Development of a Freeway Traffic Management Project Through a Public-Private Partnership

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If intelligent vehicle-highway system (IVHS) and traffic management systems are to be successful in the future, a good relationship must exist between the public and private sectors. To foster this relationship in the Houston area, a public-private sector partnership was organized by the Texas Department of Transportation. The initial objective of this group was to improve the sources and use of real-time travel information. This partnership consisted of public-sector transportation agencies, commercial transportation companies, and traffic service organizations. The initial project of the partnership was the development and operation of a cellular phone probe project as a source of real-time travel information. This information was then used by commercial transportation companies and traffic service organizations. This project demonstrated how the public, public agencies, and the private sector can have effective roles in improving the sources and use of travel information.

To obtain the maximum benefits from intelligent vehicle-highway systems (IVHS) and traffic management systems (TMS), the public and private sectors must have good working relationships. To encourage the formation of a cooperative relationship at the local level, the Houston Office of the Texas Department of Transportation (TxDOT) organized a partnership of public agencies and private-sector companies with the initial objective of increasing the sources and the use of real-time travel information. Public-sector participants were the City of Houston Aviation, Police, and Transportation departments; Harris County Metropolitan Transit and Toll Road authorities; Texas Department of Transportation; and Texas Transportation Institute. Private-sector participants were Federal Express, Houston Lighting and Power, METRO Traffic Control, ATE Bus Lines, Shadow Traffic, and Traffic Central. During monthly meetings the partners defined issues that provided the basis for a short-term joint public-private implementation project in an area called the North Houston Corridor. These issues included the following:

- Travel time information for the study area was needed to operate eight changeable message signs (CMSs). The schedule for installation of these signs was accelerated when the Harris County Toll Road Authority (HCTRA) received funding.
- Travel time information was scheduled to be provided by TMSs, which would be operational within 2 to 3 years.
- In the North Houston Corridor one of the major roadways, the US 59 Eastex Freeway, was to be reconstructed during a 5-year period. The monitoring of roadway and traffic conditions was essential for the implementation of congestion mitigation efforts.
- Although the original purpose of the partnership was of a planning and technology sharing nature, it was decided that a short-term, successful implementation project for demonstration purposes would be needed to maintain the interest of all partners.

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The North Houston Corridor offered the best potential for satisfying the requirements raised in these issues and for fostering the public- and private-sector cooperation needed for implementing and participating in the project. The project involved use of a technology for tracking vehicles through the corridor so that travel times could be monitored in real time. Automatic vehicle identification (AVI) and automatic vehicle locator systems were considered the best technologies, but a technique using manual data collection and transmission was selected for the first phase to meet the schedules for early implementation. Cellular telephones were issued to 200 volunteers who were asked to serve as traffic reporters (probes) during their commute trips to and from work. The experiences in involving the public, public agencies, and the private sector in the development and conduct of the study are reported in this paper. The results of the cellular telephone demonstration study as a source of travel time information are also discussed.

FACTORS IN SELECTING THE PROJECT CORRIDOR

The North Houston Corridor study area is defined by the three parallel radial freeways: IH 45 North Freeway, the Hardy Toll Road, and US 59 Eastex Freeway (Figure 1). The High-occupancy vehicle (HOV) lane on IH 45 was also included in the study. Several factors favored the selection of this corridor:

- The three parallel freeways are spaced such that they can serve as alternate routes for each other.
- The US 59 Eastex Freeway was scheduled for reconstruction beginning in 1992, and installation of a TMS would not begin until completion of construction in 3 to 4 years.
- Eight electronic CMSs are installed in the corridor for traffic diversion operations (Figure 2). These signs were in-

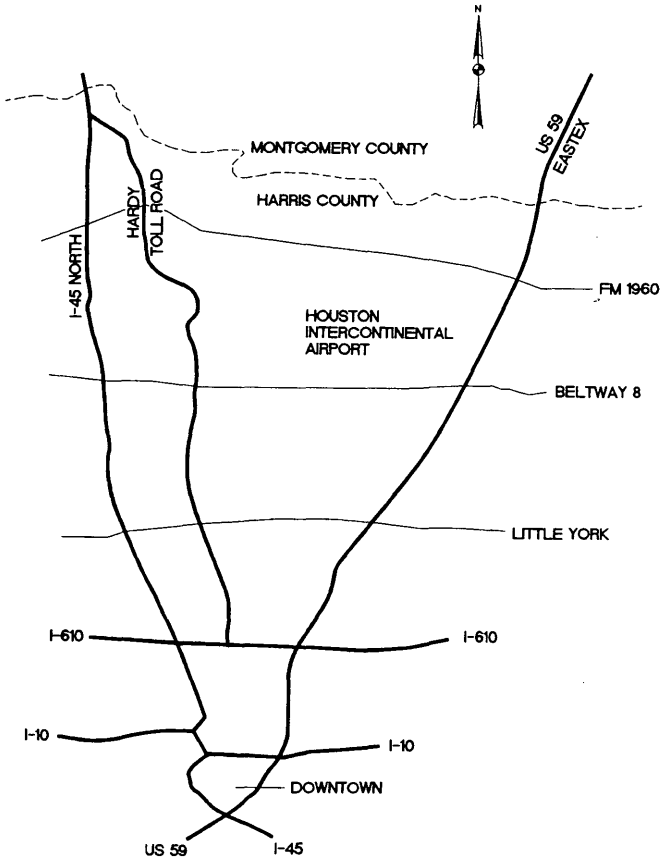

FIGURE 1 North Houston Corridor.

stalled with funding assistance from HCTRA, which operates the Hardy Toll Road.

- The TMS being installed on IH 45 North Freeway is not scheduled to be operational for 2 years. No traffic management or monitoring systems are planned for the Hardy Toll Road.
- The North Houston Corridor serves several major activity centers, including
  - –Houston Intercontinental Airport,
  - –Woodlands and Kingwood residential communities,
  - –Downtown Houston and the Greenway Plaza employment centers, and
  - –Houston Medical Center.
- The North Houston Corridor carries a high volume of commercial traffic.

DEVELOPING THE CELLULAR TELEPHONE PROJECT

Several developments in transportation should be of interest to the private sector: (a) the potential impacts of the Clean Air Act on the operation of businesses; (b) the potential for new business opportunities resulting from the development of IVHS technologies; (c) the improvement in the efficiencies of operations with the availability of real-time information on traffic conditions and navigation information for guidance. Therefore the development of the public-private partnership was successful in enlisting companies representing the following business groups:

- Commercial transportation companies, including contract carriers, taxi cab companies, and package and long-haul trucking companies;
- Traffic advisory service companies;
- Cellular telephone companies;
- Utility companies; and
- Greenway Plaza Property Transportation Center.

The discussions conducted at the monthly meetings of the partnership were useful in defining the interests and potential roles of the various companies in developing the IVHS program in Houston. For example, although the commercial transportation companies were interested in the development of IVHS and expected to participate in future IVHS projects, they were not interested in making financial investments in demonstration and development projects at this time. Further, it was determined that the number and time of trips by commercial vehicles in the study corridor during the commute time periods would not provide adequate coverage in the collection of real-time travel time data.

The traffic advisory service organizations were most interested in participating in the project because they had immediate needs for the information to be collected and could recognize the potential business that would result from the implementation of IVHS. It was determined that their support role would be to provide manpower and equipment to operate the system instead of straight financial support.

The need for the implementation of a short-term project to examine and demonstrate the benefits of real-time information became evident. The private sector needed assurance that their operations would realize real benefits. The use of cellular telephone technology with volunteer probe vehicles was determined to require the least capital expenditure. However there were major operating costs, primarily the cellular telephone air time for the traffic reports, for which private-sector support was necessary.

Cellular Telephone System

The probe study required 200 vehicles equipped with cellular telephones to provide the desired coverage of the four routes. The reporters (probes) would make 10 telephone calls per day, the cost for which would accrue to $180,000 annually for air time. Other costs include the 200 cellular telephones and the monthly charges for cellular telephone service.

The partnership obtained support from the Houston Cellular Telephone Company to provide free air time for project calls. The sponsoring agency, TxDOT, funded the cost of the telephone equipment and the monthly access charge for telephone service, which was $29.75 per month per telephone.

Office Staff

The telephone calls were received by three operators who recorded the information directly into the computer system. Two of the operators were provided by the two traffic advisory

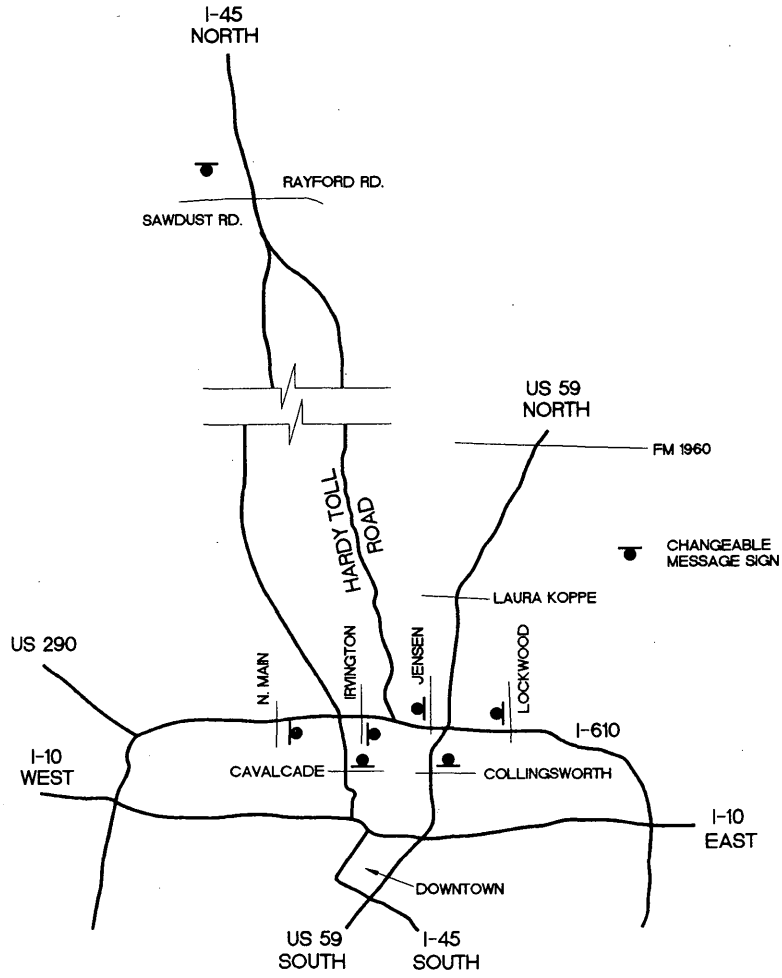

FIGURE 2 CMS locations.

services in Houston, METRO Traffic and Shadow Traffic, which market traffic information to radio and television stations. The third operator was provided by the study. A third traffic advisory service, Infobanq, provided equipment in lieu of personnel support. Supervision of the operators was provided by the Texas Transportation Institute (TTI) under contract to TxDOT.

Office Facilities

Office space of approximately 1,000 ft^2 was required to house the operators and computer equipment. Senterra Development Corporation, manager of the Greenway Plaza Properties, provided the office space at cost (approximately 50 percent of the leasing rate). An additional 1,000 ft^2 was acquired to house the TxDOT's interim communications center, which uses the real-time information to operate the CMSs and dispatches emergency vehicles to incidents.

Computer Network

A network of six computers, three for data input by the operators, are required to receive, process, and disseminate the information. Some additional equipment, such as printers, fax machines, and networking devices are also needed. This equipment was furnished by the Southwest Regional Transportation Center of the Texas A&M University in exchange for the opportunity to conduct several studies that involve the information obtained in the cellular telephone project.

Project Management

A project staff was required to develop the project, acquire the equipment, furnish the office, develop the computer software, and supervise the operators, probes, and other personnel involved in the study. TTI provide this function under contract to TxDOT. An existing interagency agreement between TTI and TxDOT was used, which enabled this project to become operational within 1 year.

Although support by the private sector was eventually received, it became apparent that the public sector's perception of what the private sector's role should be in such a project was not accurate. For example, because cellular telephones are often advertised at prices as low as $29.00 per unit, the staff expected that the equipment could be obtained at no cost to the project. This proved to be incorrect, and through a competitive bid procedure, 200 units were purchased at a

cost of $105 per unit. Both cellular telephone companies in Houston were invited to participate in the project, but only Houston Cellular elected to participate. Houston Cellular provided free air time for the traffic reports and provided a good rate schedule for personal calls equal to a government plan. However the project was required to pay the monthly access fees of $29.50 per month per telephone for the 200 units.

RECRUITMENT OF VOLUNTEER TRAFFIC REPORTERS (PROBES)

Tracking vehicles along streets and highways has been a standard technique for measuring travel characteristics. The floating car method with various techniques for recording the time intervals between check points has been improved over the years with the application of automatic sensing devices and recorders on the vehicle. Laptop computers that can plug into the vehicle electronics have made the study technique practically independent of the operator of the vehicle. However to get real-time information over a large area for a long time period, the information must be collected at frequent intervals from many vehicles. It is impractical to equip and to operate many vehicles on a permanent basis to collect this information. However the development of automatic systems that can identify a vehicle or determine its location is moving forward because there are other applications for the data collected from these systems. These applications include bus locator systems and small fleet management systems to aid in the dispatching functions, vehicle locator systems for the retrieval of stolen vehicles, and identification systems for automatic collection of tolls. Other IVHS applications that are becoming more important include vehicle navigation systems, advanced information systems, and TMSs.

In the cellular telephone study for the North Houston Corridor, the data requirements were time of day, vehicle identification, and vehicle location at intervals of 3 or 4 mi on the four roadways, which were approximately 20 mi long. The proposed average time interval between vehicles was 5 min during the commute time periods, and 2 to 3 min during the critical peak periods. The challenge to the study staff was to contact potential volunteers, explain the study, and enlist 200 volunteers for a minimum of 1 year.

The study staff contacted several major employers in Houston to solicit their help in contacting their employees. Arrangements were made to visit the companies to present a brief slide presentation and to obtain the names of people interested in participating in the project. The presentation appealed to their civic duty to help solve the traffic congestion problem, but the project offered real incentives to compensate them for their time and efforts in making the reports:

- A mid-priced cellular telephone (Motorola Model MC310 or NEC Model 3800, installed or transportable);
- Free installation;
- No monthly access charges for 1 year;
- Free air time for traffic-related calls; and
- Government rates for air time charges for personal calls.

Some of the companies, agencies, and groups that participated in the program include Exxon, First City Bank, Houston Medical Center, and TxDOT. Many individuals were contacted through newspaper advertisements and word of mouth. The major problem in obtaining the 200 volunteers was the distribution of trips in time and space. Table 1 depicts the distribution of the probes by time of day and roadway. It was difficult to enroll persons for some time slots on some roadways. Another problem that eliminated several potential participants was that each volunteer had to have a satisfactory credit rating to open an account with the Houston Cellular Telephone Company.

Even though people may have been contacted through their employer, it was important to emphasize that this was a voluntary effort, totally separate from the company. It was difficult to maintain the interest of the 200 persons for a 1-year period. Monthly newsletters were developed to give the probes information on the progress of the study, the activities of the probes (how many incidents were reported, for example), and activities on the level of their participation. Recognizing that people do not travel to work each weekday for 1 year, the project established a 70 percent goal. To qualify for the free monthly access and for the telephone at the end of the year, the volunteers were required to report 70 percent of the weekdays during the year.

The project staff had to work continuously with the cellular telephone company to keep the billing and the credits for access charges and air time up to date. Also, several of the original 200 probes left the program for various reasons. Many persons were transferred to other locations outside the corridor area. These persons were given the opportunity to either purchase the telephones for their personal use or to return them to the project. Telephones were issued to replacement volunteers to maintain the coverage.

Although the project has been judged to be a success, the amount of management effort required to set up and to maintain the level of participation was more than anticipated. The experience gained in this project will be valuable in establishing the fleet of vehicles that will use transponders in an AVI system to collect the same type of information.

RESULTS

Table 2 presents the summary of information developed from the data collected during a 15 min time period on a particular

TABLE 1 Probe Distribution by Time of Day and Roadway

Distribution by Time of Day			
AM	Number	PM	Number
6:00- 7:00	106	3:00-4:00	18
7:00- 8:00	73	4:00-5:00	58
8:00- 9:00	18	5:00-6:00	89
9:00-10:00	3	6:00-7:00	35

Distribution by Roadway	
Roadway	Number
IH 45 Freeway (North)	95
IH 45 HOVL	14
Hardy Toll Road	20
US 59 Freeway (North)	71
Total	200

TABLE 2 Houston Intelligent Transportation System Travel Summary and Incident Information

Travel Summary for 21 July 1992 at 4:45 p.m.					
Roadway				Distance (miles)	Travel-Time (min)
North Freeway (IH 10 to Holzwarth)				19.5	28.9
North Freeway HOV Lanes				10.8	14.4
Hardy Toll Road (No. Toll to 1960)				16.8	17.0
Eastex Freeway (IH 10 to FM 1960)				16.5	28.4
Incident Information					
Time Reported	Freeway	Cross Street	Type	Comments	Status
1.16:35	59/NB	Laura Koppe	Accident	2 cars blocking left lane	HPD on scene

Note: This travel time and incident information is automatically faxed every 15 minutes. If you fail to receive any fax, please contact us at 840-9470.

Source: Texas Transportation Institute
3800 Buffalo Speedway
Phone: 840-9470

day from the cellular phone probes. These summaries are transmitted to the traffic service organizations and the TxDOT's Interim Communication Center for further dissemination.

The travel patterns in the North Houston Corridor indicate that the peak traffic flows occur from 6:00 to 8:00 a.m. and 4:00 to 6:00 p.m. Fortunately these were the times that the study staff enrolled the majority of the probes. For a typical month, 28,000 calls were made to determine travel times and 230 calls were made to report incidents.

Although commercial transportation companies are interested in the use of real-time traffic information, they are not yet interested in investing financial resources for this purpose. The volumes and trip times of the commercial transportation companies reveal that they are more interested in information concerning incidents and the resultant congestion (nonrecurrent congestion) instead of the recurrent congestion of the peak periods. The benefits of the real-time travel time information to commercial transportation companies is under evaluation.

There is also some misperception about the potential contribution by the private sector to the cooperative projects by the public sector. Even though the Houston Cellular Telephone Company made a significant contribution by providing free air time, the company received 200 new customers recruited by the project. The free air time is significant when measured in the manner that it is charged by cellular companies. Each call is charged a minimum of 1 min, regardless of the length of the call. Most of the calls to report the vehicle identification number and the location station require no more than 15 sec. Therefore the $180,000 worth of free air time is by actual time worth approximately $50,000.

The traffic service organizations are interested in becoming partners in the collection and processing of traffic information because that is the very essence of their business. This relationship between the private and public agencies in traveler information should continue to expand.

The use of TTI of the Texas A&M University System as the management agency simplified the project administration and enabled the demonstration project to move forward at an accelerated pace. However these types of projects will become the responsibility of the public operating agencies in the future, and procedural changes will have to be made to accomplish the implementation.

CONCLUSIONS

The use of the cellular telephone probes was an acceptable and reliable source of real-time traffic information. Errors in reporting were small. Test runs by the study staff confirmed the accuracy of the reports. There will be a place in future systems for the use of traffic reports from on-the-scene reporters, even though there may be automatic systems for tracking and locating vehicles. One of the major benefits of the cellular system is the reporting and description of incidents that require the dispatch of emergency vehicles.

The improvement of the real-time information from the cellular telephone probes did not result in an increase in the use of the CMSs in the corridor. These signs, operated by TxDOT from the Interim Communication Center, are used to alert motorists of major incidents and to advise the use of alternate routes. During the 9 months of the study and the 4 to 5 hr per day of the probe study, the use of the CMSs as compared with the previous year did not change significantly. As the coverage of traffic monitoring systems approaches 24 hr, the usage of the signs should increase. In the future the signs will be to advise motorists of the best routes under normal conditions.

The participation by the private sector is dependent on some specific benefits that may be realized in the short term. The office complex provided space at cost. The cellular telephone company provided free air time but collected 200 new customers with monthly access fees. It was difficult to maintain the participation of the private individuals for the full year, even though they received free telephones and paid no access fees.

FUTURE PLANS FOR THE IVHS PARTNERSHIP

Several agencies are installing AVI systems in the Houston area. HCTRA installed an AVI system for the Hardy and

Sam Houston toll roads in September 1992 for automatic toll collection. TxDOT installed an AVI System on the IH 10 Katy Freeway, US 290 Northwest Freeway, and the IH 45 North Freeway HOV lanes and main lanes in early 1993 to measure real-time travel times between the HOV lanes and main lanes. These installations, which will replace the cellular telephone probes on IH 45 North Freeway and the Hardy Toll Road, will be used to enhance the use of public transportation facilities (HOV lanes).

The City of Houston Aviation Department has proposed an AVI system for monitoring traffic flow and for automatic fare collection of commercial vehicles at the two airport facilities. The progress on these three AVI projects has been monitored and coordinated through the meetings of the public-private partnership.

All three of the agencies will probably use the same AVI technology to ensure compatibility and to increase the coverage of vehicles equipped with transponders.

An interim traffic monitoring system will be installed on the US 59 Eastex Freeway during the reconstruction project. The speed detection system will replace the cellular telephone probes in fall 1993.

A part of the IVHS "SMART Commuter Project" will use the real-time travel time information collected with the AVI and cellular telephone probes. Certain commuters will be provided with the information in various forms and locations to encourage an increase in the use of the buses and carpools on the HOV lanes. The SMART Commuter Project will begin in fall 1993.

The Houston area has been designated as a priority corridor under the Intermodal Surface Transportation Efficiency Act of 1991. One of the proposed projects is to expand the AVI network by supplementing the AVI installations along the two toll roads with additional AVI traffic monitoring stations and to monitor the park-and-ride facilities supporting the HOV lanes. Additional AVI systems are proposed for the IH 610 Loop Freeway from the US 59 Eastex Freeway to the US 59 Southwest Freeway and on the Southwest Freeway from the Sam Houston Toll Road to downtown (Figure 3). If funding from the Congestion Mitigation and Air Quality Program is approved, installations should be completed in 1993.

Initially all AVI systems will be accessed by telephone lines. After the fiber optics trunk lines are installed for the TMSs, the telephone communications will be converted to the state-owned fiber network.

Initially all of the real-time travel time information will be received and distributed by the TxDOT Interim Communication Center. This center will be replaced by an interagency central control facility (CCF) to be constructed in 1994. Plans are being made to include the private traffic service organizations in the CCF to assist in the management and distribution of traffic and transit information, but this arrangement is contingent on interpretation of state law concerning the joint use of public facilities by private companies.

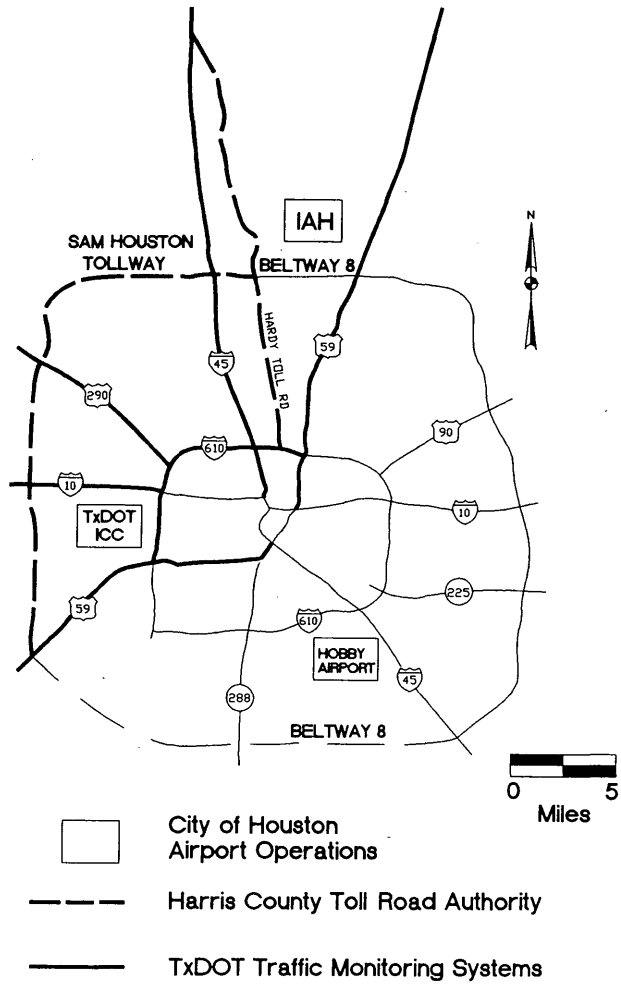

FIGURE 3 Proposed AVI systems.

Future applications of real-time monitoring systems will include commercial fleets, thus expanding the coverage into time periods that will benefit their operations. With the use of automatic systems the interaction with the drivers to report locations is eliminated. In addition, multiple use of the AVI system for toll collection and other restricted area monitoring will enhance the use by the private sector.

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