

Federal Highway Administration Regional Pooled Fund Proposal

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Establishment of a Program to Support  
the Research, Development, and Deployment of  
Cooperative Vehicle-Highway Automation Systems

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#### Problem Statement:

Within national Intelligent Transportation Systems (ITS) activities, the long-term planning, research, development, and deployment of the next generation of surface transportation systems has not been fully considered. Complex challenges related to traffic congestion, safety, and environmental impact are not being adequately addressed and can no longer be solved by traditional highway technologies, or even by deploying mainstream ITS. These challenges threaten to adversely affect the ability of transportation infrastructure operators to provide for the mobility of people and goods. One ITS area that has the potential to significantly alleviate these more complex challenges is Cooperative Vehicle-Highway Automation Systems (CVHAS).

#### Objective:

Through a regional pooled fund study, the California Department of Transportation (Caltrans) proposes to work with other state departments of transportation to establish a program to facilitate the development of cooperative vehicle-highway automation systems. The participants in this program will create a research, development and deployment plan for cooperative vehicle-highway automation systems and solicit researchers from the private and public sectors and academia to perform the work necessary to implement it.

The research, development and deployment plan will be used to identify and prioritize the research areas that support CVHAS. Pooled funds will be initially used to create the program, organization, and development plans. Remaining funds will pay for specific projects that advance the objectives of the program. The strategy proposed is to use a “building-block” approach to develop CVHAS, initially using as the foundation the results of previous research performed by private industry, academia, the National Automated Highway System Consortium, and the Intelligent Vehicle Initiative. The emphasis will be on research, development, and deployment of vehicle and vehicle-highway improvements that contribute directly to the long-term goal of significantly improving the efficiency and safety of the nation's surface transportation system.

#### Background and Significance of Work:

The concept of automating the control of highway vehicles has a long history, dating back to the 1930s, when the first public visualization took place in the General Motors “Futurama” exhibit at the 1939 New York Worlds Fair. Technology development toward this end began at the RCA Laboratories in the early 1950s, and RCA continued its efforts in collaboration with General Motors in the late 1950s and early 1960s. Subsequently, research was conducted by the Ohio State University, as well as by researchers in Europe and Japan, during much of the 1960s and 1970s. Many of the ideas behind highway automation were initially implemented in automated guideway transit systems during the 1970s, and since that time, driverless systems have safely carried millions of passengers in airports and urban areas around the world. Support from the U.S. Department of Transportation (USDOT) has been cyclical, including sponsorship of some of the Ohio State University research from about 1965 to 1980, as well as separate studies by TRW in 1969, Calspan in 1977, and General Motors in 1980-82.

The modern revival of interest in vehicle automation began in 1986, when Caltrans joined with the University of California Partners for Advanced Transit and Highways (PATH) to pursue research to identify the most promising alternatives for alleviating traffic congestion, leading to the development of Automated Highway Systems (AHS). Using California state transportation research funds, this partnership made significant progress in developing technologies and strategies for deploying automated vehicles and the associated supporting infrastructure. This work subsequently stimulated interest from the USDOT and resulted in inclusion of a provision for AHS testing and demonstration in the federal Intermodal Surface Transportation Efficiency Act of 1991.

In 1994, nine public and private organizations, including Caltrans and PATH, joined with the USDOT to form the National Automated Highway System Consortium (NAHSC). The NAHSC mission was to develop a prototype automated highway system for the United States and to demonstrate AHS technology by 1997. **Demo 97** in San Diego, California, in August 1997 was a major public success and one of the best demonstrations of transportation technology in U.S. history. However, despite that success and completion of significant AHS research, the USDOT ended its participation in the NAHSC in early 1998. Without a primary source of funding, the NAHSC ceased its activities in June 1998.

The USDOT has now redirected the focus of its Advanced Vehicle Control and Safety System (AVCSS) research into a program called the Intelligent Vehicle Initiative (IVI). The primary goal of the IVI Program is to improve the safety of vehicle travel through the development of autonomous intelligent vehicles. While this goal is noble and should be pursued, it does not consider the long-term societal need for traffic congestion relief.

In addition to the work performed under the IVI Program, all the major motor vehicle manufacturers and their suppliers are currently developing a variety of AVCSS products. Almost all of these products are autonomous in nature, meaning that they do not depend on any specific interaction and cooperation with other vehicles or with the roadway infrastructure. The first of these systems to come to market are the adaptive cruise control systems, which are likely to be followed by a variety of safety-enhancing warning systems. Virtually all of the developers of these products recognize that their system performance could be significantly improved if there were clear methods to provide a means of cooperation with other vehicles and the roadway infrastructure. This cooperation will enable the developers to create effective products that would still be economically feasible for installing on vehicles.

Prior research also indicates that significant congestion relief can be achieved by adding the concept of cooperation between vehicles and the highway infrastructure to the autonomous intelligent vehicles produced by the IVI Program. Recognizing that vehicle systems developed under the IVI Program will likely be deployed sooner than the CVHAS products developed under this proposal, it will be essential that the CVHAS Program be complementary in nature to the IVI Program, rather than competitive.

Despite the cancellation of the NAHSC program, there is still substantial national and international interest in CVHAS. In 1998, Caltrans and PATH created an initiative called The Phoenix Project (*Phoenix*) whose mission is to continue CVHAS research, development, and deployment with public, private, and academic partners in the U.S. and abroad. Among *Phoenix*'s goals are to:

1. establish a national-international public-private organization capable of pursuing CVHAS from research and development through full deployment;
2. establish linkages among funding partners, research organizations, transportation system owners and operators, and vehicle manufacturers and suppliers; and
3. mainstream CVHAS by raising awareness of its capabilities in the transportation planning process and by incorporating precursor technologies into the infrastructure.

This CVHAS Program is intended to be the first step in establishing The Phoenix Project as the national focal point for research activities related to CVHAS. Subsequent steps will include bringing interested private sector (primarily vehicle manufacturers and suppliers) and international partners into the program to facilitate CVHAS deployment from both the public and private sector sides.

#### Benefits:

While the IVI Program will address near-term vehicle safety needs, cooperative vehicle-highway automation systems will address the nation's long-term surface transportation needs. As the technologies developed under this program mature, they will help to ease traffic congestion, in addition to increasing traveler safety, comfort, and convenience. Achieving that vision will require the development of "building-block" or precursor systems that will also have applications in the current transportation system. There will be "spin-off" technologies developed from this research, such as lane and roadway departure warning/assistance, merge and lane-change driver assistance, and safer braking systems for heavy vehicles. For example, the sensors designed to detect obstacles ahead of a truck on an automated truck lane could also be used to warn the driver of danger when the truck is operating on conventional highways, thereby increasing safety for all parts of the roadway transportation system.

This program is intended to benefit state DOTs by:

- Identifying and planning a research agenda that addresses major transportation challenges and attains the long-term CVHAS goals in an efficient and achievable manner
- Focusing on research, development, and deployment of near-term solutions while retaining a long-term vision of CVHAS
- Encouraging the creation of partnerships; cooperative systems necessitate collaboration among infrastructure owners and operators, communications service providers, and the manufacturers and suppliers of vehicles
- Helping to unify the market demand, which will, in turn, help achieve the deployment of both the near-term and long-term solutions

- Building the research foundation to support the deployment of automated transportation systems
- Addressing state DOT concerns regarding CVHAS, such as public safety and maintenance and operations needs

This program will also benefit state DOTs by developing a consensus on standardization and interoperability for cooperative vehicle-highway automation systems. In addition, the program will:

- Address transportation user needs at the national level to help bring consistency to the market and thus support both the supply and the demand for the various products that will eventually be developed
- Enable the tailoring of local solutions that can meet regional needs (transportation user needs differ among localities; the flexibility of the approach in this proposal is critical for success)
- Improve ITS planning and deployment by increasing the number and variety of potential solutions to traffic congestion, safety, and other challenges
- Enable manufacturers to realize the economic benefits that come from commercialization and implementation by building cooperative relationships between government, industry, and academia
- Begin the development of guidelines that will eventually lead to standardization, interoperability, and widespread deployment

#### Program Management:

Caltrans will act as the lead state and program manager for this regional pooled fund study. Caltrans staff will perform the administrative duties that are necessary for the study, such as preparing quarterly reports and executing contracts. Each participating state Department of Transportation (DOT) will provide a representative to the *Program Steering Committee* (PSC), which will oversee the day-to-day activities of the CVHAS Program. This representative shall be of sufficient management level in their organization to make decisions regarding the resources of the program. The PSC will meet approximately three times per year, typically in conjunction with other events, such as the ITS America Annual Meeting, in order to reduce travel costs. Other PSC discussions and information exchanges will take place via telephone, teleconference, email, website postings, and newsletters. The state DOTs participating in this program will contribute to the overall effort by attending the meetings and performing the activities as assigned by the PSC.

Participating state DOTs will also provide a representative for the *Technical Advisory Committee* (TAC). This representative will ideally be someone with expertise and experience in the technical aspects of cooperative vehicle-highway automation systems. It is not necessary that TAC representatives come from within the state DOT that they are representing; academic

partners or industry representatives are also acceptable, provided there is no conflict of interest between their role as a proposal evaluator and as a potential submitter of proposals. The role of the TAC will be to provide recommendations to the PSC on technical matters pertaining to the activities of the program. The TAC will not have regular face-to-face meetings, but will instead rely on electronic means in order to perform its duties.

#### Work Plan:

The program work plan will consist of the following three tasks: (1) Program Start-up and Management, (2) RFP Development and Proposal Review, and (3) Monitoring the Progress of the Projects.

### **Task 1. Program Start-up and Management**

Program start-up and management activities include soliciting the participation of other state DOTs, organization of a kickoff meeting of the PSC, establishing the TAC, development of program goals and objectives, and identifying the participants' roles and responsibilities.

Caltrans will create a website for the cooperative vehicle-highway automation systems program. Program activities will be highlighted to provide information to the global ITS community. Links to and from participating state DOT websites will be established. With the increasing level of access to the Internet, websites are becoming an effective method of marketing, professional "networking", and information sharing. In addition to providing general CVHAS information, the website will also contain a bulletin board where visitors can provide feedback and suggestions, thereby expanding the knowledge base of the program participants.

### **Task 2. RFP Development and Proposal Review**

Based on the results of task 1, the next step will be for the PSC and TAC to identify the content and priority of the program's research agenda. After that task is completed, the TAC will develop a Request for Proposals (RFP) to solicit research projects. The RFP will be published in a national forum and proposals will be received and reviewed by the TAC. The TAC will prioritize the list of proposals that it recommends for approval, and will then forward its recommendations to the PSC. Based on available funding, the PSC will approve funding for the proposals and Caltrans will develop them into contracts.

### **Task 3. Monitoring the Progress of the Projects**

After the contracts have been executed and the projects are underway, the PSC and TAC will monitor the progress of the researchers and ensure that they deliver the products that are expected. As additional funds are acquired (by the addition of other state DOTs, for example), additional proposals may be solicited.

#### Reports:

Caltrans staff members will prepare and submit Quarterly Progress Reports, as required by the Federal Research Guidelines. The final deliverable report will consist of the documentation from each of the individual projects that are completed under this program.

#### Time Schedule:

This regional pooled fund study will begin on July 1, 2000, and run through June 30, 2004. After three years of operation, an independent evaluation of the progress of the program will be performed to determine whether or not it should continue beyond the four-year horizon.

#### Resources:

The total amount of funds will depend on the number of state DOTs that participate and the level of funding that they contribute. Funds will be allocated each year to pay for the participants' travel and costs associated with setting up meetings. The remaining funds will be used to initiate projects that are approved by the PSC. The amount of staff time spent reviewing proposals and preparing for and attending the program meetings is not expected to be significant and will be absorbed by the participating state DOTs.

#### Travel:

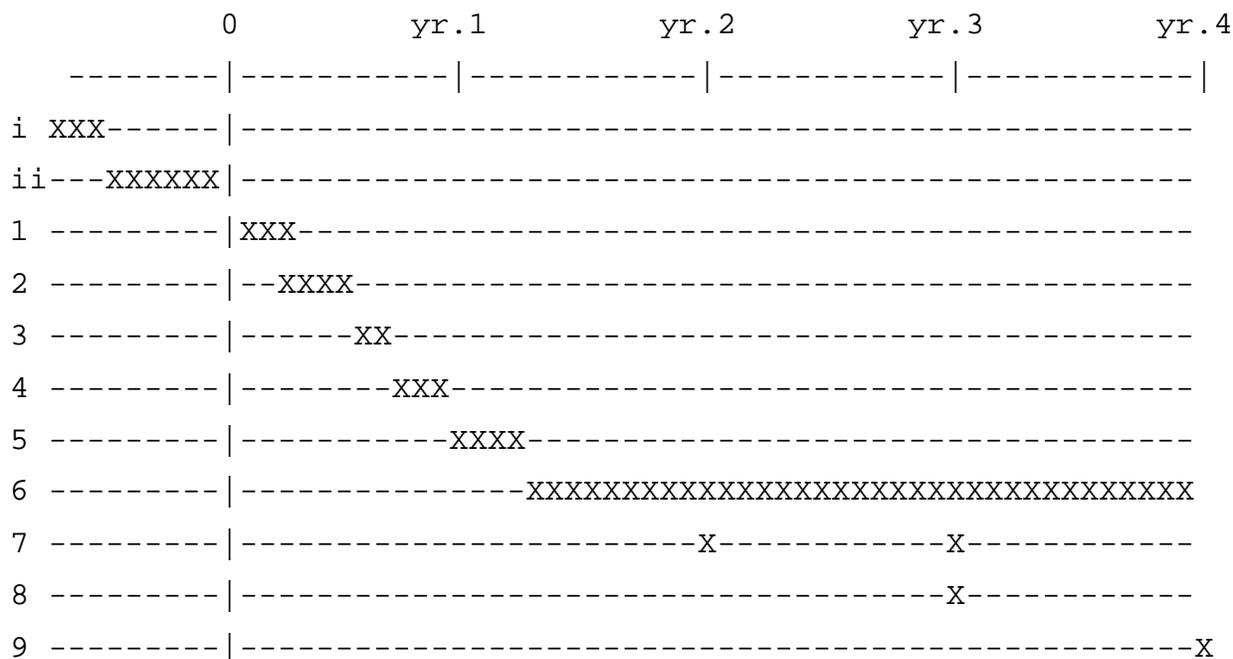
Since this topic of research is of national importance and requires collaboration among experts from various states, some travel will be involved. All attempts will be made to combine program meetings with other conferences, so that a maximum pool of program participants can be consulted with minimum travel cost. Travel costs estimated within this proposal cover airline expenses and per diem. Travel is needed for PSC members to travel to two large conferences per year, and to one specific workshop on cooperative vehicle-highway automation systems. These travel expenses will be paid out of the contribution that each state DOT makes to the regional pooled fund study.

#### Funding Requirements:

Caltrans agrees to provide \$200,000 per year for the first four years of operation. Other participating states will be asked to contribute at least \$25,000 per year from their State Planning and Research (SP&R) allocation, or a fair share if that amount is a hardship. Fair shares would be determined based on the percentage of the annual SP&R funds for the state, so that small states are not unfairly burdened. It is estimated that the funding level needed for this effort to reach full potential will be approximately \$400,000 annually.

## Program Task Timeline

- i) Solicit interest from other state DOTs - 3 months
- ii) Set up the pooled fund contract - 6 months
- 1) Establish the PSC - 3 months
- 2) Organize the TAC and develop the research plan - 4 months
- 3) RFP Process: develop and advertise the RFP – 2 months
- 4) Receive and review the proposals - 3 months
- 5) Execute research contracts and begin projects - 4 months
- 6) Monitor the projects
- 7) Iterate the RFP process (if funds allow; return to step 3)
- 8) Independent review of the program progress after three years
- 9) Completion of the program after four years (unless the participants agree to continue)



## Estimated Budget

Caltrans Contribution: \$200,000

Others (eight states at \$25K): \$200,000

Total: \$400,000 per year

Travel Expenses: \$40,000 (\$5K per year for each participating state)

Meeting Expenses: \$20,000

Total: \$60,000

Therefore, approximately \$340K per year will be available for projects, based on eight additional states participating.