1st Phase SIP-adus
Large-scale Field Operational Tests

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1st Phase SIP-adus: Overall Schedule

2014 ➔ 2015 ➔ 2016 ➔ 2017 ➔ 2018

- **Establishment of framework**
- **R&D on specific themes**

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

- **Integration into five key themes**

(1) Dynamic map
(2) Cyber security
(3) Interaction between humans and vehicles (HMI)
(4) Pedestrian traffic accident reduction
(5) Next generation transport

- **Large-scale field operational tests**

Practical application

- Activation of research/technical development
- Evaluation/issue identification with more objectives
- Focus on deployment
- International cooperation and coordination
- Nurturing of social acceptance
Large-scale Field Operational Test (FOT)

Objective:
Provide **opportunities for open discussions** through large-scale FOTs on public roads and promote international standardization and R&D based on five key themes + events for nurturing social acceptance.

Period:
**October 2017 to December 2018**
(Test periods will be set individually depending on the content of the test.)

Participants:

- Expressways
  - A section of **about 300 km in total**, including:
    - Joban Expressway,
    - Metropolitan Expressway,
    - Tomei Expressway,
    - Shin-Tomei Expressway

- Surface streets
  - Around the Tokyo waterfront area

- Participants:
  - Dynamic map
  - Test course
  - HMI
  - Social acceptance
  - Cyber security

- Participants:
  - Next generation transport
  - Pedestrian traffic accident reduction
  - JARI test course
  - Dynamic map
  - Social acceptance

Activities:
- Dynamic map
- HMI
- Cyber security
- Social acceptance
- Next generation transport
- Pedestrian traffic accident reduction
- JARI test course

FOT sites:
A concept to utilize the **high-definition 3D map** and positioning-enabling **dynamic data** held by various entities and that changes over time (dynamic data, semi-dynamic data, and semi-static data) while ensuring conformity by establishing **linkage rules**.

### Dynamic Map

**Dynamic data**
- Movement of vehicles, status of pedestrians, traffic signals, etc.

**Semi-dynamic data**
- Accidents, congestion, traffic regulation, road construction, detailed weather, etc.

**Semi-static data**
- Traffic regulation, road construction, weather, etc.

**Static data**
- Road, lane, 3D shape of structures, etc.

### Common (platform) data

- Additional data
- Competitive area
- Cooperative area

### Digital mapping

- 3D common platform data
- Point clouds, graphics, probe data, etc.
FOT in FY2017:
- Improvement of **high-definition 3D map** of 758 km in total and distribution to participants
- Verification of the specifications and precision of the map data in actual public road environments

Example of verification of information currentness:

1. Identification of information nonconformity
2. Check of conformity
3. Confirmation of changes in features after survey

(Image gathered by FOT participants) -> (Image during survey) -> (Map data)

Formation of consensus on essential features
FOT in FY2018:
- Preparation and distribution of **real-time traffic information** linked to high-definition 3D map at public road

Confirmation and establishment of “dynamic map” concept

Dynamic Map FOT

DSSS: Driving Safety Support System
TSPS: Traffic Signal Prediction System
Objective: Establishment of guidelines for evaluating the cyber security defense performance of vehicles

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.

The best guidelines were selected and proven.

FY2017

FY2018
Demonstration of effectiveness of the guidelines through the vehicle vulnerability evaluation, which simulates various cyber attacks

<table>
<thead>
<tr>
<th>Major category</th>
<th>Intermediate category</th>
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</thead>
<tbody>
<tr>
<td>1. Reconnaissance</td>
<td>1. HW investigation</td>
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<tr>
<td></td>
<td>1.2 SW investigation</td>
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<tr>
<td>2. Intrusion</td>
<td>2.1 Passive attacks that require user intervention</td>
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<tr>
<td></td>
<td>2.2 Passive attacks that do not require user intervention</td>
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<td></td>
<td>2.3 Active attacks that exploit vulnerabilities</td>
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<td></td>
<td>2.4 Active attacks that utilize information obtained by intercepting communication</td>
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<tr>
<td>3. Privilege escalation</td>
<td>3.1 Disabling a protection function</td>
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<tr>
<td></td>
<td>3.2 Acquisition of a higher privilege level</td>
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<tr>
<td>4. Actions on objectives</td>
<td>4.1 Information leakage</td>
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<tr>
<td></td>
<td>4.2 Suspension of services</td>
</tr>
<tr>
<td></td>
<td>4.3 Unauthorized operation (control system)</td>
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<tr>
<td></td>
<td>4.4 Unauthorized operation (other than the control system)</td>
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</tbody>
</table>

Removal of chips from ECUs

Firmware extraction
Main issues of the human-machine interface (cooperative area)

A. Understanding the functions, readiness, and behavior of the automated driving system
B. Detecting the driver’s readiness and setting the appropriate time required for take-over
C. Interface between the automated driving system and other road users

Competitive area

A sense of connectedness between the horse (car) and the driver

Smooth HMI without a sense of incompatibility

Guidelines and rules for HMI

Minimum arrangements to ride a horse (car) safely
HMI: FOT to Determine the Driver’s Readiness

(1) Development of a driver monitor

Research on detection of driver readiness and time required for take-over

Driver’s state

Automated driving mode

Manual driving

Driver state A

Driver state B

Time

TOR (Take-Over Request)

Development of a technology to estimate the driver’s readiness based on eye movement by measuring various biometric information and evaluating the driving performance.

(2) Gathering and analysis of data through a large-scale FOT

Data-gathering on public roads using Level 0 to 2 commercially available cars

Verification data on the test course using Level 2 and Level 3 development vehicles

(3) International standardization

ISO/TC22/SC39/WG8

• TR 21959 Human Performance and State in the Context of AD:
  Part 1 – Terms and Definitions, Part 2 – Experimental Guidance
Objective: Evaluation of performance and effectiveness of the V2P communication system in actual traffic environments

- Development of communication terminal devices for pedestrians and an alert system for both pedestrians and drivers utilizing vehicle-to-pedestrian communication technology (V2P) and verification through an FOT

- Precision of pedestrian localization to be increased from ±20 m to ±5 m in multipath environment
- Development of hazard detection algorithm based on prediction of pedestrians’ behavior
- Development of HMI that gives a speech notification depending on the localization error and hazard level
- FOT plan based on pedestrian accident pattern analysis
- FOT in the Odaiba area
FOT for Next Generation Transport

**Objective:** Evaluation of the impact and effectiveness of the ART* system in actual traffic environments

- Achievement of next generation transport by utilizing ITS technology and automated driving technology

FOT in the Odaiba, Ariake, and Toyosu areas

*ART: Advanced Rapid Transit

- Precise docking control
- Advanced PTPS* (e.g., signal priority control)
- Optimum speed control
- Assistance for people with limited mobility
- Optimal route guidance matched to individual needs
- Offering consolidated data to achieve various services

The buses arrive based on the timetable.

**ART information center**

- Real-time bus operation information
- Crowdedness information
- Dynamic connection information

Optimal speed control

Walking map

Transport service operator

**Advanced PTPS***

(*PTPS: Public Transportation Priority System)

- Congestion prediction and avoidance guidance
- Optimal information is offered to reduce crowdedness.

Precise docking control

Optimal information is offered to reduce crowdedness.

Safe boarding/exiting, even by the elderly and wheelchair-users

Crowdedness information

Dynamic connection information

Optimal route guidance matched to individual needs

Optimum speed control

Comfortable ride with little swaying

- The buses arrive based on the timetable.
- Assistance for people with limited mobility
- Optimal route guidance matched to individual needs
- Offering consolidated data to achieve various services
- Safe boarding/exiting, even by the elderly and wheelchair-users
- Optimal speed control
- Comfortable ride with little swaying
Development of an app that enables users to **gather information about the walking route and post barrier/barrier-free information**

- 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).
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. 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.
## Main Evaluation Items

<table>
<thead>
<tr>
<th>(1) Road conditions</th>
<th>(2) Natural environment</th>
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</thead>
<tbody>
<tr>
<td>(1) Road structures</td>
<td>(1) Weather and climate conditions</td>
</tr>
<tr>
<td>(2) Roles of local governments</td>
<td>(2) Communication status</td>
</tr>
<tr>
<td>(3) Supplementation of mixed traffic</td>
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<tr>
<td>(4) Establishment of traffic centers</td>
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<tr>
<td>(a slope in a rural area)</td>
<td>(a snow-covered road)</td>
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<thead>
<tr>
<th>(3) Cost</th>
<th>(4) Social acceptance</th>
<th>(5) Impact on the local economy</th>
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<tbody>
<tr>
<td>(1) Cost of vehicle introduction and maintenance</td>
<td>(1) Ride comfort and amenity</td>
<td>(1) Increase in social participation opportunities for the elderly</td>
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<tr>
<td>(2) Necessary cost other than vehicles</td>
<td>(2) Convenience</td>
<td>(2) Improved efficiency of collecting and delivering crops, etc.</td>
</tr>
<tr>
<td>(guidelines for installing magnetic guide lines)</td>
<td>(for passengers)</td>
<td>(Mixed transport of cargo and passengers on buses)</td>
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### Details of FOTs

#### 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.

#### Merging assistance on the main lane of expressways

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). The traffic information of the main lane is provided to the road side lane. The speed and timing to enter the main lane are automatically adjusted to ensure safe merging.

#### Public transport system (automated driving buses)

Vehicles are grouped into platoons by CACC to ensure smooth operation by PTPS (in which signals are controlled to give right of way to public transportation vehicles). On-time operation based on the timetable.
Thank you