Cross-ministerial Strategic Innovation Promotion Program (SIP)
Automated Driving for Universal Services
R&D Plan

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Overview of the R&D Plan

1. Development goals and objective
Development goals: Automated driving is expected to lead to major social changes. Public-Private ITS Initiative/Roadmaps 2020 (released in July 2020) stated that Japan “aims to build and maintain ‘a society with the world’s safest and smoothest road transport’ by 2030 by promoting the development and popularization of automated driving systems and the preparation of data platforms.”

At the meeting of the Council on Investments for the Future (held in March 2018), Prime Minister Shinzo Abe stated: “By the time of the 2020 Tokyo Olympic and Paralympic Games, we will realize an automated driving society.... We will further accelerate various initiatives with the aim of facilitating the development of diverse businesses. Such initiatives include the establishment of a zone in Tokyo waterfront area for tests of safer automated driving technologies integrating traffic signal information.” While working on these initiatives, the Japanese government will play a leading role in achieving Society 5.0, which is detailed in the Fifth Basic Plan for Science and Technology (released in January 2016). This is considered to have a significant advantage in both social and industrial aspects and will increase Japan’s contribution to the global community. The 6th Science, Technology, and Innovation Basic Plan (March 2021) aims to create a sustainable and strong society that ensures the safety and security of citizens and a society where well-being can be achieved in various forms for each citizen by promoting R&D and social implementation to solve various social issues and by using convergence of knowledge in order to achieve Society 5.0.

Objective: The R&D Plan aims to help solve social issues, including reducing traffic accidents and congestion, ensuring mobility for vulnerable road users, and mitigating the driver shortage and reducing the costs of logistics and mobility services by practically applying, deploying, and expanding automated driving, thereby raising quality of life throughout society.

The specific timeline for realization will be based on the roadmaps indicated in Public-Private ITS Initiative/Roadmaps 2020. Nevertheless, the possibility of accomplishing the goals ahead of schedule will also be studied based on the international trends, technological progress, and other factors.

- Mobility services: Unmanned automated driving (SAE Level 4) mobility services based solely on remote assistance will be achieved in operational design domains (ODDs) in around FY2022.
- Logistics services: Fully automated driving (SAE Level 4) of trucks will be achieved on expressways in 2025 and beyond.
- Privately owned vehicles: Fully automated driving (SAE Level 4) will be achieved on expressways by around 2025.
- Privately owned vehicles: Driver assistance technologies will be upgraded (SAE Level 2 or higher) for arterial and general public roads.

The technologies in cooperative areas that are required to achieve these goals will be established.
by 2023, and their effectiveness will be validated through field operational tests (FOTs), etc. involving various business operators, local government bodies, and other entities. Multiple implementation projects will be conducted as examples to pave the way for social implementation.

2. Details of research
To practically apply and deploy automated driving, it is necessary both to develop vehicles and improve the driving environment. In this project, the development will focus primarily on cooperative areas, including improving the driving environment though the development of automated vehicles is a competitive area, many issues must be addressed industry-wide to ensure safety. Thus, the development will be promoted in this project through collaboration among industry, academia and government. It is also important to foster public acceptance of automated driving to facilitate deployment. Efforts will be made to clarify the advantages and issues of automated driving, promote correct public understanding, and conduct research to improve the services. International standardization will also be pursued through international cooperation so that the outcomes of the development may be used globally.

Thus, this project will focus on four areas: I) Development and validation (FOTs) of automated driving systems; II) Development of platform technologies for practical application of automated driving; III) Fostering of public acceptance of automated driving; and IV) Enhancement of international cooperation. Based on the results of the three-year R&D in the second phase of SIP Automated Driving for Universal Services (SIP-adus), the following have been set as the top-priority themes of research for practical application (including commercialization and standardization):

i) Creation of the traffic environment data framework and distribution of data
ii) Creation of a safety evaluation environment in virtual space
iii) New cyberattack techniques and countermeasure technologies
iv) Creation of an automated driving architecture for geographical data

Based on the results of these initiatives, international cooperation and public acceptance will be fostered based on the knowledge of humanities and social sciences research.

(I) Development and validation (FOTs) of automated driving systems

(1) FOTs in Tokyo waterfront area:
   1. Implementation of FOTs in Tokyo waterfront area
   2. Creation of an FOT environment to provide traffic signal information via a network in Tokyo waterfront area
   3. Improvement, preliminary validation, maintenance, and management of infrastructure for FOTs in Tokyo waterfront area
   4. Modification, etc. of ITS roadside units for providing traffic signal information which were used in FOTs in Tokyo waterfront area

(2) FOTs for social implementation of mobility and logistics services in local regions and other areas:
1. Achievement of social implementation of automated driving services in local regions, and surveys and research on permanent implementation
2. Practical application of mobility services in local regions

(II) Development of platform technologies for practical application of automated driving

(1) Technologies for using the traffic environment data:
   1. R&D toward social implementation of providing traffic signal information by using the cloud, etc.
   2. R&D on technologies including traffic signal control using GNSS (location information), etc.
   3. Study and evaluation of technologies for automated driving control by using probes at the lane level, etc.
   4. Surveys and research on a model system related to improving the data accuracy of traffic regulation information, etc.
   5. R&D on collecting, integrating, and distributing small and medium-sized area information
   6. R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4)
   7. R&D on location-based services using the Quasi-Zenith Satellite System (Michibiki)

(2) Safety assurance technologies:
   1. Development of techniques to establish an automated driving evaluation environment in virtual space

(3) Cybersecurity:
   1. Surveys and research on new cyberattack techniques and countermeasure technologies

(4) Creation of an architecture for geographical data for automated driving:
   1. Surveys and research on design and creation of an architecture for automated driving and driver assistance
   2. FOTs and evaluation to increase the efficiency of logistics based on the architecture that uses vehicle information (e.g., probes)

(5) Other platform technologies:
   1. Surveys and research on HMI and safety education methods in line with the sophistication of automated driving
   2. Study on communication protocols for achieving Use Cases for Cooperative Driving Automation

(III) Fostering of public acceptance of automated driving

(1) Information dissemination to citizens, etc. and promotion of understanding:
   1. Formulation of a strategy to foster public acceptance and evaluation surveys
   2. Surveys to measure the effectiveness of efforts to foster public acceptance by
organizing exhibitions, etc.

(2) Surveys and research to solve social issues by using automated driving technologies:
   1. Research on assessment of the impact of automated driving on society and the economy and on measures to promote deployment

(IV) Enhancement of international cooperation
   (1) International dissemination of information by organizing the SIP-adus Workshop (an international workshop) and other events:
      1. Surveys of developments related to strengthening the ability to disseminate information to achieve automated driving
   (2) Promotion of joint research on automated driving with overseas research institutes:
      1. Creation of a cooperation structure to promote joint research with overseas research institutes related to automated driving

3. Organizational structure for implementation
   Program Director Seigo Kuzumaki (hereafter, “PD”) manages the Steering Committee. He formulates the R&D plans and technology strategies and organizes industry-academia-government collaborative discussions on the deployment milestones. The application procedures, purchase order specifications, and other documents are created by the relevant ministries and agencies as well as the New Energy and Industrial Technology Development Organization (NEDO), which serves as the management agency.

4. Intellectual properties and their evaluation
   Efforts are being made based on the intellectual property strategies reflecting the opinions of external experts. Intellectual properties and their evaluation are handled based on the Operational Guidelines for Cross-ministerial Strategic Innovation Promotion Program (authorized by the Governing Board).

5. Deployment milestones
   The coordination between measures under SIP-adus will be enhanced by taking into account the results of the three-year R&D, etc. Toward practical application, we will overcome three barriers (i.e., technology development, amendment of the legal system, and fostering of public acceptance) through industry-academia-government collaboration by conducting FOTs in Tokyo waterfront area, local regions, and other areas, as well as developing platform technologies to maximize the outputs. FOTs in Tokyo waterfront area, local regions, and other areas will involve automobile manufacturers, business operators, local government bodies, and other entities to encourage investment in practical application and commercialization. In addition, multi-purpose use of map data and geographical data, which are improved for automated driving and advanced driver assistance, will be actively promoted to contribute to the realization of Society 5.0.
1. Development goals and objective

(1) Background and domestic and overseas situation

There is growing interest in automated driving. Automobile manufacturers, auto parts manufacturers, etc. have been actively investing in R&D, and the national government has been working to attract R&D projects and FOTs. In addition, the legal system, environment, etc. have been steadily improved toward practical application mainly in Japan, the U.S., and Europe.

Such growing interest is driven by high expectations for social changes brought about by automated driving, such as solving social issues (e.g., reducing traffic accidents and congestion, and ensuring mobility for elderly persons and individuals who have limited access to mobility) and creating new services and businesses for logistics and mobility.

In the global arena, work on automated driving has been shifting from the excessive expectation of fully automated driving (i.e., Level 5) to more realistic initiatives. There have been further discussions on measures to ensure safety and reliability and address ethical issues. Today, FOTs on automated driving are being conducted around the world. Progress has been made toward formulating a common testing method and a common format for the collected data in order to share knowledge. However, the Covid-19 pandemic, which quickly spread globally from early 2020, has had a significant impact on the global and local movement of people and logistics. It has become necessary to adapt to the new lifestyle (“new normal”). R&D on automated driving, etc. has been partly delayed but has been promoted actively on an ongoing basis. With many events having been cancelled or held online around the world, efforts have been made to seek a new model of information sharing.

In January 2020, the White House and the U.S. Department of Transportation released “Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0” (AV 4.0). The initiative aims to establish federal guidelines for the development and integration of automated vehicles in three core fields: placing top priority on safety and cybersecurity, promoting innovation, and establishing a consistent regulatory approach. The Automated Vehicles Comprehensive Plan was released in January 2021 based on the principles stated in the AV 4.0 before transition to the new administration, which started in January 2021. The plan defines three goals in order to attain and promote the vision of the automated driving system by the U.S. Department of Transportation: promotion of collaboration and transparency, modernization of the regulatory environment, and preparation of a transport system.

In Europe, research projects on automated driving are being conducted in respective countries, including PEGASUS in Germany and DRIVEN and HumanDrive in the U.K. In the EU, many research projects on connected and automated driving are under way under Horizon 2020, which is led by the European Commission. In December 2020, an agreement was reached on the implementation of Horizon Europe, a program following Horizon 2020. “Climate, Energy and Mobility” is one of the six clusters under the initiative to solve social issues.
In Japan, the first phase of SIP-adus, which started in FY2014, played a key role in promoting R&D in the cooperative areas of automated driving. In FY2017, large-scale FOTs were launched for various purposes, including validation of the effectiveness of dynamic maps, etc. and formulation of standardized specifications. Specific accomplishments included the establishment of the fundamental structure for improving the maps. In the second phase of SIP-adus, development initiatives have been promoted mainly in the cooperative areas (e.g., improvement of the driving environment). In October 2019, FOTs of vehicle-infrastructure cooperative driving automation started in Tokyo waterfront area by using traffic signal information from the transport infrastructure of arterial and general public roads, the merging lane assistance information from expressways, etc. In terms of the legal system, the bills to revise the Road Transport Vehicle Act and the Road Traffic Act passed the Diet in May 2019, and the revised acts were enforced as of April 2020. In November 2020, an automated vehicle equipped with an automated driving system (Level 3) received type designation for the first time in the world in accordance with the Acts. In March 2021, the automated vehicle was put on the market for the first time in the world. The bill to revise part of the Road Act was enacted in May 2020 and was enforced in November 2020 to, among other things, improve facilities that assist the operation of automated driving in the road space.

Japan is a leading country in addressing contemporary social challenges, such as lack of means of mobility in underpopulated, aging areas and the shortage of drivers in the logistics industry. Japan is strongly expected to serve as a model of a super-aging society in which safe and secure mobility is ensured for all citizens by expanding automated driving to arterial and general public roads and by becoming the global leader in commercializing logistics and mobility services that use automated driving technologies.

(2) Development goals and importance in terms of the national policy
This project, which aims to achieve practical application of automated driving, has economic significance in addition to social significance, such as reducing traffic accidents and congestion, ensuring mobility in underpopulated areas and other areas, and alleviating the shortage of drivers.

The auto industry has been undergoing a once-in-a-century transformation due to innovations, including automated driving, electrification, connected cars, and shared cars. Efforts to survive the development competition are expected to maintain and enhance the competitiveness of the auto industry (which is Japan’s core industry underpinned by a broad range of related industries), have ripple effects on related industries (e.g., digital infrastructure, sensors, and communication for automated driving), and create new industries and services for the era of Society 5.0. This has a great potential to contribute to Japan’s economic development in the future.

Against this backdrop, Public-Private ITS Initiative/Roadmaps 2020 (released in July 2020) stated that Japan “aims to build and maintain a society with the world’s safest and smoothest road transport’
by 2030 by promoting the development and popularization of automated driving systems and the preparation of data platforms."

At the meeting of the Council on Investments for the Future (held in March 2018), Prime Minister Shinzo Abe stated: “By the time of the 2020 Tokyo Olympic and Paralympic Games, we will realize an automated driving society.... We will further accelerate various initiatives with the aim of facilitating the development of diverse businesses. Such initiatives include the establishment of a zone in Tokyo waterfront area for tests of safer automated driving technologies integrating traffic signal information.”

The Integrated Innovation Strategy 2020 (released in July 2020) also sets out goals to improve the data coordination platform across different fields, improve the data coordination platform within respective fields (automated driving), and build the architecture (geographical data [automated driving]) in order to improve the data coordination platform toward Society 5.0.

While working on these initiatives, the Japanese government will play a leading role in achieving Society 5.0, which is detailed in the Fifth Basic Plan for Science and Technology (released in January 2016). This is considered to have a significant advantage in both social and industrial aspects and will increase Japan’s contribution to the global community. The 6th Science, Technology, and Innovation Basic Plan (March 2021) aims to create a sustainable and strong society that ensures the safety and security of citizens and a society where well-being can be achieved in various forms for each citizen by promoting R&D and social implementation to solve various social issues and by using convergence of knowledge in order to achieve Society 5.0.

(3) Objectives and targets

(a) Overall objective

The R&D Plan aims to help solve social issues, including reducing traffic accidents and congestion, ensuring mobility for vulnerable road users, and mitigating the driver shortage and reducing the costs of logistics and mobility services by practically applying, deploying, and expanding automated driving, thereby raising quality of life throughout society.

The specific timeline for realization will be based on the roadmaps indicated in Public-Private ITS Initiative/Roadmaps 2020. Nevertheless, the possibility of accomplishing the goals ahead of schedule will also be studied based on the international trends, technological progress, and other factors.

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- Privately owned vehicles: Driver assistance technologies will be upgraded (SAE Level 2 or
higher) for arterial and general public roads.

By taking into account the future issues and needs in the mobility field in Japan as discussed in Public-Private ITS Initiative/Roadmaps 2020, the technologies in cooperative areas that are required to achieve these goals will be established by 2023 while keeping in mind the future vision of a mobility-centered society in 2030 (in local regions, urban areas where people depend mainly on private cars for mobility, and urban areas where public transport is in widespread use). Their effectiveness will be validated through FOTs, etc. involving various business operators, local government bodies, and other entities in Tokyo waterfront area, underpopulated areas, and other areas. Multiple implementation projects will be conducted as examples to pave the way for social implementation.

In this R&D Plan, the definitions of driving automation levels in SAE International’s J3016 standard (released in September 2016) and JASO TP 18004 (Japanese translation of the J3016 standard for reference released in February 2018) are used from the viewpoint of international cooperation.

There are two different approaches in the current development of automated driving as shown in Fig. 1-1: (A) automated driving in limited time and space and (B) applications in more diverse environments.

Approach (A) tends to attract attention due to the term “driving automation ‘levels’” and expectations for unmanned driving. However, Approach (B) (which aims to attain advanced driver assistance by using automated driving technologies on the assumption that the driver drives the vehicle) helps enhance vehicle safety, reduce traffic congestion, etc. This approach can also contribute to enhancing the competitiveness of the auto industry by offering added value to consumers. Meanwhile, Approach (A) is an innovative solution for addressing issues such as depopulation and driver shortage and ensuring mobility for vulnerable road users. This approach is also highly expected to create new businesses. In this project, both approaches are considered necessary to help expedite the attainment of these goals by using automated driving technologies.
In automated driving, a vehicle is driven by a system instead of a human driver. To achieve automated driving, it is necessary to build a cyber-physical space to collect and store various types of road traffic environment data that are used by the system. This is the essence of realizing Society 5.0. The probe vehicle data collected and stored while developing automated driving can be used for various purposes, including updating maps and predicting traffic congestion. The road traffic environment data can also be used to conduct safety simulations in a virtual environment. The map data and geographical data obtained in this process can also be used in various fields, including maintenance and management of infrastructure, disaster prevention and mitigation, and IT-based agriculture. This project aims to build a service platform of geographical data, which is based on the map data created for automated driving, in cooperation with the above-mentioned fields, thereby contributing to the realization of Society 5.0.

1) Use of probe vehicle data will commence for the automated driving and driver assistance systems (e.g., updating of maps, provision of data).
2) A framework for the use of high-precision map data and traffic data (e.g., accident data) will be built.
3) Operation of a service platform for sharing the map data and dynamic geographical data will commence.
4) An architecture that contributes to data coordination, etc. will be built through FOT projects in cooperation with other fields that use geographical data.

Fig. 1-1 Overall initiative of automated driving
Fig. 1-2 Roadmap to create a framework related to the use of the traffic environment data

(c) Social objectives

Mobility of people and goods is an important part of life in society. Automated driving is likely to have a direct impact on community building. We will consider how to use automated driving to meet the needs of respective regions and applications in combination with other modes of transportation (e.g., air, rail) and thereby contribute to those regions. It is also necessary to study the possibility of deployment in combination with new forms of vehicle ownership such as car sharing.

Based on the overall vision discussed above, the R&D Plan aims to help solve social issues, including reducing traffic accidents and congestion, ensuring mobility for vulnerable road users, and mitigating the driver shortage and reducing the costs of logistics and mobility services by practically applying, deploying, and expanding automated driving that meets respective needs, thereby raising quality of life throughout society.

However, there is a wide gap between the expectations of elderly persons, vulnerable road users, etc. toward automated driving and the current state of maturity of automated driving technologies. In this project, we will start research on the driving capabilities required to operate vehicles equipped with automated driving technologies by such means as validating the effectiveness of advanced driver assistance systems for the large number of people with minor visual impairments.

1) A mobility business using automated driving technologies will be launched in underpopulated areas and other areas by 2020.
2) Traffic accident fatalities will be reduced by using automated driving, and techniques to predict the CO₂ reduction effects will be established.
3) The effectiveness of driver assistance for persons with minor visual impairments, etc. using
advanced driver assistance systems will be clarified, and changes in the legal system will be proposed.

(d) Industrial objectives
In addition to maintaining and enhancing the competitiveness of the auto industry through the early practical application of automated driving, efforts will be made to create new digital infrastructure industries using the map data, geographical data, and probe vehicle data that are created for automated driving, strengthen the competitiveness of the sensor industry, and promote the development of the cybersecurity and simulation industries.

1) New logistics and mobility service businesses using automated driving technologies will commence.
2) Operation of a service platform for sharing the map data and dynamic geographical data will commence.
3) Developers of auto industry-related software will be trained by establishing virtual evaluation methods.
4) White-hat hackers and evaluation organizations that have advanced cybersecurity skills will be trained and developed.

(e) Technological objectives
To practically apply automated driving, various technological issues must be resolved. This project promotes development in cooperative areas focusing on platform technologies that are needed to improve the environment for driving automated vehicles and ensure safety. While studying ways of improving the driving environment, etc., efforts will be made to determine and standardize the format and communication requirements of the road environment traffic data needed for automated driving.

When evaluating the safety of vehicles, it is difficult to evaluate all possible events that may occur on public roads using actual vehicles, and would require enormous man-hours. To solve this problem, efforts will be made to build virtual evaluation and demonstration simulation environments for simulating various objects (e.g., vehicles, motorcycles, bicycles, pedestrians), weather conditions (e.g., rain, snow, backlighting), and traffic environments (e.g., expressways, arterial and general public roads).

In line with the sophistication of automated driving, the amount of communication data is expected to increase, necessitating further evolution of cybersecurity and communication technologies. We will develop technology to continuously enhance cybersecurity technologies, collect and use probe vehicle data, use new communication technologies (including V2X technology), etc. R&D will also be conducted on the human-machine interface (HMI) model with traffic participants (e.g., pedestrians) in line with the increase in the number of automated vehicles and sophistication of automated driving. The results will be reflected in the vehicle structure.
1) Provision of traffic signal information will commence for automated driving and advanced driver assistance.

2) Provision of infrastructure data (e.g., merging lane assistance on expressways) will commence.

3) Provision of road traffic environment data using probe vehicle data will commence.

4) A virtual evaluation and demonstration simulation environment will be built based on model-based design (MBD).

5) Cybersecurity technologies for software updates, etc. will be developed, and guidelines will be established.

6) HMI guidelines for the deployment of automated driving will be established.

(f) Legal system objectives, etc.

In terms of the legal system, the Charter for Improvement of Legal System and Environment for Automated Driving Systems was formulated (in April 2018 by the IT Strategic Headquarters of the Cabinet Secretariat), and studies have been conducted by respective ministries. This project aims to clarify the issues and accelerate the discussions on regulations and legal system that need to be reformed by planning FOTs (FOTs in Tokyo waterfront area, FOTs for ensuring mobility in underpopulated areas and other areas, FOTs for offering logistics and mobility services) and by creating opportunities for stakeholders, including business operators and local government bodies, to participate. These initiatives will seek to avoid redundancy with studies on improving the legal system conducted by respective ministries and to create opportunities to conduct comprehensive studies through cooperation by the Cabinet Office, ministries, and agencies. Efforts will also be made to ensure that these FOTs serve as internationally open R&D projects, thereby establishing R&D hubs on automated driving in Japan.

In the first phase of SIP-adus, international standardization activities were promoted in close cooperation with the Japan Automobile Manufacturers Association, Inc. (JAMA), the Society of Automotive Engineers of Japan, Inc. (JSAE), and other organizations. Cooperation with other organizations, such as the Japan Auto Parts Industries Association (JAPIA) and the Japan Electronics and Information Technology Industries Association (JEITA), will also be strengthened to promote standardization strategies in terms of both de facto standards and de jure standards.

SIP-adus has received offers for cooperation between Japan and Germany and joint research under the framework of EU funded projects. The second phase of SIP-adus will support joint research on automated driving with universities and research institutes in Japan and research institutes in Europe and the U.S. by arranging discussions to explore joint research themes, adding conditions for public calls for proposals, etc. These initiatives are intended to build a system for long-term and continuous international cooperation and ensure Japan’s leadership in the standardization activities.

1) The legal system will be reformed in line with the Charter for Improvement of Legal System
and Environment for Automated Driving Systems.

2) At least three proposals will be made to establish ISO standards.

3) At least five joint research projects will be conducted on automated driving with foreign research institutes.

**(g) Strategy for global benchmarking**

Although automated driving technologies have been evolving rapidly, it is still expected to take considerable time to achieve “Level 5” of driving automation, which is defined as vehicles capable of driving under any condition. SAE J3016, which established the driving automation levels, requires that operational design domains (ODDs) be defined as drivable conditions for the driving automation levels. Given such technological hurdles, Japan is not in an advantageous position to practically apply automated driving because its traffic environment is complicated and the weather changes significantly in the four seasons. Heavy R&D investments mainly by foreign “tech giants” also pose threats. However, Japan has an advantage in its capabilities to develop vehicles, engineering capabilities to manufacture products including sensors and cameras, and capabilities to ensure the quality of vehicles that must meet the safety requirements. In the ITS field, Japan has a track record of industry-academia-government collaboration for more than 20 years. Japan also has strength as a global leader in the practical application of vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication, etc.

Against this backdrop, Japan’s strategy should focus on further promoting industry-academia-government collaboration, actively creating environments in which automated driving technologies can be applied, acquiring techniques and technologies to ensure safety by accumulating on-site expertise, and globally spreading automated driving as systems (not as vehicles).

To achieve Society 5.0, efforts should be made to promote the use of data through coordination across the auto industry and build an ecosystem beyond the auto industry. To this end, we will enhance the industry-academia-government collaboration, cooperation across the industry (e.g., automobile manufacturers, auto parts manufacturers, and service providers), cooperation in academia (e.g., engineering, medicine, law, and urban engineering), cooperation between the central government and local government bodies, and cooperation with other fields.

**(h) Cooperation with local government bodies, etc.**

To lead R&D to commercialization, the initiatives by various stakeholders must be integrated. The second phase of SIP-adus attaches more importance to practical application. Thus, top priority is placed on promoting initiatives involving business operators and local government bodies and creating opportunities for FOTs.

Specifically, with the Olympic and Paralympic Games Tokyo 2020 set as a milestone, cooperation mainly between the national government, the Tokyo Metropolitan Government, and the private sector will be strengthened, a roadmap toward improving the FOT environments will be
created, and a plan for FOTs will be formulated. Regarding FOTs for ensuring mobility in underpopulated areas and other areas, and for offering mobility and logistics services, FOTs will be conducted toward social implementation in collaboration with stakeholders, including business operators and local government bodies.
2. Details of R&D

To practically apply and deploy automated driving, it is necessary both to develop vehicles and improve the driving environment. In this project, the development will focus primarily on cooperative areas, including improving the driving environment.

Arterial and general public roads are characterized by complicated traffic environments that involve crossing vehicles as well as pedestrians, bicycles, etc. Thus, it is currently difficult to achieve automated driving based solely on information from on-board sensors and other devices. On expressways, it is sometimes difficult to continue automated driving (e.g., at junctions where the merging lane is not long enough for automated vehicles). To solve these issues, it is useful to provide traffic signal information and merging lane assistance information from the infrastructure and to provide up-to-date road traffic environment data using probe vehicle data. Such information and data must be created through public-private cooperation. Toward practical application of these technologies, internationally open FOTs will be arranged in cooperation with the Tokyo Metropolitan Government by using the Olympic and Paralympic Games Tokyo 2020 as an opportunity. Regarding commercialization of mobility services in underpopulated areas and other areas, as well as commercialization of logistics services, long-term FOTs will be promoted based on a business plan involving local government bodies and business operators.

Although the development of automated vehicles is a competitive area, many issues must be addressed industry-wide to ensure safety. Thus, the development should be promoted through collaboration among industry, academia and government.

The first phase of SIP-adus focused primarily on five key issues (dynamic maps, HMI, cybersecurity, pedestrian accident reduction, and next-generation transport) as cooperative areas. The second phase of SIP-adus will promote development through industry-academia-government collaboration on the themes in the cooperative areas, focusing mainly on the development of simulation tools for safety evaluation and demonstrations, which will become particularly important in the future, and research on the use of public-private road traffic environment data including private probe vehicle data. Based on the results of the three-year R&D in the second phase of SIP-adus, the budget will be allocated primarily to research for practical application (including commercialization and standardization). Efforts will be made to maximize the outputs by enhancing coordination between research projects. These results will be reflected in FOTs in Tokyo waterfront area to study the possibility of creating a legacy that will become a center of developing automated driving and a center of R&D on mobility services using automated driving in the future. Efforts will be made to create an R&D center. Against this backdrop, the following have been set as the top-priority themes:

i) Creation of the traffic environment data framework and distribution of data
ii) Creation of a safety evaluation environment in virtual space
iii) New cyberattack techniques and countermeasure technologies
iv) Creation of an automated driving architecture for geographical data
In pursuit of practical application and deployment of services and vehicles using automated driving technologies, it is necessary to foster public acceptance. Efforts must be made to dispel misunderstandings and concerns related to automated driving and to present the fact to the public that automated driving will increase convenience and lead to better lives and thereby promote understanding. To this end, we will facilitate dialog with stakeholders, quantify the social and economic impacts, and develop technologies to improve the services.

On the path toward automated driving, it is important to consider deployment milestones for respective regions and applications. Given that automobiles are international products and the auto industry is a key industry in Japan, it is necessary to always keep in mind international standardization. We will actively disseminate the results of SIP at international conferences and on the web and lead the discussions on standardization. We will also actively promote cooperation through joint research, etc. between Japanese and foreign research institutes.

Based on the results of the initiatives that have been established as the top-priority themes, international cooperation and public acceptance will be fostered based on the knowledge of humanities and social sciences research.

Thus, this project will focus on four areas: I) Development and validation (FOTs) of automated driving systems; II) Development of platform technologies for practical application of automated driving; III) Fostering of public acceptance of automated driving; and IV) Enhancement of international cooperation.
I) Development and validation (FOTs) of automated driving systems

(1) FOTs in Tokyo waterfront area

[Overview]
On expressways where traffic is heavy or on arterial and general public roads where the traffic environment is complicated, vehicle-infrastructure cooperation that uses information to assist merging with the main lane, traffic congestion information, traffic signal information, etc. obtained from the transport infrastructure is useful for automated driving. FOTs were conducted in Tokyo Waterfront City area, Haneda Airport area, and the Metropolitan Expressway that connects Haneda Airport and Waterfront City area, etc. to solve the abovementioned technological issues, facilitate the development of automated vehicles, promote international cooperation and standardization, foster public acceptance, and showcase superb technologies.

An internationally open FOT environment was improved in the actual traffic environments on public roads with the participation of entities from industry, government, and academia, including domestic and foreign automobile manufacturers, auto parts manufacturers, and research institutions, to expedite the validation of platform technologies, etc. to practically apply automated driving, the studies toward standardization, and social implementation. While this goal was attained, there were delays in the development of automated vehicles by participating companies, and test ride events in coordination with the Japan Automobile Manufacturers Association, Inc. were postponed due to the Covid-19 pandemic. There were requests from participants to extend the period of many FOTs. Thus, it was decided to extend the period of FOTs in Tokyo waterfront area by one year by commencing the distribution of new traffic environment data and validation in coordination with “Development of techniques to establish an automated driving evaluation environment in virtual space.”

1. Implementation of FOTs in Tokyo waterfront area

[Persons responsible for R&D] Yoshiaki Tsuda (Mitsubishi Electric Corporation)


[Activities]
- To build a mechanism to distribute the traffic environment data by using the vehicle-to-network (V2N) communication and further expand the use of the traffic environment data, an FOT environment will be built to distribute data in Tokyo waterfront area, and FOTs will be conducted in the actual traffic environment. Specifically, traffic signal information; information about congestion, regulations, fallen objects, etc. at the lane level based on probe information in the private sector; and weather information, accident information, etc. owned by other business operators will be added as new traffic environment data. FOTs will be conducted toward practical application of smooth and advanced automated driving in more diverse use cases to
facilitate initiatives to solve issues concerning technologies, the legal system, and public acceptance, and thereby accelerate practical application and deployment.

[Objectives for FY2021]

- Based on the results of FOTs up to FY2020, a mechanism for distributing traffic signal information by V2N will be created with a view to spreading the services to provide traffic signal information over a wider area in addition to providing traffic signal information through ITS roadside units by using existing ITS wireless communication (V2I: Vehicle-to-Infrastructure), whose effectiveness for achieving automated driving on arterial and general public roads has been confirmed. The effectiveness and issues will be identified toward practical application.
- A mechanism for collecting and generating information and distributing information by V2N will be created to contribute to judging driving route plans with a sufficient margin by advanced automated vehicles and determining ODDs as well as to providing effective information to and alerting the driver by using the ever-changing wide-area traffic environment data (e.g., traffic congestion tail information at the lane level, information about vehicles involved in accidents, precipitation information). The effectiveness and issues will be identified toward practical application.
- Data will be collected, analyzed, verified, etc. in cooperation with FOT participants through FOTs. Draft standard specifications related to a mechanism for using various types of traffic environment data by V2N will be compiled in the cooperative areas.

2. Creation of an FOT environment to provide traffic signal information via a network in Tokyo waterfront area

[Persons responsible for R&D] To be determined through a public call for proposals
[Participating bodies] To be determined through a public call for proposals
[Activities]
- Traffic signal information is currently provided by V2I in Tokyo waterfront area. In addition, an FOT environment will be created to provide traffic signal information by V2N and its distribution will be implemented.
[Objectives for FY2021]
- A prefectural police system (for Odaiba area) will be created to provide traffic signal information by using V2N in Tokyo waterfront area.
- The traffic signal information for verifying its effectiveness in “Implementation of FOTs in Tokyo waterfront area” will be distributed properly from the created environment so that receivers can receive such traffic signal information reliably.
3. Improvement, preliminary validation, maintenance, and management of infrastructure for FOTs in Tokyo waterfront area

[Persons responsible for R&D] Kuniaki Okajima (Mitsubishi Electric Corporation)
[Participating bodies] Mitsubishi Electric Corporation
[Activities]
   • The mechanism for using traffic environment data (e.g., merging lane assistance information provided by the transport infrastructure), the equipment required for public transport that uses automated driving technologies, and environments required to conduct FOTs for early practical application of advanced vehicle-infrastructure cooperative driving automation (all of which were improved in Tokyo waterfront area) will be maintained and managed, etc.

[Objectives for FY2021]
   • The system for providing information about the state of operation of ETC gates and information to assist merging with the main lane to automated vehicles, which was installed on the Metropolitan Expressway that connects Haneda Airport and Waterfront City area, etc., will be maintained and managed, etc.

4. Modification, etc. of ITS roadside units for providing traffic signal information which were used in FOTs in Tokyo waterfront area

[Persons responsible for R&D] To be determined through a public call for proposals
[Participating bodies] To be determined through a public call for proposals
[Activities]
   • GPS synchronization and switching processes of the ITS roadside units will be modified, etc.

[Objectives for FY2021]
   • A modified program related to the changes in the GPS synchronization and switching processes of the ITS roadside units will be developed, and will be reflected in 37 ITS roadside units installed in Tokyo Waterfront City area and Haneda Airport area. The ITS roadside units, etc. in Haneda Airport area will be removed.

[Final goals] (by the end of FY2022)
   • Environments and organizational structures that are required to distribute traffic signal information (in accordance with the standard specifications based on the validation through FOTs) and road traffic environment data at the lane level (using probe vehicle data, etc.) will be built. Even after the completion of the second phase of SIP-adus, the possibility of creating a legacy will be studied so that Tokyo waterfront area will become the center of development of automated driving. Efforts will be made to create an R&D center.
(2) FOTs for social implementation of mobility and logistics services in local regions and other areas

[Overview]
As the first step toward commercialization of mobility services and logistics services by automated driving, issues in social implementation (e.g., securing driving space on the road, operation management) will be solved with local regions considered as candidate areas, where there is little other traffic and where automated driving-based mobility services can be introduced on arterial and general public roads at the current technology level. Toward national deployment, guidelines on introducing automated driving-based mobility services in local regions will be formulated, the standards of the road space for driving automated vehicles will be improved, etc. To this end, validation will be performed in cooperation with local government bodies and relevant business operators while taking into consideration the creation of business models that can continuously operate automated driving-based mobility services, etc. Surveys and research, etc. required for such validation will also be conducted. Regarding FOTs in local regions, these will be implemented within the scope necessary for social implementation while taking into account acceptance by local government bodies that will introduce automated driving services. Thus, efforts required for social implementation will be made, including enhancement of interregional cooperation, while ensuring financial capability by local government bodies that will introduce automated driving services in local regions.

1. Achievement of social implementation of automated driving services in local regions, and surveys and research on permanent implementation


[Activities]
- The items required to study the measures, legal system, and mechanism will be examined in order to broaden the base in the transition period toward national deployment of automated driving-based mobility services in ODDs.
- Validation will be conducted on both items that are required for the transition from FOTs to social implementation and items that are required for the transition to social implementation from short-term FOTs or without implementing FOTs.

[Objectives for FY2021]
- Regarding “commencement of automated driving services in ODDs in 2020,” which is a government target, implementation started at Michi-no-Eki “Kamikoani” in Akita Prefecture in November 2019. Measures will be studied, including service models that can be nationally deployed (e.g., vehicle maintenance which requires confirmation of deterioration due to age) and contribution to solving social issues in respective regions while utilizing the
accomplishments in advanced fields.

- Social implementation will also be achieved at certain locations across Japan. A study will be conducted on the following issues, including vehicles, operation and services, and improvement of environments (e.g., infrastructure) that are required for national deployment of the services by taking advantage of the characteristics of each implementation location:
  - Achievement of stable operation, etc. through cooperation with other businesses, including electric power companies and transport companies
  - Study of a space that contributes to ensuring the safety of pedestrians when it is snowing, etc. and ensuring safety in a space where other vehicles are present
- Efforts in cooperation with local educational institutions and safety and security measures for vehicles, etc. will be studied in terms of fostering public acceptance.

2. Practical application of mobility services in local regions
   [Persons responsible for R&D] To be determined through a public call for proposals
   [Participating bodies] To be determined through a public call for proposals
   [Activities]
   - The foundation of practical application for social implementation will be established by upgrading the manual for permanent implementation, which was studied in “Achievement of social implementation of automated driving services in local regions, and surveys and research on permanent implementation,” and by reflecting the results of projects in respective regions in which FOTs are conducted.
   [Objectives for FY2021]
   - A system that can be implemented in respective regions across Japan will be created by using the past results to improve vehicles, operation and services, and environments that enable social implementation in respective regions.
   - From the viewpoint of acceptance by local government bodies, arrangements to study the abovementioned automated driving services will be presented as options for local government bodies which study the possibility of introducing new mobility services to solve regional issues (e.g., ensuring mobility in daily lives).
   - Technologies will be developed for vehicles, such as ego-vehicle position estimation technology using magnetic markers installed intermittently, in addition to that using electromagnetic induction wires installed continuously, and FOTs will be conducted.

[Final goals] (by the end of FY2022)
- Projects to implement automated driving-based mobility services will be conducted and expanded in multiple regions (at least five locations) to improve the technology level and expand the services (including expansion of ODDs) so that such services become available in respective regions across Japan.
II) Development of platform technologies for practical application of automated driving
(1) Technologies for using the traffic environment data

[Overview]
In the first phase of SIP-adus, the standardized specifications were formulated for high-precision 3D map data (mainly for expressways), which is indispensable for achieving automated driving, and the basic organizational structure for improving the maps was established. In the second phase of SIP-adus, R&D is conducted on technologies to generate dynamic traffic environment data (which changes with time and is used by linking to the static high-precision 3D map data) and to use such data through digital distribution in order to implement more advanced vehicle-infrastructure cooperative driving automation also for arterial and general public roads. Surveys, research, etc. related to the R&D will also be conducted.

1. R&D toward social implementation of providing traffic signal information by using the cloud, etc.
   [Persons responsible for R&D] To be determined through a public call for proposals
   [Participating bodies] To be determined through a public call for proposals
   [Activities]
   · A study will be conducted toward social implementation of a model of traffic signal information centers, which receive traffic signal information across Japan and send it to servers of business operators, etc. The prefectural police system will be built and validated. A system to gather all the traffic signal information at the National Police Agency (i.e., a system designed to gather all the traffic signal information from prefectural police to the National Police Agency, which transmits the information to traffic signal information centers) will be built, validated, etc.
   [Objectives for FY2021]
   · A study will be conducted on the social functionality requirements, technology requirements, and the implementation body of traffic signal information centers. Integrated distribution of regulation information, etc. and coordination between the traffic signal information and high-precision 3D map will also be studied. Verification will be conducted regarding improvement of the precision of traffic signal information.

2. R&D on technologies including traffic signal control using GNSS (location information), etc.
   [Persons responsible for R&D] Shunichi Kawabe (UTMS Society of Japan)
   [Participating bodies] UTMS Society of Japan, KOITO ELECTRIC INDUSTRIES, LTD.
   [Activities]
   · Priority traffic signal control, etc. is performed through coordination between automated buses, etc. and the traffic control system by using high-precision location information (GNSS) and the mobile phone network to deploy mobility services using automated buses, etc. and reduce the required infrastructure. A model system will be built to validate the effectiveness of smoothing the traffic flow, etc. by effectively using the collected location information. The cost effectiveness
of introducing the system will be clarified. An FOT environment related to simulated distribution of emergency vehicle information for FOTs in Tokyo waterfront area will be built.

[Objectives for FY2021]
• A prefectural police model system will be created based on the formulated model system specifications. The effectiveness of the current system using infrared beacons, as well as transmission delay, cost effectiveness, etc., will be verified.
• An FOT environment required for simulated distribution of the emergency vehicle information in Tokyo waterfront area will be created in coordination with "Implementation of FOTs in Tokyo waterfront area."

3. Study and evaluation of technologies for automated driving control by using probes at the lane level, etc.

[Persons responsible for R&D] Hirokazu Ichikawa (PACIFIC CONSULTANTS CO., LTD.)
[Participating bodies] PACIFIC CONSULTANTS CO., LTD.
[Activities]
• The technological specifications for collecting and using road traffic environment data at the lane level on expressways will be reviewed, and probe data from the private sector (owned by automobile manufacturers, manufacturers of car navigation systems, etc.) will be processed based on the technological specifications to conduct FOTs to provide road traffic environment data on the Metropolitan Expressway at the lane level.
• An investigation of the current status will be conducted about the probe vehicle data through a study meeting involving public and private stakeholders toward creating a mechanism to provide road traffic environment data at the lane level using the probe vehicle data that contributes to automated driving and safe driver assistance. A study will be conducted toward social implementation.

[Objectives for FY2021]
• Regarding the mechanism to generate and provide road traffic environment data at the lane level, a study will be conducted on the details that should be improved and upgraded, etc., technologies will be validated through FOTs, and a study will be conducted toward actual operation by taking into account the issues, improvements, etc. identified in the study of technologies and FOTs conducted by the end of FY2020.
• The accuracy of road traffic environment data at the lane level will be improved, and road traffic environment data will be distributed in real time to validate the effectiveness.
• A mechanism for generating and providing road traffic environment data at the lane level by using probe data will be upgraded so that multiple business operators can offer online connection data.
• To contribute to a cooperative driving automation system, a server system for gathering all the data will be created to collect not only probe data but also various types of information
(emergency reporting information, emergency vehicle position information, V2N traffic signal information, precipitation information), convert them to designated communication specifications, and distribute them to medium range and wide range communication business servers, which will be developed through "R&D on collecting, integrating, and distributing small and medium-sized area information." Evaluation and verification will be conducted through FOTs, etc. in coordination with “Implementation of FOTs in Tokyo waterfront area.”

4. Surveys and research on a model system related to improving the data accuracy of traffic regulation information, etc.

[Persons responsible for R&D] To be determined through a public call for proposals
[Participating bodies] To be determined through a public call for proposals
[Activities]
- Surveys and research will be conducted to contribute to providing appropriate and useful traffic regulation information for automated vehicles (e.g., improvement of the data accuracy of traffic regulation information). To upgrade the automated driving environment on arterial and general public roads for a centralized management system of the national traffic information, the accuracy of the registered data related to traffic regulation information will be improved by using image recognition technology.
- An application that links the traffic regulation information with the road sign information, etc. will be developed. A model system will be built to validate and evaluate the effectiveness through FOTs, and efforts will be made toward social implementation.

[Objectives for FY2021]
- Based on the evaluation database and model system specifications created in FY2020, technology capable of accurately registering the traffic regulation information will be developed through simple and efficient collection of the traffic regulation information by using image recognition technology. A model system will be developed and created to improve the accuracy of the registered data related to the traffic regulation information.
- FOTs will be conducted to collect and provide more traffic regulation information by using the model system. Evaluation and verification will be conducted on the improvement of position and coordination, etc. of decision-making information and traffic regulation information. Techniques to create a safe and smooth traffic environment at an early stage will be studied through public-private cooperation.

5. R&D on collecting, integrating, and distributing small and medium-sized area information

[Persons responsible for R&D] Yuji Aburakawa (NTT DOCOMO, INC.)
[Participating bodies] NTT DOCOMO, INC.
[Activities]
- Toward social implementation, R&D will be conducted on technology to collect dynamic and
static information obtained from various sources of information, integrate these sources of information to determine the real-time traffic situation, and distribute only necessary information to automated vehicles so that peripheral traffic information that cannot be recognized by onboard sensors, etc. of automated driving vehicles can be monitored comprehensively. FOTs using actual equipment will be validated to standardize the interface (e.g., data format and protocol to collect, analyze, and distribute information).

[Objectives for FY2021]

- Based on the R&D results by FY2020, a system to distribute the traffic environment data by V2N will be created. An optimal mechanism to distribute the traffic environment data, which is provided by the "Study and evaluation of technologies for automated driving control by using probes at the lane level, etc.," depending on requests from vehicles will be investigated and studied.
- FOTs will be implemented in coordination with "Implementation of FOTs in Tokyo waterfront area." Issues toward evaluation and practical application of a system to distribute the traffic environment data will be identified.

6. R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4)

[Persons responsible for R&D] Naoki Suganuma (Kanazawa University)
[Participating bodies] Kanazawa University, Chubu University, Meijo University
[Activities]
- A test vehicle equipped with automated driving technologies of Level 3 and Level 4 will be developed. The technological requirements and deployment requirements of the transport infrastructure (required for automated vehicles of Level 3 and Level 4 on arterial and general public roads in urban areas) will be clarified by conducting FOTs on public roads (e.g., Tokyo waterfront area). The technological requirements, including recognition and judgment for automated driving systems in such transport infrastructure, validation of the effectiveness of providing traffic information by wireless communication and the coverage of driving scenarios in urban areas using simulation technologies, and establishment of a feedback loop, will be clarified.
- Opportunities to test-drive the test vehicle will be provided in Tokyo waterfront area and other areas. Initiatives to disseminate the R&D results and foster public understanding of the current status of automated driving technologies will be made.

[Objectives for FY2021]

- FOTs will be conducted in Tokyo waterfront area for V2I-based ITS roadside units, which provide traffic signal information, and V2N-based traffic environment data by using the developed test vehicle. The technological requirements, deployment requirements, etc. for the infrastructure that provides various types of traffic environment data will be proposed based on
knowledge acquired from FOTs on public roads.
- Identification of issues related to reproduction of the traffic environment by simulation technology, effectiveness evaluation to improve recognition technology, establishment of a scenario feedback loop to verify and improve the coverage of driving scenarios in urban areas using simulation technology, etc. will be studied in coordination with the “Development of techniques to establish an automated driving evaluation environment in virtual space” (DIVP project: Driving Intelligence Validation Platform) and the “Safety Assurance Kudos for reliable Autonomous vehicles” (SAKURA project), which is implemented by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism. As for improving the accuracy of simulation tools and models, the value of results will be refined by using the actual data of FOTs in the past items of this R&D and by using AI technology.
- The possibility of offering important scientific data (among the data acquired from FOTs) to external entities will be studied.

7. R&D on location-based services using the Quasi-Zenith Satellite System (Michibiki)
   [Persons responsible for R&D] Naoki Suganuma (Kanazawa University)
   [Participating bodies] Kanazawa University, Chubu University, Meijo University
   [Activities]
   - A position estimation system, which can be applied to automated driving systems to achieve Level 3 and Level 4 driving automation in urban areas, will be upgraded by using information from the Quasi-Zenith Satellite System (Michibiki) and integrating it with that obtained from general-purpose on-board sensors.
   [Objectives for FY2021]
   - The effectiveness of position accuracy estimation technology, which is required for the developed automated driving systems of Level 3 and Level 4, will be evaluated based on knowledge acquired from FOTs using a test vehicle equipped with a receiver that can use the data from the Quasi-Zenith Satellite System (Michibiki), and the technology will be upgraded.
   - The possibility of offering important scientific data (among the data acquired from FOTs) to external entities will be studied.

   [Final goals] (by the end of FY2022)
   - Environments and organizational structures that are required to distribute traffic signal information (in accordance with the standard specifications based on the validation through FOTs) and road traffic environment data at the lane level (using probe vehicle data, etc.) will be built.
(2) Safety assurance technologies

[Overview]
In the current evaluation methods focusing mainly on FOTs using actual vehicles on public roads, the required driving environment conditions cannot be set intentionally, making it difficult to judge whether automated vehicles meet the necessary safety requirements. It is therefore necessary to develop techniques for evaluating vehicle safety under specific driving environment conditions. To increase the efficiency of safety evaluations using actual vehicles (which require much time in the current development of automated vehicles), efforts will be made to develop simulation tools (mainly evaluation of sensor performance), standardize the interface, etc., and a safety evaluation environment will be built in virtual space. The developed tools, interface, etc. for the safety evaluation environment will be standardized among automobile manufacturers, suppliers, etc. to raise the level in the whole industry and increase the efficiency of safety assurance technologies for automated vehicles and systems, thereby enhancing industrial competitiveness.

1. Development of techniques to establish an automated driving evaluation environment in virtual space

[Persons responsible for R&D] Hideo Inoue (Kanagawa Institute of Technology)


[Activities]
· To conduct safety evaluation with high reproducibility under various road traffic environments, a simulation model which can be substituted for the experiment evaluation in the real environment and whose consistency with actual phenomena is high will be developed. Based on this model, the Driving Intelligence Validation Platform (DIVP), a safety evaluation environment in virtual space, will be created. Conformity with the real environment will be verified, and connectivity, etc. will be confirmed in FOTs in Tokyo waterfront area and monitoring evaluation by automobile manufacturers and sensor manufacturers to achieve social implementation through commercialization.

· Social implementation will be promoted in coordination with the SAKURA project, a safety evaluation initiative promoted by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism, and other measures in SIP-adus, including “R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4).”

· To strengthen the international competitiveness of automobile manufacturers and sensor manufacturers, a standard interface will be proposed to enable performance evaluation and development (at the module level) by individual sensor manufacturers and sharing of intermediate outputs by automobile manufacturers and sensor manufacturers. This will
contribute to fostering confidential relationship with OEMs to strengthen the international competitiveness of OEMs and sensor manufacturers in Japan.

[Objectives for FY2021]
- Based on the malfunction factor scenario scheme for automated driving safety evaluation compiled by the Japan Automobile Manufacturers Association, Inc., the requirements, which have been different for each manufacturer, will be standardized, and the priority level of the sensor malfunction mechanism, which should be reproduced, will be compiled to establish models.
- Creation of a database will be started mainly for Tokyo Waterfront City area, which is the field of the FOTs in Tokyo waterfront area. A virtual FOT environment will be created for safety evaluation related to automated driving to enable verification of conformity with the real environment.
- A technical study will be promoted across manufacturers using the simulation data as common tools to facilitate international cooperation and standardization.
- Information about the effectiveness of DIVP will be disseminated based on the evaluation with the participation of automobile manufacturers and sensor manufacturers through FOTs in Tokyo Waterfront City area. Practical application and deployment of the DIVP project will be accelerated to start commercialization.

[Final goals] (by the end of FY2022)
- Commercialization will be promoted so that the data platform of the safety evaluation environment in virtual space can be built and operated on an ongoing basis. Consensus will be built in the industry toward use by third-party evaluation organizations while promoting standardization of the interface.
(3) Cybersecurity

[Overview]
Regarding vehicle cybersecurity, new cyberattack techniques have been continuously reported at international conferences (e.g., Black Hat) and other events. The intrusion detection system (IDS) for coping with new techniques of cyberattacks on vehicles after their sale has attracted much public attention. Accordingly, surveys will be conducted on cybersecurity, etc. by taking into account the update, etc. of the automated driving system software by wireless communication. Required technologies will be developed and studies for formulating guidelines, etc. will be conducted.

1. Surveys and research on new cyberattack techniques and countermeasure technologies
   [Persons responsible for R&D] Ken Okuyama (PwC Consulting LLC)
   [Participating bodies] PwC Consulting LLC
   [Activities]
   - By taking into account the fact that the IDS is effective against new cyberattacks targeting connected cars, surveys on the IDS will be conducted. The performance of the IDS will be evaluated by using testbeds and actual vehicles to establish IDS evaluation techniques and formulate guidelines. These guidelines will be transferred to industry organizations to encourage them to establish industry guidelines.
   - Surveys will be conducted on methods of observing, collecting, analyzing, and accumulating threat intelligence about cyberattacks on connected cars and an information sharing system to assist the initial response activities. The performance targets of the overall system will be studied, and the basic system specifications of the overall system will be created to promote transfer to industry organizations.

[Objectives for FY2021]
- The evaluation guidelines will be created, and an operation plan toward transferring the operation to industry organizations will be proposed.
- Techniques for collecting and accumulating threat intelligence regarding vehicles and on-board devices will be studied while continuing surveys and research on threat intelligence and initial response assistance for connected cars, and the basic designs for collecting and accumulating intelligence will be studied. The methods of linking threat intelligence with IDS will be studied, and likewise the basic designs for assisting the initial response after a cyberattack is detected.

[Final goals] (by the end of FY2022)
- Techniques for evaluating the IDS will be established, and the formulated guidelines will be transferred to the industry organization, JASPAR.
- The basic designs for a system to collect and accumulate threat intelligence and a system to assist initial response by linking threat intelligence with IDS will be formulated, and the operation will be transferred to the industry organizations.
(4) Creation of an architecture for geographical data for automated driving

[Overview]
An architecture for automated driving (“automated driving architecture”) will be built for geographical data through the public-private cooperation structure while consulting to the Society 5.0 reference architecture. To share common views and understanding between public and private stakeholders through the automated driving architecture, the requirements, mechanisms, etc. required for multi-purpose deployment of traffic environment data will be studied through FOTs and other activities in Tokyo waterfront area, local regions, and other areas to accelerate technological development, social implementation, data coordination, and international standardization, among others.

1. Surveys and research on design and creation of an architecture for automated driving and driver assistance

[Persons responsible for R&D] Naoki Iso (NTT DATA Corporation)
[Definition of requirements for automated driving services in local regions, etc.] Kosuke Watabe (Nippon Koei Co., Ltd.)

[Participating bodies] NTT DATA Corporation
[Definition of requirements for automated driving services in local regions, etc.] Nippon Koei Co., Ltd., Highway Industry Development Organization (HIDO), PACIFIC CONSULTANTS CO., LTD.

[Activities]
- A mechanism will be built to facilitate matching between owners and users of information so that various entities can use traffic environment data for different services (e.g., operation management and transfer guidance for automated driving-based mobility and logistics services, search of driving routes in the event of disasters, provision of road congestion information, etc. based on probe vehicle data). To this end, the data underpinning the mechanism will be created, and a single portal site for viewing all the data will be launched. Technological issues will be validated and R&D will be conducted in Tokyo waterfront area, local regions, and other areas.
- Cooperation with the ICT industry will be promoted through this measure to commercialize services for multi-purpose use of geographical data that underpins Society 5.0.

[Objectives for FY2021]
- Measures to solve issues faced by data providers will be reflected, such as discovering and collecting valuable mobility data as the portal of traffic environment data, concluding contracts related to data sharing, and processing data.
- Efforts will be made to create use cases based on matching projects between companies that participate in the portal site and to create matching opportunities between data providers and service providers by strengthening the communication function. The functions to turn metadata into a Resource Description Framework (RDF) and automatically collect metadata will be added to improve the matching rate.
• An app competition to solve issues faced by Kyoto will be held in cooperation with data providers, data users, local government bodies, etc. A scheme that enables continuous use of data offered for competition will be studied.
• A portal for traffic environment data will be released to promote participation of companies and organizations that possess the data. New services will be created, and activities to promote deployment to data users, who disseminate information about the needs for using data, will be accelerated.
• An organizational structure will be established to promote sustainable development and management of a portal site for creating use cases in cooperation with data platforms and organizations in other fields.

2. FOTs and evaluation to increase the efficiency of logistics based on the architecture that uses vehicle information (e.g., probes)

[Persons responsible for R&D] To be determined through a public call for proposals
[Participating bodies] To be determined through a public call for proposals

[Activities]
• Having to wait at logistics centers, etc. (e.g., waiting one’s turn for loading and unloading), unmatched cargoes, and various kinds of manual work, etc. increase the working hours of drivers. Based on studies on using vehicle information (e.g., probes) to solve these issues, evaluations will be conducted through FOTs.
• Regarding data in the cooperative area in terms of vehicle information (e.g., probes), an architecture for using data will be built to standardize the format.

[Objectives for FY2021]
• To reduce the waiting time for loading and unloading and working hours and to improve the matching conditions and safety, FOTs will be conducted to validate the effectiveness based on an architecture that uses vehicle information and probe data.

[Final goals] (by the end of FY2022)
• The portal site service for multi-purpose deployment of geographical data (e.g., traffic environment data for automated driving) will be launched.
• Proposals will be made for standardization of the interface (e.g., data format, protocol) to use the probe vehicle data of commercial vehicles.
(5) Other platform technologies

[Overview]
Surveys will be conducted on the model of HMI (including methods of appropriate presentation and education) for the Level 4 driving automation systems to ensure communication between automated vehicles and other traffic participants (e.g., pedestrians, bicycle riders, vehicle drivers) and between automated vehicles and drivers while taking international developments into account. Studies will be conducted on developing the required technologies, establishing guidelines, etc. R&D, etc. will be conducted on the V2X communication technologies required to achieve advanced automated driving and other platform technologies required for automated driving.

1. Surveys and research on HMI and safety education methods in line with the sophistication of automated driving

[Persons responsible for R&D] Satoshi Kitazaki (National Institute of Advanced Industrial Science and Technology)

[Participating bodies] National Institute of Advanced Industrial Science and Technology, University of Tsukuba, Keio University, Tokyoto Business Service Co. Ltd., The University of Tokyo, Kumamoto University

[Activities]
- Reliable and smooth communication methods will be established to ensure the safety of automated vehicles and other traffic participants (e.g., pedestrians, bicycles riders, vehicle drivers) and a clear understanding of the intentions of each other in anticipation of mobility and logistics services using automated vehicles equivalent to Level 4 to secure the means of mobility in underpopulated areas and mitigate the driver shortage.
- HMI will be developed for appropriate takeover, etc. in cases where the driving environment is outside the scope of applicable conditions and where the automated driving systems lose functionality. Methods of educating drivers will also be established.
- Knowledge that drivers, pedestrians, etc. should acquire and effective education methods will be established regarding automated vehicles equivalent to Level 3 and Level 4 and driver assistance systems equivalent to Level 2, which have been increasingly deployed.

[Objectives for FY2021]
- Experiments will be conducted in the virtual reality (VR)/driving simulator (DS) environments based on analysis of images observed in past FOTs. Possible means and methods of communication and their effectiveness will be validated in use cases involving drivers. Communication knowledge that should be acquired by traffic participants will be formulated.
- Examples of methods of quantitatively assessing the impact on takeover of driving control, etc. and the effectiveness of HMI for appropriate takeover, etc. will be validated. An evaluation index for the status of the driver’s proper understanding about an automated driving system will be created.
Regarding driving education on automated vehicles equivalent to Level 3, validation will be performed using a driving simulator and web-based experiments. Opinions will be exchanged with the National Police Agency, and trial application of safe driving contents will commence.

[Final goals] (by the end of FY2022)
- Guidelines regarding the communication design (including the means such as external HMI and road markings) will be proposed and reflected in the ISO standards.
- The results of research on quantitative evaluation techniques of the Object and Event Detection and Response (OEDR), the effective process of transition among the automated driving levels on expressways, HMI for assisting the driver to take over control on arterial and general public roads, etc. will be provided to the Japan Automobile Manufacturers Association, Inc. and other entities. International standardization will be promoted through ISO.
- General knowledge on automated driving systems will be summarized, and safe driving education programs and teaching materials will be created. Particular knowledge that should be provided for specific automated driving systems will be summarized, and methodologies to disseminate knowledge will be proposed.

2. Study on communication protocols for achieving Use Cases for Cooperative Driving Automation

[Persons responsible for R&D] Satoshi Kimura (NEC Corporation)
[Evaluation related to 700 MHz band ITS] Tadayoshi Ito (KYOCERA Corporation)
[Participating bodies] NEC Corporation
[Evaluation related to 700 MHz band ITS] KYOCERA Corporation

[Activities]
- Technological requirements for communication will be established through simulations, etc. for achieving SIP Use Cases for Cooperative Driving Automation (first edition, September 2020). Studies will be conducted on the frequency bandwidth, etc. required to achieve vehicle-infrastructure cooperative connected and automated driving, taking into account the expected penetration rate of automated vehicles in each case. A roadmap will be formulated that reflects the technological requirements that will be required in each phase.

[Objectives for FY2021]
- Regarding cases in which communication is used for automated driving as described in Use Cases for Cooperative Driving Automation, the applicability to the existing 700 MHz Intelligent Transport Systems will be studied. Measures, including the use of the cellular V2X protocol and a new frequency band (5.9 GHz band), will be studied. Technical feasibility will be validated.
- Regarding Use Cases for Cooperative Driving Automation, specific requirement specifications (e.g., data amount, communication area, permissible latency, communication speed, packet arrival rate) of respective wireless communication technologies will be summarized from the technological viewpoint, and a draft roadmap for information communication technology will be
proposed.

[Final goals] (by the end of FY2022)
- The conditions required for communication in the use of traffic environment data will be clarified, and a draft roadmap for the information communication technologies required to achieve automated driving will be formulated and proposed to Public-Private ITS Initiative/Roadmaps, etc.
III) Fostering of public acceptance of automated driving

(1) Information dissemination to citizens, etc. and promotion of understanding

[Overview]
With a view to the social implementation and deployment of automated driving in the future, a model of providing information to citizens, etc. and the information dissemination strategy will be formulated regarding the legal system, technologies, etc. of automated driving to foster public acceptance while reflecting the knowledge derived from research in humanities and social sciences. Interactive events involving citizens, officials of local government bodies, business operators, etc. will be organized taking into account the regional traffic environment, needs, and other factors. Studies on new mobility services will be accelerated. Overconfidence in and distrust of automated driving will be dispelled by interacting with citizens and providing information to promote correct understanding.

1. Formulation of a strategy to foster public acceptance and evaluation surveys

[Persons responsible for R&D]
- [Formulation of strategy] Noriko Moriuchi (DENTSU MEITETSU COMMUNICATIONS INC.), Shinya Omori (SC-ABeam Automotive Consulting)
- [Evaluation] Katsuhiko Saito (Dai-ichi Life Research Institute Inc.)

[Participating bodies]
- [Formulation of strategy] DENTSU MEITETSU COMMUNICATIONS INC., SC-ABeam Automotive Consulting
- [Evaluation] Dai-ichi Life Research Institute Inc.

[Activities]
- Studies will be conducted on information required to correctly understand automated driving, effective information transmission methods, effectiveness measurement techniques, and other matters to raise social awareness and correct understanding. An overall strategy will be formulated to foster public acceptance (including information dissemination). Specifically, the benefits, effects and potential risks of automated driving will be clarified for traffic participants. Initiatives to promote public understanding, etc. of the overall vision related to automated driving (including the future vision and rules of automated driving) will be studied.
- Based on the strategy, initiatives to continuously promote correct understanding by using the optimal method of appealing to respective targets will be proposed while ensuring interactivity (e.g., public relations through mass media and the Internet in connection with events and FOTs).
- The effectiveness of initiatives conducted based on the strategy will be measured and evaluated, and the strategy will be reviewed promptly.

[Objectives for FY2021]
- The overall strategy will be reviewed based on the results of effectiveness measurement and evaluation of the activities, etc. that have been conducted based on the strategy. The overall implementation plan for FY2021 and beyond will be formulated and implemented.
The conventional technique of gathering many people at one venue will be reviewed. A new method of disseminating information based on new behavior, which is not dependent solely on local events, will also be studied.

A plan to organize events for media, which aim to establish a relationship with media, improve literacy, and share information, will be formulated.

On the occasion of the Olympic and Paralympic Games Tokyo 2020 in summer 2021, etc., the possibility of organizing events for the general public will be studied in cooperation with the Japan Automobile Manufacturers Association, Inc., automobile manufacturers, etc. Top priority will be placed on encouraging participation by the general public and media targeted at them to foster public acceptance.

2. Surveys to measure the effectiveness of efforts to foster public acceptance by organizing exhibitions, etc.

[Persons responsible for R&D] Noriko Moriuchi (DENTSU MEITETSU COMMUNICATIONS INC.), Shinya Omori (SC-ABeam Automotive Consulting)

[Participating bodies] DENTSU MEITETSU COMMUNICATIONS INC., SC-ABeam Automotive Consulting

[Activities]

- Initiatives to raise public awareness and promote correct understanding will be conducted such as by using websites, social networking services (SNS), etc. to which many traffic users have access.

- Information will be disseminated through interactive and other events involving citizens organized during the period of FOTs in Tokyo waterfront area and other areas. Initiatives will be conducted to promote understanding and raise awareness of automated driving even among those who do not use it. Events will be jointly held with various industry organizations. Efforts will be made to promote correct understanding of social needs and the usefulness of automated driving and to introduce new automated driving-based mobility services, etc., thereby spreading automated driving services in society.

- Interactive events involving citizens, officials of local government bodies, business operators, etc. will be organized taking into account the regional traffic environment, needs, and other factors. Studies on new mobility services will be accelerated. Overconfidence in and distrust of automated driving will be dispelled by interacting with citizens and providing information to promote correct understanding.

[Objectives for FY2021]

- Correct understanding of automated driving will be promoted by using FOTs in Tokyo waterfront area and local regions.

- Interactive events involving citizens, officials of local government bodies, business operators, etc. will be organized by taking into account the regional traffic environment, needs, and other
factors. A mechanism for deploying these initiatives nationwide will be built to accelerate the study on new mobility services.

- Based on knowledge derived from technical verification of driver assistance for persons with visual impairments, etc., information will be disseminated about the effectiveness of the safe driver assistance system by automated driving, etc.
- Public relations activities will be conducted, and events will be held, etc. based on a plan in “Formulation of a strategy to foster public acceptance and evaluation surveys.”

[Final goals] (by the end of FY2022)

- An organizational structure for operation will be built to continuously disseminate information and promote understanding of automated driving in FY2022 and beyond in cooperation with industry organizations, etc.
(2) Surveys and research to solve social issues by using automated driving technologies

[Overview]
Japan's long-term vision will be summarized by taking into account the developments in automated driving (e.g., technology level, deployment status). The impact of automated driving (e.g., reduction in traffic accidents, influence on traffic congestion, and reduction in CO₂ emissions) will be summarized and quantitatively presented to provide data for open discussion on the effects and potential risks of automated driving. The organizational structure for industry-academia-government collaboration will be built beyond the existing framework (between organizations, industries, and disciplines) to organize the ecosystem related to implementation of automated driving. To achieve mobility services that can be used safely by vulnerable road users (e.g., elderly persons, persons with disabilities, pregnant women, foreign tourists), surveys will be conducted on respective needs. Surveys and research will be conducted on the possibility of using optimal automated driving technologies in terms of both hardware and software. Surveys and research, etc. required for solving social issues by automated driving will be conducted.

1. Research on assessment of the impact of automated driving on society and the economy and on measures to promote deployment
   [Persons responsible for R&D] To be determined through a public call for proposals
   [Participating bodies] To be determined through a public call for proposals
   [Activities]
   ‧ The overall vision related to the impact assessment on society and the economy will be summarized by taking into account the techniques of estimating the penetration rate of automated vehicles and driver assistance vehicles by 2050 for each driving automation level and of assessing the impact on road transport (e.g., reduction in traffic accidents, reduction in CO₂ emissions, influence on traffic congestion), mobility and logistics services, and industry and society. The details and methods of disseminating information externally will be studied, and information will be disseminated.
   ‧ Joint research, etc. will be conducted with foreign research institutes in the U.S., Europe and other countries about the fostering of public acceptance.
   [Objectives for FY2021]
   ‧ Preconditions for the simulation model for forecasting deployment and impact, and measures to promote deployment (multiple scenarios will be formulated) will be summarized, and discussions will be promoted in meeting bodies related to SIP-adus. The penetration rate in response to measures to promote deployment of scenarios will be estimated. Based on the penetration rate, the number of traffic accidents, traffic congestion, and CO₂ emissions will be estimated, and the impact on society and the economy will be studied.
   ‧ Based on the estimation related to assessment of the impact on society and the economy, the details and method of disseminating information externally will be studied, and information
about the impact of automated driving on society and the economy will be disseminated while reaching consensus between stakeholders.

[Final goals] (by the end of FY2022)

- An action plan based on the quantitative impact assessment (e.g., influence on reduction in traffic accidents, influence on traffic congestion, reduction in CO$_2$ emissions) will be proposed to Public-Private ITS Initiative/Roadmaps.
IV) Enhancement of international cooperation

[Overview]
To maintain the international competitiveness of Japan's auto and related industries, Japan must take
the initiative and ensure international coordination in the standardization activities for automated
driving. To use the results related to the SIP-adus project, information will be actively disseminated in
Japan and foreign countries by preparing a report that presents an overview, and opportunities will
be created for internationally open R&D and social implementation that drive the discussions forward.
Necessary surveys, research, etc. on the developments to formulate standards, etc. related to the
traffic environment data in and outside Japan, among other topics, will be conducted to enhance
international cooperation (e.g., standardization, joint research).

(1) International dissemination of information by organizing the SIP-adus Workshop (an international
workshop) and other events
1. Surveys of developments related to strengthening the ability to disseminate information to achieve
automated driving

[Persons responsible for R&D] Yoichi Onagi (Congrès Inc.)

[Participating bodies] Congrès Inc.

[Activities]
- The ability to disseminate information will be strengthened to increase Japan’s initiative in R&D
  on automated driving, showcase technologies developed in Japan, promote harmonization
toward international standardization, and facilitate international cooperation through joint
research, etc. Information about the initiatives to conduct R&D, FOTs, etc. on automated driving
in Japan will be actively disseminated (e.g., by using websites and organizing international
workshops), focusing mainly on FOTs in Tokyo waterfront area, which aim to offer
internationally open R&D environments, and demonstration events. The data of FOTs
conducted on public roads by the Public-Private Council will be managed.

[Objectives for FY2021]
- Based on a review of SIP-adus Workshop 2020, which was held despite the impact of the Covid-
  19 pandemic, SIP-adus Workshop 2021 will be planned and held with new lifestyles ("new
  normal") in mind.
- The number of visits to the website will be increased by upgrading the website contents and
  updating the contents in a timely manner.
- Information will be disseminated through international conferences. International cooperation
  (e.g., standardization activities, joint research) will be further enhanced on the occasion of
  holding the SIP-adus Workshop. A network of experts will be built to foster young experts who
  will be the future leaders.
(2) Promotion of joint research on automated driving with overseas research institutes

1. Creation of a cooperation structure to promote joint research with overseas research institutes related to automated driving

[Persons responsible for R&D] Yoshihiro Suda (The University of Tokyo)

[Participating bodies] The University of Tokyo

[Activities]
- In order to facilitate international cooperation based on joint research, etc. with overseas research institutes in the automated driving field, the environment will be improved and themes will be decided through industry-academia-government collaboration. The database of research on automated driving (mainly in Japan) will be upgraded, etc.
- Efforts will be made to build a sustainable organization that can work as an equal partner of overseas research institutions established through industry-academia-government collaboration and can also cope with issues specific to Japan.

[Objectives for FY2021]
- Research themes that may lead to sustainable international cooperation will be proposed toward FY2022 and beyond through a liaison conference (with the Mobility Innovation Liaison Conference serving as the core organization and other research institutes involved).
- In the cooperation between Japan and Germany, implementation of joint R&D on human factors, socioeconomic impact assessment, safety evaluation, cybersecurity, etc. will be assisted.
- In the cooperation between Japan and the EU, workshops to share information, etc. will be held in the cooperation projects selected. The next step of possible cooperation will be studied by sharing information.
- A study will be conducted toward a new phase of cooperation through activities to share information with North America, Asian countries, etc. in addition to cooperation between Japan and Germany and between Japan and the EU.
- The database of research on automated driving will be upgraded, and methods of using it (including disclosure) will be studied. Industry-academia collaborative R&D will be promoted by using the database.
- To establish a sustainable organization for industry-academia collaboration in FY2022 and beyond, the ultimate vision of the organization (including cooperation with other organizations) will be shared, and a specific roadmap toward realization will be created. Studies on achieving a collaboration model will be conducted through consultations and interviews with relevant ministries, agencies and industries.

[Final goals] (by the end of FY2022)
- An organization for industry-academia-government collaboration will be established to continue such collaboration that has been promoted through SIP-adus and to ensure sustainable cooperation with overseas research institutes in the field of automated driving based on the
inter-academia cooperation structure.

- Regarding international standardization, its arrangements will be made so that Japan can take a leadership role in the standardization activities for automated driving (in terms of both the *de facto* standards and the *de jure* standards) through close cooperation with Japan Automobile Manufacturers Association, Inc., Society of Automotive Engineers of Japan, Inc., and other organizations.

- The process for facilitating the establishment of the cooperation environment and promoting the research themes with overseas research institutes will be improved. Three or more specific cooperation themes will be established.
### (I) Development and validation (FOTs) of automated driving systems

<table>
<thead>
<tr>
<th>R&amp;D item</th>
<th>FY2018 plan</th>
<th>FY2019 plan</th>
<th>FY2020 plan</th>
<th>FY2021 plan</th>
<th>FY2022 plan</th>
<th>Deployment milestone</th>
<th>Commercialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arterial and general public roads</td>
<td>Automated driving FOT in the Tokyo waterfront area</td>
<td>Automated driving FOT toward deployment</td>
<td>Automated driving FOT toward deployment</td>
<td>Automated driving FOT toward deployment</td>
<td>Automated driving FOT toward deployment</td>
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<td>1.1 Privately owned vehicles</td>
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<tr>
<td>1.1.1 Improvement of traffic environmental information systems</td>
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<td>1.1.2 Public buses and small group transport services</td>
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<tr>
<td>1.2 Expressways (inter-city expressways)</td>
<td>Development of infrastructure information systems and traffic environmental information systems</td>
<td>Improvement of FOT environments</td>
<td>Long-term survey of actual traffic flow and FOT infrastructure installation</td>
<td>Building an environment to distribute traffic environmental data</td>
<td>Building an environment to distribute traffic environmental data</td>
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<td>2. Local public transport</td>
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<td>2.1 Privately owned vehicles</td>
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<td>2.2 Arterial and general public roads</td>
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<td>2.3 Expressways (inter-city expressways)</td>
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</table>

- TRLs represent the expected values at the time of formulation of this plan and may change depending on future research.

### (II) Development of platform technologies for practical application of automated driving

<table>
<thead>
<tr>
<th>R&amp;D item</th>
<th>FY2018 plan</th>
<th>FY2019 plan</th>
<th>FY2020 plan</th>
<th>FY2021 plan</th>
<th>FY2022 plan</th>
<th>Deployment milestone</th>
<th>Commercialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technologies for using traffic environmental data</td>
<td>Study of technological requirements of transport infrastructure, etc.</td>
<td>Building evaluation environment for automated driving</td>
<td>Building an evaluation environment for automated driving</td>
<td>Building an evaluation environment for automated driving</td>
<td>Building an evaluation environment for automated driving</td>
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<tr>
<td>2. Creation of a safety evaluation environment in cyberspace</td>
<td>Sensory evaluation method, driver model</td>
<td>Building a safety evaluation environment</td>
<td>Building a safety evaluation environment</td>
<td>Building a safety evaluation environment</td>
<td>Building a safety evaluation environment</td>
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<td>3. Surveys and research on new cyberattack techniques and countermeasure technologies</td>
<td>Building a database, developing a safety evaluation technique</td>
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<td>4. Creation of an architecture for geographical data for automated driving</td>
<td>Building a database, developing a safety evaluation technique</td>
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<td>5. Other platform technologies</td>
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<tr>
<td>5.1 Communication protocols</td>
<td>surveys and research on external HMI safety education, etc.</td>
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- TRLs represent the expected values at the time of formulation of this plan and may change depending on future research.

### (III) Fostering of public acceptance

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<tr>
<th>R&amp;D item</th>
<th>FY2018 plan</th>
<th>FY2019 plan</th>
<th>FY2020 plan</th>
<th>FY2021 plan</th>
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### (IV) Enhancement of international cooperation

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<th>R&amp;D item</th>
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**Fig. 2-1 R&D Roadmap**

**Definition of TRLs in the second phase of SIP-adus**

<table>
<thead>
<tr>
<th>TRL</th>
<th>Definition</th>
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<tbody>
<tr>
<td>1</td>
<td>Discovery of basic scientific principles or phenomena</td>
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<tr>
<td>2</td>
<td>Formulation of other principles or phenomena; applied research</td>
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<tr>
<td>3</td>
<td>Confirmation of the technology concept</td>
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<tr>
<td>4</td>
<td>Testing in the laboratory</td>
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<tr>
<td>5</td>
<td>Testing in the expected usage environment</td>
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<tr>
<td>6</td>
<td>Verification demonstration (on the system level)</td>
</tr>
<tr>
<td>7</td>
<td>Top user test (on the system level)</td>
</tr>
<tr>
<td>8</td>
<td>Pilot run</td>
</tr>
<tr>
<td>9</td>
<td>Mass production</td>
</tr>
</tbody>
</table>

SIP can handle up to TRL 7. TRLs 8 and 9 will be developed by industry.
3. Organizational structure for implementation

(1) New Energy and Industrial Technology Development Organization (NEDO)

This project is implemented based on the organizational structure shown in Fig. 3-1 by using subsidies for the New Energy and Industrial Technology Development Organization (NEDO). NEDO assists the Program Director (PD) and Steering Committee, studies R&D plans, manages the progress of R&D and budgeting, supports the clerical work in self-checking, prepares the evaluation materials, conducts relevant surveys and analyses, etc.

(2) Selection of principal investigators

Based on this plan, NEDO creates the application procedures, etc. for research programs and selects the research bodies that will work on the research programs through the public call for proposals. NEDO determines the method of creating the application procedures, etc. for research programs and the screening procedures (e.g., screening standards, judges) for selecting research bodies through consultations with the PD, Cabinet Office, ministries and agencies in charge of measures, and the Steering Committee. Stakeholders related to researchers who participate in the research programs subject to the application process do not participate in the screening of such programs. The definition of stakeholders is determined by NEDO.

(3) Arrangements to optimize the organizational structure for research

Practical application of automated driving requires initiatives on vehicle technologies, legal system, and improvement of the environment. Cooperation among the Cabinet Office, ministries, and agencies as well as industry-academia-government collaboration are required to improve the data such as the traffic signal and road restriction information. Cooperation will be enhanced in the industry in the cooperative areas through the PD’s activities. Meanwhile, SPDs support the SIP activities from the viewpoint of industry-academia-government collaboration with participation from industry and academia. While maintaining trust built in the first phase of SIP-adus, cross-disciplinary initiatives have been promoted to attain higher goals in the second phase of SIP-adus and to develop an organizational structure for promoting industry-academia-government collaboration nationwide. Cooperation with overseas projects will be actively promoted to take the initiative in advancing the international cooperation and standardization strategy.

In February 2019, new initiatives commenced in the second phase of SIP-adus. The organizational structure, including the Steering Committee members and subsidiary bodies (e.g., working groups, task forces) was completely changed. The System Implementation Working Group (WG), Business Promotion WG, and International Cooperation WG were established. Under the Business Promotion WG, Task Force (TF) on FOTs in Tokyo waterfront area continues its activities to formulate a plan for FOTs in Tokyo waterfront area. TF on Transport Information Infrastructure has been established under the System Implementation WG to study the use, etc. of traffic environment data. In September 2019, TF on V2X Communication for Cooperative Driving Automation was
established to study communication protocols required for vehicle-infrastructure cooperative driving automation.

While ensuring cooperation with other SIP projects on an ongoing basis, coordination between measures under SIP-adus will be enhanced. Efforts will be made to maximize the outputs by combining FOTs in Tokyo waterfront area, local regions, and other areas with the development of platform technologies. Regarding creation of the traffic environment data framework and distribution of data, a study meeting, etc. will be established by public and private stakeholders to demonstrate the creation and operation of a system assuming social implementation. Specifically, regarding the traffic signal information, a technical committee will be established by involving the Cabinet Office, the National Police Agency, the UTMS Society of Japan, the Japan Road Traffic Information Center, the Japan Automobile Manufacturers Association, Inc., infrastructure manufacturers, ICT vendors, etc. Regarding the probe data in the private sector, a probe data study meeting, etc. will be established by involving the Cabinet Office, the National Police Agency, the Ministry of Land, Infrastructure, Transport and Tourism, the Japan Road Traffic Information Center, the Vehicle Information and Communication System Center, etc.

Regarding commercialization of safety assurance technologies in virtual space, a commercialization study WG will be established by social implementation bodies while ensuring coordination with the SAKURA project, which is a safety evaluation initiative promoted by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism, and other projects, to promote the study. Regarding cybersecurity, industry guidelines will be established in cooperation with J-Auto-ISAC and JASPAR.

Regarding the portal of the traffic environment data, social implementation bodies will create a system, promote deployment, expand participation by companies, upgrade data, prepare use cases through competition, etc., and study business models, etc. Social implementation of mobility and logistics services by automated driving in local regions and other areas will be promoted through coordination with initiatives by relevant ministries and agencies, including last-mile FOTs conducted by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism while enhancing cooperation between regions that conduct FOTs by using a common operation management system, etc.
(4) Collaboration among the Cabinet Office, ministries, and agencies
Practical application of automated driving requires initiatives on vehicle technologies, legal system, and improvement of the environment. Cooperation among the Cabinet Office, ministries, and agencies as well as industry-academia-government collaboration are required to improve the data such as the traffic signal and road restriction information. While maintaining trust built in the first phase of SIP-adus, cross-disciplinary initiatives will be further promoted. Regarding creation of the traffic environment data framework and distribution of data, a study meeting, etc. will be established by public and private stakeholders, including the National Police Agency and the Ministry of Land, Infrastructure, Transport and Tourism, to demonstrate the creation and operation of a system assuming social implementation. Regarding commercialization of safety assurance technology in virtual space, coordination will be ensured with the SAKURA project, a safety evaluation initiative promoted by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism, and other projects. Social implementation of mobility and logistics services by automated driving in local regions and other areas will be promoted in coordination with initiatives by relevant ministries and agencies, including the last-mile FOTs conducted by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism.

(5) Contributions expected from industry
Industry will be encouraged to invest in developing automated vehicles, employing evaluation personnel, etc. A subsequent practical application plan for creating a legacy will be formulated and promoted.
One third or more of the total amount of R&D expenditure, etc. (i.e., the total of contributions from the national government and industry) is expected to be derived from future contributions from industry (including both personnel and supplies) (during the entire five-year period).

4. Intellectual property and evaluation
Efforts will be made based on intellectual property strategies in the fields of safety evaluation, cybersecurity, etc. by reflecting the opinions of external experts from the viewpoint of enhancing industrial competitiveness, promoting international standardization, and ensuring deliverables.

The R&D results and evaluations will be handled based on the Operational Guidelines for Cross-ministerial Strategic Innovation Promotion Program (authorized by the Governing Board).

5. Deployment milestones
(1) Promotion of research toward deployment milestones
The coordination between measures under SIP-adus will be enhanced by taking into account the results of the three-year R&D, etc. Toward practical application, we will overcome three barriers (i.e., technology development, amendment of the legal system, and fostering of public acceptance) through industry-academia-government collaboration by conducting FOTs in Tokyo waterfront area, local regions, and other areas, as well as developing platform technologies to maximize the outputs. The FOTs will involve automobile manufacturers, business operators, local government bodies, and other entities to encourage investment in practical application and commercialization. In addition, multi-purpose use of map data and geographical data, which are improved for automated driving and advanced driver assistance, will be actively promoted to contribute to the realization of Society 5.0.

a. Promotion of social implementation through commercialization of research results, formulation of guidelines, and technology transfer to the private sector, etc.
This project basically aims to conduct R&D on themes in cooperative areas. Thus, it is assumed that the results will be handled by public institutes to take over the project. The research results will be handed over for technology licensing to existing public institutes or private companies established through equity participation by multiple companies, such as Dynamic Map Platform Co., Ltd. (DMP) established in the first phase of SIP-adus. Specifically, efforts will be made to commercialize the simulation platform created based on the results of safety assurance technology in virtual space (DIVP) and the portal of traffic environment data to promote sharing of the geographical data (MD communet™). The results related to the vehicle structure (e.g., cybersecurity, HMI) will be used to establish the industry guidelines and will be reflected in products.

b. Planning and administration of FOTs involving business operators and local government bodies
Regarding FOTs for ensuring mobility in underpopulated areas and other areas, and for offering
mobility and logistics services, commercialization-oriented FOTs will be conducted in collaboration with stakeholders, including business operators and local government bodies.

c. Use of the Olympic and Paralympic Games Tokyo 2020
Opportunities for information dissemination will be arranged through industry-academia-government collaboration in a timely manner by using the R&D results in the public and private sectors, which have been prepared to showcase Japan’s technologies to the global community during the Olympic and Paralympic Games Tokyo 2020, which will attract much public attention.

d. Enhancement of cooperation with other SIP projects
Improvement of the high-precision map data and road traffic environment data as well as data collection using probe vehicle data toward realization of automated driving are expected to contribute to the auto industry and various other industries. Efforts will be made to ensure cooperation with other SIP projects (e.g., Big-data and AI-enabled Cyberspace Technologies, Cyber-Physical Security for an IoT Society, Enhancement of National Resilience against Natural Disasters) focusing mainly on data coordination. A mechanism for sharing such information in a more secure and user-friendly manner will be created, thereby encouraging the ongoing commercialization of data improvement.

(2) Measures for deployment (strategy to foster public acceptance)
It is important to foster public acceptance of automated driving to facilitate deployment. Efforts will be made to visualize the social effects of automated driving and the mobility needs, clarify the advantages and issues of automated driving, promote correct public understanding, and conduct R&D to improve the services. International standardization will also be pursued through international cooperation so that the outcomes of the R&D may be used globally.

a. Dissemination of correct information about automated driving
The benefits and effects of automated driving as well as the limitations and potential risks of automated driving technologies, etc. will be clarified. Efforts will be made to raise public awareness about the overall vision of automated driving and to dispel overconfidence, distrust, misunderstanding, etc. about automated driving and promote correct understanding.

b. Planning and arranging opportunities for communication with citizens in line with FOTs in Tokyo waterfront area, local regions, and other areas
The effects of automated driving (e.g., reduction in accidents and traffic congestion), mobility environment that can be offered to elderly persons, people with limited mobility, etc., future changes in logistics and mobility services and society, etc. will be visualized in an easy-to-understand manner for respective targets through test ride events and dialogs with citizens, etc.
Efforts will be made to promote understanding through interaction.

c. Promoting R&D and practical application of services toward deployment of automated driving
   Efforts will be made to identify the mobility needs of the public depending on their environment
   and attributes. Considering the identified needs, feasible automated driving services will be
   implemented based on the current technology levels, legal system, etc. Public understanding of
   the benefits and limitations of automated driving, etc. will be facilitated.

6. Other important matters
(1) Applicable laws and regulations, etc.
This project is implemented in accordance with: Article 4, Paragraph 3, Item 7-3 of the Act for
Establishment of the Cabinet Office (Act No. 89 of 1999); Basic Policy for Expenditure on Science,
Technology and Innovation Promotion (May 23, 2014, Council for Science, Technology and
Innovation, revised on February 27, 2019); Operational Guidelines for Cross-ministerial Strategic
Innovation Promotion Program (May 23, 2014, Governing Board, revised on March 28, 2019);
Implementation Policy for the Second Phase of the Cross-ministerial Strategic Innovation Promotion
Program (SIP) (supplemental budget measures in FY2017) (March 29, 2018, Council for Science,
Technology and Innovation); Implementation Policy for the Cross-ministerial Strategic Innovation
Promotion Program (supplemental budget measures in FY2018) (February 28, 2019, authorized by
the Governing Board); Implementation Policy for the Cross-ministerial Strategic Innovation Promotion
Program (SIP) in FY2019 (February 28, 2019, authorized by the Governing Board); Implementation
Policy for the Cross-ministerial Strategic Innovation Promotion Program (SIP) in FY2020 (February
27, 2020, authorized by the Governing Board); Implementation Policy for the Cross-ministerial
Strategic Innovation Promotion Program (SIP) in FY2020 (August 20, 2020, authorized by the
Governing Board); Implementation Policy for the Cross-ministerial Strategic Innovation Promotion
Program (SIP) in FY2021 (February 25, 2021, authorized by the Governing Board); and Article 15,
Item 2 of the Act on the New Energy and Industrial Technology Development Organization.

(2) Flexibility of the plan
This plan will be revised flexibly to maximize the results as fast as possible. The Covid-19 pandemic,
which started in early 2020, has affected the global community including Japan. It is expected to have
a prolonged impact, including the one-year postponement of the Olympic and Paralympic Games
Tokyo 2020 and cancellation of international conferences on automated driving. The plan will be
revised as necessary if R&D and other activities are likely to be hindered depending on the spread of
Covid-19, etc.
(3) Assignment history of the PD and personnel in charge

(a) PD

Seigo Kuzumaki  
(April 2018–)

(b) Directors in charge (Counselors)

Takao Nitte  
Leader/Director  
(April 2018–June 2019)

Yasuyuki Koga  
Leader/Director  
(April 2020–)  
Leader/Counselor  
(July 2019–March 2020)  
Counselor  
(August 2018–June 2019)

Naohiko Kakimi  
Sub-leader  
(April 2018–June 2019)

Kenji Ueki  
Sub-leader  
(July 2019–)

Yoshihiro Izawa  
Counselor  
(April 2018–July 2018)

(c) Personnel in charge

Masaki Chikuma  
(April 2018–March 2019)

Kaoru Sugie  
(April 2018–March 2019)

Yukiko Hatazaki  
(October 2018–September 2020)

Kazuya Murata  
(April 2019–March 2021)

Toshikazu Tanaka  
(April 2019–March 2021)

Kotaro Matsumoto  
(July 2019–)

Yuichi Araki  
(October 2020–)

Osamu Hosaka  
(April 2021–)

Kotaro Sugiyama  
(April 2021–)
Appendix: Financial plan and estimates
(Unit: millions of yen)

Total in FY2018: 3,000

(Breakdown)

1. Research expenditures, etc. (including general and administrative expenses and indirect expenses) 2,884
   (Breakdown for each R&D item)
   [I] Development and validation (FOTs) of automated driving systems 1,820
       (relevant ministries and agencies: National Police Agency (NPA), Ministry of Internal Affairs and Communications (MIC), Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), etc.)
   [II] Development of platform technologies for practical application of automated driving 896
        (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [III] Fostering of public acceptance of automated driving 50
         (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [IV] Enhancement of international cooperation 118
        (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)

2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses) 116

Total in FY2019: 3,520 (including a supplemental budget of 400)

(Breakdown)

1. Research expenditures, etc. (including general and administrative expenses and indirect expenses) 3,404
   (Breakdown for each R&D item)
   [I] Development and validation (FOTs) of automated driving systems 1,004
       (relevant ministries and agencies: National Police Agency (NPA), Ministry of Internal Affairs and Communications (MIC), Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), etc.)
   [II] Development of platform technologies for practical application of automated driving 2,007
        (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [III] Fostering of public acceptance of automated driving 213
         (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [IV] Enhancement of international cooperation 180
        (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)

2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses) 116
Total in FY2020: 3,210 (including an additionally allocated budget of 90)

(Breakdown)

1. Research expenditures, etc. (including general and administrative expenses and indirect expenses) 3,094
   (Breakdown for each R&D item)
   [I] Development and validation (FOTs) of automated driving systems 895
   (relevant ministries and agencies: National Police Agency (NPA), Ministry of Internal Affairs and Communications (MIC), Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), etc.)
   [II] Development of platform technologies for practical application of automated driving 1,804
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [III] Fostering of public acceptance of automated driving 217
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [IV] Enhancement of international cooperation 178
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)

2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses) 116

Total in FY2021: 3,120

(Breakdown)

1. Research expenditures, etc. (including general and administrative expenses and indirect expenses) 3,004
   (Breakdown for each R&D item)
   [I] Development and validation (FOTs) of automated driving systems 672
   (relevant ministries and agencies: National Police Agency (NPA), Ministry of Internal Affairs and Communications (MIC), Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), etc.)
   [II] Development of platform technologies for practical application of automated driving 2,030
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [III] Fostering of public acceptance of automated driving 152
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)
   [IV] Enhancement of international cooperation 150
   (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)

2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses) 116