architectural design, production of goods, placement and maintenance of equipment, etc.).

Legal Issues

The group discussed legal issues related to IVHS deployment. Participants did not mention specific cases but noted that tort liability must be considered in all policy decisions. Privacy concerns (an issue because much of IVHS depends on tracking capabilities) are another relevant issue, as are antitrust requirements. In addition, partnerships must be structured to protect intellectual property rights. Regulation will be necessary to ensure the protection of the public's rights and also to avoid legal liability arising from infringement of these rights.

The group agreed that before action is taken, research to determine the degree to which legal concerns inhibit private sector in-

vestment should be conducted. In addition, the participants asserted, the question of how to divide the burden of legal responsibility between the public and private sectors must be answered.

Regional Governance

This research, according to the group, should begin by cataloging possible and actual structures, noting what systems have been successful or unsuccessful and why. Subtopics in this area included regional regulatory issues, intermodal transportation issues, and partnership issues. The group asked what institutional or regulatory barriers make effective coordination difficult to achieve; how regional authorities can integrate IVHS into intermodal transportation systems and planning; whether it is possible for a regional authority to own and manage a project for profit; how jurisdictions will be defined; and what partnership structures will enable effective IVHS deployment within regions. This research would help define the degree to which regional institutional integration is necessary or helpful for successful IVHS deployment.

Skills and Training Requirements

Several people in the group felt that the training needs for administrators, regulators, and technicians involved in IVHS deployment should be researched. Questions to be answered in this area include the following: What skills will be required? Will IVHS become part of civil engineering curricula? What professional positions will be available in IVHS? Can demand for professionals be projected?

Comparison with the IVHS AMERICA Strategic Plan

The three research and development areas highlighted in the Strategic Plan for IVHS in the United States are:

- (1) legal and institutional issues;
- (2) socioeconomic issues; and
- (3) benefits analysis.

All of these areas were discussed by the breakout participants. Legal and institutional issues were a constant subtext throughout the session. Socioeconomic issues and benefits analysis were covered under "Motivation, Benefits, and Resources."

Breakout Session 5: Evaluating Institutional Issues in Operational Tests

Facilitator Donald Orne opened the session by explaining how participants should develop products from the breakout discussion: identify key issues, look for innovation, develop strategies for implementation, identify specific researchable topics, set priorities, and—most important—be specific. Mr. Orne presented the following questions to guide the discussion: (1) Why evaluate? (2) What are priority issues? (3) What is not known? (4) What can be done? (5) What should be the action agenda? The participants agreed that the discussion need not be limited to current operational tests. In addition, the discussion might include the issues raised in the panel discussion of elements that could be included in the tests; i.e., technology, institutional issues, and market mechanisms.

Why Evaluate?

Workshop participants agreed that operational tests are needed to make the whole process work. The technology cuts across institutional arrangements within the public sector. Furthermore, the move toward privatization complicates those arrangements. Decisions about who will provide which products or services do not fall neatly into place.

One participant commented on the perception that problems will occur later in implementation if institutional issues are not considered in the operational tests. In addition, these issues should be covered in the nontechnical reports to Congress.

Operational tests allow participants to learn the lessons needed before deployment. Other parties can also learn from the tests. Once enough data have been collected from operational tests, the lessons can be generalized, and modeling that leads to effective deployment can occur. Mr. Orne commented that major gaps exist between “what we know that we don’t know” and “what we don’t know that we don’t know.” The operational tests can provide a record, or case history, of the institutional problems that occurred and how they were solved. That information is valuable to all parties involved in IVHS.

One participant observed that operational tests can aid in communication among different organizations involved the ATMS/ATIS

system. The operational test can bring the parties (cities, counties, MPOs, etc.) together to overcome political barriers and solve other problems. Operational tests also establish precedents that can be incorporated into models for conducting analysis.

Interactions among driver, vehicle, and roadway are changing. At one time, driver and vehicle were independent entities, but that situation is changing. Operational tests are needed to help predict problems and situations that may need to be evaluated but that have not even been considered yet.

One group member stated that two mandates or rationales for testing exist. The first is to look down through the process and to learn how the process works. The second rationale is to determine what mandates FHWA is operating under and what pressures to produce data the agency faces.

Mr. Orne was disturbed by private sector representatives’ contentions that the public sector does not understand the market. Another participant replied that the market is multifaceted, leading to disagreement about what the market is. He asserted that it is not the public sector’s job to determine the consumer’s willingness to pay; its job is to: (1) ensure that a playing field exists in which willingness to pay can be tested; and (2) to serve public interests in areas in which the willingness to pay sometimes does not exist (e.g., in safety).

Operational tests can show under what conditions the market can discover its own level, and what considerations fall outside the marketplace. However, one member of the group noted that, because the public sector is spending large amounts of money on infrastructure, it is responsible for knowing the market. Another participant added that the public sector is responsible for determining not the details of who will pay how much for what services but, in a larger sense, whether a political constituency exists to support the program, just as the interstate highway system was supported. Someone else noted that the public sector needs to ensure that the system enjoys broad public acceptance and that it will be used effectively and efficiently.

Finally, the workshop participants acknowledged that, whereas the providers of highways and the providers of vehicles have traditionally interacted very little, the inefficiency of travel today requires that a marriage

of sorts takes place between them. The previous system was an open-loop system. The aim in IVHS is a closed-loop system in which intelligence is fed back through iteration loops to the control mechanism for the system. At the other extreme is the concept of IVHS as a market-driven system that provides information and devices and leaves the market to take its course. The dilemma is to design a master system, or at least a system with specified parameters; but doing so requires multiple players from government and private industry, and the most important aspect is the response of the constituency. Operational tests can evaluate this factor.

Priority Issues

Mr. Orne turned the discussion to priority issues by listing those presented as highest priority from Breakout Session 1: societal versus individual benefits, level of risk taking, assurance of long-term public commitment, procurement procedures, lack of standards and protocols, liability, and intellectual property rights. He invited the group to establish the issues that they perceive as having the highest priority. A member of the group explained that these issues were broader issues and that the group should focus on institutional issues at a more detailed level.

One participant stated that these issues are not the highest priority in his locality. His priority is bringing the basic infrastructure up to standards first. When he learned of FHWA's IVHS program, he considered it premature by several years. The infrastructure must be in place if traffic is to be managed. This participant has discovered that IVHS funds can be used to accomplish that goal; however, his jurisdiction does not have a problem that warrants such a level of risk.

Mr. Orne commented that this perspective is illustrated by the fact that a person can drive into almost any small town that has two traffic lights and be stopped by one of them. The transportation community is at such an elementary level of applying current knowledge and technology in IVHS that its deployment as a comprehensive systems approach will be restricted to a very few jurisdictions that will serve as showplaces and will be emulated over time.

One person stated that the question of who performs surveillance is an important issue. Should it be a public or a private function? The

answer is not self-evident and may differ in different settings. He maintained that this question should be resolved in operational tests, along with the institutional arrangements associated with surveillance.

Another participant contended that operational tests should examine the ability of organizations to take on responsibilities in the IVHS arena. The capabilities to be examined would include decision-making capacity, financial resources, level of expertise, and institutional culture. Another person said that operational tests should show whether existing political jurisdictions and constituencies are capable of the cooperation that ATMS requires. Participants referred to the "islands-of-darkness" phenomenon. Part of the problem is also that two neighboring jurisdictions may have incompatible systems, or one jurisdiction may need to upgrade its existing system. Local governments do not have the finances to swap their existing equipment; to gain these financial resources, local jurisdictions must have public support and acceptance of the program. One way of gaining that support is to promote the benefits of IVHS: congestion relief, increased safety, and cleaner air, among others.

Referring to the earlier panel discussion, one participant asked how both the technological and the institutional assessment can be accomplished in operational tests. IVHS is in the first phase of operational tests; however, neither the current tests nor those planned take such a broad approach. One participant commented that operational tests must at least include the institutional issue of liability because that must be addressed before the test can proceed. In some cases, the public sector will indemnify; in other cases, the private sector will indemnify. Participants can evaluate the negotiations and how the decision affects the deployment. This information is critical to anyone who wants to use the situation as a model; the information must be captured in the operational test.

One group member pointed out that different IVHS technologies may involve different institutional issues, some of which may not lend themselves to operational tests. An example of an institutional issue that can be tested in operational tests is level of enforcement. For example, if signal and ramp metering are not enforced, even the best systems cannot operate optimally. Referring to the earlier panel discussion, another person reiterated

that these evaluations should be done at two levels. At the first level, information is captured in the operational test; case studies of perhaps half a dozen important operational field tests are then conducted.

The final issue raised was how much public sector participation in the operational test itself can be reasonably expected.

What Is Not Known

Mr. Orne explained that the items on this list should constitute researchable issues. The participants agreed that the following issues should be examined:

- The private sector process of making business decisions to invest in research and development and beyond (to improve public sector understanding).
- The dynamics of consumer behavior that affect public acceptance levels.
- The dynamics of the motivations that affect institutions' behavior (e.g., self-interest, public opinion, or turf battles).
- Feasible range of service-delivery options (which, someone pointed out, can be tested in operational tests).
- Thresholds of public acceptance and level of networking needed to make IVHS work (i.e., critical mass).
- Cost effectiveness of different systems and different levels of implementation for surveillance technology.
- The different combinations of institutional arrangements and range of issues that can be evaluated in operational tests.
- Methods of dealing with institutional issues in other areas of the transportation industry and their applicability to IVHS.
- Efficiency of alternate roles for public/private sector opportunities.
- Perceptions of who will be winners and losers in IVHS implementation. For instance, ramp metering may cause a localized increase in air pollution, but IVHS may improve overall air quality.

Action Agenda

On the basis of their discussion, the participants developed the following action agenda for operational tests:

- For all current operational tests, include an institutional history in the evaluation plans.
- Require a valid institutional evaluation plan with experimental features for all future operational tests. Include "before" and "after" data, as appropriate.
- Publicize operational tests and measure the effectiveness of the publicity in gaining public acceptance. Share the results with others in the IVHS community.
- Look across operational tests to generate hypotheses and make broader inferences.
- Call out the most critical institutional issues in operational tests and indicate how they were resolved (using the histories of operational tests).
- Enumerate the benefits of IVHS (safety, air quality, improved productivity) to smaller jurisdictions with fewer resources and recommend alternative IVHS strategies and technologies.
- Sell system upgrades that use IVHS technology (include demonstration projects) and profit from technology transfer.
- Evaluate franchise proposals and other innovative public/private arrangements.
- Continue to define institutional issues and translate them into operations so that they can be evaluated in future operational tests.
- Include institutional issues in a clearinghouse for information.
- Conduct workshops in which operational test participants can share the information gained from test results.

Breakout Session 6: Public/Private Sector Roles in Deploying IVHS

This group, facilitated by Dan Brand of Charles River Associates, agreed that private sector roles are very diverse. For example, software and hardware providers, systems integrators, facilities management firms, etc., all play different roles depending on a company's focus. Therefore, the participants generally did not agree that, from an operational standpoint,

ATMS is primarily a public sector responsibility and ATIS is primarily a private sector function. For example, one participant said that in Westchester County, New York, a model traffic management (surveillance) center is being run by a private contractor.

ATMS/ATIS Model

The participants discussed an ideal ATMS/ATIS networking model with four main elements that included information (ATMS/ATIS information gathering devices), the traveler, a vehicle, and the (IVHS) system operator. In this model, information would be supplied to the system operator (e.g., State highway departments) by the information-gathering devices. The data would be merged with pretrip information and then would be sent back to the driver via lane restrictions, traffic signals, etc. One participant said that, from an operator's point of view, ATIS is a part of ATMS because operators must gather information to operate the system. Once that information is gathered, he said, the operator can supply it to anyone who wants it. Thus, a traffic management system cannot be run without ATIS, and ATIS cannot be operated without a traffic management system. One participant said that she could envision the model being run without a system operator, citing the example of a fleet of trucks being managed by the parent company. Commenting on the model, one group member added that the authority could contract for the system operator.

Private Sector Motivation

The group then discussed what motivates the private sector. The private sector questions how to make money in a user-oriented system. Because the media widely disseminates travel information, the rest of the private sector does not recognize a big market for IVHS and is therefore reluctant to invest capital. The private sector wants revenues from value-added products, but the public sector wants to invest in ways in which the public benefits.

Who Pays?

One participant said the focus should not be on whether the consumer would pay for IVHS. He related a story in which the head of a State travel and information division told him that IVHS could be financed then (several years ago) by the hotel and restaurant industries, theme parks, recreational areas, etc., because these concerns would receive benefits from

having their information in consumers' cars. Since that time, the participant said, no one has discussed that particular issue; instead, most of the discussion has focused on whether the consumer will buy a car with a guidance map system. The private sector wants to sell products, and the public sector may not see the value of those products. One participant said that because there are so many different private sector roles, the discussion will not be fruitful if all the roles are grouped together. He mentioned consulting firms; software suppliers; system integrators; facilities management firms; secondary service suppliers, such as maintenance, communications, and training companies; value-added service providers; and primary service providers as having different motivations. One participant added that once the workshop is finished, the roles and motivations of each of the previously mentioned industries should be investigated. He said that people are not paying enough attention to the diversity of the private sector, whose motivations for becoming involved with IVHS are different. One participant referred to a workshop session in which a group agreed that the end user may not be the person who pays for the service. There are different kinds of sellers and different kinds of buyers.

Supplying the Benefits of IVHS

Mr. Brand then explained four areas in which IVHS could help the consumer:

(1) *Consumption item.* People want to buy cars with aspects of IVHS because it is a consumption item: 30 percent of top-of-the-line Lexus cars in Japan are being sold with autonomous map navigation systems.

(2) *Trip planning.* Being able to plan trips would be advantageous not only to consumers but also to fleet operators.

(3) *Conditions of travel.* System operators could affect the conditions of travel because of congestion.

(4) *Activities at end of trip.* Several industries—such as restaurants, theme parks, etc.—would be able to “advertise” directly to consumers, who would receive a benefit from the services received at the end of their trip.

Mr. Brand contended that some aspects of IVHS are not in the public interest and could degrade the operation of the entire transportation infrastructure. He warned that the public sector must be aware of those aspects and

should protect the public interest. One participant said that there should be some checks and balances for the advertising by some industries, believing that this aspect could become too commercial and that consumers could be exploited.

Another participant, referring to Mr. Brand's list of benefits to the consumer, said that items one and four could be supplied exclusively by the private sector. He said that the public sector will not be interested in producing end-user subsidies or providing end-of-trip activities. Items two and three, he added, were areas in which the public and private sectors share many overlapping and potentially competitive interests.

One participant said that the list was incomplete and that all of the items could be supplied 100 percent commercially. As an example, he cited the cellular telephone industry, which could collect traffic data and pay Metro Traffic Control to distribute it because they perceive that the public sector is not organized enough to perform these tasks. Despite that attitude by the cellular telephone industry, the participant said that in-vehicle signing cannot progress without public sector involvement.

Most other participants agreed that because the private sector is so segmented, the list could not achieve an accurate reading. One participant said that Mr. Brand's approach is useful from the point of view of the user or traveler because it obscures the traditional boundaries between public/private sector activities. He said that users do not care who provides information as long as it meets their needs. One participant stressed the need to further discuss the possibility for contracting ATMS/ATIS to open up new areas of public/private cooperation. He felt that Mr. Brand's list omitted a great deal of potential private sector activities.

Private Sector Representation

Another participant commented that the private sector was not well represented and wondered if the private sector believes in IVHS. He said that his role was to return to his company and sell IVHS to many people who are skeptical. Another participant said that many private sector industries, such as telecommunications companies, do not relate to the term "IVHS." These companies, he said, are interested in providing information to

people on the move rather than in helping people maneuver around obstacles to get from one point to another. He contended that the public sector needs to sell IVHS (i.e., by informing the telecommunications companies that hotels, restaurants, etc., would pay for the system) so that the private sector will become interested and involved. Furthermore, he said, the public sector must find a way to relate IVHS to the full range of private sector services.

Another participant countered that several firms such as General Motors, Ford, AT&T, Sprint, and Motorola, have clear stakes in IVHS; they have already invested billions of dollars in the technology. Finally, one participant asserted that the public sector should not view IVHS as its responsibility, calling for private sector cooperation only when the public sector lacks expertise or resources; nor should the private sector see IVHS strictly as a business opportunity without public sector cooperation. He concluded that these attitudes taken by the private and public sectors will lead to unnecessary duplication of efforts and the inefficient use of resources.

One group member said that the group must bear in mind that FHWA is a small player in IVHS and that other organizations and industries must be considered. The group concurred that this workshop should be the first of many workshops and that more private sector firms should be invited to provide more input. In these conferences, participants could discuss ways in which the public sector could team with private sector organizations.

Another participant said that future conferences should be specialized by industry type and categories of suppliers. One group member suggested that a workshop dedicated to meeting with the communications and information industries be planned. These industries have the largest stakes in IVHS because IVHS is an information entity; they also have the most insight into its commercial potential. Participants agreed that follow-up workshops should be conducted in which private industries could discuss their business needs. Mr. Brand suggested that the selective process be used for inviting private sector industries for future conferences. Because of the varying knowledge and interest levels of those industries, they may not communicate on the same level of understanding. The participants agreed that an educational outreach program

should be developed, incorporating traveling exhibits and presentations to inform private industry about IVHS.

Sample Discussion Questions

The group then discussed the sample questions provided for the breakout session. Participants generally agreed that there were both advantages and disadvantages to franchising, cooperative agreements, and design-build types of public/private partnerships. However, one participant argued that the issue had not been discussed thoroughly enough, on either the public or the private sector sides, to make those general conclusions. The group unanimously agreed that enablement is the main advantage of public/private partnerships in deployment of IVHS.

They also agreed that it would not be appropriate to provide a guaranteed return on investment as an incentive for private sector involvement. State projects that provide venture capital to stimulate private sector involvement should be investigated. Startup capital, money to operate and maintain IVHS traffic control systems, and information provided to the control infrastructure are incentives for local agencies to cooperate with the public sector.

One participant said that protocols for routing should be established. Most other group members did not agree, citing the potential for overregulation. The group was aware that, in some areas across the country, the private sector operates areawide traffic control systems under the auspices of the public sector. In these arrangements, the private sector is able to perform better management than the public sector can. One participant, however, warned that the

public sector owns the traffic control system and that it must ultimately have some sort of control over the system regardless of what entity provides management functions. For example, one participant said that electric power companies used to own traffic light systems in the Midwest. However, because of liability concerns, those companies have relinquished their control of those systems. The electric companies' actions left many cities with deteriorating and crumbling systems.

The group concurred that private sector opportunities exist for near-term, privately funded surveillance through probes, cellular arrangements, video cameras, etc. Participants agreed that, although the RBOCs may soon be prohibited from providing data for ATMS, allowing the RBOCs to become involved with IVHS would be in the public interest. The group also mentioned the satellite Global Positioning System (GPS) and spread-spectrum systems as possible solutions for surveillance.

Some parts of system architecture must be tailored to accommodate potential public/private sector models of deployment. For example, route guidance can be performed either in the vehicle or from a centralized location, depending on the model.

Telecommunications providers could play a significant role in IVHS. However, the participants agreed that their role will be shaped by pending legislation. The group agreed that IVHS could combine with industries such as information, commercial fleet, medical emergency, outdoor advertising, and business directories, all of which have large interests in IVHS.

Closing Remarks

Summary

Moderator Tom Humphrey of MIT summarized the workshop as an excellent forum for leaders in the development and deployment of IVHS programs in the United States to address the issues that must be resolved in defining how the private sector and the public sector might establish new and innovative partnerships. Mr. Humphrey noted a consensus that the workshop provided an important and necessary step in dealing with the issues. He summarized a number of common themes that emerged in the discussions throughout the workshop:

- To fully understand the programs and opportunities in IVHS for both the public and private sector, widely based education programs are needed. Also, the role of the Nation's universities in the development and deployment of IVHS technologies needs to be established.
- "Corporate" cultural changes may be needed within many public agencies to establish the means for innovative deployment. For example, procurement constraints in the public sector are impeding progress. Actions must be taken to address this and other similar constraints that are hindering and will continue to hinder innovative solutions.
- The potential motivation for private sector involvement in IVHS is not fully understood by the public sector, partially because the private sector includes such a broad range of interests (e.g., manufacturers, suppliers, and distributors).
- It is clear that much better estimates of the costs and benefits of IVHS are required if the private sector is to be attracted to these programs. The private sector also needs assurances that intellectual property rights are defined so that adequate opportunities are available for investment and risk-taking.
- A key to the deployment of ATIS/ATMS innovations is to have real-time information on travel conditions. Because the private sector currently seems well suited to providing this information, activities in this area may be targeted as opportunities for the private sector; the public sector needs to provide incentives for the private sector to pursue such opportunities.
- Many aspects of IVHS are directly related to the communications, information, and other industries with whom transportation agencies have previously had little or no interaction. Because agencies are unaccustomed to dealing with these industries, actions must be taken to establish these relationships.
- The role of public transit, although discussed only marginally at the workshop, is an essential element in establishing innovative methods for maintaining mobility.
- All parties involved in IVHS should view Federal and State environmental concerns (such as the Clean Air Act Amendments of 1990) as opportunities for motivating IVHS deployment actions.

Mr. Humphrey stressed that the public sector must view the private sector as a partner, consulting the private sector to define opportunities and to ensure that the opportunities are valid. Public/private partnerships may require new and revolutionary approaches, which have yet to be identified; these approaches must be forward looking, not merely attempts to fix existing problems. For example, Mr. Humphrey maintained that the private sector must become more actively involved in planning and conducting workshops, and he recommended that such a workshop be held as an immediate follow-up to this one. In closing, Mr. Humphrey urged that action must be taken now to develop fiscal year 1992 and 1993 re-

search priorities from the number of research topics identified at the workshop.

Conclusion

Steve Lockwood of FHWA closed the session, thanking the workshop planners, presenters, panelists, facilitators, moderator Tom Humphrey, and all the meeting participants. He commended the group on its

evenly balanced, active participation in the 2-day workshop.

In closing, Mr. Lockwood expressed his hope that, in addition to generating papers and documentation of the workshop proceedings, the workshop had laid the groundwork for continuing dialogue in the important area of public/private sector roles in IVHS deployment.

Appendix A

Public/Private Sector Roles in Intelligent Vehicle – Highway Systems (IVHS) Deployment

Sponsored by the Federal Highway Administration

Participants

Geary Andrews
Office of the Secretary
U.S. Department of Transportation

Brien Benson
George Mason University

Chris Bertram
Office of Management and Budget

Madeleine Bloom
Federal Highway Administration
U.S. Department of Transportation

Daniel Brand
Charles River Associates

Sadler Bridges
Texas Transportation Institute

Gary Brosch
University of South Florida

Jack Brown
Florida Department of Transportation

Bruce Brumfield
New Jersey Department of Transportation

Donald Capelle
Parsons Brinckerhoff

Gang-Len Chang
University of Maryland

Kan Chen
University of Michigan

Mel Cheslow
MITRE Corporation

Steve Crosby
SmartRoute Systems

Larry Darnes
Federal Highway Administration
U.S. Department of Transportation

Richard Darwin
Battelle Memorial Institute

Gene Donaldson
Montgomery County (MD) Department of
Transportation

Matt Edelman
TRANSCOM

Sheldon M. Ednor
Federal Highway Administration
U.S. Department of Transportation

Neil Emmott
Castle Rock Consultants

Robert Ervin
University of Michigan
Transportation Research Institute

Lowell Evjen
Georgia Institute of Technology

David Gehr
Virginia Department of Transportation

Jonathan L. Gifford
George Mason University

Kostas Goulias
Pennsylvania State University

Rachel Halterman

House Committee on Public Works
& Transportation
U.S. House of Representatives

David Hensing

American Association of State Highway and
Transportation Officials

Thomas Horan

U.S. General Accounting Office

Thomas Humphrey

Massachusetts Institute of Technology

William Hyman

The Urban Institute

Shelton Jackson

Office of the Secretary
U.S. Department of Transportation

Denny Judycki

Federal Highway Administration
U.S. Department of Transportation

Jack L. Kay

JHK & Associates

Amy Kegley

Navigation Technologies

Hans Klein

Massachusetts Institute of Technology

Art Korfin

Barrier Systems

Alain L. Kornhauser

Princeton University

Al Kosik

Texas Department of Transportation

Eva Lerner-Lam

The Palisades Group

Joseph Ligas

Illinois Department of Transportation

Steve Lockwood

Federal Highway Administration
U.S. Department of Transportation

Wesley Lum

CalTrans

Jim March

Federal Highway Administration
U.S. Department of Transportation

Tom Marchessault

Office of the Secretary
U.S. Department of Transportation

Gary Maring

Federal Highway Administration
U.S. Department of Transportation

Charles McLaughlin

Federal Highway Administration
U.S. Department of Transportation

Michael Meyer

Georgia Institute of Technology

Scott G. Meyerhoff

Econolite Control Products, Inc.

Edward Mierzejewski

University of South Florida

Linda Morris

Federal Highway Administration
U.S. Department of Transportation

Mark Norman

Institute of Transportation Engineers

John O'Donnell

Volpe National Transportation Systems Center
U.S. Department of Transportation

Don Orne

University of California

Ken Orski

Urban Mobility Corporation

Raphael Panitz

House Committee on Public Works
& Transportation
U.S. House of Representatives

James T. Pearson

BDM International, Inc.

Jim Pivovar

New Jersey Department of Transportation

Larry Powers

Federal Highway Administration
U.S. Department of Transportation

Harley Radin

Radin Associates

Gary Ritter

Research & Special Programs Administration
U.S. Department of Transportation

Craig Roberts

IVHS AMERICA

Edwin G. Roberts

New York State Department of Transportation

Paul Rothberg

Library of Congress

Ed Rowe
Los Angeles Department of Transportation

Beverly Russell
Federal Highway Administration
U.S. Department of Transportation

Jim Saklas
Federal Highway Administration
U.S. Department of Transportation

Don Savitt
Hughes Aircraft Company

Sigmund Silber
Consultant

David Skinner
Volpe National Transportation Systems
Center
U.S. Department of Transportation

Frank Stafford
University of Michigan

Steve Steckler
Price Waterhouse

Burt Stephens
Federal Highway Administration
U.S. Department of Transportation

Sandra Stinson-Stout
City of Atlanta Bureau of Traffic and
Transportation

Roger Stough
George Mason University

Bo Strickland
Federal Highway Administration
U.S. Department of Transportation

Peggy Tadej
IVHS AMERICA

Phillip Tarnoff
Farradyne Systems

Mary Lynn Tischer
Virginia Department of Transportation

Tom Urbanik
Texas Transportation Institute

Norm Van Ness
Federal Highway Administration
U.S. Department of Transportation

W. Scott Wainwright
Montgomery County Department of
Transportation

Richard Weiland
SEI Information Technology

Appendix B

Public/Private Sector Roles in Intelligent Vehicle – Highway Systems (IVHS) Deployment Sponsored by the Federal Highway Administration

Agenda

April 8 – 9, 1992
Rockville, Maryland

- 7:30 – 8:30 am **Registration**
- 8:30 – 9:15 am **Welcome and Opening Remarks:** Brief statement of the issues to be covered, the scope of the papers developed for the workshop, the objectives of the workshop
Denny Judycki, Steve Lockwood—FHWA
Craig Roberts—IVHS AMERICA
Tom Humphrey—M.I.T.
- 9:15 – 10:15 am **Current U.S. and Foreign Experience with Public/Private Sector Deployment of IVHS**
Moderator: *Craig Roberts*
Papers by: *Kan Chen—University of Michigan*
 Neil Emmott—Castle Rock Consultants
 Ken Orski—Urban Mobility
 Wesley Lum—CalTrans
Discussion by: *Bill Hyman—Urban Institute*
- 10:15 – 10:30 am **Break**
- 10:30 – 11:30 am **Current U.S. and Foreign Experience with Public/Private Sector Deployment of IVHS (Continued)**
Questions/Comments: All Workshop Participants
- 11:30 – 12:45 pm **Lunch** — Buffet lunch in the Papa's Restaurant (Please bring coupon)

- 12:45 – 3:00 pm **Public/Private Roles in IVHS Deployment**
Moderator: *Bob Ervin*
Papers by: *Ed Rowe—Los Angeles DOT*
 Phil Tarnoff—Farradyne
 Steve Crosby—SmartRoute Systems
 Sigmund Silber—Consultant
 Richard Darwin—Battelle Memorial Institute
Discussion by: *Matt Edelman—TRANSCOM*
Questions/Comments: *All Workshop Participants*
- 3:00 – 3:15 pm **Break**
- 3:15 – 4:30 pm **Breakout Sessions: Issues affecting public/private roles in IVHS deployment**
Facilitators: *Eva Lerner-Lam, Tom Urbanik, Dave Gehr*
See attached breakout assignments and list of discussion questions.
- 4:30 – 5:00 pm **Summary of Breakout Sessions**
- 8:00 – 9:30 am **Procurement Issues, Operational Tests, Design and Deployment Alternatives, and Other Topics**
Moderator: *Don Capelle*
Papers by: *Jack Kay—JHK & Associates*
 Don Savitt—Hughes Aircraft Company
 Jonathan Gifford—George Mason University
Discussion by: *Joe Ligas—Illinois DOT*
 Melvyn Cheslow—MITRE
Questions/Comments: *All Workshop Participants*
- 9:30 – 9:45 am **Break**
- 9:45 – 12:00 pm **Breakout Sessions: Develop workshop products and recommendations in the following areas: (See attached breakout assignments and list of discussion questions.)**
Future Research Needs (*Facilitator: Mike Meyer*)
Evaluating Institutional Issues in Operational Tests (*Facilitator: Don Orne*)
Public/Private Sector Roles in IVHS deployment (*Facilitator: Dan Brand*)
- 12:00 – 1:15 pm **Lunch**
- 1:15 – 4:00 pm **Workshop Summary and Closing Remarks: Discussion of breakout group findings and recommendations (Tom Humphrey)**
- Adjourn