SIP –Automated Driving for Universal Services Mid-Term Results Report

Comments

Under the direction of the Council for Science, Technology and Innovation, which acts as a control center, the Cross-Ministerial Strategic Innovation Promotion Program (SIP) of the Cabinet Office, a national project to realize innovation through cross-agency as well as industry–government–academia cooperation, embarked on its second phase in 2018, with 2020 marking the third year milestone of that phase. This document constitutes the *Mid-Term Results Report* summarizing the initiatives of SIP–Automated Driving for Universal Services, one of the 12 topics covered by the program. The composition and contents of the various chapters are described below.

Chapter 1 Second Phase of SIP-Automated Driving for Universal Services

In the *5th Science and Technology Basic Plan*, the government of Japan espoused Society 5.0 (the realization of a super-smart society, Fig. 1), and assigned the Strategic Innovation Promotion Program (SIP) a central role in that realization.

The Society 5.0 concept is defined as a human-centered society that achieves both economic growth and the resolution of social issues through systems that achieve a high level of fusion between the cyber (virtual) and physical (real) worlds. In that context, automated driving is expected to both spur economic growth by redefining the data industry through, notably, high precision 3D maps and expanding the industry for sensors and other devices, while at the same time helping to solve the social issue of ensuring safe and secure means of transport. This makes automated driving a crucial technology in realizing Society 5.0, and it was therefore carried over from the first to the second phase of SIP as one of the twelve selected topics.

The specifics of the SIP-adus initiative take advantage of the characteristics of an industry-government-academia collaboration project , discussing issues that should be tackled cooperatively by the industry, and focusing its research efforts on those issues. (Fig. 2)

Chapter 1, Overview of the Second Phase of SIP-Automated Driving for Universal Services, describes the status of the second phase of SIP, and the main achievements from the first phase. It also outlines the goals, deployment milestones, major research projects, and the framework of the initiatives.

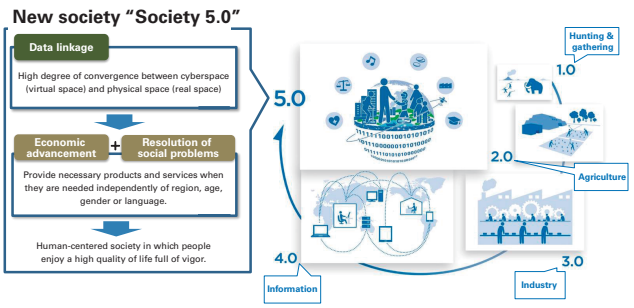

Fig. 1: Society 5.0

Fig. 2: Cooperative Area Technologies and Issues

Chapter 2 Building and Making Use of Traffic Environment Information

Realizing automated driving requires making use of localization and road traffic environment data such as high precision 3D maps, traffic regulation, accidents or congestion information, and traffic signal information.

We refer to the database of traffic environment information necessary for automated driving as dynamic maps. As shown in Fig. 3, the concept is arranged in four layers.

Building dynamic maps is viewed as a cooperative area, and the project constitutes a pillar of SIP-adus activities. Using the results of the field operational tests (FOTs) from the first phase of SIP, Dynamic Map Platform Co., Ltd. (DMP) was established in 2017, and has been distributing high precision 3D maps covering the 30,000 km of expressways throughout Japan since 2018.

In the second phase of SIP, dynamic information linked to high precision 3D maps, which consists of information on traffic signals, regulations, the end of lines of traffic due to congestion, fallen objects, and vehicles in the main lane near expressway merging points, is designated as high priority information for the realization of automated driving. Initiatives have therefore focused on building such information (Fig. 4).

The initiatives of the *Development of Technology Concerning the Generation of Traffic Environment Information* and *Development of Technology Concerning the Transmission of Traffic Environment Information* projects are summarized in Chapter 2.

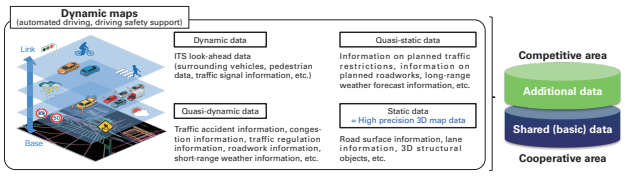

Fig. 3: Dynamic Maps

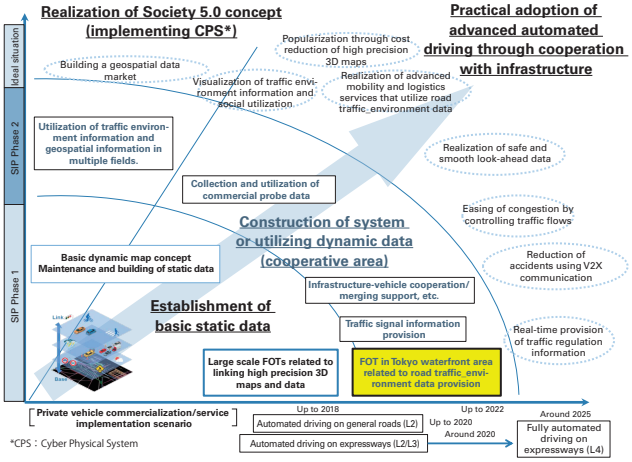

Fig. 4: Road Traffic Environment Data Roadmap

Chapter 3 Ensuring the Safety of Automated Driving

Safety is the most critical issue in automated driving. Fear and doubts about automated driving by the system not only have a major impact on the public acceptance of automated driving, but also create the possibility that a single instance of an accident could bring the automated driving development itself to a halt. Consequently, safety must be both ensured and proven.

The SIP-adus project considers field operational tests an important initiative in research and development, and follows a plan-do-check-act (PDCA) cycle to validate safety and effectiveness on-site.

Field operational tests (FOTs) on public roads in the Tokyo waterfront area were planned for the second phase of SIP. With the participation of a total of 29 organizations including automakers and suppliers from Japan and other countries, business ventures, and universities, we obtained feedback on the effectiveness and accuracy, as well as formats, of the aforementioned and worked on defining standards. During the tests, participants also validated the safety of their own automated vehicles (Fig. 5).

The details and results of the FOTs in the Tokyo waterfront area are presented in Chapter 3, *Field Operational Tests in the Tokyo Waterfront Area*.

At the same time, validating safety also requires evaluations in dangerous environments that simulate accidents. The FOTs on public roads therefore have to be complemented with validation on test fields and evaluations in virtual space (simulations). Building a simulation platform that is highly consistent with actual environmental conditions and capable of evaluating the sensor performance crucial to automated vehicles was considered essential. Initiatives pursued in the second phase of SIP therefore focus on building a safety evaluation environment in cyberspace as a crucial theme (Fig. 6).

Similarly, communication is essential for automated vehicles that drive while receiving the latest traffic environment information from external sources, and future cyberattacks pose a high risk of becoming major threats. Consequently, surveys and research on new cyberattack techniques and countermeasure technologies rep-

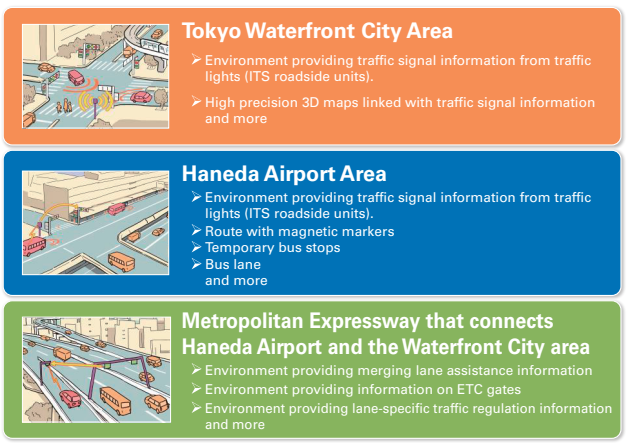

Fig. 5: Field Operational Tests in the Tokyo Waterfront Area

resent another crucial theme actively tackled in the second phase of SIP. These initiatives are covered in the *Realizing a Safe Automated Driving Society* section of Chapter 3.

Ensuring safety must go beyond hardware and systems, and also encompass safety education for users as well as finding complementary approaches to communicate with other traffic participants. The *Realizing a Safe Automated Driving Society* section of Chapter 3 also describes these initiatives.

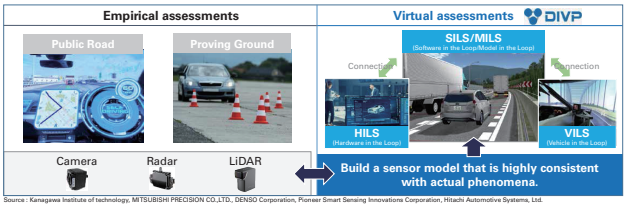

Fig. 6: DIVP Initiatives

Chapter 4 A Society with Automated Driving

SIP activities range from basic research to pursuing application and commercialization as the program seeks to resolve social issues.

In depopulated areas of Japan, public transportation services face a grim future and are gradually being cancelled. Securing means of transportation for a population consisting primarily of elderly citizens has become an urgent issue that calls for implementing mobility services relying on automated driving as soon as possible.

In the second phase of SIP, we therefore joined forces with many regional promoting organizations and local governments to conduct long term FOTs using a customized golf cart using electromagnetic induction lines with a carrying capacity of seven people. At the Kamikoani Michi-no-Eki (in Kamikoani-mura, Akita), these tests led to launching a service adapted to local needs at the end of 2019. The service involves local volunteers working as vehicle crew, and combines a reservation-based on-demand service with a regular scheduled route (Fig. 7).

These initiatives are presented in Chapter 4, *Automated Driving Services in Regional Communities*.

We also believe that encouraging the spread of automated driving will require fostering a correct understanding of what it entails, as well as quantifying its various impacts (influences) while presenting its advantages and disadvantages in clear and specific terms.

As part of the second phase of SIP, we have therefore conducted a large-scale annual survey providing a fixed-point observation of public acceptance, and have also worked on developing methods to estimate the effectiveness of automated driving at reducing accidents as well as its socioeconomic impacts.

We have also cooperated with the medicine and engineering fields to validate the effectiveness of advanced driving support for drivers with visual field deficit as part of efforts aimed at applying automated driving technology to help vulnerable road users. All of these topics are covered in the *Social Acceptance of Automated Driving* section of Chapter 4.

Fig. 7: Mobility Service in Kamikoani-mura, Akita

Chapter 5 Data linkage and Use to Realize Society 5.0

As already noted, commercializing automated driving requires various forms of geographical data, including high precision 3D maps and traffic environment information, and SIP-adus has been carrying out research and development in that area. At the same time, as outlined in the introduction to this article, the vision for Society 5.0 is not limited to automated driving and encompasses a cyber-physical space that includes data from other fields.

In the second phase of SIP, we determined that a portal site providing catalogs indicating the owner and format of data and offering opportunities for matching was necessary to promote the coordination and use of the various forms of geographical data possessed by the government and corporations, and launched MD communet™ in the spring of 2021 (Fig. 8). That initiative, along with an application design contest for the use of data, are presented in Chapter 5, *Promoting Data Linkage*.

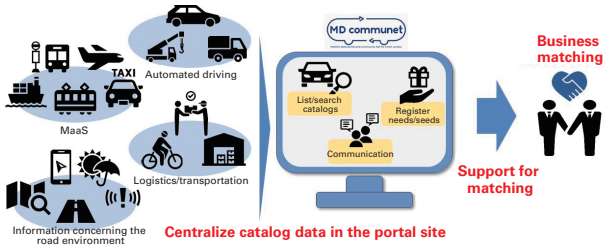

Fig. 8: MD communet™

Chapter 6 Promoting International Cooperation

As described above, SIP-adus has been working on developing technology and fostering public acceptance in the cooperative areas necessary to realize automated driving. At the same time, vehicles are a worldwide product, and achieving automated driving only in Japan is not competitive and also makes it unlikely to spread. Consequently, we have diligently pursued international cooperation to ensure global harmony since the inception of SIP, and actively worked on international standardization as we strengthened our relationships with standardization bodies in Japan. The second phase of SIP, in particular, defines dynamic maps, human factor, safety assurance, connected vehicles, socioeconomic impacts, and service implementation as crucial international cooperation themes, with their respective leader taking the initiative in promoting those themes. In addition, an international cooperation coordinator appointed as the face SIP-adus activities in that area, is actively building a global network centered on Japan–Germany and Japan–EU cooperation. Chapter 6, *International Cooperation and International Standardization Activities*, presents those activities.

Chapter 7 Other Matters

The SIP-adus projects cover a wide array of themes, and the limitations of the paper medium for this *Mid-Term Results Report* means that many projects have not been presented. The *Other Major Projects* section of Chapter 7, outlines promising and potentially useful research results left out of the main text, and describes where to obtain the relevant reports.

Due to the need for the ongoing sharing of information and communication with various stakeholders concerning fostering public acceptance, and in light of the long-term strategy, we have also conducted public relation activities such as dialogs with the general public, test-ride events for journalists, and report conferences as a complement to the research and development initiatives described in Chapter 4, *Social Acceptance of Automated Driving*. These activities are also briefly presented in Chapter 7.

In closing, SIP-adus defines 2020, the third year of the 5-year second phase, as a milestone, and our activities to reach that milestone involved not only setting a timeline for commercialization, but also setting the stage to make the transition to commercialization and practical application over the remaining two years. The main SIP-adus projects and the overall schedule are presented in Fig. 9. We will be strengthening collaboration between business operators in our various projects as well as coordination with projects by other government agencies to maximize the results of our projects.

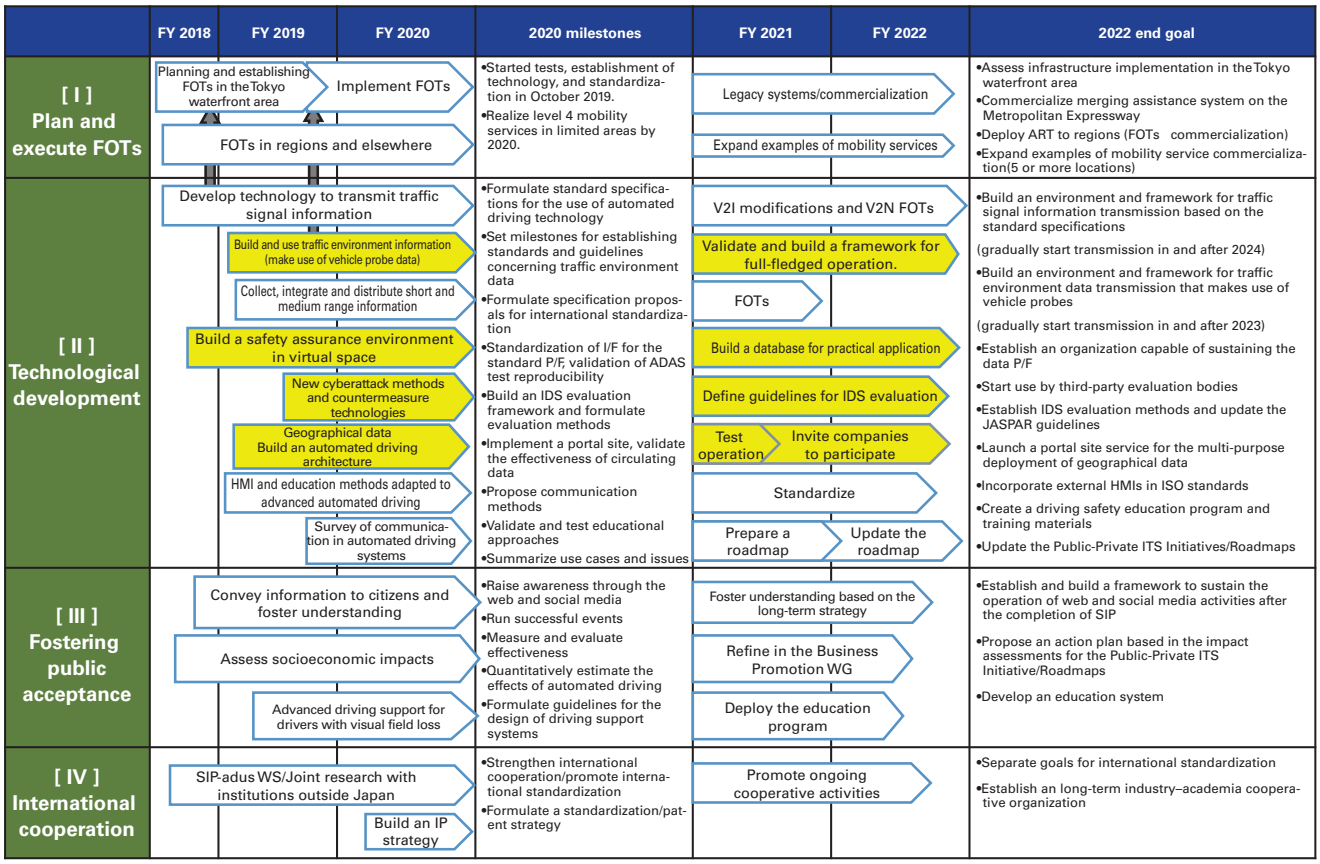

Fig. 9: Main SIP-adus Projects and Overall Schedule