（provisional translation）

Cross-ministerial Strategic Innovation Promotion Program (SIP)

Automated Driving for Universal Services

R&D Plan

May 14, 2020

Cabinet Office

Director General for Science, Technology and Innovation

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Overview of the R&D Plan

1. Development goals and objective

Development goals: Automated driving is expected to lead to major social changes. The Public-Private ITS Initiative/Roadmaps 2019 (released in June 2019) stated that Japan "aims to build and maintain 'a society with the world's safest and smoothest road transport' by 2030 by promoting the development and popularization of automated driving systems and the preparation of data platforms."

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

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 the Public-Private ITS Initiative/Roadmaps 2019. 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 will be achieved in operational design domains (ODDs) by 2020.
- 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 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.

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

(1) FOTs in the Tokyo waterfront area:

1. Improvement, preliminary validation, maintenance, and management of infrastructure for the FOTs
2. Improvement of ITS wireless roadside devices for providing traffic signal information for the FOTs
3. Study and evaluation of plans for the FOTs

(2) FOTs for social implementation of mobility and logistics services in local regions and other areas:

1. Improvement of environments toward practical application and national deployment of automated driving-based mobility services
2. Achievement of social implementation of unmanned automated driving services in local regions, and surveys and research on permanent implementation

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

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

(2) Technologies for using the traffic environmental data:

1. R&D on updating high-precision 3D maps based on vehicle probe data and other data
2. R&D on improving the technology to provide traffic signal information and other

technologies for achieving automated driving

3. R&D on providing traffic signal information by using the cloud, etc.
4. Surveys and research on technologies including traffic signal control using GNSS (location information), etc.
5. Surveys and research on improving the data accuracy of traffic restriction information, etc.
6. R&D on collecting, integrating, and distributing small and medium-sized area information
7. R&D on recognition technology, etc. required for automated driving technologies (Level 3 and Level 4)
8. R&D on location-based services using the Quasi-Zenith Satellite System (Michibiki)
9. Study and evaluation of technologies for generating and providing traffic environmental data at the lane level by using vehicle probe data, etc.

(3) Safety evaluation technologies:

1. Building a safety evaluation environment in cyberspace

(4) Cybersecurity:

1. Surveys and research on new cyberattack techniques and countermeasure technologies

(5) Other platform technologies:

1. Surveys and research on HMI and safety education methods in line with the sophistication of automated driving
2. Study on communication protocols for achieving Use cases of Cooperative Driving Automation

(III) Fostering of public acceptance of automated driving

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

1. Formulation of a strategy to foster public acceptance and evaluation surveys
2. Surveys to measure the effectiveness of efforts to foster public acceptance by organizing events, etc.

(2) Surveys and research to solve social issues by using automated driving technologies:

1. Research on the impact of automated driving on reduction of traffic accidents, etc.
2. Advanced driver assistance system for those who suffer from visual field loss, etc.
3. Visualization of the reduction in traffic accidents achieved by automated driving and driver assistance
4. Basic survey of automated buses that are convenient for vulnerable road users

(IV) Enhancement of international cooperation

1. International dissemination of information by organizing the SIP-adus Workshop (an international workshop) and other events

2. Promotion of joint research on automated driving with overseas research institutes

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 to formulate 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 Olympic and Paralympic Games Tokyo 2020 are one of the deployment milestones. 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. The FOTs will involve automakers, 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. Automakers, component 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.

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 security, promoting innovation, and establishing a consistent regulatory approach.

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. Many research projects on connected and automated driving are under way under Horizon 2020, an EU Research and Innovation program. Preparations have been made for Horizon Europe, a program following Horizon 2020, which is scheduled to be launched in 2021.

In Japan, the first phase of SIP Automated Driving for Universal Services (SIP-adus), which started in 2014, played a key role in promoting R&D in the cooperative areas of automated driving. In 2017, 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, 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 automated driving 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 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 February 2020, the bill to revise part of the Road Act was approved by the Cabinet to, among

other things, improve facilities that assist the operation of automated driving in the road space. Automated driving is likely to be practically applied on expressways by 2020 in line with the government strategies (the Future Investment Strategy and the Public-Private ITS Initiative/Roadmaps).

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.

Against this backdrop, the importance of developing automated driving was recognized in the second phase of SIP. At the start of this project, the theme was changed from automated driving systems to automated driving to expand systems and services). There were three main reasons. First, the second phase of SIP was not the mere continuation or extension of the first phase. Second, it was decided to use “automated driving,” which became a more commonly used term, in the Public-Private ITS Initiative/Roadmaps 2017. Third, the phase was shifting from the technology development of automated driving systems to expansion of services toward practical application of automated driving. Meanwhile, it was decided to continue to use SIP-adus (Automated Driving for Universal Services) as an abbreviation in English.

(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 technological 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, the Public-Private ITS Initiative/Roadmaps 2019 (released in June 2019) stated that Japan “aims to build and maintain ‘a society with the world’s safest and smoothest road transport’ by 2030 by promoting the development and popularization of automated driving systems and the preparation of data platforms.”

At the meeting of the Council on Investments for the Future (held in March 2018), Prime Minister Shinzo Abe stated: “By the time of the 2020 Tokyo Olympic and Paralympic Games, we will realize an automated driving society.... We will further accelerate various initiatives with the aim of facilitating

the development of diverse businesses. Such initiatives include the establishment of a zone in the Tokyo waterfront area for tests of safer automated driving technologies integrating traffic signal information."

The Integrated Innovation Strategy 2019 (released in June 2019) 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.

(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 the Public-Private ITS Initiative/Roadmaps 2019. 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 will be achieved in operational design domains (ODDs) by 2020.
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The technologies in cooperative areas that are required to achieve these goals will be established by 2023, and 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.

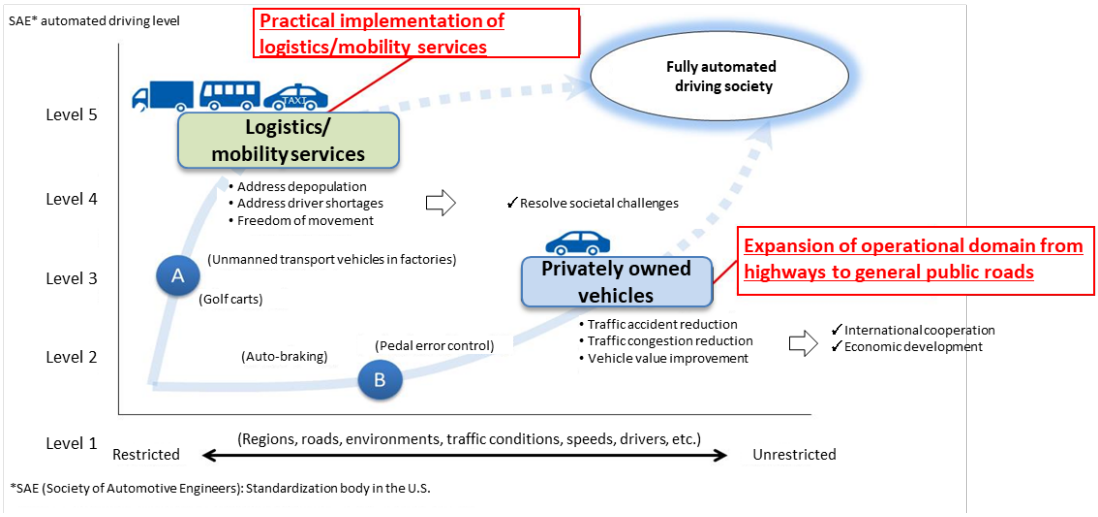


Fig. 1-1 Overall initiative of automated driving

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

(c) Social objectives

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

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

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

1) A mobility business using automated driving technologies will be launched in underpopulated areas and other areas by 2020.
2) Traffic accident fatalities will be reduced by using automated driving, and techniques to predict the CO_2 reduction effects will be established.
3) The effectiveness of driver assistance for persons with minor visual impairments, etc. using advanced driver assistance systems will be clarified, and changes in the legal system will be proposed.

(d) Industrial objectives

In addition to maintaining and enhancing the competitiveness of the auto industry through the early practical application of automated driving, efforts will be made to create new digital infrastructure

industries using the map data, geographical data, and vehicle probe data that are created for automated driving, strengthen the competitiveness of the sensor industry, and promote the development of the information security 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 information security 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 will increase, necessitating further evolution of information security and communication media. We will develop technology to continuously improve information security technologies, collect and use vehicle probe 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 vehicle probe data will commence.
4) A virtual evaluation and demonstration simulation environment will be built based on model-based design (MBD).

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

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

1) The legal system will be reformed in line with the Charter for Improvement of Legal System and Environment for Automated Driving Systems.
2) At least three proposals will be made to establish ISO standards.
3) At least five joint research projects will be conducted on automated driving with foreign research institutes.

(g) Strategy for global benchmarking

Although automated driving technologies have been evolving rapidly, it is still expected to take considerable time to achieve “Level 5” of driving automation, which enables vehicles to drive 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 infrastructure-to-vehicle (I2V) 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 (automakers, component 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 attaches more importance to practical application. Thus, top priority is placed on promoting initiatives involving business operators and local government bodies and creating opportunities for FOTs.

Specifically, with the Olympic and Paralympic Games Tokyo 2020 set as a milestone, cooperation mainly between the national government, the Tokyo Metropolitan Government, and the private sector will be strengthened, a roadmap toward improving the FOT environments will be created, and a plan for FOTs will be formulated. Regarding FOTs for ensuring mobility in underpopulated areas and other areas, and for offering mobility and logistics services, commercialization-oriented FOTs will be conducted 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 in-vehicle 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 vehicle probe data. Such information and data must be created through public-private cooperation. Toward practical application of these technologies, internationally open FOTs will be arranged in cooperation with the Tokyo Metropolitan Government by using the Olympic and Paralympic Games Tokyo 2020 as an opportunity. Regarding commercialization of mobility services in underpopulated areas and other areas, as well as commercialization of logistics services, long-term FOTs will be promoted based on a business plan involving local government bodies and business operators.

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

The first phase of SIP focused primarily on five key issues (dynamic maps, HMI, information security, pedestrian accident reduction, and next-generation transport) as cooperative areas. The second phase of SIP will promote development through industry-academia-government collaboration on the themes in the cooperative areas, focusing mainly on the development of simulation tools for safety evaluation and demonstrations, which will become particularly important in the future, and research on the use of public-private road traffic data including private vehicle probe 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.

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 will be conducted in the Tokyo Waterfront City area, Haneda Airport area, and the Metropolitan Expressway that connects Haneda Airport with Tokyo Waterfront City 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 will be improved in the actual traffic environments on public roads with the participation of automakers and other entities to expedite the validation of platform technologies, etc. to practically apply automated driving and the studies toward standardization. Events to foster public acceptance will be organized and the technologies will be publicized in line with the Olympic and Paralympic Games Tokyo 2020.

1. Improvement, preliminary validation, maintenance, and management of infrastructure for the FOTs in the Tokyo waterfront area

   [Persons responsible for R&D] Kuniaki Okajima (Mitsubishi Electric Corporation), Yoichi Omori (PACIFIC CONSULTANTS CO., LTD.)

   [Participating bodies] Mitsubishi Electric Corporation, PACIFIC CONSULTANTS CO., LTD., NIPPO CORPORATION

   [Activities]

   - The mechanism for using traffic environmental data (e.g., merging lane assistance information provided by the transport infrastructure) and the equipment required for public transport that uses automated driving technologies will be put in place. Environments required to conduct FOTs for early practical application of advanced vehicle-infrastructure cooperative automated driving will be improved in the Tokyo waterfront area. Preliminary function validation as well as maintenance and management will be conducted.

   [Objectives for FY2020]

   - On the Metropolitan Expressway that connects Haneda Airport with Tokyo Waterfront City, etc., the system for providing information about the state of operation of ETC gates installed in FY2019 and information to assist merging with the main lane to automated vehicles will be maintained and managed; data for analyzing the accuracy and effectiveness of the information provided will be collected and analyzed; and the infrastructure installation requirements, etc. will be validated.
   - In the Haneda Airport area (on arterial and general public roads), magnetic markers, temporary

bus stops, dedicated bus lanes, etc. required for the automated driving system for public transport will be improved, and the FOT environment will be maintained and managed.

2. Improvement of ITS wireless roadside devices for providing traffic signal information for the FOTs in the Tokyo waterfront area

   [Persons responsible for R&D] Katsuhiro Shikata (OMRON FIELD ENGINEERING CO., LTD.)

   [Participating bodies] OMRON FIELD ENGINEERING CO., LTD.

   [Activities]

   - The traffic signal information will be used for automated driving to conduct FOTs in the Tokyo waterfront area. An environment for safe and smooth control of automated vehicles will be improved.

   [Objectives for FY2020]

   - ITS wireless roadside devices will be installed at one location where the road will come into service in FY2020 in the Haneda Airport area.

3. Study and evaluation of plans for the 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., INCREMENT P CORPORATION, ZENRIN CO., LTD., TOYOTA MAPMASTER INCORPORATED, PASCO CORPORATION, Sumitomo Electric Industries, Ltd., Nippon Koei Co., Ltd., and PACIFIC CONSULTANTS CO., LTD.

   [Activities]

   - A driving environment will be built to achieve safer and more comfortable automated driving based on the vehicle-infrastructure cooperative automated driving technologies that use, among other things, high-precision 3D map information, traffic signal information provided by the transport infrastructure on arterial and general public roads, ETC gate operation status and information to assist merging with the main lane on expressways, and equipment required for public transport that uses automated driving technologies. FOTs will be conducted to facilitate initiatives to solve issues concerning technologies, the legal system, and public acceptance and thereby accelerate practical application and deployment.

   [Objectives for FY2020]

   - Data of FOTs on vehicle-infrastructure cooperative automated driving (using in-vehicle devices for the FOTs and high-precision 3D maps prepared in FY2019) will be collected.
   - The effectiveness of providing information from the transport infrastructure will be validated by using data collected in the FOTs. The effectiveness (advantage) of introducing transport infrastructure will be clarified. The deployment model of transport infrastructure required for automated driving, the positive and negative impacts of transport infrastructure and automated vehicles on road transport, etc. will be summarized.

- The specifications of the transport infrastructure, which is required for the vehicle-infrastructure cooperative automated driving system, will be discussed with FOT participants based on the results collected and analyzed through FOTs in order to reach a consensus.

[Final goals] (by the end of FY2022)

- Issues in practically applying the transport infrastructure required for automated driving systems in FOTs in the Tokyo waterfront area will be summarized to determine whether the transport infrastructure can be implemented on arterial and general public roads. The merging lane assistance system on the Metropolitan Expressway will be practically applied. This will lead to FOTs in local regions and other areas toward practical application of Advanced Rapid Transit (ART).

(2) FOTs for social implementation of mobility and logistics services in local regions and other areas

[Overview]

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

1. Improvement of environments toward practical application and national deployment of automated driving-based mobility services

   [Persons responsible for R&D] Seiya Hamada (Highway Industry Development Organization)

   [Participating bodies] Highway Industry Development Organization, NEW CIVIL ENGINEERING, Oriental Consultants Co., LTD., Nippon Koei Co., Ltd., FUKKEN CO., LTD.

   [Activities]

   - FOTs that directly lead to social implementation will be conducted in regions where automated driving-based mobility services can be achieved (among regions where the driving environment, etc. has been validated). Long-term FOTs will be conducted in regions where the road environment makes driving difficult for automated vehicles and where efficiency can be increased (e.g., past data can be used).
   - Data will be collected and validated for items required in the initial phase of social implementation through long-term FOTs, etc. on public roads using automated vehicles. A manual for introducing automated driving-based mobility services in local regions will be formulated (updated). Information will be provided to other regions in Japan that wish to introduce automated driving-based mobility services, and the effectiveness of providing such information will be validated.

   [Objectives for FY2020]

   - FOTs that directly lead to social implementation will be conducted at multiple locations, beginning with the full-scale introduction of automated driving services at Michi-no-Eki”Kamikoani” (Kamikoani Village, Akita Prefecture) in November 2019. In this process, issues that must be overcome will be solved (e.g., measures to secure a driving space for automated vehicles, creation of an organizational structure for autonomous operation in respective regions,

creation of a sustainable business model). Social implementation of automated driving-based mobility services will thus be achieved in local regions.

- A manual for social implementation of automated driving-based mobility services in local regions will be revised toward national deployment. Knowledge derived from past results will be provided, and ideal service models will be studied. Validation will be conducted toward national deployment of mobility services by supporting the formulation of specific plans.

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

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

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

[Objectives for FY2020]

- Measures will be studied so that automated driving services in ODDs (which are scheduled to commence across Japan by 2020) can solve social issues in respective regions and will be successful as businesses.
- When studies are launched assuming the implementation of automated driving services, targets for fostering public acceptance will be set (e.g., for dispelling concerns of regional residents who will be directly affected), and measures will be studied. Notably, these studies will take into account the fact that survey respondents felt uncomfortable with the idea that their parents or children would use automated driving services compared with the idea of using such services themselves.
- Mechanisms, etc. will be studied regarding regional arrangements to ensure safety when automated driving services are implemented.
- Social implementation will be achieved at certain locations across Japan.

[Final goals] (by the end of FY2022)

- Projects to implement automated driving-based mobility services will be conducted and expanded in multiple regions (at least six locations) to improve the technology level and expand the services (including expansion of ODDs) so that such services become available in respective regions across Japan.

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

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

[Overview]

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

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

[Persons responsible for R&D] Naoki Iso (NTT DATA Corporation)

[Definition of requirements for automated driving services in local regions, etc.] Kosuke Watabe (Nippon Koei Co., Ltd.)

[Participating bodies] NTT DATA Corporation

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

[Activities]

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

[Objectives for FY2020]

- To expand the data contents of the portal site created in FY2019, data in the automated driving field will be upgraded, studies will be conducted on linking the data with other fields, and an action plan will be formulated. As a specific measure to upgrade the data in other fields, mutual linkage with the Association for Promotion of Infrastructure Geospatial Information Distribution/Shared Information Platform for Disaster Management (SIP4D) will commence.
- The functionality will be improved to enhance the user friendliness and quality of the portal site.

Studies will be conducted to upgrade the functions that facilitate use of the data, and implementation will be achieved in stages.

- The possibility of establishing a promotion organization that is responsible for permanent administration of the portal site will be studied. Promotional activities will be conducted at test ride and exhibition events.
- Studies will be conducted to include new services that use geographical data in the automated driving field (e.g., upgrading cases of use in the logistics field on which FOTs were conducted in the Tokyo waterfront area in FY2019).
- An app competition to solve issues in tourism and transport will be held to create mobility and logistics services that use traffic environmental data in Kyoto, a tourism city, as FOT was started in FY2019. Issues and effectiveness of data sharing (e.g., traffic environmental data) will be validated.
- Validation will be conducted on the effectiveness of measures to add service functions (with a view to expanding social implementation) that are derived from validation in FOTs for automated driving-based mobility services (e.g., location management of vehicle positions, safety monitoring using images captured by in-vehicle and outside-vehicle cameras, reservation management, embarkation/disembarkation information management) that are applicable as common services (on which FOTs were conducted in underpopulated areas of local regions and other areas in FY2019).

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

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

   [Participating bodies] To be determined through a public call for proposals

   [Activities]

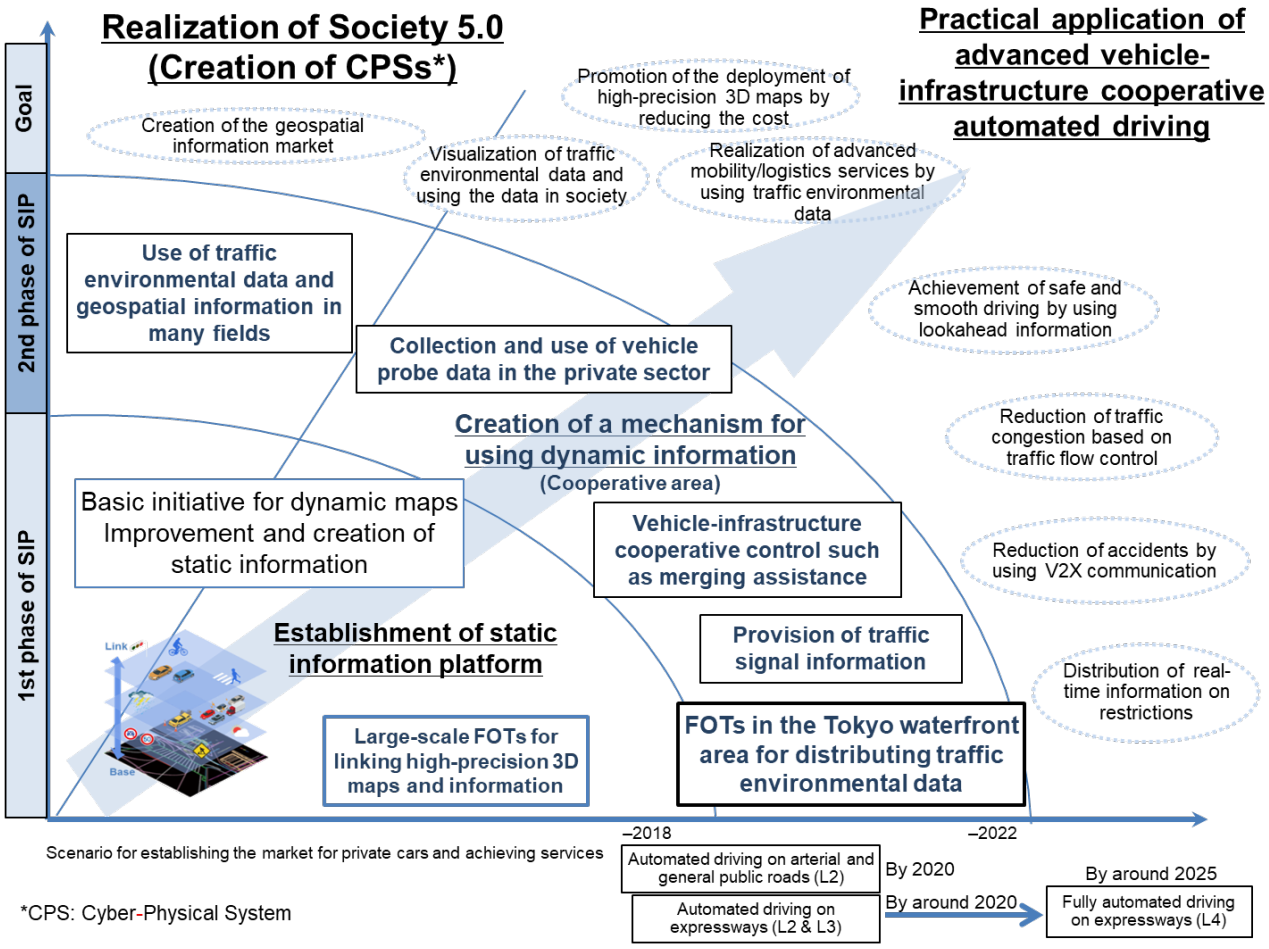
   - Having to wait at container yards, logistics centers, etc. (e.g., waiting one's turn for loading and unloading) increases the working hours of drivers. Studies on using vehicle information (e.g., probes) to solve these issues will be conducted.
   - The overall situation of logistics will be summarized, and the causes of long working hours will be surveyed and analyzed to identify the issues. FOTs that enable validation to solve issues by using the architecture-based data will be planned, conducted, and evaluated.
   - An architecture for using vehicle information (e.g., probes) and data will be built. FOTs to validate the effectiveness, etc. will be conducted.

   [Objectives for FY2020]

   - To reduce the waiting time for loading and unloading, an information architecture will be built by using vehicle information and probe data. FOTs will be conducted to validate the effectiveness.

[Final goals] (by the end of FY2022)

- The portal site service for multi-purpose deployment of geographical data (e.g., traffic environmental data for automated driving) will be launched.
- Proposals will be made for standardization of the interface (e.g., data format, protocol) to use the vehicle probe data of commercial vehicles.



(2) Technologies for using the traffic environmental data

[Overview]

In the first phase of SIP, 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, R&D is conducted on technologies to generate traffic environmental data (which changes dynamically with time and is used by linkage 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 automated driving. Surveys, research, etc. related to the R&D will also be conducted.

1. R&D on updating high-precision 3D maps based on vehicle probe data and other data

[Persons responsible for R&D] Hiromichi Amagai (Dynamic Map Platform Co., Ltd.)
[Participating bodies] Dynamic Map Platform Co., Ltd.
[Activities]

- Technologies will be developed to efficiently identify locations that require updating of maps (e.g., technology to identify road changes by using vehicle probe data, technology to link with high-precision 3D maps and identify locations to be updated) by using road change data, vehicle probe data, etc. in a coordinated manner. This will reduce both the maintenance cycle and cost of high-precision 3D maps.

[Objectives for FY2020]

- The technology to identify road changes will be achieved by using vehicle probe data, etc.
- To detect changes, the requirements for formulating the interface specifications for processing and analyzing the images and sending them to the cloud will be studied. Feature extraction will be performed using images that contain location information as the data source. Feature points required for detecting changes will be studied, and the requirements will be summarized.

2. R&D on improving the technology to provide traffic signal information and other technologies for achieving automated driving
[Persons responsible for R&D] Shunichi Kawabe (UTMS Society of Japan)
[Participating bodies] UTMS Society of Japan, Sumitomo Electric Industries, Ltd.
[Activities]

- The functional and technological requirements of ITS wireless roadside devices and traffic signal controllers, which provide traffic signal information for automated vehicles, will be clarified in order to sophisticate the technologies for providing traffic signal information by ITS wireless roadside devices that is required to control automated vehicles. Prototype devices will be fabricated and validated, and the specifications of the traffic signal information will be reviewed.

[Objectives for FY2020]

- The final specifications that reflect the testbed evaluation results, validation results, etc. using the prototype devices fabricated in FY2019 will be formulated.

3. R&D on providing traffic signal information by using the cloud, etc.
[Persons responsible for R&D] To be determined through a public call for proposals
[Participating bodies] To be determined through a public call for proposals
[Activities]

- R&D on provision of traffic signal information by using techniques other than I2V communication (e.g., ITS wireless roadside devices) was conducted in FY2019. Based on the results, it was decided to use a traffic control system, in which the traffic control center generates and distributes the traffic signal phase and timing information, as the main system. As techniques to support the traffic control system, it was decided to use a centralized system and a traffic

signal controller system (in which a traffic signal controller generates the traffic signal phase and timing information). Based on the results, the functions, technological requirements, etc. related to the method of providing the traffic signal information using the cloud, etc. will be studied, and the draft specifications for the prefectural police model system will be formulated. A system will be built to conduct field experiments, validation, etc. Draft specifications of a system to gather all the traffic signal information at the National Police Agency will be formulated.

[Objectives for FY2020]

- A prefectural police model system will be built and field validation will be conducted. The functions, technological requirements, etc. of the system to gather all the traffic signal information at the National Police Agency will be clarified in greater detail, and the specifications will be formulated.

4. Surveys and research on technologies including traffic signal control using GNSS (location information), etc.

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- Priority traffic signal control, etc. is performed through coordination between automated buses, etc. and the traffic control system by using high-precision location information (GNSS) and the mobile phone network to deploy mobility services using automated buses, etc. and reduce the required infrastructure. A model system will be built to validate the effectiveness of smoothing the traffic flow, etc. by effectively using the collected location information. The cost effectiveness of introducing the system will be clarified.

[Objectives for FY2020]

- To build a model system in FY2021, the technological requirements for traffic signal control using GNSS and the mobile phone network will be studied. The cost effectiveness will be studied, and the draft specifications of the model system will be formulated.

5. Surveys and research on improving the data accuracy of traffic regulation information, etc.

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- Surveys and research will be conducted to contribute to providing appropriate and useful traffic regulation information for automated vehicles (e.g., development of technologies to automatically collect traffic regulation information such as road signs and markings, improvement of the data accuracy of traffic regulation information). To upgrade the automated driving environment on arterial and general public roads for a centralized management system of the national traffic information, the accuracy of the registered data related to traffic regulation

information will be improved by using image recognition technology. Traffic environments will be made safer and smoother by developing technologies to easily and efficiently collect a broad range of information about traffic regulations by vehicles, etc. and make diagnoses. A technology to automatically collect traffic regulation information using in-vehicle cameras, an application for easy collection and registration of traffic regulation information, etc. will be developed. A model system will be built to validate and evaluate the effectiveness through FOTs, and to improve the system.

[Objectives for FY2020]

・ The technological requirements to automatically collect traffic regulation information from in-vehicle cameras will be studied, and the specifications of the model system will be formulated.

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

[Persons responsible for R&D] Yuji Aburakawa (NTT DOCOMO, INC.)

[Participating bodies] NTT DOCOMO, INC., Oki Electric Industry Co., Ltd., Sumitomo Electric Industries, Ltd., Panasonic Corporation

[Activities]

・ R&D will be conducted on technology to collect dynamic and static information obtained from various sources of information, integrate these sources of information to determine the real-time traffic situation, and distribute only necessary information to automated vehicles so that peripheral traffic information that cannot be recognized by in-vehicle sensors, etc. of automated driving vehicles can be monitored comprehensively. FOTs using actual equipment will be validated to standardize the interface (e.g., data format and protocol to collect, analyze, and distribute information).

[Objectives for FY2020]

・ The environment for evaluating technologies to collect, integrate, and distribute dynamic and static information will be improved based on simulation and actual equipment. The draft specifications to standardize the interface (e.g., data format, protocol) will be formulated.

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

[Persons responsible for R&D] Naoki Suganuma (Kanazawa University)

[Participating bodies] Kanazawa University, Chubu University, Meijo University

[Activities]

・ A test vehicle equipped with automated driving technologies of Level 3 and Level 4 will be developed. The technological requirements and deployment requirements of the transport infrastructure (required for automated vehicles of Level 3 and Level 4 on arterial and general public roads in urban areas) will be clarified by conducting driving FOTs on public roads (e.g., Tokyo waterfront area). The technological requirements for recognition and judgment for

automated driving systems in such transport infrastructure will be clarified.

- Opportunities will be provided to test-drive the test vehicle in the Tokyo waterfront area and other areas. Initiatives to disseminate the R&D results and foster public understanding of the current status of automated driving technologies will be made.

[Objectives for FY2020]

- Driving FOTs will be conducted in the Tokyo waterfront area by using the completed test vehicle and ITS wireless roadside devices that provide traffic signal information. The technological requirements, deployment requirements, etc. for the transport infrastructure that provides traffic signal information will be proposed based on knowledge acquired from the driving FOTs on public roads.
- The possibility of publicizing important scientific data (among the data acquired from the driving FOTs) will be studied.
- In the development of simulation tools and models in (3) 1. “Building a safety evaluation environment in cyberspace,” evaluations will be made by using the actual data acquired from the driving FOTs in this R&D item, thereby improving the accuracy of the simulation tools and models.

8. 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]

- Technologies will be developed for a position estimation system that can be applied to automated driving systems to achieve Level 3 and Level 4 driving automation in urban areas by using information from the Quasi-Zenith Satellite System (Michibiki) and integrating it with that obtained from general-purpose in-vehicle sensors.

[Objectives for FY2020]

- The position accuracy required for the automated driving systems of Level 3 and Level 4 will be defined based on knowledge acquired from the driving FOTs using a test vehicle equipped with a system for receiving the signals from the Quasi-Zenith Satellite System (Michibiki). Proposals will be made for the requirements for sensors required to achieve this objective, the installation of necessary transport infrastructure, etc.
- The possibility of publicizing important scientific data (among the data acquired from the driving FOTs) will be studied.

9. Study and evaluation of technologies for generating and providing traffic environmental data at the lane level by using vehicle probe data, etc.

[Persons responsible for R&D] Hirokazu Ichikawa (PACIFIC CONSULTANTS CO., LTD.)

[Participating bodies] PACIFIC CONSULTANTS CO., LTD.

[Activities]

- The technological specifications for collecting and using road traffic data at the lane level will be created, and probe data from the private sector (owned by automakers, manufacturers of car navigation systems, etc.) will be processed to conduct FOTs to provide road traffic data at the lane level.
- The specifications for providing road traffic data at the lane level will be formulated by taking into account the issues, improvements, etc. identified in the FOTs.

[Objectives for FY2020]

- FOTs will be planned based on the technology study policy in FY2019 to create a mechanism, etc. for generating and providing road traffic data at the lane level by using probe data.
- The possibility of building an FOT system to generate road traffic data at the lane level and provide it to vehicles will be studied. Initiatives will be promoted to validate the effectiveness through FOTs.

[Final goals] (by the end of FY2022)

- Environments that are required to distribute traffic signal information (in accordance with the standard specifications based on the validation through FOTs) and road traffic data at the lane level (using vehicle probe data, etc.) will be built.

(3) 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 arbitrarily, making it difficult to judge whether automated vehicles meet the necessary safety requirements. It is therefore necessary to develop techniques for evaluating vehicle safety under specific driving environment conditions. To increase the efficiency of safety evaluations using actual vehicles (which require much time in the current development of automated vehicles), efforts will be made to develop simulation tools (mainly evaluation of sensor performance), standardize the interface, etc., and a safety evaluation environment will be built in cyberspace. The developed tools, interface, etc. for the safety evaluation environment will be standardized among automakers, suppliers, etc. to raise the overall level in the industry and increase the efficiency of safety evaluation technologies for automated vehicles and systems, thereby enhancing industrial competitiveness.

1. Building a safety evaluation environment in cyberspace

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

[Participating bodies] Kanagawa Institute of Technology, Ritsumeikan University, Mitsubishi Precision Co., Ltd., SOKEN, INC., Hitachi Automotive Systems, Ltd., DENSO CORPORATION., Pioneer Corporation, Nihon Unisys, Ltd., SOLIZE Engineering Corporation, Sony Semiconductor Solutions Corporation

[Activities]

- To build a safety evaluation environment in cyberspace, industry and academia will cooperate to develop: 1) an environment model that simulates the external environment recognized by in-vehicle sensors of automated vehicles, 2) a tool that generates test data based on the evaluation scenarios, 3) a sensor model that simulates the detection functions of actual in-vehicle sensors (cameras, millimeter-wave radar sensors, LiDAR), and 4) an automated driving model that simulates the motion control of automated vehicles based on sensor detection results.
- The interface between modules will be defined and standardized to build a safety evaluation environment in cyberspace so that the developed models and tools can be modularized and used as extended functions.

[Objectives for FY2020]

- The function to reproduce the conditions under which sensor recognition may malfunction will be added to the simulation platform that has been developed.
- The simulation tools and models will be improved based on measurement results under actual environment conditions using actual equipment. Sufficient consistency for safety evaluations will be attained in the sensor perception and recognition output of the actual environment and simulation.

- To verify the usefulness of the simulation platform, demonstrations will be conducted to confirm that the tests of Advanced Driver Assistance Systems (ADAS) can be reproduced in simulations under the conditions of the Japan New Car Assessment Program (JNCAP), the European New Car Assessment Programme (Euro NCAP), etc. as typical examples.
- An ecosystem that consists of scenario generators to create a virtual evaluation space by combining databases and scenarios (based on the databases and scenarios to share the environmental model and space rendering model) will be built toward social implementation and commercialization.

[Final goals] (by the end of FY2022)

- Commercialization will be promoted so that the data platform of the safety evaluation environment in cyberspace can be built and operated on an ongoing basis. Consensus will be built in the industry toward use by third-party evaluation organizations while promoting standardization of the interface.

(4) 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] To be determined through a public call for proposals

   [Participating bodies] To be determined through a public call for proposals

   [Activities]

   - Based on the survey results in FY2019 which showed that the intrusion detection system (IDS) is effective against new cyberattacks targeting connected cars, the scope of surveys on the IDS conducted in FY2019 will be expanded. The performance of the IDS will be evaluated by using testbeds and actual vehicles to establish IDS evaluation techniques and formulate guidelines. These guidelines will be transferred to industry organizations to encourage them to establish industry guidelines.
   - Surveys will be conducted on methods and systems mainly to observe, collect, analyze, and accumulate threat intelligence about cyberattacks on connected cars. FOTs will be conducted to collect and accumulate threat intelligence regarding vehicles and in-vehicle devices, and the system specifications will be formulated. The methods of linking threat intelligence with IDS will be studied, and the specifications of a system to assist the initial response after a cyberattack is detected will be studied. The performance targets of the overall system will be studied, and the basic system specifications will be created to promote transfer to industry organizations.

   [Objectives for FY2020]

   - Surveys will be conducted on the new IDS. An organizational structure for evaluation using testbeds and actual vehicles will be built, and evaluation methods will be formulated.
   - Basic surveys will be conducted on the threat intelligence of connected cars. Techniques to collect and accumulate threat intelligence will be studied.

   [Final goals] (by the end of FY2022)

   - Techniques for evaluating the intrusion detection system (IDS) will be established, and the formulated guidelines will be transferred to industry organizations.
   - The basic specifications for a system to collect and accumulate threat intelligence and a system to assist initial response by linking threat intelligence with IDS will be formulated, and the operation will be transferred to the relevant industry organizations.

(5) Other platform technologies

[Overview]

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

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

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

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

   [Activities]

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

   [Objectives for FY2020]

   - Experiments will be conducted in a virtual reality (VR) environment based on cases of communication between automated vehicles and other traffic participants observed in past FOTs. Possible methods of communication using external HMI and measures to cope with negative effects when using HMI will be formulated.
   - Methods of quantitatively evaluating the impact on takeover, etc. and HMI for appropriate takeover, etc. will be developed.
   - Regarding driving education on automated vehicles equivalent to Level 3, validation will be performed using actual vehicles based on the validation using a driving simulator. Trial

application to driver's education (e.g., driving schools) will commence.

[Final goals] (by the end of FY2022)

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

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

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- Technological requirements for communication will be established through simulations, etc. for achieving Use cases of Cooperative Driving Automation that require the use of V2X (created based on the survey results for new communication technologies in the automated driving systems implemented in FY2019). Studies will be conducted on the frequency bandwidth, etc. required to achieve vehicle-infrastructure cooperative connected and automated driving, taking into account the expected deployment rate of automated vehicles in each case. A roadmap will be formulated that reflects the technological requirements that will be required in each phase.

[Objectives for FY2020]

- The technical conditions required for communication (e.g., permissible latency, required data amount) will be summarized regarding cases in which communication is used for automated driving as discussed in Task Force on V2X communication for Cooperative Driving Automation.
- Studies will be conducted on Use cases of Cooperative Driving Automation (which requires the use of V2X) to determine the applicability to the existing 700 MHz Intelligent Transport Systems through a desk-based study and simulation.

[Final goals] (by the end of FY2022)

- The conditions required for communication in the use of traffic environmental data will be clarified, and a draft roadmap for the information communication technologies required to achieve automated driving will be formulated.

III) Fostering of public acceptance of automated driving

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

[Overview]

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

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

[Persons responsible for R&D]

[Formulation of strategy] Noriko Moriuchi (DENTSU MEITETSU COMMUNICATIONS INC.), Shinya Omori (SC-ABeam Automotive Consulting)

[Evaluation] Kaori Asakura (Dai-ichi Life Research Institute Inc.)

[Participating bodies]

[Formulation of strategy] DENTSU MEITETSU COMMUNICATIONS INC., SC-ABeam Automotive Consulting

[Evaluation] Dai-ichi Life Research Institute Inc.

[Activities]

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

[Objectives for FY2020]

- The overall strategy will be reviewed based on the results of effectiveness measurement and evaluation of the activities, etc. that have been conducted based on the strategy. The overall implementation plan for FY2021 and beyond will be formulated and implemented.

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

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- Initiatives to raise public awareness and promote correct understanding will be conducted such as by using websites, social networking services (SNS), etc. to which many traffic users have access.
- Information will be disseminated through interactive and other events involving citizens organized during the period of the FOTs in the Tokyo waterfront area and other areas. Initiatives will be conducted to promote understanding and raise awareness of automated driving even among those who do not use it. Events will be jointly held with various industry organizations. Efforts will be made to promote correct understanding of social needs and the usefulness of automated driving and to introduce new automated driving-based mobility services, etc., thereby spreading automated driving services in society.
- Interactive events involving citizens, officials of local government bodies, business operators, etc. will be organized taking into account the regional traffic environment, needs, and other factors. Studies on new mobility services will be accelerated. Overconfidence in and distrust of automated driving will be dispelled by interacting with citizens and providing information to promote correct understanding.

[Objectives for FY2020]

- Events for promoting correct understanding of automated driving will be organized by using the FOTs in the Tokyo waterfront area.
- 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.

[Final goals] (by the end of FY2022)

- An organizational structure for operation will be built to continuously disseminate information and promote understanding of automated driving in FY2022 and beyond in cooperation with industry organizations, etc.

(2) Surveys and research to solve social issues by using automated driving technologies

[Overview]

Japan's long-term vision will be summarized by taking into account the developments in automated driving (e.g., technology level, deployment status). The impact of automated driving (e.g., reduction in traffic accidents, reduction in CO_2 emissions, influence on traffic congestion) 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. The effectiveness of safe driver assistance systems achieved by automated driving will be quantitatively evaluated and disseminated through technological validation of driver assistance for persons with visual impairments, etc. Surveys and research, etc. required for solving social issues by automated driving will be conducted.

1. Research on the impact of automated driving on reduction of traffic accidents, etc.

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

   [Participating bodies] The University of Tokyo, Doshisha University, Kagawa University, Tottori University

   [Activities]

   - The relationship between automated driving and SDGs will be summarized. The deployment rate of automated vehicles and driver assistance vehicles by 2050 will be estimated for each driving automation level to assess the impact on road transport (e.g., reduction in traffic accidents, reduction in CO_2 emissions, influence on traffic congestion). The impact on the transport service field (ensuring mobility for vulnerable road users and in areas where transport services are limited [e.g., underpopulated areas], coping with the driver shortage in the logistics and mobility services and reducing costs, meeting the changing structure of consumers' choice regarding vehicle ownership, use, and mobility) and the industrial and social fields (impact of the changes in vehicle ownership structure, etc. on the overall auto industry, contribution to improving the total factor productivity of the Japanese economy), etc. will be summarized and quantitatively estimated.
   - Joint research, etc. will be conducted with foreign research institutes in the U.S., Europe and other countries about the fostering of public acceptance.

   [Objectives for FY2020]

   - The deployment rate of automated vehicles and driver assistance vehicles by 2050 for each

driving automation level (which serves as the common basic value when analyzing the impact of implementation on various aspects in FY2019) will be estimated. The impact on road transport will be summarized and quantitatively estimated from the viewpoint of effects and potential risks.

- The preconditions required for estimation (e.g., various types of statistical data, interviews in respective industries) will be summarized. The impact on the transport service field and the industrial and social fields will be summarized and quantitatively estimated from the viewpoint of effects and potential risks.

2. Advanced driver assistance system for those who suffer from visual field loss, etc.

[Persons responsible for R&D] Masayo Takahashi (RIKEN)

[Participating bodies] RIKEN, Nagoya University, University of Tsukuba, Kobe City Eye Hospital, Tohoku University, Niigata University

[Activities]

- The driving behavior data of those with visual field loss and able-bodied persons will be collected using a simple driving simulator used in ophthalmic clinics to identify causes of accidents specific to those with visual field loss (depending on the area and degree of visual field loss).
- The driver assistance functions that are truly useful for those with visual field loss will be identified and implemented in a driving simulator to validate the effectiveness in reducing accidents.
- Methodologies for ensuring the safety of those with visual field loss by using the driver assistance system will be established. Guidelines for designing the driver assistance system will be formulated.

[Objectives for FY2020]

- Driving data of those with visual field loss will be accumulated by using a driving simulator. Potential issues in the driver assistance system will be identified to formulate guidelines for designing the driver assistance system to help reduce accidents.

3. Visualization of the reduction in traffic accidents achieved by automated driving and driver assistance

[Persons responsible for R&D] Akito Adachi (Japan Automobile Research Institute)

[Participating bodies] Japan Automobile Research Institute

[Activities]

- Using the information on traffic signal, traffic restriction, etc. of the target areas provided by the National Police Agency, JARI will evaluate the effect of automated driving and driving support on reducing the number of traffic accidents in those areas through traffic flow simulations.
- JARI will also consider how useful each of the current traffic regulations could be to reduce the

number of traffic accidents after automated vehicles and driving support vehicles are common, which may contribute to the research on future traffic restrictions among other things. .

[Objectives for FY2020]

- Aiming to create public acceptance, JARI will conduct simulations using the data of penetration rate of automated vehicles and driving support given by a different measure (“Research on the impact of automated driving on reduction of traffic accidents, etc.”), and evaluate the effect of automated driving and driving support on reducing the number of traffic accidents. The evaluation results will be provided to the measure and used for assessing the impact.

4. Basic survey of automated buses that are convenient for vulnerable road users

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- The design guidelines for the cabin layout of bus-type mobility (which is expected to be the main type of service) and the mechanism to ensure safety will be formulated for automated driving-based mobility services based on the needs identified through such a process as an experience-based study in which people with limited mobility are invited to participate, in cooperation with organizations for vulnerable road users and through industry-academia-government collaboration, as well as based on surveys and analyses of domestic and overseas developments.

[Objectives for FY2020]

- The draft design guidelines will be shared with bus manufacturers, etc. to promote technology development based thereon.

[Final goals] (by the end of FY2022)

- An action plan based on the quantitative impact assessment (e.g., influence on reduction in traffic accidents, reduction in CO_2 emissions, influence on traffic congestion) will be proposed to the Public-Private ITS Initiative/Roadmaps.
- The effects and risks of using automated driving to assist vulnerable road users, etc. will be clarified. The guidelines for driver assistance systems that are effective for those with visual field loss and bus-type mobility designs will be proposed to auto-related organizations, etc. and reflected in improving the legal system and developing technologies.

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. Japan will actively disseminate information and create opportunities for internationally open R&D and social implementation to drive the discussions forward. Surveys, research, etc., which are required to enhance international cooperation (e.g., standardization, joint research), will be conducted.

1. International dissemination of information by organizing the SIP-adus Workshop (an international workshop) and other events

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

   [Participating bodies] Congrès Inc.

   [Activities]

   - Initiatives in FY2019 (e.g., information dissemination, SIP-adus Workshop) will be reviewed, and 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 FY2020]

   - Information will be disseminated through websites and international conferences. The SIP-adus Workshop will be organized to further enhance international cooperation (e.g., standardization activities, joint research).

2. Promotion of joint research on automated driving with overseas research institutes

   [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 FY2020]

- Research themes that may lead to sustainable international cooperation will be proposed toward FY2022 and beyond through a liaison conference (with the Mobility Innovation Liaison Conference serving as the core organization and other research institutes involved).
- In the cooperation between Japan and Germany, formulation and implementation of a joint research plan (including establishing specific research themes, defining the scope, and creating the schedule) for safety evaluation and cybersecurity will be assisted, with a view to future standardization. Implementation of joint R&D on human factors and socioeconomic impact assessment (on which an agreement was reached to start joint R&D in February 2019) will be assisted.
- In the cooperation between Japan and the EU, specific cooperation projects will be selected, and workshops to share information, etc. will be held. The next step of possible cooperation will be studied by sharing information.
- The database of research on automated driving will be upgraded, and methods of using it (including disclosure) will be studied.
- To establish a sustainable organization for industry-academia collaboration in FY2022 and beyond, the ultimate vision of the organization (including cooperation with other organizations) will be shared, and a specific roadmap toward realization will be created. Studies on achieving a collaboration model will be conducted through consultations and interviews with relevant ministries, agencies and industries.

3. Formulation of intellectual property strategies

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

[Participating bodies] To be determined through a public call for proposals

[Activities]

- Priority R&D themes under this project will be identified. Developments in relevant patents and standardization efforts will be summarized, and an intellectual property strategy will be reorganized in cooperation with contractors who undertake measures (e.g., R&D) based on analyses and proposals by intellectual property experts, and a future action plan will thus be formulated.

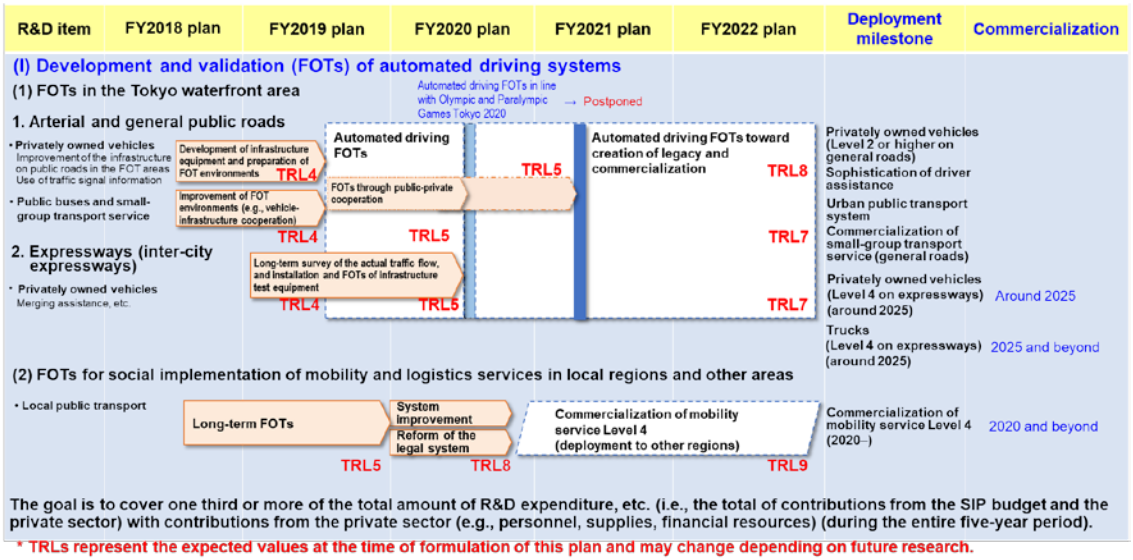
[Objectives for FY2020]

- Developments in patents and standardization efforts in Japan and other countries will be summarized regarding technology elements in target themes. The approach and basic policy for reorganizing the intellectual property strategy will be formulated.
- Regarding the target themes, the contents that should be standardized and that should be turned into intellectual property will be summarized from the viewpoint of deploying automated driving, expanding the use of traffic environmental data related to automated driving, and

ensuring competitiveness. The standardization strategy and patent strategy will be formulated.

[Final goals] (by the end of FY2022)

- An organization for industry-academic -government collaboration will be established to continue such collaboration that has been promoted through SIP-adus and to ensure sustainable cooperation with overseas research institutes in the field of automated driving based on the inter-academia cooperation structure.
- Regarding international standardization, 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.



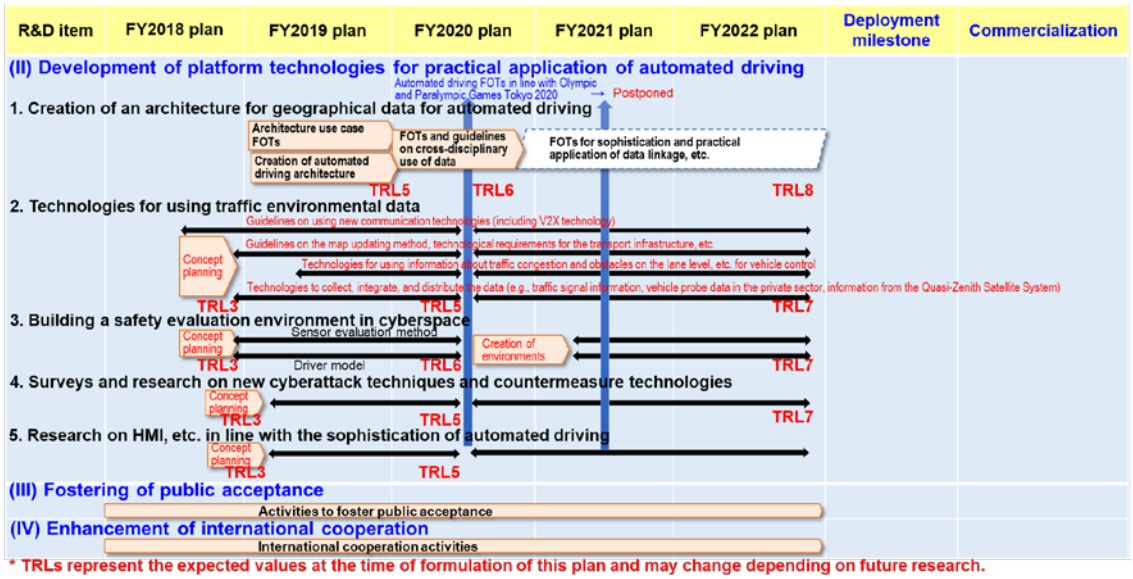


Fig. 2-1 R&D Roadmap

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-check, 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. Regarding the PD's activities, cooperation will be enhanced in the industry in the cooperative areas. Meanwhile, SPDs offer support from the viewpoint of industry-academia-government collaboration with participation from industry and academia. While maintaining trust built in the first phase of SIP, cross-disciplinary initiatives will be promoted to attain higher goals in the second phase of SIP 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. 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 automated driving.

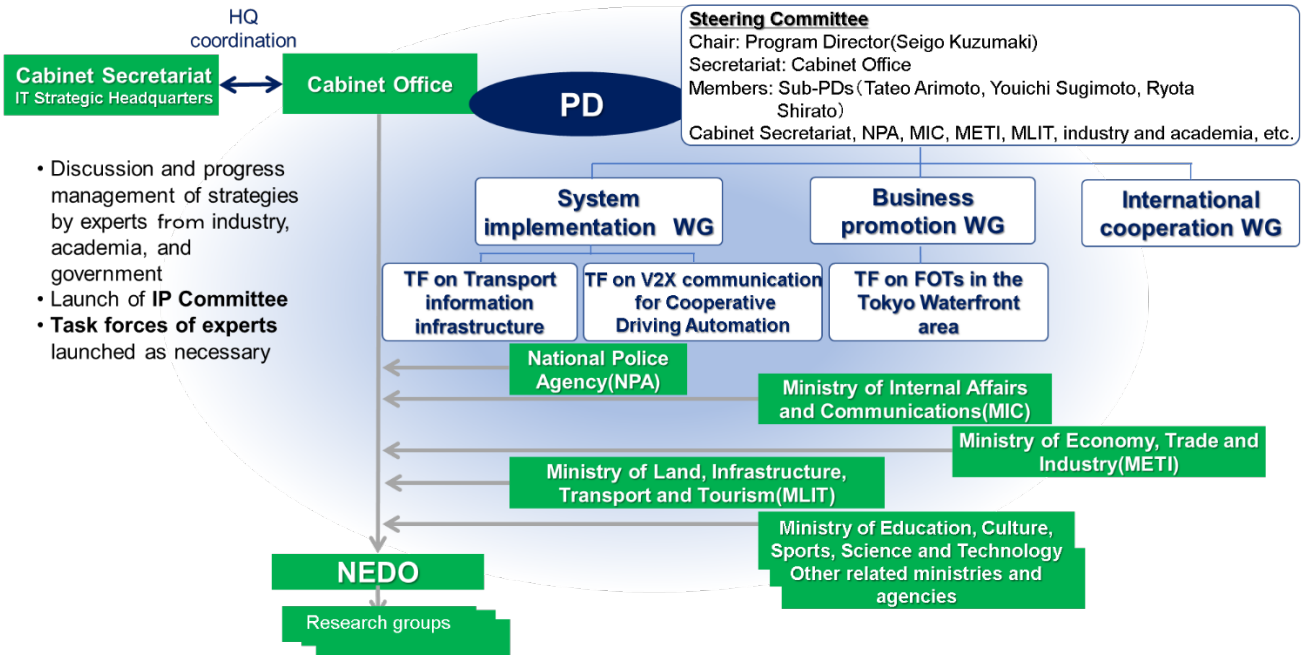


Fig. 3-1 Organizational structure for implementation

(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, cross-disciplinary initiatives will be further promoted.

(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

Intellectual property strategies will be formulated on specific issues (e.g., safety evaluation, security) 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

With the Olympic and Paralympic Games Tokyo 2020 set as a deployment milestone, we will overcome three barriers (i.e., technology development, improvement of the legal system, and fostering of public acceptance) toward practical application through industry-academia-government collaboration by conducting FOTs in the Tokyo waterfront area, local regions, and other areas, as well as developing platform technologies. The FOTs will involve automakers, 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. Use of the Olympic and Paralympic Games Tokyo 2020
   Opportunities for information dissemination will be arranged through industry-academia-government collaboration in a timely manner by using the R&D results in the public and private sectors, which have been prepared to showcase Japan's technologies to the global community during the Olympic and Paralympic Games Tokyo 2020, which will attract much public attention.

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 map data and road traffic data as well as data collection using vehicle probes 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.

d. Selection of recipients of research results and technology licensees in the private sector
   This project 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. 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.

(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 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.

a. Increasing the profile by leveraging the Olympic and Paralympic Games Tokyo 2020
   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, and 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); and Article 15, Item 2 of the Act on the New Energy and Industrial Technology Development Organization.

(2) Flexibility of the plan

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

(3) Assignment history of the PD and personnel in charge

(a) PD

Seigo Kuzumaki
(April 2018–)

(b) Directors in charge (Counselors)

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

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

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

Kenji Ueki
Sub-leader
(July 2019–)

Yoshihiro Izawa
Counselor
(April 2018–
July 2018)

(c) Personnel in charge

Masaki Chikuma
(April 2018–
March 2019)

Kaoru Sugie
(April 2018–
March 2019)

Yukiko Hatazaki
(October 2018–)

Kazuya Murata
(April 2019–)

Toshikazu Tanaka
(April 2019–)

Kotaro
Matsumoto
(July 2019–)

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, ML IT, 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, ML IT, etc.)	180
2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses)	116

Total in FY2020: 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 (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.)	830
[II]	Development of platform technologies for practical application of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	1,779
[III]	Fostering of public acceptance of automated driving (relevant ministries and agencies: NPA, MIC, METI, MLIT, etc.)	217
[IV]	Enhancement of international cooperation (relevant ministries and agencies: NPA, MIC, METI, ML IT, etc.)	178
2. Expenditures for promoting the project (e.g., personnel expenses, evaluation expenses, meeting expenses)		116