MGA Webiner

Automated Driving Systems and Dynamic Map

15th June 2018

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Mitsubishi Research Institute Inc.

MRI

Contents of this presentation

Self Introduction

◆ Satoru Nakajo

- ✓ Doctor of Engineering (the University of Tokyo)
- ✓ MBA (McGill University)

1998-
Consultant, Mitsubishi Research Institute Inc.
2008-2012, 2017-
Visiting researcher, Center for Spatial Information Science (CSIS), the University of Tokyo
2012-2017
Project Associate Professor, CSIS, the University of Tokyo
2018-
Visiting member of Faculty, Nagoya University
Guest Professor, Tokyo City University

- ✓ Member of SIP-adus, a project for automated driving
- ✓ Convenor, ISO/TC204 SWG3.3, location references for ITS

others

1. Purpose of this Presentation

Purpose of this Presentation

- **Introduction of activity for developing map for ADS (Automated Driving Systems) in Japan**
  - ✓ Car OEMs, system benders and map providers are developing “Dynamic Map”, a map system for ADS.
  - ✓ the Cross-ministerial Strategic Innovation Promotion Program (SIP) of Cabinet Office of Japan supports this project.

- **Discuss the expectations for GNSS from ADS perspective**
  - ✓ Explain the personal views.
  - ✓ Discuss the possibility, etc.

2. Activity of SIP-adus in Japan

Overview of SIP program

SIP: Cross-ministerial Strategic Innovation Promotion Program

- ✓ Start from FY2013.
- ✓ The Council for Science, Technology and Innovation selects 10 projects.
- ✓ Cross-ministerial Initiatives.
- ✓ Promote focused, end-to-end research and development, from basic research to practical application and commercialization.
- ✓ Total budget for FY2015 is \50 billion (around 400 million euro).

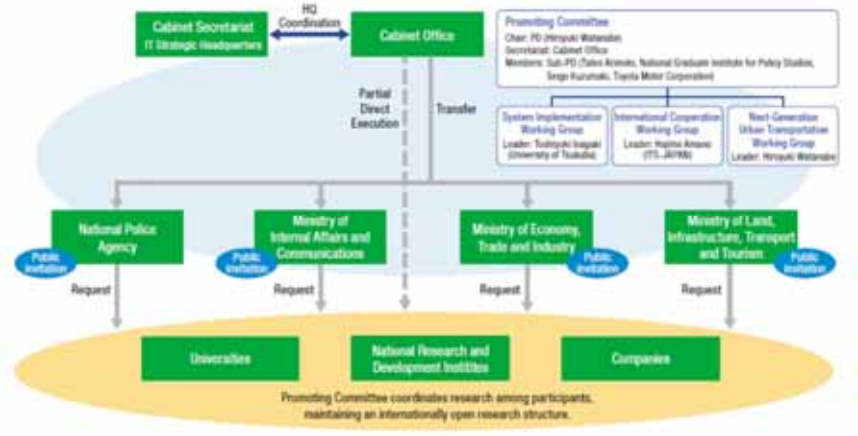
\2.32 billion (FY2015) (around 18.8 million euro)

Source:
Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
http://en.sip-adus.go.jp/wp/wp-content/uploads/e04_itsforum2018_s.pdf (checked on 13th June 2018)

Overview of SIP program

Targets / Goals of Automated Driving System program (SIP-adus)

- ✓ Set national goals to reduce the number of annual traffic fatalities to 2,500 or fewer by the year 2018 and create the world's safest road traffic environment by the year 2020.
- ✓ Develop automated driving systems, including next-generation urban transportation infrastructure, to accomplish these goals.
- ✓ Drastically reduce accidents and traffic congestion for a major leap forward in travel convenience.



adus: Automated Driving for Universal Services

Source:
Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
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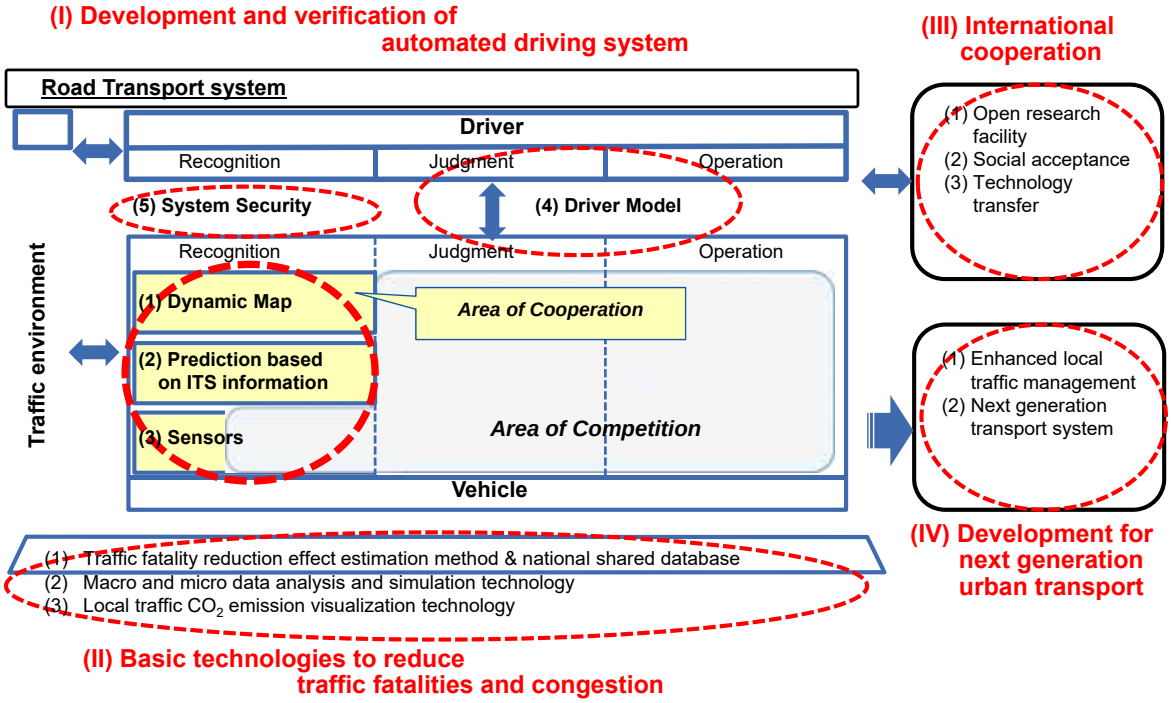
Scope of SIP-adus



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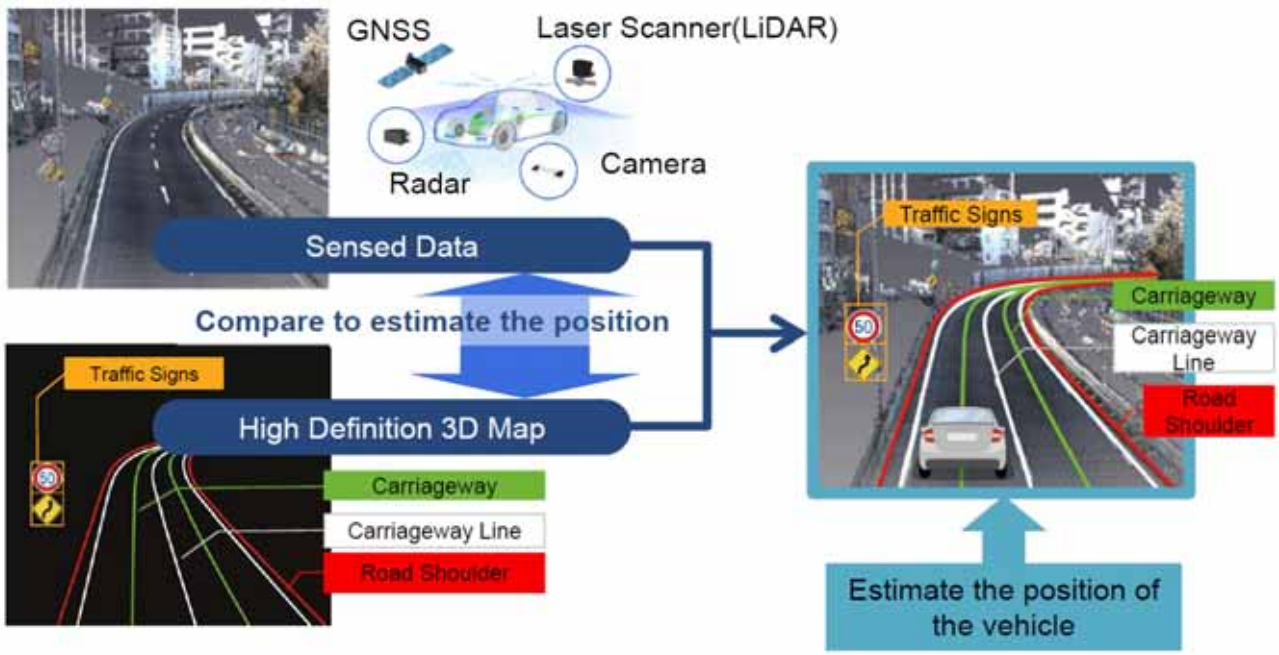
http://en.sip-adus.go.jp/wp/wp-content/uploads/e04_itsforum2018_s.pdf (checked on 13th June 2018)

3. What is “Dynamic Map”?

Dynamic Map

Source:
Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
http://en.sip-adus.go.jp/wp/wp-content/uploads/e04_itsforum2018_s.pdf (checked on 13th June 2018)

Example of Application: Vehicle Position Detection



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Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
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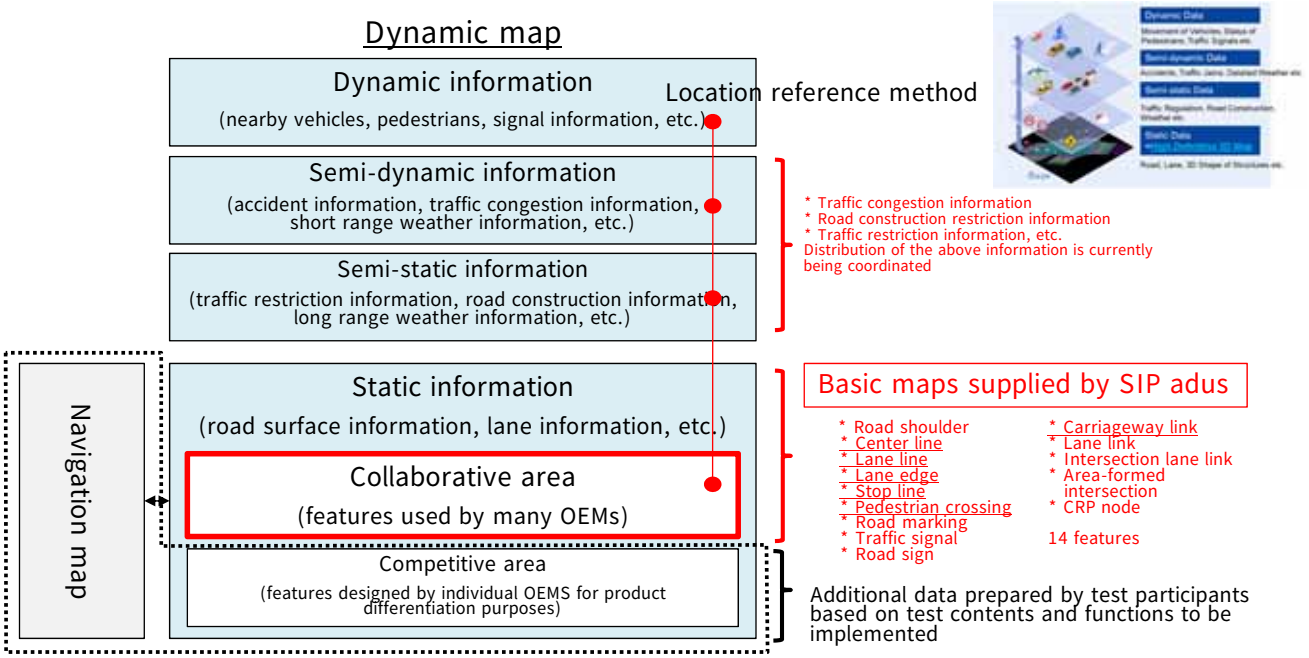
Dynamic Map Data Structure and Scope for Cooperation



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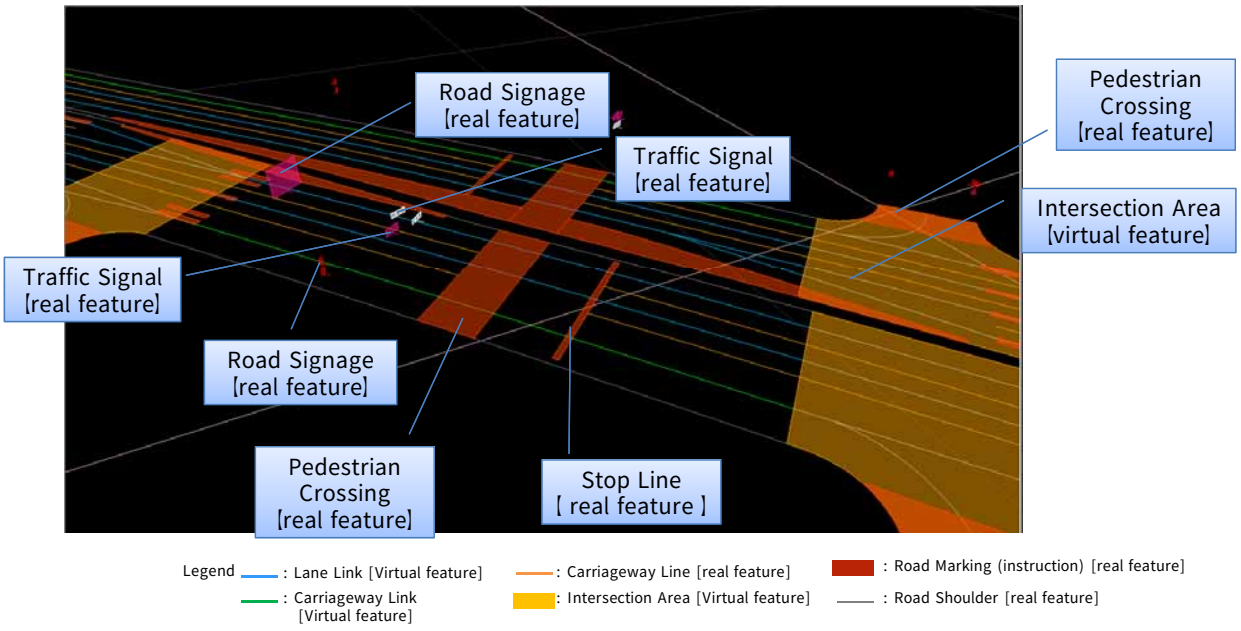
Sample Expression



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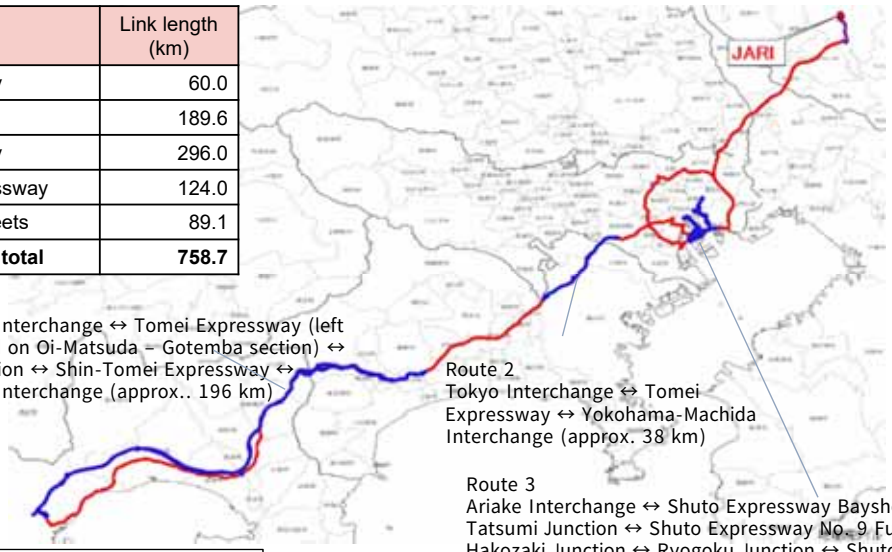
Areas for Static Map Trial

Route	Link length (km)
Joban Expressway	60.0
Shuto Expressway	189.6
Tomei-Expressway	296.0
Shin-Tomei Expressway	124.0
Surface streets	89.1
Trial section total	**758.7**



Route 1
Hadano-Nakai Interchange ↔ Tomei Expressway (left route outbound on Oi-Matsuda – Gotemba section) ↔ Gotemba Junction ↔ Shin-Tomei Expressway ↔ Shimizu-Ihara Interchange (approx.. 196 km)

Route 2
Tokyo Interchange ↔ Tomei Expressway ↔ Yokohama-Machida Interchange (approx. 38 km)

Route 3
Ariake Interchange ↔ Shuto Expressway Bayshore Route ↔ Tatsumi Junction ↔ Shuto Expressway No. 9 Fukagawa Route ↔ Hakozaki Junction ↔ Ryogoku Junction ↔ Shuto Expressway No. 6 Mukojima Route ↔ Komagata Interchange (approx.. 20 km)

Explanation
FY2016 section
FY2017 section

Activities to ensure conformity with public surveys and achieve multipurpose application will continue together with the trials.

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Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
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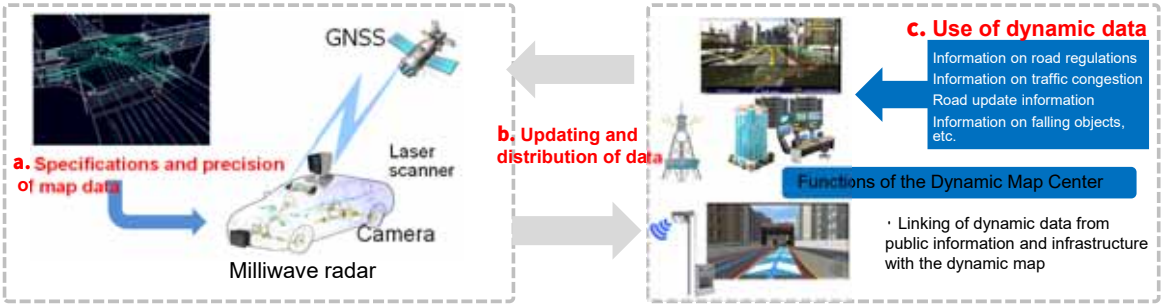
Positioning of the Dynamic Map Field Operational Tests

Test details

a. Validation of specifications and precision of static, high-accuracy 3D map data
b. Validation of data updating and distribution systems
c. Validation of linkage of dynamic data delivered from infrastructure, etc.



Objectives

■ Confirmation of and agreement on final specifications toward practical implementation of the dynamic map
■ Promoting standardization activities
■ Promoting R&D on use of the dynamic map and development of applications

Benefits of participation

■ Participation in opportunities to table desired features and proposals toward practical implementation of the dynamic map
■ Participation in examining details of proposals for standardizations
■ Acceleration of R&D at participating companies

* Dynamic Map Field Operational Test Briefing (Material created by NEDO)

Source:
Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
http://en.sip-adus.go.jp/wp/wp-content/uploads/e04_itsforum2018_s.pdf (checked on 13th June 2018)

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

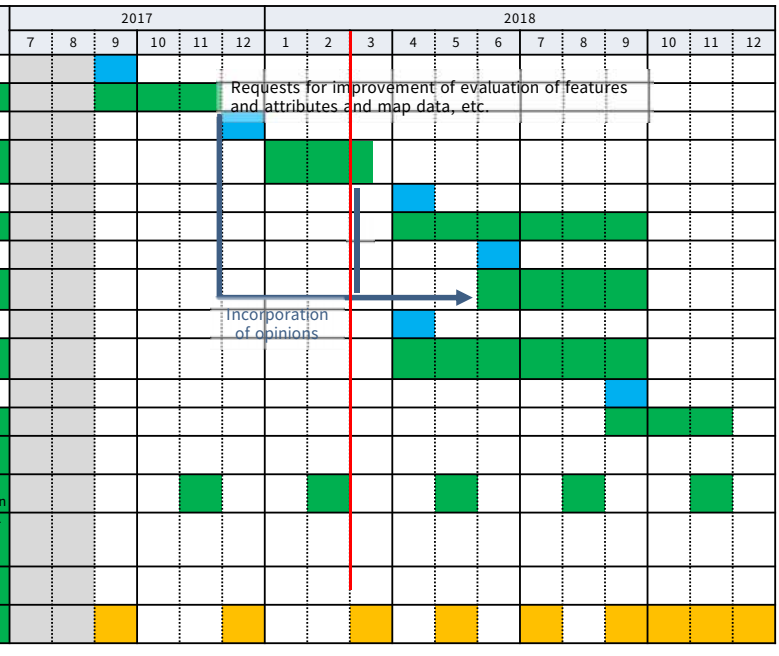
Total: 22 Organizations

*As of the end of March, 2018 Participants in the Dynamic Map or HMI tests

Schedule and Progress

- ◆ Static maps for 758.7 km have been provided to participants
- ◆ Tested more than 90 days/route in October and November

Main item	Sub-item	Supplied data, tools, etc	Classification
Supply and evaluation of dynamic map data and tools	Static high-precision 3D map data	Static high definition 3D map data (304 km) + Viewer	Supply
			Evaluation
		Static high definition 3D map data (758.7 km) + Viewer + API (Step 1)	Supply
			Evaluation
		Static high definition 3D map data (updated data)	Supply
			Evaluation
		Static high definition 3D map data (updated data: incorporation of improvement requests, etc.)	Supply
			Evaluation
	Semi-static / Semi-dynamic information	Semi-static / Semi-dynamic information + Viewer + API (Step 2)	Supply
			Evaluation
	Dynamic information	Dynamic information	Supply
			Evaluation
Document submittal	Preparation/updating of test plans		Submittal of first version
			Submittal of updated version
	Application for use of outcomes / license agreement for map data relating to the dynamic map field operational test		Application for use of outcomes
			License agreement
Meeting	Dynamic Map Field Operational Test Working Group		



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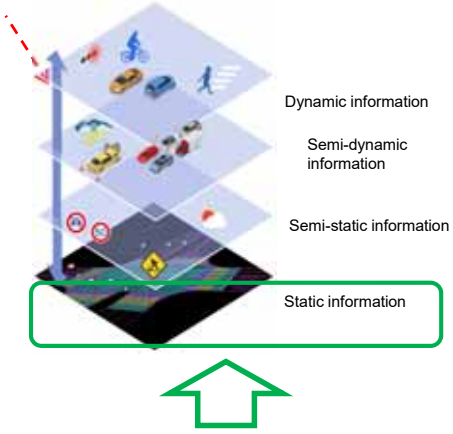
Test Process for Static Information Updates and Delivery

Location reference method



Study of the update scope and conditions for this portion

(1) Study of use cases

Types of road condition changes, etc.

(2) Arrangement of matters requiring updates

Update units, frequency, etc.

(3) Study of update rules, information to be added to high definition 3D maps, etc.

*More than 9,600 road signs, traffic signals, and road markings exist in the section provided in September (approx. 300km).

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Static-Dynamic Information Field Operational Test Area (Areas are under discussion)

Dynamic map	**Test area (candidate)**
Dynamic information	TBD
Semi-dynamic information	TBD
Semi-static information	TBD
Static information (update)	TBD

Explanation:
Blue line: Zone supplied in September
Red line: Zone supplied in December

A reduced-shade map of the Geospatial Information Authority of Japan is used as the base map.

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4. International Cooperation

Activities

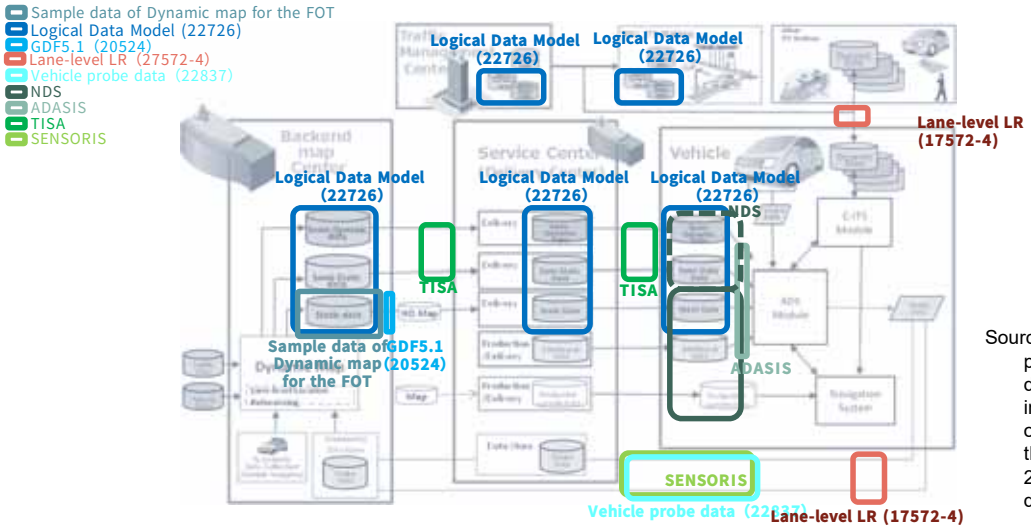
◆ Promotion of items in ISO/TC204/WG3
- ✓ GDF5.1 CD20524-1, NP20524-2
- ✓ Lane-level location referencing method: NP17572-4
- ✓ Map data model for automated driving: PWI22726, others

◆ Promotion of dialogue and cooperation with domestic and overseas bodies using SIP-adus workshops and other opportunities
- ✓ DMP, JAMA, JASPAR
- ✓ Tri-lateral meetings: ART-WG, OADF, NDS, ADASIS, SENSORIS, TN-ITS, TISA, etc.

◆ Systems for future discussions
- ✓ Establishment of a small body to discuss standardization strategies in Japan under the Dynamic Map Task Force
- ✓ Formal participation in OADF as SIP-adus
- ✓ Support for the holding of an OADF joint meeting with ISO/TC204/WG3 (January 2018), etc.

Overview of Standardization / International Cooperation Activities and ISO/TC 204 Activities

- Thus far, Japan has led standardization activities in ISO/TC204/WG3.
- Beginning this fiscal year, Japan will actively participate in activities aimed at industry standards.



Source: Overall diagram prepared based on discussions with European industrial standards organizations and others at the SIP-adus Workshop 2017 (currently under discussion)

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Satoru Nakajo, Dynamic Map, The 12th Japan ITS Promotion Forum presentation
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5. Expectations for GNSS

Expectations for GNSS

◆ World wide usage
- ✓ Global procurement is widely used by automotive makers.
- ✓ Not only in Asia but also in other regions is needed.

◆ Not only GNSSs but also set the control points
- ✓ Positioning and also the matching with Map DB is very important.
- ✓ Connecting lots of data from multiple source is crucial.
- ✓ Lots of data shall be delivered with accurate position.
- ✓ Crustal movements shall be took into account like Japan.
- ✓ 25cm movement is equal to the width of a tire.

◆ Supplemental methods of positioning for NOT GNSS area like a tunnel or under a double deck
- ✓ Long. & Lat. is very useful but difficult to use such as in a tunnel
- ✓ Supplemental methods to detect the position are needed.

◆ Cheap receivers

Thank you

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