SIP-adus Overall Progress Report

Yasuyuki Koga
Counsellor for SIP
Bureau of Science, Technology and Innovation,
Cabinet Office, Government of Japan

February 27, 2019

SIP

Cabinet Office

INDEX

1. Society 5.0
2. Council for Science, Technology and Innovation (CSTI)
3. Efforts of SIP-adus
4. Architecture

1

Society 5.0

— A future society envisioned by the 5th Science and Technology Basic Plan

Society 5.0
— A future society envisioned by the 5th Science and Technology Basic Plan

5th Science and Technology Basic Plan (FY2016–2020)

○ Target national profile:

- Sustainable growth and self-sustaining regional development
- Ensure the safety and security for our nation and its citizens along with a high-quality, prosperous way of life
- Respond to global challenges and contribute to global development
- Sustainable creation of intellectual property

○ Efforts to achieve the target national profile

i) Acting to create new value for the development of future industry and social transformation "Society 5.0"

ii) Addressing economic and social challenges

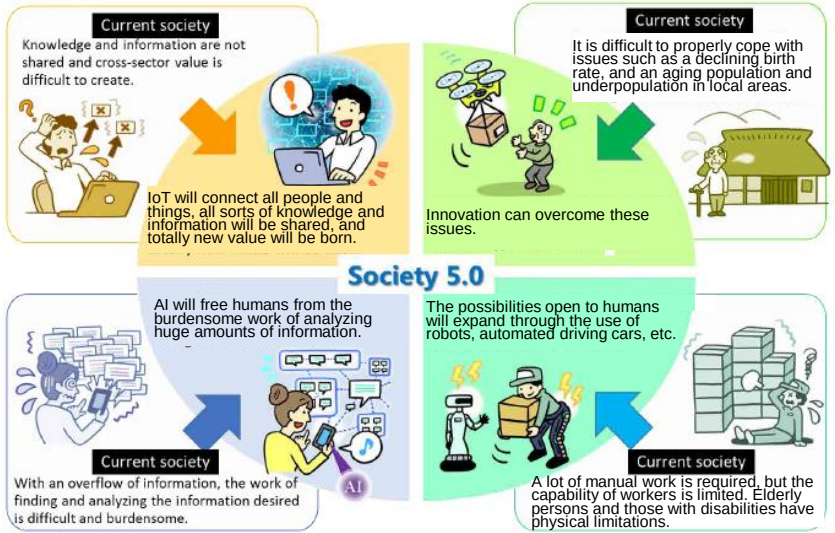
iii) Reinforcing the "fundamentals" of science, technology and innovation (STI)

iv) Establishing a systemic virtuous cycle of human resources, knowledge, and capital for innovation

What is Society 5.0?

A human-centered society that balances economic advancement with the resolution of social problems by a system that **highly integrates cyberspace and physical space**.

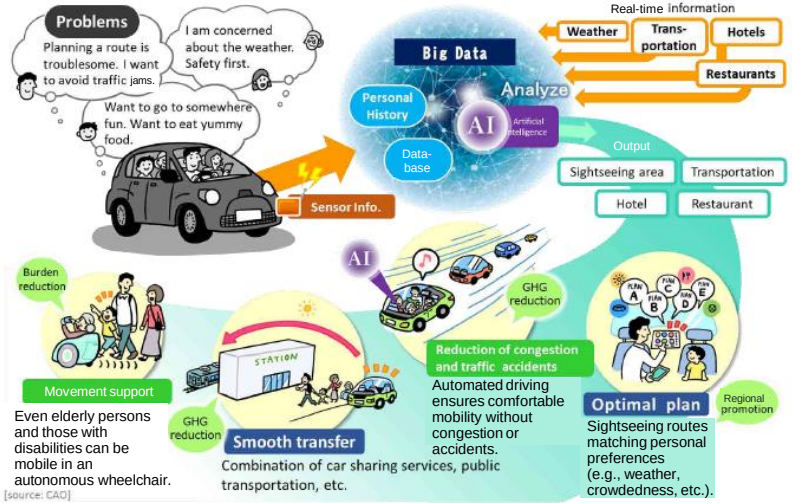
A society realized with "Society 5.0"



Society 5.0
— A future society envisioned by the 5th Science and Technology Basic Plan

New value created through innovation will enable the provision of products and services tailored to diverse needs. In this way, it will be possible to achieve a society that can both promote economic development and find solutions to social problems.

Example of creating new value (Mobility)



Other examples
(Healthcare and caregiving)
(Manufacturing)
(Agriculture)
(Food)
(Disaster prevention)
(Energy)

Economic advancement	Resolution of social problems
● The demand for energy is increasing ● The demand for foodstuffs is increasing ● Lifespan is becoming longer, and the aging society is advancing ● International competition is becoming increasingly severe ● Concentration of wealth and regional inequality are growing	● Reduction of GHG emissions ● Increased production and reduced loss of foodstuffs ● Mitigation of costs associated with the aging society ● Promotion of sustainable industrialization ● Redistribution of wealth, and correction of regional inequality

Incorporating new technologies such as IoT, robotics, AI, and big data in all industries and social activities, provide goods and services that granularly address manifold latent needs without disparity

2

Council for Science, Technology and Innovation (CSTI)

Overview of the Integrated Innovation Strategy

- With the progress of disruptive innovation, the rules of the game have fundamentally changed. Japan cannot win the global competition based on policies derived from conventional approaches.
- The inflexible socioeconomic structure must be entirely optimized in a flexible and autonomous manner by overcoming weaknesses and taking advantage of strengths.
- The global goals, logical road map, and timeline will be presented. The policies will be integrated to promote efforts seamlessly.
- Japan will become the most innovation-friendly country in the world, and the global leader in offering a model for solving issues faced by respective countries.

Weaknesses: ➢ Inadequate university reform, inflexible systems, slow globalization, lack of IT engineers (hundreds of thousands of engineers)
Strengths: ➢ Knowledge in various fields, strong R&D capabilities, excellent technologies and abundant funds of industries

Sources of knowledge
- ➢ Build a big data exchange platform (scale: one billion people) (in cooperation with Europe and the U.S., etc.)
- ➢ Build a platform for managing, collecting, accumulating, and utilizing all the data derived from research, science and technology

Knowledge creation

Promotion of university reform, etc.
- ➢ Fully introduce impartial annual salary system
- ➢ Introduce a method of distributing management expense grants linked with acquisition of private funds
- ➢ Create an environment where more than half of young researchers can take on challenges (increase research expenses by about 40% in the next six years)

Promotion of strategic R&D
- ➢ Fundamentally reform R&D management (expand to the entire government under the initiative of CSTI)

Social implementation of knowledge

World-class environment for startups
- ➢ Share information by concluding confidentiality agreements (integrated support by the government and private sector)
- ➢ Enhance moonshot-type and challenging R&D and review legal regulations

Innovation in government projects/systems, etc.
- ➢ Create a mechanism for policy innovation
- ➢ Introduce new technologies for public procurement

Global deployment of knowledge

Contribution to attainment of SDGs
- ➢ Formulate a road map that sets an example (a road map toward 2030)
- ➢ Disseminate information to the world at G20 (Osaka Declaration (tentative name))

Establishment of Society 5.0 as a global model
- ➢ Comprehensively promote international standardization of the overall designs, systems, equipment, etc.

Deployment in fields that should be enhanced

Utilization of AI in various situations
- ➢ Develop human resources on a far greater scale
- ➢ Enable all students to acquire IT literacy (one ICT supporter per four schools)
- ➢ Formulate the principles for a human centric AI society

Integration of biotechnology and data
- ➢ Data-driven technology development

Attainment of the "2°C target" of the Paris Agreement
- ➢ Develop technologies to achieve renewable energy equivalent to fossil fuels

Ensuring safety and security
- ➢ Achieve comprehensive security

Deployment of smart agriculture technologies and systems in Japan and abroad
- ➢ Enable almost all the players to fully utilize data

Council for Science, Technology and Innovation

1. Functions

The Council for Science, Technology and Innovation (CSTI) is a “source of wisdom” that assists the Prime Minister and the Cabinet. It aims to oversee science and technology policies in Japan as well as plan and coordinate comprehensive and basic policies on science and technology from a vantage point higher than the various ministries. The CSTI was established under the Cabinet Office as one of the councils of important policies in accordance with the Act for Establishment of the Cabinet Office in January 2001 (Council for Science and Technology Policy until May 18, 2014).

2. Roles

(1) Investigate and discuss the following matters in response to consultations with the Prime Minister, etc.:
A. Basic policies to promote science and technology comprehensively and systematically
B. Important matters related to the resource allocation policies (e.g., budget for science and technology, human resources) and promotion of science and technology
C. Investigation and discussion of comprehensive development of the environment for promoting innovative creation by implementing R&D results
(2) Evaluate large-scale R&D and other nationally important R&D related to science and technology
(3) Offer opinions to the Prime Minister, etc. regarding A, B, and C of (1) above without consultation if necessary

3. Organization

The chairperson is the Prime Minister. The 14 members are: 1) Chief Cabinet Secretary, 2) Minister of State for Science Technology Policy, 3) relevant cabinet ministers appointed by the Prime Minister (Minister of Internal Affairs and Communications, Minister of Finance, Minister of Education, Culture, Sports, Science and Technology, Minister of Economy, Trade and Industry), 4) head of a relevant administrative organ appointed by the Prime Minister (President of Science Council of Japan), 5) those who have excellent knowledge (seven persons) (term of office: three years (two years for those appointed by May 18, 2014), reappointment allowed).

Executive Members of the CSTI (The members are appointed by the Prime Minister with the consent of both Houses of the Diet.)

Takahiro UEYAMA
(Full-time member)
Former Vice President, National Graduate Institute for Policy Studies

Yumiko KAJIWARA
(Part-time member)
Corporate Executive Officer, Fujitsu Ltd.

Motoko KOTANI
(Part-time member）
Director, Professor and Principal Investigator, Advanced Institute for Materials Research, & Mathematics Institute, Graduate School of Science Tohoku University

Yoshimitsu KOBAYASHI
(Part-time member）
Chairman, Member of the Board, Mitsubishi Chemical Holdings Corporation, Chairman, KEIZAI DOYUKAI (Japan Association of Corporate Executives)

Masakazu TOKURA
(Part-time member)
Representative Director & President, Sumitomo Chemical Co., Ltd.

Kazuhito HASHIMOTO
(Part-time member)
President, National Institute for Materials Science

Seiichi MATSUO
(Part-time member)
President, Nagoya University

Head of a relevant administrative organ

Juichi YAMAGIWA
(Part-time member)
President of Science Council of Japan

Overview of the Cross-ministerial Strategic Innovation Promotion Program (SIP)

- A cross-ministerial and multidisciplinary program
- The CSTI selects Program Directors (PDs) as leaders to tackle issues that must be addressed for society and that are important for the economic and industrial competitiveness of Japan, and allocates budget.
- Efforts are made from basic research to exit (implementation, commercialization).
- The regulatory/system reform and utilization of the special zone programs, etc. are also taken into account in promoting the efforts.

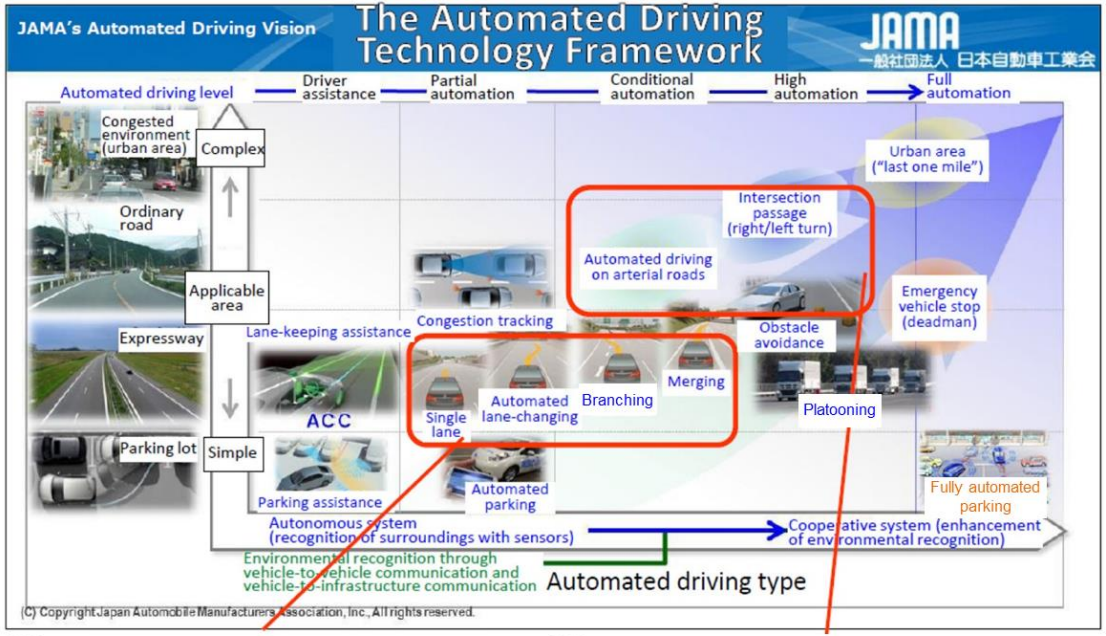
adus: Automated driving systems for universal service

3

Efforts of SIP-adus

Targets of SIP-adus

(1) Reduction of traffic accidents and congestion
(2) Early realization and deployment of automated driving systems
(3) Realization of an advanced public bus transport system that is easy to use by elderly people and individuals who have reduced mobility in the road transport system



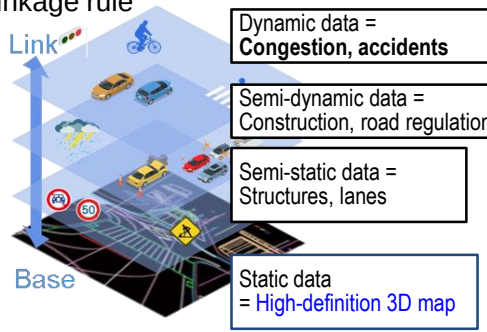
(1) Practical application of a high-end partial driving automation system (Level 2) by 2020

(2) Clarification of functional expandability requirements and priority for next step and scheduling of its implementation

Five Key Issues of SIP-adus

(1) Dynamic map
(high-definition 3D map + changes over time)

Linkage rule



Dynamic data = **Congestion, accidents**

Semi-dynamic data = Construction, road regulations

Semi-static data = Structures, lanes

Static data = High-definition 3D map

★**Dynamic Map Platform Co., Ltd. (DMP) was established (June 2017).**
(Six surveying/map companies and 10 automakers in Japan invested in the company.)

★**Expand the scope of infrastructure information provided through industry-government cooperation**

- Information about lane closures on expressways (Ministry of Land, Infrastructure, Transport and Tourism)
- Traffic signal information/information about traffic regulations in respective prefectures (National Police Agency)
- Vehicle probe statistics information (business operators), etc.

(2) HMI (Interaction between humans and vehicles)

Human Machine Interface

The transition time required, depending on driver's readiness, to safely switch from automated driving to human driving

Interfaces with other road users

Instruction method concerning the operating condition of the automated driving system, etc.

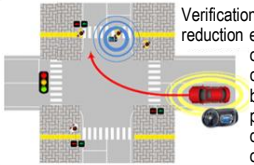
Involve experiment participants (including overseas manufacturers) to collect data on public roads, build a database, and share results

(3) Base technologies

Cyber security

Guidelines for protection against cyber attacks on vehicles, etc.

(4) Pedestrian traffic accident reduction



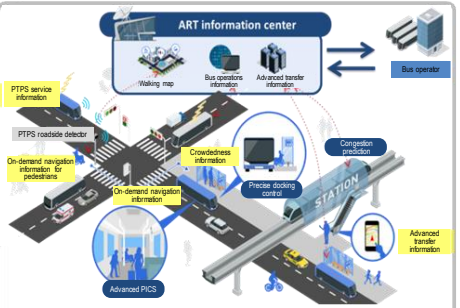
Verification of the accident-reduction effects of wireless communication between cars and pedestrians' devices and use of radar, etc.

(5) Next generation transport

Application of automated driving technologies to buses, etc.

Precise stopping at bus stops with almost no space between the bus and the curb to make getting on/off easier for wheelchair users and elderly passengers

Improved express performance and on-time operation through enhancement of PTPS*, etc.



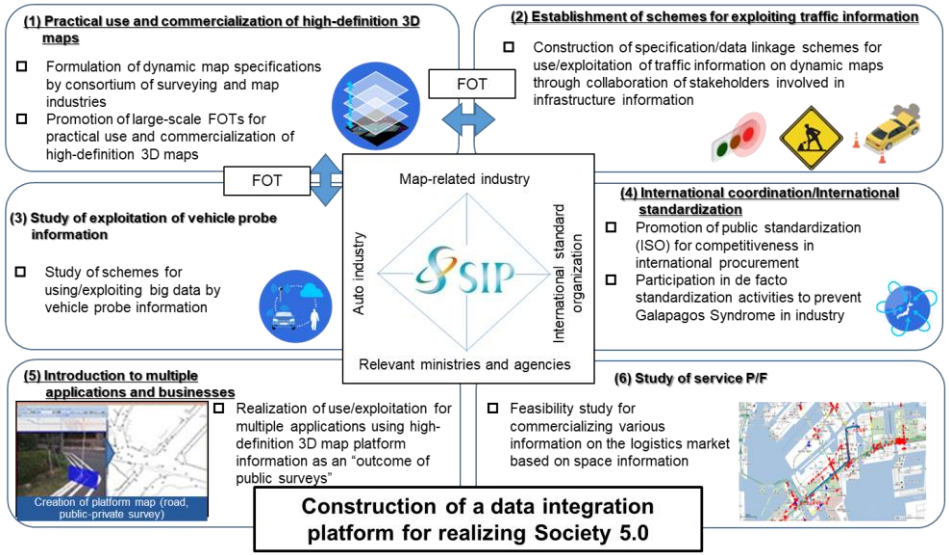
<Mobility support services using ART** as the core system>

*Public Transportation Priority System

** Advanced Rapid Transit

Efforts to Address the Five Key Issues of SIP-adus

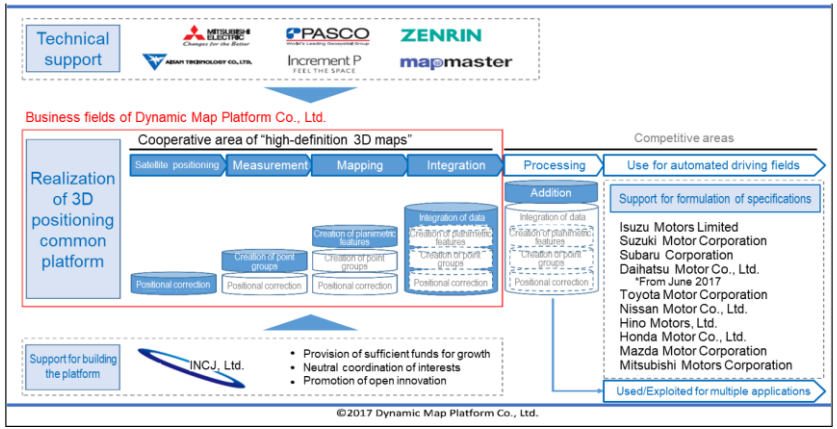
◆ Initiatives to formulate specifications of dynamic maps, standardize dynamic maps, introduce them to multiple applications, and achieve commercialization with SIP-adus at the core in collaboration with **relevant ministries**, **industrial bodies**, **international standard organizations**, etc.



Foundation of Dynamic Map Platform Co., Ltd.

To leverage the achievements of the SIP, Dynamic Map Platform was founded (in FY2017) through joint capital investment by electrical appliance, map, and surveying companies and automakers, to create, verify, and manage high-definition 3D maps, which are static data for "dynamic maps," in cooperative areas.

⇒ **In FY 2018, commercial distribution of information on approximately 30,000 km of all expressways will begin.**



Efforts to Address the Five Key Issues of SIP-adus

HMI

◆ **Formulation of HMI guidelines and international standardization of HMIs for realization of Automated Driving Level 3**

Issue A
Method of displaying information required for **correct takeover of driving** from an automated driving vehicle

Issue B
Method of measuring the state of preparation for takeover of driving from automated driving mode, and definition of the index of the state of preparation

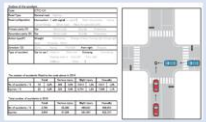
HMI Consortium
AIST 筑波大学 慶應義塾 DENSO
JAMA Japan Automobile Manufacturers Association — Automated Driving Study Group HMI WG
SAE Society of Automotive Engineers of Japan — Ergonomics Technical Committee HMI Subcommittee

Issue C
Method of communication between vehicles in automatic driving mode and nearby traffic participants

Achievements:
- ✓ These initiatives are included in the industry guidelines **"Considerations for Automated Driving HMIs"** (Japan Automobile Manufacturers Association).
- ✓ Japan made proposals to international standards. **(ISO/TC22/SC39/WG8*)**

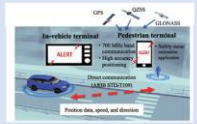
◆ **Analysis for the reduction of pedestrian accidents, which account for half of all fatal traffic accidents – Development of technologies – Verification**

Analysis of patterns of traffic accidents and compilation of traffic accidents into a database



- Analysis and classification of accident data for 5 years*
- Clarification of patterns of pedestrian accidents
- Disclosure as a national database

Development of a pedestrian-vehicle communication system (using V2P)

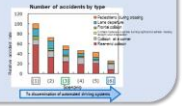


- Development of a system exploiting technologies for high-accuracy positioning of pedestrian positions, behavior estimation, and communication

Development of pedestrian detection infrastructure radar (79 GHz)

Validation of the system through FOTs

Verification of the accident reduction effect by developing a simulation tool**



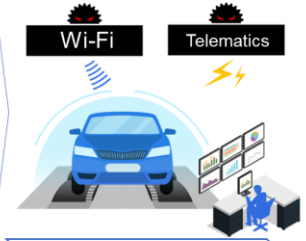
Base technologies (security)

◆ **Establishment and international standardization of evaluation methods and protocols on vehicle and component levels**

Threat analysis
- ◆ Investigation of system configurations, such as automated driving demonstrations conducted in the world
- ◆ Investigation of known vulnerabilities and incidents
- ◆ Risk/Impact analysis

Formulation of security evaluation guidelines

Verification by FOTs with domestic OEM



Guidelines were competitively formulated by each of three leading security vendors.
(1) Deloitte Tohmatsu Risk Services (2) Nihon Synopsys
(3) PwC Consulting & Cyber Defense Institute

The best guidelines were selected and proven.
PwC Consulting & Cyber Defense Institute

Achievements:
- ✓ **Specific guidelines were quickly formulated** although evaluation methods specified in both international regulations and international standards are ambiguous.
- ✓ **These initiatives are included in the industry guidelines (JASPAR*).**

Reduction of pedestrian accidents

Achievements:
- ✓ **Validation of the system** by FOTs is completed, and **technologies** for commercialization **appear set to be achieved**.
- ⇒ However, there are still issues to solve for implementation, including costs.

Efforts to Address the Five Key Issues of SIP-adus

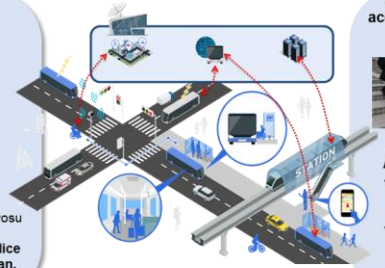
Next generation transport

◆ Proposal and implementation of the next-step ART (Advanced Rapid Transit) envisaging the Olympic and Paralympic Games Tokyo 2020 and the future

On-time bus services by advanced PTPS

Achievements:

✓ Infrastructure is being built in Odaiba and Toyosu **through collaboration among the National Police Agency, the Tokyo Metropolitan Police Department, and the UTMS Society of Japan,** and FOTs are in progress.



Assistance to those who have limited access to road transportation by optimum route guidance

Achievements:

✓ **An app for collecting barrier-free information has been developed and has already been publicly released.**

✓ **Navigation companies have been preparing to commercialize the services (e.g. release of beta version, testers solicited from the general public).**

Precise docking control and acceleration/deceleration control applying automated driving technologies enable anybody to use bus services safely.

Achievements:

✓ The **target clearance (4±2 cm)** between the bus stop platform and the steps of the bus **is achieved.**

✓ **The system is set to be implemented in society by the time of the Olympic and Paralympic Games Tokyo 2020** (guide line type) through **collaboration among the National Police Agency, the Tokyo Metropolitan Police Department, and the government of Tokyo.**

✓ The **implementation** of a future technology (sensor fusion system) for **acceleration/deceleration control and precise docking control appears set to be achieved.**

FOTs of mobility services as solutions to social problems in local communities

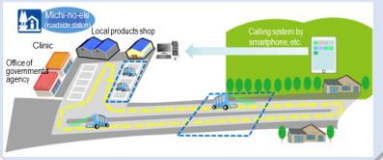
FOTs of automated driving of buses in Okinawa Prefecture

As the first step of introduction to local communities, FOTs of automated driving of buses are being conducted in Okinawa Prefecture, which is discussing reorganizing public transportation means, and are gradually being extended to local communities with heavy traffic. (Cabinet Office's department in charge of Okinawa Prefecture/Okinawa Prefecture/Relevant municipalities)

Demonstrations of precise docking control at bus stops, etc. are also conducted.

Implementation of automated driving in society in hilly and mountainous areas

Social implementation of automated driving services through vehicle-infrastructure cooperation in hilly and mountainous areas where population-aging is extreme, etc. using "**Michi-no-eki (roadside stations)**" as core facilities to ensure mobility for daily lives
(In 13 locations across Japan, these services are operated under the Local Test Council organized in each location.)



Achievements:

✓ **Verification of technologies and identification of issues have been completed** through FOTs in various environments in different communities in Japan **in collaboration with local governments**.

SIP-adus Efforts in International Cooperation and Standardization

(1) Actively disseminating information about achievements
(2) Regularly organizing international conferences
(3) Offering internationally open R&D environments

5th SIP-adus Workshop

November 13–15, 2018 at Tokyo International Exchange Center;
64 speakers (including 36 from overseas), approx. 500 participants
→ Disseminate information, exchange opinions with key persons, and build personal networks

Compilation and publication of English papers on achievements of SIP-adus

→ Summary of R&D achievements for 5 years (to be published in March 2019)

Large-scale FOTs

Participants are solicited widely and publicly from Japan and overseas.
⇒ Overseas OEMs and suppliers participate in FOTs and discuss standardization based on test results.

+ Cooperation with standardization organizations

JAMA, JARI, JASPAR

(1) ISO standard

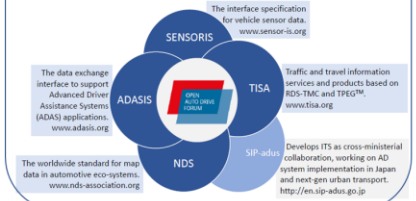
HMI (ISO/TC22/SC39/WG8)
Dynamic Map (ISO/TC204/WG3)

Draft standards have already been submitted by Japan
⇒ Expected to be released as ISO standard.

(2) Industry standardization

Cooperation with Open Auto Drive Forum (OADF)

The OADF requested SIP-adus to participate in the Steering Committee.



(3) Industry guidelines

HMI
Cybersecurity

They are adopted as industry guidelines, and will be continuously revised in the future.

(4) Joint research

Japan-Germany cooperation
Cooperation with EU

Specific processes and themes are under discussion.

(5) Personnel development

Leaders in five important themes are appointed.

With our staff recognized as leaders in international discussions, our personnel development program has succeeded in making ourselves and our efforts known to the public.

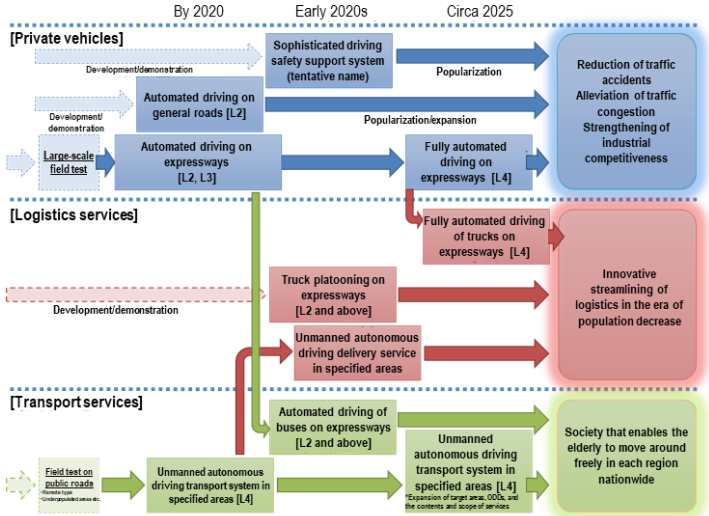
Major Achievements

ALPINE, BOSCH, Calsonic Kansei, Continental, DAIHATSU, HONDA, mazda, MLT, MITSUBISHI ELECTRIC, 名古屋大学, NISSAN, OMRON, Pioneer, 埼玉工業大学, SUZUKI, SUBARU, TOYOTA, Valeo, VOLKSWAGEN

Targets of SIP-adus

Public-Private ITS Initiative/ Roadmaps 2018

Scenario for the commercialization and service of fully automated driving by 2025



- Establish technologies in **cooperative areas** required for implementation by 2023
- Verify the effectiveness in FOTs, etc. involving various **business operators and local governments**, etc. and **set multiple examples of implementation**

Overview of SIP-adus

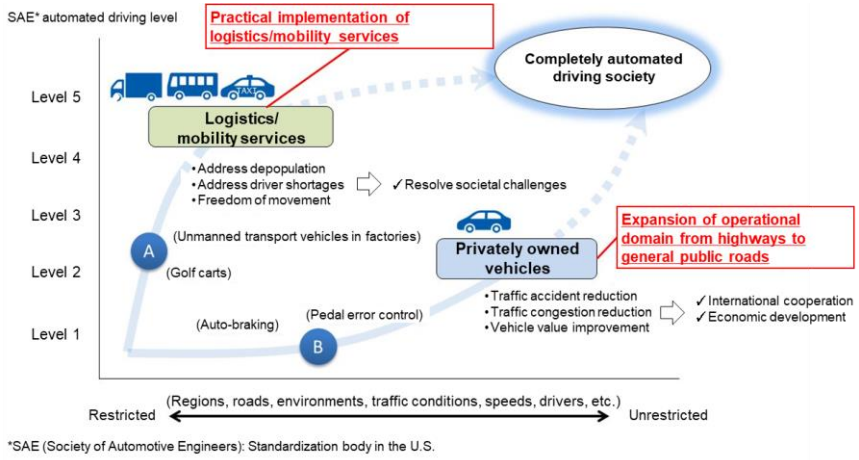
Overview

The operational domain of automated driving will **be extended from highways to arterial and general public roads**, and **automated driving systems will be implemented in mobility services including public transport and logistic operations**.
These actions will help solve social issues such as reducing traffic accidents and congestion, providing greater mobility for those with reduced transport in local communities, and alleviating the shortage of drivers in the logistics industry, and finally ensuring **safe and comfortable mobility for everyone in society**.

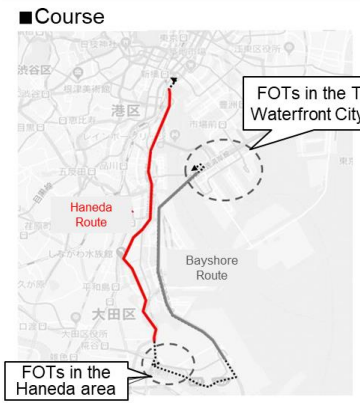
Exit Strategy

Stakeholders of commercialization participate in the R&D phase and mobility services will be commercialized smoothly at the exit from the project. Specifically, investment and business planning by private operators will be promoted by:

1) **taking full advantage of the Olympic and Paralympic Games Tokyo 2020**
2) **conducting FOTs based on the plans of business operators and local government**



*SAE (Society of Automotive Engineers): Standardization body in the U.S.

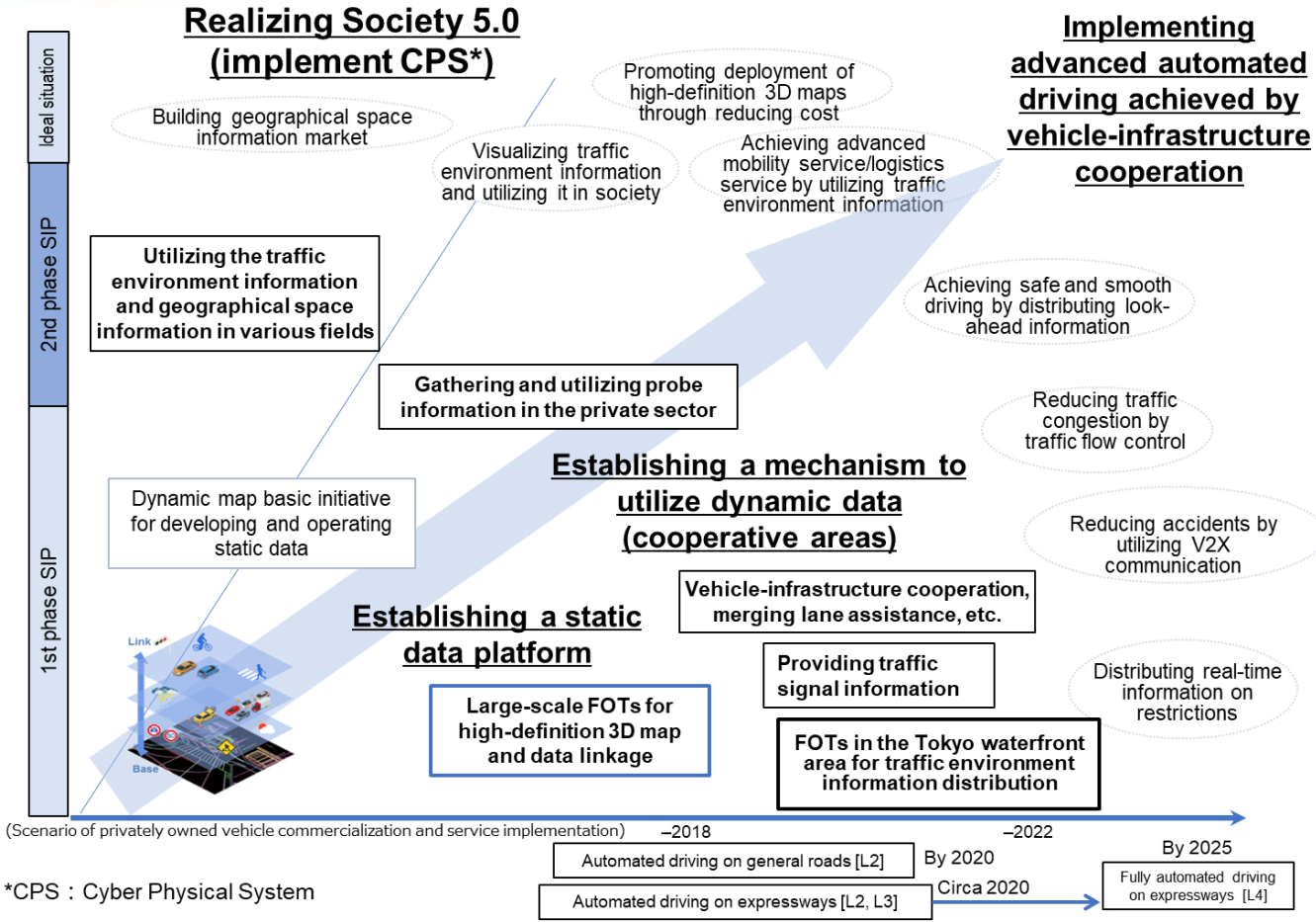


Opportunities for open discussion will be provided to promote international standardization and R&D (scheduled to start in October 2019).

The cost including the vehicles used, personnel expenses for testing, and vehicle insurance premiums is paid by respective companies in the private sector (matching fund).

Local FOTs involve **business operators and local government**.

SIP-adus Road Map for Building and Utilizing the Traffic Environment Information



*CPS：Cyber Physical System

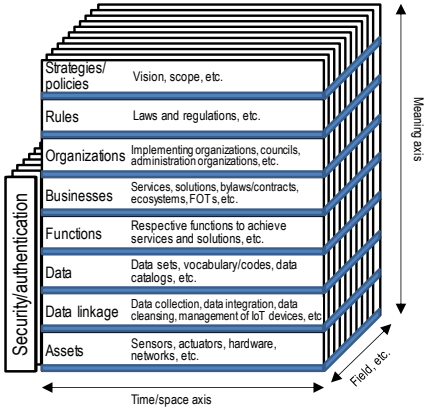
4

Architecture

Architecture

Overview and objective of the project

- FOTs utilizing AI, big data, etc. will be implemented through an organization for cooperation between the government and private sector in smart city and geographical information-related fields (automated driving, agriculture, disaster prevention, infrastructure), as well as personal data-related fields based on the Society 5.0 reference architecture (see the figure below). A comprehensive architecture that promotes interdisciplinary cooperation will be built.
- The architecture aims to accelerate the development of AI technology, social implementation, interdisciplinary data linkage, international standardization strategy, etc.



Society 5.0 reference architecture

A framework that enables all the stakeholders to share the vision and deepen understanding in order to reasonably promote technology development and standardization, etc. through mutual cooperation

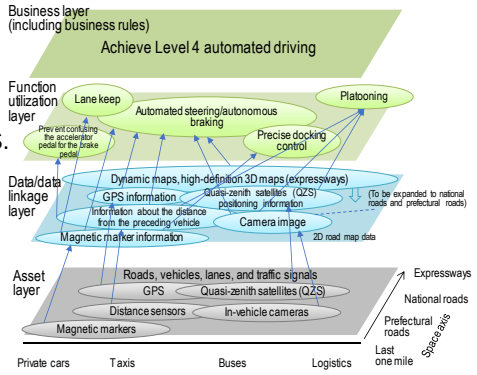
Image of the project and a specific example

- The architecture will be designed while promoting FOTs utilizing AI, big data, etc. with the cost paid by the government and private sector. The architecture in respective fields will be built by adjusting the size of component elements, etc. in each layer while ensuring overall interdisciplinary coordination.
- Lack of technologies and standards, etc. required in each layer will be identified based on the overall image to study the technology development, data linkage, standardization strategy, etc.

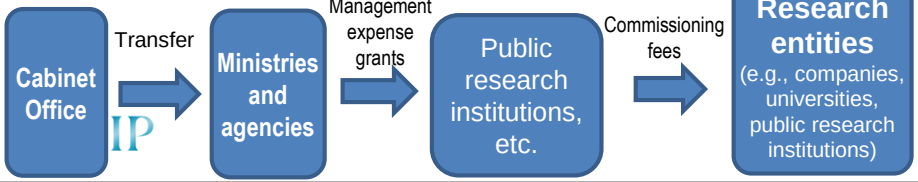
Overall image of the architecture

Regarding automated driving, there are intersections where Level 4 automated driving is difficult to attain due to the inadequate positioning accuracy of GPS.

It is possible to study solutions from various options based on the overall image (e.g., solve issues by using technologies to increase the GPS accuracy [data layer], improve intersections/add magnetic markers partially [asset layer]).



Financial flow



Expected effects

- The architecture will enable stakeholders of the government and private sector to share the vision, deepen understanding and gain a comprehensive view.
- AI technology development and social implementation, international standardization strategy, system development, interdisciplinary data linkage, etc. will be accelerated through interdisciplinary cooperation to help achieve Society 5.0 without focusing on respective fields.


Thank you