SIP-adus: Project Reports, 2014-2018
- Automated Driving for Universal Services -

2018

Cross-ministerial Strategic Innovation Promotion Program

Looking Back on Five Years of SIP-adus

Seigo Kuzumaki
SIP-adus Program Director
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There are many issues to solve for the realization of automated driving systems (ADS). Therefore, it was fortunate for us that ADS was picked up in the Cross-ministerial Strategic Innovation Promotion Program (SIP), which aims for industry-government-academia collaboration.

In the beginning, there was a big gap in understanding about ADS among the people involved, and each OEM has a different stance on ADS development. Through frequent and tense discussions in SIP, a consensus gradually grew to finally reach the conclusion that ADS development needs a "competition and cooperation" strategy.

Two decades of intelligent transport systems history (ITS) development have helped us collaborate with NPA, MIAC, METI and MLIT. The Cabinet Office has been working with the Cabinet Secretariat to make a roadmap of ADS and ITS. These relationships have made cross-ministerial collaboration smooth.

We have been proactive at presenting our activities at the international congresses. Ultimately, we made our presence felt with respect to *de jure* and *de facto* standardization activities in the areas of dynamic mapping and HMI. Large-scale field operational tests began in Japan in October 2017. We recruited more than 20 participants from industry and academia, not only in Japan but also in Europe. This created an opportunity for open discussion to enhance international cooperation and harmonization.

As a result of our SIP-adus activities, Dynamic Map Platform co Ltd was established in 2017. We take pride in having produced such outcome, which is not an end, but a beginning. We want to keep striving for the realization of Society 5.0 by pursuing the expansion of big data uses, such as maps and geographical information.

Lastly, I want to convey special thanks to all the members involved in SIP for their support. I would also like to dedicate this report to former Program Director, Dr. Watanabe, who passed away in the midst of his efforts to make the program a success.

Toward the Realization of Mobility in Society 5.0

Ryo Kuroda
(Deputy Director General for Science, Technology and Innovation, Cabinet Office)

The novel Society 5.0 concept was proposed as the ideal Japan should pursue in the 5th Science and Technology Basic Plan formulated by the Council for Science, Technology and Innovation (CSTI) in 2016. Society 5.0 is the human-centered society that simultaneously realizes solutions to social problems and economic growth by means of the integrated ICT technologies in cyberspace and in physical space. CSTI established the Cross-ministerial Strategic Innovation Promotion Program (SIP) for Society 5.0. The feature of SIP is to carry out activities ranging from basic research to practical application and commercialization with the cooperation of cross-ministerial government agencies, academia and industry.

SIP-adus (Automated Driving for Universal Services) is one of the eleven SIP projects. It aims to reduce traffic accidents and provide mobility as a necessary service by gathering the information from vehicles in physical space, analyzing it in cyberspace, and feeding the analyzed results back to the vehicles for safe and comfortable control. SIP-adus precisely embodies Society 5.0 in the mobility domain. Under the leadership of Program Director Seigo Kuzumaki, members of SIP-adus from industry, academia, and government have collaborated with each other and solved many of the challenges presented by advanced automated driving systems. We hope the fruitful outcomes developed in these five-year of the SIP-adus project will be widely shared and utilized as firm foundation for the future stages.

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Overview

SIP Automated Driving System Outline

Yasuyuki Koga (Cabinet Office)

ABSTRACT: SIP-adus(Automated Driving for Universal Service) started in June 2014 as a national research and development project for innovation. It has a social significance, providing a fundamental solution to suchissues as the reduction of traffic fatalities, the reduction of the environmental burden by easing traffic congestions, travel support for elderly people and other vulnerable road users, and the revitalization of rural areas. The improvement of the competitivenessof the automobile industry and the expansion of related markets are significant from an industrial point of view. Under the Steering Committee, we established the System Implementation WG, the International Cooperation WG, and the Next-Generation TransportWG. In 2016, we identified five important area of focus (1) dynamic maps, (2) human-machine interface(HMI), (3) cyber-security, (4) pedestrian accident reduction, and (5), next-generation transport. We also conducted a large-scale FOTs on these area from 2017and delivered the achievement of the research and development.

1 Significance and Targets

1.1. Background, Domestic and International Situation

Automated driving systems have been promoted through industry-academia-government collaboration in cross-field efforts made in cooperation with government departments under the framework of the Strategy Innovation Creation Program (SIP) started in June 2014. In addition to conducting comprehensive R&D starting from the development of core technologies and aiming for practical application and commercialization, the results obtained through field operational tests (FOTs) have also contributed to reviews of regulations and systems. Since automobiles are international products and also one of Japan's key industries, the projects has always been promoted with international standardization in mind.

The promotion of R&D, practical application and commercialization of automated driving has a two-sided significance for the Japanese government. It has a social significance, providing a fundamental solution to such issues as the reduction of traffic fatalities, the reduction of the environmental burden by easing traffic congestion, travel support for elderly people and other vulnerable road users, and the revitalization of rural areas. The improvement of the competitiveness of the automobile industry and the expansion of related markets are significant from an industrial point of view.

In addition to various projects promoted under the EU R&D program Horizon2020, Germany, the UK and other European countries have been working on formulating a strategy and developing technologies. In the United States, the Federal Department of Transportation (USDOT) formulated a national strategy on automated driving systems and ITS in December 2014. Since July 2015, the University of Michigan has been conducting a large-scale public road FOT near Detroit involving car manufacturers from Japan, the United States and Europe, imitating an urban area based on the M City test course.

Moreover, the joint statement between Japan and Germany on the promotion of R&D in the field of automated driving technology in January 2017 marked the beginning of international collaboration.

The number of traffic accident fatalities in our country has been decreasing for more than 10 years as a result of long-standing efforts by national and regional public organizations, related private organizations and citizens. The Tenth Fundamental Traffic Safety Program, approved in March 2016, established a national target of reducing the number of traffic accident fatalities to 2500 or less by 2020, and realizing the safest road traffic in the world. However, while the number of fatalities declined for two consecutive years, dropping to 3,694 in 2017, considerable efforts are still required to reach the national target. In particular, intersection, pedestrian, bicycle, and motorcycle accidents are major problems. An integrated approach including not only vehicles, but also improvements to the traffic environment, and the education of people, is required.

On a different note, vehicle driving functions are comprised of three elements: recognition, decision and operation. There are technologies that recognize the road environment through radars installed in vehicles (automated systems), and technologies that recognize the road environment by relying on communication between vehicles, and between vehicles and external devices (cooperative systems). To realize automated driving systems, advances in the three elements mentioned above must be achieved by integrating both types of technologies. Auto-

mated systems alone cannot solve the problem of reducing the traffic fatalities, and they must be complemented by cooperative systems.

1.2. Significance and Politic Importance

According to the Declaration to be the World's Most Advanced IT Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization approved by the Cabinet in May 2017, "the relevant ministries and private enterprises shall work together to promote the development and practical application of safe driving support and automated driving systems, as well as the utilization of traffic data, based on the Public-Private ITS Initiative/Roadmaps 2016. In particular, they will promote efforts, including the development of institutions and infrastructure, aimed at realizing the possibility of automated driving on expressways and unmanned automatic driving in limited areas, including the necessary FOTs, by 2017."

In addition, the Comprehensive Strategy on Science and Technology Innovation 2017 formulated based on the 5th Science and Technology Basic Plan shows that it is necessary to actively promote R&D for automated driving systems to realize Society 5.0, core efforts and positioning towards the realization of full-scale cyber-physical systems, the development of dynamic maps, and so on.

Over the past 20 years, Japan has developed and introduced the world's most advanced ITS system, and the automobile industry is currently its largest export industry. As various Western countries accelerate their R&D on automated driving systems as part of their national policy, it is important for Japan to push forward with the development, practical application, and popularization of these systems. Reaching the aforementioned national target and realizing the world's best road traffic society will produce both great social and industrial value for the people.

On the other hand, many ministries are involved in the field of ITS and automated driving systems, and it must be considered not only from a technical point of view, but also based on other considerations, including social acceptance and institutional aspects. Government agencies, as well as public and private organizations, must work together to promote the development of the field.

At the beginning of the SIP automated driving system project, we were seeking collaboration in the absence of mutual public and private understanding. However, in the process of establishing the Public-Private ITS Initiative/Roadmaps with the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters) in June 2014, the SIP Automated Driving System Steering Committee and the Headquarters were able to promote cooperative studies, as well as advance the understanding of the parties involved and foster communication. Through these discussions, institutional development was also promoted by various government departments based on automated driving measures specific to each department and in accordance with the Outline of Development of Institutions for Automated Driving (April 2018, Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society, Strategic Conference for the Advancement of Public and Private Sector Data Utilization).

Regarding industry-academia cooperation, which cannot be said to always have been strong in the automotive field, SIP has created opportunities for cooperation by promoting interaction allowing the different parties to meet with one another. The industry-academia cooperation in the automotive field must now be strengthened even further.

International standardization is also important for vehicles, which are global products. It is essential for the SIP efforts aimed at maximizing effectiveness through FOTs based on a hands-on approach to generate international cooperation and gain citizen understanding and acceptance. With respect to international collaboration, we were able to demonstrate initiatives for the standardization and de-facto standardization of dynamic maps and HMI through the use of ITS Japan networks in EU (ERTICO) and US (ITS America), as well as active popularization efforts in cooperative areas of automatic operation from Japan.

1.3. Targets and Objectives

1.3.1. Social Targets

We seek to achieve national targets such as the reduction of traffic accident fatalities (2,500 people / year) and easing of traffic congestion. The timeline for these targets will be clarified by following up on the Public-Private ITS Initiative/Roadmaps 2018 and developing technologies enabling the effectiveness of traffic accident fatality reduction safety measures to be predicted. These approaches will be integrated in a PDCA cycle.

1.3.2. Technological Targets

We decided to revise the automated driving levels and definitions of the automated driving systems and driving support systems implementing these levels, taking into consideration international trends on the definition of automated vehicles including those in Europe and the United States. To avoid confusion due to differences in definitions, and to ensure international consistency, we will adopt the definitions in SAE J 3016, which was approved by SAE International in September 2016 in the US.

However, at any level, the driver can take control of the system at any time.

- Regarding the expected commercialization time, we plan to establish the technology required to implement a system that utilizes infrastructure information such as signaling information and congestion information (SAE level 2) by 2017, and a high-end system (SAE level 2) that will be a step towards SAE level 3 by 2020. We will promote R&D in cooperative areas to ensure the commercial availability of SAE level 3 systems in 2020, and SAE level 4 systems in 2025.
- We will create an internationally open R&D environment and establish a new international collaboration system to solve global problems.

1.3.3. Industrial Targets

(1) Industry creation

There is a wide range of new industry fields that can be related to automated driving systems. It is expected that the market will expand drastically not only for vehicle sensors (cameras, radars, etc.), but also for vehicle communication equipment, roadside communication equipment, portable communication equipment and other information communication equipment and digital infrastructure.

Moreover, as new platform technologies related to high precision 3D mapping technology, basic dynamic map technology, and probe information-based map update technology, evolve after automated driving systems are put to practical use and popularized, new industries will be created in various fields beside automated driving, such as information development, operation, or services utilizing high precision positioning information. In addition, the combination of HMI, security technology and advanced automotive control technology will bring a new value in the context of a cyber-physical system where machines adapt to, and support, people. New technologies and businesses, such as next-generation transportation systems, support systems for vulnerable road users and walking movement, and package-based export of regional traffic management services and infrastructure, will be created.

(2) World Share

We will lead the standardization of automated driving systems in terms of international cooperation, and establish our position as the top global player by building upon the work of our predecessors in the area of cooperative systems.

To establish concrete numerical targets (KPI), we aim to build a collaborative organization towards the further advancement of automated driving systems, which will consist of representatives from industry, government and academia and will remain even after the SIP project ends. A wide range of university experts will analyze social and industrial impacts, and determine these targets in cooperation with the IT Strategic Headquarters, the Investigation Committee for New Strategy Promotion and the Road Transportation Subcommittee.

2 Deployment Milestones

2.1. Reaching the National Target for the Reduction of Traffic Accident Fatalities

We will establish a technical foundation and execution organization to implement traffic accident countermeasures adapted to vehicles, people and infrastructure as a whole to reach the national target described in the Tenth Fundamental Traffic Safety Program.

In addition to development of driving support systems and automated driving systems, and the promotion of the practical application and popularization thereof, we will develop technology to advance the data analysis and simulation of traffic fatalities and predict and verify the effectiveness of safety measures. We will analyze the execution organization integrating multiple related parties, and use the results to establish a mechanism to progress towards the national target.

2.2. Implementation and Popularization of Automated Driving Systems

Regarding the expected commercialization time, we plan to establish the technology required to implement a system that utilizes infrastructure information such as signaling information and congestion information (SAE level 2) by 2017, and a high-end system (SAE level 2) that will be a step towards SAE level 3 by 2020. We will promote R&D in cooperative areas to ensure the commercial availability of SAE level 3 systems in 2020, and SAE level 4 systems in 2025. In the area of dynamic maps, Dynamic Map Platform Co., Ltd. was established in June 2017, and there are plans for that company to prepare high-precision maps of all expressways and all motorways by the end of 2018. This will represent a big step towards practical application.

2.3. Development in Collaboration with Tokyo Metropolis with the Tokyo Olympics and Paralympic Games in 2020 as a Milestone

Defining the Tokyo Olympics and Paralympic Games in 2020 as a milestone, work is progressing on the practical application of next-generation transportation systems that contribute to the future generations in Japan, improve accessibility (measures for vulnerable road users), and propose solutions to social acceptance and institutional issues

for social implementation of the aforementioned measures in anticipation of the development of Tokyo and the aging of society. In particular, we have signed a memorandum of understanding with the Cabinet Office, the Tokyo Metropolitan Government and related parties to incorporate ART technology into the waterfront city area BRT which is under consideration by the Tokyo Metropolitan Government. Technical development, demonstration experiments and other efforts are promoted in close cooperation by the parties involved.

3 Outline of R&D

3.1. System Development and Research Subjects

Since the beginning of the SIP project in 2014, we have been advancing R&D on individual topics while promoting the establishment of teams such as the Steering Committee, the System Implementation WG, the International Cooperation WG, and the Next-Generation Transport WG. In 2016, we identified five important areas of focus: (1) dynamic maps, (2) human–machine interface (HMI), (3) cybersecurity, (4) pedestrian accident reduction, and (5) next-generation transport.

The R&D in the competitive field of automated systems for vehicles is carried out by the automobile industry itself, while SIP has mainly promoted the development and practical application of fundamental technologies and of cooperative areas (related to cooperative systems) which require collaborative public and private efforts.

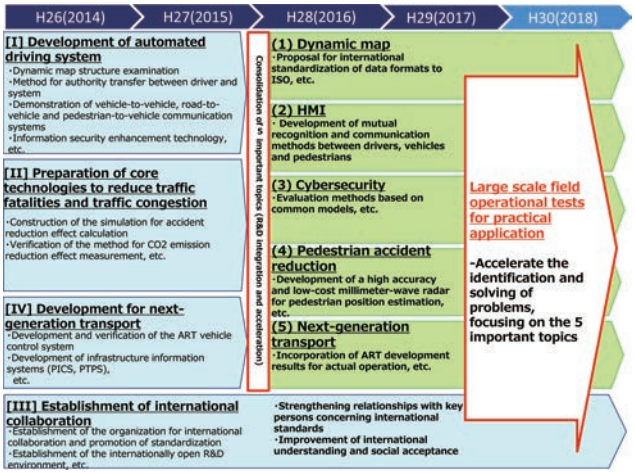

Fig. 1 Process Chart

3.2. Large-Scale FOTs

Conducting large-scale FOTs in cooperation with government departments is important to promote collaboration between industry, academia and government. The purpose of the experiments is to speed up the realization of the deployment milestones by identifying institutional, business and other problems from the R&D results obtained so far, providing feedback for development, and applying the PDCA cycle consisting of: (a) the activation of technology development, promotion of infrastructure development, (b) the prompt identification and solving of problems for practical application, and (c) a sequence of large-scale FOTs mainly focused on the five important topics started in October 2017 on 300 km of road (600 km round-trip) covering the Joban, Shuto, Tomei, and Shin Tomei expressways as well as general public roads around the Tokyo waterfront city area. The main purposes of these FOTs were the intensification of international collaboration by providing a forum for open study and discussion for participants, including overseas manufacturers, and the intensification of collaboration between industry, academia and government, transmission of the state of social demands and R&D results. Twenty-two domestic and overseas automobile manufacturers, automotive part manufacturers, universities, and other organizations participated in long-term experiments and development conducted until the end of December 2018.

4 acknowledgment

Two distinguished program directors devoted their energy to SIP-adus program to make automated driving technologies in reality. Counsellors and expert staffs has supported PD's effort with their full capacity. I would like to thank you all of them and all contributors to the program.

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