SIP Automated Driving for Universal Services (SIP-adus) R&D Plan

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Outline

• 1st phase of SIP-adus (2014-2018)
  – Vision and development goals
  – Objectives and fields of R&D
  – Initiatives and progress

• 2nd phase of SIP-adus (2018-2022)
  – Overview and objectives
  – Details, schedule, and organization
Government Initiatives to Advance Automated Driving in Japan: Vision and Development Goals

Vision for social aspects

**Safer and more comfortable transport system**
- Reduce traffic accidents
  Target reduction in traffic fatalities
  2017: 3,694 → 2,500 or less
- Reduce traffic congestion

**For a society with a declining birth rate and aging population, and productivity revolution**
- Ensure means of mobility in local areas
- Alleviate the shortage of human resources (drivers)

Vision for industrial aspects

**More competitive in auto industry**

Shipment value of the auto manufacturing industry: accounts for 20% of major manufacturing industries

- Persons employed
- Value of manufactured goods shipped

<table>
<thead>
<tr>
<th>Persons employed</th>
<th>Value of manufactured goods shipped</th>
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<tbody>
<tr>
<td>5.29 million employees (8.3%)</td>
<td>53.3101 trillion yen (17.5%)</td>
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</table>

**Creation of new industries**

Sensor-equipped vehicle (e.g., cameras, radar sensors)

Communication device

Digital infrastructure

- Amid the fierce global development competition, the **SIP-adus project** conducts R&D on solving issues in cooperative areas through **industry-government-academia cooperation** in order to achieve automated driving.
- **CSTI serves as the headquarters** to help solve cross-ministerial issues in implementing automated driving under several ministries and agencies (National Police Agency, Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, Ministry of Land, Infrastructure, Transport and Tourism (road administration, automotive safety)).
1st Phase of SIP-ads in Japan: Objectives

(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 vulnerable road users in 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
1st Phase of SIP-adus: Fields of R&D

**Vehicle**
- Recognition
- Judgment
- Operation

**HMI**
- Human Machine Interface
- Cooperation with human

**Important technologies**
- Self-position estimation
- Neighboring environment recognition

**Dynamic map**
- High-definition 3D map
- ITS predictive information

**Onboard sensors**
- GNSS
- Laser scanner (LiDAR)
- Radar
- Camera

**Platform technologies**
- Cyber-security, simulation, database, etc.

**Red: cooperative areas under SIP**
Initiatives to Address Five Important Issues and Progress (1)

(1) Dynamic map

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

- **Expanding 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 (businesses), etc.

(2) HMI

- **Gathering data on public roads, developing a database, and sharing results** with participants including manufacturers outside Japan

- **Establishing an index of the driver’s condition** and determining the correlation with the time required for TOR*

*Take Over Request
Initiatives to Address Five Important Issues and Progress (2)

(3) Cyber-security

- Developing the **evaluation guidelines**
  - In cooperation with JasPar
- Establishing organizations for evaluation

FOTs based on the guidelines

(4) Pedestrian accident reduction

- Developing a mutual alert system for pedestrians and vehicles utilizing **V2P communication**
  - (V2P equipped smartphone, 79GHz millimeter-wave radar)

Developing technologies to estimate position with high accuracy and predict behavior

(5) Next-generation transport

- Achieving on-time operation by **advanced PTPS** and **ART** information center function
- Developing **ART control function**
  - (precise docking control at bus stops, smooth acceleration/deceleration control)

*Public Transportation Priority Systems  **Advanced Rapid Transit Systems*
1st Phase of SIP-adus: Overall Schedule

Promoting Committee

- System Implementation Working Group
- International Cooperation Working Group
- Next-Generation Transport Working Group

2014

- Development of organizational structure
- R&D on specific themes

2015

- Integrate into five important issues

2016

- Large-scale FOTs

2017

- Stimulating research and technology development
- Making evaluations and identifying issues in more applications
- Assessing the feasibility of implementation
- Encouraging international cooperation and coordination
- Fostering public acceptance

2018

- SIP-adus WS at Odaiba November 13–15
- Results report meeting at Odaiba in early February

Start a new project to achieve higher goals

2nd Phase of SIP (2018–2022)
Outline of the Presentation

• 1st phase of SIP-adus (2014-2018)
  – Vision and development goals
  – Objectives and fields of R&D
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• 2nd phase of SIP-adus (2018-2022)
  – Overview and objectives
  – Details, schedule, and organization
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 vulnerable road users in local communities, and alleviating the shortage of drivers in the logistics industry, and finally ensuring **safe and comfortable mobility for everyone in society**.
Objectives

Public-Private ITS Initiative/ Roadmaps 2018

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

- The cooperative areas technologies essential for implementation will be established by 2023
- The effectiveness of the technologies will be validated through FOTs, involving various businesses and local government, and multiple example cases for commercialization will be created.
Deployment Milestones

Stakeholders of commercialization participate in the R&D phase and mobility services will be commercialized smoothly at the completion of 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 businesses and local government**

**Course**

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).

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

Local FOTs involve **businesses and local government**.
Building the Road Traffic Environmental Info. Framework

**Realizing Society 5.0**
*(implementation CPS*)

- Building geographical space information market
- Utilization of traffic environment information and geospatial information in multiple fields
- Collection and utilization of vehicle probe information
- Dynamic map basic concept
- Construction of static information
- Large-scale FOT on linking high definition 3D map and information

**Establishment of static information infrastructure**

**Developing and operating dynamic traffic information**
*(Cooperative area)*

- Visualization of traffic environment information and social utilization
- Collection and utilization of vehicle probe information
- Cooperative control of infrastructure and vehicle such as traffic merging support
- Signal information provision
- FOT at Tokyo waterfront area for dynamic information distribution

**Implementing cooperative automated driving**

- Promote dissemination by cost reduction of high-definition 3D maps
- Realization of smart mobility service/logistics service
- Accident reduction by V2X technology
- Distribution real-time information on restrictions
- Achieve safe and smooth traveling by prefetching information
- Reducing traffic congestion by traffic flow control

**Ordinary road<\L2>**
- By 2020

**Expressway<\L2\cdot\L3>**
- By around 2020

**Expressway<\L4>**
- By around 2025

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*CPS: Cyber Physical System*
Details of R&D

I. Development and validation (FOTs) of automated driving system
1. Development of technologies for delivering traffic signal data
2. Development of technologies to support V2I coordination and vehicle merging assistance, etc.
3. Development of technologies for gathering and utilizing vehicle probe data
4. Development of next-generation public transport systems
5. Development of road environment suited to the practical implementation of mobility services, etc.

Tokyo Waterfront City–Haneda area
Local transport

II. Development of core technologies for the practical implementation of automated driving
1. Creation of a safety assessment environment in virtual space
2. Development of technologies for efficient data gathering, analysis, and distribution
3. Development of cyber-security technologies with online software updates, etc.
4. Creation of requirement for HMI required for more sophisticated automated driving, etc.

III. Fostering public acceptance of automated driving
1. Planning and hosting of events that promote public acceptance of automated driving
2. Clarification of the impact of automated driving
3. Research on support for vulnerable road users (e.g., elderly, disabled, pregnant women, foreign tourists), etc.

Regulatory reform and rule-making
SIP conducts a comprehensive review through cooperation of ministries and agencies. Rule-making actions are taken by respective ministries.

IV. Enhancement of international cooperation
1. Dissemination of the outcomes of the project at international conferences
2. Implementation of joint research with overseas research institutions
3. Distribution of project related information on the web, etc.
## Overall Schedule

<table>
<thead>
<tr>
<th>R&amp;D item</th>
<th>FY2018 plan</th>
<th>FY2019 plan</th>
<th>FY2020 plan</th>
<th>FY2021 plan</th>
<th>FY2022 plan</th>
<th>Deployment Milestones</th>
<th>Commercialization</th>
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<tr>
<td>I. Development and validation (FOTs) of automated driving system</td>
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<td>A) Waterfront city area (general roads)</td>
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<td>Improve the platform for the public road</td>
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<td>FOT area Utilize traffic signal information</td>
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<td>A-2. Next-generation public transport</td>
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<td>2) Transport services for a small number of people</td>
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<td>B) Highways (intercity expressways)</td>
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<td>B-1. Privately owned vehicles</td>
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<td>Merging lane assistance, etc.</td>
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<td>B-2. Logistics services</td>
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<td>C) Local areas, etc. (to be determined)</td>
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<td>C-1. Local public transportation</td>
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II. Development of core technologies for the practical implementation of automated driving

1. Creation of a safety assessment environment in virtual space
   - Formulate a plan
   - Sensor evaluation method
   - Driver model
   - Create the environment

2. Development of technologies for efficient data gathering, analysis, and distribution
   - Formulate a plan
   - Utilize new communication technologies (including V2X technologies)
   - Map update/landmarks
   - Technology to utilize traffic congestion/obstacle information in vehicle control
   - Technology to collect, analyze, and distribute information (e.g., vehicle probe data) in the private sector

3. Development of cyber-security technologies with online software update, etc.
   - Formulate a plan

4. Creation of requirements for HMI for more sophisticated automated driving
   - Formulate a plan
FOTs (Tokyo Waterfront City–Haneda Area)

- FOTs will start in autumn 2019 in the Tokyo waterfront city area (general roads and Metropolitan Expressway in the Tokyo Waterfront City area/Haneda area) toward the Olympic and Paralympic Games Tokyo 2020 (in cooperation with Japan Automobile Manufacturers Association).
- R&D in cooperative areas will be promoted to achieve early implementation of automated driving (L2 to L4 on highways and general public roads). Efforts will also be made to increase public acceptance by involving local government, the general public, etc.

Details of FOTs (draft)

Providing traffic signal information

Vehicles are allowed to pass through intersections safely and smoothly based on the signal display and change timing information even in environments where recognition is difficult using in-vehicle cameras.

Providing vehicle information on the main lane

A vehicle detector is installed at two locations before the merging reference point on the main lane (E and F). A roadside detector is installed at two locations before the merging reference point on the acceleration lane (G and H).

Public transport system (self-driving buses)

FOTs for the next-generation ART will be implemented on public roads by using automated driving technology in mixed traffic flow.
FOTs (Local Transportation)

- **Long-term FOTs** will be implemented in underpopulated areas, local communities, etc. through collaboration with businesses and local government to validate the effectiveness and business feasibility of automated driving in terms of logistics and mobility services.

  The long-term FOTs will increase public acceptance by involving the general public, etc. and aim to create multiple implementation examples.

### Details of FOTs (draft)

- **Mobility/logistics services in underpopulated areas, etc.**

  Ensuring means of mobility in areas where many elderly persons live or that are not easily accessible
Build a Virtual Environment for Safety Evaluation

■ Simulation tools for assessing the safety of automated driving in various traffic environments — Joint research will be conducted by experts in industry and academia. Comprehensive and objective safety assessments will be achieved based on actual long-term and long-haul driving evaluations, followed by virtual assessments.

Various weather conditions

Various traffic environments

Safety validation based on driving experiments of more than 10 billion km

Virtual safety assessment

Simulation tools that can reproduce and combine various environments will be developed for performing safety assessments based on automatic assessment by repeating critical situations.
The promoting committee will be reviewed after the end of the 1st phase of SIP. A new organization will be established in 2019 to promote the project.
Mobility bringing everyone a smile!

Thank you for your attention.