

Applications of Advanced Technologies in Highway Transportation

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I would like to discuss today one aspect of the advancing technology in this country — a program called Intelligent Vehicle Highway Systems (IVHS). This program has received a lot of attention lately. In fact a recent article in *US News and World Report* contains comments by Secretary Skinner concerning his view of IVHS as part of the national transportation policy and strategy. First, let me give you an overview of what the program is, how it is being developed as a national cooperative program, and provide you with some insight into where IVHS will go in the future.

We are currently experiencing a billion vehicle hours of delay in this country in the major metropolitan areas. That number could significantly increase if we don't make improvements to the highway system. The dramatic fact is that about 60 percent of these delays are from non-recurring congestion — events that are not anticipated and are, in fact, unpredicted. This is particularly frustrating because these are random events.

Operational needs in the United States are obviously not just urban mobility needs. Safety is also very important on the national list. There are significant rural as well as the metropolitan needs. We still have a death toll in this country of about 45,500 per year. Air quality is becoming a major issue that is on the congressional agenda this year and on everybody's mind. Service to all of our citizens is particularly important. Commercial productivity is significantly influenced by the highway system.

IVHS is not the total solution to these problems. This is only one component of the solution to our mobility and safety issues. Certainly, we must continue to think in terms of increasing capacity, managing demand from land-use, and attempt to make more routine applications of exceptional practices that are currently available to us. At this point, let me give you my definition of the concept of IVHS. Intelligent vehicle highway systems merely provide some functional and institutional integration of the vehicle, the highway and the driver through a cooperative program.

By cooperative, I mean a joint public-private venture that addresses advancing technology through research and development, field operational tests and deployment. I would stress field operational tests and deployment because all of the research associated with this program is dedicated toward producing products and making this program applicable to today's needs. The IVHS functional areas that are used to describe the program are Advanced Traffic Management Systems

(ATMS), Advanced Driver Information Systems (ADIS), Commercial Operations and Advanced Vehicle Control. I'm shall discuss each of these briefly and give an overview of what projects are being considered for them.

The goal of Advanced Traffic Management Systems is to gain maximum efficiency of real time traffic management systems and control. This is clearly urban oriented. It is a traditional public sector responsibility in this country; one that the transportation departments are familiar with. ATMS provides an aggressive application of acceptable and exceptional operational technology that is currently available through integrating systems. There is a need for additional research. For example, a new wide area detection system is needed to supplement or replace in-pavement loop detection. There is much that can be done on communication systems, research and driver behavior, artificial intelligence, and the development of real-time traffic control strategies.

It is always important to inform the motorist so that he does not get into a position where he sees a sign and wishes that he had gone the other way. Current technology includes changeable message signs as well as highway advisory radios. Of course, there is a great deal of potential for making improvements here. Currently, there are a number of comprehensive freeway management systems in operation around the country. Although, of the approximately 17,000 miles of urban freeways in this country (which carry about 30 percent of the traffic), only about 6 percent have what we would term comprehensive management systems — surveillance and control, incident management systems or ramp metering. That 6 percent (just over a thousand miles) is spread out in corridors around the country, and about half of it is in California. Of the roughly 200,000 urban signalized intersections in this country, I would say only about 20 percent, are computer connected. So, we have a long way to go in applying today's technology.

The goal of Advanced Driver Information Systems is to provide enhanced route guidance through in-vehicle information and safety warning systems. Information on road conditions, route guidance, parking availability, tourist services, fatigue monitoring and, even in-vehicle could be potentially possible. Display mechanisms in the vehicle could be as simple as the heads-up displays currently available or the in-vehicle navigation systems that are being tested to provide real time system performance information to the motorist.

A device that is being used in the Los Angeles Smart Corridor for an operational test called Path-finder is the ETAX Screen. This experiment on the thirteen mile Smart Corridor of the Santa Monica freeway is a cooperative operational test between the Federal Highway Agency, Caltrans and General Motors. Twenty-five vehicles are being used to test the ability to provide real-time information from the traffic control center back to the vehicle on the congestion in that vehicle's path. We will then be able to draw some conclusions about how people divert, whether they divert and what the dynamics are of a real-time in-vehicle system.

In our next step in the development of an Advanced Driver Information System, we are going to put together another demonstration in a different city. This will be an area wide system test, not just a corridor system such as path-finder. This test will use 100 vehicles instead of 25. It will not merely provide route information in the vehicle, letting the driver make the decisions. This experiment

will, in fact, give route guidance information to the driver and suggest to him which alternative routes might be the most beneficial.

Europe and Japan are also working very hard on in-vehicle navigation. In Japan there are two systems that are being tested. One or both will be applied, and obviously system architecture becomes very important as well as national standards. The British are testing a system in London. It is called Auto-guide, and it is a small screen vehicle that counts down and shows what direction to turn as you move through the London network. Once you punch in your destination, it is much simpler than the ETAX screen, which displays a map. The London system has been under demonstration for several months now and is being expanded significantly for another operational test cycle.

Next, I would like to discuss Commercial Vehicle Operations as a component of IVHS. The goal of Commercial Vehicle Operations is safety and efficiency and the improvement of commercial productivity in this country. Many of the same features that appear in ADIS, Driver Information Systems and Traffic Management Systems, also apply to commercial vehicle operations. It is discussed as a separate component of IVHS because of some of the unique commercial needs.

Commercial Vehicle Operations encompasses the development of vehicle priority systems, in-vehicle yellow page information systems, automatic vehicle classification and identification, cargo identification for hazardous materials and weigh-in-motion. One application of improved efficiency would be vehicles that receive a preference if they are electronically identified through the roadway network. The national program for IVHS will build upon the Crescent Project, which is discussed in another paper, and another project called HELP (Heavy-vehicle Electronic License Plate). I would suggest that we should be doing more of those operational tasks around the country.

Finally, it is important to spend a little time on the functional area of Advanced Vehicle Control (AVC). We are not talking about Buck Rogers when we discuss advanced vehicle control. In fact, the first stage of AVC is merely to provide safety systems in the vehicle. Many of these are independently vehicle based. For example, rear proximity radar systems are now being developed and could be available shortly. Other systems might include lateral guidance systems for safety and systems for speed control, such as the cruise control on many vehicles. Headway control would be a natural extension along with infra-red visibility enhancements. Condition warning systems could also be part of Advanced Vehicle Control.

Many of these technologies are currently becoming available through the auto industry. Eventually, we look towards full automation. That raises some dramatic issues related not only to technology, but also liability, safety and public acceptance. Much attention will have to be given to these issues as we develop a program. In fact, that is beginning to occur now. It is conceivable that in a number of years the technology as well as the public acceptance and liability issues could lead us to advancements in automated systems. Work is underway in some states. California is the most notable through their Path Program, which looks at automated systems and electronic guidance systems.

That is an overview of the concept of IVHS as the program is developing. For the last couple of years there have been a lot of players nationally and internationally that have participated in the development of the concepts that I

just discussed. We are certainly playing in a global market place. The Europeans have provided the leadership and the Japanese have technology that's advanced significantly. The Japanese have in fact, funded their advanced technology programs much more significantly in the long term than we have in the United States, and they are organizing to apply that technology.

Interestingly enough, in the U.S., a group called Mobility 2000 has really been the catalyst for cooperation and national discussion. Mobility 2000, as a group, started about three years ago. It is not an organization. It is, rather, a nationally recognized ad-hoc group that has been meeting and developing programs for IVHS. Mobility 2000 represents state departments of transportation, the federal establishment and the university systems around the country. Currently, Mobility 2000 is the focal point for much of the program development. Over the last year, Mobility 2000 has been developing programs for each of the four functional areas that I discussed. The developments of Mobility 2000 and through Mobility 2000 reflect the support that the individual partners have brought to this national issue.

If there is one important area in the reauthorization, it is the need for a long-term, stably funded research and technology program. A part of that has to be the intelligent vehicle highway system. Read the recommendations from AASHTO. Look at the recommendations made by the Highway Users Federation. See what we are doing within the Department of Transportation, and the support that Secretary Skinner and our Administrator have given to these concepts. I think you have to believe that the need for advancing a program of this nature is one item that everyone agrees on as we get into this reauthorization cycle. The funding level has not yet been determined, but certainly we have fund this at a higher level in the long term and keep that level more stable than we have for our research and operational demonstration programs in the past.

AASHTO itself recently formed a committee called The Special Committee on Transportation Systems Operation, which is the focal point within AASHTO for IVHS. That special committee has a task force on IVHS. The program vision is one that is being cooperatively described through Mobility 2000 and individual groups that will be proposing legislative changes. In addition, there is currently a draft of a report to Congress by the Department of Transportation, that we hope will get congress to make recommendations on a program of IVHS.

I think what is encouraging about this IVHS program is that it has truly been developed and defined by a cooperative venture between the public sector, the private sector and academia. The goals are that we will come to some agreement on what the program should be, that there will be some unanimity in how to apply that program and to take the first steps toward completing that program as soon as possible.

We, in the Federal Highway Administration, have requested that in the 1991 budget, which will be a transition to the post 1991 reauthorization legislation, that there be an increase of our budget to take an initial step towards IVHS. Then we will be able to go beyond what I have described in pathfinder and some of the other operational tests and research and take a step forward before 1992 is here. hopefully, by then we will have a program that will more significantly address IVHS in this country's need to advance technology in some cooperative and fundamental way.