Outsmarting the Driver

Advanced vehicle and highway technology could mean a better future for drivers and for existing roads

It's 5:00 p.m. After a long and tiring day, you start your car, flip a switch, and watch color maps on a video screen and listen to a synthesized voice inform you of the best route, traffic conditions ahead, optimum speed, and total travel time. Variable message signs on the roadway warn of impending problems, and you cruise through toll booths without stopping to throw in change. You sit back and take in the scenery as the road chauffeurs you to your destination.

Although it smacks of science fiction, this scenario could become as commonplace in the coming decades as congestion is now. The introduction of advanced vehicle and highway, or "smart," technology, such as dashboard-navigation systems, car trains, and synchronized traffic lights, promises to eliminate bottlenecks and gridlock, increase safety, and reduce pollution. When the wrinkles are smoothed out, experts say, a smart vehicle and highway system in the United States could become a reality as soon as 50 years from now.

Smart systems incorporate radar, electronic sensing devices, lasers, video and audio technology, and even satellites to produce an efficient, automated, smoothly running highway system. Its applications are seemingly endless.

Smart Applications

The main applications of smart technology can be grouped into four categories: advanced traffic management systems, advanced driver information systems, freight and vehicle control operations, and automated vehicle control systems.

One of the associated benefits of smart technology is elimination of toll booth queues. Instead, electronic sensors could, for example, scan a bar code much like that at a supermarket checkout that allows the driver to automatically be billed. Testing of these systems is under way in the United States and abroad.

Another benefit is automatic headway control, or regulation of the front-to-rear distance between cars, which prevents traffic jams. On highways, radar or laser braking adjusts the speed accordingly and sets up a protective "cushion." This cushioning effect creates "car trains," caravans made up of any number of cars that travel uniformly, centipede-like, along the highway. By some estimates, freeways could accommodate three times the capacity they do now. One drawback is the so-called Slinky effect, by which cars not built to standard cause the car trains to stretch out and contract, creating waves of uneven speed.

On urban streets, flow can be made smoother by synchronized traffic lights that adjust according to signals relayed by sensors embedded in the road. New York and Los Angeles are experimenting with this idea through their Smart Street programs.

Several applications that are already in place are electronic billboards, which flash variable traffic information to direct vehicles away from bottlenecks and

Smart Technology R&D in the United States

The United States has begun to take an active role in developing smart technology. Major R&D projects include the following:

- FHWA, the California Department of Transportation, and General Motors are sponsoring Pathfinder, a $1.6 million, three-year project being conducted along a 12-mile stretch of the Santa Monica Freeway. Twenty-five Oldsmobile Delta 88s have been equipped with ETAK (map display) or similar navigators to instantly inform drivers of traffic conditions. A Traffic Operation Center (TOC) has been set up to receive feedback from the vehicles. Equipment such as cellular telephones will be used to transmit information between the TOC and the vehicles.
- The Institute of Transportation Studies at the University of California, Berkeley, operates the Program on Advanced Technology for the Highway (PATH), funded by government and private interests. The six-year, $56 million project will investigate such advances as cars that run on power from electric cables embedded in pavement, automatic vehicle control, and automatic navigation. PATH also provides outreach to other states that are interested in developing a national program. So far, Michigan and Texas have started programs, and Massachusetts and Pennsylvania have taken an interest.
- The University of Michigan Transportation Research Institute is conducting research on automatic navigation and highways through its Intelligent Vehicle Highway Systems program. The Michigan Department of Transportation and 19 other sponsors from government and industry, including GM, Ford, and Chrysler, are participating.
- The Texas State Department of Highways and Public Transportation, FHWA, and NHTSA are backing the Texas Advanced Technology Program, begun in late 1988 by the Texas Transportation Institute, to study automated systems.
- Mobility 2000 is an ad hoc coalition of transportation professionals drawn from government, universities, and industry that has set up an agenda for research, development, and demonstration of advanced vehicle and highway technology in the United States.

to make traffic more uniform, antilock braking systems, and cruise control. These innovations are just the first steps toward widespread use of smart technology.

Slow Progress

Smart technology has been explored for about 30 years, even before the invention of the microchip, but the possibility of its implementation is relatively new. Questions of liability, operational responsibility, and funding need to be resolved before serious strides can be taken. Despite these weighty issues, large experimental programs in Europe (PROMETHEUS) and Japan (AMTICS, RACS) (see "Europe and Japan Get Smart") and smaller-scale projects in the United States (see "Smart Technology R&D in the United States") are testing various systems with some success.

But why are bells and whistles needed on a highway network that is yet to be completed? The main impetus for developing smart systems is the strain being exerted on the capacity of the existing road system by overwhelming congestion. The 110 million commuters in the United States spend 2 billion hours a year in traffic jams. By FHWA estimates, that figure will increase fivefold by the year 2005. Transportation officials say that more than $73 billion in productivity is lost each year because of congestion.

Besides reducing traffic congestion, using smart technology will benefit the environment. Much of the pollution from automobiles is caused by idling and stop-and-go traffic. Increased safety is another plus. Taking control away from the driver will result in fewer accidents.

A Weighty Task

So, who is to take responsibility for developing and, ultimately, funding this massive undertaking? It appears that both government and industry will have to collaborate to decide who is going to shoulder the cost and liability. But before decisions are made, the logistics must be studied more closely. TRB is in an ideal position to contribute.

NCHRP, through its Assessment of Advanced Technologies for Relieving Urban Traffic Congestion project, is studying the implications of applying smart technology and lending special emphasis to applications that could enter demonstration in less than 10 years.

Through the Special Projects Division, a committee representing a cross section of the private and public sectors will be performing a more strategic, long-term study. The project is being funded by a consortium of public and private organizations including FHWA, NHTSA, AASHTO, Motor Vehicle Manufacturers Administration, Motorola, and Dupont Automotive Products. Among the topics the committee will examine are the following:

- The nature, locations, and scale of transportation problems that could be solved or significantly reduced;
- "Low-tech" or "no-tech" alternatives and their relative benefits and costs;
- Institutional, administrative, and legal barriers to public and private partnerships;
- The order of and schedule for introducing various stages of the technology;
- Guidelines for U.S. R&D; and
- The level of and method of raising funding for R&D.

Concerned about unwarranted delays in introducing smart technology that would put U.S. firms at a disadvantage, in 1988 Congress commissioned the Secretary of Transportation to submit a report on U.S. and foreign efforts and their potential effect on the U.S. economy. The report is forthcoming.

Smart vehicle technology has a long road to travel before it can be fully implemented. More R&D on and evaluation of how existing technologies will evolve to create this system are needed, and which techniques and strategies will prove most efficient must be studied. Cost-effectiveness is a major question, as is liability in the event of component or system failure. Already, though, improvements in vehicle and highway technology have reduced traffic delay, increased capacity, and afforded greater safety. As progress continues, the problems facing drivers today could be vastly mitigated.

Europe and Japan Get Smart

Most of the R&D on smart technology is being conducted in Europe and Japan. The enormous leaps in progress made there have prompted concern by U.S. government and industry about the commercial disadvantages to this country.

PROMETHEUS (Program for European Traffic with Highest Efficiency and Unprecedented Safety) is Europe's contribution to the realization of smart technology. The $875 million project, started in 1986 and scheduled to run for eight years, aims to develop European, and eventually, industry standards for automatic navigation. Its participants include 70 research institutes and 20 automotive manufacturers from six countries. One of its goals is to reduce the risk of collision by 50 percent by the year 2000; another is to enhance the overall efficiency of highway transportation. A navigation system called Autoguide is being tested in West Berlin. Later this year, London will begin testing Autoguide, and by 1992, Munich, Seville, Paris, Toulouse, and Turin will have the system installed.

Japan also has a leg up on the United States in studying smart technology. The Ministry of International Trade and Industry is conducting a $700 million project on intelligent vehicle systems. The National Police Agency, in cooperation with 50 automotive and electronic companies, sponsors the Advanced Mobile Traffic Information and Communication System (AMTICS), a cooperative effort among 50 automotive and electric companies in 74 Japanese cities. The Ministry of Construction supports the Road/Automobile Communications System (RACS). Both AMTICS and RACS are working toward developing a standard navigation system as well as supplementary information systems such as where to find available parking spaces.