

13<sup>th</sup> Japan ITS Promotion Forum

# Automated Driving Systems

## Dynamic Map

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The University of Tokyo

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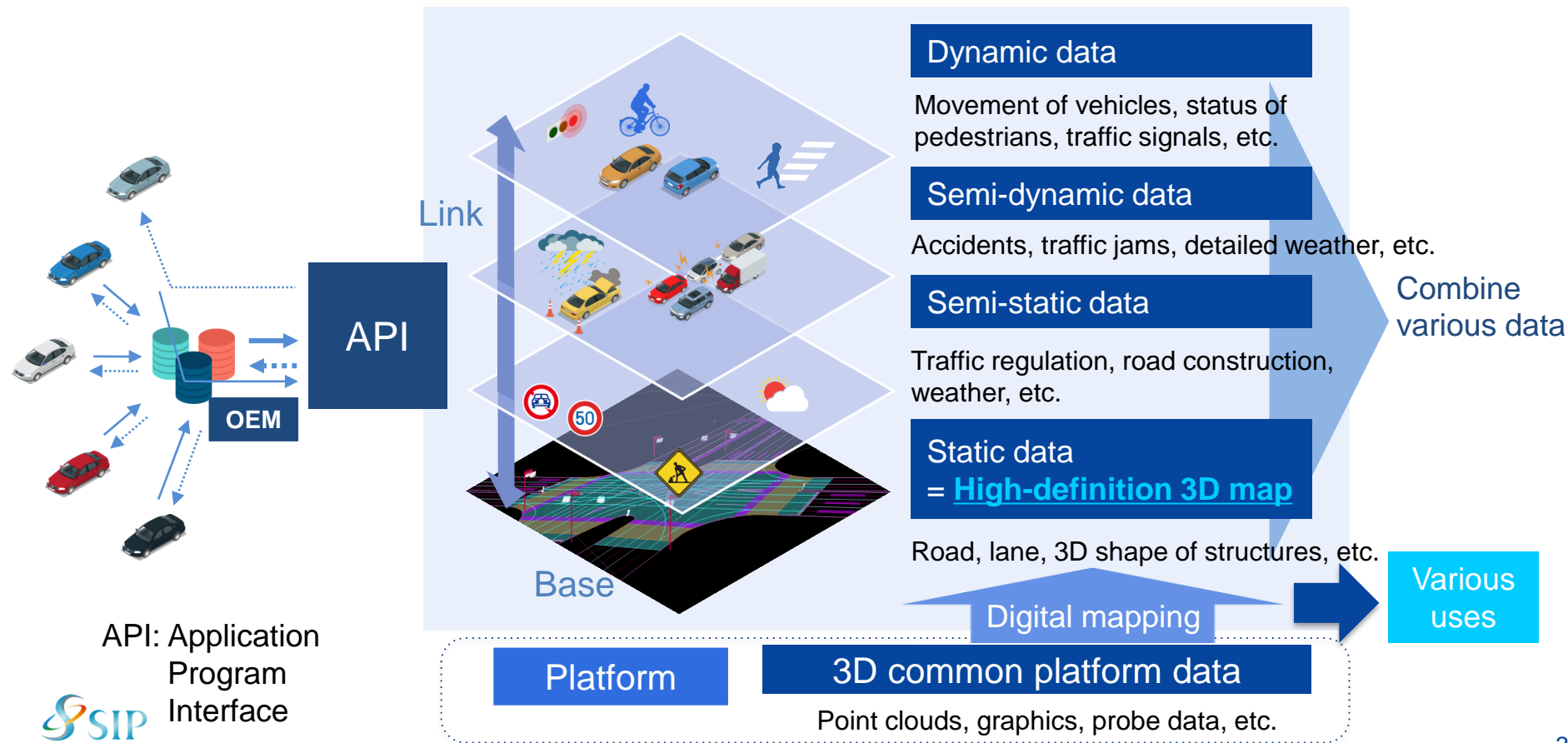
A vertical image on the left side of the slide showing light trails from a city street at night. The trails are in various colors (yellow, white, blue, purple) and create a sense of motion and depth, leading towards a vanishing point in the distance.

- 1. What is “Dynamic Map”?**
- 2. Large-scale Field Operational Tests**
- 3. Utilization of Vehicle Probe Information**
- 4. Feasibility in Various Applications**
- 5. Prototyping and Verification of the Service Platform**
- 6. Standardization and International Cooperation**
- 7. Looking Ahead**

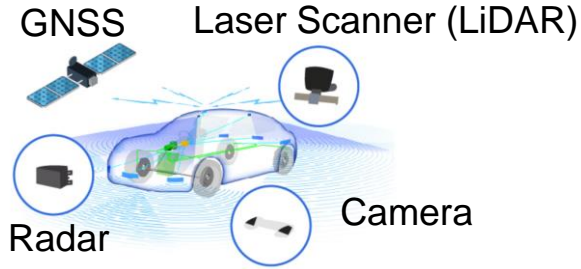


# 1. What is “Dynamic Map”?

# Dynamic Map



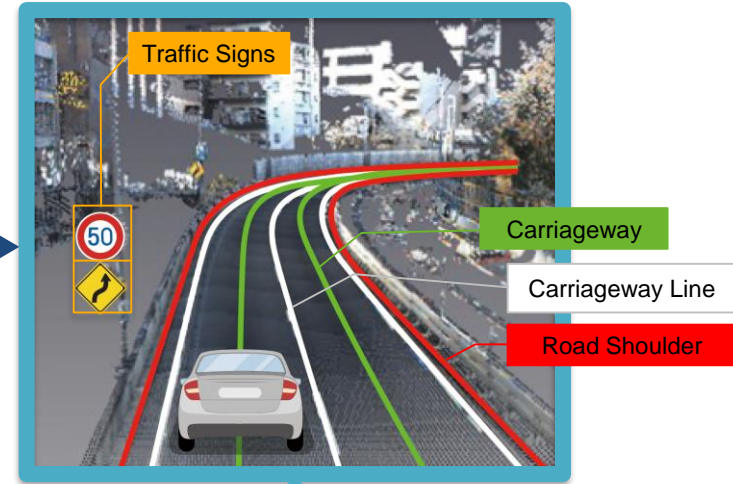
# Example of Application: Vehicle Position Detection



Sensed data

Compare to estimate the position

High-definition 3D map



Estimate the position of the vehicle



## **2. Large-scale Field Operational Tests**

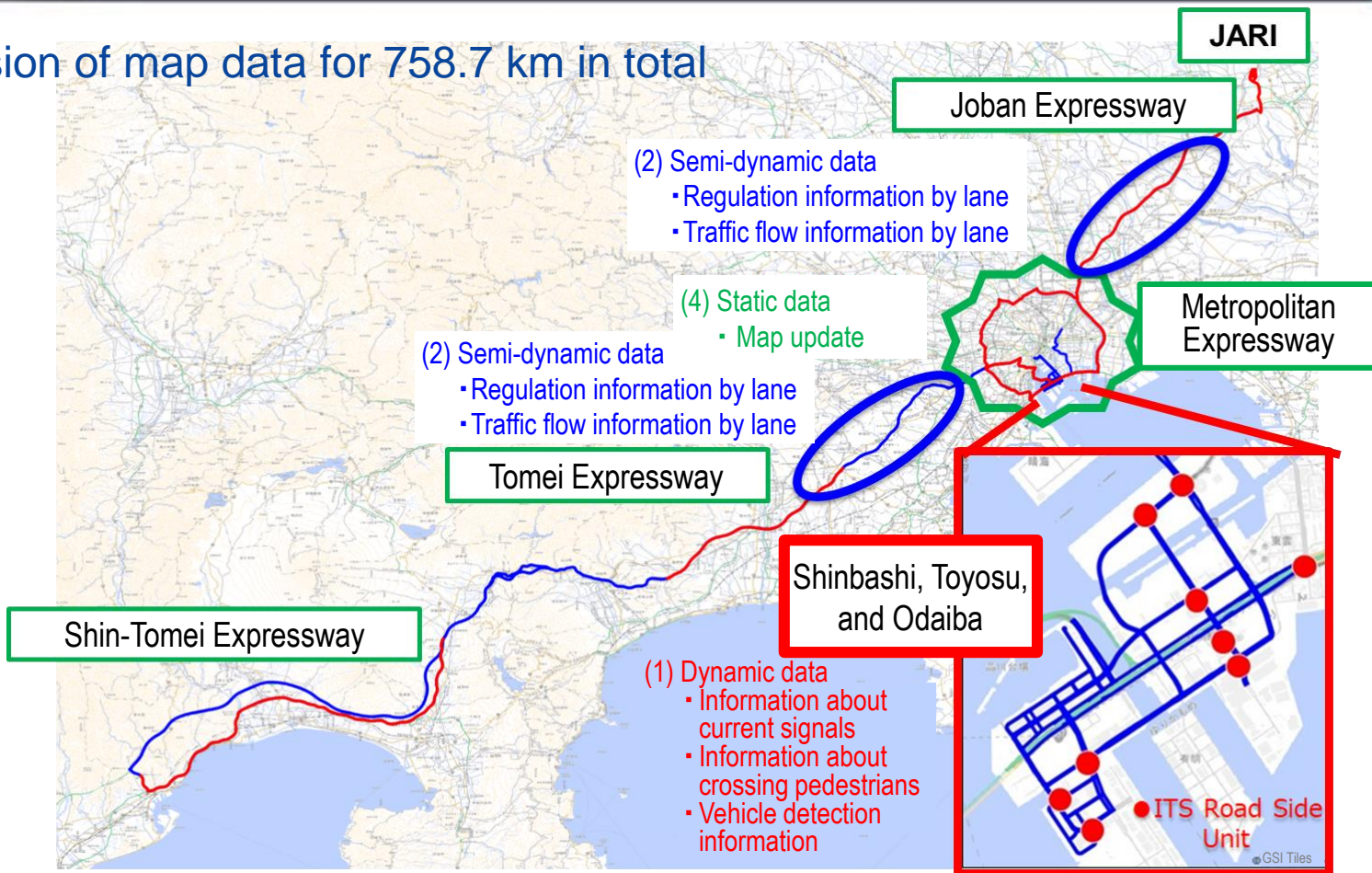
# Field Operational Test Participants

Daihatsu Motor Co., Ltd.  
Continental Automotive Corporation  
Meiji Logitech Co., Ltd.  
Toyota Motor Corporation  
Pioneer Corporation  
Suzuki Motor Corporation  
BMW  
Honda R&D Co., Ltd.  
Alpine Electronics, Inc.  
Volkswagen Group  
Calsonic Kansei Corporation

Mazda Motor Corporation  
Mitsubishi Electric Corporation  
Mercedes-Benz Japan  
Omron Corporation  
Subaru Corporation  
Robert Bosch GmbH  
Nissan Motor Co., Ltd.  
ZMP Inc.  
Saitama Institute of Technology  
Nagoya University  
Valeo Japan Co., Ltd.

# Areas and Details of FOT

- Provision of map data for 758.7 km in total

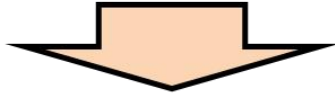




# System Configuration

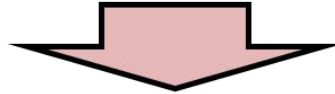
ETC 2.0  
Wireless roadside  
equipment

(2) Regulation information by lane



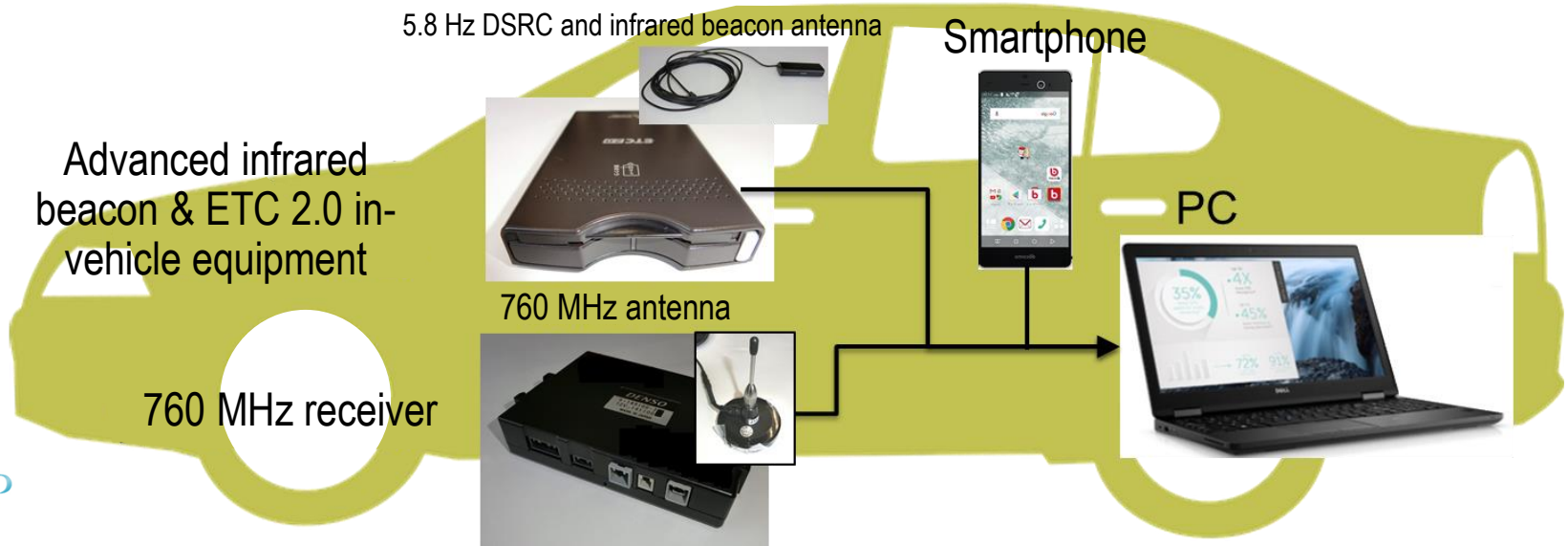
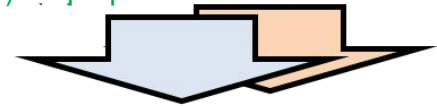
Advanced infrared beacons,  
ITS wireless roadside equipment

(1) Information about current signals



FOT server  
DM, probe data

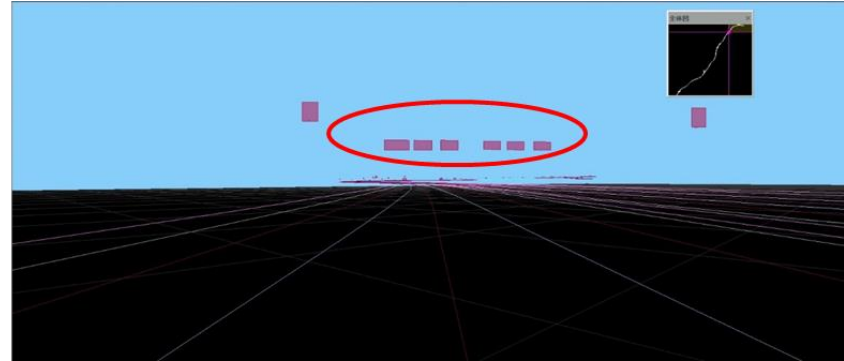
(2) Traffic flow information by lane  
(4) Map update data



# Evaluation of Static Data



Yokohama Machida IC-Tokyo IC on the Tomei Expressway



The signs no longer exist at around 5 km from Tokyo IC.

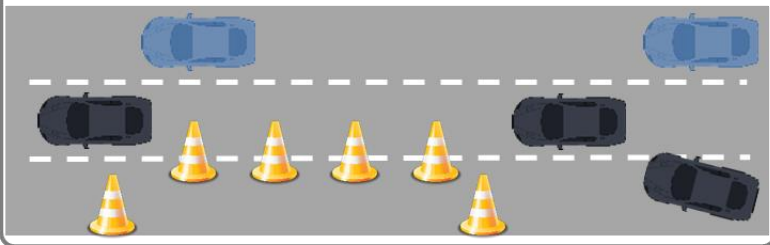
## **Result of checking the source information**

- The signs existed in the source information.
- = Changes after preparing the static data

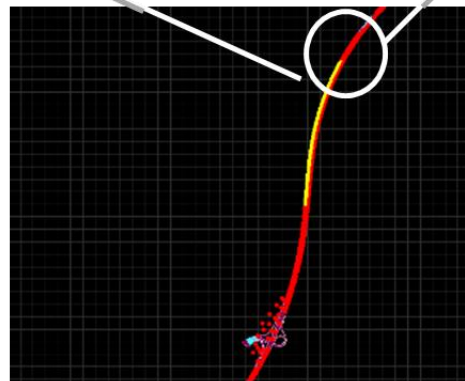
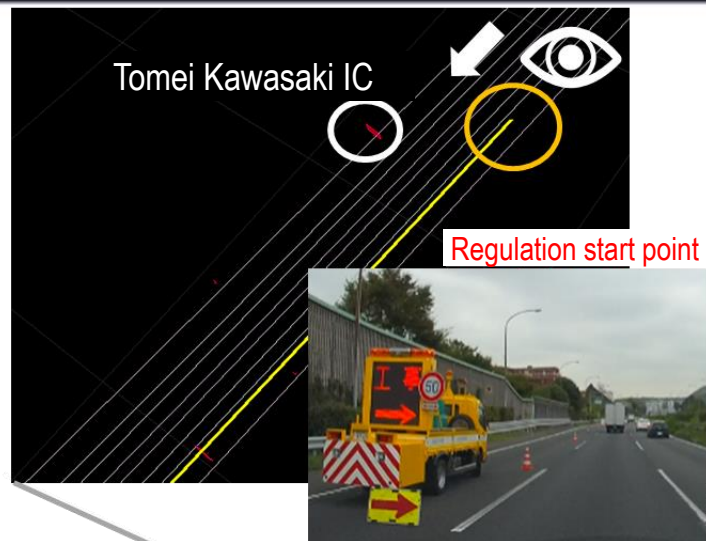
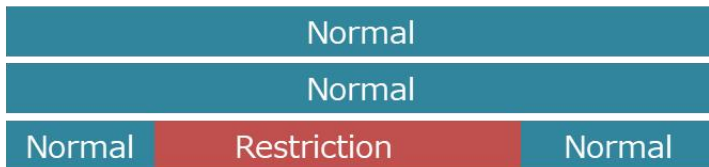


# Evaluation of Semi-dynamic Data

Actual road condition



Distributed data



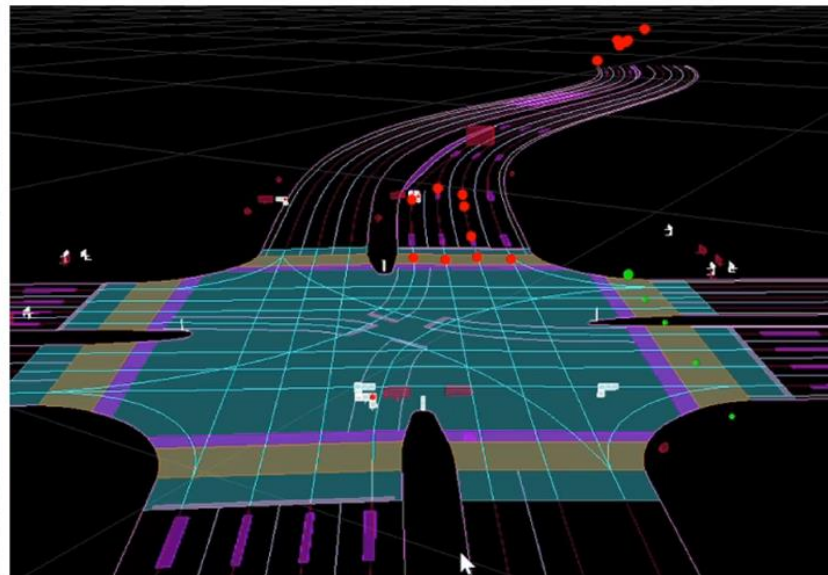
# Evaluation of Dynamic Data

## Dashboard camera



Signal

## Viewer image

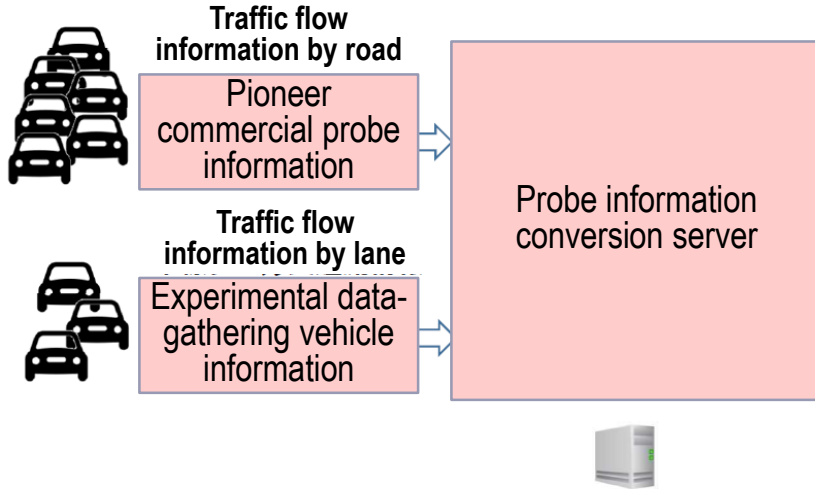




### **3. Utilization of Vehicle Probe Information**

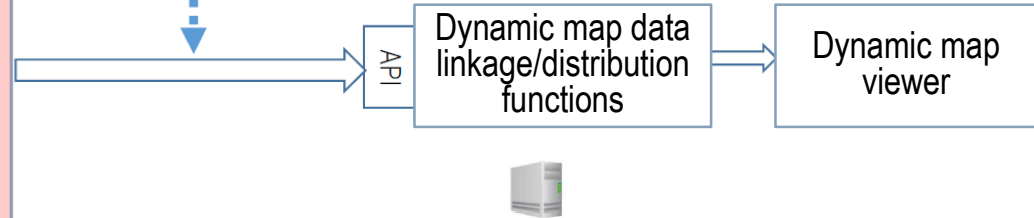
# Overall Configuration of the FOT

## Preparation and construction based on this FOT



JASPAR  
Dynamic Vehicle  
Information Sharing  
WG

## Dynamic map large-scale FOT



- Implementation of the draft version of the vehicle information-sharing specifications formulated at the end of FY2017
- Verification of the “traffic flow,” one of the contents defined in the vehicle information-sharing specifications
- Proposals for the vehicle information-sharing specifications Ver. 1.0 formulated in FY2018



## **4. Feasibility in Various Applications**

# Summary of Study Outcomes (Outcomes in FY2017)

Item implemented in this fiscal year	Outcome of this fiscal year and future outlook
Study on application to public surveys	<ul style="list-style-type: none"><li>● A work manual (draft) applicable to public surveys was prepared based on measurements on prefectural and municipal roads in Gifu Prefecture.<ul style="list-style-type: none"><li>➢ A work manual (draft) that can be used in combination with a method indicated in the Standards for the Work Rules was prepared based on the dynamic map data improvement specifications for automated driving, etc. (This manual can be used to apply Article 17 of the Standards for the Work Rules.) A survey will be recognized as a “public survey” if an application is made based on the manual on the assumption that the survey receives the designation of Article 5, Item 2 of the Survey Act. (However, a precision verification report will be required if an entity other than the consortium serves as a surveying organization.)</li></ul></li></ul>
Study on utilization in various fields	<ul style="list-style-type: none"><li>● Improvement/update of the road ledger, support for snow removal, daily inspection of electric cables/utility poles, and usability for maintenance were verified based on the measurement results in Gifu Prefecture.</li><li>● The requirements of dynamic maps were studied for utilization for infrastructure maintenance. (There were no changes from the requirements for automated driving in the desk study.)<ul style="list-style-type: none"><li>➢ It was found that there were potential applications without significantly changing the data improvement specifications, etc. of dynamic maps for automated driving.</li><li>➢ To utilize data, it is necessary to actualize the mechanism and business model of providing data, etc.</li></ul></li></ul>
Cooperation with SIP agriculture	<ul style="list-style-type: none"><li>● A dynamic map was created for roads between farms of the Kitamura flood prevention reservoir in cooperation with SIP agriculture.<ul style="list-style-type: none"><li>➢ In SIP agriculture, the data will be integrated with farm data to conduct an FOT in FY2018.</li></ul></li></ul>





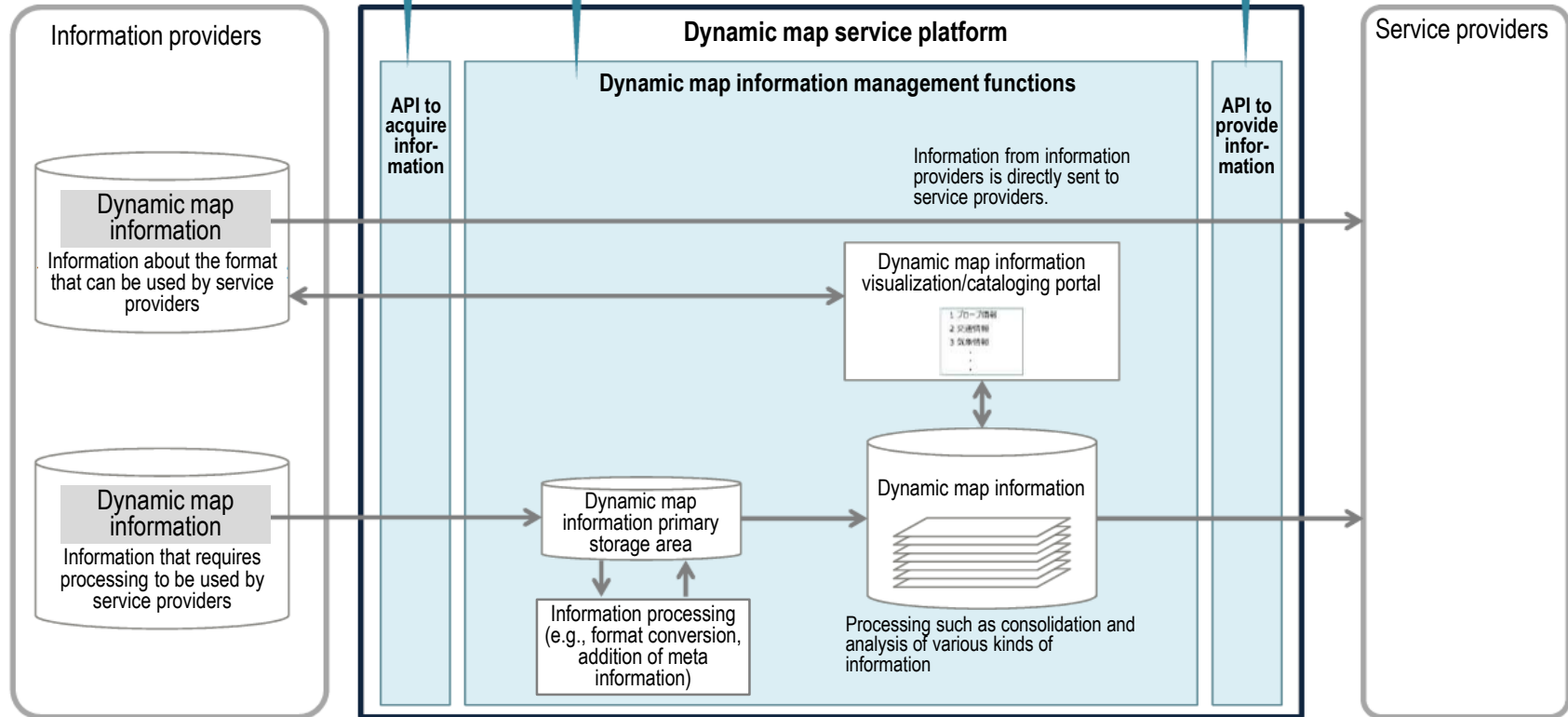
## **5. Prototyping and Verification of the Service Platform**

# Verification of the Service Model FOT Environment

Study of specifications of API to acquire various kinds of information

Study of functions that are required to use various kinds of information in different fields

Study of specifications of API to output information upon request from service providers



Source: Report on prototyping and evaluation of the dynamic map service platform (March 2018)



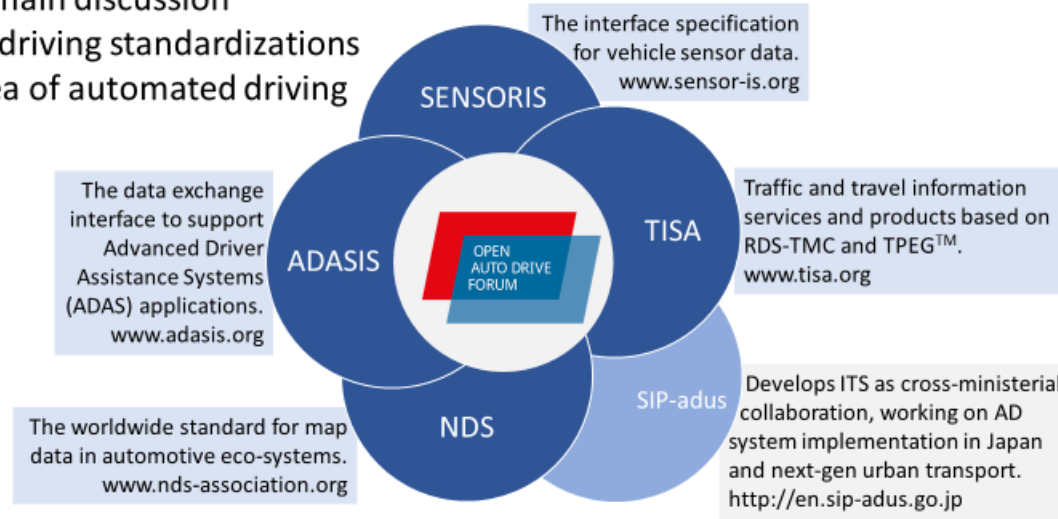
## **6. Standardization and International Cooperation**

# Participation in the Industry Standardization Activities

## OPEN AUTO DRIVE FORUM (OADF)



Cross-domain discussion  
platform driving standardizations  
in the area of automated driving



OpenDRIVE  
managing the road ahead



OADF conference in February 2019  
(source: OADF website)

Source: a document for ITS World Congress 2018 in Copenhagen

# Main Activities in FY2018

- ◆ Promotion of items in ISO/TC204/WG3
  - GDF5.1 DIS 20524-1, CD 20524-2
  - Lane-level location referencing method: CD 17572-4
  - Map data model for automated driving: NP22726-1, others
- ◆ Cooperation with industrial standards organizations
  - Cooperative sessions at the ITS World Congress
  - Formal participation in OADF, promotion to a Steering Committee member
- ◆ Promotion of dialogue and cooperation with domestic and overseas bodies using SIP-adus workshops and other opportunities
  - Dynamic Map Platform Co., Ltd., JAMA, JASPAR
  - Tri-lateral meetings: ART-WG, OADF, NDS, ADASIS, SENSORIS, TN-ITS, TISA, DI activities in the U.S., CICV in China, etc.
  - Dialogue toward 2nd Phase activities, etc.



## **7. Looking Ahead**

- ◆ Commencement of operation of dynamic maps
  - Start to offer dynamic maps for expressways and limited highways (about 30,000 km) in Japan
  - Acquisition of Ushr, Inc. (U.S.)
- ◆ Linkage and coordination of various kinds of information
  - In the 2nd Phase FOT, signal information, merging/ETC gate support information, road traffic information by lane, etc. will be distributed.
  - Utilization of various (international) standards is one of the key solutions (to ensure consistency).
  - The method of implementing location referencing will be actualized based on the circumstances of roads and information in Japan.
- ◆ Advancement of map updating
  - Information will be updated more quickly and in larger quantities. The border between static data and dynamic data will gradually become blurred.
  - The method of evaluating the quality of dynamic maps will be actualized by taking into account the mechanism of updating.
    - There are difficulties in actualizing the method, but this is an important issue in maintaining Japan's competitiveness in maps.
  - The view of the future will be achieved eventually using AI, etc.



# Thank you

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