NEVADA TRANSPORTATION T2 CENTER

StreetWise

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ENVISIONING AN AUTOMATED HIGHWAY

The new technologies described in this futuristic scenario offer a realistic forecast of the state of transportation in 2050.

The General Motors ***Futurama*** exhibit at the 1939 World's Fair in New York featured a vision of technologically advanced superhighways by 1960, where cars would navigate curves at speeds up to 50 miles per hour using "automatic radio control" to maintain safe distances.

Despite the potential for dramatic mobility and safety benefits, automation of the driving task has proven difficult to achieve. The technological challenges of automation seemingly would require that vehicle systems be designed to incorporate the full information available to a driver with the same level of intelligence.

In response to this challenge, some engineers have approached automation by simplifying the environment to make automated systems easier to achieve.

USDOT's Automated Highway System research in the 1990s was based on protecting the vehicle from unexpected incursions by people, animals and other vehicles by providing a physically protected roadway. The control systems then could be designed to address "known" problems such as keeping the vehicle in the lane, safely following preceding vehicles and bringing the driver back into control at the exit from the designated roadway.

Can tomorrow's highway overcome congestion?

Because transportation in 2050 certainly will be quite different from today, the transportation community can only speculate on the differences. Even if the highway of tomorrow does not realize the potential of fully automated driving, transportation agencies still can make considerable progress in overcoming congestion through partially automated systems.

Although travel demand and freight movement will continue to increase, passenger car travel will still offer people enormous mobility opportunities through the use of technology and operational methods that will fundamentally alter how people drive.

Improved communications systems, complemented by expected advances in sensors and processors on vehicles, will provide cooperation between vehicles, which will facilitate many new services. For example, vehicles will be able to follow other vehicles more closely, and yet more safely, then they can today.

This improved technology will enable at least two or three times as many cars to use major highways in the future, greatly increasing the capacity and efficiency of the existing highway system. All vehicles will travel at the fastest speed allowed for the facility at that time, as determined by a traffic management system that will balance demand and performance at the highest level. The traffic flow will be much greater and safer than it is today, so that congestion on expressways could all but disappear.

On arterial streets, traffic signal systems still will control traffic flow but will incorporate advanced algorithms that will communicate the signal timing data to vehicles and their drivers. Motorists will make use of the timing

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data to improve their progression and avoid the need to stop in most cases.

Even if stopped, vehicles will start again automatically and will follow other vehicles in the queue more closely, allowing more cars to be accommodated faster and more safely than today. These advances will permit much smoother traffic flow, thereby easing the driving task and providing more efficient operation.

Tomorrow's highway will improve travel reliability

Traffic congestion will be reduced through new technologies. Smoother traffic flow will prevent many crashes that cause congestion. In addition, vehicle mechanical failures will be reduced dramatically by onboard diagnostic and correction features.

Any mechanical failures that do occur will be identified immediately by onboard vehicle systems and communicated to emergency responders and traffic management authorities so that help can be provided quickly. Information on the problem, and potential route guidance suggestions, then can be provided automatically to other drivers through their onboard vehicle systems, so that most of the safety and delay consequences of the incident can be avoided.

Can many crashes be eliminated?

New technologies will eliminate many crashes, dramatically reduce injuries and fatalities and make highway travel much safer than it is today.

- Communications between the vehicle and the infrastructure will reduce intersection collisions by warning drivers of likely traffic signal violations and then helping them maneuver safely through the intersection.
- Advanced run-off-the-road and curve warning systems will help prevent the driver from leaving the roadway — a major cause of crashes and fatalities today, particularly in rural areas.
- Rear-end collisions will be significantly reduced because vehicles will communicate with each other and will recognize, before a driver could, that the leading vehicle is stopped or stopping. The onboard system will warn the driver to take evasive action and will brake automatically, if necessary, to avoid the crash.

- Similarly, through communication and sensors, vehicles will know where they are, where they are heading and possibly whether people or animals are in the roadway. This technology will enable the vehicles to maneuver to avoid potential conflicts.
- Should a crash occur, onboard vehicle systems will alert emergency responders immediately, providing the crash location and other advance information that will improve a responder's ability to provide assistance.

How will the driver's role change?

Mobility and safety benefits will be achieved not only through technology and operational improvements but also through fundamental changes in how drivers access and use the highway systems of the future.

Pervasive communication will enable drivers to receive needed information in advance of their trip, or during their trip as needed.

Planning trips will be much easier. Advances in information processing, and associated behavioral changes, will allow travel requests to be generated effortlessly, as people essentially will be able to talk to their vehicles or personal information devices.

> Verbal request: *Planning to drive to Aunt Rosie's in an hour or two. OK?*
>
> Response: *No problem. A slot has been reserved for you on the Smithtown Automated Expressway at 3 p.m. The toll will be $8.*

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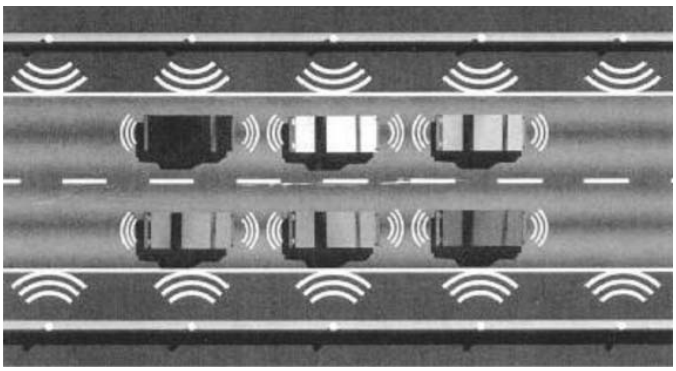

Artist's vision of an automated highway system (from http://www.tfhrc.gov/pubrds/summer94/p94su1.htm)

Seven technical and institutional challenges, however, remain before AHS will be mastered.

1 First, as learned from the AHS demonstration, a major challenge to deploying automated highways is the need for protected, dedicated lanes that provide a manageable and extremely reliable environment for safe automated travel.

The dedicated lanes would require a communications system capable of real-time management of traffic and would increase construction costs, thus limiting the number of major highways where the needed infrastructure could be provided.

The need for dedicated lanes would complicate the distribution of automated traffic, as existing streets will not be capable of accommodating so many additional vehicles. For example, special features might be needed to allow for the circulation and parking of automated vehicles once they leave the automated highway for city centers and other destinations.

2 Second, an Automated Highway System has to be designed so that it will be accepted by drivers and will be used effectively. The actual public experiences of AHS technologies in the 1990s were overwhelmingly positive. However, significant design challenges remain to ensure that drivers will be able to use the AHS safely and effectively under all circumstances.

3 Third, the complexities of automated driving systems will require vehicle and highway systems that operate at a higher level of reliability and performance than today. Highways that support AHS will require much more sophisticated communication and control systems.

4 Fourth, institutional challenges are likely to include increased liability for manufacturers and owners of automated systems. Even though automated systems are expected to offer significant safety benefits compared with manual driving, technological failures potentially could result in new problems.

5 Fifth, the phenomenal growth of truck traffic and the significantly different handling and operating characteristics of commercial motor vehicles present real challenges to accommodating commercial vehicle operations on an automated highway. Any attempt at automating roadways will have to take mixed car and truck traffic into consideration.

6 Sixth, perhaps the greatest challenge would be the cost and deployment itself. On the part of manufacturers, investments would be needed to redesign vehicles, create and retool factories, ramp up distribution channels and train mechanics. Obviously, enough drivers would need to purchase a sufficient number of specially designed automobiles. Furthermore, large public-private investment would be needed to rehabilitate existing infrastructure or add dedicated lanes.

7 The final challenge is environmental. The inherent capability of an automated highway to accommodate much more traffic efficiently could encourage more travel and aggravate existing tendencies for urban sprawl. The tradeoffs between the advantages to motorists and the environmental costs must be weighed in terms of public policy, much as the construction of new highways is today.

The challenges discussed here likely will be overcome eventually as the performance of automated systems more closely replicates all aspects of human driving performance. For example, computer vision and intelligent systems processing can be expected to improve over time. Improved technology thus could eliminate the need for physically separate lanes and hence simplify deployment staging and potentially reduce costs.

Vehicles also will monitor actual driver behavior as needed and will be able to interact with the traffic management center.

How will transit and pedestrians fare?

Transit services have substantial potential to benefit from specialized automation services.

Automation will enable some transit services to use automated control so that the enormous costs of driving can be reduced or avoided, and flexibility in offering peak-period services can improve.

Additionally, the more efficient and economical services allowed by automation can help extend transit to areas that currently cannot be served, including low-density residential neighborhoods.

With dramatic changes in future transportation technology and automation, more people will be able to walk or bike to their destinations. Land use patterns characterized by "new urbanization" and transit-oriented development will provide greater opportunities for people to make short trips by bicycle or on foot.

What to expect in 2050?

The transportation system of 2050 will almost certainly not achieve the full vision of the Futurama City of Tomorrow. But there is every reason to believe that future transportation management systems and sophisticated new vehicles will provide a safer, faster and more convenient driving experience that the transportation community can only dream of today.

For additional information, contact the Nevada T^2 Center at the address shown below.

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