Public-Private ITS Initiative/Roadmaps 2018

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Strategic Headquarters for the Advanced Information and Telecommunications Network Society

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1. Introduction and Definitions

(1) Introduction

The collective term "Intelligent Transport Systems" ("ITS") means new road transport systems designed to integrate people, roads, and vehicles via cutting-edge information and communications technology to enhance the safety, transport efficiency, and comfort of road transport, and the systems devoted to improving the safety and convenience of road transport.

In recent years, ITS, in particular automated driving systems, has been experiencing significant innovations due to the development of information technology (IT) and progress in the use of data. In particular, since June 2013 when the Declaration on the Creation of the World's Most Advanced IT Nation (hereinafter referred to as "the Declaration of Creation") was announced by the Japanese government, many domestic and overseas manufacturers have conducted demonstrations of automated driving systems and field operational tests on public roads. As can be seen by the fact that nations around the world have also been announcing policies regarding automated driving, it seems that the era of global competition over the practical application and popularization of automated driving systems has set in. In the midst of this global context, the government of Japan has been promoting public-private partnership-based research and development under the Cross-Ministerial Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (hereinafter referred to as "SIP"): Automated Driving Systems since fiscal 2014.

In the past, Japan has maintained the world's highest technology, an automobile industry that is the largest export industry in Japan, and the world's most advanced level of ITS-related infrastructure. However, in the midst of the significant global innovation in ITS, it is no longer easy for Japan to maintain its relatively high competitive edge.

The whole society of Japan aims to acutely respond to this innovation wave, continue building and maintaining the world's most advanced ITS, and develop and implement strategies through collaboration between the public and private sectors to allow its people to enjoy the fruits of the world's best road transport that society can offer.

By doing so, Japan aims to build and maintain the world's best ITS and thereby contribute to its people and the world.

With this as an objective, Japan has developed and revised the Public-Private ITS Initiative/Roadmaps four times since June 2014 and will continue to pursue this objective.

The development of the Public-Private ITS Initiative/Roadmaps has led to the sharing of the future direction among ITS-related ministries, agencies, and private companies; the promotion of specific collaboration among related ministries and agencies; and the encouragement of competition and collaboration among private companies. In particular, as a system to enable field operational tests of unmanned autonomous driving transport services on the public road in specified areas has been developed and demonstration projects have been implemented in regions across the country, and companies that are tied to the development of high-precision three-dimensional maps constituting static information as a subset of dynamic maps underpinning the large-scale SIP field operational tests of automated driving on highways begun in fiscal year 2017 have been established in collaboration with private-sector companies.

On the other hand, technologies and industries related to ITS including automated driving systems (hereinafter referred to as "ITS/Automated Driving" to clearly state that it includes automated driving) have been making rapid progress. In particular, as the structure by which data are distributed changes with the evolution of the Internet of Things (IoT), artificial intelligence (AI) – which utilizes such data as an infrastructural element – is important for the development of recognition and judgment technologies. In addition, domestic and foreign emerging automakers companies such as automakers and emerging IT companies have announced their efforts for the commercialization of highly automated driving and competition in development is becoming increasingly intense. Meanwhile, some countries and regions have begun considering the development of systems for the commercialization of highly automated driving.

This Public-Private ITS Initiative/Roadmaps 2018 developed as a radical revision of the Public-Private ITS Initiative/Roadmaps 2017 after discussing recent changes in the situation surrounding ITS and automated driving in the meetings of the Road Transport Working Team, New Strategies Promotion Expert Panel, IT Strategic Headquarters, including joint meetings with the SIP Automated Driving Systems Promotion Committee, which have been held since December 2017.

(2) Definitions of Automated Driving Systems

Definitions of automated driving levels

Ranging from driving performed entirely by the driver and driving partially performed by the vehicle’s driver assistance system to driving performed entirely without the driver’s involvement, there are various concepts of driving in terms of the driver’s level of involvement in driving.

Definitions provided by SAE[1] International’s J3016[2] (September 2016) and JASO TP 18004[3] (February 2018), the Japanese version of the former translated for reference, are utilized as definitions of automated driving levels in the Public-Private ITS Initiative/Roadmaps 2018. Accordingly, particulars can be accessed by referring to these definitions. An outline of these definitions is provided in Table 1.

[1] Society of Automotive Engineers
[2] SAE International J3016 (2016) "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicle”.
[3] JASO technical paper “Level categories and definitions corresponding to driving automation systems for automobiles” (published on February 1, 2018)

In addition, automated driving systems at Level 3 and above are called "Highly Automated Driving Systems", [4] and those at Levels 4 and 5 are called "Fully Automated Driving Systems" in the Initiative/Roadmaps 2018.

[Table 1] Overview of the definitions of automated driving levels

Level	Overview	Object and Event Detection and Response for Safe Driving by:
The driver performs some or all dynamic driving tasks.		
Level 0 No automation	▪ The driver performs all dynamic driving tasks.	Driver
Level 1 Driver assistance	▪ A system performs vehicle driving control sub-tasks in either a longitudinal or lateral direction within an operational design domain.	Driver
Level 2 Partial automation	▪ A system performs vehicle driving control sub-tasks in both longitudinal and lateral directions within an operational design domain.	Driver
An automatic driving system (when activated) performs all dynamic driving tasks.		
Level 3 Conditional automation	▪ A system performs all dynamic driving tasks within an operational design domain. ▪ Where continued activation is difficult, an appropriate fallback response can be made to an intervention request made by the system.	System (DDT fallback-ready driver)
Level 4 High automation	▪ A system performs all dynamic driving tasks and can respond within an operational design domain where continued activation is difficult.	System
Level 5 Full automation	▪ A system performs all dynamic driving tasks and can respond within limitation where continued activation is difficult (in other words, not within an operational design domain).	System

The definitions of the terms in J3016 are shown below.

Term	Definition
Dynamic Driving Task (DDT)	▪ All real-time operational and tactical functions required to operate a vehicle in on-road traffic, exclusive of such strategic functions as trip planning and the determination of way points. ▪ Including, but not limited to, the following sub-tasks: 1) Vehicular motion control in a lateral direction by steering; 2) Vehicular motion control in a longitudinal direction through acceleration and deceleration; 3) Monitoring the driving environment through the detection, recognition, and classification of objects and events and preparations of reactions thereto; 4) Executing reactions to objects and events; 5) Driving plans; 6) Improving conspicuity through lighting, signals, gestures, and more.
Object and Event Detection and Response (OEDR)	▪ Sub-tasks for dynamic driving tasks inclusive of the monitoring of the driving environment (detecting, recognizing, and classifying objects and events and preparing to respond thereto where necessary) and the execution of

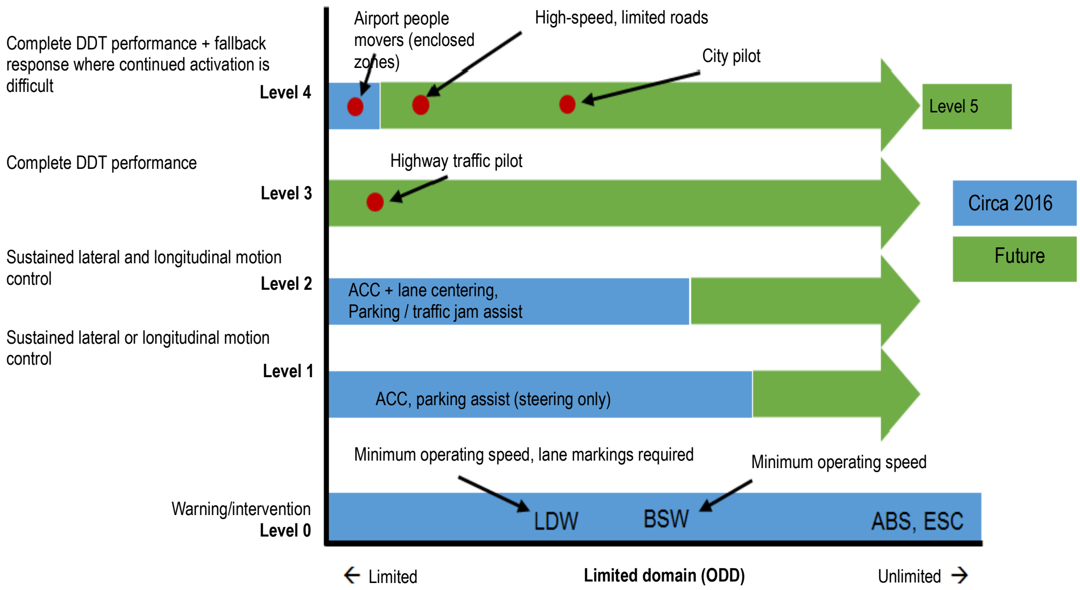
[4] In the Federal Automated Vehicle Policy (September 2016) by the U.S. NHTSA, vehicles of SAE Level 3 and above are called "highly automated vehicles (HAV)."
In J3016, vehicles in level 3 and above are defined as automated driving systems (ADSs.) However, the Public-Private ITS Initiative/Roadmaps 2017 uses the term "automated driving system" as a general term for systems relating to driving automation.

	appropriate responses to such objects and events (dynamic driving tasks and/or where necessary to complete a fallback response in any case where continued activation of dynamic driving tasks is difficult).
Operational Design Domain (ODD)	▪ The specific conditions under which the given driving automation system or functions thereof are designed to operate (including, but not limited to, driving modes). Note 1: An ODD can include geographic, roadway, environmental, traffic, speed, and/or temporal limitations. Note 2: An ODD can include one or more driving modes.

In addition, it is pointed out in J3016 that the range of operational design domains (ODD) serves as an important indicator for evaluating automated driving technology as well as automated driving levels. At each of Levels 1 to 4, the wider the ODDs that are specific conditions under which the driving automation system is designed to function are, the more technically sophisticated the system is. In other words, even at Level 4 (one of the fully automated driving systems), if the system enables automated driving within a narrow range of ODDs, its level of technical sophistication is relatively low.

In addition, Level 5 is defined as one of the Level 4 automated driving systems but with unlimited ODDs, and thus its technical level is very high.

[Figure 1] Significance of ODD at each automated driving level



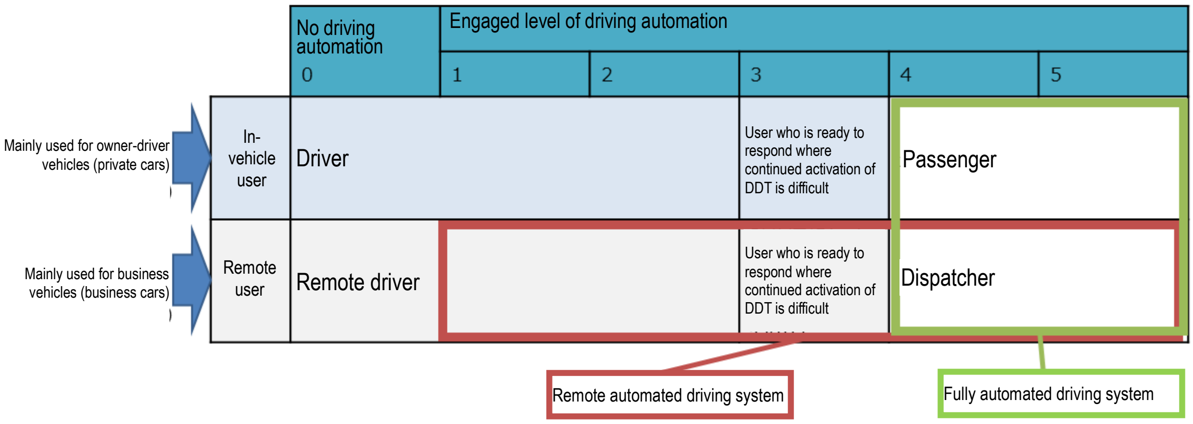
These definitions will be reviewed as needed in accordance with SAE's review of their definitions.

Remote automated driving system

Moreover, according to J3016, automated driving systems are divided into those with a user who is inside the vehicle (including those who are the equivalent of drivers; hereinafter the same applies) and those with a user outside the vehicle who remotely monitors and operates it.

The Initiative/Roadmaps defines the latter, "driving automation system with a user outside the vehicle",[5] as "Remote Automated Driving System" and transport services that use such remote automated driving systems are called "unmanned autonomous driving transport Services."

[Figure 2] "User" roles in automated driving (created based on J3016)



<u>**Definitions of specific automated driving systems**</u>

Based on the above-mentioned definitions of J3016, the Initiative/Roadmaps 2018 describes "semi-autopilot" and "autopilot" as specific automated driving systems that are expected to be commercialized and applied to services in the near future and defines them as follows.

[Table 2] Specific Automated Driving Systems and Overview

Name of System	Overview	Corresponding Level
Semi-Autopilot	・ It supports automated driving on expressways (from entrance ramps to exit ramps; merging, changing lanes, keeping lanes or a certain distance between cars, diverging, etc.). ・ Though the driver performs object and event detection and response for safe driving during automated driving mode, the system notifies the driver of traveling conditions.	Level 2
Autopilot	・ It supports automated driving on expressways and under other specific conditions. ・ Though the system performs all the DDT during automated driving mode, the driver takes over in response to a request by the system.	Level 3

[5] In this case, the user plays the following roles according to automated driving levels:
- At SAE Level 2, "Remote Driver" remotely performs monitoring and operation.
- At SAE Level 3, "DDT Fallback-Ready User" positioned remotely performs monitoring and operation as a remote driver in case of a request to intervene made by the system.
- At SAE Level 4, "Dispatcher" (tentative translation, formal translation will be discussed) positioned remotely operates the vehicle as a remote driver in case of necessity such as vehicle malfunction.

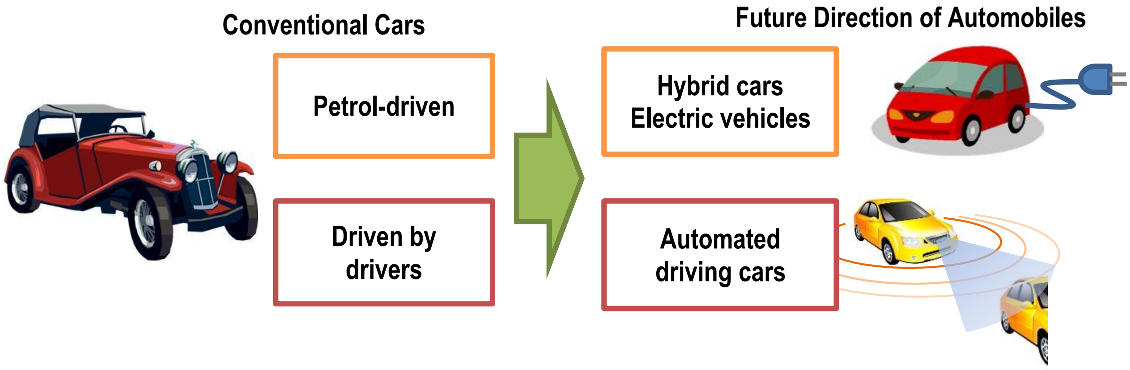
2. Positioning and Future Direction of ITS/Automated Driving

(1) Positioning of ITS/Automated Driving Systems

Since the start of mass production by Ford in 1908, the use of automobiles has rapidly spread throughout the world, and today, the automobile is an indispensable part of our lives. Over the past 100 years or so, gradual ongoing innovation has taken place with regard to automobiles, leading to the development of today's sophisticated automobiles. However, the fundamental structure of automobiles, such as their being petrol-driven and driver-driven, has not changed until recently.

This fundamental structure of automobiles is expected to go through discontinuous, disruptive innovations over the coming ten to twenty years. Specifically, such innovation includes a trend toward automated driving systems that have been enabled by the recent development of IT and networks, as well as trends toward hybrid cars and electric vehicles.

[Figure 3] Future Changes in the Structure of Automobiles



In particular, interest in Automated Driving Systems has been growing rapidly throughout the world in recent years as exemplified by the fact that many automobile and emerging IT companies in the world have been actively developing the systems. Moreover, developed countries have been making efforts to promote automated driving through industrial policy competition and coordination such as the announcement of comprehensive strategy documents concerning automated driving by developed countries since the announcement of the Public-Private ITS Initiative/Roadmaps (June 2014) by Japan and the holding of the G7 Transport Ministers’ Meetings where automated driving has been addressed since 2015.

The emergence of automobiles more than 100 years ago and its subsequent widespread use revolutionized the mobility of people and the means of logistics of goods, had a significant impact on society, and drastically changed the industrial structure. Along with the emergence and widespread use of automobiles, institutions and social systems related to road transport have been developed as global standards. The recent trend toward automated driving systems is expected to have a similar impact on society, and the existing institutions and social systems may be required to evolve again.

With these points in mind, we need to review roadtransport-related institutions and social systems to allow further evolution and to fully enjoy the positive impact of automated driving systems.

(2) Future Direction of Automated Driving Systems

A. Impact on society and business models

Social Impact of Automated Driving Systems

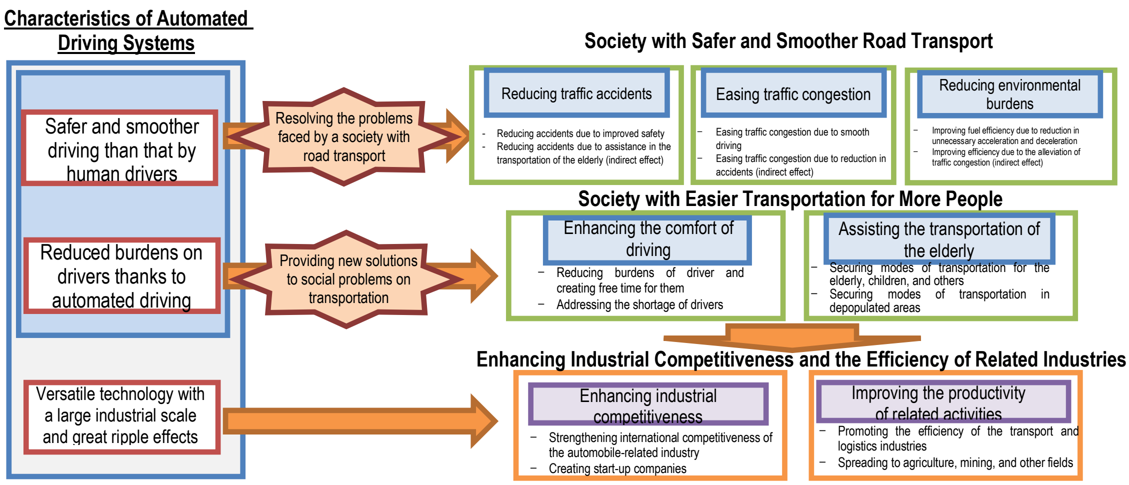
While automated driving systems are not expected to readily become common, they are expected to spread rapidly over the coming ten to twenty years and have a significant impact on society.

Specifically, driving via automated driving systems is generally safer and more efficient than that by humans; therefore, these systems can significantly contribute to solving issues faced by a society with conventional traffic systems, such as reducing traffic accidents, alleviating traffic congestion, and reducing the environmental load.

Moreover, in addition to solving those issues, automated driving systems can drastically reduce the burden of driving on drivers. In particular, sophisticated automated driving systems potentially provide new means to solve conventional social issues related to mobility.

The automobile-related industries, including peripheral industries, are large in size and based on highly versatile technologies that have significant ripple effects. Therefore, promoting innovation based on new automated driving technology that can solve the aforementioned issues will not only lead to the strengthening of the competitiveness of the automobile industry and the creation of new industries, but also have a significant impact on various industries through improved efficiency and innovation in the mobility/logistics industry and promote the application of automated driving technology to other fields related to automated driving technology (e.g., agriculture and mining).

[Figure 4] Social Expectations for Automated Driving Systems (Example)



<u>Direction of the business models for automobile/transportation services</u>

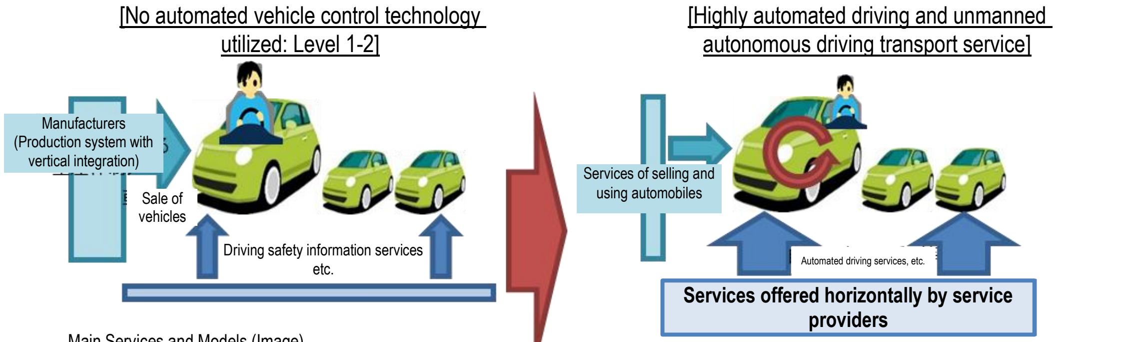
The development of automated driving systems not only has an impact on society, but can also possibly change the conventional industrial structure related to automobile/transport services by changing the focus of the business models and the added value of these services.

Specifically, since conventional automobiles presuppose driving by drivers, the focus of the added value related to the automobile/transport services was placed on the sale of automobiles, which were produced by manufacturers under vertical integration systems, to drivers. However, especially in highly automated driving systems, as systems—not drivers—drive vehicles, the focus of added value may shift to lateral business, such as the provision of transport services to a large number of vehicles through a highly automated driving system. Moreover, particularly in fully automated driving systems, competition and collaboration may intensify between such lateral business bases and those associated with the assignment and matching of vehicles, which arise from a growing sharing economy.

In the future, the business model related to automobiles and mobility will change along with the developments in automated driving systems and the sharing economy, and transport services provided by a wide variety of operators, including individuals and businesses, will increase. Therefore, we need to examine matters that facilitate the smooth operation of transport services by private companies while keeping a close watch on business trends.

[Figure 5] Change in Business Models Associated with the Development of Automated Driving Technology (for illustrative purposes only)[6]

Direction of a change in the business model based on the sale of vehicles (example)[7]



Main Services and Models (Image)

- Individuals buy, own, and drive automobiles.
- Individuals use Transport Services (e.g. taxi).

Major Services and Models (Image)

Individuals use and own automobiles, and buy automated driving services as necessary.

Individuals use Transport Services (e.g. automated driving services).

Note: "Automated driving services" (tentative name) are services where service providers drive or operate automobiles on behalf of drivers or during the entire travel.

B. Direction of the evolution of the data architecture

Future direction of data architecture for automated driving systems

These changes in the business model for automated driving systems have arisen from the changes in data architecture related to automated driving systems.[8]

The informatization of vehicles has advanced as an embedded architecture,[9] where along with the informatization of in-vehicle equipment and systems, various sensors have been installed in vehicles, and based on data from these sensors, in-vehicle equipment is controlled electronically.

Toward the further advance of automated driving systems, which represents the trends toward IoT, big data, and AI, the data architecture, including control judgment based on the data and knowledge platforms in each vehicle, is expected to become more sophisticated and evolve toward the following directions:

i. Part of the driving knowledge data, including probe data[10] and video data collected by each vehicle, is transferred to and accumulated in outside data and knowledge platforms such as cloud

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[6] The added value of the transport service business, in addition to the added value of personal ownership-based business, may increase because of the developments in automated driving systems.

[7] Changes in business models should be examined not only from the perspective of the sale of vehicles, but also from the perspective of a sharing economy.

[8] A basic design conception that segments and allocates product components according to their functions and that designs and adjusts interfaces for those components

[9] Architecture (design conception) that incorporates hardware and software into a product to achieve certain functions. Generally, there is no architectural compatibility among vehicles or manufacturers.

[10] Probe: It originally means sensors or remote monitoring devices.
Information that is collected, accumulated, and analyzed as big data includes locations where the brakes were applied and locations and time where and when the wipers were turned on. Information collected by cameras and radar equipped for automated driving systems is expected to be included in the future, and this will enable the generation of sophisticated map information regarding road shapes.

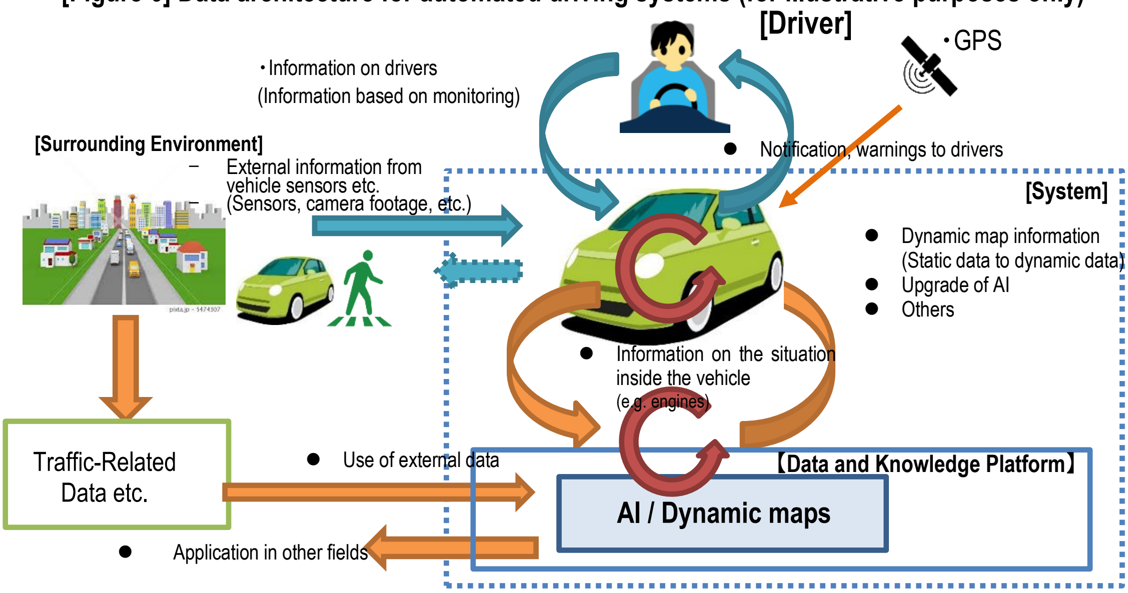
platforms via networks. Such data are used in various fields such as various big data analyses as well as dynamic maps[11] and base data for artificial intelligence.[12]

ii. In addition to the data obtained from a large number of vehicles, part of the data and knowledge platforms, such as artificial intelligence (AI) generated from outside data including high-precision 3D maps and driving video data associated with dynamic maps, is sent back to each vehicle via networks and used as data and knowledge required to make judgments related to automated driving.

iii. As a network structure, architecture such as edge/fog computing is used.

As a result, automated driving technology and the use of traffic data obtained through data platforms are expected to develop synergistically. Consequently, while automated driving systems are complementary even as they are primarily designed to enable the autonomous control of vehicles, traffic data will continue to be obtained from data platforms and used accordingly. Core technologies for utilizing such data will thus shift from conventional vehicular technology to software technology, which includes AI, and data platforms. It is also expected that the roles played by dynamic maps and cloud services utilized for the storage, processing, and provision of such maps will become more important as elements of these data platforms (see chapter 5).

[Figure 6] Data architecture for automated driving systems (for illustrative purposes only)



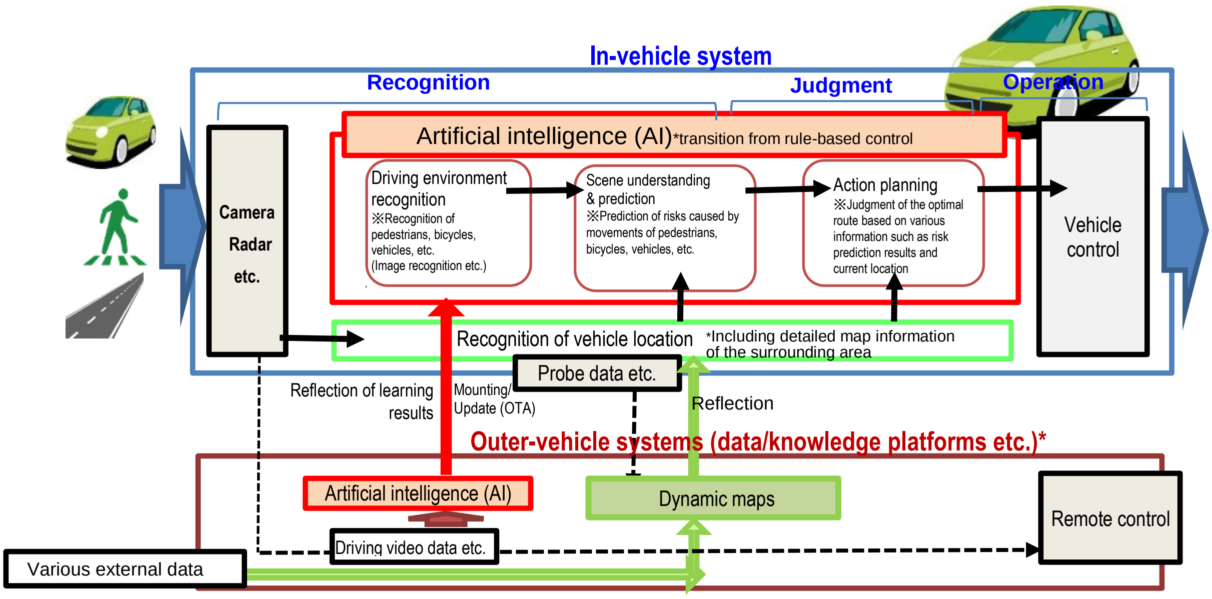
Many of the automated driving systems currently used for field operational tests are mainly controlled by traditional software (rule-based control), excluding some functions such as image recognition in the

[11] Dynamic maps are high-accuracy 3D maps (maps for automated driving) linked with time-varying dynamic data (dynamic information, quasi-dynamic information, and quasi-static information). High-precision 3D maps are being developed by privately-funded infrastructure developers as a cooperative area for dynamic maps (see chapter 5).

[12] Information that is collected, accumulated, and analyzed as big data includes locations where the brakes were applied and locations and time where and when the wipers were turned on. Information collected by cameras and radar equipped for automated driving systems is expected to be included in the future, and this will enable the generation of high-precision 3D maps information.

driving environment recognition function. Artificial intelligence (AI) and rules-based controls will likely come together to provide scene-recognition and scene-prediction functions, action-planning functions, and other such features to enable driving actions on city streets and in other more complex settings.

[Figure 7] Roles of artificial intelligence (AI) in future automated driving systems



In the architecture of automated driving systems, the role of interfaces seems to become more important in vehicles. Specifically, for driver interfaces,[13] interfaces that enable communication between drivers and vehicles while monitoring driver conditions will be developed (in particular Levels 2 and 3). For interfaces for the surrounding environment, interfaces for the provision of information (including that collected from the aforementioned in-vehicle equipment and sensors) to and communication with pedestrians and other moving objects around the vehicle will be developed.

Artificial intelligence (AI) is expected to be increasingly used in interfaces between vehicles and drivers, pedestrians, and other moving objects around the vehicle.

Autonomous-type architecture, cooperative-type architecture, and safety assurance

In these types of automated driving systems, plenty of data concerning information surrounding the vehicles are collected from various sources and used for driving operations.

The methods to collect information surrounding vehicles can be categorized into the following: a method to obtain information via radar installed in vehicles (autonomous type), a method to use information in the information platform on the cloud via networks (mobile phone networks etc.) (mobile type), and a method to collect information via communication with equipment installed on the road infrastructure or with equipment

[13] Specifically called HMIs (Human Machine Interfaces).

installed in other vehicles (narrow cooperative type; the former is a road-vehicle cooperative type while the latter is a vehicle-vehicle cooperative type).

These are not mutually exclusive technologies, but technologies that, when combined, enable more sophisticated driving safety support systems and automated driving systems that are based on diverse information. In fact, automated driving systems where vehicles are controlled by bi-directionally exchanging information obtained from sensors (autonomous type) and information (such as dynamic maps) obtained from the cloud (mobile type) are being developed.[14]

[Table 3] Types of information collection technology for driving safety support systems and automated driving systems

Types of information collection technology		Content of technology (method to input information)
Autonomous Type		Obtains information, such as obstacles, via radar and cameras installed in the vehicles
Cooperative Type (broad sense)[15]	Mobile Type	Collects location information via GPS. Collect information (including map information) on the cloud via mobile networks.
	Road-Vehicle Communication Type	Collects road traffic information surrounding vehicles via communication with equipment installed on roadside infrastructure.
	Vehicle-Vehicle Communication Type	Collects location and speed information of the vehicle via communication with equipment installed in other vehicles.

In the future, strategies toward the integration of autonomous and cooperative types will be particularly required as driving safety support systems develop into automated driving systems. Then, the automatic control type, including automated driving systems, will be based on autonomous information-based systems, where informational-type driving safety support devices are added as modules.[16]

In light of the increased dependence on data by automated driving systems, the data architecture for automated driving systems needs to be designed while handling and leveraging massive amounts of information. When designing, the following must be considered and practiced for security purposes: the

[14] Information collected and provided by dynamic maps is considered to be the cooperative type in a broad sense. From the perspective of automated driving, it is considered that such information complements information collected by the autonomous type such as radars and cameras and improves its reliability.
As for the methods for collecting and distributing such information, the utilization of communications through the mobile type is generally considered the most likely. However, it is necessary to discuss such methods in detail in view of future advances in technology while considering the division of roles between the mobile type, road-vehicle communication type, and vehicle-vehicle communication type.

[15] In this categorization, the mobile type was included in the broad cooperative type from the perspective of technology types related to information collection. (While it is not clearly defined, vehicles that use road-vehicle communication-type or vehicle-vehicle communication-type technology are sometimes called connected cars.)
For the mobile type, road-vehicle communication type, and vehicle-vehicle communication type, since these types have different real-time characteristics and popularization strategies, the cooperative type in this document shall indicate, in principle, the road-vehicle communication type and the vehicle-vehicle communication type, except the mobile type.

[16] For detailed strategies for the integration of autonomous and cooperative (road-vehicle cooperative type, vehicle-vehicle cooperative type) technologies, please refer to the Public-Private ITS Initiative/Roadmaps 2015.
For traffic light information that is indispensable for the realization of automated driving systems, since it seems difficult for the autonomous type to accurately detect and process such information, it is important for vehicles to ensure the detection and processing of such information by adding cooperative-type functions and referring to data provided by roadside infrastructure.

securing of redundancy, multiple safety design, such as a fail-safe mechanism, security measures (including required devices and operations management systems), and the development of technology and environment (testbed) to evaluate such measures.

In particular, in light of the possible risks, such as errors and discontinuation, the responsibility to implement the aforementioned measures for mobile-type outside data, including dynamic maps and cooperative-type road-vehicle/vehicle-vehicle data, shall be borne, in principle, by automated driving systems that use such data.[17]

(3) Future direction of the traffic-related data sharing platform and its use

In light of the increased importance of data in the big data era, traffic data not only help obtain traffic congestion information and the planning of traffic measures, but also play an important role as a foundation for automated driving systems as represented by the aforementioned dynamic maps. Moreover, it is also expected that the disclosure and effective use (in combination with other data) of such traffic data will contribute to the creation of new services in the tourism and insurance industries.

Conventional traffic-related data sharing platform

In Japan, the government has taken the initiative in installing a number of vehicle detectors and advanced optical beacons on roads. Information from these devices has been used for controlling road traffic. After being centrally collected mainly by the Japan Road Traffic Information Center (JARTIC), such information has been provided to drivers through traffic information boards, traffic information providers, and the Vehicle Information and Communication System (VICS).

In recent years, however, automobile manufacturers, electric appliance manufacturers, transportation companies, smartphone and tablet operating system manufacturing companies, and application development companies, as well as insurance companies, have been creating more sophisticated information services for vehicle users by collecting various probe data from vehicles, analyzing them as big data, and combining such data with the aforementioned public road traffic information.

On the other hand, the public sector has been developing initiatives for the smart use of roads by comprehensively leveraging a broad range of detailed pieces of big data, including data on speed and behavior with respect to ETC 2.0 and advanced optical beacons. In the future, the accumulation of such a wide variety of vehicle data will accelerate along with the progress in vehicle informatization and networking.

Future direction of the traffic-related data sharing platform

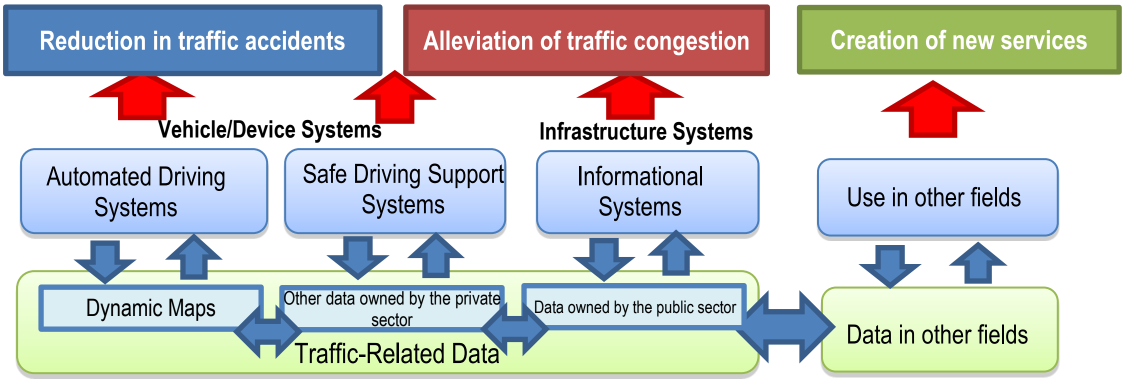
In the midst of such trends, particularly a trend in traffic data toward IoT, not only location and speed information, but also a wide variety of data collected by sensors and cameras installed in vehicles will be

[17] Safety design and measures that take risks into consideration are required for data acquired by the autonomous-type method.

used as probe data, and along with the further evolution of automated driving systems, dynamic maps that utilize such data will be maintained and managed efficiently in light of the status of acquisition of such data by private sectors and their needs.

While the systems owned by the public and private sectors have been developed separately in a vertically integrated manner to achieve the unique objectives of each system, in the big data era, the architecture will shift to horizontal specialization, and data are expected to be shared not only within each field, but also across fields, leading to the use of such data in various fields other than the traffic field.

[Figure 8] Positioning of traffic-related data platforms (for illustrative purposes only)



In the midst of such a structural change, many discussions and reviews must be made regarding the development of standards and rules that enable the sharing and distribution of the most-needed data, which are selected from among an enormous volume of traffic-related data, via public-private cooperation and the development of systems to examine ways to make such data available to the public.

In doing so, due consideration should be given to the following facts: data from individuals are often collected within the extent of their purposes of use and the predetermined handling method; data held by private companies have been collected from a business perspective to begin with; and the data held by the public sector will require a significant amount of money to build new systems and databases for the release of the data to the public.

3. ITS and Automated Driving Systems-Related Society, Industrial Objectives, and Overall Strategies

(1) Society and industrial objectives that we aim to achieve via ITS and automated driving systems

Social vision to be achieved via the public and private sectors

Automated driving technologies, which are rapidly evolving, are expected to enable driving that is safer and smoother than what can be accomplished by human drivers and to someday solve various road traffic-related issues affecting Japan.

For instance, the rate at which elderly people are being victimized by traffic accidents and the rate at which traffic accidents are being caused by the elderly are rising in line with the aging of this country. How we reduce traffic accidents involving the elderly is a huge issue that must be addressed.

Against this backdrop, we can expect to offer safer, more comfortable transport options for the elderly by bolstering driving operations and safety checks, reducing traffic accidents involving the elderly by commercializing automatic driving vehicles that provide autonomous driving transport services, promoting circumstances to facilitate safe driving on a continuous basis even for elderly drivers, and carrying out other such initiatives.

In aging regions, hilly and mountainous areas, decrepit large-scale housing complexes that were developed during the high-growth period of the Japanese economy (superannuated satellite towns), and other areas being depopulated as residents age, the ability to secure means of transport is a problem as local public transit services scale back and elderly residents quit driving. By establishing new transport services based on autonomous driving vehicles, this problem can also be solved.

Another huge issue in recent years is the shortage of drivers for logistics services. This shortage, which is taking place amid dramatic increases in the volume of logistics, is an issue that has serious implications for the Japanese economy. However, we can expect to address this issue by realizing automated driving vehicles, thereby reducing the burden placed on drivers and reducing the number of drivers that are needed.

In this way, automatic driving technologies can be expected to solve a large number of issues relating to road traffic in Japan. In addition, the commercialization of automated driving vehicles should lead to the followings:

i. Realizing a safer, smoother road-traffic society by reducing traffic accidents and relieving traffic congestion

   The ability to move from place to place safely and securely and to do so under smooth, comfortable conditions is the ongoing dream of many people. If we accept that most traffic accidents can be attributed to mistakes made by human drivers, we can expect to see a significant reduction in the number of traffic accidents as automated driving vehicles become more widespread. Traffic congestion on highways is often caused when the smooth flow of traffic is disrupted as the velocity of vehicles naturally drops on upward slopes and at other such locations, thereby causing the interval between vehicles to shrink and drivers in trailing vehicles to step on their brakes. However, traffic congestion will likely be eased, thanks in part to the spread of automated driving vehicles and the adoption of vehicle-to-vehicle communications and road-to-vehicle communications. The easing of congestion and the promotion of smooth traffic will give rise not only to a driving environment that is comfortable for drivers but also to a traffic environment that can enable trucks tasked with accommodating the steep increase in demand for the logistics of goods to ship items rapidly and on time. This can lead to the streamlining of the logistics of goods and to a favorable impact on the shipping of perishable foodstuff and other such products whose quality is determined to a considerable extent by transit duration.

ii. Creating a new mobility service sector to provide finely-tuned transport services

The utilization of automated driving vehicles is expected to lead to the spread of various new finely-tuned services. For example, incorporating tourism data on nearby sites into automated driving vehicles can provide new transport services for tourism. Delegating to automated driving vehicles the task of bringing children, who have no drivers' licenses, to and from locations can reduce the burden on guardians. When going on a shopping excursion, you can avoid having to look for a parking spot and instead simply drop off your vehicle and determine a pick-up time to have yourself picked up by an automated driving vehicle after you complete your shopping tasks. It is expected that these sorts of services will become widespread, new services based on the use of automated driving vehicles will be created, and the ways in which travel time is spent for different patterns of life and lifestyles themselves will transform significantly. New sectors providing such services will likely evolve as growth sectors helping to create new ways of living for the future.

iii. Regional revitalization in Japan as made possible by automated driving vehicles

While regional revitalization is vital for the growth of the Japanese economy, the economy is actually beset by many issues, including a shrinking population and slumping industries. However, the establishment of new transport services based on the use of automated driving vehicles—such as circuit buses consisting of automated driving vehicles and on-call automated driving taxis—to provide new means of supporting lives and logistics in regional areas could underpin an infrastructure for local residents' lives. This will improve the quality of the lives of people living in rural areas. If revitalization can be stimulated in this way, vitality will naturally be imparted to these areas and an environment capable of fostering various new industries by harnessing the inherent advantages possessed by regional areas—such as their natural beauty, human resources, and local specialty products—will likely emerge. This will in turn help revive local areas. In this context, automated driving vehicles will probably play a catalytic role in the revitalization of regions.

iv. Japan's automotive industry will continue to maintain its world-leading position by prevailing in the global competition for developing automated driving vehicles

The Japanese automotive industry is an industry that represents Japan by maintaining a world-leading competitive edge. Supported by a vast expanse of supporting industries, the automotive industry drives the Japanese economy as the central element of many related sectors by posting huge sales figures and employing a massive number of workers. Among automotive manufacturers around the world, the primary battle these days is being fought by participants seeking to commercialize their automated driving vehicles as quickly as possible. With each passing year, this competition over the development of technologies is becoming more and more intense. The unassailable positioning of the Japanese automotive industry as a global leader through the commercialization of automated vehicles ahead of the rest of the world, achieved by prevailing in a competition over the development of automated driving vehicles being fought by the Japanese automotive industry with overseas automotive manufacturers, is also essential for the future economic growth of this country.

Thus, automated driving vehicles hold tremendous promise as something that will invoke a *transport revolution* by providing support for new ways of living and new modes of mobility and material distribution in Japan and that will thereby allow us to live *affluent lives* by solving many of society's issues.

With an eye toward the coming ten to twenty years, significant innovation centering on automated driving systems is expected to occur in ITS as mentioned above. In light of this, we will aim to build the following two societies from the industrial and social perspectives and promote efforts to achieve them, along with efforts to attain the aforementioned goal:

- **Social perspective:** Japan aims to build "a society with the world's safest road transport" by 2020 and then aims to build and maintain "a society with the world's safest and smoothest road transport"[18] by 2030 by promoting the development and diffusion of automated driving systems and the preparation of data platforms.
- **Industrial perspective:** Japan aims to expand the export of ITS-related vehicles and infrastructure via public-private collaboration and become a global hub of innovation related to automated driving systems (including the development of data platforms) after 2020.

<u>**Setting social and industrial objectives**</u>

In an effort to set the vectors of the public and private sectors in the same direction toward the realization of such a society and industries and keep track of progress in such efforts, toward 2020, we will set key indicators for the achievement of objectives, mainly a reduction in traffic accidents, based on the

[18] "The world's smoothest" here indicates a traffic situation with little congestion, which enables the elderly to move smoothly without any stress. Moreover, the realization of smooth road traffic by alleviating traffic congestion is expected to contribute to reducing effects on the environment.

Fundamental Traffic Safety Program and promote necessary measures based on the set indicators.[19]

For the key objective achievement indicators toward 2030, while keeping the widespread use of automated driving systems in mind, social indicators related to “reduction in traffic accidents,”[20] “alleviation of traffic congestion,”[21] “streamlining of logistic traffic,”[22] and “transportation support for the elderly,”[23] and industrial indicators related to “diffusion of automated driving systems,” “production and export of vehicles,”[24] and “export of infrastructure” shall be set.[25] When setting specific numerical targets, numerical targets of other countries shall be referred to as benchmarks since Japan aims to realize and maintain the safest road traffic in the world. The set numerical targets shall then be compared with those of other countries in an ongoing manner, and revised on an as-needed basis.

[19] When examining the measures, the SIP Automated Driving Systems shall implement a survey on the methods to estimate the effects in reducing traffic accidents related to automated driving systems and examine the measures based on the results of the survey.

[20] When examining traffic accident-related indicators, a reduction in the number of persons injured from traffic accidents should be included as an indicator, as well as indicators related to the number of fatalities from traffic accidents (such as aiming to achieve zero deaths from traffic accidents, etc.)

[21] The Declaration of Creation specifies that indicators related to traffic congestion be set as KPIs. In the future, the existing data on traffic congestion, including surveys on the methods used overseas to obtain congestion data, shall be sorted out, and methods to obtain such data using probe data shall be studied and considered to set specific indicators.

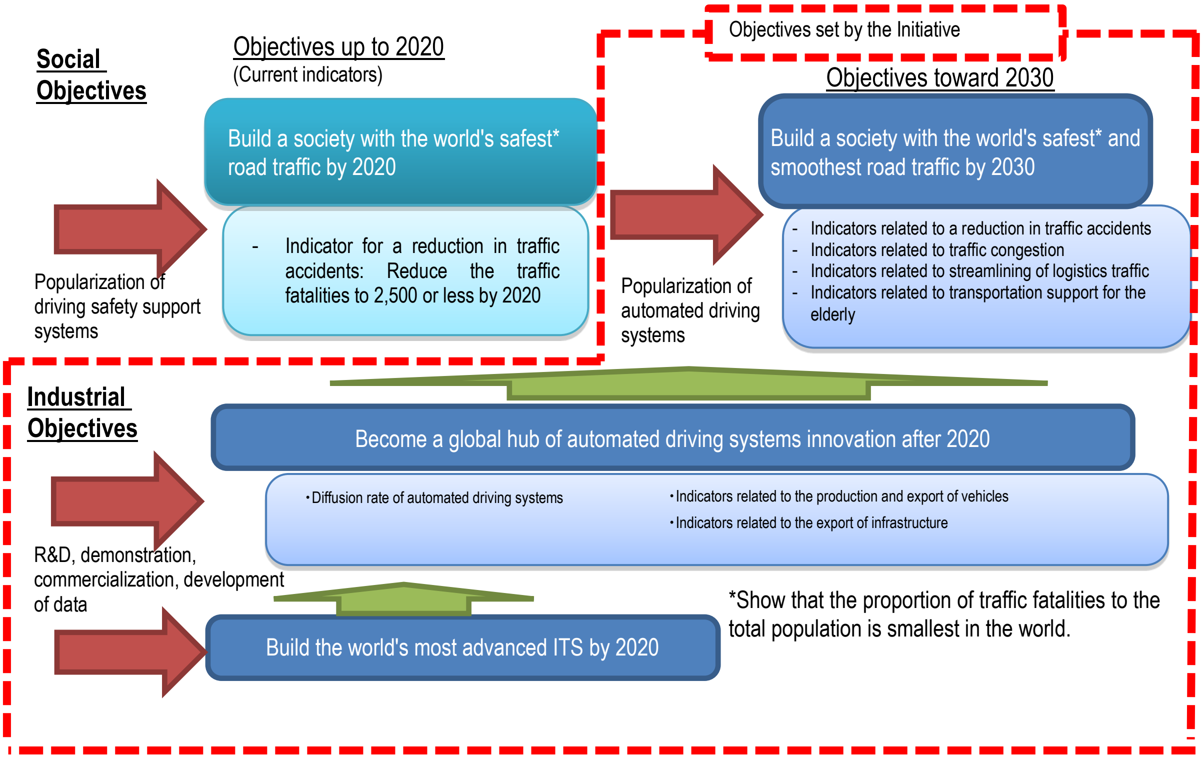
[22] Indicators related to the streamlining of logistics traffic require further consideration.

[23] For indicators related to the mobility of the elderly, specific indicators and methods to measure them, such as the rates of utilization of public transportation and automobiles by the elderly, shall be examined in the future.

[24] As for indicators related to the production and export of vehicles, they will be measured based on the number of vehicles for the time being. In the future, however, due consideration should be given to the possibility that the surrounding business, such as car sharing, may become more important.

[25] When setting specific indicators and numerical targets, discussions shall be held on statistical data required to determine them with industry, and examinations shall be conducted in consideration of surveys on the assessment of the impact of automated driving systems on society.

[Figure 9] Society that the Initiative aims for and Key Indicators for the Achievement of Objectives



(2) Basic strategies related to automated driving systems and the use of traffic data

Basic strategies for and social impact by automated driving systems

For automated driving systems, we will build the world's most advanced ITS by 2020 by commercializing semi-autopilot systems on highways and realizing unmanned autonomous driving transport services by 2020. Then, with an eye toward further sophistication of the systems, including technology that achieves fully automated driving systems, and the deployment of such systems in the world, we will aim to reduce traffic accidents, alleviate traffic congestion, support the mobility of the elderly by introducing automated driving systems mainly for new vehicles into society and spreading them across the country, and build a society with the world's safest and smoothest road traffic by 2030.

In Japan, while traffic accidents by the elderly account for most of the total in the aging society, transportation means for people with decreased mobility such as the elderly need to be secured. It is also urgent to secure transportation means in underpopulated areas and address the lack of drivers, since Japan's population is projected to decline. By working on the development of highly automated driving systems, which are considered important in solving these urgent issues in a strategic manner with business models in mind, Japan aims to realize automated driving systems ahead of the world and strengthen its global industrial competitiveness.[26] Specifically, highly automated driving systems with the following 3 items as objectives should be prioritized, and efforts should be made for their commercialization and popularization by 2025.

i. Further sophistication of automated driving systems for private vehicles
ii. Realization of innovative, efficient logistics services to address the lack of drivers
iii. Realization of unmanned autonomous driving transport services for rural areas and the elderly

[Table 4] Society and automated driving systems to be achieved

Item	Society to be achieved (example)	Automated driving systems to be achieved
Sophistication of automated driving systems for private vehicles	Strengthening of industrial competitiveness Reduction of traffic accidents Alleviation of traffic congestion	▪ Fully automated driving on expressways (Level 4) ▪ Sophisticated driving safety support system (tentative name)[27]
Realization of innovative, efficient logistics services to address lack of drivers	Innovative streamlining of logistics responding to the era of population decrease	▪ Truck platooning on expressways (Level 2 and above) ▪ Fully automated trucks on expressways (Level 4)
Realization of unmanned transport services for rural areas and the elderly	Society that enables the elderly to freely move around the country	▪ Spread of unmanned autonomous driving transport services for specified areas throughout the country (Spread of services that utilize remote automated driving systems at SAE Level 4 in particular)

<u>Basic strategies for driving safety support systems and the use of traffic data</u>

For driving safety support systems and the use of traffic data, while we should keep casting a careful eye toward 2020 and onward when automated driving systems are expected to be widely used, we shall, up to 2020, work toward the realization of a society with the world's safest road traffic (traffic fatalities of 2,500) and the world's most advanced ITS.[28]

Specifically, while promoting automobiles equipped with driving safety support functions such as automatic braking systems that have been becoming popular in recent years, in light of the fact that it will take time to popularize new vehicles equipped with such devices,[29] the introduction and popularization of

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[26] Though automated driving is a promising technology that may solve various issues that Japan faces, it is not the only method for solving them. It is socially expected to solve such issues based on overall optimization by combining automated driving with various methods.
[27] The official name for the sophisticated driving safety support system (tentative name) will be discussed. It should be noted that it is not a sophisticated version of the Driving Safety Support Systems (DSSS) whose practical application has already been promoted (see 4. (1) for details.)
[28] Especially when promoting measures to reduce traffic accidents, it is necessary to identify measures to focus on by taking into account the results of the analysis of the current situations of traffic accident fatalities (analysis of accident situations such as locations of intersections, collisions, pedestrians, etc.) and examining the possibility of the spread (expected amount of measures widely implemented as of 2020 etc.) of technical measures to deal with such situations including their feasibility and cost effectiveness.
[29] The number of automobiles owned in Japan in recent years is about 80 million. The annual number of new automobiles sold is about 5 million. Therefore, it will take about more than 15 years to completely replace existing automobiles with new ones.

driving safety support devices to be installed on existing vehicles and the introduction of information systems required to provide information that will be useful in reduction of traffic accidents and alleviation of traffic congestion shall also be promoted.

(3) Popularization scenario for and expected timing of commercialization of automated driving systems

Approach to achieving automated driving systems and their development scenario

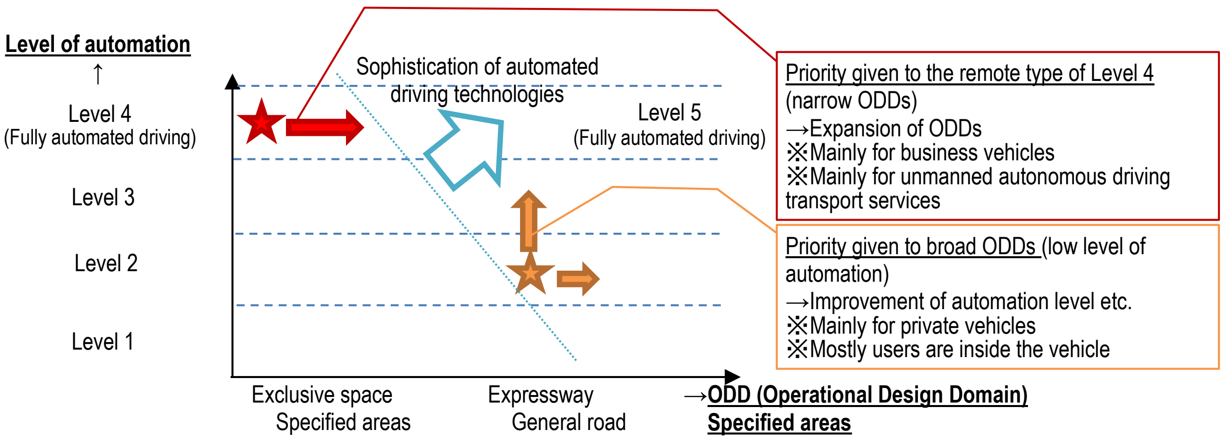
As a basic approach (policy) toward the implementation of automated driving systems in society, Japan aims to be the world's best both in "technology," one of the tangibles of automated driving, and "commercialization," one of its intangibles. From such a standpoint, we aim to implement automated driving systems in society by utilizing the latest technologies and complementing them with institutions and infrastructures, rather than implementing them only after technologies are completely established. Since it is important that vehicle performance surpass the complexity of the driving environments, we will consider categorizing and indexing the complexity of driving environments and tangible and intangible performance of the vehicle and, based on their combinations, select areas and promote the examination of required performances. Taking the results of this indexing into consideration, we will expand the Operational Design Domains (ODDs), i.e., the specific conditions under which driving automation systems are designed to function, so that they include complex driving environments.

For the evolution of automated driving technology, there are roughly two approaches to the realization of technology that enables fully automated driving in a wide variety of traffic conditions.

i. The approach that increases the level of the automatic control type with priority given to addressing broad ODDs (e.g. Various traffic situations such as the entire expressway): This approach will be the strategy mainly for automated driving systems for private vehicles (including commercial vehicles) that are generally required to drive regardless of location and time. In many cases, private vehicles with such automated driving systems have drivers inside.

ii. The approach that starts working on narrow ODDs (narrowly limited traffic situations) and then expand them gradually with priority given to realizing remote automated driving systems (fully automated driving systems) of Level 4: This approach will be the strategy mainly for automated driving systems used for business vehicles (local public transportation, freight transportation, etc.) that can be serviced at limited locations within a limited time.

[Figure 10] Two approaches to the realization of automated driving systems



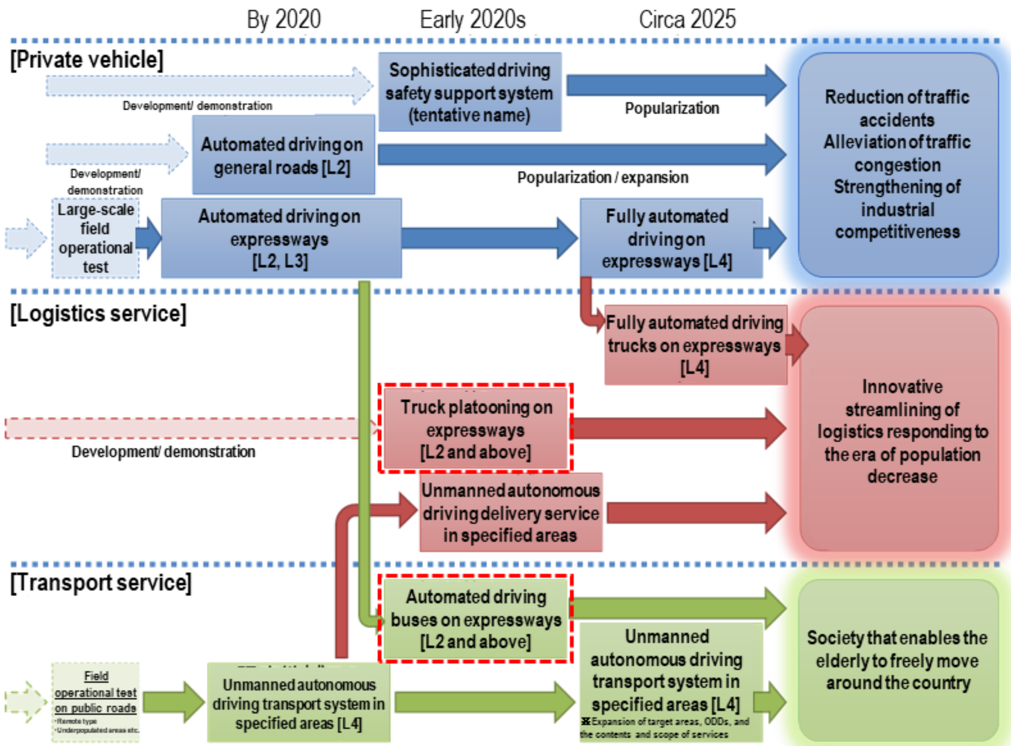
Taking these approaches into consideration, the Initiative/Roadmaps 2017 specifies the strategies for the commercialization of automated driving systems utilized for private vehicles, those utilized for business vehicles such as transportations services, and those utilized for logistics vehicles (trucks etc.) as applied to the logistics area in light of the social objectives described above.[30]

Specifically, we will make efforts to realize the (1) commercialization of vehicles that can be automatically operated on expressways (semi-autopilot) and (2) provision of unmanned autonomous driving transport services (Level 4) in specified areas (underpopulated areas, etc.[31]) by 2020. Then, we aim to realize the commercialization of fully automated driving systems on expressways, the popularization of sophisticated driving safety support systems (tentative name), the introduction and popularization of automated driving systems in the logistics area, and the popularization of unmanned autonomous driving transport services (Level 4) for specified areas throughout Japan by 2025.

[30] Though the Initiative/Roadmaps 2017 discusses automated driving systems for private vehicles, logistics services, and transport services separately, their concepts and names will be further reviewed in light of the future direction of automated driving systems and services utilizing them.

[31] From the policy perspective of securing transportation means in rural areas, unmanned autonomous driving transport services should be realized first in underpopulated areas. However, from a business perspective, their introduction in urban areas and suburban areas may be considered.

[Figure 11] Scenario for the realization of commercialization and service of fully automated driving by 2025



Note: Based on the above schedule, the relevant ministries and agencies will cooperate with the private sector and promote the necessary measures according to the specific status of their development and business models. In doing so, they will promote information sharing between the government and the private sector, provide advice, and review systems and infrastructure as needed.

Expected timing of commercialization and service of automated driving systems

Based on the objective of becoming the world's best, we have set the expected timing of the commercialization[32] of automated driving systems at each level (timing comparable to those of other countries, that is, the fastest or almost the fastest in the world) while referring to the commercialization objectives and roadmaps of other countries. However, in light of the recent progress in technological development by private companies, we have specified the expected timings for the commercialization and service of automated driving systems for private vehicles and business vehicles (logistics services and transport services) separately as shown below.

For these systems, it is important to aim to become the world's number one in terms of not only the expected commercialization timing, but also the enhancement of industrial competitiveness and the popularization of automated driving systems.

In addition, compact means of mobility and bus platooning on expressways are some of the

[32] The expected timing of commercialization is the common target timing by which the government and private sector must address various measures. It is not the timing for them to express their commitment.

technologies that are also expected to be realized in the future.

[Table 5] Expected timing of commercialization and service of automated driving systems※1

		Level	Technology expected to be realized (example)	Expected timing of commercialization etc.
Sophistication of automated driving technologies				
	Private vehicle	Level 2	Semi-autopilot	By 2020
		Level 3	Autopilot	Circa 2020※3
		Level 4	Fully automated driving on expressways	Circa 2025※3
	Logistics service	Level 2 and above	Truck platooning on expressways with the trailing vehicle being manned by a driver	By 2021
			Truck platooning on expressways with the trailing vehicle being unmanned	From 2022
		Level 4	Fully automated driving of trucks on expressways	From 2025※3
	Transport service	Level 4※2	Unmanned autonomous driving transport services in specified areas	By 2020
		Level 2 and above	Automated driving of buses on expressways	From 2022
Sophistication of driving support technologies				
	Private vehicle		Sophisticated driving safety support systems (tentative name)	(early 2020s) It may vary depending on future discussions.

(※1) At the expected timing of commercialization, technologies of remote automated driving systems and automated driving systems of Level 3 and above must be consistent with treaties concerning road traffic. In addition, the expected timing of commercialization shall be reviewed based on the domestic and overseas industrial and technology trends, including overseas trends in the development of automated driving systems.

(※2) Though unmanned autonomous driving transport systems range from SAE Level 0 to 5 by definition, it is expected that the unmanned autonomous driving transport system of Level 4 will be realized by 2020.

(※3) The timing is set as a target time by which the government should make efforts to enable commercialization by private companies.

The specific scenario and schedule to achieve these objectives are described in the next chapter.

4. Efforts toward the commercialization of automated driving systems

(1) Utilization of automated driving systems for private vehicles

We aim to realize fully automated driving systems for expressways (Level 4) and sophisticated driving safety support systems (tentative name) by 2025 to sophisticate improve the safety of automated driving systems developed by automakers. By doing so, the reduction of traffic accidents and strengthening of industrial competitiveness should be realized.

A. Previous efforts and realization of semi-autopilot driving systems

The Roadmaps 2016 stated that it was the "aim to commercialize semi-autopilot automated vehicles (automated driving systems) by 2020. To this end, SIP shall implement large-scale field operational test projects in collaboration with related organizations from 2017."

In light of this, the Cabinet Office indicated that large-scale field operational testing as part of the SIP project would gradually commence from October 2017. Accordingly, we will continue to engage in efforts in this regard.

[Table 6] Overview of SIP's large-scale field operational tests

Test location	Test contents
Expressway	▪ Validating high-precision 3D map data relating to curves and various other types of road configurations, course environments, structures, and other such elements; ▪ Validating linkages between congestion information, construction information, and other forms of dynamic information with dynamic maps; ▪ Testing HMI in terms of driver condition assessments; and more.
General road	▪ Validating usability and effectiveness with respect to mobility support, such as in terms of controls to ensure the precise stoppage of buses and the sharing of route information through pedestrians' mobile devices; ▪ Validating the usability and express performance of public buses that operate based on the use of ART technologies to collect and amass traveling data at the ART Information Center and share information with users.
Test course etc.	▪ Validating the method by which information security evaluations are conducted.

In addition, toward the realization of semi-autopilot driving systems in 2020, we will continue addressing institutional issues (examining the necessity of the HMI-related guidelines in light of the issue of overconfidence where drivers have too much confidence in the system's capabilities and put themselves at higher risk of accidents), issues related to social receptivity (promotion of understanding among drivers involved in automated driving and consumers), and issues related to technologies and infrastructure (development of dynamic maps and information and communications infrastructure.)

B. Realization of fully automated driving on expressways and automated driving on general roads

Highly/fully automated driving on expressways

In light of the realization of semi-autopilot driving systems by 2020, we aim to commercialize fully automated driving systems for expressways (Level 4) by 2025.

In fully automated driving systems for expressways (Level 4), fully automated driving is available from the entrance to the exit of an expressway, and the driver can either override the system as needed or let the system operate. The vehicle must automatically pull over to the side of the road when it exits ODDs, i.e., the specific conditions under which the driving automation system is designed to function, or in case of abnormalities (technology for transition to a minimal risk condition.[33]) For the realization of automated driving systems for expressways (Level 3), how to secure safety in case of a request to intervene made by the system is an issue to be solved.[34] In light of industrial trends in technology development and commercialization, we will reconsider the commercialization timing of Level 3 and 4 systems where necessary.

Automated driving on general roads (Level 2, etc.)

We will commercialize automated driving systems (Level 2) that enable automated driving on general roads by expanding the areas where automated driving systems function based on Level 2 automated driving systems that will be commercialized for expressways.

Specifically, we aim to realize automated driving systems (Level 2) that enable straight driving on major highways (national roads and major local roads) around 2020. Then, it is expected that ODDs of Level 2 automated driving systems will be expanded around 2025, enabling right and left turns on major highways and straight driving on other roads.

Future initiatives for the realization and popularization of automated driving on general roads

In order to realize these aims, we aim to develop driving environments for highly automated driving systems (Level 3) by 2020 as an institutional objective in light of progress being made in the area of international discussions on consistency with treaties concerning automated driving and road traffic, measures to ensure such consistency, and progress being made in the development of technologies concerning automated driving. As a technological objective, we aim to establish transitional technologies for risk minimization. (See “5”).

In order to support automated driving at diverging and merging sections on expressways and in other

[33] Technology that enables the vehicle to transition to a minimal risk condition automatically and safely in case of abnormalities. It is essential to develop and adopt such technology in order to realize fully automated driving (Level 4) and sophisticated driving safety support systems (tentative name.)

[34] Technology for transition to a minimal risk condition may be added as a measure to secure safety in case of a request to intervene made by the system. In this case, systems considered as SAE Level 4 in terms of technical specifications may be commercialized as systems of SAE Level 3, which require the driver inside the vehicle and can send requests to intervene to the driver.

complex traffic environments, the Ministry of Land, Infrastructure, Transport and Tourism began, at January, 2018, joint public-private sector research on schemes for sharing information from road-side sources and will continue to promote studies undertaken jointly by public- and private-sector entities.

Beginning in fiscal year 2018, the second phase of SIP[35] is expected to entail the promotion of research and development activities in collaborative fields by members of academia, the government, and industry working in tandem in line with the expected timing of the popularization and commercialization of automated driving as set forth in Roadmap 2017 (when focus is also slated to be newly directed at the further development of driving-support technologies in private automobiles for use on general roads and automated driving technologies in private automobiles for use on expressways, as well as services for logistics and transport services), which will in turn lead to the formation of a sustained system of collaboration by members of academia, the government, and industry.

C. Popularization of driving safety support systems and realization of sophisticated driving safety systems (tentative name)

Popularization of driving safety support systems

Considering it will take time to commercialize, service, and popularize the automated driving systems mentioned above, we need to address measures to popularize driving safety support systems with an eye on establishing a society with the world's safest road traffic and the world's best ITS by 2020.

Considering the fact that the prevention of traffic accidents by the elderly is an urgent issue, the government announced "the Interim Report of the Meeting of Senior Vice Ministers of Relevant Ministries on Safety Driving Support Vehicles" in April 2017. The report specifies the definitions of safety driving support vehicles (Support Car S) for the elderly, which are shown in Table 7. Based on these definitions, we will work on the promotion of popularization and public awareness of driving safety support vehicles, improving and expantion of vehicle assessment, and development standards for advanced safety technologies, utilizing various public relations tools.

[35] A determination was made in the New Package of Economic Policies (as approved by the Cabinet in December 2017) to commence the following SIP, whose start date was slated for fiscal year 2019, ahead of schedule. At the general conference of the CSTI subsequently held on March 29 (general science, technology, and innovations conference), twelve issues—including automated driving—were formally adopted.

[Table 7] Definitions of Safety Support Car S (nickname) (abbreviated name: Support Car S)

Wide	Automatic braking (pedestrian detection), acceleration suppression device for pedal misapplication Lane departure warning, advanced lights
Basic+	Automatic braking (vehicle detection), acceleration suppression device for pedal misapplication
Basic	Low-speed automatic braking (vehicle detection), acceleration suppression device for pedal misapplication

In addition to the efforts for the popularization of Support Car S for the elderly mentioned above, the government and private sectors will jointly work on promoting the popularization and public awareness of vehicles with automatic braking and other safety features, giving it the nickname “Safety Support Car (abbreviated name: Support Car),” to help prevent traffic accidents by all drivers.

In addition to promoting driving the safety support vehicles mentioned above, we will promote measures for the popularization of various driving safety support systems and information provision systems, as shown in Table 8.

[Table 8] Promotion of measures related to driving safety support systems (other than driving safety support vehicles)

- Further popularization and sophistication of the Automatic Collision Notification (ACN) system and the Help System for Emergency Lifesaving and Public Safety (HELP), which enable drivers to report accidents using their on-board device or mobile phone
- Popularization and utilization of on-board devices such as driving video recorders and event data recorders, from which information can be obtained to understand and analyze accident situations
- Preparation for the introduction of Driving Safety Support Systems (DSSS), which provides visual and audio information on surrounding traffic situations to the driver utilizing the infrastructure of traffic control systems, and the Traffic Signal Prediction System (TSPS), which provides prior information on which signal is on when the vehicle arrives at an intersection with traffic signals.
- Efforts to realize smooth, safe, and secure road traffic based on the use of ITS technologies, such as through the popularization and promotion of ETC 2.0 and advanced optical beacons, as well as through an expansion of the utilization of ETC and other forms of ITS technologies at private parking lots and other facilities not constituting expressways.
- Joint considerations among government, academia, and industry on more effective measures against driving the wrong way on expressways such as prompt detection of vehicles driving in the wrong direction, provision of warning on the road or inside the vehicle, and utilization of automated driving technologies
- Development of pedestrian-vehicle communication technologies useful for reduction of pedestrian accidents

<u>Realization of sophisticated driving safety systems (tentative name)</u>

In order to achieve traffic accident prevention at a higher level, it is necessary to develop vehicles with sophisticated driving safety support systems (tentative name) and that cause almost no accidents not only by improving the level of automated driving but also by further sophisticating existing technologies related to vehicle safety[36] and utilizing automated driving technologies, while assuming that the driver will operate the vehicle. Such automated vehicles are considered to contribute not only to the reduction of traffic accidents but also to the strengthening of competitiveness of Japan's auto industry by providing added value to consumers as vehicles that enable drivers to enjoy driving safely.

Though specific technical specifications of sophisticated driving safety support systems will be discussed in the future, we aim to sophisticate individual technologies including "technologies for transition to a minimal risk condition" such as more advanced damage reduction braking and driver emergency support systems[37] and integrate such technologies into a system by adopting artificial intelligence (AI) and driver-friendly interfaces (HMI). In addition, we also need to consider sophisticating information gathering technologies for cooperative types (including the development and sophistication of information and communications infrastructure (see 5. (2)).

In light of industrial trends in technology development, we aim to specify concrete specifications by cooperating with public and private sectors where necessary and realize vehicles with sophisticated driving safety support systems (tentative name) around the mid-2020s (by 2025.)

[Table 9] Specific element technologies of "sophisticated driving safety support systems (tentative name)" (image)

For example, sophistication of individual automated driving technologies will be promoted as described below, and these technologies will be integrated into a system that includes AI and HMI technologies.

- Sophistication of damage reduction braking (automatic braking)
  - ✓ Drastic expansion of the distance between the vehicle and an obstacle and speed that damage reduction braking systems (automatic braking systems) can detect
  - ✓ Drastic improvement of fail-safe functions in collaboration with an acceleration suppression device for pedal misapplication[38]
- Sophistication of driver emergency support systems (including technologies for transition to a minimal risk condition)
  - ✓ Promotion of development from the push-button type to the automatic detection type and from the simple/in-lane stop type to the roadside stop type
- Others (Lane keeping assist etc.)

[36] Including technologies called ADAS (Advanced Driver Assistance Systems)

[37] The Ministry of Land, Infrastructure, Transport and Tourism announced the world's first guidelines for driver emergency support systems of deceleration stop type in March 2016, and the one of road shoulder retreat type in March 2018.

[38] A device that prevents rapid acceleration by controlling engine output if the accelerator pedal is applied when the on-board radar detects a wall or a vehicle

(2) Utilization of automated driving systems in the logistics services

In Japan's trucking logistics industry, there are high expectations for the utilization of automated driving systems as a measure to improve business efficiency, address lack of drivers, enhance safety, and promote energy conservation. Thus, we aim to realize truck platooning first and then fully automated driving trucks for logistics services on expressways. For local delivery, we will realize delivery services utilizing unmanned autonomous driving services in specified areas. By doing so, we will realize innovative, efficient logistics responding to the era of population decrease.

A. Realization of truck platooning on expressways

In order to realize truck platooning, we must take steady steps in cooperation with concerned parties including related ministries and agencies, since there are many important issues to solve such as the impact on surrounding traffic environments and road structures as well as technical issues (safety of electronic coupling, securing of reliability, etc.) and institutional issues (positioning of electronic coupling under related laws and regulations etc.)

Specifically, we will conduct the necessary examinations on business environments such as infrastructure based on the past field operational tests of truck platooning on a test course[39] and the progress of the test of doubles currently being conducted.[40] In addition, we will begin, in fiscal year 2018, field operational testing on public roads of truck platooning with the trailing truck being unmanned[41] upon taking into account social receptivity and technical issues identified through field operational testing on public roads of truck platooning with the trailing truck being manned, as based on the use of CACC (an existing technology),[42] which began in fiscal year 2017.

We must take sufficient safety measures when conducting these field operational tests and examine improvement of social receptivity, operational control technologies, and the role of the business model of truck platooning operational control systems, as well as technology development.

Moreover, we will consider how to develop the necessary institutions and infrastructures to enable such field operational tests. Specifically, we will discuss the requirements of electronic towing[43] and requirements for over 25-meter long platooning comprising 3 trucks or more by October 2018. We will

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[39] "R&D for Autonomous Driving and Platooning, Development of Energy-saving ITS Technologies" by NEDO (July 2010- March 2015)

[40] As the Ministry of Land, Infrastructure, Transport and Tourism has been conducting field operational tests of doubles (November 2016- 2018), we will provide the necessary cooperation on business environments such as infrastructure.

[41] Field operational testing of truck platooning on public roads will be conducted with the trailing vehicle manned by a driver first. Once safety is confirmed, field operational testing of platooning with the trailing vehicle unmanned will be conducted.

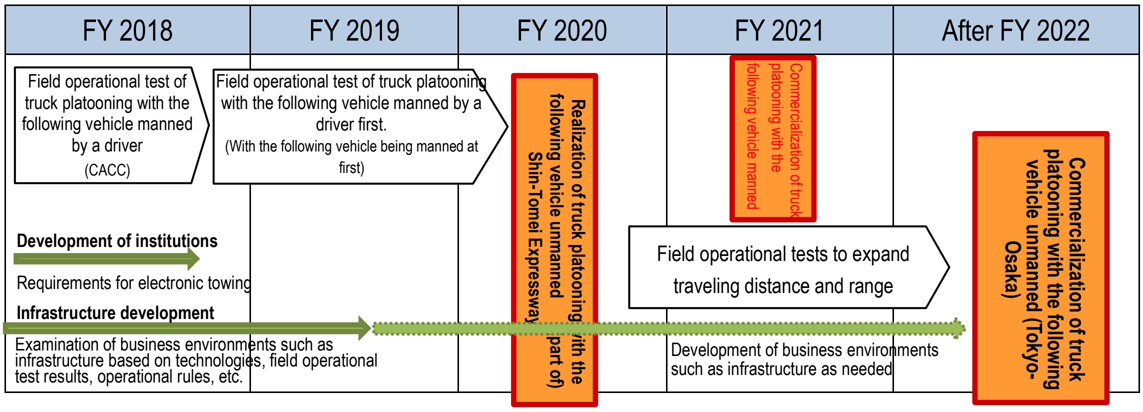
[42] CACC (Cooperative Adaptive Cruise Control): System that adds vehicle-vehicle communications to ACC (adaptive cruise control, which constitutes a technology that uses radar measurements to maintain a proper distance to the vehicle in front) to share information on the acceleration/deceleration of other vehicles and thereby engage in more precise inter-vehicle distance control. It has already been commercialized.

[43] Vehicle standards, required driver's license, driving lanes, etc.

also examine business environments such as infrastructure by FY 2019 based on the results and operational rules of field operational tests.

Based on the above, we aim to expand traveling distance and range through repeated testing after realizing a system of truck platooning with the trailing vehicle unmanned on expressways (Shin-Tomei Expressway) in fiscal year 2020, and thereby realize the commercialization of truck platooning with the trailing vehicle unmanned for long-distance transportation on expressways in or after fiscal year 2022. With a view to contributing to the development of a system of truck platooning with the trailing vehicle unmanned, we aim to first commercialize a realistic system of truck platooning with the trailing vehicle manned by a driver by 2021. We will therefore comprehensively study technical and business-related issues and proceed with specific discussions concerning operating rules and other matters to be sorted out among government and private-sector officials during fiscal year 2018, while also taking policies on logistics into account.

[Figure 12] Schedule for realization of truck platooning on the expressways (overview)



B. Utilization of fully automated/unmanned autonomous driving in logistics

Realization of fully automated driving trucks[44] on expressways

As an effort to utilize automated driving systems, we will prioritize the realization of truck platooning on expressways described in A. from the standpoint of technological ease.

However, given the fact that, with progress being made in terms of development work and field operational testing of fully automated driving systems for private vehicles, the results of such development work and testing are expected to be applied to trucks in the future as described in **(1)**. Given as well that many field operational tests are being conducted overseas by private companies including venture companies to realize fully-automated driving trucks,[45] and that fully-automated driving trucks on

[44] In the Initiative/Roadmaps 2017, trucks with fully automated driving systems are called fully-automated driving trucks.

[45] Some overseas companies announced that they would commercialize such trucks in 2025. Some companies in Japan are also

expressways are expected to not just solve the problem of driver shortages but also become more effective in reducing carbon dioxide emissions and improving the efficiency of road usage through the use of truck platooning, we should also ideally focus on commercialization and the promotion of services in Japan.

Thus, we will move ahead on the realization of fully-automated driving trucks on expressways after 2025 in light of the technological progress of automated driving systems for private vehicles and results of field operational tests of truck platooning.[46]

Realization of unmanned autonomous driving delivery services in specified areas

When realizing innovative, effective logistics, streamlining not only transport on highways such as expressways but also the logistics for small-lot delivery including delivery to users is an urgent issue. Due to this, Japan has started conducting field operational tests on the utilization of automated driving for delivery services by private companies.

We aim to realize unmanned automated delivery services in specified areas after 2020 by applying the technologies of unmanned autonomous driving transport service in specified areas shown in (3). Specifically, for example, it is expected that both-way transport between a center and a settlement in underpopulated areas and door-to-door delivery services in settlements will be realized, and then service recipients and areas will be expanded.

In addition, after it will become possible to offer transportation services based on the use of automated driving vehicles in underpopulated areas, where it is now possible to combine cargo and passengers under certain conditions in September 2017, it is conceivable that both passenger transportation and cargo transportation services will be provided using the same vehicle.

(3) Utilization of automated driving systems in transport services

In Japan, where the birthrate is falling and the population is aging, regional revitalization is an important issue. Due to this, it is urgent to secure transportation means for people with limited mobility such as the elderly and for those living in rural areas such as underpopulated areas. To solve this issue, we aim to realize transport services utilizing unmanned autonomous driving systems for specified areas by 2020 and implement such services throughout the country after 2025. By doing so, we will develop a society that enables the elderly to freely move around the country.

A. Previous efforts for unmanned autonomous driving transport services for specified areas

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considering developing plans for the realization of fully-automated driving on expressways.

[46] The timing of realization needs to be examined based on the progress of development, operational tests, and realization of automated driving systems for private vehicles and truck platooning by and considerations of business operators.

Institutional efforts[47] required to conduct field operational tests of unmanned autonomous driving transport services on public roads in specified areas have been steadily implemented in accordance with the Road Traffic Act and the Road Transport Vehicle Act, which enable field operational tests of remote automated driving systems on public roads that can be conducted under the current treaties concerning road traffic.[48]

Field operational tests on public roads have been conducted in National Strategic Special Zones with an eye to realizing fully automated driving. In addition to such tests, many government-led field operational test projects for the realization of automated driving services for specified areas such as "Field Operational Test for Social Implementation of Device Traffic Systems" by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and "Field Operational Tests of Automated Driving Services Using Roadside Stations in Hilly and Mountainous Areas as a Hub" by the MLIT are conducted after June 2017. In addition to government-led projects, field operational tests of automated driving systems and discussions on their implementation are being conducted by municipalities, universities, etc. in regions across the country.

B. Efforts to be made for the realization and popularization of unmanned autonomous driving transport services in specified areas

In consideration of the institutional development of unmanned autonomous driving transport services in specified areas mentioned above, we started field operational tests of remote automated driving systems on public roads from fiscal year 2017. After commencing field operational testing on public roads on a 1-to-1 basis where one remote driver monitors one vehicle and assuming that safety can be ensured based on an accumulation of data obtained from a series of field operational tests conducted on public roads, we will decide to proceed to field operational testing on public roads on a 1-to-N basis where one remote driver monitors multiple vehicles at the same time.[49]

In addition, while we tried to specify requirements for dedicated spaces and driving methods in 2017

47 The National Police Agency (NPA) established "Standards Applicable to the Handling of Applications for Road-Usage Licensing Pertaining to the Field Operational Testing of Remote Automated Driving Systems on Public Roads" in June 2017 and took measures to make it possible to implement the public road demonstration experiment of the remote type automatic driving systems in which the driver does not get in the driver's seat of the experimental vehicle, by receiving the road use permission under Article 77 of the Road Traffic Law.

48 The MLIT revised related laws and regulations based on the Road Transport Vehicle Act in February 2017. Due to this revision, the standards have been relaxed on vehicles with no steering wheel or accelerator pedal on the premise that safety is secured in order to enable field operational tests of unmanned autonomous driving transport services for specified areas on public roads. At the 72nd meeting (held in March 2016) of the Working Party on Road Traffic Safety (known as WP1. The name was changed to the Global Forum for Road Traffic Safety in February 2017) of the UN Economic Commission for Europe (UNECE) under the United Nations Economic and Social Council, the opinion that "testing of driverless vehicle is possible under current treaties where there is a person who is ready and able to take control of the experimental vehicle(s); this person may or may not be inside the vehicle" was formulated as a result of discussions on automated driving by the informal working group, and WP1 accepted it.

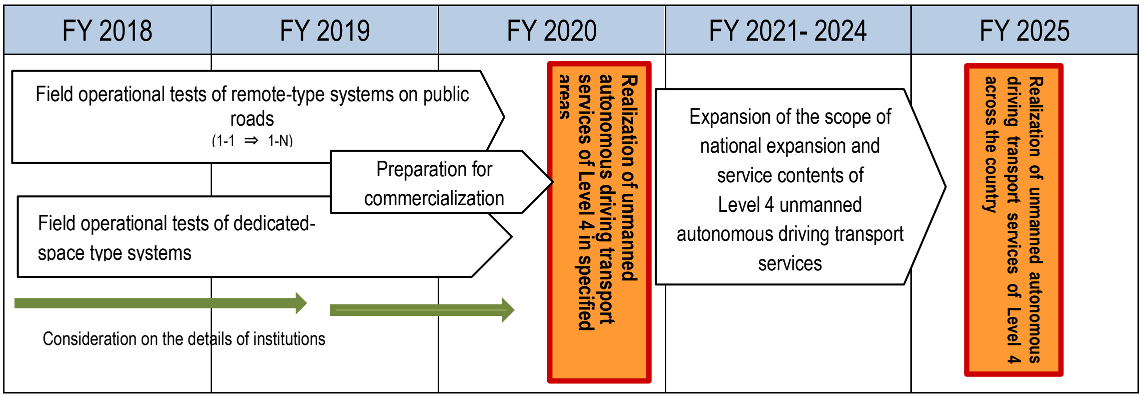
49 Conditions pertaining to field operational testing of remote automated driving systems on public roads on a 1-to-N basis have already been set forth in the "Standards Applicable to the Handling of Applications for Road-Usage Licensing Pertaining to the Field Operational Testing of Remote Automated Driving Systems on Public Roads," as provided for by the National Police Agency.

to promote field operational tests of unmanned autonomous driving transport services outside public roads in specified areas, we realized that unmanned autonomous driving transport services in dedicated spaces may be provided using fully-automated driving systems with no remote driver in the future. For such unmanned autonomous driving transport services, we aim to expand automated driving businesses in the private sector from 2020 onwards by confirming social receptivity through field operational testing beginning in fiscal year 2017 and conducting longer-term field operational testing with a view to commercialization, in collaboration with concerned business enterprises in order to build a proper business model.

Based on these field operational tests on public roads, we will make efforts to realize Level 4 unmanned autonomous driving transport services (transport services utilizing fully automated driving) by 2020. To this end, we shall aim to establish technologies for a transition to a minimal risk condition as a technological objective while aiming to develop actual driving environments for highly automated driving systems by around 2020. On the institutional side, we need to presuppose the trends in international discussions on consistency with treaties concerning automated driving and road traffic, measures to ensure such consistency, and progress being made in the development of technologies concerning automated driving. (See "5.")

After that, we will work on realizing a society that enables the elderly to freely move around the country by around 2025 by expanding unmanned autonomous driving transport services across the country, while improving technology levels (including expansion of ODDs) and expanding service contents.

[Figure 13] Schedule for realization and popularization of Level 4 unmanned autonomous driving transport services (summary)



[Table 10] Image of unmanned autonomous driving transport services

Examples of Level 4 unmanned autonomous driving transport services in specified areas to be commercialized by 2020 are shown below (but not limited to them).

- Service areas include areas with good visibility and relatively low traffic volume such as underpopulated areas, urban areas where pedestrians and two-wheeled vehicles are unlikely to run into the road suddenly, or areas in university campuses and airport facilities with relatively simple driving environments.
- The vehicles drive on specific predetermined routes at 10-30 kilometers per hour.
- The number of passengers who can get in the vehicles is small and they get in and out of the vehicles at specific locations.
- The vehicles are operated only during the daytime when weather conditions are favorable, but not during the night and not in poor weather conditions such as rain and snow.
- Operational status is monitored by private service providers and the vehicles promptly stop operation when the driving environment of the operational vehicles exits or is about to exit ODDs. Then the vehicles are limitedly operated by a remote driver, or service providers come to the vehicles and implement the necessary measures.
- A person who is not a driver may be on board to provide support to passengers (help passengers get in and out) and prepare for events that cannot be handled by automated driving systems.

C. Next-generation urban transportation system and other transport support services

Next generation urban transportation system (ART: Advanced Rapid Transit)

Our challenge with regard to the 2020 Tokyo Olympics and Paralympics is to achieve stress-free Olympics by improving accessibility from the coastal areas that have a relatively inconvenient transportation system to downtown Tokyo, and by developing universal transportation infrastructure that facilitates the mobility of all people, including wheelchair and stroller users.

To this end, based on the operation schedule for the Practical Application of the Next Generation Urban Transportation System (ART) for the Development of Tokyo and the Aging Society,[50] ART shall be promoted under the leadership of the SIP Automated Driving Systems. Such efforts shall be promoted while regarding the 2020 Tokyo Olympics and Paralympics as a milestone and aiming at the ultimate goals of spreading the system across Japan and exporting system packages overseas after 2020.

Automated valet parking[51]

Currently, automated parking, where vehicles are automatically steered into parking spaces, is being put into practical use. On the other hand, there is a strong need for automated valet parking, where the driver gets out of the car, for example, in front of a store, and the car runs without the driver in the parking lot of the store, finds an empty space, and parks itself in the space, due to the parking lot owners' desire to

[50] It was discussed at the meeting of the Task Force on Science, Technology, and Innovation for the 2020 Tokyo Olympics and Paralympics, which was established under the Council for Science, Technology and Innovation in fiscal 2014.

[51] Automated valet parking is a system that is supposed to be utilized for private cars. However, since it is an automated driving system that is utilized in highly specified areas and it will be introduced in the services that utilized business vehicles first, we included it in “(3) Utilization of automated driving systems in transport services.”

improve parking lot management efficiency and enhance safety in parking lots and customer satisfaction.

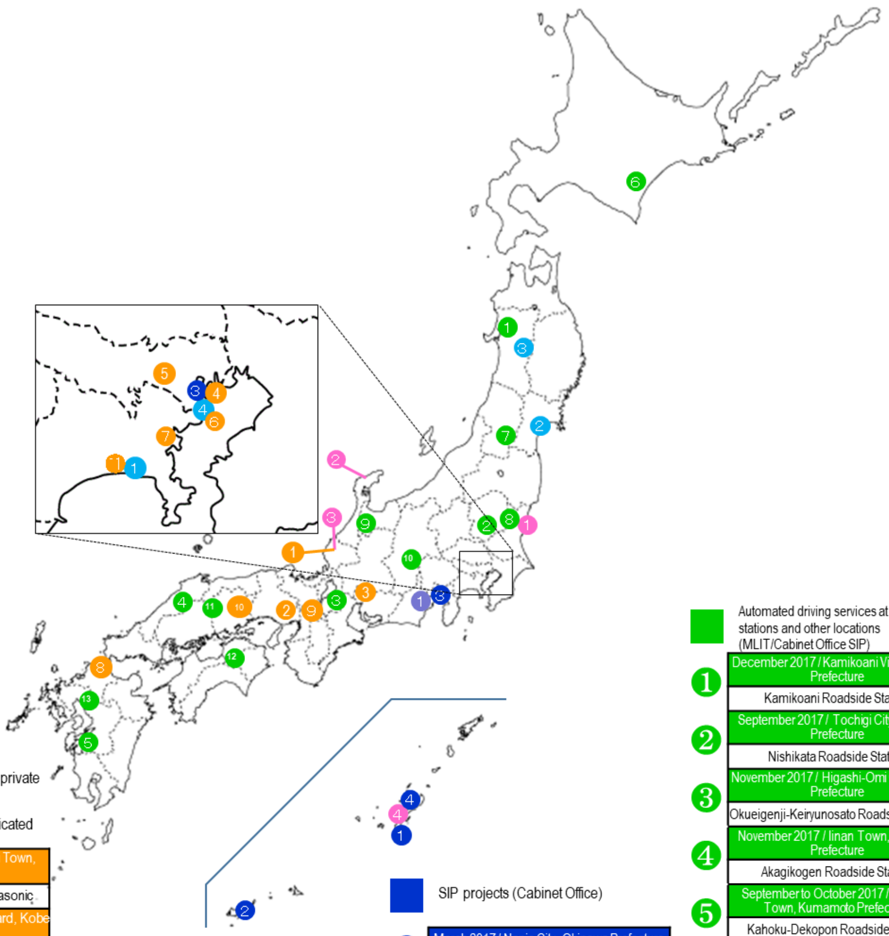
We aim to realize automated valet parking in dedicated parking lots (separated from general traffic, installation of a control center) for vehicles compatible with the automated valet parking system from around 2020, assuming its application to rental car services in tourist areas and commercial vehicle leasing services. To this end, efforts toward the formation of a consensus among concerned parties and an international standardization of the automated valet parking system shall be promoted through field operational tests on automated valet parking systems, which is conducted in fiscal year 2018. In addition, we assume such a system will develop into an automated valet parking system in general parking lots with social implementation of fully-automated driving systems.

(4) Field operational testing on automated driving as conducted by public-sector or private-sector actors in Japan

As noted above, field operational testing on automated driving is being or is slated to be conducted throughout Japan after safety standards and traffic rules that were applied to field operational testing conducted between fiscal year 2016 and the first half of fiscal year 2017 are updated.

[Figure 14] Primary automated driving field operational tests conducted in Japan[52]

As of May 11, 2018



Conducted by a local government, private company, or university

* Primary verification testing indicated

1	October 2017 to March 2019 / Eiheiji Town, Fukui Prefecture	Fukui Prefecture, Eiheiji Town, Panasonic
2	November to December 2017 / Kita Ward, Kobe City	Kobe City, Minato Kanko Bus, Gunma University, and others
3	December 2017 to February 2018 / Kota Town, Kasugai City, Nagoya City; Aichi Prefecture	Aichi Prefecture, Aisan Technology, and others
4	December 2017 / Koto Ward, Tokyo	ZMP
5	January 2018 / Suginami Ward, Tokyo	Suginami Ward, Aisan Technology, University of Tokyo, and others
6	February 2018 / Seibijo Zone, Haneda Airport	ANA, SB Drive
7	March 2018 / Yokohama City, Kanagawa Prefecture	Nissan, DeNA
8	March 2018 / Kitakyushu City, Fukuoka Prefecture	Kyushu Institute of Technology, Kitakyushu City, Kitakyushu Foundation for the Advancement of Industry, Science and Technology
9	March 2018 / Kyoto, Osaka, Nara Prefectures (Keihanna Science City)	Keihanna Science City, RDMM Support Center
10	April 2018 / Akaiwa City, Okayama Prefecture	SP Drive, Uno Bus
11	April 2018 / Fujisawa City, Kanagawa Prefecture	Yamato Transport, DeNA

Last-mile automated driving / (METI and MLIT)

1	FY 2018 / Hitachi City, Ibaraki Prefecture	Hitachi City, SB Drive, and others
2	From December 2017 / Wajima City, Ishikawa Prefecture	Wajima City, Wajima Chamber of Commerce, Yamaha Motor, and others
3	From April 2018 / Eiheiji Town, Fukui Prefecture	Eiheiji Town, Fukui Prefecture, Yamaha Motor, and others
4	June 2017, from February 2018 / Chatan Town, Okinawa Prefecture (non-public road)	Chatan Town, Yamaha Motor, and others

Truck platooning / (METI and MLIT)

1	January 2018 / Shin-Tomei	Toyota Tsusho, domestic truck manufacturers, and others

SIP projects (Cabinet Office)

1	March 2017 / Nanjo City, Okinawa Prefecture	SB Drive, Advanced Smart Mobility
2	June to July 2017 / Ishigaki City, Okinawa Prefecture	SB Drive, Advanced Smart Mobility
3	From October 2017 / Expressways in the Kanto region and other areas, general roads around the Tokyo coastal area, and elsewhere	Domestic and overseas automotive manufacturers, automotive parts manufacturers, universities, and others
4	November to December 2017 / Ginowan City/Kitanakagusuku Village, Okinawa Prefecture	SB Drive, Advanced Smart Mobility

National Strategic Special Zone projects / (Cabinet Office)

1	February to March 2016 / Fujisawa City, Kanagawa Prefecture	Fujisawa City, Robot Taxi
2	March 2016 / Sendai City, Miyagi Prefecture	Sendai City, Tohoku University, Robot Taxi
3	November 2016 / Senboku City, Akita Prefecture	Senboku City, DeNA
4	Unknown timing / Area around Haneda Airport	Tokyo

Automated driving services at roadside stations and other locations (MLIT/Cabinet Office SIP)

1	December 2017 / Kamikoani Village, Akita Prefecture	Kamikoani Roadside Station
2	September 2017 / Tochigi City, Tochigi Prefecture	Nishikata Roadside Station
3	November 2017 / Higashi-Omi City, Shiga Prefecture	Okueigenji-Keiryunosato Roadside Station
4	November 2017 / Iinan Town, Shimane Prefecture	Akagikogen Roadside Station
5	September to October 2017 / Kahoku Town, Kumamoto Prefecture	Kahoku-Dekopon Roadside Station
6	December 2017 / Taiki Town, Hokkaido	Cosmall Taiki Roadside Station
7	February to March 2018 / Takahata Town, Yamagata Prefecture	Takahata Roadside Station
8	November 2011 / Hitachiota City, Ibaraki Prefecture	Hitachiota Roadside Station
9	November 2017 / Nanto City, Toyama Prefecture	Taira Roadside Station
10	February 2018 / Ina City, Nagano Prefecture	Minami Alps Hase Roadside Station
11	March 2018 / Niimi City, Okayama Prefecture	Koigakubo Roadside Station
12	December 2017 / Miyoshi City, Tokushima Prefecture	Nishiiya Roadside Station/Kazurabashi Yume Butai
13	February 2018 / Miyama City, Fukuoka Prefecture	Yamakawa Branch of Miyama City Hall

* In addition, five locations have been selected as sites for conducting feasibility testing with a view to further substantiating business models.

52 Primary field operational tests that have been or are slated to be conducted as of May 11, 2018.

Primary items subject to verification in field operational tests

Primary items subject to government-led automated driving field operational testing that has been or is slated to be held are indicated below.

[Table 11] Classifying field operational tests by purpose

Purpose	Verification items
Verify vehicle performance	• Verifying the safety and reliability of remote monitoring (such as by checking compliance with safety standards and verifying that safety is ensured for measures that entail the easing of standards)
Verify the impact of weather conditions on vehicle performance	• Verifying the detection function of sensors under conditions of rainfall, snowfall, snow accumulation, and thick fog • Verifying the ability to travel during periods of snow accumulation; and more
Verify issues concerning technologies comprising automated driving	• Testing high-precision 3D maps • Testing HMI in terms of driver condition assessments; and more
Verifying the configuration, maintenance, and management of roads and surrounding facilities	• Verifying road structure conditions and road management levels • Verifying communication systems for remote monitoring; and more
Verifying service contents	• Shipping tests using vehicles carrying both cargo and passengers between roadside stations and other local sites and communities • Creating new tourist movement flows; and more
Verifying service operations	• Verifying the costs of maintaining and managing vehicles • Investigating operator models; and more
Verifying social receptivity	• Reliability of automated driving technologies, riding comfort, psychological response to a driverless state • Survey of social receptivity to public buses using automated driving technologies and last-mile mobility options; and more

Field operational testing with eyes focused on the 2020 Tokyo Olympic and Paralympic Games

Based on remarks made by the Prime Minister at a meeting of the Growth Strategy Council for Investing in the Future,[53] field operational testing and demonstrations will be carried out primarily in 2020 by JAMA by combining field operational testing in coastal areas around Tokyo with the development of basic technology, and the results thereof will be harnessed for commercialization purposes. Popularization measures will be studied, and research and development work will continue while a focus on obsolescence subsequent to the Olympic/Paralympic Games is maintained.

Specifically, investments are being promoted through the participation of automotive manufacturers, businesses, local governments, and other parties in these field operational tests, and the results of this

[53] Remarks made by the Prime Minister at the fourteenth meeting of the Growth Strategy Council for Investing in the Future, held on March 30, 2018: *We are striving to realize an automated driving society in Japan by the Tokyo Olympic and Paralympic Games of 2020. Field operational testing pursued in the public and private sectors with a view to attaining this significant goal has finally entered the stage at which commercialization can be promoted. Efforts will be further accelerated while we maintain a focus on the expansion of various kinds of business.*

process will be used to promote commercialization. In the SIP as well, efforts are being made to improve dissemination on an international level and social receptivity with respect to automated driving in Japan through research and development work, the development of infrastructure and other elements of a driving environment, and collaborations with JAMA while keeping these field operational tests in mind.

Other kinds of field operational testing

In addition to the above, various kinds of field operational testing are slated in hopes of resolving new societal issues. Examples are presented below.

[Table 12] Other primary kinds of field operational testing

Field operational testing	Conducted by	Outline
Upgrading snow-removal vehicles with a focus on automated driving	MLIT	The development of snow-clearing vehicles upgraded with driving-control and operating-support functions for power-saving benefits is being progressively promoted, such that upgraded snow-clearing vehicles are slated to undergo trial runs on expressways beginning in February 2018 and field operational testing on general roads in fiscal year 2018.
Investigating measures for the utilization of automated driving technologies for urban traffic	MLIT	・Field operational testing is slated to be conducted beginning in fiscal year 2018 based on reports of effectiveness and issues through the adoption of automated driving services with a view to realizing sustainable public transit services in areas with new housing developments. ・Plans are in the works to prepare for field operational testing on guideway buses, route-defined excursion-type buses, and other core bus service vehicles and provide for the means by which information can be shared.

Field operational testing in the future will need to be promoted by determining what sorts of solutions will be needed after further clarifying issues standing in the way of commercialization based on the results of evaluations of vehicle performance, evaluations of the impact of weather conditions (such as snow accumulation) on vehicle performance, evaluations of issues concerning technologies comprising automated driving systems, evaluations of the configuration, maintenance, and management of roads and surrounding facilities, evaluations of the operations of services, and evaluations of social receptivity as verified to date. In addition, we will need to further accelerate efforts with a view to deploying a wide range of businesses ahead of 2020.

5. Efforts toward the promotion of ITS/ automated driving innovation

(1) Development of institutions toward the popularization of automated driving and enhancement of social receptivity

As described in the previous chapter, with the recent progress of automated driving technologies, commercialization and commencement of service of automated driving systems by 2020 have begun to come into sight. Thus, we will proceed with consideration of the institutional side with a view toward the commercialization and commencement of service of highly automated driving businesses in 2020.

Based on the objective of becoming the world's best, we will work out a schedule with our eyes set on world-leading business operators. We need to work on institutional design with the aim of leading the world while collaborating with other countries, as it is an issue unprecedented in the world. In addition, when designing specific institutional plans, we shall take the following approach to make sure they will promote innovation while securing safety, given the fact that automated driving is highly beneficial for society.

[Table 13] Basic approach to institutional design for highly automated driving systems (3 principles)

- Recognize the huge social benefits of automated driving systems and develop institutions to promote their introduction
  - ✓ Drastic improvement of traffic safety can be expected by eliminating human error as much as possible.
  - ✓ Many social benefits can be expected, such as smooth traffic, energy conservation, smooth transportation for the elderly, reduction in drivers' burden, enhancement of industrial competitiveness, and creation of new industries.
- Develop institutions that give priority to securing safety and reduce risks associated with introduction of automated driving systems
  - ✓ Promote introduction of automated driving systems, given that they will reduce overall current traffic safety risks
  - ✓ Develop institutional designs that promote safety-related innovation based on driving results while securing safety.
  - ✓ Develop a mechanism that reflects new progress in technology in the existing systems
- Develop institutions that promote various types of innovation related to automated driving systems
  - ✓ Design institutions that promote efforts toward various types of innovation while maintaining technological neutrality
  - ✓ As for social responsibilities, design institutions that promote innovation by manufacturers and system operators including insurance systems while giving priority to social receptivity such as relief measures for victims

A. Development of institutions concerning field operational tests on public roads and promotion of test projects

Institutional environments related to field operational tests and actual operation of automated driving systems (current situation)

Environments of field operational tests on public roads and actual operation of automated driving systems in Japan are being developed based on international discussions on the consistency between automated driving systems and treaties concerning automated driving and road traffic. Specifically, field operational tests on public roads can be conducted regardless of SAE Level (Level 1- 5) without prior arrangement with or permission from police, if the vehicle operates in compliance with related laws and regulations including the Road Traffic Act, with a driver in the driver's seat and ensuring that emergency situations can be handled. As of June 2017, Japan has developed a system to enable the implementation of testing to be conducted on public roads, of remote automated driving systems that have been confirmed to be consistent with treaties concerning road traffic. Thus, the institutional environment pertaining to field operational testing in Japan is superior to similar environments when compared in terms of initiatives being carried out by other countries around the world.

Since active discussions on the consistency between automated driving and treaties concerning road traffic are being conducted mainly by an informal specialist group of the Global Forum for Road Traffic Safety (WP1) of the UN Economic Commission for Europe (UNECE), Japan aims to examine of development of institutions concerning highly automated driving while actively participating in such discussions.

In addition, with an eye to promoting various types of innovation, related laws and regulations were revised based on the Road Transport Vehicle Act in February 2017 so that standards will be relaxed on vehicles with no steering wheel or accelerator pedal, and field operational tests on public roads are continuously be promoted.

[Figure 15] Developing safety standards and traffic rules for field operational testing

2016

May — **Guidelines for Subjecting Automated Driving Systems to Field Operational Testing on Public Roads** (National Police Agency)
It is clarified that field operational testing of an automatic driving system for which a driver is seated in the driver's seat of the test vehicle and can take over the necessary operations in an emergency can be conducted on public roads without requiring any special permit to be obtained or notification to be submitted.

2017

Feb — **Revising Notifications Pursuant to Safety Standards Applicable to Road Transport Vehicles** (MLIT)
Even a vehicle not equipped with a steering wheel or accelerator and brake pedals can be subjected to field operational testing on public roads if measures to ensure safety—such as in terms of speed restrictions, limitations on driving routes, and the installation of an emergency-stoppage button—are taken.

Jun — **Standards Applicable to the Handling of Applications for Road-Usage Licensing Pertaining to the Field Operational Testing of Remote Automated Driving Systems on Public Roads** (National Police Agency)
A road-usage license can be obtained to enable the conduct of field operational testing on public roads even if there is no driver positioned in the driver's seat of a test vehicle, as long as remote monitoring/operators are positioned externally.

Dec — Field operational testing using fully unmanned vehicles (with remote monitoring/operators) conducted in Wajima City, Ishikawa Prefecture.

[Table 14] Institutional environments for field operational tests and actual operation of automated driving systems in Japan and other countries

<table>
<tr><th>Field operational test</th><th colspan="2">Every level of automation (including the unmanned type)</th></tr>
<tr><td>Driver inside the vehicles</td><td colspan="2">UN[54]: Allowed
Japan: Allowed (No permission is needed)[55]
Overseas: Allowed (Note that permission is needed in many countries)</td></tr>
<tr><td>No driver inside the vehicle (including remote drivers)</td><td colspan="2">UN: Allowed if there is a remote driver (March 2016)
Japan: Allowed if there is a remote driver (June 2017)
Overseas: Allowed on a limited basis (in California and elsewhere; licensing system)</td></tr>
<tr><th>Actual operation</th><th>Level 2 and below</th><th>Highly automated driving (including the unmanned type)</th></tr>
<tr><td>Driver inside the vehicle</td><td>UN: Allowed under treaties
Japan: Allowed under existing laws. Already commercialized.
Overseas: Generally allowed under existing laws. Already commercialized.</td><td>UN: Discussions are being held on consistency with treaties
Japan: Not allowed (Traffic-related laws and regulations need to be reviewed)
Overseas: Allowed on a limited basis (Germany)</td></tr>
<tr><td>No driver inside the vehicle (including remote drivers)</td><td></td><td>UN: Treaty conformity issues are currently under discussion
Japan: Not allowed (reviews of traffic-related statutes required)
Overseas: Allowed on a limited basis (in California and elsewhere; licensing system)</td></tr>
</table>

54 The Global Forum for Road Traffic Safety (WP1) of the UN Economic Commission for Europe (UNECE)

55 In Japan, regarding tests to demonstrate technologies for automated driving systems of SAE Levels 3-5 and the unmanned type, field operational tests on public roads can be conducted regardless of automation level (Levels 1- 5) without prior arrangements with or permission from police, if the vehicle operates in compliance with related laws and regulations including the Road Traffic Act, with a driver in the driver's seat and ensuring that emergency situations can be handled.

The NPA developed and announced "the Guidelines for Field Operational Tests of Automated Driving Systems on Public Roads" in May 2016 as guidelines to refer to when conducting field operational tests on public roads.

Institutional development concerning field operational tests on public roads and promotion of test projects

With respect to the development of institutions pertaining to field operational testing on public roads with a view to realizing unmanned autonomous driving transport services in specified areas, field operational testing of automated driving on public roads involving remote vehicles or vehicles without steering wheels and accelerator and decelerator pedals has been made possible since June 2017 due to the development of relevant institutions that has been undertaken as mentioned in the preceding chapter. In April 2017, mock urban area test courses were opened.[56] Preliminary test services for evaluating safety measures through the use of these test courses were launched in February 2018.[57] As mentioned in the preceding chapter, many field operational tests on public roads, including those conducted for projects led by the national government, have been carried out. We will continue to utilize these institutions and facilities and proactively promote field operational testing on public roads in Japan.

The Supplementary Provisions of the Act to Partially Revise the National Strategic Special Zone Act and Act on Special Districts for Structural Reform, which came into effect in September 2017, stipulate that specific measures will be investigated and taken within one year of enactment in order to enable the expeditious conduct of field operational testing of automated driving. Investigations were accordingly conducted, whereupon a bill to amend the National Strategic Special Zone Act was submitted to the Diet in March 2018. This bill is intended to promote the rapid and smooth realization of unprecedented field operational testing of advanced innovative near-future technologies for automated driving by establishing a regionally-limited regulatory sandbox program in national strategic special zones and having zone plans that have been drafted by the national government, local governments, and businesses working in tandem (sandbox-implementation plans) become subject to special regulatory measures where approval has been granted by the Prime Minister.

In September 2017, an Automated Driving One-Stop Center to provide advice and information to private-sector businesses conducting field operational testing in Tokyo and Aichi Prefectures was established. Efforts to promote the further utilization of this center will be taken in the future.

Development of the public-private cooperation system and sharing of data related to field operational tests

As indicated above, the future investments strategy of 2017 called for the establishment of a system for sharing and collecting information, such as through the indexing of the complexity of driving environments in fiscal year 2017 and the clarification of testing data that should be commonly collected, amid expectations

[56] The Japan Automobile Research Institute (JARI) established Jtown as an evaluation facility for automated driving vehicles in Tsukuba City, Ibaraki Prefecture and held a press conference to announce the opening of this facility in March 2017.

[57] JARI launched preliminary testing services for businesses utilizing Jtown to conduct field operational testing on public roads (performance testing of automated driving systems built into test vehicles, testing of the ability of test drivers sitting in the driver's seat to take over operations where necessary in an emergency, and the training of test drivers) in February 2018.

that multiple government-led projects for testing on public roads will be promoted. In response, five meetings in total of the Joint Public-Private Sector Council for Automated Driving—whose members consist of concerned parties and key figures from both the public and private sectors—were held beginning in August 2017. Testing progress was outlined; basic ideas concerning data to be collected and shared through national projects for testing on public roads were organized; a traveling-environment format, commercialization format, and difficult-situation format were indicated as data formats; and systems for the collection, sharing, analysis, and utilization of data were set up.

In particular, data obtained from field operational tests on public roads are not only useful for securing social receptivity but also important for considerations with regard to future R&D and institutional design. It is necessary to consider developing a framework that enables a public announcement of the test results as much as possible.

We shall investigate the methods by which information sharing will be undertaken for accident data pertaining to automated driving, safety-related data other than accident data (such as override data, near-miss data, and points of concern uniquely applicable to certain regions), technical data pertaining to automated driving that requires standardization, and information on traffic-service needs in field operational testing areas and business models. As for the sharing of safety-related data including accident data, the possibility of mandatory storage, submission, and disclosure of data by business operators, how to handle personal information, and a study framework for the safety assessment of automated driving vehicles and systems should also be included in the considerations with regard to the overall institutional design including the commercialization of future automated driving systems. In addition, investigations to enable the standardization of input and output formats will be needed for use for AI and simulation.

Issues concerning coordination with traffic signals and crosswalks, how vehicles should interact with other vehicles, and measures for determining the causes of accidents relating to automated driving also need to be addressed in the future.

B. Institutional challenges toward the realization of highly automated driving systems (Development of the outline)

Necessity of the outline of institutional development by the whole government toward the realization of highly automated driving systems

As described in the roadmaps toward the commercialization of automated driving systems in the previous chapter, since the expected timing of the commercialization of highly automated driving systems, including autopilot driving systems for expressways (Level 3) and Level 4 unmanned autonomous driving transport services in specified areas and fully automated driving systems, is set at 2020, it is necessary to consider the direction of institutional development including a review of traffic-related laws and regulations to realize the commercialization of the systems.

As for the actual operation of highly automated driving systems on public roads, international discussions are being undertaken by the UN, since consistency between automated driving systems and treaties concerning road traffic needs to be secured. On the other hand, some major countries are considering the role of legal systems toward the domestic commercialization of highly automated driving systems.[58]

In order to enable the actual operation of highly automated driving systems, a full review of the existing traffic-related laws and regulations that are based on the assumption of "operation by the driver" is required, to incorporate into them an institution that enables "operation by the system."[59] The scope of consideration for the review ranges from identification of automated driving vehicles and systems and the roles of safety standards, traffic rules, and so on to clarification of responsibilities such as automobile liability insurances. In addition, since they are considered to be mutually related, it is necessary to clarify the policy of the whole government on institutional development toward the realization of highly automated driving systems. Therefore, the Charter for Improvement of Legal System and Environment for Automated Driving Systems, a policy on institutional development by the entire government towards the realization of highly-automated driving systems, was formulated in close collaboration with related ministries and agencies and finalized by the IT Strategic Headquarters (April 17, 2018) (full text as set forth in an exhibit attached hereto).

Though such institutional development is a matter of global concern, other countries are still in the trial and error stage, and international discussions on consistency between automated driving and treaties on road traffic are being undertaken. In addition, given that there are no established technologies pertaining to highly automated driving, various technologies are expected to emerge in the future, and time will be required to develop international technical standards. Thus, we will need to hold a follow-up meeting in the next half year on matters concerning legal systems and promote ongoing studies concerning revisions of legal systems.

<u>Basic approach to institutional design for highly automated driving systems</u>

Japan shall consider the policy (outline) on institutional development toward the realization of highly automated driving systems based on the following basic approach (strategy):

i. Exercise international leadership in institutional design from a mid-term perspective

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[58] Specifically, considerations are being undertaken based on the situation of each country. Some examples are shown below.

- California, USA: started accepting applications for permission of test driving of unmanned cars on public roads in April 2018 based on the moves of IT companies in the state with a condition of obtaining cyber security countermeasures, two-way communication functions with the outside
- In Germany: the bill to amend the Road Traffic Regulations (StVO; the regulations that specify not only drivers' obligations but also their compensation liabilities and vehicle registration) was passed in May and in effect in June, 2017. As a measure for the time being, it allows for practical use of "advanced fully automatic operation" (equivalent to Level 3) assuming driver's riding.UK: the bill concerning automated driving and electric cars was submitted to the House of Representatives in October, 2017. It stipulates that insurance companies are liable for payment for accidents during automated driving, and prescribes exempted cases. Currently under discussion at the Senate.

[59] "Operation by the driver" and "operation by the system" mean "dynamic driving tasks performed by the driver" and "dynamic driving tasks performed by the system" of SAE J3016 (2016) respectively. The same shall apply hereinafter.

ii. Develop an institutional framework that promotes innovation while securing safety
iii. Clarify responsibilities in a way that promotes innovation while giving priority to social receptivity

i. Exercise international leadership in institutional design from a mid-term perspective

As for institutional development, as mentioned above, Japan must lead the world and develop the most advanced institutions concerning automated driving while considering the progress of deliberations by other countries. As for consistency between automated driving systems and treaties concerning road traffic, Japan shall conduct necessary study on a framework for institutional development in the country and prepare to promptly develop domestic systems in line with the direction of international discussions on the matter while actively participating in such discussions.

In Japan, compared with other countries in the world, more balanced consideration is given to the commercialization of automated driving systems to be utilized for both private vehicles and business vehicles (logistics and transport services), and many field operational tests of automated driving systems for both types of vehicles are conducted on public roads. Therefore, Japan is able to identify issues in both systems swiftly. Since the commercialization and service of both systems are expected to be realized in around 2020, Japan shall consider developing a consistent institutional framework toward the commercialization of both systems from a mid-term perspective. It is necessary to design institutions with an eye not only on the role of manufacturers of vehicles equipped with automated driving systems but also on that of service providers that utilize automated driving systems, while considering technological and business neutrality.[60]

ii. Develop an institutional framework that promotes innovation while securing safety

As for an institutional framework for securing safety such as permits and licenses for automated driving vehicles and systems and conditions and rules for actual operation on public roads, mandating uniform safety standards and measures to secure safety is not necessarily appropriate, since there are no established automated driving technologies yet. Given that various technologies are expected to emerge in the future and it will take time to develop international technical standards and establish methods for assessing the safety of automated driving systems, we should, for the time being, develop a framework/ structure where the safety of systems that are separately applied is assessed from a technical and scientific perspective while confirming the direction of specific technology development. However, we must consider operating such a framework in a way that helps promote innovation, such as preannouncing the minimum requirements where possible, in light of the status of development within the industry.

[60] In order to move towards provision of full-fledged services in 2020 based on the results of field operational tests, the relaxation of regulations only after securing safety must be considered. In addition, consistency between the full-fledged services and the existing business laws must be examined where necessary based on specific service contents.

In addition, when conducting safety assessment, discussions should be held with business operators from a technical perspective with the understanding that they must take responsibility in principle, and appropriate conditions should be set where necessary. Assessment must be conducted by taking into consideration ODD and DDT, concepts that are coming into acceptance globally. For example, we should consider developing a framework where operation within ODDs that are recognized as safe is permitted first, and then ODDs are expanded if safety is confirmed. In light of such knowledge and experience, Japan must promote consideration of the appropriate method for assessing safety related to highly automated driving systems while actively collaborating with other countries.

iii. Clarify responsibilities in a way that promotes innovation while giving priority to social receptivity

Since there is not necessarily a uniform global system that clarifies where responsibility lies in case of accidents,[61] each country has developed institutions that clarify responsibilities based on their long history of taking measures against traffic accidents and the social norms (social recognition and receptivity) related to them. In such a trend, Japan shall consider where responsibility lies in case of accidents caused by "operation by the system" based on the existing domestic legal systems, such as the Automobile Liability Security Act, which establishes the concept of victim relief, while looking at international developments. In addition, discussions must be held on where responsibility lies while considering social benefits that can be brought by automated driving and the promotion of innovation related to the safety of automated driving.

Though responsibilities of the systems may be discussed by envisioning automated driving vehicles operated by AI capable of making autonomous decisions, they should be considered as a future issue to discuss.

Basic policy concerning a charter for improvement of legal system and environment for highly automated driving systems

Based on the above thinking, institutional investigations will be conducted in accordance with the following basic policy in light of the fact that the current environment surrounding automated driving is such that we are at the outset in terms of the innovations that will give birth to the various technologies of the future and of the process by which these technologies will become popularized, and in light of the fact that, despite the relative lack of safety evaluations and institutional precedence internationally, ensuring safety is an important objective, such that future technological progress and international trends will need to be taken into account.

- The inventiveness of businesses in response to social receptivity and social needs should be promoted;

[61] Including response to cyber-attacks.

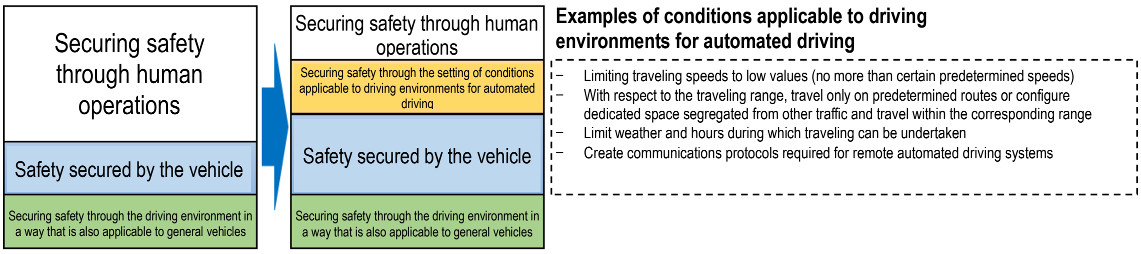
- Earlier detection of and response to safety issues while giving priority to the need to ensure safety shall be promoted;
- Environmental changes affecting automated driving should be flexibly accommodated, such as by gradually reviewing institutions and systems.

<u>Ensuring safety on an integrated basis</u>

In order to ensure safety, there has conventionally been a need to reach a certain level at the intersection of three different elements: people, vehicles, and driving environments.

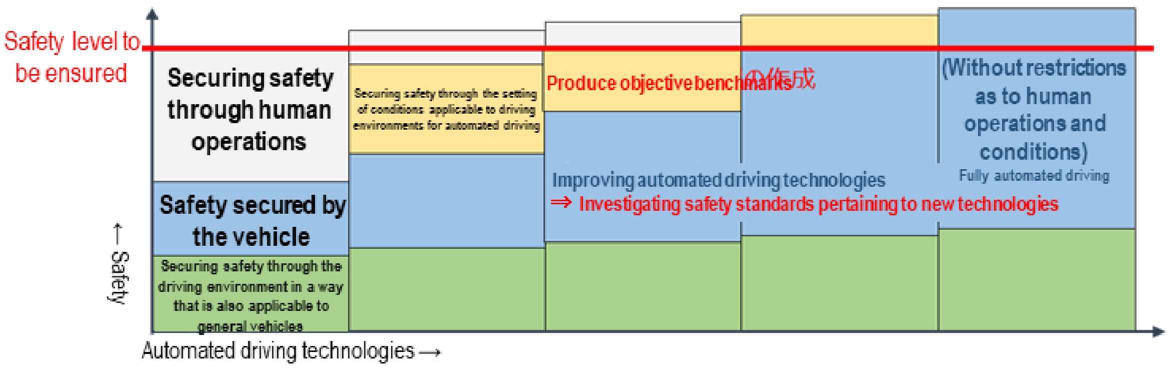
As automated driving technologies evolve, greater safety is secured as human operations are displaced in part by the vehicle itself. Safety will be difficult for the vehicle alone to ensure in a complex traffic environment during the initial rollout of automated driving systems; however, new conditions applicable to driving environments for automated driving will be set to ensure safety in combination with the role played by the vehicle in ensuring safety.

[Figure 16] Thinking on ensuring safety through the setting of conditions applicable to driving environments for automated driving



In line with the evolution of automated driving technologies, we expect to see greater levels of safety reached in the future.

[Figure 17] Illustration of the way in which steps will be progressively taken towards the commercialization of automated driving



In line with these notions, we will investigate safety standards according to technical levels and investigate and formulate conditions applicable to driving environments for automated driving as objective benchmarks in collaboration with concerned ministries and agencies.

For the time being, however, we will establish a scheme for ensuring safety by verifying conditions on a case-by-case basis in collaboration with concerned ministries and agencies after taking into account regional idiosyncrasies rather than applying universal conditions, as well as for ensuring safety in an integrated manner by setting safety standards and conditions applicable to driving environments for automated driving (operating and driving environments).

Notions on securing the safety of automated driving vehicles (Road Transport Vehicle Act and others)

In formulating safety standards, we will continue to spearhead international discussions in order to help spread Japanese world-leading automotive technologies around the world.

i. We will summarize the safety requirements to be met by automated driving vehicles into guidelines by around summer 2018;
ii. We will progressively formulate safety standards applicable to automated driving vehicles based on trends in technological development and international discussions;
iii. We will investigate the ideal approach to be taken in formulating measures to ensure the safety of vehicles in current use;
iv. We will investigate requirements pertaining to vehicles to be driven in a convoy/platoon formation.

Traffic rules (Road Traffic Act and others)

With a focus on commercialization in 2020, we will continue to spearhead collaborations with concerned countries in the course of engaging in international discussions at the Convention on Road Traffic (Geneva Convention), and we will investigate traffic rules aimed at commercializing world-leading technologies premised on ensuring safety in accordance with progress in this area and with progress in terms of the development of technologies.

i. We shall pursue investigations on domestic statutory revisions in line with international discussions and quickly develop a domestic legal system in accordance with international discussions and progress in terms of the development of technologies relating to automated driving.
ii. We shall study measures required to ensure that automated driving systems comply with norms set forth in road traffic laws and regulations.
iii. With respect to unmanned autonomous driving transport services in specified areas, the current framework for field operational testing used for remote automated driving systems will also be rendered usable for commercialization for the time being.
iv. Requirements for traffic rules applicable to platooning will be investigated.

Liability matters (such as with respect to the Automobile Accident Compensation Security Act, the Civil Code, the Product Liability Act, and the Act on the Punishment of Acts Inflicting Death or Injury on Others by Driving a Motor Vehicle)

We seek to clarify liability issues in the event of an accident and determine the causes of accidents in order to both enable the provision of prompt relief for victims in the unlikely event of an accident and have automated driving become accepted by society. We will investigate the acquisition, retention, and use of data toward this end.

i. The conventional liability of an automobile operator with respect to damages arising due to an accident in the course of the utilization of an automated driving system shall be maintained in the Automobile Accident Compensation Security Act (hereinafter referred to as “Automobile Compensation Act”);
ii. The Automobile Compensation Act stipulates that it would be proper for damages due to an accident caused by hacking (where the owner of the automobile cannot be held liable as the automobile operator) to be handled through a governmental compensation fund just as with accidents involving stolen vehicles except where the automobile owner has not taken necessary security measures;
iii. When commercializing an automated driving vehicle, studies on criminal liability shall be undertaken based on a clarification of roles and obligations expected of various concerned parties by, among others, traffic rules and legal systems concerning transportation businesses;
iv. The necessity of mandating the installation of data-recording devices, necessity of data recording functions, and necessity of mandating the submission of accident logs by an information owner shall be investigated by 2020.

Relationship to legal systems concerning transportation businesses

Measures that need to be implemented when transporting passengers in an automated driving vehicle without a driver present shall be investigated.

Other matters

Required matters concerning various types of infrastructure, such as the road-vehicle cooperative type of infrastructure, and explanations for consumers shall be studied.

C. Securing of social receptivity and development of a society-wide collaboration system

Overall societal framework for securing social receptivity

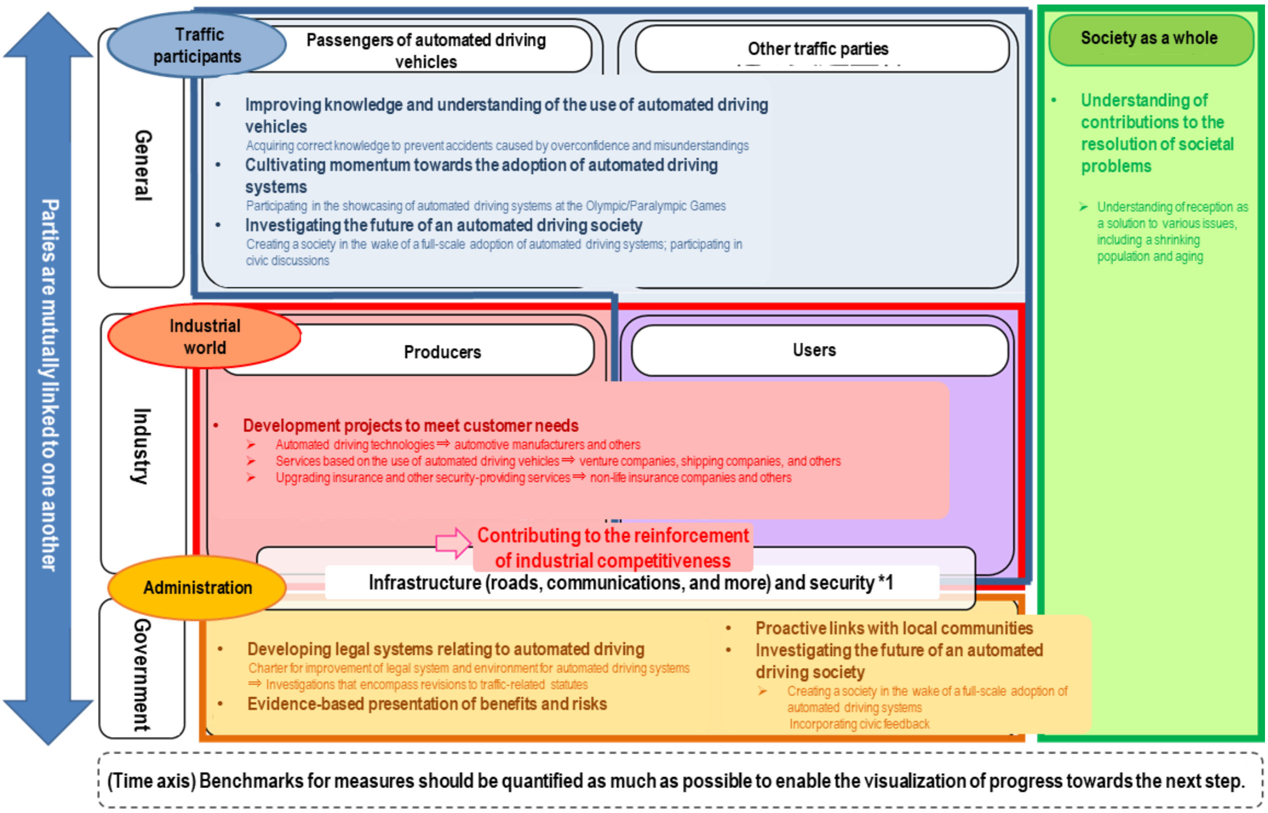
In Japan, a prerequisite for building the world's most advanced ITS in specific regions and expanding it across the nation is that citizens who will use and live with ITS/automated driving participate in the efforts to build such systems with a prior understanding of the social costs for their introduction and their limitations as well as the benefits given by them. In particular, when introducing automated driving systems into society as a new technology, it is indispensable not only to develop institutions as mentioned above but also to secure social receptivity.

Issues related to the securing of social receptivity have recently become evident, since there have been problems not only in the case of highly automated Level 3 driving systems and above but also in technologies related to automated driving corresponding to Level 0-2 that have already been commercialized.

With the impending arrival of the time for commercialization and service realization corresponding to Level 3 or above, we will need to clarify the stakeholders that pertain to ITS and automated driving and define the roles that should be fulfilled by each stakeholder in order to secure social receptivity.

These stakeholders and the initiatives that should be carried out by each stakeholder are outlined below.

[Figure 18] Initiatives to be undertaken by each stakeholder to secure social receptivity



(*1) It is assumed that roads, communications, and other infrastructural elements as well as security tools and measures will be developed by industry and/or the government.

Stakeholders pertaining to ITS and automated driving are categorized as set forth in the table below.

[Table 15] Categories of stakeholders pertaining to ITS and automated driving

i. Traffic participants

Refers to all parties participating in road traffic. For example, this term includes common individuals who own and drive their own automated driving vehicles as well as transit companies, shipping companies, and other operators of businesses that utilize automated driving vehicles and their passengers.

Likewise, this term refers to common individuals who own and drive conventional vehicles not equipped with an automated driving system (hereinafter referred to as "non-automated driving vehicles") as well as operators of businesses that utilize non-automated driving vehicles and their passengers. Also included in this term are non-automotive traffic participants, such as cyclists and pedestrians.

ii. Industry

Refers to automotive manufacturers, parts manufacturers, and other parties involved in the production of automobiles, both automated driving vehicles and non-automated driving vehicles, as well as transit companies, shipping companies, and other operators of businesses that utilize automated driving vehicles and businesses that are linked to the provision of automotive insurance plans.

iii. Government

Refers to the national government and local governments as administrative bodies.

iv. Society as a whole

In addition to i to iii above, refers to society as a whole, inclusive of parties that are not directly involved with automated driving vehicles, such as the recipients of packages delivered by shippers utilizing automated driving vehicles.

*: A single party may come under multiple categories. (For example, a person working for an automotive manufacturer would come under multiple categories as both an industry player and a traffic participant.)

In seeking to secure social receptivity, it is believed that various initiatives will need to be undertaken by these stakeholders as outlined below.

i. Traffic participants

Traffic participants will need to improve their acquisition of knowledge and level of understanding with respect to the use of automated driving vehicles irrespective of whether or not they personally use automated driving vehicles. We expect that correct knowledge of automated driving vehicles can help prevent accidents caused by overconfidence in or misunderstandings of automated driving functions and lead to the securing of social receptivity on the part of society as a whole.

General traffic participants will also need to be involved in cultivating momentum for the adoption of automated driving systems by helping to showcase automated driving systems to an international and domestic audience through the use of automated driving vehicles at the Olympic and Paralympic Games and at other such times, and participating as citizens in discussions and studies concerning the approach society should take in the wake of the adoption of automated driving systems.

ii. Industry

In the realm of industry, it is expected that automated driving-related products and services tailored to meeting customer needs will be developed. In addition to improvements to automated driving technologies in terms of the technology itself, we expect to also see social receptivity secured and the competitiveness of the Japanese automotive-related sectors bolstered through the development of various attractive services based on the use of automated driving vehicles, the development of insurance products for automated driving vehicles so as to promote the safety of automated driving vehicles, and the development of a business model to facilitate the provision of various services based on the use of automated driving vehicles with a view to creating new businesses.

iii. Government (administration)

The national government will develop institutions relating to automated driving, inclusive of the investigation of revisions to traffic-related statutes as set forth in a Charter for Improvement of Legal System and Environment for Automated Driving Systems. The national government and local governments are expected to proactively join forces to promote the development of infrastructural environments, make evidence-based presentations of the benefits and risks of adopting automated driving systems, investigate the framework for promoting proactive participation on the part of local residents and businesses in field operational testing and commercialization initiatives, and accelerate initiatives that are focused on the future of an automated driving society in which traffic participants and society as a whole are involved.

iv. Society as a whole

In society as a whole, we will need to ascertain the extent to which automated driving can be effective as a solution to local depopulation, aging, and other such issues based on the evidence outlined in iii above, and cultivate an understanding that automated driving can help solve such societal issues.

<u>Specific initiatives for securing social receptivity</u>

In order to endeavor to improve social receptivity pertaining to ITS/automated driving systems, operators that provide such products and services must provide their consumers with appropriate knowledge of the benefits, effectiveness, new risks, and other pertinent details of such technologies by having them first understand their functions and performance. However, upon taking into account progress in terms of the popularization and standardization of such products and services, such efforts should not necessarily be made by one company alone. In addition, given that government efforts need to be made from the perspective of the social system as a whole, it is necessary to consider developing a framework of collaboration among industrial, governmental, and academic actors that includes neutral, independent academic societies such as universities and research institutions.

Taking the matters mentioned above into account, in FY 2016, we started and have been developing since, a review system consisting of experts from a variety of fields such as engineering and social studies and conducting surveys on social and industrial analyses of automated driving through SIP Automated Driving Systems, with the objective of assessing the social impact of automated driving objectively in order to improve social receptivity.

In addition, SIP-adus (Automated Driving for Universal Service) has held dialog sessions directly with students and other citizens. Symposiums have also been held since fiscal year 2016 as part of a program of collaboration with the Ministry of Economy, Trade and Industry and the Ministry of Land, Infrastructure, Transport and Tourism. These initiatives will continue to be undertaken.

Development of collaboration systems by a variety of entities, including regions

In order to promote innovation in the midst of heightened interest in ITS/automated driving, it is essential to build places where a variety of industries and entities exchange information and create new efforts based on the needs of the field, and raise the level of the entire society, including regions, small and medium-sized enterprises, and venture companies.

Thus, places (such as regional councils and forums) shall be developed where not only the automobile and electronic industries, but also a range of industries including IT and finance, as well as SMEs, venture companies, universities, research institutions related to automated driving, NPOs and other public bodies, and also regions with interests and needs, can exchange opinions on the matter across sectors.

Through these systems and based on the specific mobility needs in each region, efforts shall be made to develop a mechanism that enables specific efforts toward the resolution of regional issues via ITS/automated driving, including the use of small-size mobility, through collaboration between local governments and local small, medium-sized, and venture companies, and thereby to contribute to regional revitalization.

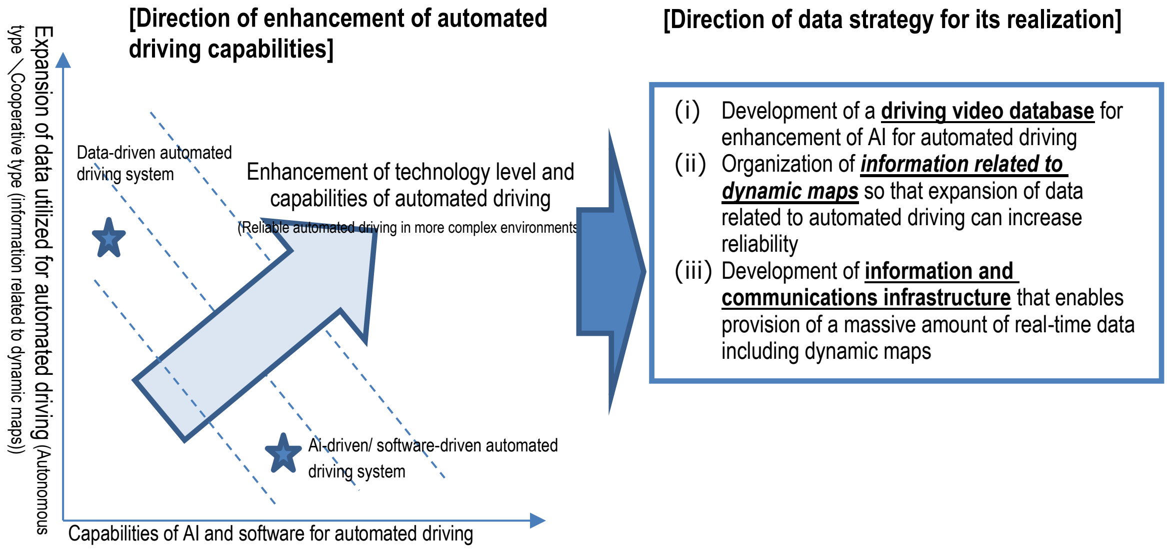
(2) Data strategy related to automated driving and utilization of traffic data

A. Data strategy toward the realization of automated driving

Since automated driving systems are becoming more data-driven, when sophisticating and commercializing such systems, the creation of a database for operation in many situations will be a key to industrial competitiveness. These situations include field operational tests on test courses and public roads, incorporation of skilled driving techniques into artificial intelligence based on the database, and development of a system that provides the massive amount of data that is required for the expansion of data to be utilized for automated driving.

From this perspective, “enhancement of the capabilities of artificial intelligence (AI) for automated driving and the fortification of safety-evaluation technologies” and “efficient expansion of data utilized for automated driving” should be promoted. The data strategy for the “development of information and communications infrastructure,” which is required to realize the former two, is shown below.

[Figure 19] Direction of data strategy related to automated driving[62]



<u>Developing a driving video database to enhance the capabilities of AI and formulating scenarios for the fortification of safety-evaluation technologies</u>

Amid growing interest in artificial intelligence in recent years caused by deep learning, automated driving is generally deemed one of the most important fields for AI application.

Existing automated driving systems are mainly controlled by traditional software excluding some

[62] The relationship between capabilities of AI and software for automated driving and expansion of data to be utilized for automated driving is described below.
•In principle, automated driving is possible only with autonomous-type information (with minimum cooperative-type information) if AI/software technologies with humanlike capabilities are developed.
•On the other hand, AI/software technologies for automated driving can be complemented by providing various external information (cooperative type) related to dynamic maps to the vehicle. Note, however, that there are issues, shown below.
▪Since information related to dynamic maps is cooperative-type data, reliability will be increased by the provision of information. However, it is positioned just as complementary information.
▪In order to make automated driving vehicles using dynamic maps internationally available, international institutions must be developed including international standardization.
▪Dynamic information linked with high-accuracy 3D maps in dynamic maps is provided by information and communications infrastructure separately from high-accuracy 3D maps. So, it depends on the status of the development of the information and communications infrastructure.

functions such as image recognition and are not fully driven by artificial intelligence technologies. However, based on the view that utilization of AI is essential to realize the operation of automated driving systems in more complex environments such as urban areas, research toward its utilization is actively pursued and considered to enhance competitiveness of automated driving in the future.

In order to enhance the capabilities of AI through deep learning and other forms of machine learning, it is necessary to have AI learn as many driving scenarios as possible and the behavior of automated driving vehicles in accordance with different driving scenarios. In this light, a massive amount of driving video data and accident data will play an important role. In Japan, such data has been developed to be used for simulations of automated driving technologies (software) on test courses and public roads.[63]

In addition, the development of safety-evaluation technologies is an urgent matter for the introduction of highly automated driving vehicles to the market. In evaluating safety, the belief that we should not just conduct evaluations on actual vehicles being driven, as has been the practice to date, but also conduct driving evaluations using simulations is one that is internationally supported.[64] Usage cases, accident data, and driving video data developed by the Japan Automobile Manufacturers Association and the Japan Automobile Research Institute will be utilized to produce scenarios for the development and investigation of safety-evaluation technologies beginning in fiscal year 2018. Any new driving video data that are required for a new purpose shall be collected upon investigating the specific method of use, required resolution and other such conditions, method of data management, and other pertinent matters. It is expected that driving footage will also be utilized to update high-precision three-dimensional maps for dynamic map applications and applied to fields outside the realm of automated driving.[65]

Data collection and utilization will be promoted in accordance with the Basic Policy on the Strategic Collection and Use of Driving Video Data and Accident Data as compiled in the Policy on Initiatives for the Realization of Automated Driving (Version 2.0) (March 30, 2018)[66] as enacted by the Automated Driving Business Investigative Council.[67]

<u>Commercialization and sophistication of dynamic maps</u>

Dynamic maps in automated driving are high-accuracy 3D maps linked with time-varying dynamic data (dynamic information, quasi-dynamic information, and quasi-static information). The main purpose of

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[63] In Japan, we positioned the "Awareness and Judgment Database" as a cooperative area and have been building a database of driving video, sensing data, and driving action data through the contract projects from SIP-Adus and METI. The Projects are implemented by the companies including Japan Automotive Research Institute (JARI).

[64] Such as can be seen in the German PEGASUS project.

[65] It has been pointed out that footage data obtained from an automobile's cameras can be used to update high-precision three-dimensional maps for dynamic map applications as well as to visualize the environment surrounding roads and enable information-sharing by the police, firefighting services, hospitals, and other first-responders in an emergency. (Materials provided by the Investigative Council on Institutional Development Concerning the Use of IT, IT Strategic Headquarters; November 2015).

[66] Established in February 2015 as an investigative council by the head of the Manufacturing Industries Bureau of METI and the head of the Road Transport Bureau of MLIT in order to help solve various societal issues as a global pioneer in the field of automated driving.

[67] http://www.meti.go.jp/report/whitepaper/data/20180330002.html

dynamic maps in terms of the realization of automated driving is to provide high-accuracy 3D map information as complementary information for self-position estimation and driving route determination.

Since it costs a great deal to establish high-accuracy 3D map information that will serve as the foundation of dynamic maps, a privately-funded infrastructure development company[68] was established in June 2016 and became a business corporation in June 2017 in order to promote public-private collaboration, including collaboration on the development of specifications and maps between companies toward the commercialization of automated driving systems on expressways.

In alignment with such efforts by private companies and the measures of each ministry with the SIP project at the center, "development, demonstration, and standardization of dynamic maps," "development of technologies to deliver and update high-accuracy 3D maps related to dynamic maps," "sophistication of the method for providing traffic control information," and "consideration on utilization of dynamic maps in other fields" are being promoted through public-private collaboration in order to promote the commercialization of dynamic maps. Specifications of dynamic maps discussed in SIP are now being internationally standardized such as ISO standards and efforts are being made to ask overseas related standardization organizations to harmonize specifications. It is necessary to strongly promote the international standardization of their specifications so that dynamic maps can be used smoothly in Japan and overseas.

In addition, efforts should be made to achieve intersystem coordination and cooperation in light of the fact that the advanced map information infrastructure related to dynamic maps can be utilized not only for automated driving systems but also for pedestrian support and non-traffic related fields such as disaster prevention, tourism, and road management. Specifically, development of an information distribution structure that includes an infrastructure developer that develops high-accuracy 3D maps is being discussed. Via public-private collaboration through SIP projects, such a structure will;

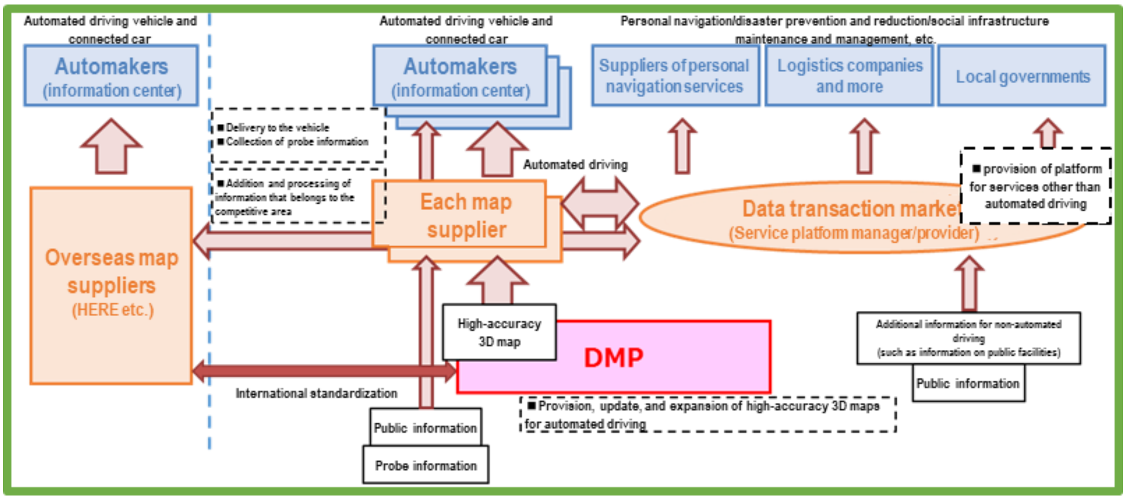
- establish a data distribution platform that enables high-accuracy 3D maps to be used in other fields
- secure interoperability with maps of other countries by promotion of international standardization

Development of such information distribution structure will be continued based on the results of the discussions.

[68] Dynamic Map Platform Co., Ltd. (DMP) was established in June 2016 as a planning company, consisting of 6 companies from the Dynamic Map Development Consortium that have considered specifications of dynamic maps in SIP and automakers and became a business company in June 2017. DMP is aimed at considering development, demonstration, and operation of high-accuracy 3D maps (shared platform that is a cooperative area of dynamic maps) that are required to realize automated driving/driving safety support systems. It sets a goal of becoming a business corporation within 2017. It aims to expand dynamic maps not only in the field of automated driving/ driving safety support but also in a wide range of fields such as disaster prevention and reduction and social infrastructure maintenance and management.

※In realizing automated driving, high-accuracy 3D maps of roads and their surrounding environments are important for self-position estimation and driving route determination as well as autonomous-type information. However, since it costs a great deal for individual companies to develop such maps, they were positioned as an area that each company should work together on. To this end, DMP was established.

[Figure 20] Information distribution structure for dynamic maps currently under consideration (image)[69]



In light of such circumstances, the demonstration and commercialization of the technologies related to dynamic maps that have been developed will be promoted. Institutional development and international standardization will also continue to be promoted. In addition, ways to utilize data related to automobile-related information held by the public and private sectors for dynamic maps (including development into open data) should be discussed. Specifications and structures of dynamic maps and ways to utilize probe information shall be discussed and put together within fiscal year 2018.

[Table 16] Future direction of utilization of information related to dynamic maps through public-private collaboration (image)

- Considerations with regard to the provision of automobile-related data held by the public sector (including development into open data)
  - ✓ Target data should be identified by clarifying the needs of private sectors including clarification of whether the data is required for automated driving (including high-accuracy 3D map information) and whether it is currently difficult for private sectors to obtain such data.
    (The following are just examples. Specific discussions will be held.)
    - ➢ Information on updating of 3D map information such as alterations to roads
    - ➢ Other data that are required for automated driving and suit private sectors' needs
  - ✓ Then, provision of such data should be considered including with regard to the clarification of the future schedule in light of the current methods for collecting and holding various data in the public sector and an appropriate, efficient information provision structure.
  - ✓ If possible, provision of data other than the above should be promoted and it also should be made open.
- Utilization of automobile-related information held by private sectors (automakers, business operators, etc.) (Probe data etc.)
  - ✓ Specifications and structures (cooperative area) for the utilization of dynamic maps should be clarified promptly to facilitate establishment of business models in private sectors.
  - ✓ Then, the current methods for collecting and storing various data should be sorted out and efforts should be made through public-private collaboration, taking into account past efforts.

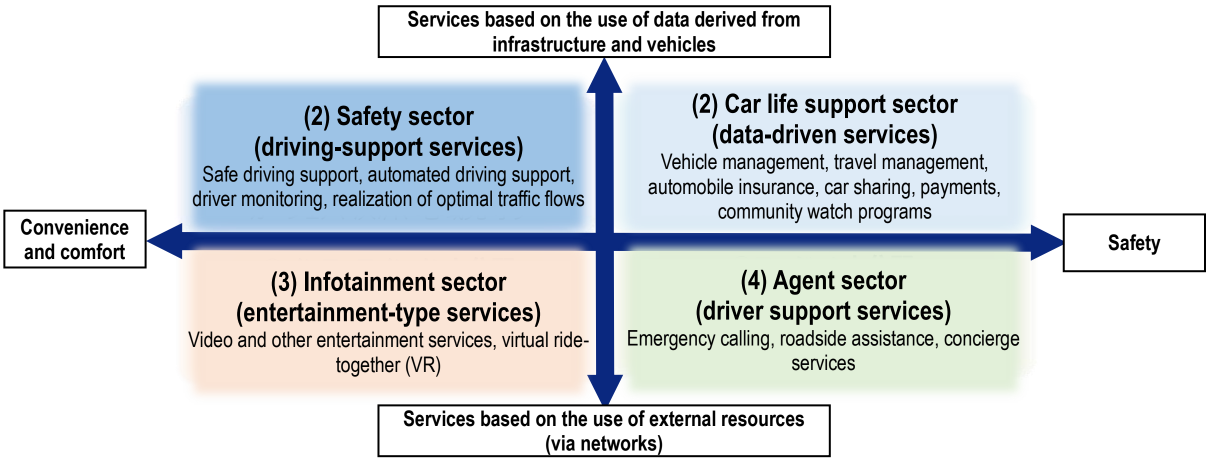
[69] The figure shows the image of the structure under consideration and the details may be modified in the future.

✓ In addition, the possibility of the utilization of driving video data in dynamic maps should be examined.

Sophistication of information and communications infrastructure

Against the backdrop of advancements in the use of big cata both in terms of the evolution of fifth-generation mobile communications systems (5G) and other mobile networks and the spread of the IoT and of advancements in artificial intelligence (AI) based on deep learning and other new theories, it is expected that we will see connected cars (cars connected to networks) expand rapidly around the world, and progress in terms of the creation of new services and businesses spanning a wide range of sectors, including the automated driving sector, the sector for improving safety, the car life support sector, the infotainment sector, and the agent sector.[70]

[Figure 21] Service categories (examples)



[70] Accordingly, the Ministry of Internal Affairs and Communications held panel sessions for realizing a connected car society from December 2016 to July 2017 and drafted a written report. Based on the results of investigations conducted at these panel sessions, initiatives for developing and testing wireless systems supporting connected cars are slated to take place for the purpose of realizing a connected car society that is safe, secure, and convenient.

In addition, investigations are being conducted for the promotion of commercialization with respect to 5G not only in Japan but also in other countries with a view to realizing 5G in 2020. In the 5G era, 5G systems are expected to be utilized not only in businesses based on traditional devices such as smart phones but also in new fields such as IoT, automobiles, industrial equipment, and smart meters. In the ITS field (automated driving, connected cars, etc.), serious discussions on the commercialization and popularization of automated driving utilizing a wireless system such as 5G are being held in Japan and abroad.

The upgrading of information and communications infrastructure will become essential in particular for the realization of automated driving, given that it is expected that the autonomous collection of peripheral information and the real-time transmission and transfer of large amounts of data, including dynamic map-related information, through cloud services and other external data platforms via Networks will become necessary.

[Table 17] Data exchange related to automated driving and connected cars that is supposed to occur (image)

	Content (examples)	Remarks (Future considerations: example)
Remote monitoring/operation	・Transfer of video data and execution of remote operation based on the data	・Transfer of a massive amount of data and real-timeness (minimum delay) are required.
Data exchange related to dynamic maps/probe data	・Update of dynamic maps (OTA) ・Use of in-vehicle probe data ・Driving video data for update of high-accuracy 3D maps	・A scheme for updating and distributing maps for each piece of information will be necessary in order to update data pertaining to dynamic maps. ・Uploading probe data will make it possible to use data to generate lane-specific traffic-flow information.
Data exchange related to AI/driving video data	・Update of AI data (OTA)	・As for OTA updates, legal and technical issues must be discussed depending on their contents. ・Though it is considered that a massive amount of data needs to be transferred for OTA updates, it is not required in real-time.
Other than automated driving (entertainment purposes etc.)	・Exchange of other data such as video data for entertainment and HMI data	・Same as cell phones. Depending on the usage (e.g. video for entertainment), a massive amount of data needs to be transferred.

Note: The details must be discussed separately in the future.

It will be necessary to examine elements of the information and communications infrastructure, including with respect to edge computing and other aspects of architecture and the full-fledged utilization of 5G, while maintaining a focus on requirements in such terms as data-transfer amounts and real-time performance needed for automated driving and connected cars and the timing at which such requirements will be realized. To this end, we will promote efforts to enhance the reliability and precision of automated driving controls and surveys, studies, research and development work, and field operational testing with respect to technologies for updating dynamic map-related information and probe information on a highly efficient, real-time basis as well as technologies and systems for distributing information to vehicles with a view to quickly realizing highly automated driving systems based on the use of new communications technologies (such as V2X technology[71]) and mobility and logistics services based on the use of automated driving technologies.

In addition, initiatives by private-sector companies pertaining to activities for automated driving systems and connected cars that are based on the use of mobile telephone technologies are intensifying.[72] The development of 5G and other elements of an information and communications infrastructure thus needs to be pursued in order to satisfy needs relating to automated driving systems and connected cars in light of such international developments as those that concern research and development work being undertaken around the world for the realization of automated driving systems that utilize not just conventional ITS frequencies but also LTE and 5G networks. Also, it should be paid attention to the increasing importance of ensuring security and privacy as connected cars increase.

B. Development and utilization of traffic-related data and automobile-related data[73]

Efforts toward the effective use of probe data

In recent years, data collected from moving objects (automobiles) are expanding because of the progress in IoT to include probe data, such as location and speed information of automobiles, sensor and image information, and in-vehicle operation information. However, since these data are held separately by the public and private sectors,[74] and systems are developed separately by each entity, mutual connectivity has not been established.

In the private sector, these data contribute not only to providing information to automobile users, but also to creating new business and the sophistication of existing business, including the sophistication of

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71 Stands for *Vehicle to Everything*. A term meaning communications between an automobile and everything else; specifically includes vehicle-to-vehicle communications (V2V), vehicle-to-infrastructure communications (V2I), vehicle-to-pedestrian communications (V2P), and vehicle-to-network communications (V2N).

72 Examples, such as with the use of LTE V2X and the establishment of 5GAA, can be seen around the world.
LTE V2X: An LTE-based communications technology intended for use with automated driving systems and connected cars (such as for vehicle-to-vehicle and infrastructure-to-vehicle communications). Endorsed by the likes of Qualcomm, Huawei, Ericsson, and Nokia as of the end of 2015. Initial specifications were formulated in September 2016.
5GAA: 5G Automotive Association. Established in September 2016 to enable Audi, BMW, Daimler-Chrysler, and various telecommunications and semiconductor manufacturers to collaborate with one another on the development of services for connected cars using 5G.

73 Development and utilization of traffic-related data and automobile-related data that are not mentioned in "(i) Data strategy toward the realization of automated driving" above are discussed.

74 For example, data are being collected and accumulated separately on unique systems of a variety of private companies, such as automobile manufacturers, public transportation, and forwarding companies, automobile-related equipment (car-navigation systems) manufacturers, smartphone and tablet OS manufacturers, app manufacturers, and insurance companies. Moreover, traffic administrators and road administrators also collect data on automobile traffic through sensors installed in roadside infrastructure, such as vehicle detectors, optical beacons, and ETC 2.0. The government, auto dealers, and automobile maintenance/repair companies have inspection registration information and maintenance/repair information.

logistics systems of forwarding companies. In the public sector, these data can be used for surveys and studies on roads and road traffic management and serve as useful information in policy efforts, such as logistics, disaster prevention, and tourism. Therefore, the effective use of these data through sharing between the public and private sectors is much expected. ETC 2.0 data will also be utilized to thus facilitate the introduction of travel management support services for trucks and other such vehicles and expressway bus location systems, the provision of passage-performance information during disasters, studies on measures to deal with congestion affecting local tourism, and more.

In order to promote the utilization of data held by the public and private sectors through information linkage, standards, rules, and methods required for shared use when information is distributed, including the promotion of information distribution by linking high-accuracy 3D maps of dynamic maps mentioned above with various dynamic data,[75] shall be discussed.

In addition, when promoting efforts related to information linkage for probe data, it is necessary to pay attention to the trend of international standardization including de facto standards, and active involvement in international standardization is required.

Efforts toward the effective use of automobile-related information

In light of the expectation that safety and security related to the use of automobiles can be enhanced and that new services can be created by leveraging automobile-related information such as information on automobile inspection and registration, checking/maintenance, and driving characteristics, we will work to achieve the four service menus set forth in "the Future Vision Related to the Utilization of Automobile-Related Information" developed by the Ministry of Land, Infrastructure, Transport and Tourism in January 2015. Specifically, the following will be addressed: the development of a draft of standard specifications for the external fault diagnosis devices for safety-related vehicle equipment; the popularization and awareness raising activities for automobile insurance programs that promote drivers' safe driving by leveraging information on driving characteristics such as sudden acceleration and braking; the examination of a business scheme for services that summarize and provide vehicle history information including information on checking and maintenance of the automobile and traveling distance; and the sophistication and streamlining of inspections and maintenance via correlation analysis between checking and maintenance.

Utilization of big data, including traffic data, for policies

In parallel with the efforts to promote and sophisticate the superimposition of the aforementioned map data and to promote the utilization of probe data, efforts to resolve issues in the traffic and other fields by

[75] Since methods for information linkage and issues related to them and data that should be shared vary greatly depending on purposes of use and so on, it is necessary to clarify the scope of data that needs to be shared based on a due consideration of the needs of the public and private sectors such as disaster prevention and tourism. By sorting out the current methods for collecting and holding various data related to such fields and taking into account the past efforts related to information linkage, efforts shall be made under cooperation between the public and private sectors including private organizations with knowledge on such information linkage.

leveraging traffic-related data and other big data shall be promoted.

Specifically, efforts to use roads cleverly by leveraging a variety of detailed big data, including speed and behavior data of ETC 2.0 and advanced optical beacons, in an integrated manner shall be rolled out, and efforts to apply such data to traffic policies, such as the activation of public transportation and the mobility support to pedestrians, shall be promoted. In addition, in an effort to secure efficient mobility means in rural and underpopulated areas, the popularization of on-demand vehicle dispatch systems via collaboration with vehicles operating in local communities by leveraging IT (public transportation systems) shall be examined. In order to reduce impediments to road traffic caused by significant snowfall, ETC 2.0, the Japan Road Traffic Information Center (JARTIC), VICS information, SNS, and other resources will be utilized to ensure the proper delivery of emergency announcements relating to significant snowfalls, information concerning traffic conditions and road closures, and camera footage with which snowfall conditions can be verified to road users. In addition, initiatives based on the use of ICT and other new technologies will be pursued—such as by adopting systems to automatically detect and predict traffic hazards through the use of cameras and AI—for the purpose of streamlining the collection and provision of information.

For promoting these efforts, making data to be used (including data other than traffic data) in the efforts open shall be encouraged if appropriate, and the shared use of standard systems and the use of the cloud shall be considered to facilitate the efficient introduction and popularization of systems in each region.

C. Response to privacy and security

<u>Development of a review system for personal information protection and privacy</u>

Since data utilization in ITS/automated driving has been expanding, it is necessary to give due consideration to the protection of personal information and privacy when using data. In particular, the automobile industry has pointed out that, when utilizing a variety of data in automated driving systems, there are issues to solve, such as the securing of consent from individuals on acquisition of their personal location information by the system and how information concerning surrounding vehicles and pedestrians, which is contained in camera data, should be handled.

The revised Act on the Protection of Personal Information,[76] which was amended and promulgated in September 2015 and implemented in May 2017, allows private companies to freely use anonymized information (information that has been processed so that no individual will be identifiable from it). The examples of methods for processing probe data are shown in the report published by the Personal Information Protection Commission[77] in February 2017.

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76 The revised Act on the Protection of Personal Information was promulgated in September 2015. The Personal Information Protection Commission was established based on the act in January 2016. (Fully implemented in May 2017)

77 "Anonymized Information: Toward the Realization of Both the Promotion of Utilization of Personal Data and the Securing of Consumer Confidence" (February 2017: report by the Personal Information Protection Commission)

In addition, regarding privacy protection related to camera images, a guide[78] was published in January 2017 in order to promote the utilization of camera images based on their characteristics. It summarizes the matters for business operators to consider when they try to protect citizens and their privacy and communicate with them properly. After that, the guide was amended in March 2018.[79]

In view of these, it will be necessary to promote the utilization of probe data and driving video data. In doing so, it is crucial not only to consider legal compliance but also to make it clear that the services that utilize personal data will be useful for the individuals who provide their personal data.

Development of a system related to security

With future advances in the computerization of automobile control systems, especially advances in automated driving technologies via cooperative systems including mobile-type systems, security risks will be increased and the impact of cyber-attacks on road traffic society will become greater. Therefore, interest in automobile security measures including countermeasures against hacking has been growing. In light of the fact that automobile security issues may not only cause damage to owners or drivers of automobiles but also make them victimizers, security measures are an especially serious challenge to tackle.

Against this backdrop, the formulation of industry guidelines pertaining to security measures for automobiles is being pursued in Japan ahead of international standards.[80] Japan is advancing discussions on international standards while chairing, jointly with the United Kingdom, the cybersecurity task force that has been established under the purview of WP29. Research and development work is being undertaken broadly through the SIP and initiatives being led by the Ministry of Economy, Trade and Industry and Ministry of Internal Affairs and Communications. In particular, white-hat hacking is being carried out through the SIP in large-scale field operational testing on automobile cybersecurity. Security evaluation guidelines will accordingly be formulated sometime in fiscal year 2018. In addition, the commercialization of an evaluation environment (testbed),[81] including by way of its use for the cultivation of human resources, will be promoted through its development by fiscal year 2018. In addition, appropriate security measures for connected cars shall be discussed from the perspective of information and communications. Consideration should be given to the fact that software updates by Over the Air (OTA) may be effective as one of the prompt security measures for the vehicles that have already been brought to market. We should keep in mind that we need to constantly reinforce security measures through ongoing research and development work in accordance with external circumstances.

[78] "The Guide for Camera Image Utilization ver. 1.0" (IoT Acceleration Consortium, the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry, January 2017)
[79] "Guidebook Governing the Use of Camera Footage ver. 2.0" (IoT Acceleration Consortium, the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry, March 2018)
[80] Evaluation guidelines to be implemented by OEMs and suppliers are being gradually formulated by JASPAR.
[81] Currently being established as a Research and Development and Verification Program for the Social Implementation of Highly Automated Driving Systems (METI, MLIT).

Moreover, it is necessary to establish a system to share information between companies for incident response to strengthen security measures. To this end, we will need to pursue collaborations with the US Automotive Information Sharing & Analysis Center (Auto-ISAC)[82] and promote initiatives for prompt information sharing and analysis with respect to a system for sharing information[83] that has been set up with the Japan Automobile Manufacturers Association.

In addition, the promotion of the cultivation of cybersecurity personnel, whose shortage constitutes an acute problem in Japan, is an urgent matter. These days, industrial, governmental, and academic parties are collaborating to hold courses and programs for the cultivation of human resources.[84] We will need to proactively engage in initiatives to expand the ranks of cybersecurity personnel, including by way of scouting and recruiting mid-career overseas workers.

Progress updates on these matters and a schedule for pursuing the production of a framework for internationally common development processes and safety evaluations have been summarized in Cybersecurity Measures for Automated Driving Systems[85] by the Automated Driving Business Investigative Council.

(3) Promotion of R&D of automated driving systems and international criteria and standards

A. Promotion of R&D and demonstration of automated driving systems

Strategy for R&D and demonstration of automated driving systems toward its commercialization

In order to realize automated driving systems, it is necessary to promote public-private joint R&D of the tangibles and intangibles related to a wide range of technologies such as sensing technologies, intelligence technologies, drive technologies, communications technologies, data utilization technologies, and security technologies, with private companies playing a leading role.

In Japan, based on the Public-Private ITS Initiative/Roadmaps, public-private joint R&D and demonstrations, mainly of individual element technologies, dynamic maps, security, functional safety,[86] database establishment technologies, control technologies, research related to human aspects,[87] and

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82 In the United States, the American automotive industry (Alliance of Automobile Manufacturers) and others announced the establishment of Auto-ISAC in July 2015. (Information Sharing and Analysis Centers (ISAC): These are organizations that work to reduce risks and enhance toughness by collecting, analyzing, and sharing information pertaining to security threats.)
Subsequently, the National Highway Traffic Safety Administration and eighteen automotive companies adopted the Proactive Safety Principles 2016, which includes provisions on automotive cybersecurity. Automotive cybersecurity measures in these principles include Auto-ISAC support and expansion.

83 The J-Auto-ISAC WG was established, whereupon its activities were commenced in April 2017.

84 Including the IPA's Industrial Cybersecurity Center Personnel Cultivation Program and the Automotive Cybersecurity Course, which is offered as part of the Society of Automotive Engineers of Japan's Human Resources Cultivation Program.

85 http://www.meti.go.jp/committee/kenkyukai/seizou/jido_soukou/pdf/sankou_002.pdf

86 It is also necessary to consider the requirements for securing safety in case of fail-operational mode (including functional degeneration), performance limit, erroneous operation, and misuse, as well as functional safety.

87 When performing driver monitoring and considering the acceptable range of second tasks, it is necessary to standardize

research related to HMI, as cooperative area technologies that are not part of private companies' competitive area such as common infrastructure technologies, have been promoted through measures of SIP and each government ministry and agency.

Toward the commercialization of various automated driving systems in 2020, focus should be on the demonstration (verification of technological aspects, institutional aspects, and social benefits) and standardization of each technology while considering the expansion of the R&D areas that are promoted cooperatively by private sectors toward the realization of more advanced automated driving systems. New ideas including demonstration projects not only by major companies but also by venture companies shall be supported.[88] In addition, attention should be paid to the fact that technologies need to be detailed for transition from the demonstration stage to the commercialization stage.

Attention should also be paid to the necessity of integrating the efforts of many concerned parties in promoting R&D toward the development of information and communications infrastructure that will serve as a platform for automated driving systems such as 5G and cooperative systems.

Collaborations with academia shall be reinforced to further promote research conducted jointly by industrial, academic, and governmental actors.

The use of high-precision positioning based on the utilization of quasi-zenith satellites, an area that has been developed by Japan and in which Japan enjoys a competitive advantage, will be investigated with a view to realizing automated driving systems.

Fundamental research and human resource development for the future automated driving systems

In the future, technologies required for automated driving systems are going beyond the boundaries of the conventional IT introduction in automobile technologies and becoming more focused on sophisticated and innovative technologies such as artificial intelligence (AI) and the utilization of interdisciplinary fields including ergonomics (HMI etc.) and security.

In order to commercialize these technologies, collaboration with basic/fundamental research and the training and securing of software personnel in possession of knowledge on software and AI are essential. Therefore, skills standards applicable to automotive software pertaining to automated driving will be formulated in fiscal year 2018. Moreover, courses for the cultivation of human resources based on the use of these skills standards will commence in fiscal year 2019. In promoting R&D and demonstration activities for automated driving systems, the capabilities of multiple existing research institutions as well as universities will be actively leveraged to develop a system of collaboration among industrial, academic, and governmental actors in Japan.[89]

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requirements based on basic and fundamental ergonomic research on drivers' cognition, behavior, and physiological state and its findings from the perspective of streamlining and accelerating development and securing minimum safety.

[88] When developing automated driving systems and element technologies, the introduction of a reward-type method that provides a place for competition (contest) for many entities and challenging ideas shall be considered in light of the fact that it is necessary to gather ideas and advanced teams with various capabilities.

[89] A system for R&D of artificial intelligence (AI) has been developed under cooperation between the Ministry of Education, Culture,

In doing so, efforts shall be made to make these institutions the core centers that are open to the world from the perspective of promoting the utilization of overseas human resources and the participation of overseas companies. Through these systems, efforts shall also be made to build ecosystems that will create new ventures and industries

B. Development of criteria and standards, promotion of international collaboration, and exercise of international leadership

Strategic efforts toward the development of international criteria and standards

In order for Japan's automobile industry to lead the world and actively contribute to resolving social issues including the reduction of traffic accidents, it is important to build a system that strategically responds to the efforts to develop international rules (criteria and standards) that will serve as a foundation for the promotion of efforts in the cooperative area.

For the examination of international standards for automated driving, the Subcommittee on Automated Driving was established in the UN World Forum for "Harmonization of Vehicle Regulations" (WP 29) in November 2014, and the Expert Council on Automatic Steering where technology standards for automatic steering are examined was established in March 2015. With various expert panels on automated braking systems used in passenger vehicles set up in November 2017, Japan has been co-chairing meetings of these panels with the United Kingdom, Germany, and the European Commission. Given the existence of plans to discuss various issues, including those pertaining to manned level 3 and above automated driving systems in the future, international discussions in the field of automated driving will continue to be promoted under the purview of WP29.

For the efforts for the establishment of international standards for automated driving, Japan is in position to lead the discussion as some of the important TCs (Technical Committees) are headed by Japanese chairpersons.[90] Moreover, since the relationship between ISO/TC 204 (ITS) and TC22 (vehicles) has become more complicated, an automated driving standardization study panel was established in the Society of Automotive Engineers of Japan, a domestic deliberative body in this field, to promote cross-sector information sharing and examine strategies. On the other hand, along with growing interest in automated driving, the number of international standardization items has significantly increased in recent years. In order to respond to this trend, it is necessary to continue examining measures to strengthen a mechanism to

Sports, Science, and Technology (Riken), the Ministry of Economy, Trade and Industry (AIST), and the Ministry of Internal Affairs and Communications (NICT) since FY 2016. Discussions shall be promoted with a view to collaborating with such a system where necessary.
In addition, as for HMI, AIST established the Automotive Human Factors Research Center in April 2015 to study the attributes of humans as drivers toward the realization of safe, fun driving.

[90] In TC22, Japan serves as a chair and the secretariat for SC32 (Electrical & Electronic components and general system aspects), where issues such as information security and functional safety are handled. In TC204, a Japanese person was elected as a convener (equivalent of a chairperson) for WG3 (ITS Database technology), where map information is handled, and for WG14 (Vehicle/Roadway warning and control systems), where automobile driving control is addressed.

secure resources such as experts involved in the implementation of standardization activities. Important subjects for standardization include maps, communications, ergonomics, functional safety, security, and recognition technologies.

Moreover, in order to lead the world in the field of rule-based automated driving, it is essential to have international strategies that fully cover criteria and standards. Therefore, the Automated Driving Standardization Research Institute[91] was established in May 2016 as a place for strategic discussions to bridge the gap between criteria and standards. Japan continues developing strategies that allow it to lead international activities in accordance with its future vision of automated driving.

The UN is discussing the development of international standards related to "technologies for transition to a minimal risk condition", which are not only essential for automated driving but also indispensable for "sophisticated driving safety systems (tentative name)," and Japan will continue playing a leading role in such discussions.

In addition, it is essential to utilize radio waves and secure the safety of information and communication networks in order to achieve/upgrade automated driving and connected cars. ITU[92] has agreed to include "global or regional harmonization of frequency bands for ITS" as an agenda item for the 2019 World Radiocommunication Conference. Japan shall play a leading role in that discussion toward the global harmonization of frequency bands for ITS including automated driving.

Promotion of international collaboration and exercise of leadership

In order to build the world's most advanced ITS, including the development and popularization of automated driving systems in the future, it is necessary to promote efforts from a global perspective without limiting them within the country and display international leadership.

To this end, it is important for Japan to actively participate in existing international frameworks and activities in Europe and the Americas; promote the exchange of information on international standards including terms related to automated driving system, functions, component technologies, performance standards, and conformity assessment and joint research on human factors and social receptivity from a global perspective; and play a leading role in building global consensus through these activities. As part of an effort to display international leadership, the SIP Automated Driving Systems holds an international conference on automated driving in Japan every year.

In addition, as interest in automated driving has been growing around the world in recent years and a high level of international collaboration has been promoted, Japan shall actively respond to this trend.

[91] The Institute was established in the Japan Automobile Standards Internationalization Center (JASIC). The director of the National Traffic Safety and Environment Laboratory, National Agency for Automobile and Land Transport Technology, serves as director of the Institute.

[92] ITU (International Telecommunication Union) is an international organization that determines frequency allocation and develops international standards and recommendations related to communications. ITU-R (ITU Radiocommunication Sector) has agreed to include "global or regional harmonization of frequency bands for ITS" as an agenda item for the 2019 World Radiocommunication Conference (WRC-19).

Specifically, a G7 Transport Ministers' Meeting was held in Italy (Cagliari) in June 2017. It was agreed then that G7 countries would pursue collaboration with one another based on the results of this meeting by incorporating into their declaration both a desire to cooperate at an international level, as set forth in the UN's WP29, and the exchanging of information with respect to best practices, research activities, and data concerning automated driving among working groups dealing with automated driving, with a view to commercializing higher level (level 3 and level 4) automated driving technologies under manned conditions. In addition, as part of its efforts for bilateral cooperation, Japan has issued a high-level Joint Declaration of Intent[93] related to automated driving with Germany. Japan shall make efforts based on this statement and consider cooperating with other countries and regions from a strategic perspective on an as-needed basis.

[93] In January 2017, the Minister of State for Science and Technology Policy Yosuke Tsuruho signed "Joint Declaration of Intent of Japanese-German Cooperation on the Promotion of Research and Development on Automated Driving Technologies" with the Federal Minister of Education and Research of Germany. The Declaration states that both countries should work together to promote R&D of automated driving technologies.

In March 2017, the Minister of Economy, Trade and Industry Hiroshige Seko and the Minister of Internal Affairs and Communications Sanae Takaichi signed "Joint Statement on Cooperation Between METI and BMWi Regarding the Internet of Things (IoT)/ Industrie 4.0" (Hannover Declaration) with the Federal Minister of Economic Affairs and Energy of Germany. The Statement states that both countries will discuss policies on the issues related to the automobile industry including automated driving and connected cars.

6. Roadmaps

Based on the descriptions in chapters 2 to 5, roadmaps are attached that show the issues regarding the efforts for the social implementation of highly automated driving systems (private vehicles, logistics services, and transport services) and the promotion of innovation to be addressed by both the public and private sectors and the timeline. The roadmaps were developed in tandem with the reviews made in SIP Automated Driving Systems and are consistent with the research and development plan developed in the SIP program.

The public and private sectors shall share the roadmaps and the goals shown in them, clearly define the roles and responsibilities of each sector, and address measures and policies through discussions and mutual collaboration to promote these roadmaps.

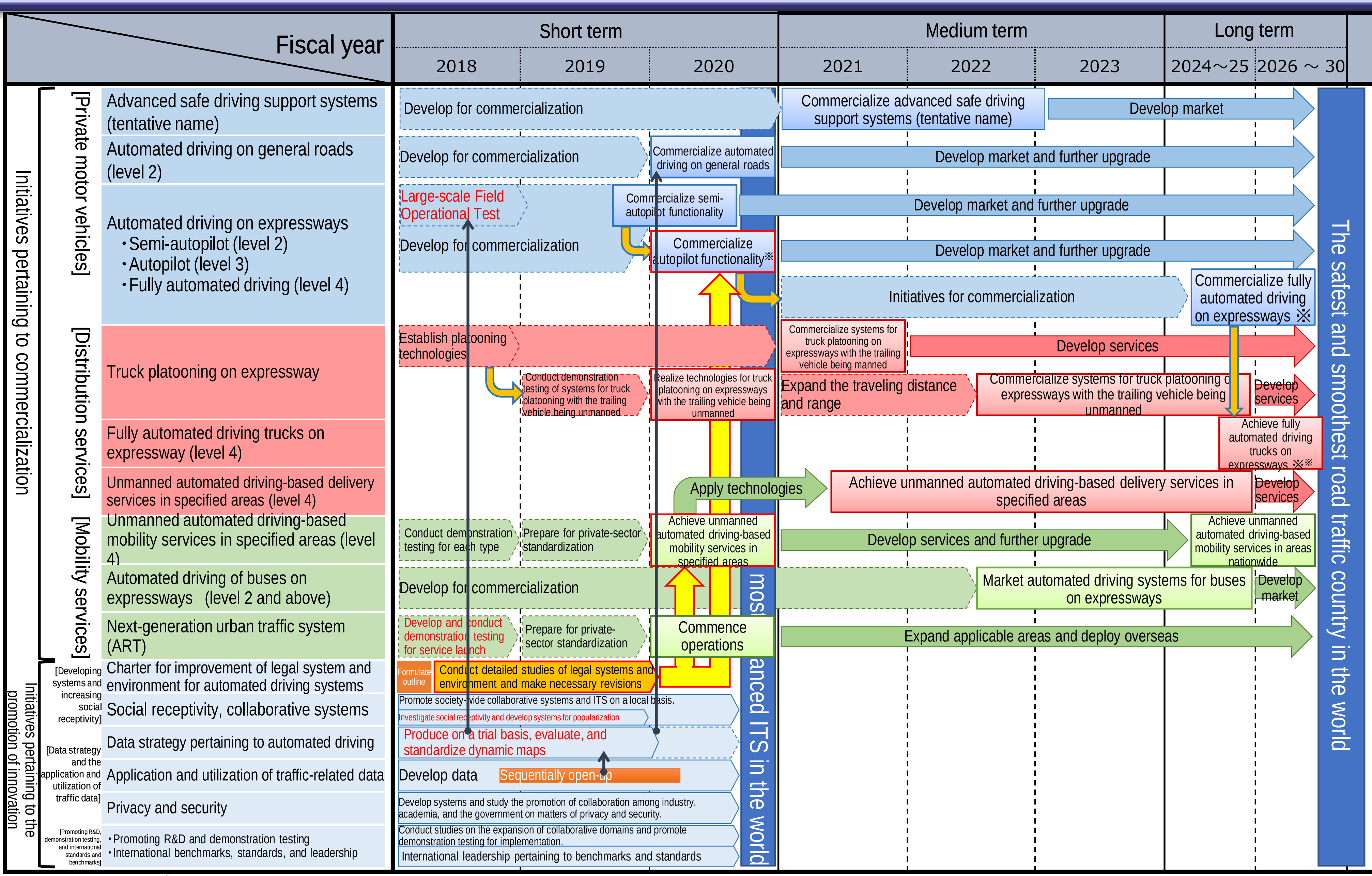
7. Method of and Structure for Moving Forward

In the future, detailed examination will be made on the issues shown in the Public-Private ITS Initiative/Roadmaps 2018 through public-private collaboration, and the joint meetings between the SIP Automated Driving Systems Promotion Committee and the Road Traffic Working Team will be held about twice a year as part of the public-private collaboration promotion system to promote the ITS/Automated Driving related measures, where the future direction will be examined and the roadmaps will be reviewed based on progress in research and development. The joint meeting shall comprise members from related ministries, agencies, and industries, and the Cabinet Secretariat and the Cabinet Office will serve as the secretariat.

Expert meetings will be set up and established under the purview of the IT Strategic Headquarters. With respect to the Charter for Improvement of Legal System and Environment for Automated Driving Systems as stated in this Roadmap, follow-up meetings will be held every half year for the time being, and institutional reviews will be subject to ongoing studies that will, in part, encompass matters to be subjected to continuous investigations in accordance with the actual state of progress in terms of technologies pertaining to automated driving.

Through examination under the public-private collaboration promotion system, the details of the Public-Private ITS Initiative/Roadmaps 2018 shall be examined, and the roadmaps shall be revised on an as-needed basis while considering progress and trends in new ITS-related industries and technologies in Japan and in the world and promoting the practice of the PDCA cycle in the examination.

Public-Private ITS Initiative/Roadmap 2018 (Roadmap overview)



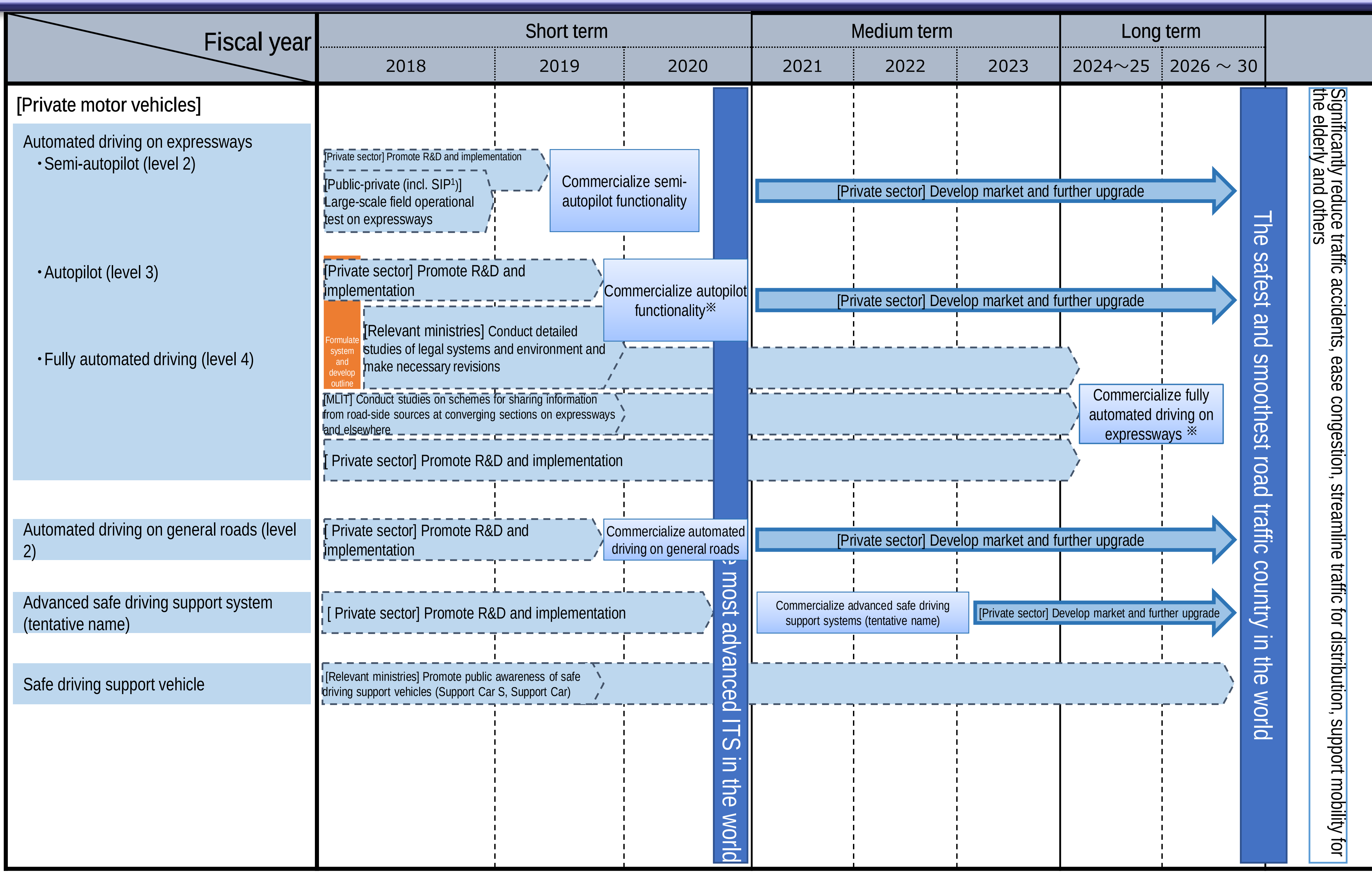
Red: Items inclusive of SIP[1]-related R&D

[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).

※: Set as timing for nonbinding targets to be fulfilled by the government in order to facilitate commercialization by private-sector companies.

Commercialization of remote automated driving systems and commercialization corresponding to level 3 and above are premised on conformity to the Convention on Road Traffic.

Roadmap pertaining to automated driving systems I: Private automated driving vehicles (1)



※: Set as timing for nonbinding targets to be fulfilled by the government in order to facilitate commercialization by private-sector companies. Commercialization of remote automated driving systems and commercialization corresponding to level 3 and above are premised on conformity to the Convention on Road Traffic.

¹SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).

Roadmap pertaining to automated driving systems I: Private automated driving vehicles (2)

Fiscal year	Short term: 2018	2019	2020	Medium term: 2021	2022	2023	Long term: 2024～25	2026 ～ 30

[Promote the popularization of safe driving support systems]

- ・Safe driving support system (DSSS)
- ・ETC2.0
- ・Measures to prevent driving in the wrong direction on expressways
- ・Systems for dealing with driver incapacitation and other initiatives

Short term (2018–2020):

- [Public-private] Promote the popularization of DSSS- and ETC2.0-compatible onboard equipment (continued through medium and long term)
- [NPA (SIP[1])] Streamline the collection and provision of traffic control information
- [MLIT] Initiatives to achieve smooth, safe, secure road traffic based on the use of ITS technologies; expand the use of ETC and other ITS technologies for private-sector parking lots and other non-expressway facilities
- [MLIT] For measures to prevent driving in the wrong direction on expressways, more effective measures – including rapid detection of vehicles being driving in the wrong direction, road and in-vehicle warnings, and the use of automated driving technologies – shall be studied through a collaboration among industry, government, and academia
- [MLIT] Conduct studies on the expansion and fortification of security benchmarks concerning commercialized highly advanced safety technologies
- [MLIT] Evaluate vehicles with onboard advanced safety technologies through motor vehicle assessments
  - Evaluate collision damage reduction brakes (for collisions with other vehicles and collisions with pedestrians)
- [MLIT] Formulate a technical policy for shoulder stoppage-type systems to deal with driver incapacitation

- ・Emergency calling system and accident data reporting system (ACN)
- ・Drive recorder, event data recorder

- [Public-private partnerships] Promote the popularization of an emergency reporting system and system for the automatic reporting of accidents (ACN)
- [MLIT] Ascertain accident conditions and analyze information using drive recorders and event data recorders

- ・Technologies for communications between pedestrians and motor vehicles to reduce accidents involving pedestrians

- [NPA, MIC, MLIT (SIP[1])] Develop and conduct demonstration testing of systems utilizing communications between pedestrians and motor vehicles[2] → [Public-private] Field Operational Test
- [NPA[3], MIC, MLIT (SIP[1])] Develop and conduct demonstration testing of systems utilizing infrastructural radar and wireless communications[2]
- [NPA, MIC (SIP[1])] Develop and conduct demonstration testing of mobility support systems for traffic-limited persons and pedestrians[2]
- [Private sector] Develop sensors and terminals → [Private sector] Develop market (continued through medium and long term)

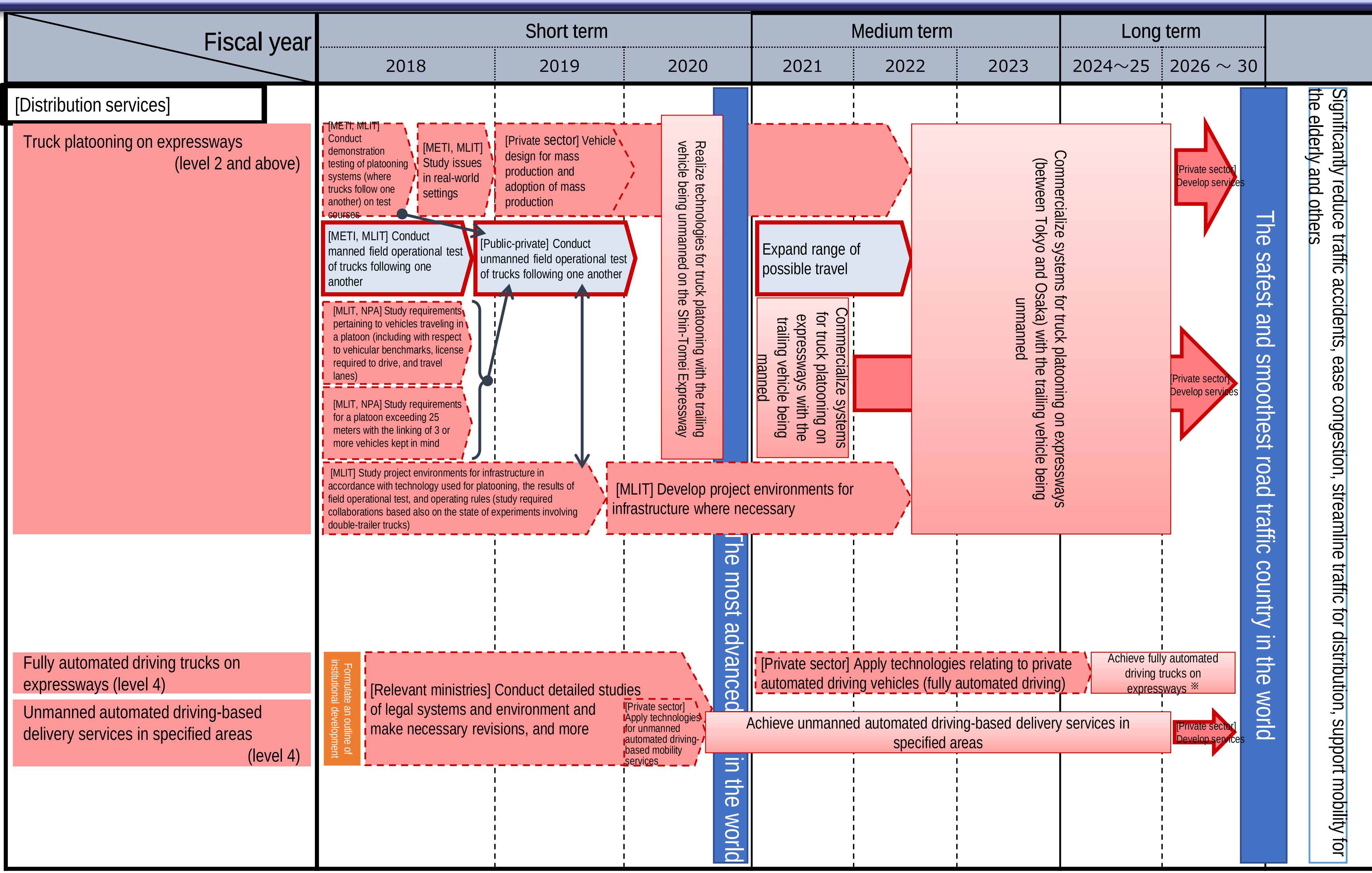
2020: **The safest road traffic country in the world**

2030: **The safest and smoothest road traffic country in the world**

Significantly reduce traffic accidents, ease congestion, streamline traffic for distribution, support mobility for the elderly and others

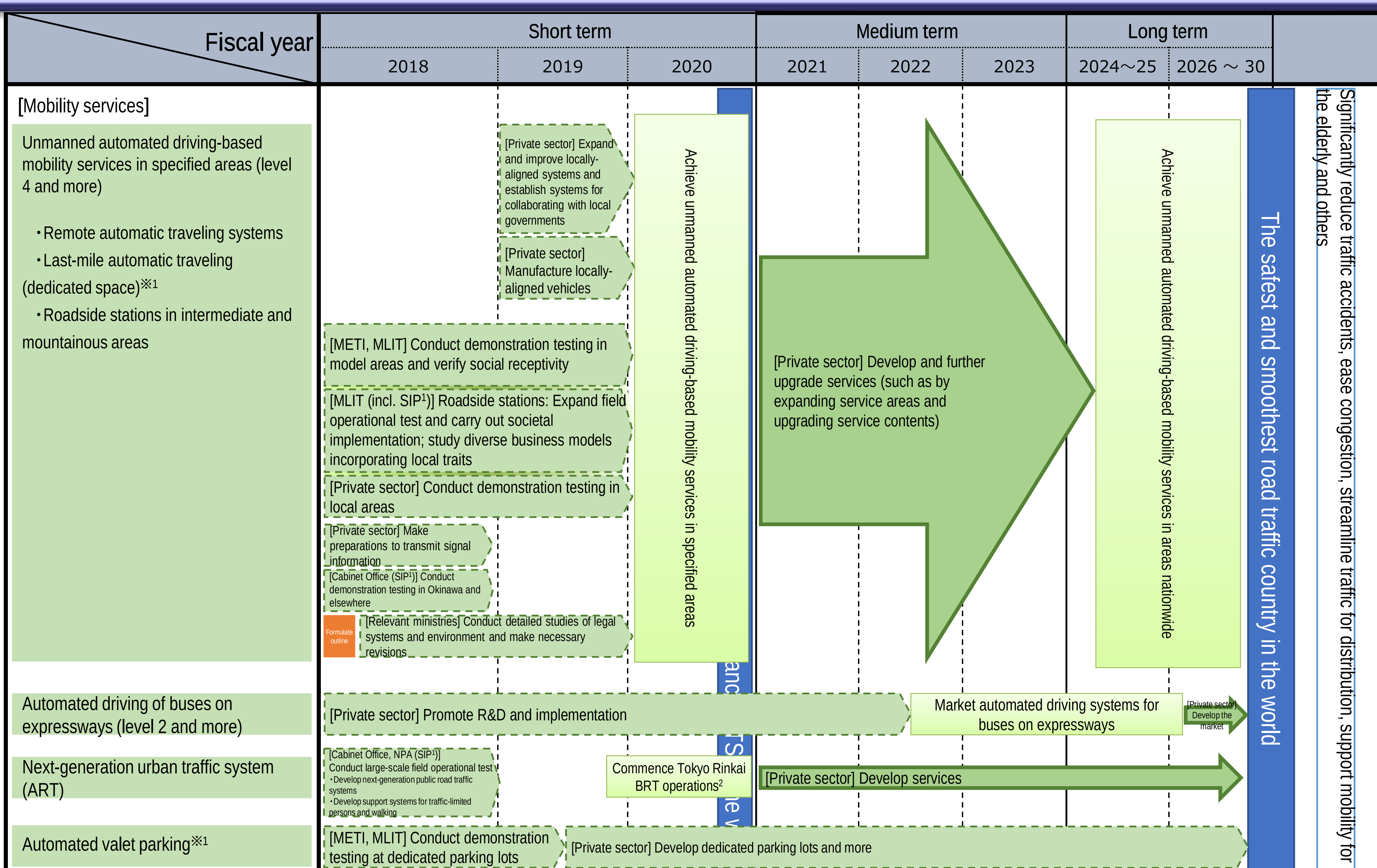
[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).
[2] Measures pertaining to safe driving support and automated driving systems.
[3] Requirements for infrastructural radar to be studied under the budget for FY2014.

Roadmap pertaining to automated driving systems I: Distribution services



※: Set as timing for nonbinding targets to be fulfilled by the government in order to facilitate commercialization by private-sector companies.
Commercialization of remote automated driving systems and commercialization corresponding to level 3 and above are premised on conformity to the Convention on Road Traffic.

Roadmap pertaining to automated driving systems I: Mobility services



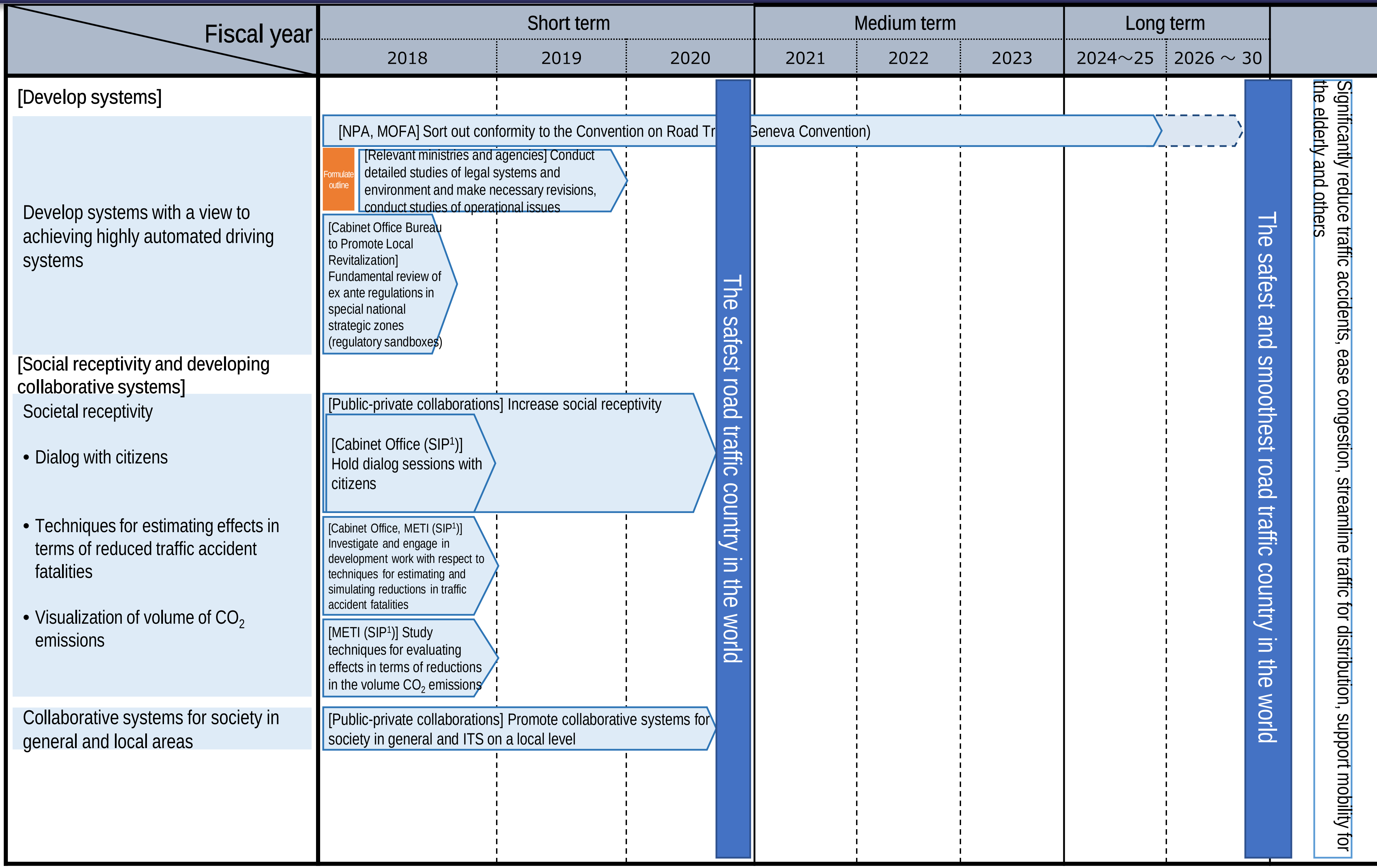
※1: Studies to be undertaken from systemic and infrastructural perspectives will be separately required.

[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).

*2:Gradually commence traveling operations in line with the status of the development of the Loop Road No. 2 project

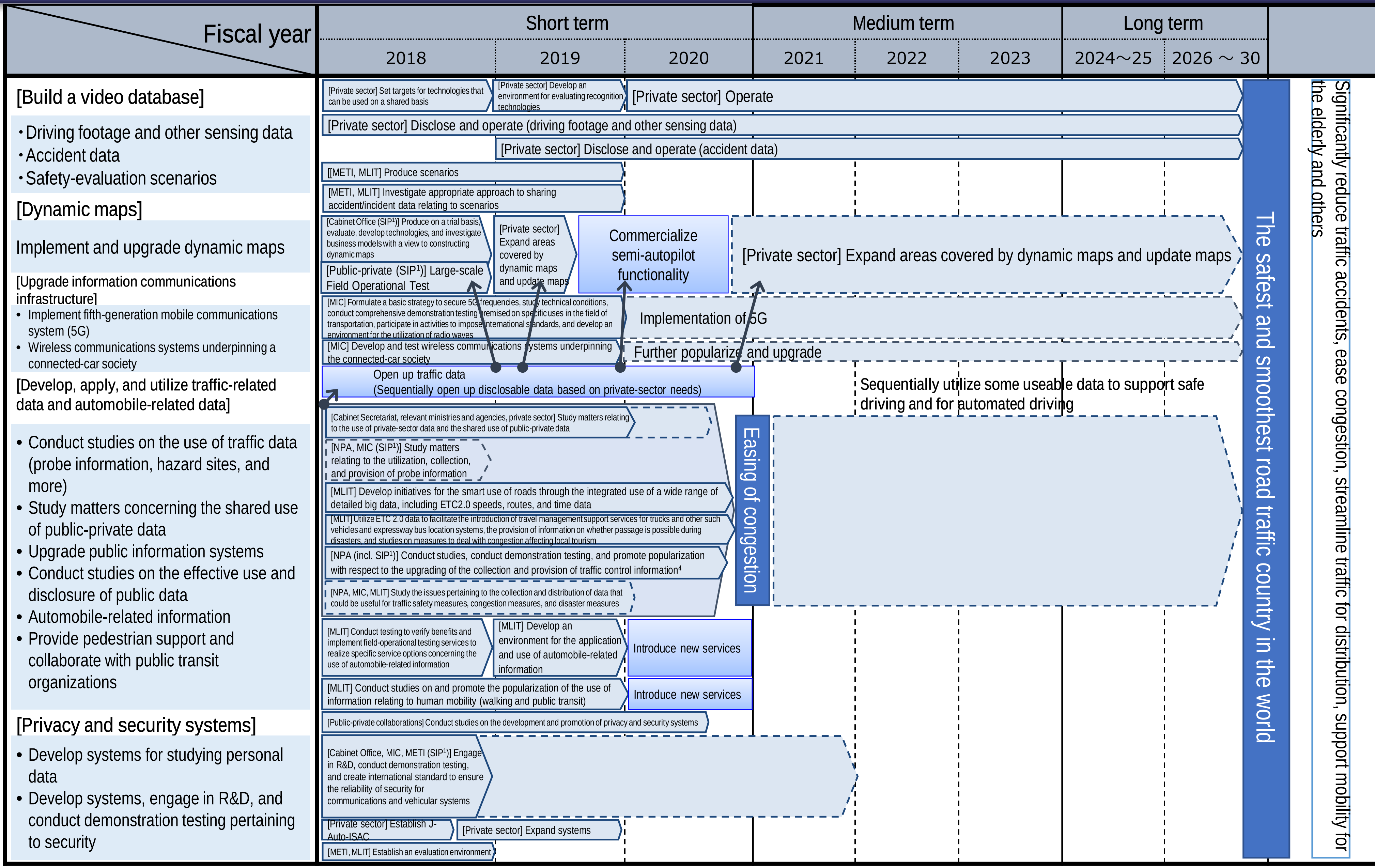
※: Set as timing for nonbinding targets to be fulfilled by the government in order to facilitate commercialization by private-sector companies. Commercialization of remote automated driving systems and commercialization corresponding to level 3 and above are premised on conformity to the Convention on Road Traffic.

Roadmap pertaining to the promotion of innovation I:
Developing systems for popularizing automated driving and increasing social receptivity



[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (2014 ~ 2018).

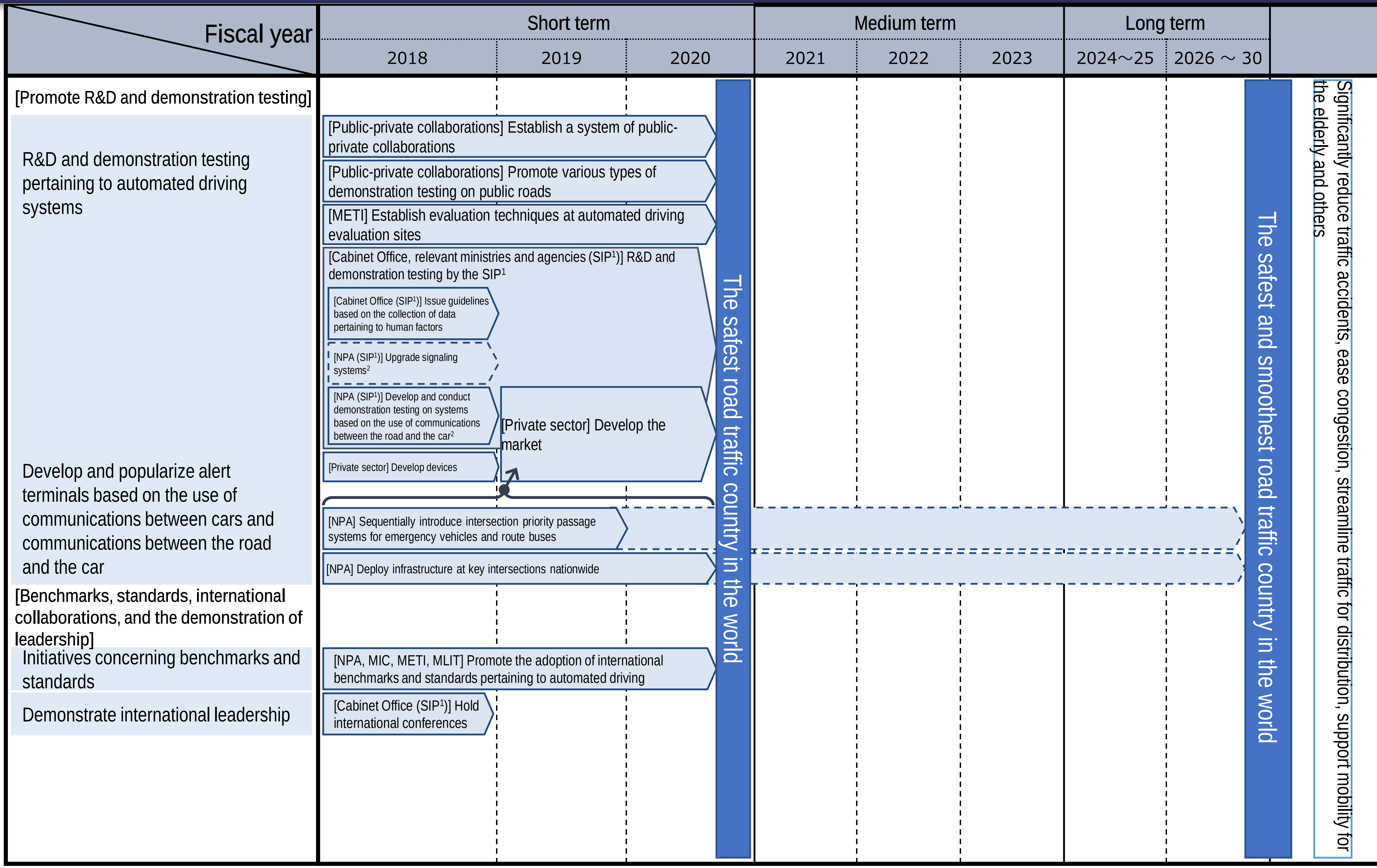
Roadmap pertaining to the promotion of innovation II:
Data strategy pertaining to automated driving and applying and utilizing traffic data



[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).

[4] Measures pertaining to safe driving support and automated driving systems and the application and use of traffic-related data

Roadmap pertaining to the promotion of innovation III: Research and development concerning automated driving systems and promoting international benchmarks and standards



[1]SIP: Strategic Innovation Promotion Program of the Council for Science, Technology and Innovation (FY2014-2018).

[2] Measures pertaining to safe driving support and automated driving systems