A Revolutionary Traffic System for Citizens and Cities

——Freedom of Movement and Safety for All

The Automated Driving System is a technology that makes use of real-time information from vehicles, people, and roads.
The ultimate goal of this program is to eliminate traffic fatalities. In the near future, developments in safety technologies and local traffic management systems will guarantee for the first time that every person across the world can enjoy freedom of movement and safety. Traffic accidents are a shared concern in every country. Our plan is to lead the world in developing a next-generation transportation system, creating a new export industry in the process.

Automated Driving System

Program Director

Hiroyuki Watanabe

Advisor
Toyota Motor Corporation

Profile

Mr. Watanabe joined Toyota Motor Corporation in 1967. He was named chief engineer of the Toyota Crown in 1986, and later named to the Toyota Motor Corporation board of directors in 1996 (mainly overseeing the Prius, fuel cell development, overseas services, etc.). Watanabe was appointed managing director in 1999 (overseeing product planning and R&D). In 2001, Mr. Watanabe was named senior managing director (technology development, product planning, intelligent transportation systems, quality assurance, environment, etc.). In 2005, Mr. Watanabe was named senior technical executive, a post he continues to serve in as of 2014.

Hiroyuki Watanabe

A Society Providing Freedom of Movement to All

The automobile is an invention that has not only made travel more convenient, it has also created a new form of enjoyment, as well as giving rise to a variety of industries. At the same time, the invention of the automobile has also had a negative impact on society in the form of traffic accidents and pollution. Today, we see numerous innovations related to the automobile, including the development of technologies contributing to environmental and energy sustainability, the use of big data to ensure safe car travel during emergencies, and many other welcome developments. One of these exciting technologies is the Automated Driving System, which is designed to ensure even greater safety through the use of advanced positioning technology, as well as automated control technology and predictive information from intelligent transportation systems (ITS). The development of this Automated Driving System is one of the research programs selected for the SIP.

"The Automated Driving System will be a technology that puts car travel into the hands of every person, regardless of age or physical capacity. We are going to create a society in which everyone can enjoy freedom of movement and safety through the automobile. My hope is that this research brings about a major innovation in society," says an enthusiastic Hiroyuki Watanabe, program director.

The Automated Driving System program is known by the abbreviation "SIP-adus." Adus stands for Automated Driving for Universal Services. "Mobility bringing everyone a smile" is the inspiring slogan under which this program is guided. In other words, the aim of this program is to develop an automated driving system as a universal public service, offering safety and advancement in driving support technologies.

Machines Adapt to People for Safe Driving

What we simply call the Automated Driving System actually consists of four stages to automated driving. Our present level, Level 1, is where technology provides acceleration, steering, or braking over a limited duration of time. In Level 2, driving systems will provide a simultaneous combination of acceleration, steering, or braking. Once we reach Level 3, automated driving systems will provide all operations, with the driver only interceding in emergencies. At Level 4, there will be no need for driver intervention at all. According to the program timeline, practical adoption of Level 3 should be a reality by the first half of 2020s, with Level 4 achieved during the second half of 2020s.

Says Mr. Watanabe, "Even after we reach Level 4, you won't see uninterrupted automated driving at all times. There may be emergency situations in which the car transfers the right to a driver for manual braking. At that point, you're operating at Level 3. So, the levels of automation will continuously change depending on the road conditions." In other words, drivers will still have an important role, even after the common adoption of automated driving. In the end, it will be an operating system in which the machine will adapt to the human driver.

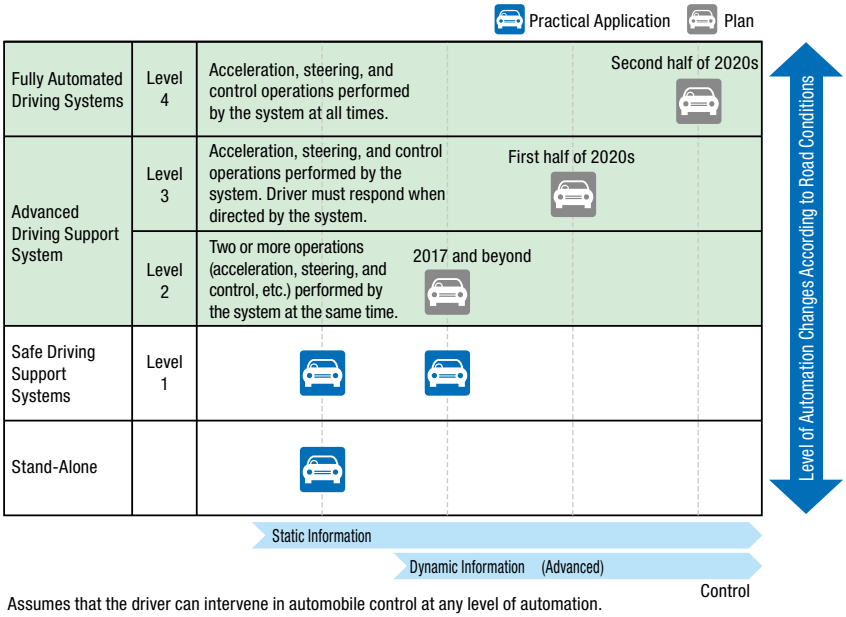
The Automated Driving System will encompass many different fields of technology. Road-to-vehicle/inter-vehicle communications, advanced map information, signal information, traffic restriction information, and information related to driving conditions are just a few examples of areas that need further development. This project also includes other activities, including creating predictive information through ITS, improving sensing capabilities, developing driver models through performance analysis, improving system security, and investing in international cooperation and standardization. Of course, one of the greatest hurdles will be to gain public acceptance for automated driving.

Traffic-Related Accidents Are a Global Issue Parallel Progress in Technology Development and International Cooperation

In fact, Automated Driving System development and validation represent only a small part of the overall program. This is because Mr. Watanabe does not consider the practical implementation of automated driving as the ultimate goal. The first task, rather, is to understand the reasons underlying the need for automated driving systems.

"Last year, there were 4,373 traffic-related deaths in Japan. The Japanese government has set a goal of reducing that number to 2,500 by 2018," says Watanabe. "While the numbers of traffic-related deaths have been declining, the figures have held steady over the past few years. I believe that to accomplish our goal, we have to figure out the reasons causing this stall in progress, and then we have to dig down to eliminate those factors."

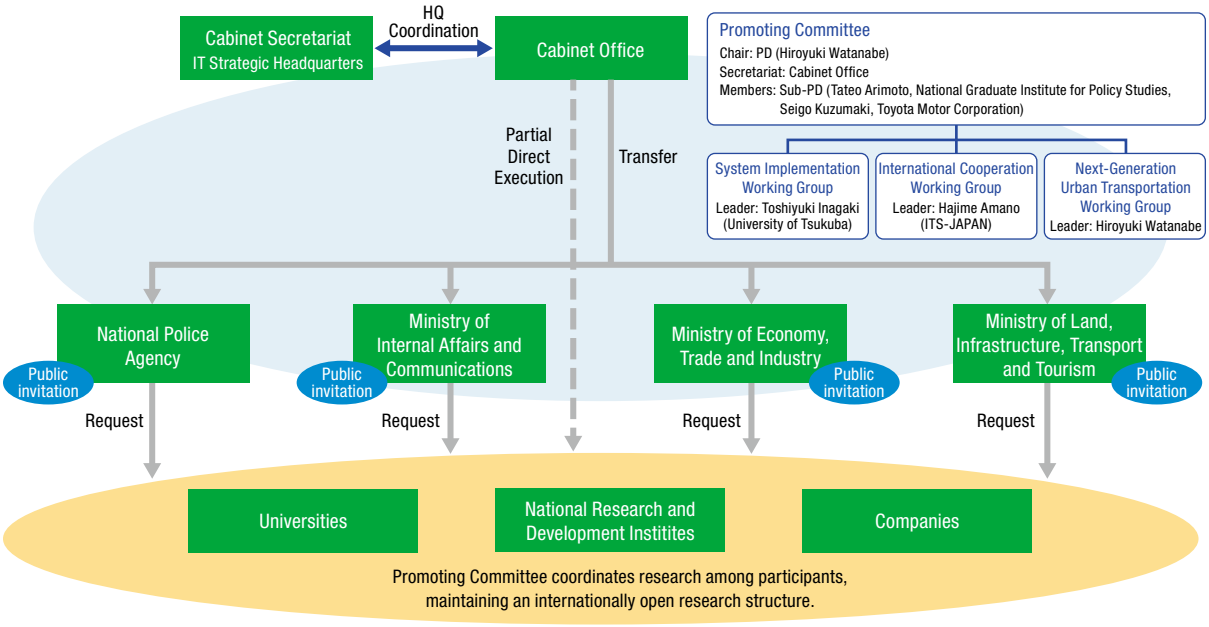
The ultimate goal is to completely eradicate traffic-related deaths.



Assumes that the driver can intervene in automobile control at any level of automation.

●**Automated Driving System Timeline**

Hiroyuki Watanabe



•Implementation Structure

Here, Mr. Watanabe has adopted a method called backcasting.

"Backcasting was the method used to successfully carry out the Apollo Program, which I consider the epitome of mankind's innovation," says Watanabe. "Using this method, one sets a challenging goal, and then identifies the current technologies available, the new technologies needed, and the areas that require improvement. This gives you a specific development plan for reaching your target. Because of this method, we were able to identify and include technological development for estimating reductions in traffic-related deaths and for simulation technology."

At present, traffic-related accidents rank as the ninth-most cause of death in the world, and the WHO predicts that traffic accidents will rank as the number five killer by the year 2030. Preventing traffic fatalities is not just a Japanese issue.

Says Watanabe, "At the same time that we conduct research and development, we also plan to push for international standards and global public acceptance of this technology. In the future, I would like to see us take the next step beyond the technology, creating a traffic management service and infrastructure package to export as a next-generation urban transportation system."

Becoming the Safest City in the World
Real-World Validation

To bring together a streamlined partnership between government agencies and between public-sector and private-sector entities for basic technology development in itself would be an incredible breakthrough. But this program has greater ambitions. This program aims to actually build the safest traffic infrastructure in the world through public-private cooperation in developing a next-generation urban transportation system that includes public road systems.

"We can't verify the benefits of a next-generation urban transportation system unless it is put into actual use on the roads in cities and outlying regions. If adoption of the new system doesn't result in fewer traffic accidents, then we will have to investigate the reasons and add those into our research and development as part of the feedback loop," says Watanabe. This underlies the importance of creating a research structure that includes the participation of national government, local governments, and a variety of private enterprises for improving regional traffic management and for implementing practical next-generation transportation systems.

By the time of the 2020 Tokyo Olympics/Paralympics, buses in Tokyo may actually be using automated driving technologies. Perhaps the most important task of all, however, will be convincing the public to accept driverless cars.

"I think the reason we haven't see further improvement in traffic-related death numbers is that we haven't done enough in our society to cater to the mobility impaired (children, senior citizens, the disabled, foreign guests, etc.). We need to rethink our fundamental approach to transportation policy," says Mr. Watanabe, emphasizing that the ability to travel from place to place is an important factor in our everyday lives.

Guaranteeing a universal right to travel was the essence of the 2013 Basic Act on Transport Policy passed by the Japanese government. Once they become a reality, automated driving systems will provide convenient, safe travel for everyone. Less traffic congestion, less burden on the environment, and less lost time. Assuring vehicle safety will also likely lead to more enjoyment of the dynamics of driving.

Reach and Development Topics

1. Develop/verify automated driving systems

Develop and test technologies for improving map information, creating ITS-based predictive information, and improving sensing capabilities.

2. Advance basic technologies to reduce traffic fatalities and congestion

Develop technologies for estimating the impact on reducing traffic fatalities, create a national database; develop technologies to analyze micro/macro data and conduct simulations.

3. Promote international cooperation

Develop an internationally open research and development environment to encourage the creation of a basic approach to and international standards for automated driving systems. Promote public acceptance of automated driving (sponsor international conferences, work with private citizens and the media) and develop an international automated driving package for export to foreign markets.

4. Deploy next-generation urban transportation

Improve regional traffic environments and engage in regional management to change driving habits; build a next-generation public road transportation system; and improve and promote universal accessibility.

Exit Strategies

☑ Accomplish national goals (reduce traffic fatalities, etc.)

Build a technological foundation and implementation system for traffic safety policies that encompass vehicles, citizens, and infrastructure.

☑ Build and promote automated driving systems

Use ITS-based predictive information to commercialize Level 2 automated driving systems by 2017 and Level 3 automated driving systems by the first half of 2020s. Aim to commercialize Level 4 automated driving systems by the second half of 2020s. Achieve these goals to create new industries that extend beyond the framework of the current automotive industry.

☑ Set the Tokyo Olympics/Paralympics as a milestone for implementing a next-generation public transportation system

Work toward the 2020 Tokyo Olympics/Paralympics as a milestone for introducing a next-generation public transportation system that promotes the city of Tokyo and helps address Japan's aging population, contributing value for future generations. Develop a packaged transportation management and infrastructure product to as a new export business.

Offer freedom of movement and happiness to all, accomplished through a streamlined research and development system and global cooperation.

Develop the world's safest traffic system and deliver value to the international community