Cross-ministerial Strategic Innovation Promotion Program (SIP)

Automated Driving for Universal Services

R&D Plan

June 10, 2022

Cabinet Office

Secretariat of Science, Technology and Innovation Policy

Table of Contents

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 (released in June 2021) stated that Japan “aims to become a global leader in realizing safe and highly convenient transport society utilizing digital that supports the affluent life of citizens.”

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 the 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 (released in June 2021). 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. Although 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 four-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 environmental data framework and distribution of data
ii) Creation of a safety assurance environment in cyberspace
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) <u>Development and validation (FOTs) of automated driving systems</u>
  (1) FOTs in the Tokyo waterfront area:
    1. Implementation of FOTs in the 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

(II) <u>Development of platform technologies for practical application of automated driving</u>
  (1) Technologies for using the traffic environmental data:
    1. R&D toward social implementation of providing traffic signal information by using the

cloud, etc.

2. Study and evaluation of technologies for automated driving control by using probes at the lane level, etc.
3. Surveys and research on a model system related to improving the data accuracy of traffic regulation information, etc.
4. R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4)
5. R&D on location-based services using the Quasi-Zenith Satellite System (Michibiki)
6. Development and analysis of a simulation environment for validating the merging lane assistance (targeting the gap on the main lane) system

(2) Safety assurance technologies:

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

(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 the communication protocol for the 5.9 GHz band V2X system

(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 four-year R&D, etc. Toward practical application, we will overcome three barriers (i.e., technology development, improvement of the legal system, and fostering of public acceptance) through industry-academia-government collaboration by conducting FOTs in the Tokyo waterfront area, local regions, and other areas, as well as developing platform technologies to maximize the outputs. The FOTs in the 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 the 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 January 2022, FOTs started regarding the generation and distribution of traffic environmental data (including traffic congestion information at the lane level, precipitation information, and position information of simulated emergency vehicles) through wide-area public network communication (V2N: Vehicle to Network) in the Tokyo waterfront area. 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. In April 2022, the bill to revise the Road Traffic Act passed the Diet; this bill aims to achieve a licensing system for driverless automated driving, which is equivalent to Level 4, while keeping in mind unmanned automated driving mobility services based solely on remote assistance in ODDs.

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 (released in June 2021) stated that Japan "aims to become a global leader in realizing safe and highly convenient transport society utilizing digital that supports the affluent life of citizens." In September 2021, the Digital Agency was established as a new leading organization to step up efforts to create a digital society, including digital transport.

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 the 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 linkage platform across different fields, improve the data linkage platform within respective fields (automated driving), and build the architecture (geographical data [automated driving]) in order to improve the data linkage 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 (released in June 2021). 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.

By taking into account the future issues and needs in the mobility field in Japan as discussed in Public-Private ITS Initiative/Roadmaps (released in June 2021), 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 the 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 improve 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.

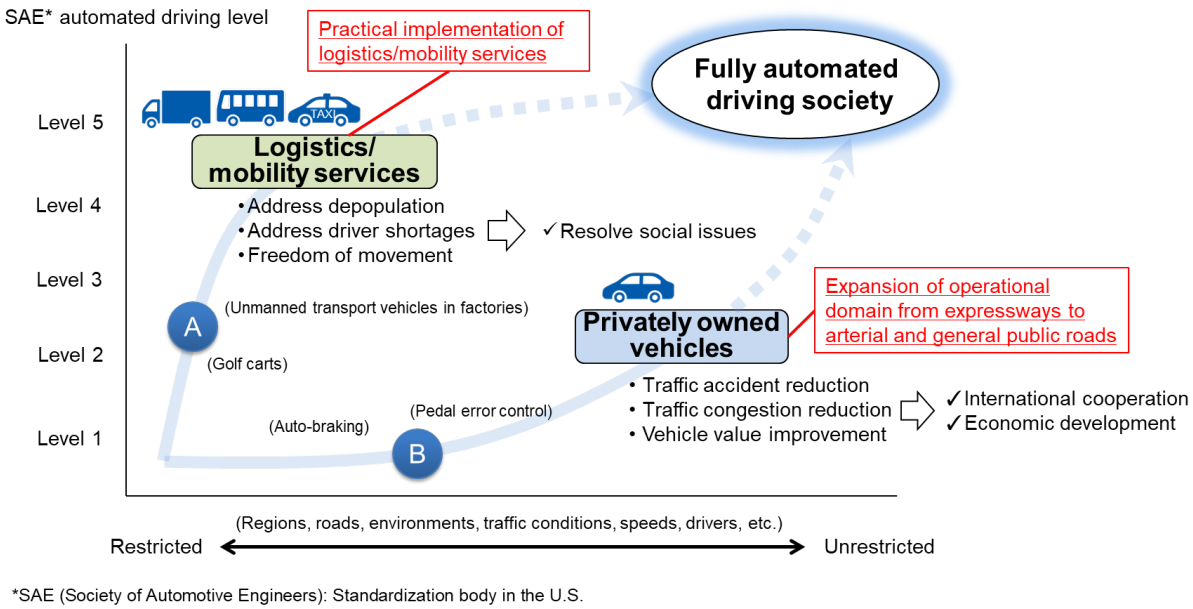


Fig. 1-1 Overall initiative of automated driving

(b) Achieving Society 5.0

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 environmental 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 environmental 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 3D 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 linkage, etc. will be built through FOT projects in cooperation with other fields that use geographical data.

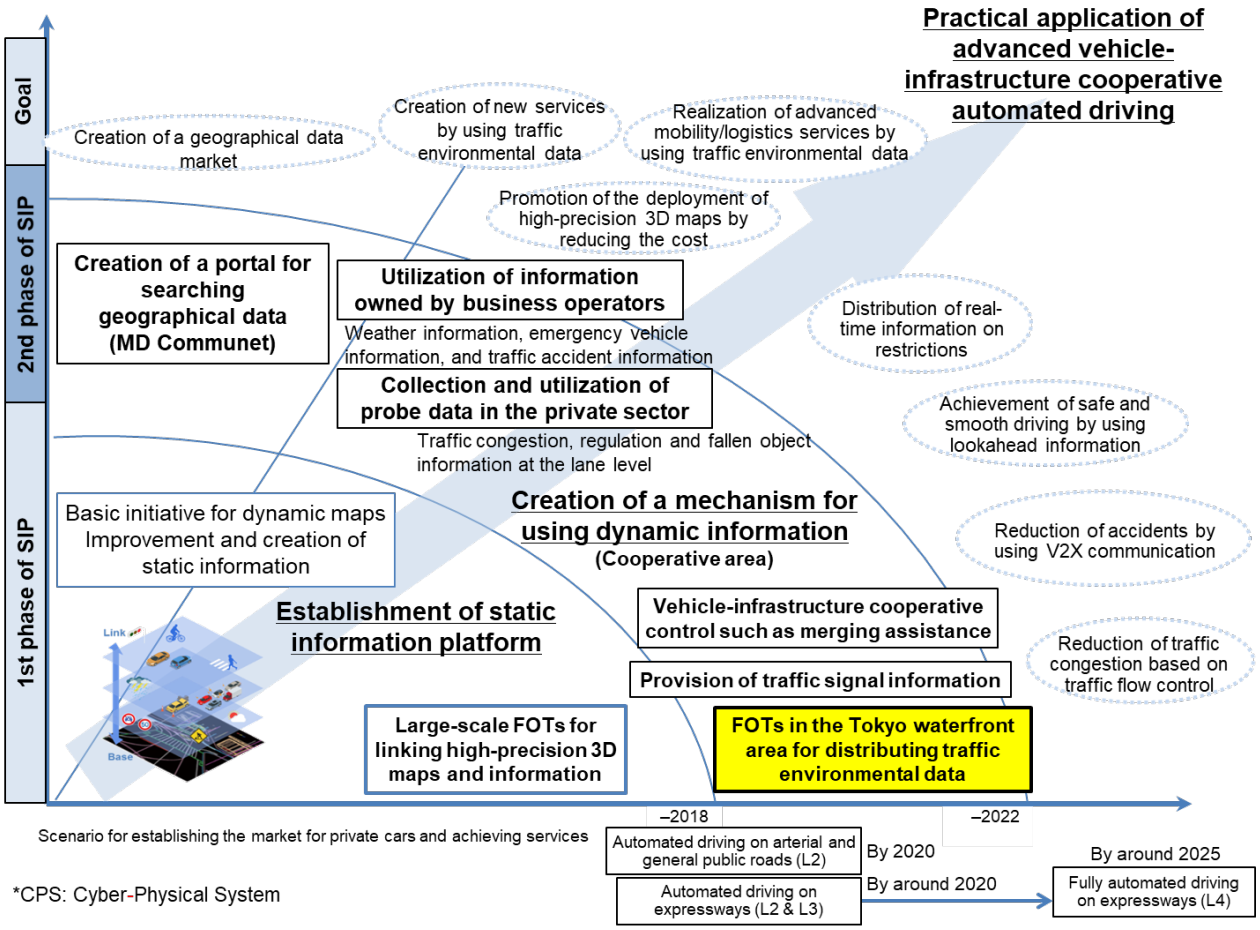


Fig. 1-2 Roadmap to create a framework related to the use of the traffic environmental data

(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 dispel overconfidence in and distrust of automated driving and promote correct understanding of automated driving.

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 CO_2 reduction effects will be established.
3) Information will be disseminated to citizens, etc. to promote understanding.

(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 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 improve 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 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 the 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. In the second phase of SIP-adus, 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.

Cooperation between Japan and Germany and between Japan and the EU will be strengthened, and support will be offered to joint research on automated driving with universities and research institutes in Japan and research institutes in Germany and the EU. 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 three 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, cooperative efforts have been made to create a roadmap toward improving the FOT environments and formulate and implement a plan for FOTs by seizing the opportunity of the Olympic and Paralympic Games Tokyo 2020. Cooperation mainly between the national

government, the Tokyo Metropolitan Government, and the private sector will continue to be strengthened. 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 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. 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 assurance and demonstrations, which will become particularly important in the future, and research on the use of public-private road traffic data including private probe vehicle data. Based on the results of the four-year R&D in the second phase of SIP-adus, the budget will be allocated primarily to research by which practical application (including commercialization and standardization) will be accelerated. Efforts will be made to maximize the outputs by enhancing coordination between research projects. These results will be reflected in the FOTs in the 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 environmental data framework and distribution of data
ii) Creation of a safety assurance environment in cyberspace
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, the number of people who understand the importance of the project and cooperate will be increased by actively disseminating the results of SIP-adus and promoting international cooperation activities. With the end of SIP-adus in mind, activities to promote sustainable R&D, international cooperation, and public acceptance will be facilitated through industry-academia-government collaboration.

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 the 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 have been conducted in the Tokyo Waterfront City area, Haneda Airport area, and the Metropolitan Expressway that connects Haneda Airport and the 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, academia, and government, including domestic and foreign automobile manufacturers, auto parts manufacturers, and research institutions, to validate platform technologies, etc. to practically apply automated driving and conduct studies toward standardization. FOTs in the Tokyo waterfront area will be continued to conduct additional FOTs, which aim to improve the accuracy of traffic congestion information at the lane level, and promote R&D to accelerate social implementation.

1. Implementation of FOTs in the Tokyo waterfront area

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

   [Participating bodies] Mitsubishi Electric Corporation, AISAN TECHNOLOGY CO., LTD., Nippon Koei Co., Ltd.

   [Activities]

   - In FY2021, efforts were made to build a mechanism to use new traffic environmental data through wide-area public network communication (V2N) in order to harness information from a wider area and information owned by other organizations in addition to providing traffic signal information of ITS Roadside Units using ITS wireless communication (V2I: Vehicle to Infrastructure), and FOTs were conducted in the actual traffic environment in the Tokyo waterfront area. Specifically, traffic signal schedule information; traffic congestion information at the lane level based on probe information in the private sector; precipitation information, and emergency vehicle position information were added as new traffic environmental data. FOTs were conducted toward practical application of smooth and advanced automated driving in more diverse use cases. In FY2022, V2I-based traffic signal information and V2N-based traffic signal schedule information and precipitation information will be provided on an ongoing basis. In line with the test ride events in autumn, data collection by FOT participants will be supported through provision of more accurate traffic congestion information at the lane level and implementation of driving FOTs using simulated emergency vehicles.

[Objectives for FY2022]

- Improvement in accuracy of traffic congestion information at the lane level will be validated compared to FOTs in FY2021.
- Based on the results of the FOTs up to FY2021, effectiveness and issues related to distribution of traffic environmental data will be compiled, and proposals will be made toward practical application.

[Final goals] (by the end of FY2022)

- The activities and results in the second phase of SIP-adus spanning five years will be summarized and compiled as a report, etc. so that the results of the FOTs in the Tokyo waterfront area, including the possible standardization specifications, will be effectively used after the completion of the second phase of SIP-adus. Efforts will be made to disseminate information. Even after the completion of the second phase of SIP-adus, the possibility of creating a legacy will be studied so that the Tokyo waterfront area district 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, and 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, FOTs 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 acceptance 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

   [Persons responsible for R&D] Yoshiyuki Kato (Highway Industry Development Organization)

   [Participating bodies] Highway Industry Development Organization, PACIFIC CONSULTANTS CO., LTD., Oriental Consultants Co., LTD., Nippon Koei Co., Ltd., FUKKEN CO., LTD.

   [Activities]

   - Automated driving services will remain in operation at Michi-no-Eki “Kamikoani” (Akita Prefecture), Michi-no-Eki “Okueigenji Keiryu no Sato” (Shiga Prefecture), Michi-no-Eki “Akagikogen” (Shimane Prefecture), and “Yamakawa Branch of Miyama City Hall” (Fukuoka Prefecture), where social implementation is already under way.
   - Efforts will be made to achieve “multitasking” of services by combining automated driving services with local tourism, logistics, welfare, commuting to school, etc. with the aim of realizing a sustainable business. Promotional activities, including exhibiting automated vehicles at local events, as well as efforts in cooperation with local educational institutions and public relations activities through webpages and social networking services (SNS), will be actively promoted.
   - To improve automated driving services, efforts will be made mainly to modify operation management systems, which reflect local needs, and offer packaged systems, investigate the deterioration of embedded electromagnetic induction lines over the long term, create manuals

on installing electromagnetic induction lines and magnetic markers, etc., modify vehicles which use magnetic markers, and validate maintenance technologies.

[Objectives for FY2022]

- Knowledge about public transport services will be gathered by continuing the operation of automated driving services in the social implementation area. Improvement in business profitability and local acceptance will be validated through the combination of multifaceted services, operational improvement, and public relations activities.
- "Jidosapo," an information desk to respond to inquiries from local governments and private business operators that aim to introduce automated driving services, will be upgraded. The introduction manual for social implementation, which compiles know-how on the operation and information about maintenance of vehicles and infrastructure, etc., will be updated.

[Final goals] (by the end of FY2022)

- A business model that is sustainable, horizontally deployable, and easy to maintain will be proposed to resolve local social issues so that local governments, etc. can take the initiative after the end of the second phase of SIP-adus.
- Of the knowledge and know-how, etc. derived from this measure, the applicable part will be used in the "Project on Research, Development, Demonstration and Deployment (RDD&D) of Automated Driving toward the Level 4 and its Enhanced Mobility Services" (RoAD to the L4) launched by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism in 2021.

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

(1) Technologies for using the traffic environmental 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 environmental 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. A study will be conducted to distribute the traffic environmental data on an ongoing basis and build a structure after the end of SIP-adus.

1. R&D toward social implementation of providing traffic signal information by using the cloud, etc.

   [Persons responsible for R&D] Shunichi Kawabe (UTMS Society of Japan)

   [Participating bodies] UTMS Society of Japan, OMRON Social Solutions Co. Ltd., Panasonic Connect Co., Ltd., Nippon Signal Co., Ltd.

   [Activities]

   - The prefectural police system will be built to collect prefectural traffic signal information in certain prefectures. 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) will be built. An environment required to validate both systems will be built to connect these systems and conduct validation.

   [Objectives for FY2022]

   - The prefectural police system and the system to gather all the traffic signal information at the National Police Agency will be built and validated. Draft standard specifications for both systems will be formulated.

2. 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]

   - In FY2021, a system for providing traffic congestion information at the lane level using probe information in the private sector and a system designed to gather all traffic signal schedule information, precipitation information, and position information of simulated emergency vehicles was built. Validation was conducted through participation in FOTs for distributing the information using the wide-area public network communication (V2N) in the Tokyo waterfront area. In

FY2022, more accurate traffic congestion information at the lane level will be provided by modifying the information generation logic in line with the test ride events in autumn. Demonstrations will be supported at the test ride events.

- An investigation of the current status of the probe vehicle data will be conducted through a study meeting involving public and private stakeholders toward creating a mechanism to provide traffic congestion information at the lane level using the probe vehicle data that contribute to automated driving and safe driver assistance. A study will be conducted toward social implementation.
- A study will be conducted on technologies to collect and generate information that affects driving of automated vehicles and that can also be used for road maintenance based on the probe vehicle data (e.g., wipers and tire sensors), including information related to bad weather and road surface condition, and to provide such information to the road administrator and automated vehicles.

[Objectives for FY2022]

- Traffic congestion information at the lane level will be distributed in cooperation with FOTs in the Tokyo waterfront area to contribute to data collection and analysis by participants of the follow-up FOTs in the Tokyo waterfront area in FY2022.
- Improvement in the accuracy of traffic congestion information at the lane level will be validated compared to FOTs in FY2021.
- The results of FOTs will be demonstrated at test ride events in autumn of FOTs in the Tokyo waterfront area to showcase the effectiveness.
- Regarding the mechanism to generate and provide traffic congestion information 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 FY2021.
- Probe information and technologies available for road maintenance will be compiled, and the possibility of using such information for automated driving and road management will be studied. Then, probe information will be collected from data providers in the private sector to compare with validation data and conduct an assessment and to validate and assess the use of such information for road maintenance.

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

[Persons responsible for R&D] Shigeyuki Eda (Japan Road Traffic Information Center)

[Participating bodies] Japan Road Traffic Information Center, TOSCO CORPORATION, Dawn Corp.

[Activities]

・ A prototype system (check system) that supports the enhanced version of the standard format of traffic regulation information will be built by using the app developed in FY2021 to collect road sign and marking information, and by using technologies to check the traffic regulation information and road sign/marking information. FOTs will be conducted to improve the checking accuracy and validate the effectiveness.

[Objectives for FY2022]

・ A prototype system which supports the enhanced version of the standard format and is capable of checking the collected road sign/marking information against the traffic regulation information will be built and FOTs will be conducted to establish technologies required to improve the data accuracy of the traffic regulation information and attain uniform accuracy across Japan.

・ A requirements document (draft) reflecting the results of the FOTs will be created for the National Police Agency's system and the prefectural police system.

4. 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]

・ The traffic environment in the urban areas of Odaiba will be reproduced in a virtual environment by using a simulation environment, etc. developed in the "Development of techniques to establish an automated driving evaluation environment in cyberspace" (DIVP® project), a different project in the second phase of SIP-adus, and the "R&D project to create a safety assurance platform for an automated driving system" known as the SAKURA Project (Safety Assurance KUdos for Reliable Automated vehicles, hereinafter referred to as "SAKURA"), which is implemented by the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism based on the traffic environmental data (mobility history of driving vehicles and pedestrians, etc.) obtained in the FOTs in the Tokyo waterfront area. The following items will be implemented in the reproduced complicated traffic environment in urban areas where many traffic participants are present to compare the recognition results in a virtual environment with those in the actual environment and conduct an assessment. An environment which causes sensor malfunction (e.g., backlighting), which is difficult to assess in the actual environment, will be reproduced in a virtual environment to conduct an assessment.

[Objectives for FY2022]

・ Regarding the details of R&D conducted by FY2021 (i.e., a) development of traffic signal recognition technology and study on conditions under which recognition is difficult, b) development of AI technology required to detect distant objects, c) development of highly accurate ego vehicle positioning technology (to be discussed as "R&D on location-based services using the Quasi-Zenith Satellite System (Michibiki)" below), d) validation of simulators

and scenarios in cooperation with SAKURA-DIVP®, e) study on problems while driving of automated driving vehicles, and f) FOTs), issues will be compiled, improvements and modifications will be made, and technological requirements and deployment requirements, etc. for the infrastructure that provides various types of traffic environmental data will be proposed.

- Important scientific data (among the data acquired from the driving FOTs) will be offered to external entities only for scientific and research purposes.

5. 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 FY2022]
   - A model will be established through simulations for errors of the inertial navigation system (INS). Continuing from FY2021, the effectiveness of simulation-based position accuracy estimation technology will be assessed, and the technology will be upgraded.

6. Development and analysis of a simulation environment for validating the merging lane assistance (targeting the gap on the main lane) system
   [Persons responsible for R&D] Yusuke Udagawa (KOZO KEIKAKU ENGINEERING Inc.)
   [Participating bodies] KOZO KEIKAKU ENGINEERING Inc.
   [Activities]
   - The feasibility and requirements of a system to support automated vehicles and drivers to achieve smooth speed adjustment and merging on the merging lane of an expressway, etc. through communication-based provision of information from the roadside infrastructure to vehicles will be derived by building a simulation environment.

   [Objectives for FY2022]
   - Analysis will be conducted based on various conditions and parameters in addition to the results of the basic validation in FY2021. The effectiveness of a merging lane assistance system, which provides information to automated vehicles on the merging lane and gives merging lane assistance instructions to automated vehicles on the main lane, will be validated.

   [Final goals] (by the end of FY2022)
   - A study will be conducted to build environments and organizational structures that are required to distribute traffic environmental data at the lane level by using the traffic signal information

and probe vehicle data, etc. (in accordance with the standard specifications based on the validation through FOTs).

(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 automated vehicle safety under specific driving environment conditions. To increase the efficiency of safety assurance 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 assurance environment will be built in cyberspace. The developed tools, interface, etc. for the safety assurance environment will be standardized among automobile manufacturers, suppliers, etc. to raise the overall level in the 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 cyberspace

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

   [Participating bodies] Kanagawa Institute of Technology, Mitsubishi Precision Co., Ltd., SOKEN, INC., BIPROGY Inc. (former Nihon Unisys, Ltd.)

   [Activities]

   - In FY2021, to conduct safety assurance with high reproducibility under various road traffic environments, a simulation model which could be substituted with the experiment evaluation in the real environment and which was highly consistent with actual phenomena was developed. Based on this model, the Driving Intelligence Validation Platform (hereinafter referred to as “DIVP®”), a safety assurance environment in cyberspace, was created. Conformity with the real environment was validated, and connectivity, etc. was confirmed in FOTs in the Tokyo waterfront area and monitoring evaluation by automobile manufacturers and sensor manufacturers to achieve social implementation through commercialization. In FY2022, measures that were implemented in FY2021 will be further promoted, and commercialization will be promoted toward social implementation.
   - Following FY2021, coordination will be promoted with the SAKURA project, a safety assurance 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 establish the automated driving (AD) safety assurance process and achieve international standardization as a national project, cooperation with the Association for Standardization of Automation and Measuring Systems (ASAM), a standardization organization, and the VIrtual Validation methodology for Intelligent Driving systems (VIVID), a joint project between Japan

and Germany, will be strengthened.

- In the FOTs in the Tokyo waterfront area, a simulation experience in cyberspace (Step 1) was offered to many applicants in various scenarios in FY2021. In FY2022, a practical version to support respective assessments (Step 2) will continue to be implemented in line with social implementation, which started in January 2022.
- The past issues will be compiled from the viewpoint of scenarios, simulation environments, validation of consistency, etc. toward the AD safety assurance, and efforts will be made to resolve these issues.

[Objectives for FY2022]

- The structure to promote the work related to LiDAR will be reorganized. Efforts will continue to be made to support the user system, including the NCAP assessment related to LiDAR and Step 2 of FOTs in the Tokyo waterfront area.
- Connectivity with general scenarios (e.g., geometry, traffic flow) will be strengthened. The capability to assess connectivity with functional simulators, such as SimuLink, and validate reproducibility and synchronization performance will be strengthened. The development of a platform that enables multi-condition and fast assessments using cloud resources will be promoted.
- The DIVP® Consortium will launch a business entity (a new company) for commercialization and start offering DIVP® products and services as a comprehensive provider. A platform for validating AD safety assurance will be built through activities by the business entity and the DIVP® Consortium with the aim of creating a model of co-existence and co-prosperity on an equal footing. The business entity will serve as the hub for building a collaborative and cooperative structure with relevant companies and establish *de facto* standards through actual business. To upgrade resources, the DIVP® Consortium will upgrade its assets, endeavor to enhance the attractiveness of the DIVP® platform, and promote cooperative activities with organizations in and outside Japan and international standardization in the safety argumentation area.
- A structure to integrate the activities of ASAM (Association for standardization of Automation and Measuring Systems) and VIVID (promoted through cooperation between Japan and Germany) will be built, with the DIVP® Consortium serving as the liaison, to promote international standardization in cooperation with the Japan Automobile Manufacturers Association, Inc. (JAMA) and SAKURA project, which are members of the Safety Assurance joint meeting.
- Regarding FOTs in the Tokyo waterfront area, a simulation experience was offered on the portal site to enable participants to experience various scenarios in cyberspace in FY2021. Many participants experienced the scenarios, contributing to raising the profile of DIVP® (Step 1). In FY2022, specific efforts will be made toward social implementation with pilot users by reflecting the results of the questionnaire survey in Step 1 (Step 2).

- In the FOTs in the Tokyo waterfront area, efforts will be made to evaluate and improve recognition technology by repeating the feedback loop from evaluation in a virtual environment and testing in the actual environment in cooperation with the Automated Driving system Under Real city environment Based on Academic researcher's Neutral knowledge (AD-URBAN) project as part of "R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4)," which is being promoted by Kanazawa University, Chubu University, and Meijo University.
- To resolve issues in AD safety assurance, efforts will be made to cope with scenario definition, including "coordinate system from the viewpoint of sensors," and simulation output. A more efficient and applicable simulation environment will be built, and the development will be promoted to expand the value proposition in AD safety assurance.

[Final goals] (by the end of FY2022)

- The data platform of the safety assurance environment will be built in cyberspace and commercialized so that it can be developed and operated on an ongoing basis even after the end of SIP-adus. 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]

   - In FY2021, surveys on the IDS were conducted by taking into account the fact that the IDS is effective against new cyberattacks targeting connected cars; the performance of the IDS was evaluated by using testbeds, and IDS evaluation techniques were established and guidelines were formulated. The transfer of these guidelines to the industry organization (JASPAR*) will be completed in May 2022 (issue a).

     *JASPAR: Japan Automotive Software Platform and Architecture
   - 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. In conducting surveys, a playground (Capture The Flag (CTF) competition) will be held to collect threat intelligence more broadly and efficiently. Honeypots using actual products will also be placed in different countries and regions to conduct observation experiments of threat intelligence (issue b).
   - In issue b, software, servers, etc. for searching and sharing threat intelligence will be built. A Proof of Concept (PoC) will be implemented so that accumulated intelligence can be used smoothly and efficiently.

   [Objectives for FY2022]

   - The transfer of the IDS evaluation guidelines to the industry organization (JASPAR) (issue a) will be completed, and the establishment of industry-wide guidelines will be promoted.
   - In issue b, the performance targets of the overall threat intelligence sharing system will be studied, and the basic specifications of the overall system will be created to promote transfer to the industry organization (J-Auto-ISAC**).

     **J-Auto-ISAC: Japan Automotive ISAC

   [Final goals] (by the end of FY2022)

   - The results and knowledge acquired through the research will be deployed and used in the

design process in the auto industry to contribute to realizing cyber-safe automated driving.

(4) Creation of an architecture for geographical data for automated driving

[Overview]

An architecture for automated driving will be built for geographical data through the public-private cooperation structure while referring to the Society 5.0 reference architecture. Based on the architecture, the traffic environmental data will be mutually linked to build a mechanism for multi-purpose use and accelerate social implementation 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)

   [Participating bodies] NTT DATA Corporation

   [Activities]

   - In FY2021, a portal site (MD communet®) was launched to facilitate matching between owners and users of information so that various entities can use traffic environmental data for different services. In FY2022, the user-friendliness of MD communet® will be improved, content will be upgraded, and its profile will be raised.
   - Efforts will be made to build an environment for creating public-private cooperation projects using MD communet®, disseminating information about the attractive features of mobility data, and offering technological support to create new services using the provided data.
   - The second KYOTO Raku Mobi Contest will be planned and held to create projects using mobility data and raise public awareness.

   [Objectives for FY2022]

   - The user interface and user experience of MD communet® will be improved by reflecting the opinions of actual users to make MD communet® a more user-friendly and easy-to-understand portal site.
   - The profile of MD communet® will be raised through search engine optimization (SEO) and MD communet® branding activities.
   - An environment for technological support, etc. will be built to upgrade data registered in MD communet® through cooperation with logistics FOT projects and public-private cooperation in local governments, etc., create and launch new projects, and conduct social implementation.
   - Specific social implementation projects will be created by holding the KYOTO Raku Mobi Contest so that the general public can feel that the use of mobility data and realization of Society 5.0 is close at hand.

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] Hiroaki Oshima (NX Logistics Research Institute and Consulting, Inc.)

[Participating bodies] NX Logistics Research Institute and Consulting, Inc. (former Nittsu Research Institute and Consulting, Inc.)

[Activities]

- Participants will be selected and FOTs will be conducted on such subjects as reduction in the waiting time for loading and unloading in the transport work by using the vehicle and probe information, etc., reduction in the working hours, etc. by checking the daily inspection items based on the vehicle and probe information, etc., and improvement in control, including the operation schedule through real-time monitoring of the load weight and tire information so that opinions from the entire logistics industry can be compiled.
- An architecture for data linkage/use in the future, including an increase in the efficiency of logistics using data obtained from trucks (OEM), will be compiled. Coordination with measures for the “surveys and research on design and creation of an architecture for automated driving and driver assistance” stated above will be ensured.
- Regarding data in the cooperative area in terms of vehicle information (e.g., probes), proposals will be made to standardize the data format, etc.
- Issues will be compiled to promote the use of probe data, etc. in anticipation of the practical application of automated driving in logistics in the future, and consultations will be held with relevant bodies to promote implementation.

[Objectives for FY2022]

- 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.
- Information (a data catalog) will be provided to MD communet® in coordination with measures for the “surveys and research on design and creation of an architecture for automated driving and driver assistance.”
- Issues will be identified and compiled, focusing mainly on information technology, data linkage and the legal system, toward implementation in the future. The overall framework of the countermeasure policy will be studied, and relevant bodies will be invited to participate in consultations based on the policy.

[Final goals] (by the end of FY2022)

- Efforts will be made to improve the user-friendliness of the portal site for multi-purpose deployment of geographical data (e.g., traffic environmental data for automated driving) (MD communet®), upgrade the services and content, raise awareness, create projects, and strengthen the support structure in order to solidify the social implementation platform.
- 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 platform technologies required for automated driving, including V2X* communication technologies required to achieve advanced automated driving.

*V2X: vehicle to everything. A generic term for communication modes between vehicles and various things, such as between vehicles (vehicle-to-vehicle (V2V) communication) and between vehicles and networks (V2N).

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.

   [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 FY2022]

   - Automated vehicles that offer mobility and logistics services in low-speed driving with external HMI, etc. implemented will be operated in FOTs at Michi-no-Eki and other locations based on the study results derived from on-site observation in automated driving FOTs and experiments, etc. in cyberspace and test courses from FY2019. Design elements for communication and possible design factors related to specifications of external HMI, etc. will be validated through observation of scenes of communication between automated vehicles and other traffic

participants. Guidance, knowledge that should be acquired by other traffic participants, possible education factors, etc. will be proposed.

- Regarding the quantitative assessment of the driver's state in automated driving which requires driving monitoring, an experimental study will be conducted on a driving monitoring state estimation technique by expanding the readiness estimation method.
- From FY2020, hypotheses for techniques to disseminate knowledge to individuals who purchased certain new models or systems were formulated to enable safe use of such systems, and the effectiveness was validated. Validation will continue to be conducted in FY2022. Efforts to improve the operation of safe driving education and develop guidelines for the instruction method, which started in FY2021, will be continued.

[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 the communication protocol for the 5.9 GHz band V2X system

[Persons responsible for R&D] Norimoto Misawa (Oki Electric Industry Co., Ltd.), Satoshi Kimura (NEC Corporation)

[Participating bodies] Oki Electric Industry Co., Ltd., NEC Corporation

[Activities]

- To achieve automated driving, it is essential to monitor the peripheral environment which automated sensors cannot recognize, such as mediation between vehicles at branching and merging points. Regarding the V2X system that achieves this, there is an international trend to use radio waves of the 5.9 GHz band, which is becoming the mainstream. In Japan, no communication protocol, etc. required for the development of devices has been established. This measure aims to draft specifications for wireless devices, including the communication protocol required for the introduction of the 5.9 GHz band V2X system, in order to resolve issues related to the introduction and accelerate the study.

[Objectives for FY2022]

・ Based on “SIP Use Cases for Cooperative Driving Automation” and communication requirements, the influence on representative use cases when the V2X system is introduced to the 5.9 GHz band will be estimated, and a technological study will be conducted based on simulation, etc. with the scope of the influence taken into account. Specifications for wireless devices, including the communication protocol required to develop and manufacture wireless devices that enable smooth linkage with the existing 700 MHz Intelligent Transport Systems and achieve sufficient expandability to use data in the future, will be drafted.

[Final goals] (by the end of FY2022)

・ To resolve issues related to the introduction of the V2X system using radio waves of the 5.9 GHz band and accelerate the study toward realization of vehicle-infrastructure cooperative driving automation, specifications of wireless devices, including the communication protocol required for introduction, will be drafted.

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. will be studied, and an information dissemination strategy in which the means of communication differs depending on the target audience 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. With the end of SIP-adus in mind, events will be planned to showcase the results, such as a final results presentation meeting.

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

[Persons responsible for R&D]

[Formulation of strategy] Tadashi Hirota (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 about automated driving. 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 FY2022]

- 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 FY2022 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.
- The possibility of organizing events for the general public will be studied in cooperation with automobile manufacturers, relevant organizations, etc. Top priority will be placed on encouraging participation by the general public and media targeted at them to foster public acceptance.
- In the final fiscal year of the second phase of SIP-adus, a final results presentation meeting will be planned to wrap up the second phase of SIP-adus, and the possibility of publishing a book that compiles the activities will be studied.

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

[Persons responsible for R&D] Tasuku Hirota (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. 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.

- A final results report meeting will be held to showcase a summary of the R&D results in the second phase of SIP-adus to the media and the general public. A book that compiles the activities of the second phase of SIP-adus, including articles featuring interviews with individuals who contributed to the second phase of SIP-adus, will be published.

[Objectives for FY2022]

- Correct understanding of automated driving will be promoted by using the web, social networking services (SNS), etc.
- 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.
- 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.”
- Public relations activities for other measures in the second phase of SIP-adus will be supported to help the target audience correctly understand the results of these measures.

[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 after the end of SIP-adus (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, reduction in CO_2 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] Yu Hasegawa (The University of Tokyo)

   [Participating bodies] The University of Tokyo, Doshisha University

   [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 deployment 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 CO_2 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.
   - A Mobility Business Innovation Contest (M-BIC) will be planned and held for university students, etc.

   [Objectives for FY2022]

   - 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 deployment rate in response to measures to promote deployment of scenarios will be estimated. Based on the deployment rate, the number of traffic accidents, traffic congestion, and CO_2 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.
- Contributions will be made to motivate Generation Z, who will play a leading role in mobility, and an M-BIC will be planned and managed so that it will be held continuously even after the end of the second phase of SIP-adus.

[Final goals] (by the end of FY2022)

- An action plan based on the quantitative impact assessment (e.g., reduction in traffic accidents, influence on traffic congestion, reduction in CO_2 emissions) will be proposed to Public-Private ITS Initiative/Roadmaps, etc.

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 result 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 environmental 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 the 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 FY2022]

- Based on a review of SIP-adus Workshop 2020 and 2021, which was held despite the impact of the Covid-19 pandemic, SIP-adus Workshop 2022 will be planned and held on site in principle, 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.
- At the SIP-adus Workshop, results in Japan will be disseminated globally, and international cooperation (e.g., standardization activities, joint research) will be further enhanced. A network of experts will be built to foster young experts who will be the future leaders. This fiscal year marks the final workshop of the second phase of SIP-adus. Thus, the workshop will be used as an opportunity to build relationships for the future and disseminate the results.

(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 FY2022]

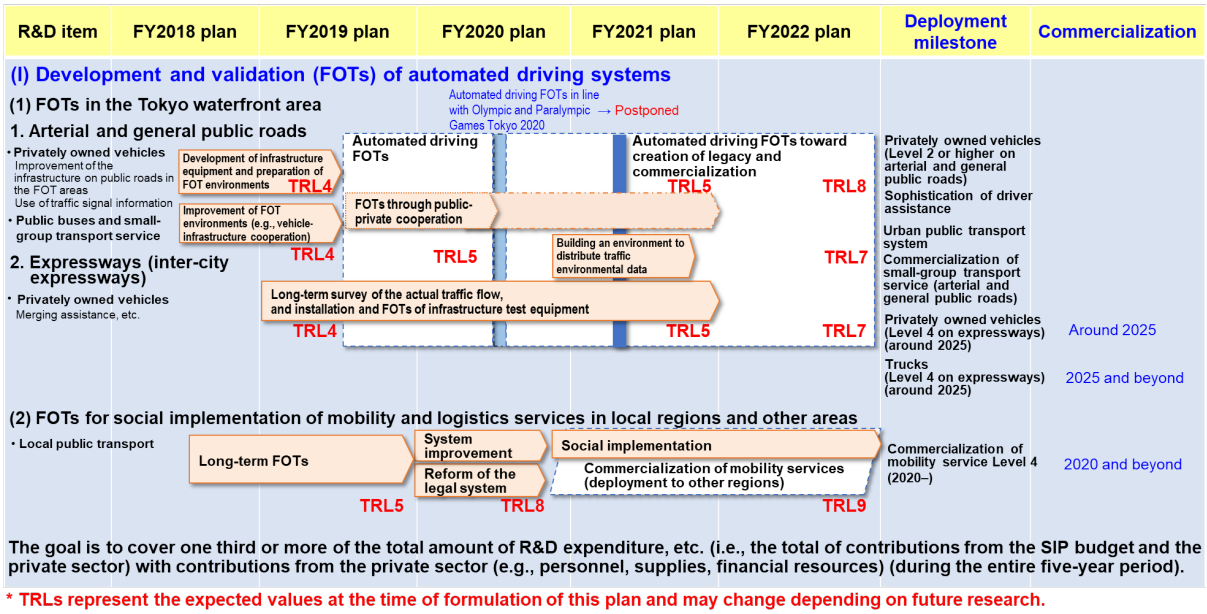
- Research themes that may lead to sustainable international cooperation will be proposed toward FY2022 and beyond through the Alliance for Promoting Mobility Innovation (with the Mobility Innovation Liaison Conference serving as the core organization and other research institutes involved).
- In the cooperation between Japan and Germany, implementation of joint R&D on human factors, socioeconomic impact assessment, safety assurance, 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.
- 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.
- A sustainable organization for industry-academia-government collaboration in FY2022 and beyond will be established.

[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 (the Alliance for Promoting Mobility Innovation).
- Regarding international standardization, 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.



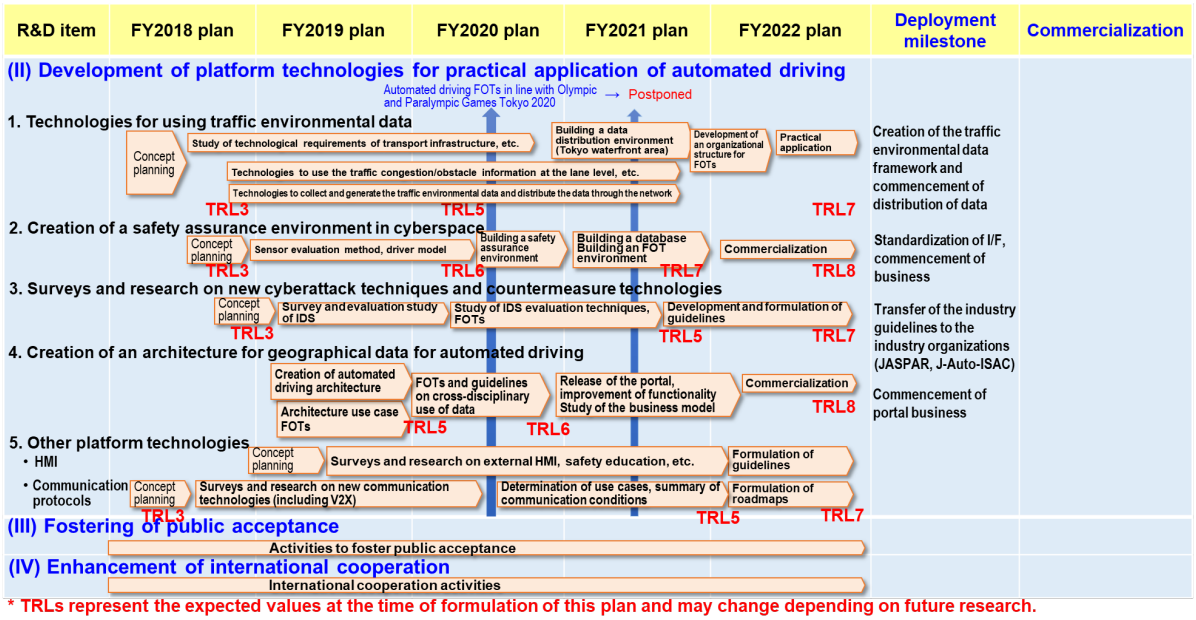


Fig. 2-1 R&D Roadmap

Definition of TRLs in the second phase of SIP-adus

TRL: Technology Readiness Level

	TRL	Definition
Basic research	1	Discovery of basic scientific principles or phenomena
	2	Formularization of the principles or phenomena; applied research
Practical research and development	3	Confirmation of the technology concept
	4	Testing in the laboratory
	5	Testing in the expected usage environment
Verification	6	Verification/demonstration (on the system level)
	7	Top user test (on the system level)
Commercialization	8	Pilot run
	9	Mass production

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 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 the Tokyo Waterfront Area continues its activities to formulate a plan for FOTs in the Tokyo waterfront area. TF on Transport Information Infrastructure has been established under the System Implementation WG to study the use, etc. of traffic environmental 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. In March 2022, the TF accomplished the expected objective and ended its activities.

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 the Tokyo waterfront area, local regions, and other areas with the development of platform technologies. Regarding creation of the traffic environmental 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 cyberspace, a commercialization study WG will be established by social implementation bodies while ensuring coordination with the SAKURA project, which is a safety assurance initiative promoted by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), 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 environmental 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 METI and MLIT while enhancing cooperation between regions that conduct FOTs by using a common operation management system, etc.

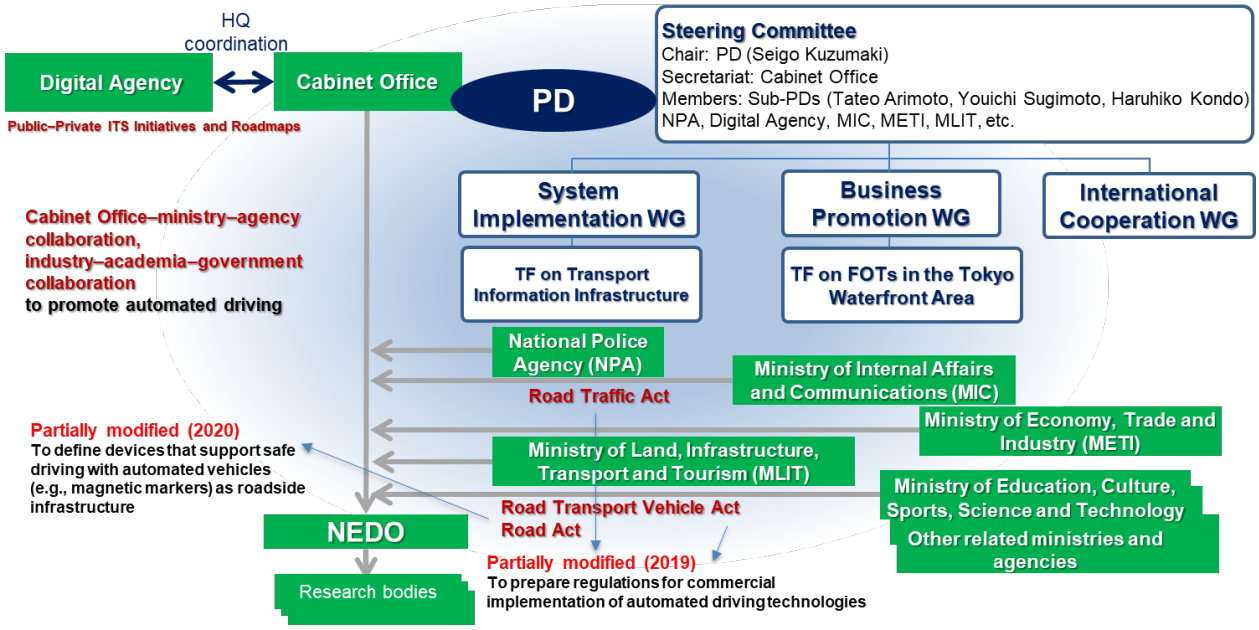


Fig. 3-1 Organizational structure for implementation

(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 environmental data framework and distribution of data, a study meeting, etc. will be established by public and private stakeholders, including the Cabinet Office, ministries, and agencies, to demonstrate the creation and operation of a system assuming social implementation. Regarding commercialization of safety assurance technology in cyberspace, coordination will be ensured with the SAKURA project, a safety assurance initiative promoted by METI and MLIT, 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 METI and MLIT. To take advantage of the assets derived from the SIP-adus activities after the second phase of SIP-adus, cooperation will be promoted with the “Project on Research, Development, Demonstration and Deployment (RDD&D) of Automated Driving toward the Level 4 and its Enhanced Mobility Services” (RoAD to the L4) launched by METI and MLIT in FY2021 with a view to using the results.

(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 assurance, 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 four-year R&D, etc. Toward practical application, we will overcome three barriers (i.e., technology development, improvement of the legal system, and fostering of public acceptance) through industry-academia-government collaboration by conducting FOTs in the 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 cyberspace (DIVP®) and the portal of traffic environmental 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. Enhancement of cooperation with other SIP projects
Improvement of the high-precision 3D map data and road traffic 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 linkage. 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 the 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); Implementation Policy for the Cross-ministerial Strategic Innovation Promotion Program (SIP) in FY2022 (March 3, 2022, 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 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 Nitta
Leader/Director
(April 2018–
June 2019)

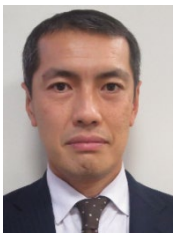
Yasuyuki Koga
Leader/Director
(April 2020–June 2021)
Leader/Counselor
(July 2019–
March 2020)
Counselor
(August 2018–
June 2019)

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

Kenji Ueki
Sub-leader
(July 2019–
June 2021)

Yoshihiro Izawa
Counselor
(April 2018–
July 2018)

Chie Fukushima
Leader/Director
(July 2021–June
2022)



Shigekazu Fukunaga
Sub-leader
(July 2021–)

Hiroaki Kimura
Leader/Director
(July 2022–)

(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–
June 2021)

Yuichi Araki
(October 2020–)

Osamu Hosaka
(April 2021–)

Kotaro Sugiyama
(April 2021–)

Raita Hiraoka
(July 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 (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.)	1,820
[II] Development of platform technologies for practical application of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	896
[III] Fostering of public acceptance of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	50
[IV] Enhancement of international cooperation (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	118
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 (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.)	1,004
[II] Development of platform technologies for practical application of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	2,007
[III] Fostering of public acceptance of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	213
[IV] Enhancement of international cooperation (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	180
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

Total in FY2022: 2,870

(Breakdown)

1. Research expenditures, etc. (including general and administrative expenses and indirect expenses)		2,870
(Breakdown for each R&D item)		
[I]	Development and validation (FOTs) of automated driving systems (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.)	300
[II]	Development of platform technologies for practical application of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	1,950
[III]	Fostering of public acceptance of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	300
[IV]	Enhancement of international cooperation (relevant ministries and agencies: NPA, MIC, METI, ML IT, etc.)	210
2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses)		110