(Tentative Translation)

Cross-ministerial Strategic Innovation Promotion Program (SIP)

Automated Driving for Universal Services

R&D Plan

July 19, 2018

Director General for Science, Technology and Innovation

Cabinet Office

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R&D Plan Overview

1. Vision and development goals

(Vision) There are high expectations for social changes stemming from automated driving. The "Public-Private ITS Initiative/Roadmap 2018" (May 2017) states that its "aim is to build the 'with the safest, smoothest roadway traffic in the world' by 2030 by developing and propagating an automated driving system and associated data infrastructure."

At the Council on Investment for the Future (March 2018), Prime Minister Shinzo Abe stated that "Automated driving will be implemented at the Olympic and Paralympic Games Tokyo 2020. Zones of the Tokyo waterfront area will be established as safer spaces for automated driving with traffic signal data transmitted to vehicles, among other strengthened initiatives aimed at various types of business development." Working toward the realization of these initiatives, and their valuable leading role in achieving the Society 5.0 detailed in the 5th Science and Technology Basic Plan (January 2016), are considered to be significant both socially and industrially, and to represent Japanese contributions to the world at large.

(Development goals) To achieve a society in which all people can attain a high quality of life through the practical implementation of automated driving and its propagation, thereby contributing to various social problems such as by achieving fewer traffic accidents, less traffic congestion, greater mobility for vulnerable road users, and the improvement of driver shortages and lowering of costs in the logistical and mobility services.

These goals will be achieved as per the timetable in the "Public-Private ITS Initiative/Roadmap 2018", but early accomplishment of the goals will also be considered based on international trends, technological developments, and other factors.

- Mobility services: Achieve high driving automation (SAE Level 4) for mobility services in limited regions (Operational Design Domain) by 2020.
- Logistical services: Achieve high driving automation in trucks (SAE Level 4) on highways around 2025 or later.
- Privately owned vehicles: Achieve high driving automation (SAE Level 4) on highways by 2025.
- Privately owned vehicles: Partial driving automation on general public roads (SAE Level 2 or higher).

The cooperative area technologies essential to achieving these goals will be established by 2023. The effectiveness of the technology will be validated through FOTs (Field Operational Tests) involving a variety of business operators, local government bodies, and others, and practical implementation in society will be achieved to a certain level through the creation of multiple practical example cases for commercialization in which the technology is actually implemented.

2. Research and development

In order to practically implement and propagate automated driving technology, both vehicle development and the development of the driving environment are required. The SIP-adus (Cross-ministerial Strategic Innovation Promotion Program [SIP] Automated Driving for Universal Services) project is an industry-academic-government collaborative project to promote development, focusing on cooperative areas such as the development of driving environments. Although the development of automated vehicles is an area of competition and not cooperative, there are issues such as safety that should be tackled jointly across the industry. Therefore, this project will promote automated vehicle development by specifying cooperative-area technologies within that development process. In order to promote the propagation of the technology, it is also important to foster society's receptivity to automated driving. The project will work to clarify the value and issues of automated driving and to have Japanese people develop a correct understanding of it, in addition to conducting research to improve the services. International standardization will be pursued through international cooperation with that aim of seeing the R&D output of this project put to use in the global market.

The following four areas will be prioritized: I) The development and validation (FOTs) of automated driving systems; II) The development of core technologies for the practical implementation of automated driving; III) The fostering of receptivity in society; and IV) The strengthening of international cooperation.

(I) **<u>Development and validation (FOTs) of automated driving systems</u>**

(1) Development of technology for delivering traffic signal data; (2) Development of technologies to support road-vehicle coordination, vehicle merging assistance, and related vehicle assistance system; (3) Development of technology for gathering and utilizing vehicle probe data; (4) Development of next generation public transport systems; (5) Development of road environments suited to the practical implementation of mobility services; etc.

(II) **<u>Development of core technologies for the practical implementation of automated driving</u>**

(1) Creation of a safety assessment environment in a virtual space; (2) Development of technology for efficient data gathering, analysis, and distribution; (3) Development of cyber security technology with online software updates, etc.; (4) Creation of requirements for HMI (Human machine interface) required for more sophisticated automated driving; etc.

(III) **<u>Fostering of public acceptance to automated driving</u>**

(1) Planning and hosting of events that promote public acceptance to automated driving (dialogue among local residents, those affiliated with local government bodies, businesses, etc.); (2) Clarification of the impact of automated driving; (3) Research on support for persons with reduced mobility (elderly, disabled, pregnant, travelers from overseas, etc.); etc.

(IV) Strengthening of international cooperation

(1) Dissemination of the outcomes of the project at international conferences; (2) Conducting joint research with overseas research institutions; (3) Communicating project-related information via the web; etc.

3. Implementation structure

Program Director Seigo K uzumaki (hereinafter "PD") manages the Promotional Committee, drafting research and development plans and strategies on technologies as well as conducting industry-academic-government collaborative discussions on exit strategies. Application procedures and procurement specification documents are created by the ministries/agencies and the New Energy and Industrial Technology Development Organization (NEDO) as the management body.

4. IP (Intellectual Property) management

The IP (Intellectual Property) Committee established in NEDO perceives and manages the IPs for which contractor organizations apply, and improves the convenience of making industrial use of those IPs by coordinating with contractor organizations.

5. Evaluations

Self-evaluations are conducted by the researcher and the PD before evaluation by the Governing Board at the end of each fiscal year.

6. Deployment Milestones

In terms of Deployment Milestones, this program sets the Olympic and Paralympic Games Tokyo 2020 as a milestone in its aim to overcome three barriers to implementation and achieve success through industry-academic-government collaboration: developing the technology, the legal framework, and the public acceptance required. This work will combine with infrastructural technology development and FOTs in the Tokyo waterfront area, regional areas, and elsewhere. These FOTs will promote investment through the participation of automobile companies, businesspeople, local government bodies, and other parties to help achieve implementation and commercialization of the technology. Moreover, the active use for a variety of purposes of maps and geographical data created to support automated and advanced driving technologies will be promoted to contribute to the achievement of Society 5.0.

1. Vision and development goals, etc.

(1) Background and domestic/international context

Interest in automated driving is on the rise every day. Car manufacturers, component manufacturers, and others are actively investing in research and development in this area, while on the national level there is also a proactive effort to attract participants in research and development projects and FOTs. There is also steady development of the legal framework and environment needed for implementation of the technology, centered primarily on Japan, the United States, and Europe.

In the background are likely other factors including the reduction of traffic accidents, less traffic congestion, greater mobility for the elderly and vulnerable road users, and other such solutions addressing problems in society, as well as the high expectation that automated driving will bring about social changes, including new logistical and transportation services and businesses.

In the United States, the company Waymo is conducting high driving automation tests aimed at providing a new service. GM has announced the commercialization of an Automated Driving Level 4 product. In response, the National Highway Traffic Safety Administration (NHTSA) has revised its guidelines for automated driving and adopted a stance of promoting the development of automated driving technology. On the other hand, fears regarding the safety of the technology have been revived by fatal accidents occurring in early 2018 that involved Uber and Tesla vehicles in self-driving mode, once again launching debate on the issue.

In Europe, automated driving research is being pursued in national government programs, including the EU-funded research project Horizon 2020 and the German PEGASUS project. Germany has also taken lead in revising its road traffic laws and is working to develop the environment needed for the implementation of automated driving technology.

In Japan, research and development was conducted in cooperative research and development areas pertaining to automated driving, primarily in the first phase of SIP beginning in 2014. Large-scale FOTs were begun in 2017 with practical implementation on highways estimated to begin by 2020 as per the government's strategy ("Growth Strategy Council - Investing for the Future" and "Public-Private ITS Initiative/ Roadmap").

Based on this, the importance of automated driving development is also recognized in the second phase of SIP, and new projects have been set in motion aimed at achieving the next accomplishment along the path.

Japan is one of the first countries in the world to suffer shortages of transportation methods in lightly populated areas with increasingly older populations and a lack of drivers in the logistics industry, among other such social problems. As a result, there is a strong desire in Japan for automated driving technology to be extended to general public roads, and for Japan to achieve the world-first commercialization of automated driving in the logistical and mobility services, thereby making Japan a model "super-aging society" in which all citizens can use transportation safely and with peace of mind.

When this project was launched, its topic was changed from the "SIP Automated Driving System" program to the "SIP Automated Driving (Automated Driving for Universal Services)". This was due to at least three factors: 1) SIP phase two is not a continuation or extension of SIP phase one; 2) Public-Private ITS Initiative/Roadmap 2017 used the increasingly common name "automated driving"; and 3) The transition from a phase focused on developing the technology behind automated driving systems to a phase in which services are expanded towards the end of implementing automated driving on a practical basis. Additionally, it was decided to continue using the English abbreviation "SIP-adus (Automated Driving for Universal Services)."

(2) Significance and strategic importance

This research aims to achieve the practical implementation of automated driving. In addition to the social significance of this technology—which could lower the number of traffic accidents, reduce traffic congestion, bring mobility to underpopulated regions, and eliminate driver shortages—it also has large economic significance as well.

At present, the automobile industry is being carried on waves of technological innovation including automated driving technology, vehicle hybridization technology, and "connected sharing" technology. It is said that the world is in a once-in-a-century period of massive change. Triumphing over competitors in the development of this technology can be expected not only to increase the competitiveness of contemporary Japan's automobile industry—one of Japan's core, broad-based industries—but also to have ripple effects in related industries such as digital infrastructure, sensors, and communications that are required for automated driving. It can also be expected to create new industries and services for the era of Society 5.0, representing great potential to contribute to Japan's future economic development.

On this basis, the "Public-Private ITS Initiative/Roadmap 2018" (June 2018) states that its "aim is to build the 'society with the safest, smoothest roadway traffic in the world' by 2030 by developing and propagating an automated driving system and associated data infrastructure."

At the Council on Investment for the Future (March 2018), Prime Minister Abe stated that "Automated driving will be implemented at the Olympic and Paralympic Games Tokyo 2020. Areas of the Tokyo waterfront area will be established as safer spaces for automated driving with traffic signal data transmitted to vehicles, among other strengthened initiatives aimed at various types of business development."

Working toward the realization of these initiatives, and their valuable leading role in achieving the Society 5.0 detailed in the 5th Science and Technology Basic Plan (January 2016), are considered to be significant both socially and industrially, and to represent Japanese contributions to the world at large.

(3) Objective/Aim

1) Overall objective

To achieve a society in which all people can live and attain a high quality of life through the practical implementation of automated driving and its propagation, thereby contributing to various social problems such as by achieving fewer traffic accidents, less traffic congestion, greater mobility for vulnerable road users, and the improvement of driver shortages and lowering of costs in the logistical and mobility services.

These goals will be achieved as per the timetable in the "Public-Private ITS Initiative/Roadmap 2018", but early accomplishment of the goals will also be considered based on international trends, technological developments, and other factors.

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The technologies of the cooperative-area type necessary for achieving these goals will be established by 2023. The effectiveness of the technology will be confirmed through FOTs involving a variety of businesses, local government bodies, and others in the Tokyo waterfront area and underpopulated regions, and practical implementation in society will be achieved to a certain level through the creation of several example cases in which the technology is actually implemented.

Moreover, in the interest of international collaboration, this research and development plan uses SAE International's J3016 (September 2016) and the Japanese translation thereof, JASO TIP18004l (February 2018), as its definitions for automated driving levels.

Current automated driving development features two different approaches, as shown in Figure 1-1: (A) Investigation of automated driving under restricted time and spatial conditions, and (B) Investigation of application of the technology under a more diverse range of environments.

Attention tends to focus on approach (A) based on terminology like the "automated driving level" and expectations of "driverless driving." However, approach (B) assumes there is a driver operating the vehicle and automated driving technology is used to achieve advanced automated driving support. This approach serves to further enhance vehicle safety, contribute to reduced traffic congestion, and can help improve the competitiveness of the automobile industry by giving consumers more added value. Approach (A) is an innovative solution for addressing depopulation, driver shortages, and giving mobility to people who have transportation problems, and there are great expectations that new businesses will grow out of this. Therefore, in order to utilize the technology of automated driving to contribute to the rapid achievement of these goals, both approaches are needed.

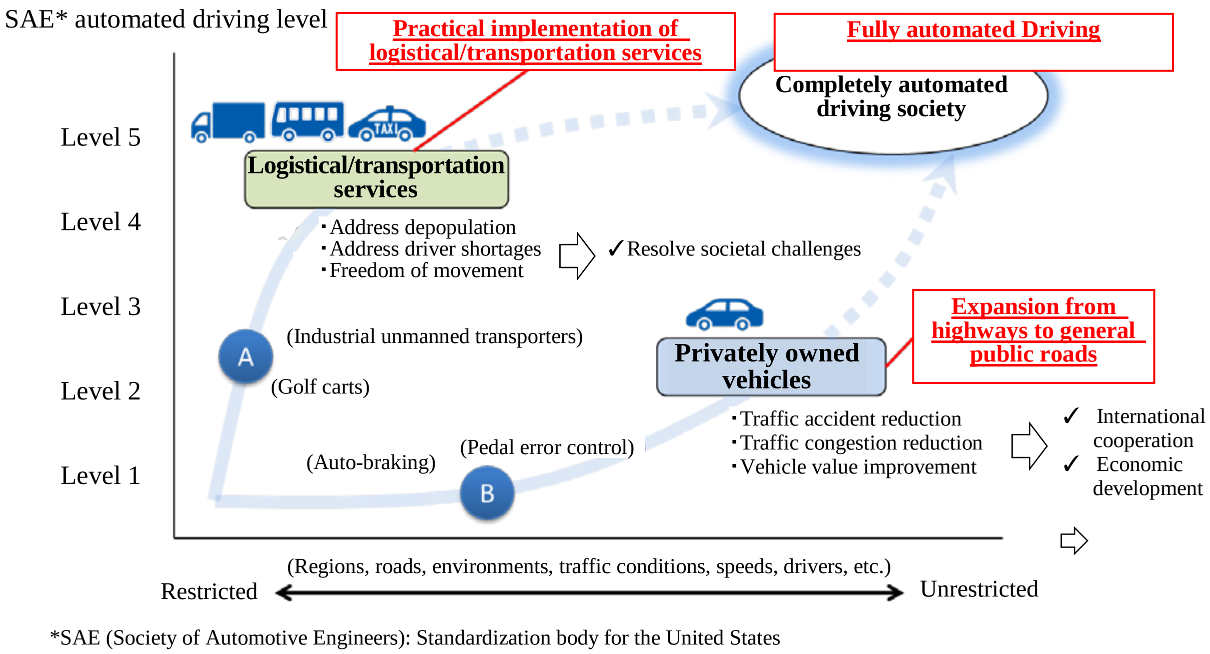

Figure 1-1. Overall conceptual image of automated driving

2) Achievement of Society 5.0

"Automated driving" means for a computer system to handle the driving that was previously conducted by human drivers. To achieve this, it is necessary to collect a variety of roadway traffic environmental data and build a cyber-physical space for the system to use: these mean nothing less than the achievement of Society 5.0 itself. Vehicle probe data gathered in the course of the development of automated driving can be used for a variety of purposes, including updating maps and predicting traffic congestion. This roadway traffic environmental data can also be used to evaluate safety in a virtual environment via simulation. Furthermore, the map and geographical data obtained here can also be used in a variety of fields including infrastructure maintenance management, disaster preparedness and prevention, and "IT agriculture". This project involves collaboration with these fields while aiming to build a service platform for geographical data built on map data produced by automated driving, thereby contributing to the achievement of Society 5.0.

1) Begin use of vehicle probe data on automated driving and support systems (map updates, data provision, etc.).
2) Build a framework for the use and application of highly accurate map data, accident data, and other traffic data.
3) Begin operating a service platform for the distribution of map data and dynamic

geographic data.

3) Social objectives

The transportation of people and things is an important element of life in society, and automated driving would likely have an impact on town planning and urban development itself. Combined with air, rail, and other forms of transportation, it is hoped that this project will contribute to local communities by thinking about how to use automated driving in a way that meets the needs of each region and specific use. There is also a need to consider the potential of progress that incorporates car-sharing and other new forms of vehicle ownership.

After creating an overall vision as above, the aim is to achieve a society in which all people can attain a high quality of life through the practical implementation of automated driving and its propagation suited to people's needs, thereby contributing to various social problems such as by achieving fewer traffic accidents, less traffic congestion, greater mobility for vulnerable road users, and the improvement of driver shortages and lowering of costs in the logistical and mobility services.

On the other hand, it is also true that there is a large gap between the expectations for automated driving held by the elderly and vulnerable road users, and the actual maturity of the automated driving technology itself. This project constitutes research on the level of driving ability necessary to operate a vehicle equipped with automated driving technology by verifying the effectiveness of advanced driving assistance systems for the reportedly large population of individuals with minor visual impairments and similar.

1) Start projects by around 2020 for underpopulated areas that utilize automated driving technology to promote mobility.
2) Reduce traffic accident fatalities through automated driving, and establish methods of predicting CO_2 reductions achieved.
3) Clarify the benefits of driving assistance provided by advanced driving assistance systems to those with minor visual impairments and similar, and propose an appropriate systematic framework.

4) Industrial objectives

To enhance and maintain the competitiveness of the automobile industry through the early practical implementation of automated driving, as well as create new digital infrastructure industries using map/geographical data and vehicle probe data created for automated driving, strengthen the competitiveness of the sensor industry, and cultivate the cyber security and simulation industries.

1) Start new logistics and mobility services using automated driving technology
2) Begin operating a service platform for the distribution of map data and dynamic geographic data.

3) Cultivate personnel to work with automobile industry-related software by building a virtual evaluation method.
4) Cultivate evaluation organizations and “white-hat hackers” that have advanced cyber security skills.

5) Technical objectives

A wide range of technical issues must be overcome in the practical implementation of automated driving. This project, which undertakes development in a cooperative area, places a priority on developing the basic technologies needed to ensure safety and to create environments in which automated-driving vehicles can operate. In the process of studying the establishment of driving environments for such vehicles, the format and transmission requirements of roadway traffic data needed for automated driving are to be determined and the aim is to standardize them as well.

In safety evaluations of self-driving vehicles, it is difficult to assess the variety of phenomena that can occur on public roads using the actual vehicles, and therefore such evaluations require a vast number of man-hours. To alleviate this problem, initiatives are underway to build simulations for virtual evaluation and verification that simulate various different objects (vehicles, motorcycles, bicycles, pedestrians), weather conditions (rain, snow, backlighting, etc.), and transportation conditions (highways, general public roads, etc.).

As automated driving becomes more advanced, the quantity if data transmitted to and from the car will increase, creating a need to upgrade cyber security and transmission media to keep pace. There will also technological development in order to continually improve cyber security techniques, the collection and usage of vehicle probe data, and the use of new communications technology (including V2X technology and similar). Research and development will be performed regarding the proper state of HMI (human-machine interfaces) with pedestrians and other traffic as participants, as automated driving improves and an increasing number of cars are equipped with automated driving. Results are reflected in the structure of vehicles.

1) Begin providing signal data for the purpose of automated driving and advanced driving support.
2) Begin providing data for merger assistance on highways and other infrastructure data.
3) Begin providing roadway traffic data that uses vehicle probe data.
4) Build a simulation environment for virtual evaluation and demonstration using MBD (Model-Based Design).
5) Establish guidelines and develop cyber security technology for software updates, etc.
6) Establish HMI guidelines for the propagation of automated driving.

6) Objectives pertaining to institutional systems

With the formulation of "The Policy (Outline) on Institutional Development by the Government toward the Realization of Highly Automated Driving Systems" (April 2018; Cabinet Secretariat IT Strategic Headquarters), institutional systems are being studied at the respective ministries. This project serves clarify the key issues and accelerate discussion on regulations and institutional systems in need of reform by planning out FOTs in the Tokyo waterfront area and FOTs regarding improved mobility and logistics/mobility services in underpopulated areas and similar, and then creating sites at which businesses, local government bodies, and other relevant parties can participate. These initiatives will seek to avoid redundancy with institutional systems-building work conducted at the respective ministries, and aim to create a venue at which government offices can collaborate on integrated study and analysis. Further, the aim is for these FOTs to serve as open international research and development sites and hubs for automated-driving research and development in Japan.

In the first phase of SIP, work to establish international standards was conducted in close collaboration with the Japan Automobile Manufacturers Association (JAMA), the Society of Automotive Engineers of Japan, and other organizations. Future work will involve deeper collaboration with organizations such as the Japan Auto Parts Industries Association (JAPIA) and the Japan Electronics and Information Technology Industries Association (JEITA) to improve standardization strategies in terms of both the *de facto* and the *de jure*.

At present, offers have been received by SIP-adus regarding participation in German-Japanese joint research and in EU-funded joint research projects. The second phase of SIP will provide support for joint research on automated driving with Japanese universities/research organizations and European/U.S. research organizations by, for example, establishing places for discussion oriented toward exploring joint research themes and adding conditions for open recruitment. These initiatives will serve to build a long-term, continuous framework for international collaboration with the aim of providing leadership for standardization work.

1) Achieve reforms to institutional systems consistent with the "The Policy (Outline) on Institutional Development by the Government toward the Realization of Highly Automated Driving Systems".
2) At least three proposals for ISO standards.
3) At least 5 joint research projects with foreign research organizations on automated driving.

7) Strategies in light of global benchmarks

Although there has been spectacular progress in automated driving technology, it is still expected to take quite some time before "Level 5" performance is achieved, at which the technology could handle driving in any environment at all. The standard SAE J3016, which established the levels of automated driving, also requires defining the conditions under which automated driving is possible (ODD: Operational Design Domain) for those levels. Considering these technical hurdles, Japan could certainly not be described as well-suited to the implementation of automated driving technology due to the complexity of its traffic environments and the large weather differences from season to season. There is also the threat posed by the enormous research and development investments currently being made by massive foreign IT corporations and similar. On the other hand, Japan does enjoy superiority in certain areas, including automobile development capabilities, technical capabilities in the manufacturing of products such as sensors and cameras, and high product quality for automobiles, a product that demands safety. Japan also has an over 20-year history of industry-academic-government collaborations in the ITS field, and boasts the advantage of having been the first in the world to achieve practical implementation of roadside-to-vehicle and vehicle-to-vehicle transmission systems and similar.

In this context, Japan should adopt a strategy of pursuing industry-academic-government collaboration to a greater extent than in the past, actively create environments in which automated driving technology can be applied, obtain safety-related methods and technologies by drawing on accumulated stores of on-site practical know-how, and spread automated driving technology throughout the world—not in the form of vehicles alone, but as "systems".

Further, Japan should work toward the realization of Society 5.0 by promoting collaboration throughout the entire automobile industry to achieve greater use and application of data, while also aiming to build an ecosystem that extends beyond the bounds of the automobile industry. In addition to industry-academic-government collaboration, deeper collaboration will also be pursued between industry players including automobile manufacturers, component manufacturers, and service providers; between academic disciplines such as engineering, medicine, law, and urban engineering; between the central government and local government bodies; and with other fields and sectors, as well.

8) Collaboration with local government bodies and similar

In order to link research and development activities to commercialization efforts, the initiatives of the various diverse stakeholders must be integrated together. The second phase of SIP places a priority on practical implementation, focusing on conducting initiatives involving businesses and those affiliated with local government bodies and establishing places for conducting FOTs.

Specifically, this program sets the Olympic and Paralympic Games Tokyo 2020 as a milestone in its plan to strengthen collaborations among the national government, the Tokyo Metropolitan Government, the private sector, and others; to create a roadmap to establishing environments for demonstrations; and to draft plans for conducting FOTs. Additionally, commercialization-oriented FOTs will also be conducted for logistics and mobility services and services that provide mobility within underpopulated areas, in collaboration with businesses and those affiliated with local government bodies.

2. Description of R&D activities

The practical implementation and propagation of automated driving requires both vehicle development and the establishment of driving environments. This project promotes development focused on cooperative areas such as the establishment of such driving environments.

General public roads are complex traffic environments, with vehicles cutting across them in addition to pedestrians, bicycles, and other types of traffic. These factors make it difficult to successfully implement automated driving only using data from vehicle-mounted sensors and similar equipment. Traffic environments on highways also present difficulties for the continuous use of automated driving, such as junctions at which merging lanes are not long enough for automated-driving vehicles. Resolving these issues requires traffic signal data and merger-assistance data transmitted by infrastructure along the roads, as well as up-to-date road and traffic data using vehicle probe data. Creating this kind of data requires collaboration between the public and private sectors. Working towards the practical implementation of these technologies, the opportunity created by the Olympic and Paralympic Games Tokyo 2020 will be utilized to collaborate with the Tokyo Metropolitan Government and others to establish internationally open FOT sites. Furthermore, long-term FOTs will be promoted based on business plans that involve local government bodies and businesses, in an effort to move toward the commercialization of mobility services for underpopulated areas and the commercialization of logistics services.

Meanwhile, although the development of automated-driving vehicles is a competitive (as opposed to cooperative) area, there are many issues that should be worked on collaboratively throughout the industry in the interest of safety. Development pertaining to these issues is required to be pursued through industry-academic-government collaboration.

The first phase of SIP focused primarily on five key issues (dynamic maps, HMI, cyber security, pedestrian accident reduction, and next-generation transport) as cooperative areas. The second phase of SIP will focus on the development of simulation tools for safety evaluations and operational tests, which will be especially important in the future, as well as research for the use and application of private vehicle probe data and other public-private road traffic data. This development work will focus on cooperative-area types of topics and feature industry-academic-government collaboration.

In pursuit of the practical implementation and propagation of services and vehicles using automated driving technology, there is a need to promote the fostering of public acceptance to the technology. This means to dispel automated driving-related misunderstandings or fears, as well as the need to make Japanese residents understand that automated driving will increase their convenience and improve their lifestyles. To this end, discussions with stakeholders, the quantification of the technology's social and economic impact, and technological development oriented toward improving services will be pursued.

On the path to the practical implementation of automated driving, it is important to consider exits appropriate for areas and usage purposes. However, automobiles are international products and the automobile industry is a key industry in Japan, and from that perspective there is a need to remain perpetually aware of international standardization. The project will actively disseminate SIP's results at international meetings and on the web, and lead the discussion on standardization in addition to actively promoting collaboration on joint research between Japanese and foreign research organizations.

Thus, based on the above, the following four areas will be prioritized: (I) The development and validation (FOTs) of automated driving systems; (II) The development of core technologies for the practical implementation of automated driving; (III) The fostering of public acceptance to automated driving; and (IV) The strengthening of international cooperation.

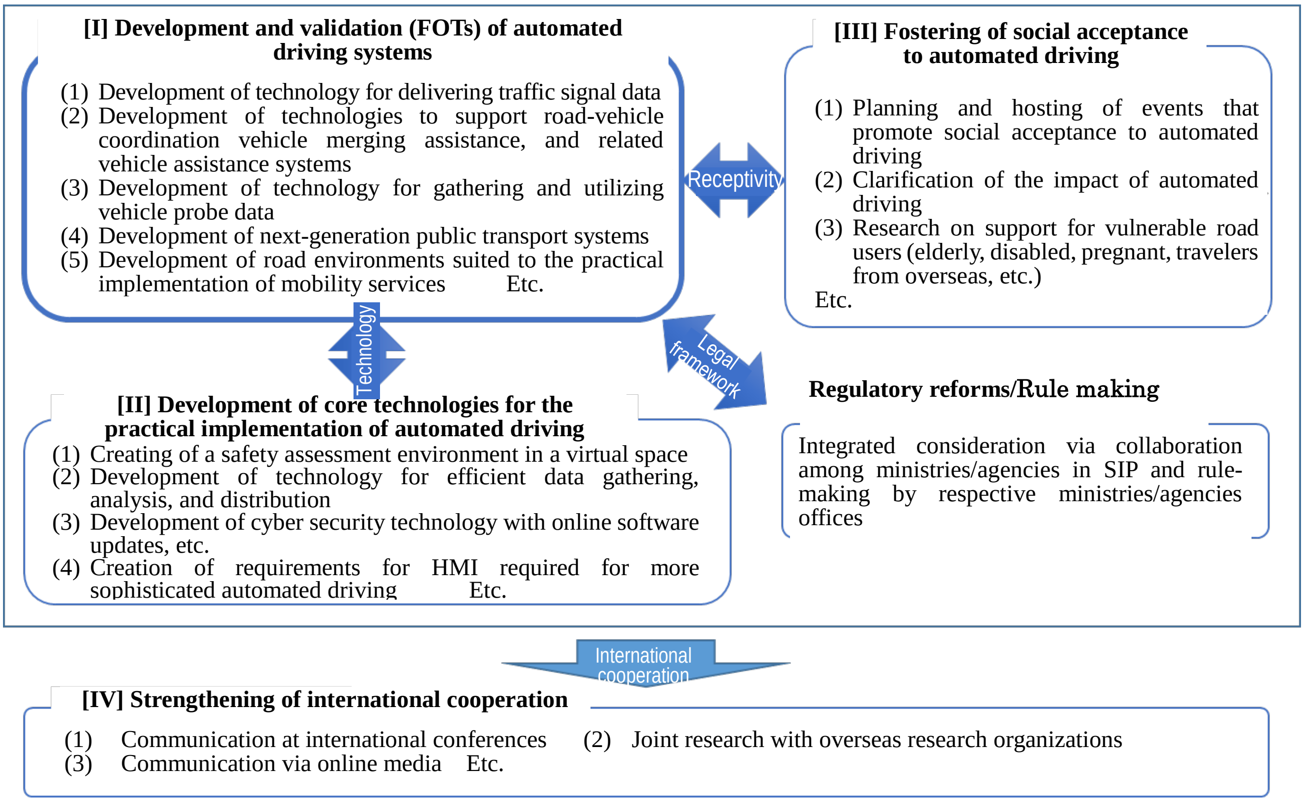

Figure 2-1. Overall R&D structure

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

(1) Development of technology for delivering traffic signal data

Plans to upgrade roadside infrastructure are surveyed based on studies by automobile manufacturers and others, and FOT sites are constructed through the implementation of model systems of upgraded roadside infrastructure. In addition, methods of providing traffic signal data other than its direct transmission from roadside equipment are considered.

New data provision and signal control methods are studied through the analysis and use of private users' vehicle probe data and vehicle-to-vehicle transmission data collected from vehicles near intersections via wireless roadside ITS devices.

(2) Development of technologies to support road-vehicle coordination vehicle merging assistance, and related vehicle assistance systems

Automated driving assistance technology is studied for merging lanes on highways by merger assistance and related vehicle assistance systems that contribute to the smooth functioning of automated driving on highways.

(3) Development of technology for gathering and utilizing vehicle probe data

The quantity of data, data formats, and other elements are studied, taking into consideration issues such as privacy and transmission costs, for the purpose of creating map updates, forecasting traffic congestion, and similar using vehicle probe data.

(4) Development of next-generation public transport systems

The technologies and services required for buses and low-capacity transportation services that contribute to a next-generation public transport system are identified. Technical studies are carried out to resolve issues and lower costs in preparation for the launch of these services.

(5) Development of road environments suited to the practical implementation of mobility services

Long-term FOTs are conducted in collaboration with local government bodies, businesses, and others with the aim of realizing automated driving-based mobility services for local communities and elsewhere in regional areas. These tests will aid in the study of technology coordinating roadside infrastructure and vehicles to support automated driving, and solving issues pertaining to technologies, the legal framework, and public acceptance.

(6) Development of technology that enables traffic data utilization for other purposes

The requirements, mechanisms, and other elements necessary to make use of traffic data for other purposes are studied.

(7) Research on the recognition technology required for automated driving technology (levels 3 and 4)

The cooperative areas pertaining to automated-driving vehicles may change as the technology progresses. For the benefit of discussions of the cooperative areas of the future, the requirements and other elements of the recognition and decision-making technologies for automated driving systems are studied through FOTs on automated-driving vehicles conducted on public roads by universities or other such bodies

(8) Research on location-based services from the Quasi-Zenith Satellite System's "Michibiki" satellite

Research pertaining to usage of location-based services such as coordinating with highly precise maps is carried out. These services are scheduled to begin being provided via the

Quasi-Zenith Satellite System's "Michibiki" satellite in November 2018.

II) Development of core technologies for the practical implementation of automated driving

1) Creating of a safety assessment environment in a virtual space

It is difficult to determine whether automated-driving vehicles satisfy minimum levels of safety or not by the assessment methods based on FOTs currently in use on public roads. Thus, methods are required whereby vehicle safety can be assessed under identical conditions. Additionally, simulation tools are developed for virtual safety assessment and validation focusing primarily on sensor performance assessments, and environments are built for assessment, in order to streamline the large-scale real-vehicle testing used in current vehicle development and assess the safety performance needed by automated-driving vehicles and advanced driving assistance systems. This research is pursued in close collaboration with automobile manufacturers, parts suppliers, and others, and builds on a proper understanding of overseas trends, as well.

2) Development of technology for efficient data gathering, analysis, and distribution

The following types of technologies are studied, developed and tested for the location data of vehicles and pedestrians and probe data from traffic signal and privately-owned vehicles: technologies that efficiently gather data and images on roadway surroundings from running vehicles, drive recorders, and other sources; technologies that analyze those data for use in automated driving, in part for prediction and estimation (platforms that integrate data on roadway surroundings, photographic images and videos taken from multiple perspectives, and abstractions of those photos/videos); and technologies that distribute gathered and/or analyzed data as optimal for the data's characteristics, uses, etc. (utilizing existing ITS communications while organizing communications methods used for specific use cases and data types, giving due consideration to the usage of V2X technology and other new communications technologies, edge computing, clouds, etc.; overall system design studies; etc.)

3) Development of cyber security technology with online software updates, etc.

Cyber security policies are studied for automated-driving vehicles using communications networks for software updates and similar techniques, the usage of which is expected to grow in automated-driving vehicles in the future. The necessary technologies and guidelines for those techniques are developed.

However, the actual development of cyber security technology is planned to begin in FY2019 within a new framework, after sufficient verification of the results from the first phase of SIP (building a method of evaluating cyber security) and discussion on appropriate research themes.

4) Creation of requirements for HMI required for more sophisticated automated driving

There is debate regarding whether data from vehicles is sufficiently useful when considering communication between automated-driving vehicles and other participants in traffic. Requirements are studied for HMI required for the more sophisticated automated driving technology of the future.

However, the actual development of the HMI is planned to begin in FY2019 within a new framework, after sufficient verification of the results from the first phase of SIP (building an HMI database, etc.) and discussion on appropriate research themes.

5) **Studies of methods of improving the absolute accuracy of geospatial data for automated driving**

In order to establish a usage environment for geospatial data, methods of improving the absolute positional accuracy of geospatial data are considered for multipurpose use in automated driving by aligning it with fundamental geospatial data that provide positional reference to geospatial information on digital maps.

III) Fostering of public acceptance to automated driving

(1) **Planning and hosting of events that promote public acceptance to automated driving (dialogue among local residents, those affiliated with local government bodies, businesses, etc.)**

Cultivation of public acceptance to automated driving is one of the most important issues facing the implementation of automated driving. To that end, dialogue-based events featuring residents, those affiliated with local government bodies, businesses, and others, and held in a format based on the needs and transportation environment of the local area, serve to accelerate the process of studying new mobility services. Use dialogue with local residents and related communications to rectify both overconfidence in and distrust of automated driving, promoting correct understanding of the technology.

(2) **Clarification of the impact of automated driving**

First presenting the context within a long-term vision of Japan, organize and quantitatively express the impact of automated driving on reducing traffic accidents, cutting CO2 emissions, changing traffic congestion, and other factors, based on trends such as the level of the automated driving technology and the state of its propagation. Provide materials for open discussion on the utility and potential risks of automated driving. Also work to build an industry-academic-government collaborative framework connecting organizations, industries, and disciplines beyond what currently exists, with the aim of organizing an ecosystem for the practical implementation of automated driving.

(3) **Research on support for vulnerable road users (elderly, disabled, pregnant, travelers from overseas, etc.)**

Conduct studies and research from both technical and "intangible" perspectives on the potential for the use of automated driving technology to achieve mobility-enhancing services usable with peace-of-mind by vulnerable road users.

IV) Strengthening of international cooperation

(1) Communication at international conferences

Working on the basis of the cooperative framework between Japan, Europe, and the United States, participate in international conferences in Japan and overseas on the six key areas for international cooperation. Lead discussion of international standardization by broadcasting and communicating SIP's results. Identify researchers and administrative officials that are international leaders in their respective fields, and search for opportunities for international collaboration for the various research and development projects within SIP.

(2) Joint research with overseas research organizations

Search for topics for collaboration and study collaborative schemes with a focus on joint research with research organizations that have a central presence in an important technical field and offer collaborations that can be expected to be beneficial. In the interest of making these initiatives continuous projects, work to build industry-academic-government collaborations toward the establishment of a major host organization that can deal with problems distinctive to Japan and is on par with industry-academic-government collaborative research organizations overseas.

(3) Communication via online media

Share research and development results from SIP on an international basis and contribute to the creation of internationally appropriate technologies and institutional systems. Broadly share information acquired at international conferences and similar venues with interested parties, and otherwise carry on and strengthen the information distribution activities conventionally targeting experts. Additionally, as it is the first year of a 5-year research and development project, formulate a communication strategy and vision for providing information to ordinary residents with the aim of cultivating proper understanding of and public acceptance to automated driving technology, with an eye to the future implementation and propagation of such technologies in society.

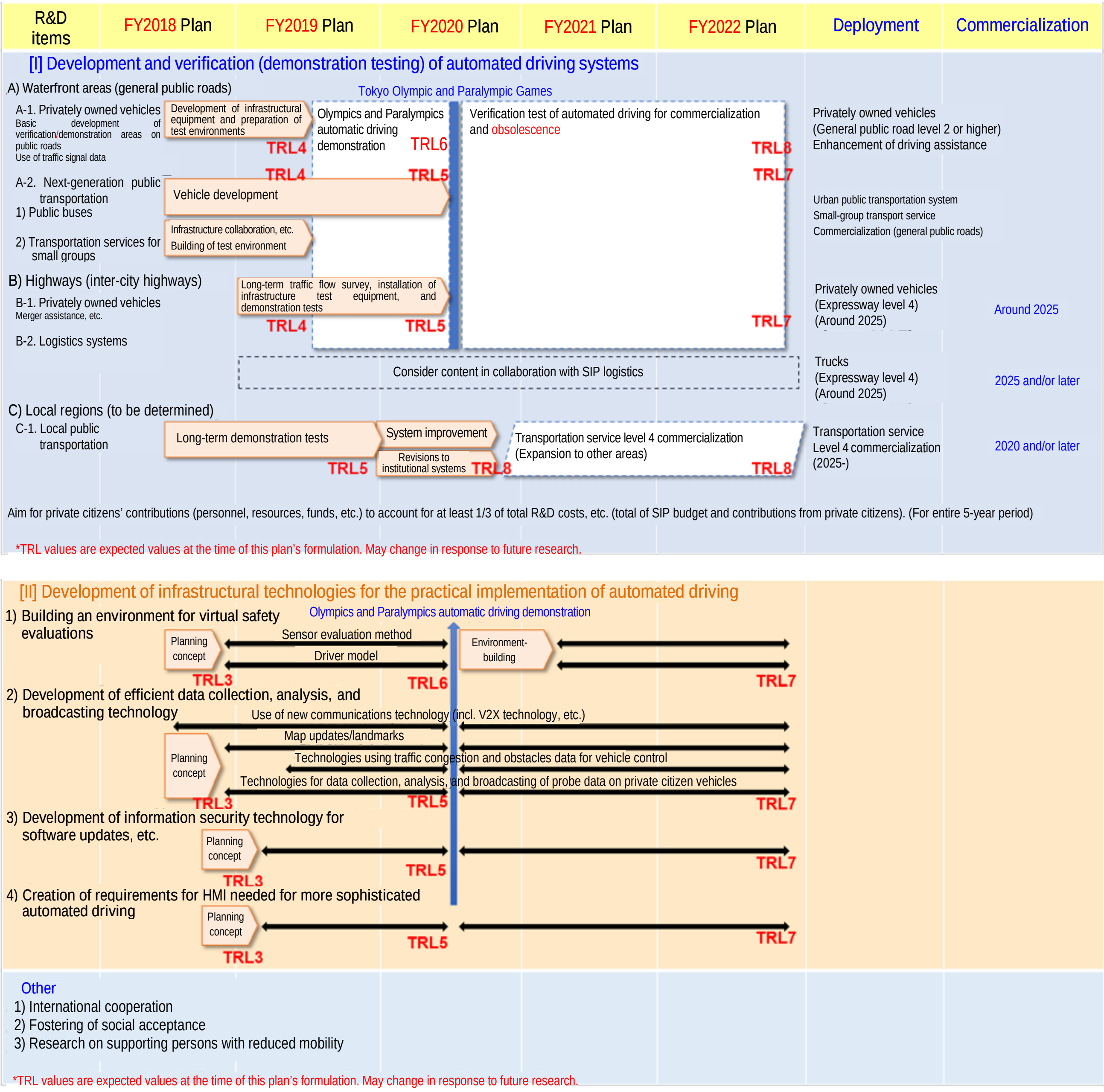

Fig. 2-2. R&D Roadmap

SIP Phase Two: TRL definitions for automated driving

TRL: Technology Readiness Level

	TRL	Definition
Foundational research	1	Basic scientific principles or phenomena discovered
	2	Formularization of the basic principles or phenomena; applied research
Practical research, development	3	Confirmation of the technology concept
	4	Laboratory testing
	5	Testing in a hypothesized use setting
Verification	6	Verification/Demonstration (system level)
	7	Top user test (system level)
Commercialization	8	Pilot run
	9	Mass production

SIP can handle up through TRL 7. TRL 8-9 are developed by the business world.

3. Implementation structure

(1) Use of NEDO

This program uses subsidies to NEDO to implement via the system shown in Figure 3-1. NEDO assists the PD and Promoting Committee to study research and development plans, manage research and development progress and budgeting, support administrative work for self-inspections, create evaluation materials, conduct relevant studies and analysis, etc.

(2) Selection of the principal investigator

Based on this plan, NEDO selects, via open application, research tasks and the principal investigator who will pursue these research tasks. Screening standards and the screening methods used by screeners are decided by NEDO in consultation with the PD, Cabinet Office, government agencies responsible for policy, and the Promoting Committee. No parties with an interest in the researchers participating in the application shall participate the screening of that application. The definition of "party with an interest" shall be determined by NEDO.

(3) Methods of optimizing the research framework

The practical implementation of automated driving requires not only technical work with respect to the vehicles but also work on institutional systems and environment-building. Moreover, collaboration is required between government agencies and between industry, academia, and the government in order to create traffic signal data, roadway regulations data, and other data. The hope is to maintain the relationships of mutual trust built up in SIP phase one while aiming for even further accomplishments in SIP phase two, deepening cross-disciplinary initiatives, and developing an industry-academic-government collaborative framework that extends throughout Japan. Collaborations will be actively sought with foreign projects and the initiative taken in promoting international cooperation and standardization strategies.

SIP's first and second phases overlap in FY2018. In order to simultaneously both properly process the results of the first phase while also developing the foundations for beginning smooth research and development activities, the program will attempt to make the effective use of time and money by avoiding redundancy in the meeting and committee structures as much as possible.

Specifically, the Promoting Committees will hold joint meetings for FY2018. New meetings and committees required for some topics will be kept at a minimum, such as the new task force for the formulation of plans for FOTs in the Tokyo waterfront areas. In FY2019, only the SIP phase two initiatives will be pursued, and the Promoting Committee, subordinate working groups, and other elements of the structure will be reorganizing.

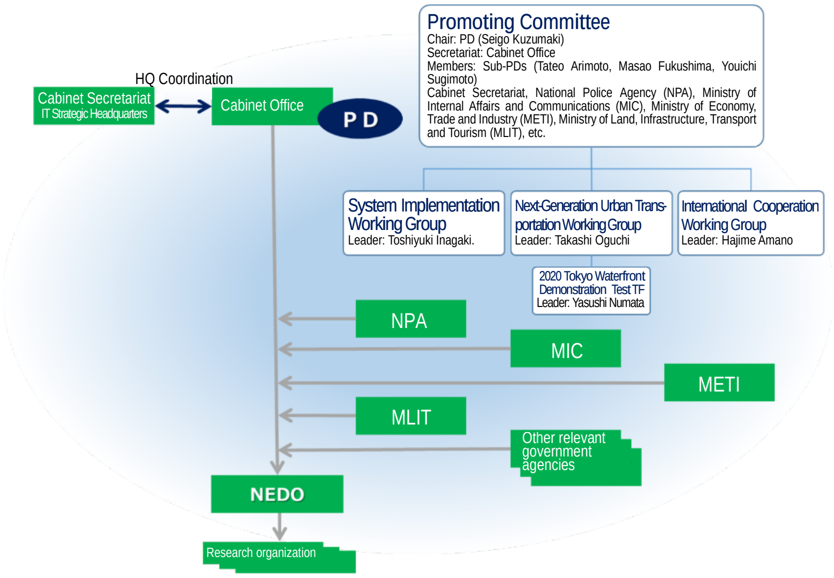

Figure 3-1. Implementation structure

(4) Collaboration between government agencies

The practical implementation of automated driving requires not only technical work with respect to the vehicles but also work on institutional systems and environment-building. Moreover, collaboration is required between government agencies and between industry, academia, and the government in order to create traffic signal data, roadway regulations data, and other data. Relationships of mutual trust built up in SIP phase one will be maintained while deepening cross-disciplinary initiatives.

(5) Expectations of contributions from the business world

The business world will be encouraged to invest in automated-driving vehicles and evaluation staff, and then the program will create and pursue practical implementation plans for legacy-oriented products.

Future contributions (including both human and material contributions) from the business world are expected to exceed 1/3 of the total value of research and development costs and similar (i.e. the total of contributions from both the national government and the business world). (Refers to the 5-year period overall.)

4. Intellectual property

(1) IP Committee

- For each task and subordinate research item therein, an IP Committee will be established at the management body or the organization (contractor) to which the selected principal investigator belongs.

- The IP Committee is responsible for publishing papers on research and development results achieved by the establishing organization, as well as for determining policies toward the application and maintenance of patents and other IP rights (hereinafter "IP rights") and for coordinating IP rights licensing as necessary.
- The IP Committee shall generally consist of the PD or a representative of the PD, principal relevant parties, experts, and others.
- The organization that established the IP Committee shall determine the specifics of how the committee will be managed.

(2) IP rights-related agreements

- In advance of any work, the management body will sign contracts or other agreements with contractors to establish the handling of nondisclosure, background IP rights (IP rights already held by the principal investigator or their organization [etc.] before participating in the program, as well as IP rights acquired independently of SIP program funds after participating in the program), and foreground IP rights (IP rights created within the program using SIP program funds).

(3) Licensing of background IP rights

- The holder of a background IP rights can license those IP rights to other program participants under conditions established by the IP rights holder (or under terms agreed upon by the program participants).
- If those conditions or other aspects of the IP rights holder's behavior risk becoming a hindrance to SIP (including not only research and development but also the implementation and commercialization of results), mediation will be conducted in the IP Committee to reach a reasonable solution.

(4) Handling of foreground IP rights

- As per Article 19-1 of Industrial Technology Enhancement Act, foreground IP rights shall generally belong to the organization (contractor) to which the principal investigator (as the inventor) belongs.
- If a subcontractor is responsible for an invention and the IP rights will belong to the subcontractor, or in similar such cases, the IP Committee must first give its approval. At this stage, the IP Committee can attach conditions to its approval.
- If an IP rights holder has little interest in commercialization, the IP Committee shall recommend that the IP rights be held by a party that will actively pursue commercialization, or that the IP rights be licensed to a party that will actively pursue commercialization.
- In the event that a party withdraws from the program in the middle of their participation period, the management body has the power to transfer without compensation all or part of

any patents, or issue licenses for all or part of any patents, for IP rights achieved using SIP program funds during that participation period (if the withdrawing party participated for multiple fiscal years, this applies to all IP rights achieved since the party first began participating).

- In general, the IP rights holder will cover any costs associated with patent application, maintenance, etc. In the case of a joint application, cost distribution and percentage interest in the patent shall be negotiated between the joint applicants.

(5) Licensing of foreground IP rights

- The holder of foreground IP rights can license those IP rights to other program participants under conditions established by the IP rights holder (or under terms agreed upon by the program participants).
- The holder of foreground IP rights can license those IP rights to a third party under conditions set by the IP rights holder, to the extent that those conditions are not more favorable than those set for program participants.
- If those conditions or other aspects of the IP rights holder's behavior risk becoming a hindrance to SIP (including not only research and development but also the implementation and commercialization of results), mediation will be conducted in the IP Committee to reach a reasonable solution.

(6) Transferal of foreground IP rights and the issuance/transferal of exclusive licenses

- As per Industrial Technology Enhancement Act, Article 19-1(4), the transferal of foreground IP rights and the issuance/transferal of exclusive licenses to such IP rights, require the approval of the management body, except in cases of transfer resulting from a merger or division (demerger), transfer of IP rights to a subsidiary or parent company, issuance or transfer of an exclusive license, etc. (hereinafter "IP rights transfer or similar resulting from a merger, etc.").
- An IP rights transfer or similar resulting from a merger, etc., shall require the authorization of the management body, subject to the contract between the IP rights holder and the management body.
- Even after the conclusion of an IP rights transfer or similar resulting from a merger, etc., the management body can hold a license with the right to sublicense for those IP rights. If the relevant conditions are unacceptable, the transfer shall not be approved.

(7) Handling IP rights after project conclusion

- If there are no claimants to IP rights after research and development has been completed, the handling (abandonment or inheritance by the management body) of those IP rights will be negotiated through the IP Committee.

(8) Participation by foreign organizations (companies, universities, researchers, etc.)

- The participation of a foreign organization is permitted if necessary to proceed with program tasks.
- In the interest of proper operational management, a representative or point of contact handling administrative issues pertaining to research and development contracts and similar must be located within Japan.
- IP pertaining to foreign organizations shall be shared between the management body and the foreign organization.

5. Evaluations

(1) Evaluating body

The Governing Board shall conduct evaluations, inviting external experts and others to participate. These evaluations shall be conducted with reference to results reports of self-inspections conducted by the PD, NEDO, etc. The Governing Board can host such evaluations for each field or task.

(2) Evaluation period

- There shall be preliminary evaluations, year-end evaluations at the end of each fiscal year, and final evaluations.
- After project conclusion, follow-up evaluations will be conducted as necessary after a certain amount of time has passed (generally three years).
- In addition to the above, evaluations can also be conducted mid-fiscal year as necessary.

(3) Evaluation parameters and standards

Based on the General Guidelines for the Evaluation of Government Research and Development (R&D) Activities (Issued by the Prime Minister on December 21, 2016), and aiming to evaluate necessity, efficiency, effectiveness, and other such factors, evaluation parameters and standards shall be as follows below. Evaluations shall not simply judge accomplishment or failure of goals, but shall further include analysis of causes, proposals for ways to make improvements, etc.

1) Importance of the purpose; consistency with the objectives of the SIP system.
2) Adequacy of targets (especially outcome targets); degree of achievement of the progress schedule for achieving those targets.
3) Whether proper management is being conducted. In particular, whether there have been benefits due to collaboration between government agencies.
4) Quality of practical implementation and commercialization strategies; degree of achievement of those strategies.

5) For final evaluations: anticipated effects or ripple effects. Whether post-project follow-up plans are appropriate and clearly established.

(4) Application of evaluation results

- Preliminary evaluations shall be conducted concerning plans for the next and subsequent fiscal years, and applied to plans for the next and subsequent fiscal years.
- Year-end evaluations shall be conducted concerning results up through the present fiscal year and plans for the next and subsequent fiscal years. These evaluations shall be applied to plans for the next and subsequent fiscal years.
- Final evaluations shall be conducted concerning results up through the final fiscal year, and applied to post-project follow-up, etc.
- Follow-up evaluations shall be conducted concerning the progress of the practical implementation and commercialization of tasks' results, and shall feature proposals for improvements, etc.

(5) Publishing results

- Evaluation results shall generally be made public.
- Governing Boards that conduct evaluations shall not be made open to the public, due to the involvement of non-public research and development information, etc.

(6) Self-inspections

1) Self-inspection by the principal investigator

The PD shall select the principal investigator who will perform a self-inspection. (In general, the principal researcher/research organization will be selected for each research item.)

The selected principal investigator shall apply "5.(3) Evaluation parameters and standards," inspect both achievements since the last evaluation and future plans, and not simply judge accomplishment or failure of goals, but shall further include analysis of causes, ways to make improvements, etc.

2) Self-inspection by the PD

With reference to the self-inspection results of principal investigators as well as the opinions of third-parties and experts as necessary, the PD shall apply "5.(3) Evaluation parameters and standards"; inspect both the achievements and future plans of the PD, NEDO, and the principal investigators; and not simply judge accomplishment or failure of goals, but shall further include analysis of causes, ways to make improvements, etc. Drawing on the results of this self-inspection, the PD shall determine whether each principal investigator should continue their research and offer necessary advice to the principal investigators and others. In this way, this system should enable autonomous, self-directed improvements.

The PD, with the help of NEDO, shall create materials based on these results for the Governing Board.

3) **Self-inspection by the management body**

Self-inspections by NEDO shall consider topics such as whether administrative procedures are being properly conducted in terms of budget implementation.

6. Deployment Milestones

(1) Exit-oriented research implementation

This program sets the Olympic and Paralympic Games Tokyo 2020 as a milestone in its aim to overcome three barriers to implementation through industry-academic-government collaboration: developing the technology, the legal framework, and the public acceptance required. This work will be conducted in combination with infrastructural technology development and FOTs in the Tokyo waterfront area, local regions, and elsewhere. These FOTs will promote investment through the participation of automobile companies, businesspeople, local government bodies, and other parties to help achieve implementation and commercialization of the technology. Moreover, the active use for a variety of purposes of maps and geographical data created to support automated and advanced driving technologies will be promoted to contribute to the achievement of Society 5.0.

1) Use of the Olympic and Paralympic Games Tokyo 2020

   Use the preparatory period leading up to the Olympic and Paralympic Games Tokyo 2020 to take advantage of the attention and opportunities presented by the games to promote Japanese technology to the world, and collaborate with the Japan Automobile Manufacturers Association to conduct FOTs in the Tokyo waterfront area.

2) FOT planning and administration that involves businesses and local government bodies

   Commercialization-oriented FOTs will be conducted for logistics and transportation services and services that provide mobility within underpopulated areas, in collaboration with businesses, local government bodies, and other relevant parties.

3) Better linkage with other SIP tasks

   High-precision map data, road traffic data, and vehicle probe data created and collected for automated driving can be expected to be useful to a variety of other industries in addition to the automobile industry. Work to link up with other SIP tasks (security, etc.) while building a framework whereby these types of data can be distributed in a safer and easier-to-use format. Aim for the on-going commercialization of data creation.

   Additionally, collaborate with SIP logistics on automated-driving research for logistics services, and plan out research and development content and FOTs after sufficient discussion regarding needs and exits.

4) Selection of clients and private-sector parties to which to transfer research results and technology
At its core, this project conducts research and development on topics that fall within cooperative areas (as opposed to competition). For that reason, it is assumed that the work of this project will be inherited by an organization of a public nature. Research results and technology will be transferred to an existing public organization or a private company invested in by several companies, such as DMP (Dynamic Map Platform Co., Ltd.), which was established in the first phase of SIP. Additionally, research results will also be reflected in actual products by making results pertaining to cyber security, HMI, and other vehicle structure-related areas into industry guidelines.

(2) Propagation-promoting measures

In order to promote the propagation of automated driving technology, it is important to cultivate society's receptivity to the technology. Initiatives will work to clarify the value of and issues with automated driving, and to have Japanese people develop a correct understanding of it, in addition to performing research to improve services. International collaboration will be pursued to see that the development of this technology occurs on a global basis as international standardization is also pursued.

1) Increase awareness by utilizing the opportunity presented by the Olympic and Paralympic Games Tokyo 2020
2) Plan and establish places for dialogue with residents alongside FOTs in local areas
3) Promote research and development on and practical implementation of services oriented toward the propagation of automated driving

7. Other important items

(1) Legal basis and related topics

This program is implemented based on the following: Act for Establishment of the Cabinet Office (Act No. 89 of 1999) Art. 4-3(7)3; Basic Policy on the Costs of Creating Innovation in Science and Technology (May 23, 2014; Council for Science, Technology and Innovation); Implementation Policy for the Cross-ministerial Strategic Innovation Promotion Program (SIP) second phase (FY2017 revised budgetary provision) (March 29, 2018; Council for Science, Technology and Innovation); Guidelines for the Cross-ministerial Strategic Innovation Promotion Program (May 23, 2014; Council for Science, Technology and Innovation, Governing Board); and National Research and Development Agency Act on the New Energy and Industrial Technology Development Organization, Art. 15-2.

(2) Plan flexibility

This plan shall be revised as required in the interest of maximizing and accelerating achievement of results.

(3) PD and assigned personnel

1) PD

Seigo Kuzumaki
(April 2018-)

2) Assigned directors (Councilors)

Takao Nitta
Leader/Director
(April 2018-)

Naohiko Kakimi
Sub-leader
(April 2018-)

Yoshihiro Izawa
Director
(April 2018-)

3) Assigned personnel

Masaki Chikuma
(April 2018-)

Kaoru Sugie
(April 2018-)

Attached material: Funding plan and estimates

(Units used below: Millions of yen)

FY2018 total: 3,000

(Subtotals)

1. Research funds and similar (incl. administrative costs, indirect expenses)		2,884
(Subtotal for each research and development item)		
[I]	Development and verification (FOTs) of automated driving systems (Relevant government agencies: National Police Agency; Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; etc.)	1,820
[II]	Development of core technologies for the practical implementation of automated driving (Relevant government agencies: National Police Agency; Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; etc.)	774
[III]	Fostering of public acceptance to automated driving in the interest of furthering the spread of automated driving (Relevant government agencies: National Police Agency; Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; etc.)	130
[IV]	Strengthening of international cooperation (Relevant government agencies: National Police Agency; Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure, Transport and Tourism; etc.)	160
2. Project costs (Personnel expenses, evaluation expenses, meeting expenses, etc.)		116