Cross-ministerial Strategic Innovation Promotion Program (SIP) Automated Driving Systems/ Large-scale Field Operational Tests/ General Survey of International Trends Regarding International Cooperation with Dynamic Maps

Overview Version

February 2019

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Overview

In order to contribute to the international community in the promising field of dynamic maps, a field expected to be integral to driving automation systems, SIP-adus investigated dynamic map data models and the map data structure of dynamic maps both in and outside Japan. Furthermore, this study worked to clarify differences in specifications of dynamic maps established by various nations. To achieve compatibility between industry standards in Japan and in other countries, it also aimed to reinforce cooperative ties, through exchange of views and debate, between organizations worldwide that conduct research and development in the driving automation field.

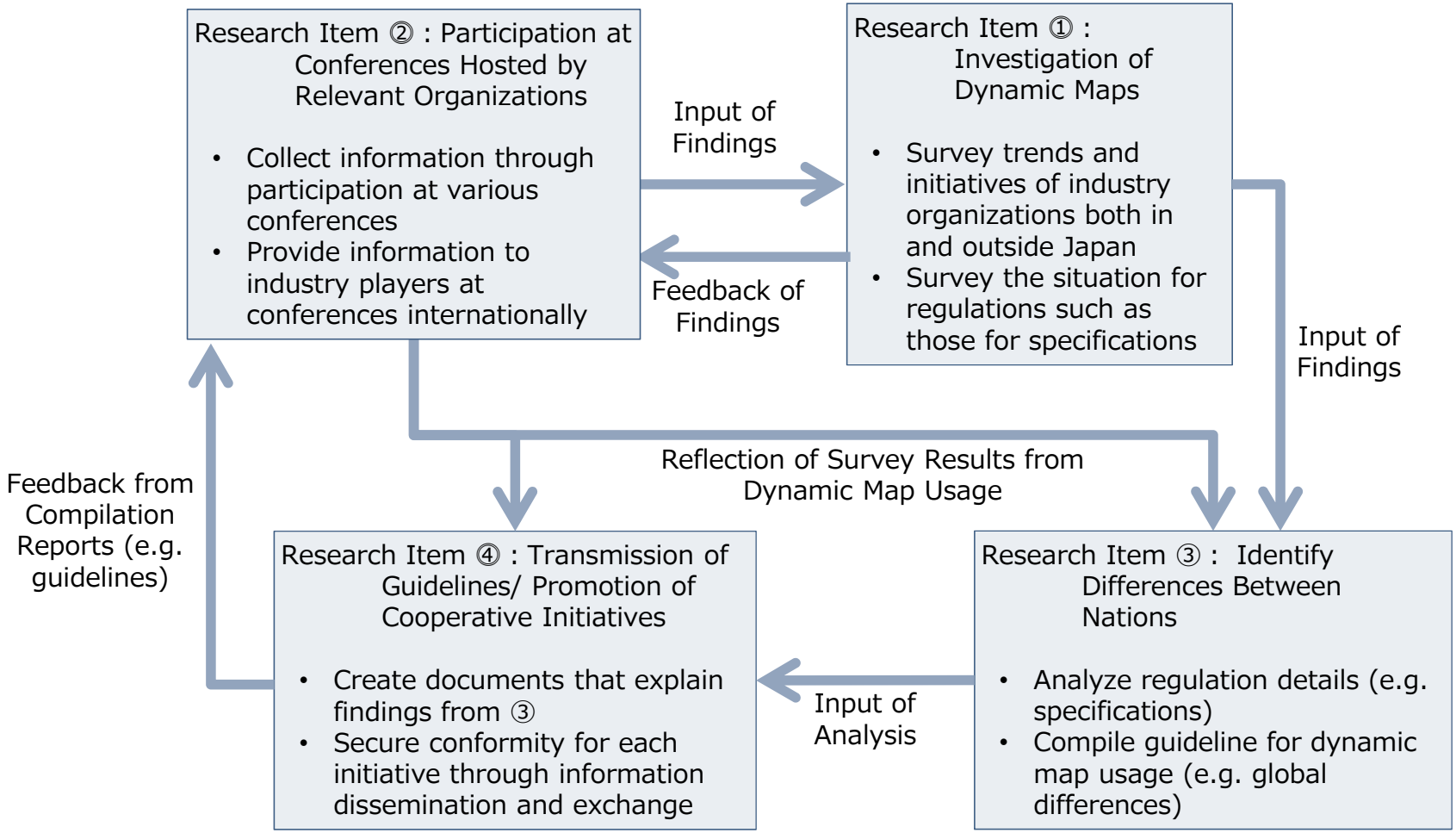


Figure: Research Items

Research Item ① : Investigation of Dynamic Maps

The investigation gathered information such as details of the standardization documents and activity surrounding the formulation of industry specifications for dynamic maps. This was done through surveying public materials and exchanging information with industry players at conferences and in individual meetings.

Table: Primary Initiatives in the Global Formulation and Development of Dynamic Map Specifications

Standardization Level	Domestic/ Int'l	Organization	Specifications
Industry Standards	Domestic	SIP-adus	Dynamic Map Specifications for Dynamic Map Field Operational Tests
	Int'l	NDS	Navigation Data Standard Open Lane Model 1.0
		ADASIS	Advanced Driver Assistance Systems Interface Specification
		TISA	Traffic Message Channel （TMC） Transport Protocol Experts Group（TPEG）
		SENSORIS	Sensor Ingestion Interface Specification
		OADF	–
International Standards	–	ISO/TC204	22726 : Dynamic events and map database specifications for applications of automated driving systems, cooperative ITS, and advanced road/traffic management systems
			20524 :Geographic Data Files – GDF5.1

Research Item ① : Investigation of Dynamic Maps [Overseas Initiatives 1/2]

The investigation compiled activity details of European organizations that are actively developing industry standards.

NDS

Navigation Data Standard

- Navigation Data Standard Association (NDS) aims to develop a standard data base format that is compatible with all car navigation systems.
- Navigation Data Standard is a standard data base format that maintains compatibility with all systems. It separates the software and map data and features immediate data update.
- “NDS Open Lane Model 1.0” was released (2016)
- Comprises 37 organizations (as of Feb 2019)

ADASIS

ADASIS
Advanced Driver Assistant Systems Interface Specifications

- Advanced Driver Assistance Systems Interface Specification Forum (ADASIS) aims to develop an interface for ADAS applications and onboard maps.
- Advanced Driver Assistance Systems Interface Specification is an application interface for vehicle control and provides map information to ADAS.
- “ADASIS v3.0” for automated driving was released (2018)
- Comprises 45 organizations (as of Feb 2019)

SENSORIS

SENSORIS

- Initiated by HERE, SENSORIS aims to develop open standards such as a format for processing and analyzing information collected onto a cloud from vehicle sensors.
- It is studying specifications for uplinking vehicle sensor data to a cloud center and those necessary for services that result from the realization of vehicle sensor data.
- “SENSORIS v1.0” was released (2018)
- Comprises 35 organizations (as of Feb 2019)

TISA

TISA
Traveller Information Services Association

- Traffic Information Service Association (TISA) aims to develop open standards for traffic information and traveler information services.
- It is developing 2 formats: TMC that is used to transfer traffic, weather, etc. information over FM channels and TPEG that uses digital broadcast to transfer information related to traffic, public transport, weather, etc.
- Workshop on “TPEG3” for automated driving was organized.
- Comprises 93 organizations (as of Feb 2019)

Research Item ① : Investigation of Dynamic Maps [Overseas Initiatives 2/2]

OADF

OPEN AUTODRIVE FORUM

- With European organizations (NDS, ADASIS, TISA, SENSORIS) and related companies at the center, Open AutoDrive Forum is a platform that promotes cross-domain debate and coordination to advance automated driving.
- It promotes the Auto Drive Ecosystem, which is a cycle of map production, delivery to vehicle, onboard cooperation with ADAS Module, and vehicle data (sensing data) feedback.
- 61 participants including auto makers and map providers (as of Feb 2018)
- Organizes meetings once every 2-3 months in Europe, U.S., or Asia

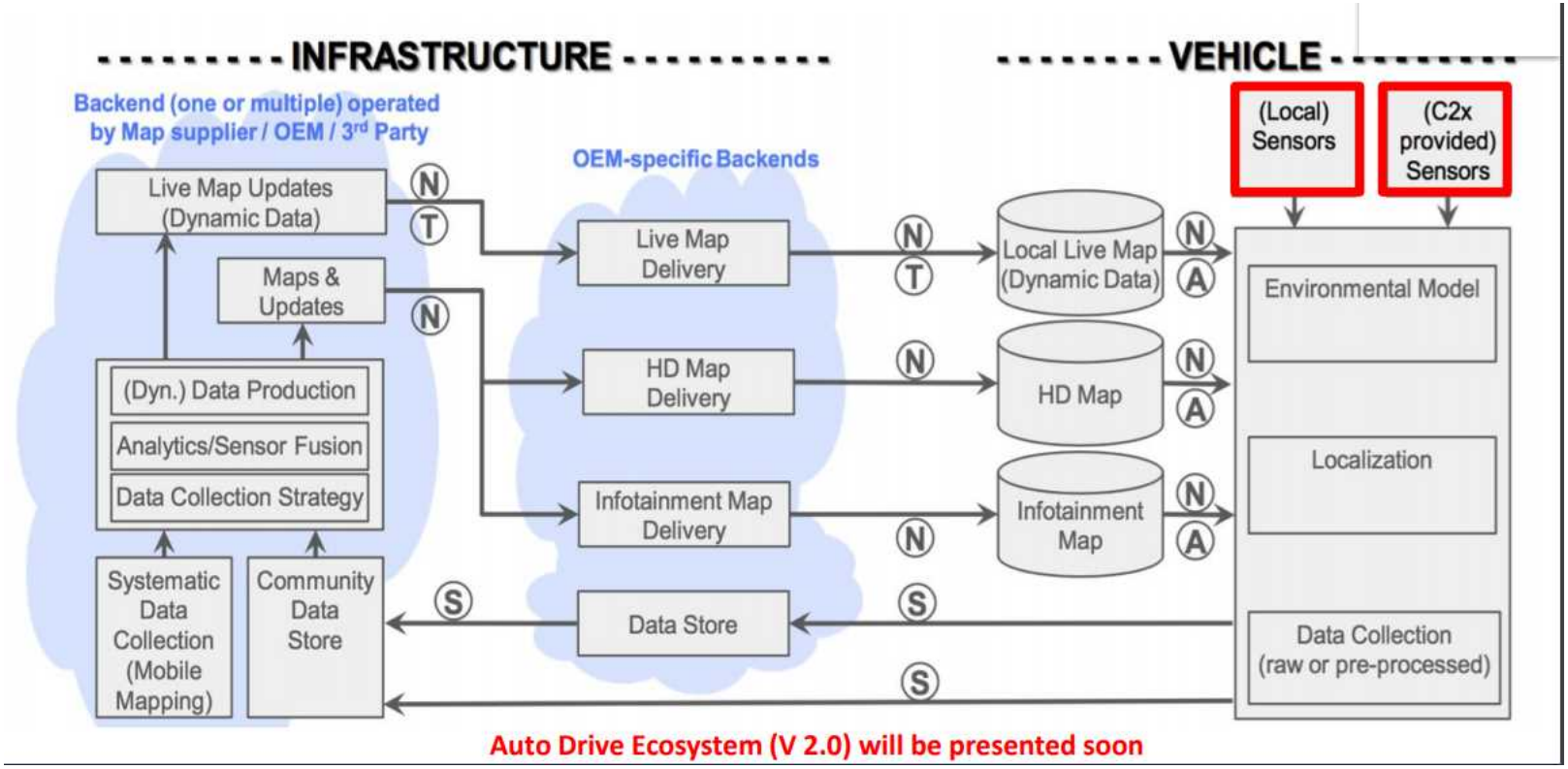
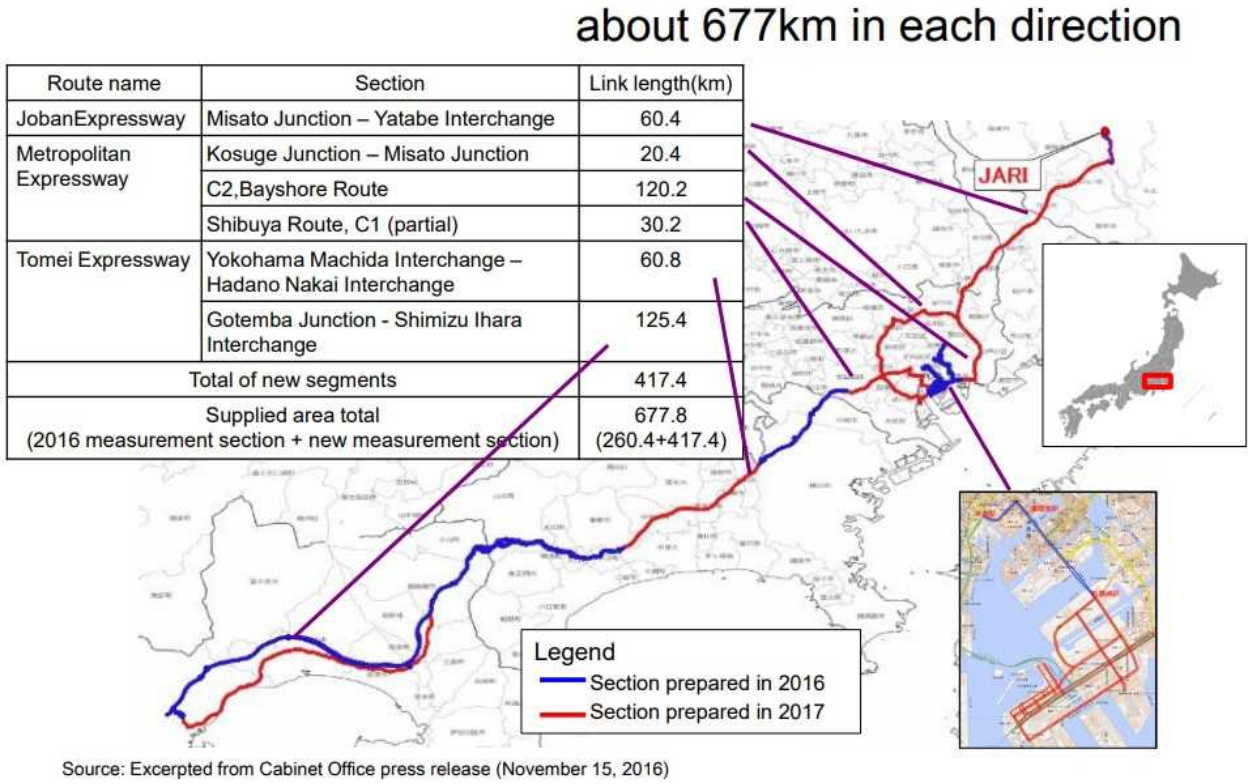


Figure: Auto Drive Ecosystem by OADF

Source : Dr. Volker Sasse, SIP-adus Work Shop2017, November 2017

Research Item ① : Investigation of Dynamic Maps [Domestic Initiatives]

- So far with regard to dynamic maps, SIP-adus has created documents defining requirements (proposed) and specifications for basic map data and production (proposed).
- In FY2017, it tested prototypes of high-accuracy 3-dimensional maps and conducted field operation tests as part of large-scale demonstration experiments.
- In FY2018, it conducted static information update experiments and semi-dynamic and dynamic information distribution experiments.



Route name	Section	Link length(km)
JobanExpressway	Misato Junction – Yatabe Interchange	60.4
Metropolitan Expressway	Kosuge Junction – Misato Junction	20.4
	C2,Bayshore Route	120.2
	Shibuya Route, C1 (partial)	30.2
Tomei Expressway	Yokohama Machida Interchange – Hadano Nakai Interchange	60.8
	Gotemba Junction - Shimizu Ihara Interchange	125.4
Total of new segments		417.4
Supplied area total (2016 measurement section + new measurement section)		677.8 (260.4+417.4)

Source: Excerpted from Cabinet Office press release (November 15, 2016)

Figure: Scheduled Test Area

Source : Mr. Yoshiaki Tsuda, MITSUBISHI ELECTRIC CORPORATION, SIP-adus Work Shop2017, November 2017

Research Item ① : Investigation of Dynamic Maps [International Initiatives]

- Under TC 204, the technical committee for ITS standardization within the ISO, WG3 is working on the standardization of geospatial information and related matters with ITS database technology at the core.
- It defines the relationship between semi-static/semi-dynamic data and static data for dynamic maps, and the logical data model that includes the 3 types of data (static, semi-static, and semi-dynamic) is PWI approved.
- Besides the logical data model, there is current deliberation that aims for ISO publication of geographic data file GDF5.1 (CD 20524-1, NP 20524-2) and lane-level location referencing (NP 17572-4).

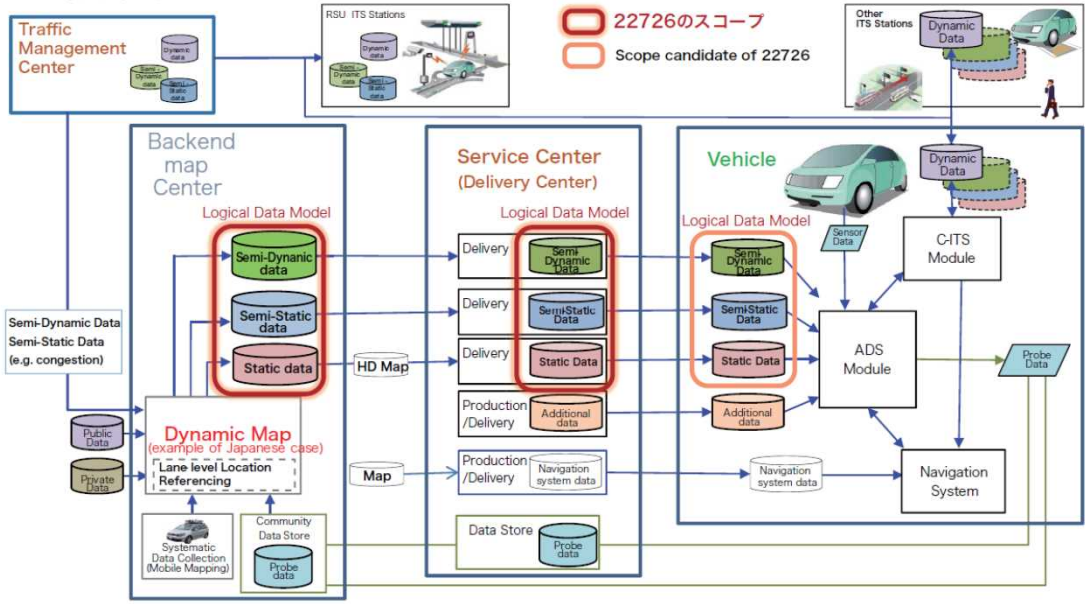


Figure: Scope of PWI22726

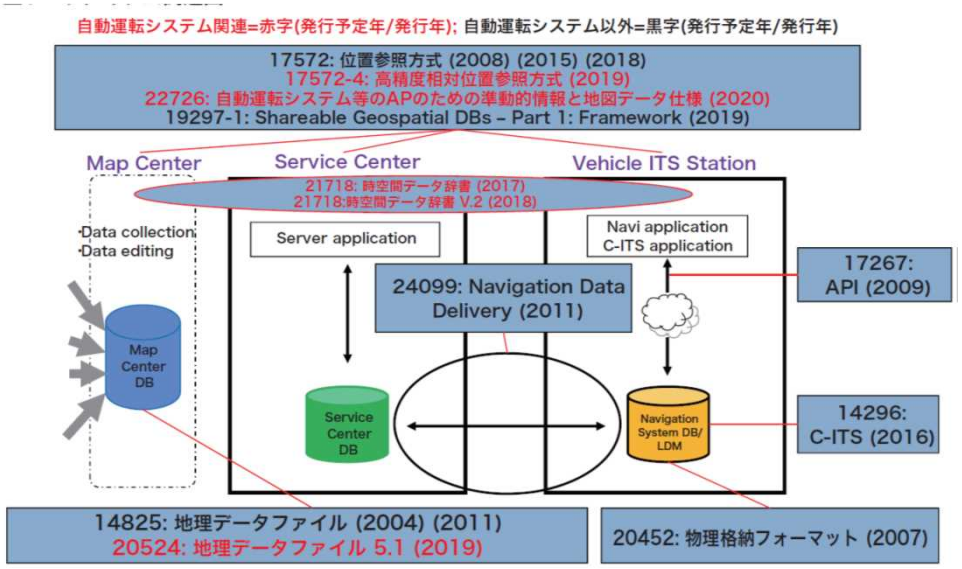


図　WG3ワークアイテム関連図

Source：ITS Standardization 2018, Society of Automotive Engineers of Japan, September 2018

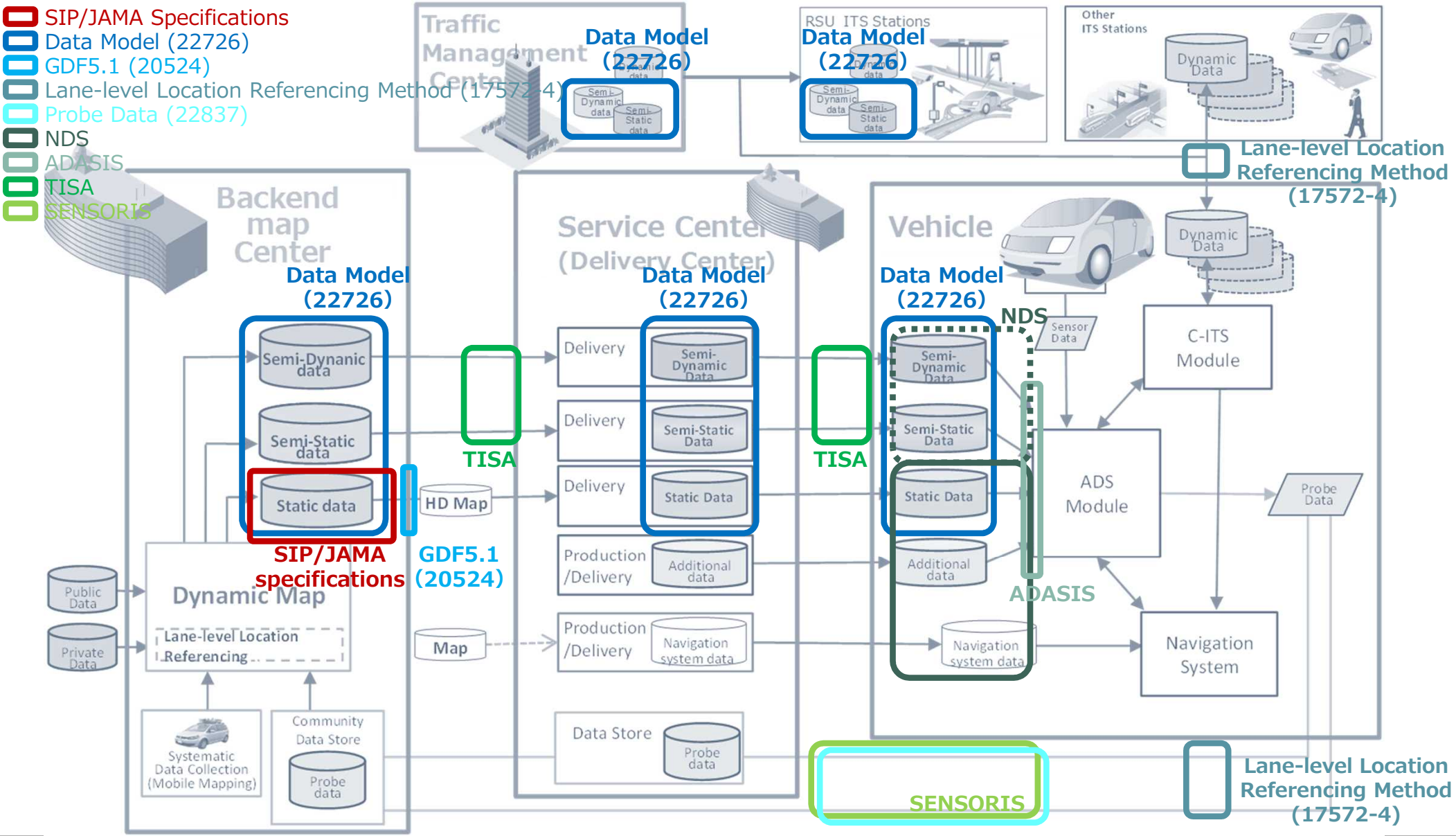
調査項目①：ダイナミックマップに関する調査［各主体の取組み範囲の整理］

Domestic and international activities related to dynamic maps are organized below.

Item			De facto Standards		Dejure Standards	
			OADF	Japan	ISO	(WG)
Map Storage Format	Exchange Format	C2C	– (not required)	DMP	GDF5.1	SWG3.1
		C2V	–	–		
	On-Board Format		NDS	Proprietary Formats	Data model	SWG3.2
	Lane Model			–	GDF5.1 Data model	SWG3.1 SWG3.2
ADAS API			ADASIS	Proprietary Formats	–	–
Dynamic information service (Existing Standards)			NDS (partly)	VICS ETC2.0 ITS-Connect Large-Scale FOT	TPEG etc	WG10
Location Referencing			TISA-TPEG		Location referencing	SWG3.3
Data Interface	V2C		SENSORIS	Proprietary Formats	Probe Data	WG16
	C2C			JasPar		
Map Data Quality			Highly Reliable Maps	Proprietary Formats	Quality principles	TC211
Other			Metadata Catalogue	Proprietary Formats	–	–

Research Item ① : Investigation of Dynamic Maps [Summary]

Domestic and international activities related to dynamic maps are organized below.



Research Item ② : Participation at Conferences Hosted by Relevant Organizations [Overseas Conferences]

The investigation disseminated information regarding the current state in Japan and sought out cooperative partnerships with appropriate organizations through participation in conferences like OADF and information exchange with relevant parties.

Table: Participation in Conferences Hosted by Relevant Organizations

Conference	Date	Location	Conference Summary
8th OADF	November 13, 2017	Tokyo, Japan	• Presentation of current state of SIP-adus – Welcome Speech by Mr. Fukushima Overview of SIP and description of items being considered with regard to automated driving systems – Keynote Speech by Mr. Ozawa, Dynamic Map Platform Co., Ltd. Presentation of the current situation regarding the maintenance of high-accuracy 3D map data at DMP and initiatives for map data maintenance updates – SIP-adus Presentation by Dr. Nakajo, University of Tokyo Presentation of verification experiment objectives, test items, distribution data (data items) and overview of data maintenance routes, promotion of automated driving, program participants, and schedule • Agreement to continue cooperation with SIP-adus
9th OADF	March 6, 2018	Budapest, Hungary	• Presentation of the current situation of SIP-adus in concert with the report from European counterparts • Agreement to periodically share their nation's recent developments with respect to automated driving

Research Item ② : Participation at Conferences Hosted by Relevant Organizations [Overseas Conferences]

Table: Participation in Conferences Hosted by Relevant Organizations [continued]

Conference	Date	Location	Conference Summary
10th OADF	July 12, 2018	Wuhan, China	• Presentation of the current situation of SIP-adus in concert with the report from European counterparts – Presentation and overview of large-scale field operation tests – Introduction and invitation of the SIP-adus workshop to be hosted in November 2018
11th OADF	February 5, 2019	Belmont, United States	• Announcement that SIP-adus will become a formal member of OADF • Presentation of the current situation of SIP-adus in concert with the report from European counterparts; invitation to participate in field operation tests. – 2nd SIP (summary, Tokyo Waterfront City Area FOT) – 1st SIP (summary, Dynamic Map FOT) – Future plans for cooperation with OADF

Research Item ② : Participation at Conferences Hosted by Relevant Organizations [Domestic Conferences]

For the purpose of sharing information among Japanese stakeholders and discussing the direction of standardization activities Japan should pursue, a conference called the Dynamic Map Standardizing Strategy Initiative was established.

Members of the conference are composed of people from academia, the automobile industry and related fields.

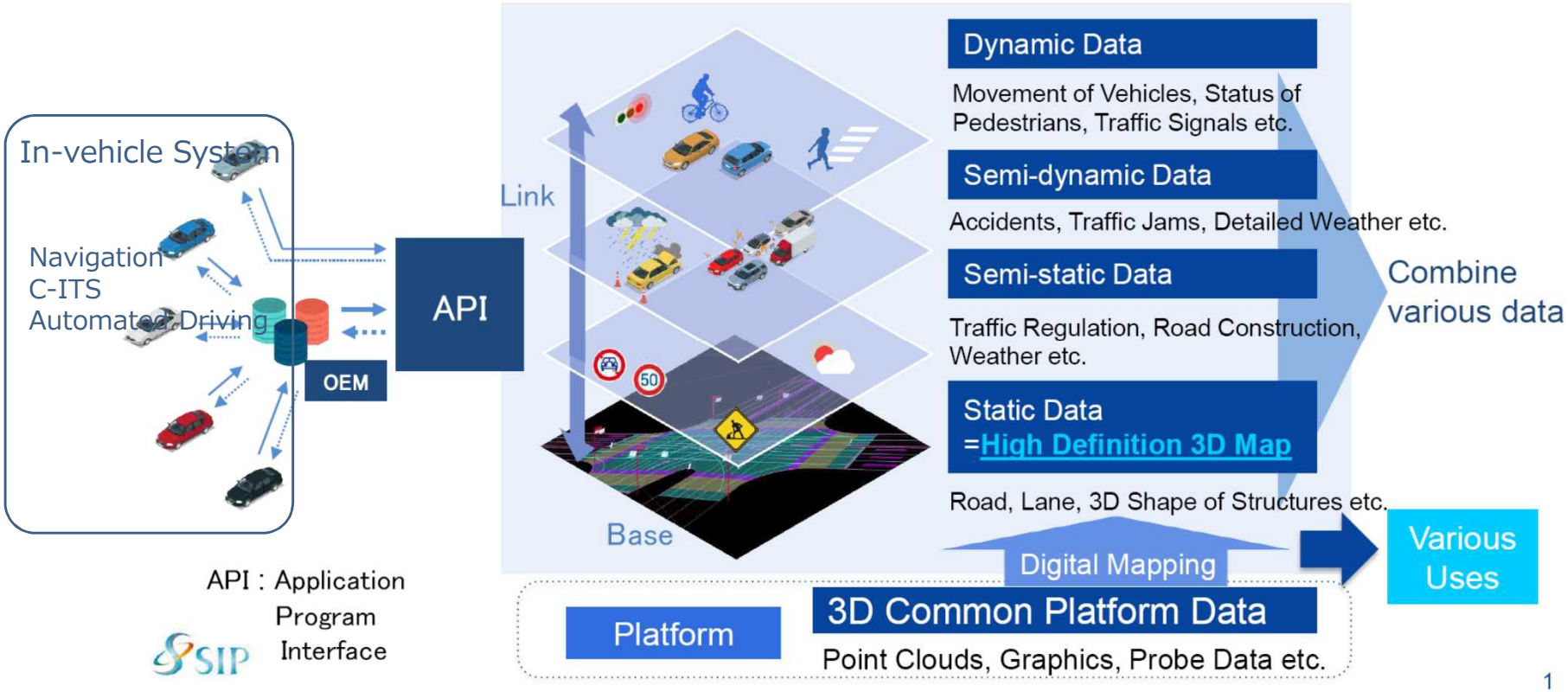
Table: Dynamic Map Standardizing Strategy Initiative Schedule

Conference	Date	Main agenda
1st Meeting	January 15, 2018	Efforts of standardization of dynamic maps both in and outside Japan
2nd Meeting	February 22, 2018	Standardization of on-board storage format
3rd Meeting	March 22, 2018	Standardization of center to center data exchange format
4th Meeting	June 20, 2018	Approach to standardization at Japan Automobile Manufacturers Association
5th Meeting	October 4, 2018	Point for discussion at the SIP-adus workshop
6th Meeting	December 20, 2018	Summary of discussion at the SIP-adus workshop and future course of action
7th Meeting	February 26, 2019	Direction of approach towards the 2nd phase of SIP-adus

Research Item ③ : Clarification of Differences Domestically and Internationally [between Japan, Europe, and ISO]

Concept of Dynamic Maps

The dynamic map is a platform that aims for its use through defining rules for linking HD 3D map information and dynamic data (dynamic/semi-dynamic/semi-static information) held by various bodies for which time-dependent location identification is possible.

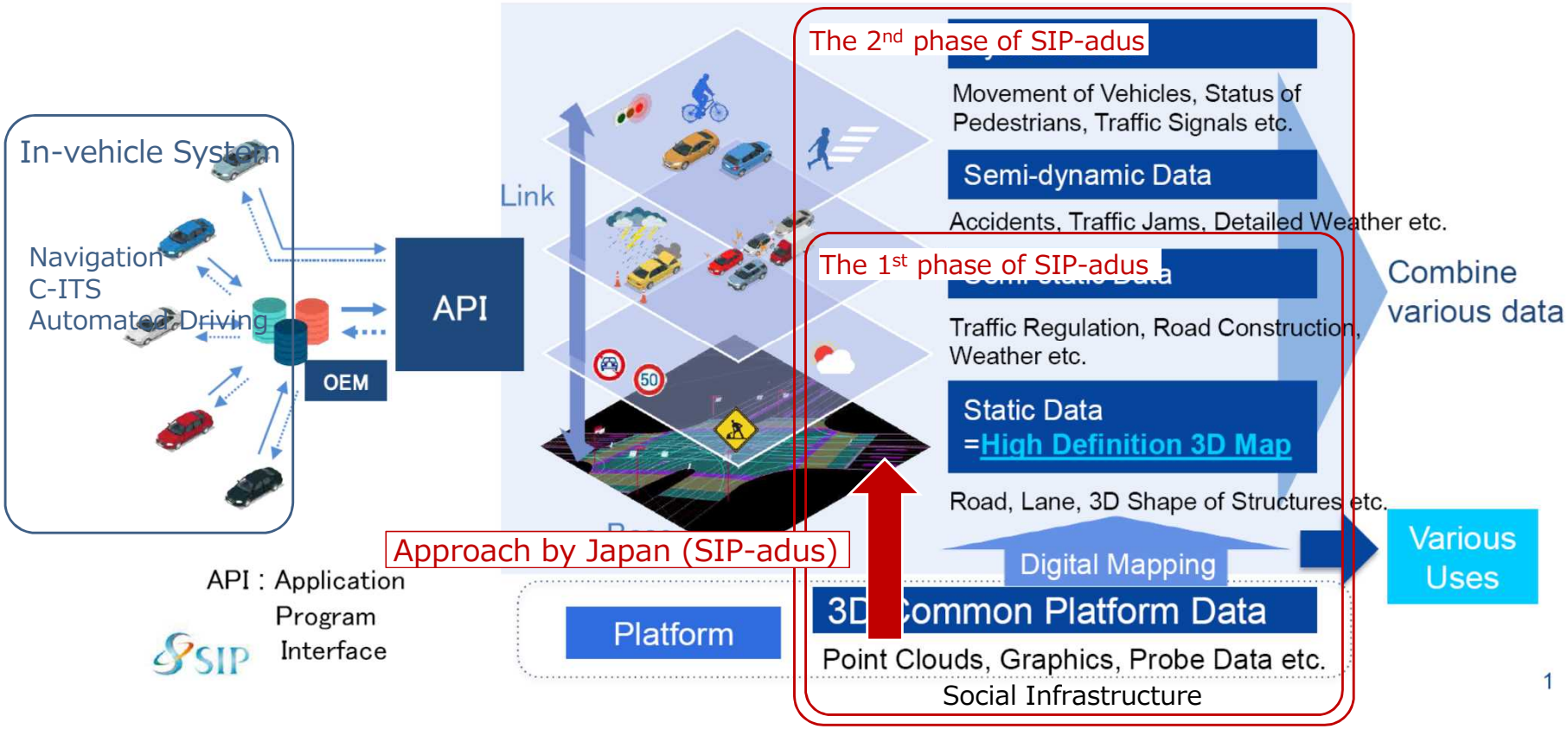


Source : Created based on Satoru Nakajo, SIP-adus Work Shop 2018 Lecture Material. Retrieved February 15, 2019. http://www.sip-adus.go.jp/evt/workshop2018/file/DM_Satoru_Nakajo_1030.pdf

Research Item ③ : Clarification of Differences Domestically and Internationally [between Japan, Europe, and ISO]

Approach by SIP-adus

The objective of SIP-adus is to determine the effectiveness of "High-Definition 3-Dimensional Map Information" as static data through its creation, maintenance, and large-scale field operation tests. The approach toward dynamic map maintenance is from social infrastructure, which provides the information.



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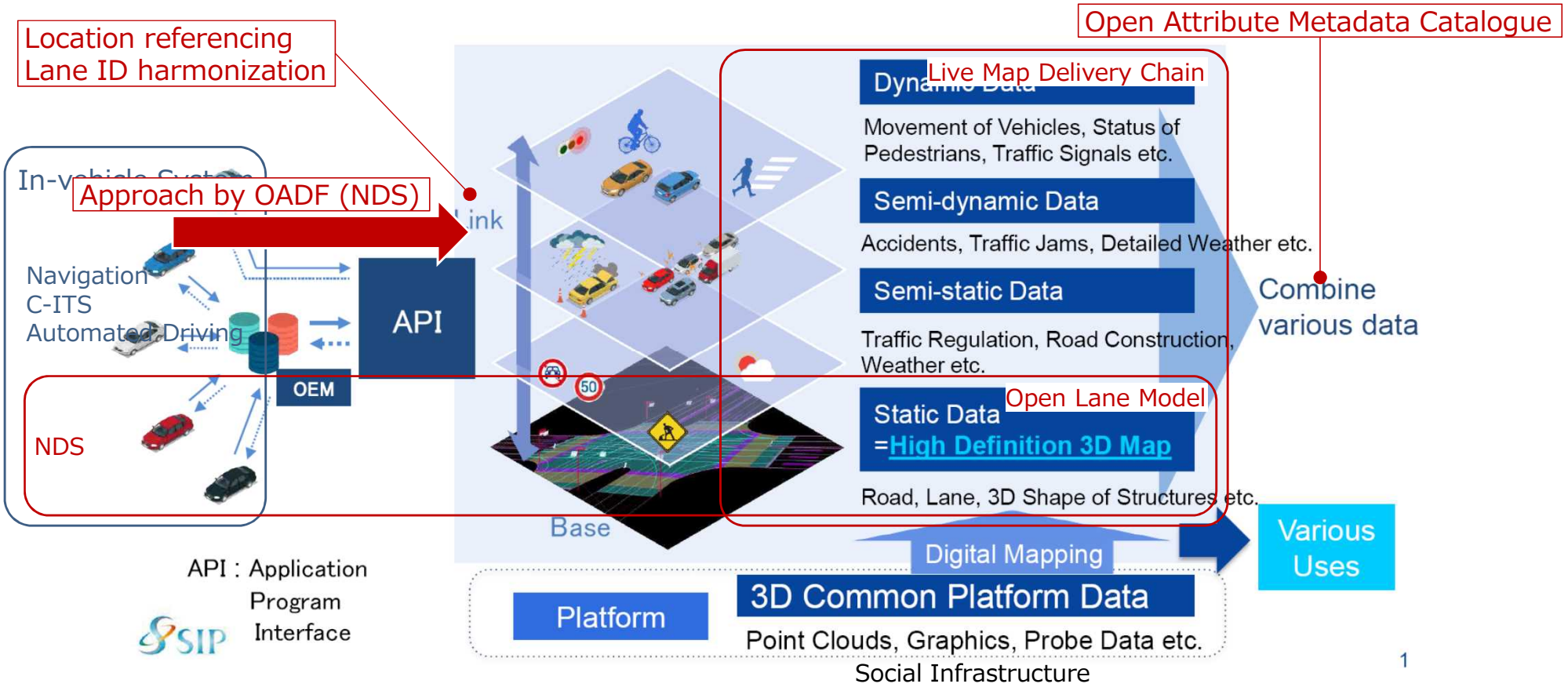
Research Item ③ : Clarification of Differences Domestically and Internationally [between Japan, Europe, and ISO]

Approach by OADF

The objective of OADF is to enable driving support and automated driving through upgrading in-vehicle systems currently used in car navigation and ITS. The approach toward dynamic map maintenance is from the in-vehicle system.



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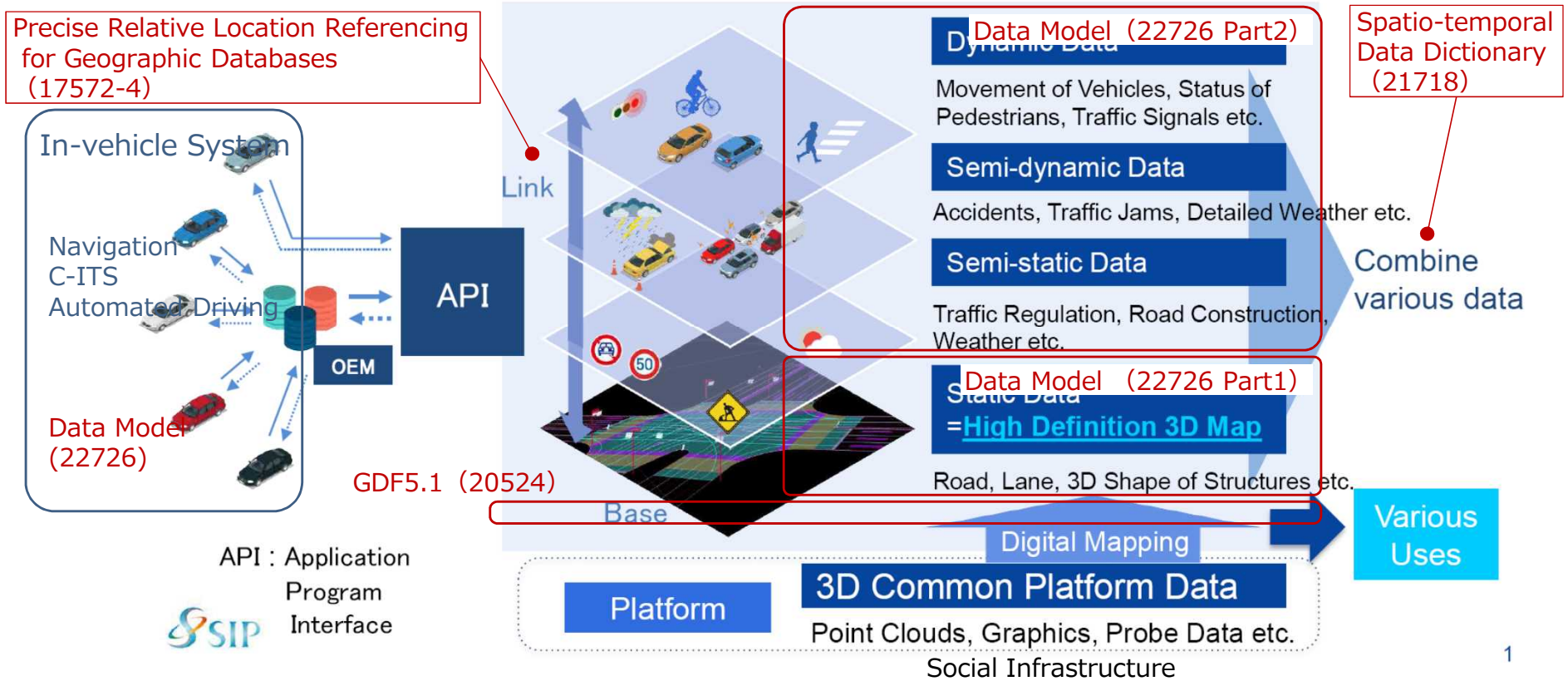
Research Item ③ : Clarification of Differences Domestically and Internationally [between Japan, Europe, and ISO]

Approach by ISO/TC204/WG3

Because the existing standards of ISO targeted car navigation and cooperative ITS, it is not able to handle new demands such as automated driving and driving support. That being the case, its current objective is to establish an environment necessary for the realization of automated driving by “expanding existing standards” or developing new standards.”



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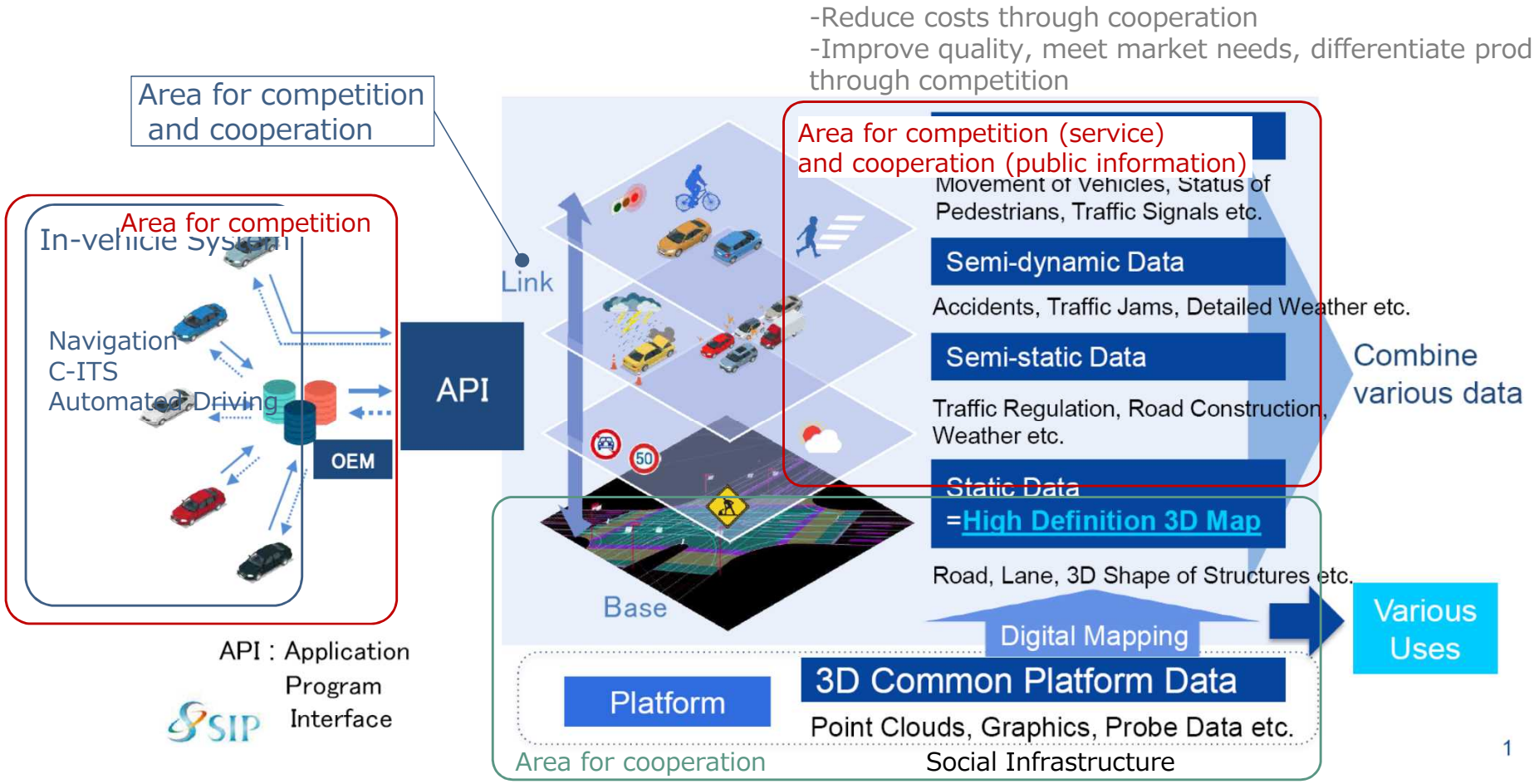
Research Item ③ : Clarification of Differences Domestically and Internationally [competition and cooperation]

Currently Dominant Views by Japanese Companies

In Japan today, automated driving and driving support is in the technology development stage, which is seen as an area for competition, while use of public information and work on social infrastructure are thought of as areas for cooperation through their ability to plan for cost reductions and improvements in quality of service.



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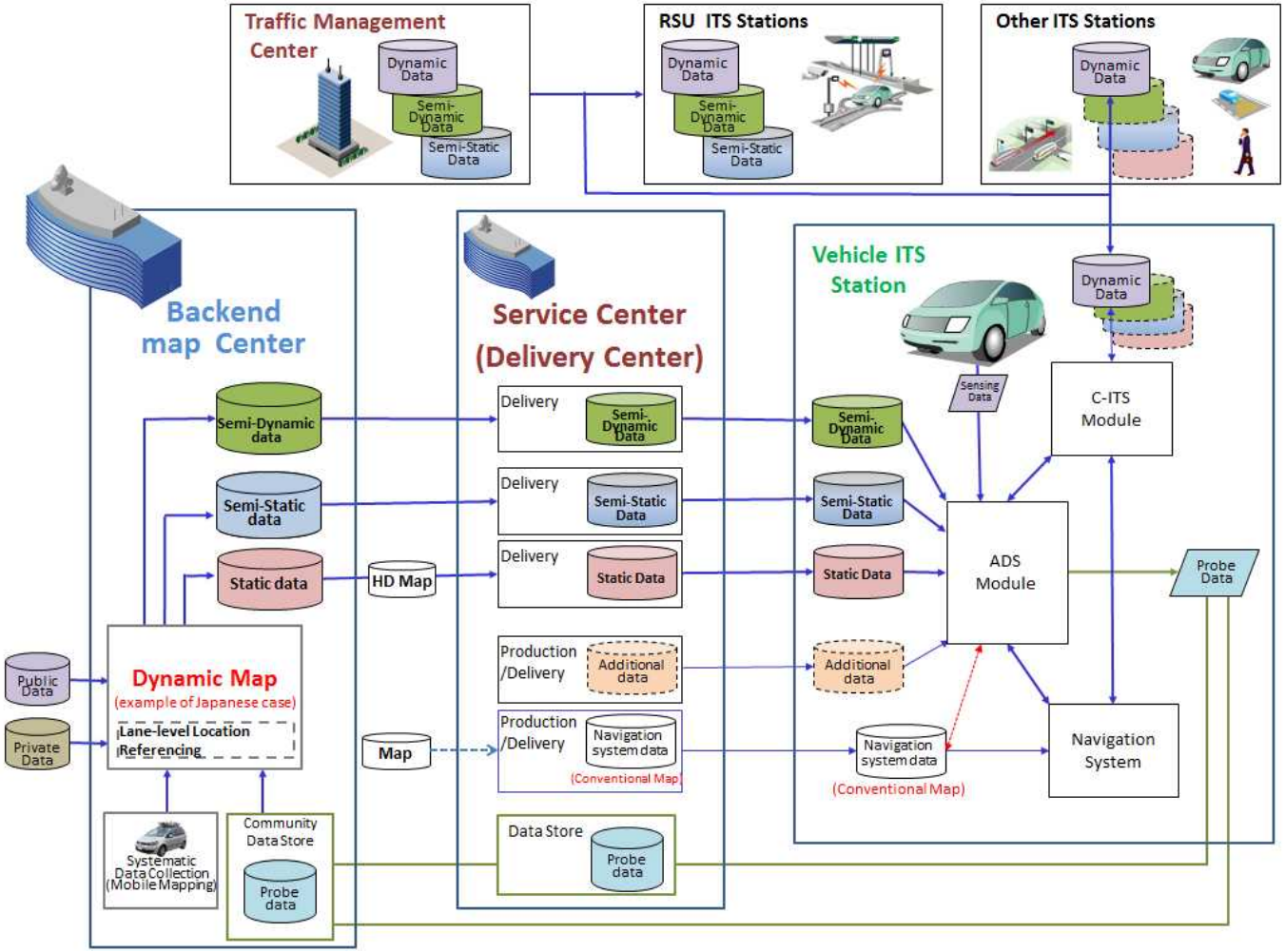
Research Item ③ : Clarification of Differences Domestically and Internationally [comparison of data distribution systems]

Comparison of Architecture and Ecosystems: Results of SIP-adus

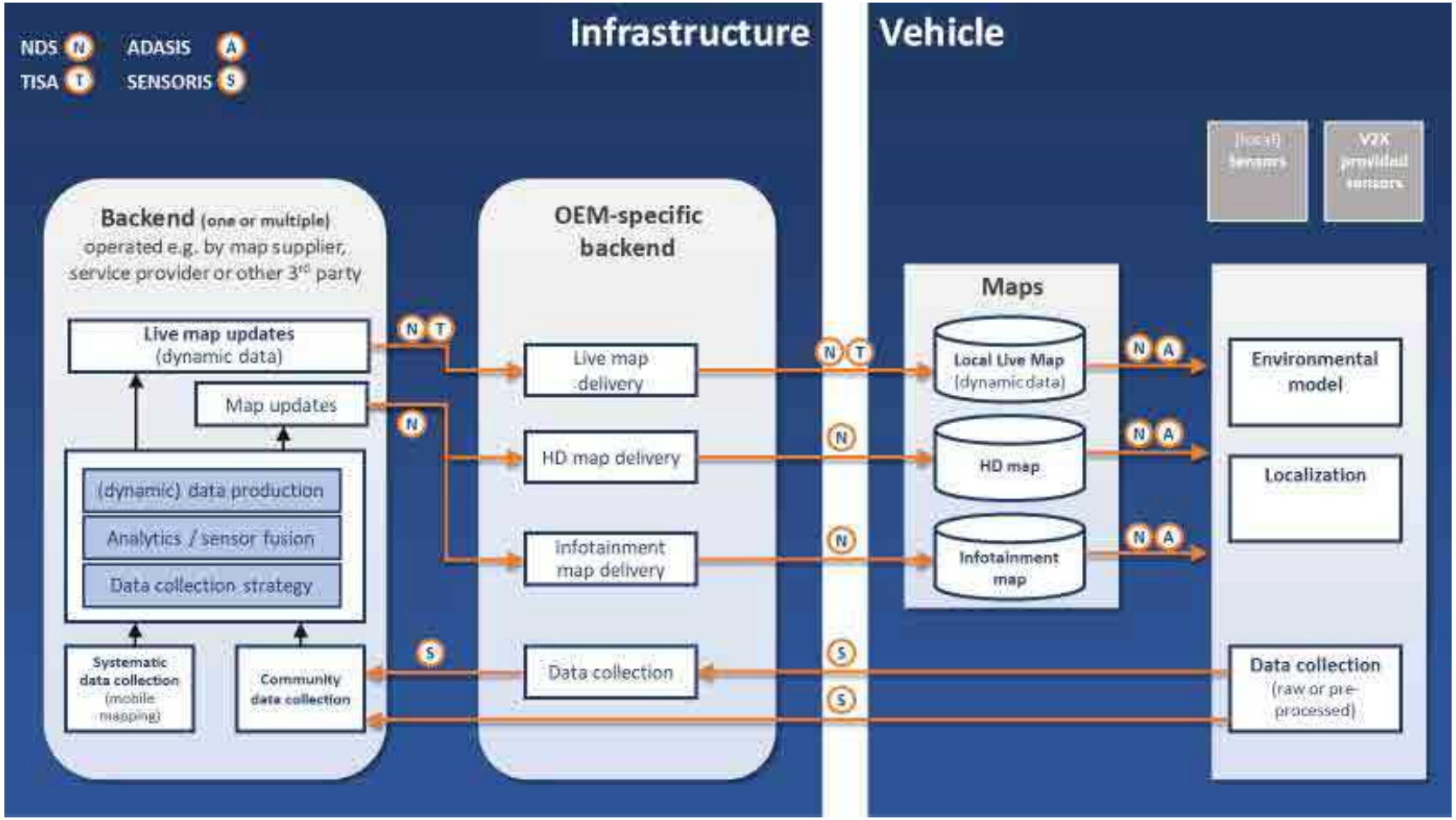
Based on SIP-adus activities, in the standardization of dynamic maps for ISO/TC204/WG3, the architecture of updating, circulating (and feedback) for static and dynamic information is explaned using following chart.



Research Item ③ : Clarification of Differences Domestically and Internationally [comparison of data distribution systems]

Comparison of Architecture and Ecosystems: Results of OADF

OADF has organized data distribution in an ecosystem and clearly defines the division of specialty for each of the 4 comprising members (NDS, ADASIS, TISA, SENSORIS) as well as the cooperative efforts for realizing automated driving and driving support.

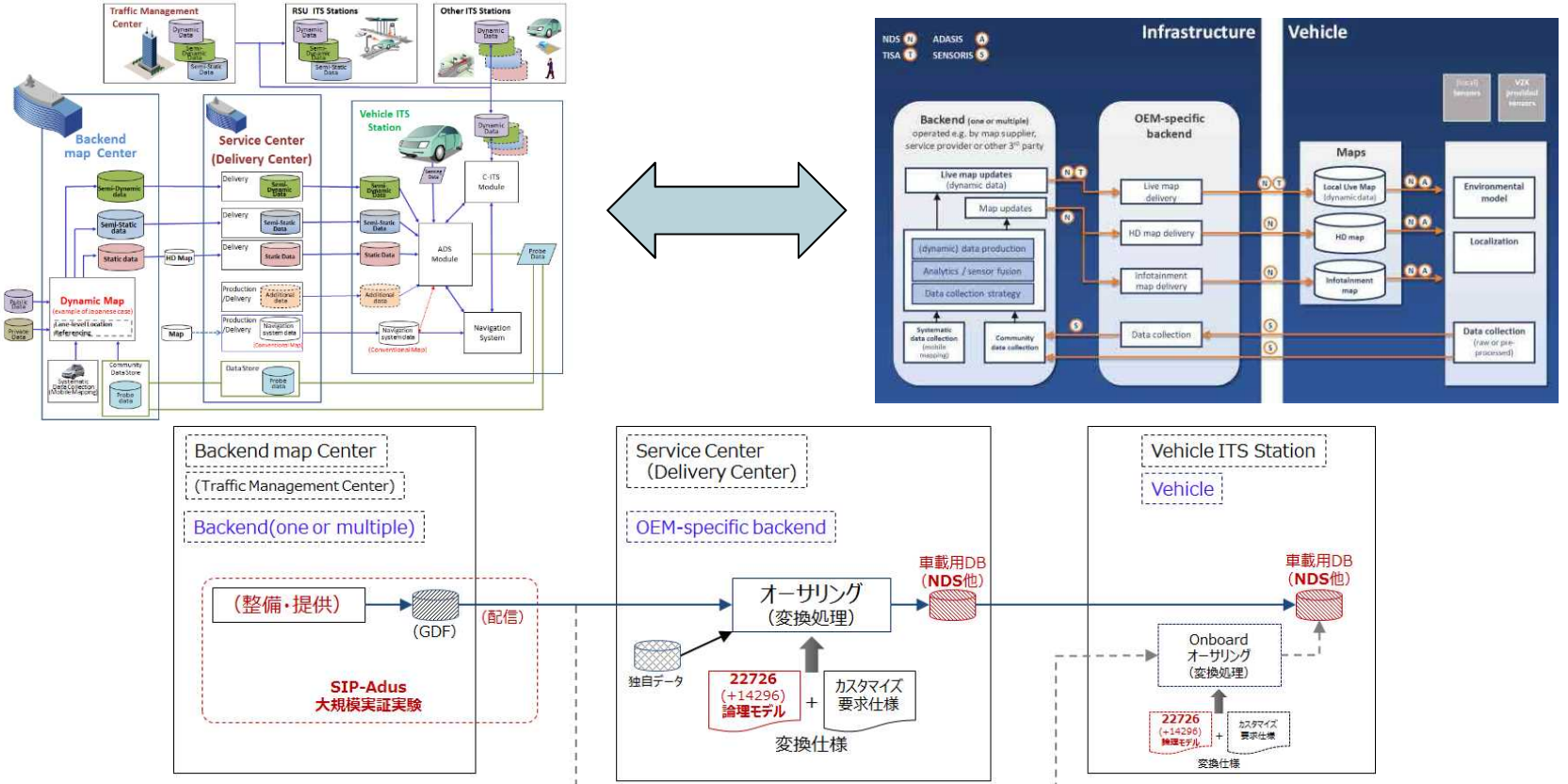


Source : Prokop Jehlicka, SIP-adus Work Shop 2018 Lecture Material. Retrieved February 15, 2019. http://www.sip-adus.go.jp/evt/workshop2018/file/new01_2018.11.13_OADF_Work_in_progress_at_SIP-adus_final.pdf

Research Item ③ : Clarification of Differences Domestically and Internationally [comparison of data distribution systems]

Comparison of Architecture and Ecosystems: Relationship of SIP-adus to ISO, OADF (NDS)

SIP-adus activities is providing geographic feature information from the Backend Map Center to the Service Center and Vehicle. Standardization activities (22726-1) is included as a part of conversion specifications at time of authoring. The physical format for the OEM-Specific Backend and in-vehicle DB produced as part of the conversion specifications is NDS (OLM : Open Lane Model).

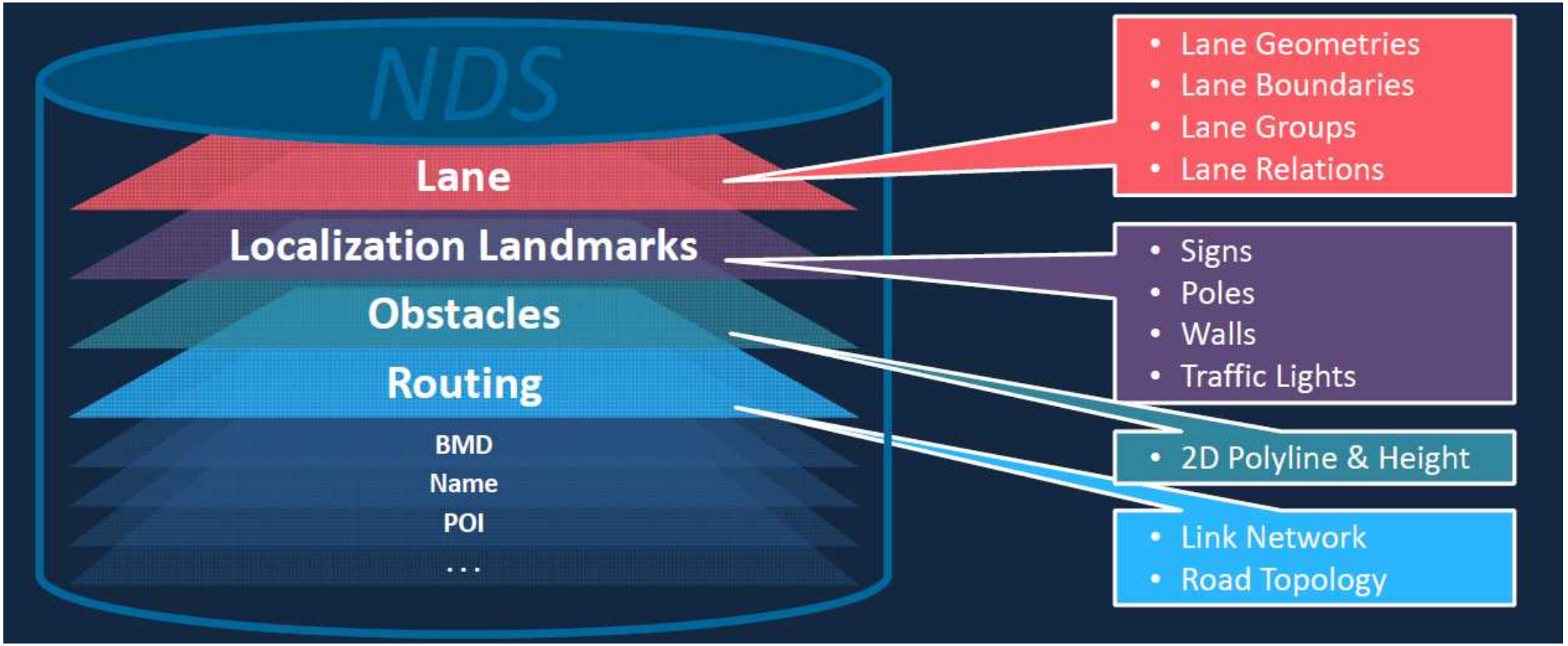


Source : Prokop Jehlicka, SIP-adus Work Shop 2018 Lecture Material. Retrieved February 15, 2019.
http://www.sip-adus.go.jp/evt/workshop2018/file/new01_2018.11.13_OADF_Work_in_progress_at_SIP-adus_final.pdf

Research Item ③ : Clarification of Differences Domestically and Internationally [classification of HD 3D map information features]

HD Map Layers in NDS: NDS High-Definition Maps

The NDS HD Map is managed by road topology and road geometry used in car navigation and ITS. It mainly comprises 1) HD Lane Models that are used to control vehicle positions, 2) Localization Landmarks used to control vehicle positions, and 3) Obstacles, or physical structures near roads, which are represented by information and elements that handle points on links or link sections.



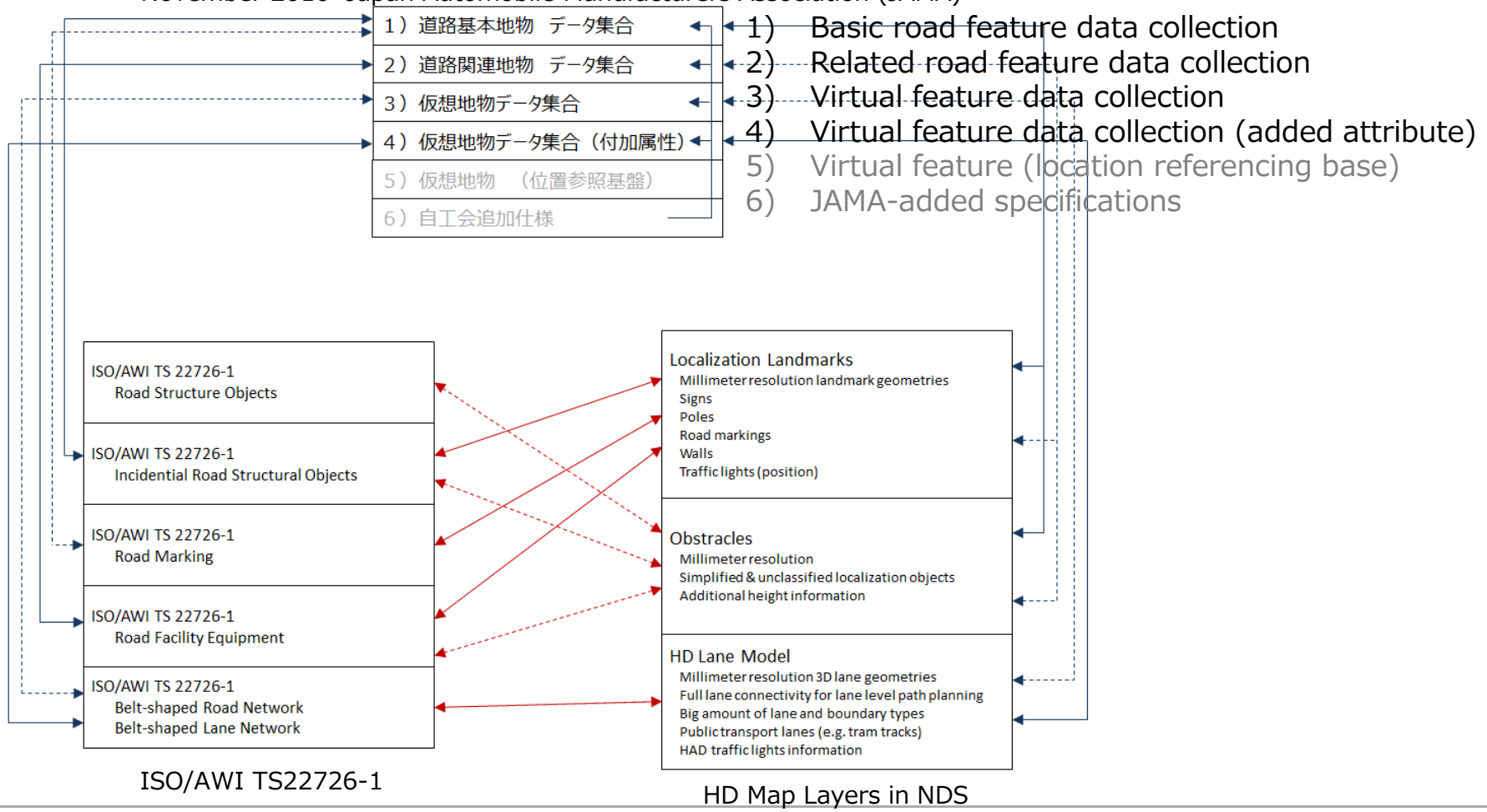
Source : Mr. Philip Hubertus, Autonomous Vehicle Symposium Lecture Material. Retrieved February 19, 2019. https://www.nds-association.org/wp-content/uploads/20180605_NDS_AutonomousVehicleSymposium.pdf

Research Item ③ : Clarification of Differences Domestically and Internationally [classification of HD 3D map information features]

Classification of Features on HD 3D Map Information

Classification of geographic feature information that comprises HD 3D map information are compatible with Japan (maintenance), OADF/NDS (use and reference), and ISO (maintenance and reference), despite their differences in usage.

Japan: Recommended Specifications for HD Map for Automated Driving
November 2016 Japan Automobile Manufacturers Association (JAMA)



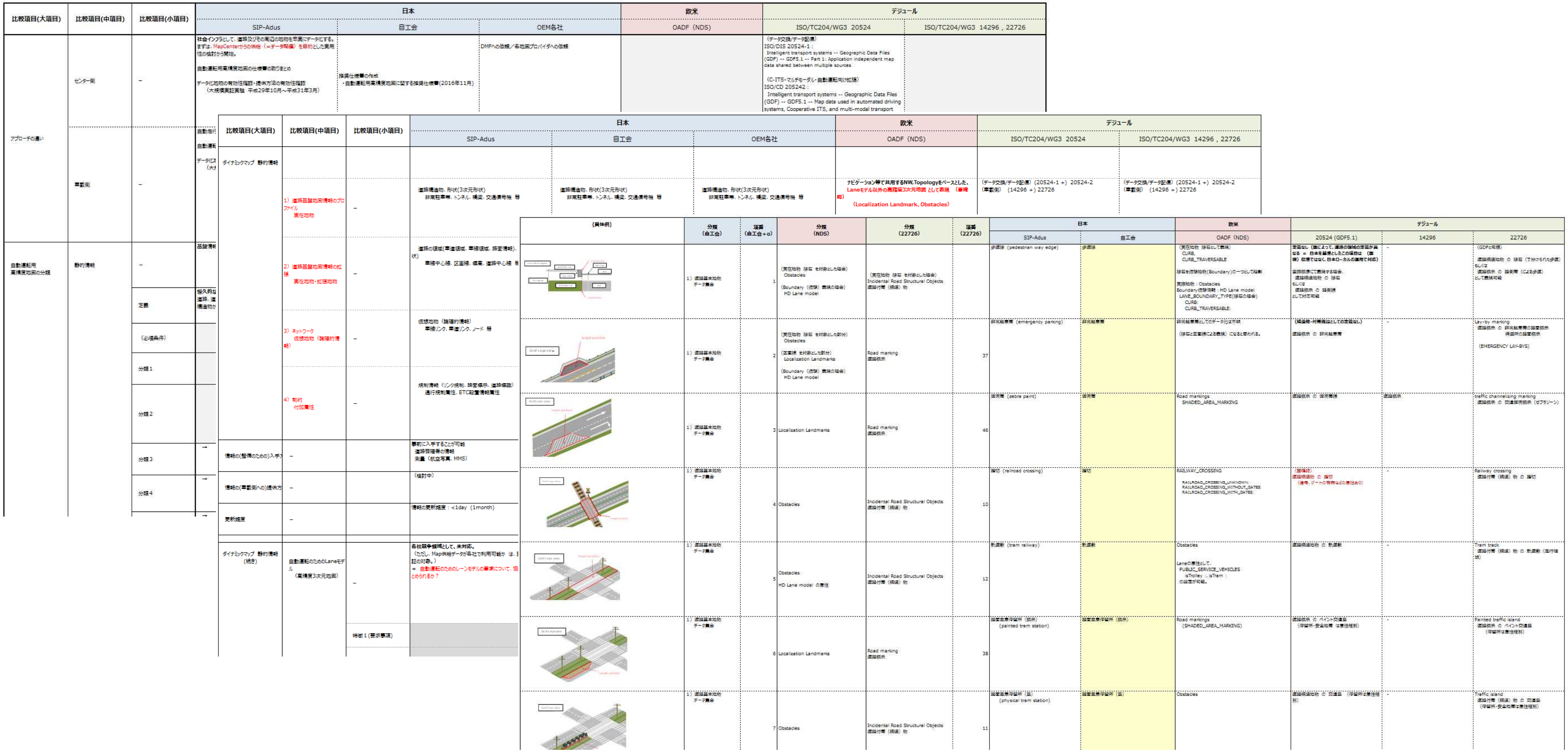
ISO/AWI TS22726-1

HD Map Layers in NDS

Research Item ④ : Distribution of Guidelines and Promotion of Cooperative Activity [Cooperative Activity Promotion]

Summary of Comparison Between Standardization Bodies

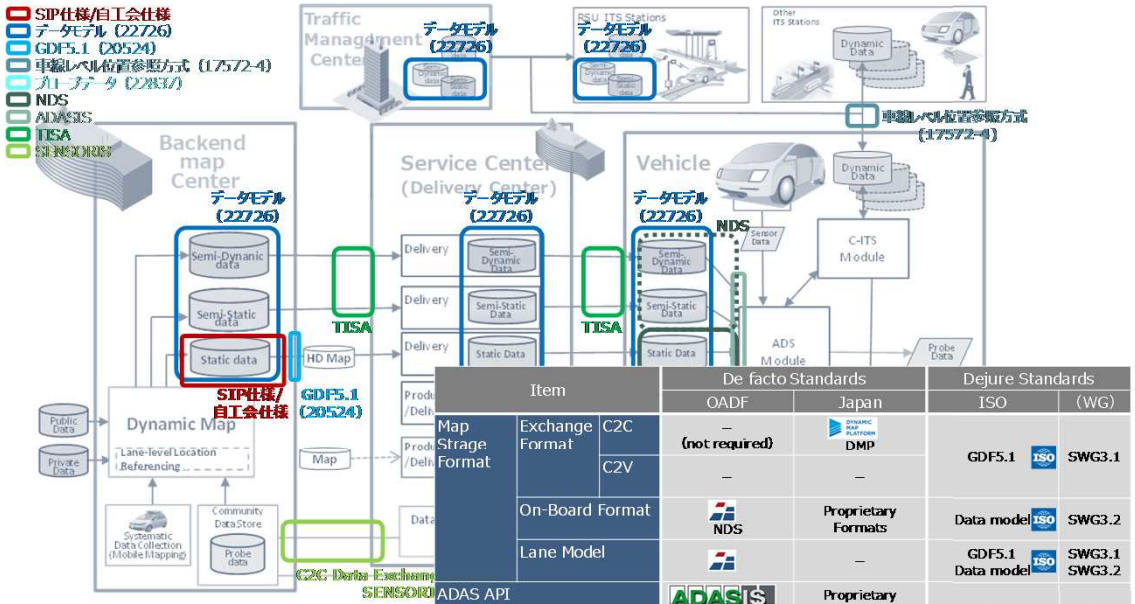
This comparison chart was created by organizing the work done by each standardization entity, including SIP-adus, Europe, and ISO.



Research Item ④ : Distribution of Guidelines and Promotion of Cooperative Activity [Cooperative Activity Promotion]

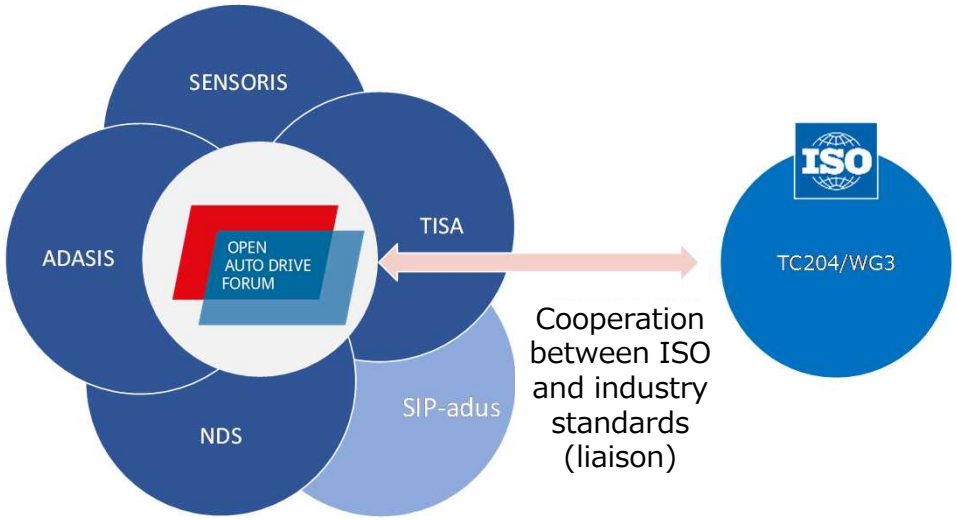
Further Points of Issue and Debate in Moving Toward Cooperation

An organized summary of further points of issue and debate was created as Japan moves toward deepening cooperative ties with organizations such as the European standardization body. As a result, SIP-adus and OADF were able to establish a cooperative partnership.



Points of Issue Document (scope of work for each body)

Item			De facto Standards OADF	De facto Standards Japan	Dejure Standards ISO	Dejure Standards (WG)
Map Strage Format	Exchange Format	C2C	– (not required)	DMP	GDF5.1	SWG3.1
		C2V	–	–		
	On-Board Format		NDS	Proprietary Formats	Data model	SWG3.2
	Lane Model			–	GDF5.1 Data model	SWG3.1 SWG3.2
ADAS API			ADASIS	Proprietary Formats	–	–
Dynamic information service (Existing Standards)			NDS (partly)	VICS ETC2.0 ITS-Connect Large-Scale FOT	TPEG etc	WG10
Location Referencing			TISA-TPEG		Location referencing	SWG3.3
Sensor Data Interface	V2C		SENSORIS	Proprietary Formats	Probe Data	WG16
	C2C			JasPar		
Map Data Quality			Highly Reliable Maps	Proprietary Formats	Quality principles	TC211
Other			Metadata Catalogue	Proprietary Formats	–	–



Points of Issue Document (de jure and de facto cooperation)