“Strategic Innovation Promotion Program (SIP) Third Phase / Development of the smart mobility platform / Research and development of a general traffic signal information provision platform using V2N”

Progress Report Overview

UTMS Society of Japan
NIPPON SIGNAL CO., LTD.
OMRON Social Solutions Co., Ltd.
Panasonic Connect Co., Ltd.

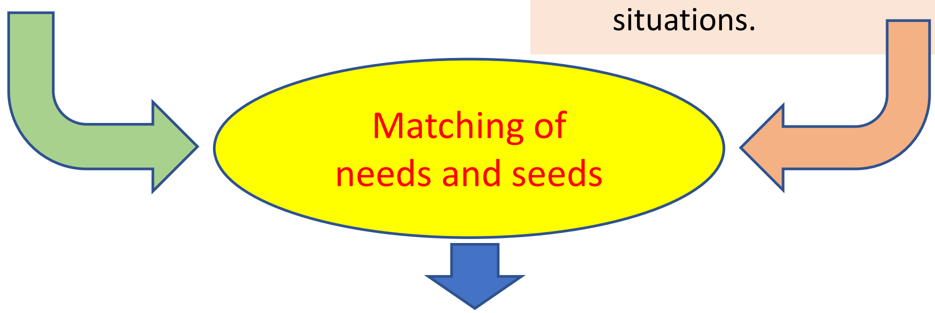
April 2025

1. Background and objective

[Background]

- Many of the fatalities in traffic accidents in Japan are among the so-called vulnerable road users (pedestrians and bicyclists), and further strengthening of safety measures at intersections is an issue.
- In Japan, the diversification of mobility is expected, including the spread of delivery robots and micromobility.

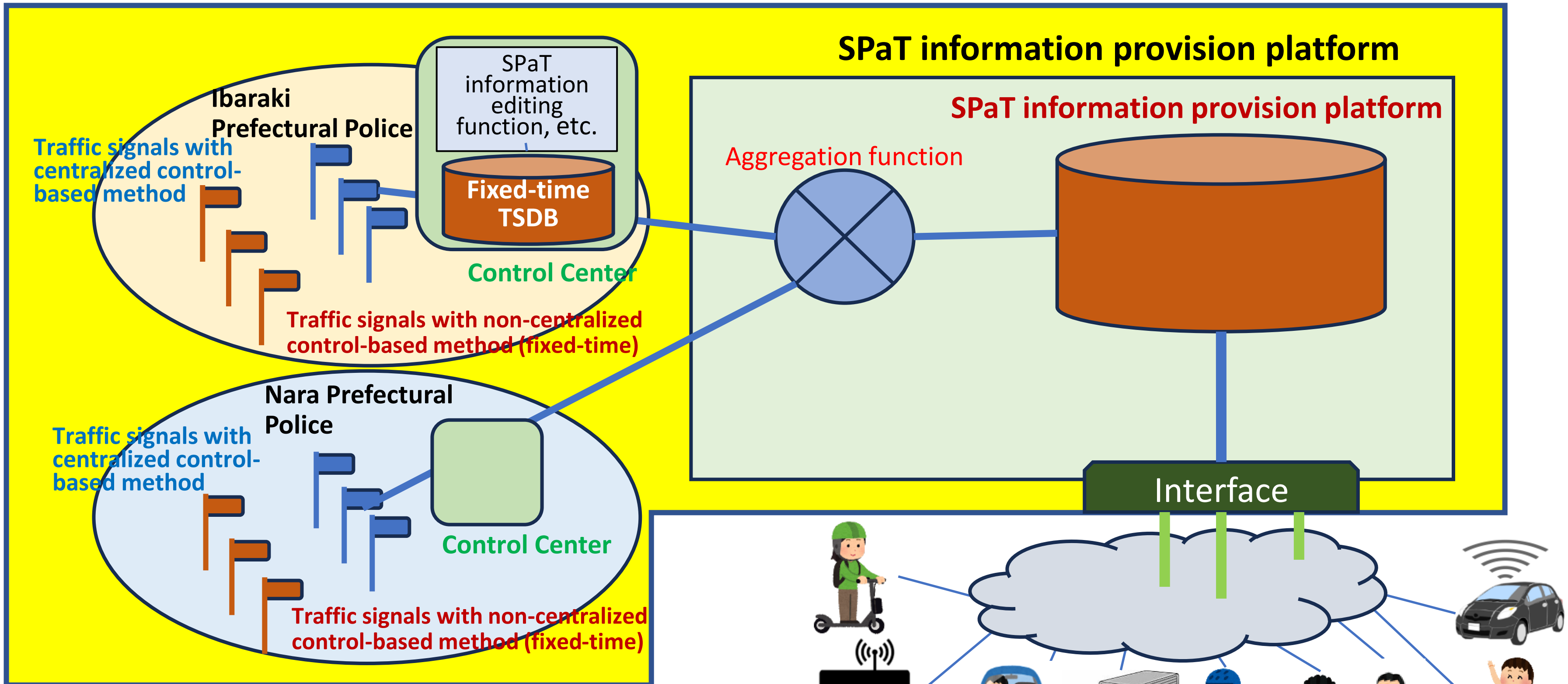
- In the second phase of the SIP Program, research and development were conducted on V2N-based traffic signal information [hereafter SPaT (signal phase and timing) information] provision technology for automated vehicles, and certain results were achieved, although some issues remain to be solved.
- By utilizing this technology, it is possible to improve safety and smoothness of various types of mobilities in addition to automated vehicles, such as driver-operated vehicles, pedestrians, bicycles, delivery robots, and micromobility, according to their respective situations.



[Objective]

As part of the "realization of a society without a mobility divide where everyone, goods and services can move freely, independently, safely, comfortably, and in a way that is friendly to the environment, other people, and the community," which is one of the objectives of the Third Phase of the SIP Program, we will establish V2N-based SPaT information provision technology in a form that can be applied to diverse mobilities, and implement this technology in society by building a platform for providing SPaT information.

1. Background and objective



- **Major technical issues aimed to be resolved by FY2025**
  - ✓ **Seamless SPaT information provision in zones with traffic lights with centralized and non-centralized control-based methods**
    - ✓ **Building of a fixed-time TSDB and development of measures to ensure its accuracy**
  - ✓ **Building of a SPaT information provision platform**
    - ✓ **Establish operations across multiple prefectures**
    - ✓ **Building of interfaces**
  - ✓ **Response to needs related to diverse mobility options**

- **SPaT information provision platform**

An integration of traffic lights, the control center, aggregation function, and SPaT information delivery platform

- **SPaT information distribution platform**

A system that serves as a common infrastructure for SPaT information delivery, equipped with a fixed-time TSDB, SPaT information processing functions for traffic lights with the centralized control-based method, and interfaces for providing such information.

- **Fixed-time TSDB (Traffic Signal information Database)**

Database that aggregates and accumulates SPaT information of fixed-time traffic signals stored at prefectural police control centers.

2. Overall overview of the research and development (Overview of research items)

Item No.	Research item	Overview
1	Research and development on seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems	Technology to lower cost for SPaT information provision for fixed-time traffic signals *1 will be developed.
		SPaT information provision technology for special signal control functions*2 that were excluded from the scope of the project in the SIP Second Phase will be developed.
2	Establishment of a SPaT information provision platform for various types of mobilities	A SPaT information distribution platform that provides SPaT information in real time to serve various types of vehicles will be built. An environment will be provided that enables the utilization of SPaT information for a wide range of users, including vehicle manufacturers, various types of mobilities, SPaT information provision companies, etc., by allowing real-time acquisition of information such as traffic signal operation status and signal cycles
3	Standardization of interfaces between the platform and mobilities	In order for various types of mobilities to obtain SPaT information from the SPaT information distribution platform, a draft standardization will be prepared.
4	Diversification of SPaT information provision destinations	• Support for people with visual impairments For people with visual impairments, a separate SPaT information provision technology called PICS*3 has been studied. However, based on the fact that people with visual impairments will be regarded as users of the SPaT information distribution platform to be newly constructed, and based on the usage status of PICS by people with visual impairments, the provision of SPaT information using devices other than smartphones will be examined. • Examination of SPaT information provision for delivery robots and micromobility For delivery robots, which have seen significant advancements in recent years, and micromobility,*4 the widespread use of which is anticipated, information provision methods will be examined taking into consideration their unique mobility characteristics.

For *1 to *4, refer to Sheet 4.

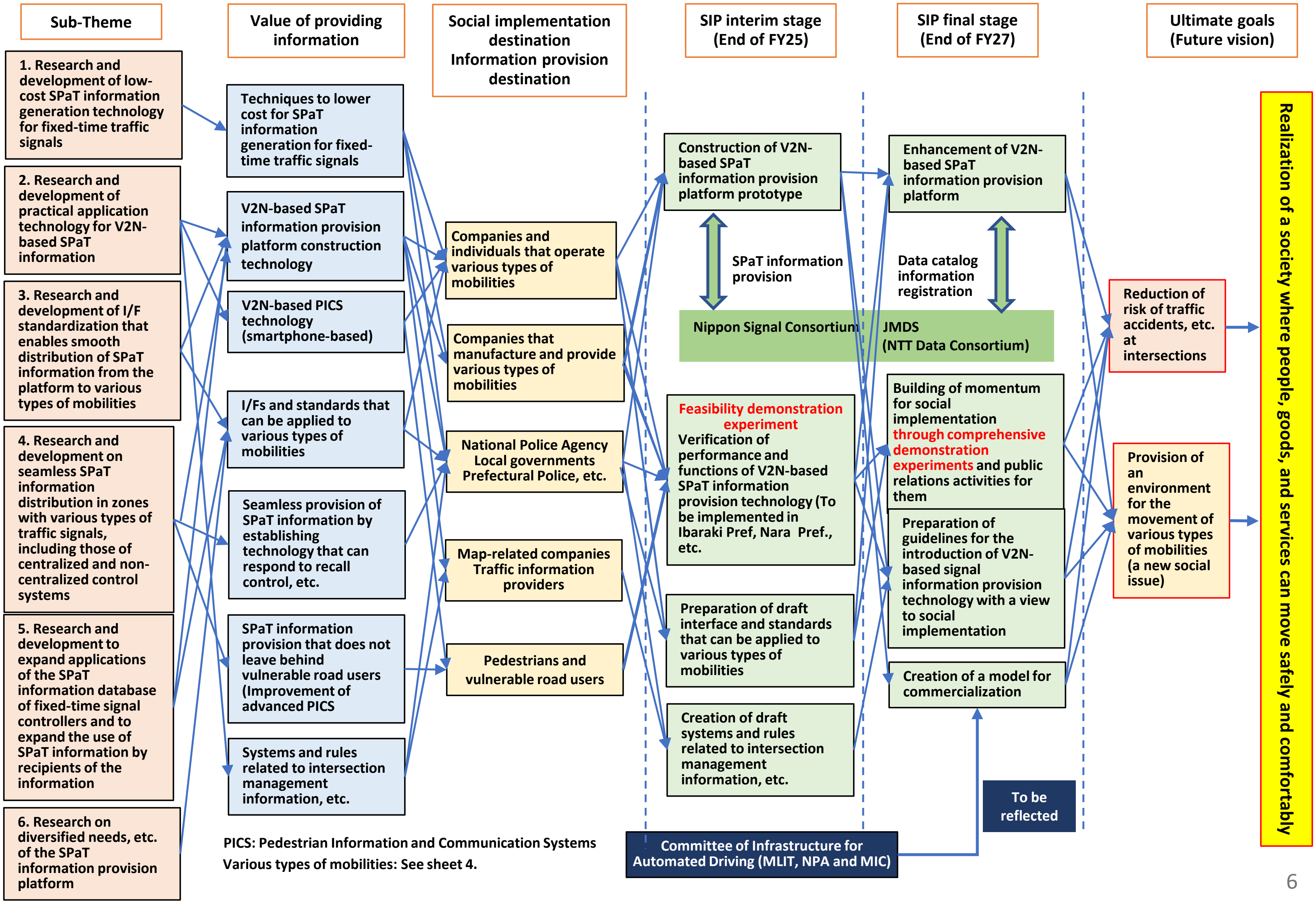
2. Overall overview of the research and development (Overview of research items)

Note No.	Item name	Overview
*1	Non-centralized control-based method	The “centralized control-based method” is a method in which the control center side controls multiple signal controllers over an area by connecting the control center system and signal controllers via communication lines. The “decentralized control-based method” is a method in which an isolated signal controller performs control according to control parameters pre-stored in the signal controller without being connected via communication lines.
*2	Special signal control functions	A function that enables special signal control such as push-button-actuated traffic signals. Technical measures are required to enable SPaT information provision.
*3	PICS	PICS (abbreviation for Pedestrian Information and Communication System). This is a system that supports the safe movement of elderly and disabled people by providing information on intersection names and pedestrian signal status by voice. In fiscal 2020, an advanced system was introduced as an advanced PICS that uses Bluetooth to transmit pedestrian signal information to smartphones, etc. and enable the extension of the green signal by operating smartphones, etc.
*4	Micromobility	A vehicle for one or two people, represented by an electric kickboard, that is more compact and maneuverable than a car and serves as a convenient means of transportation for communities.

2. Overall overview of the research and development (Correlation between research items and sub-themes)

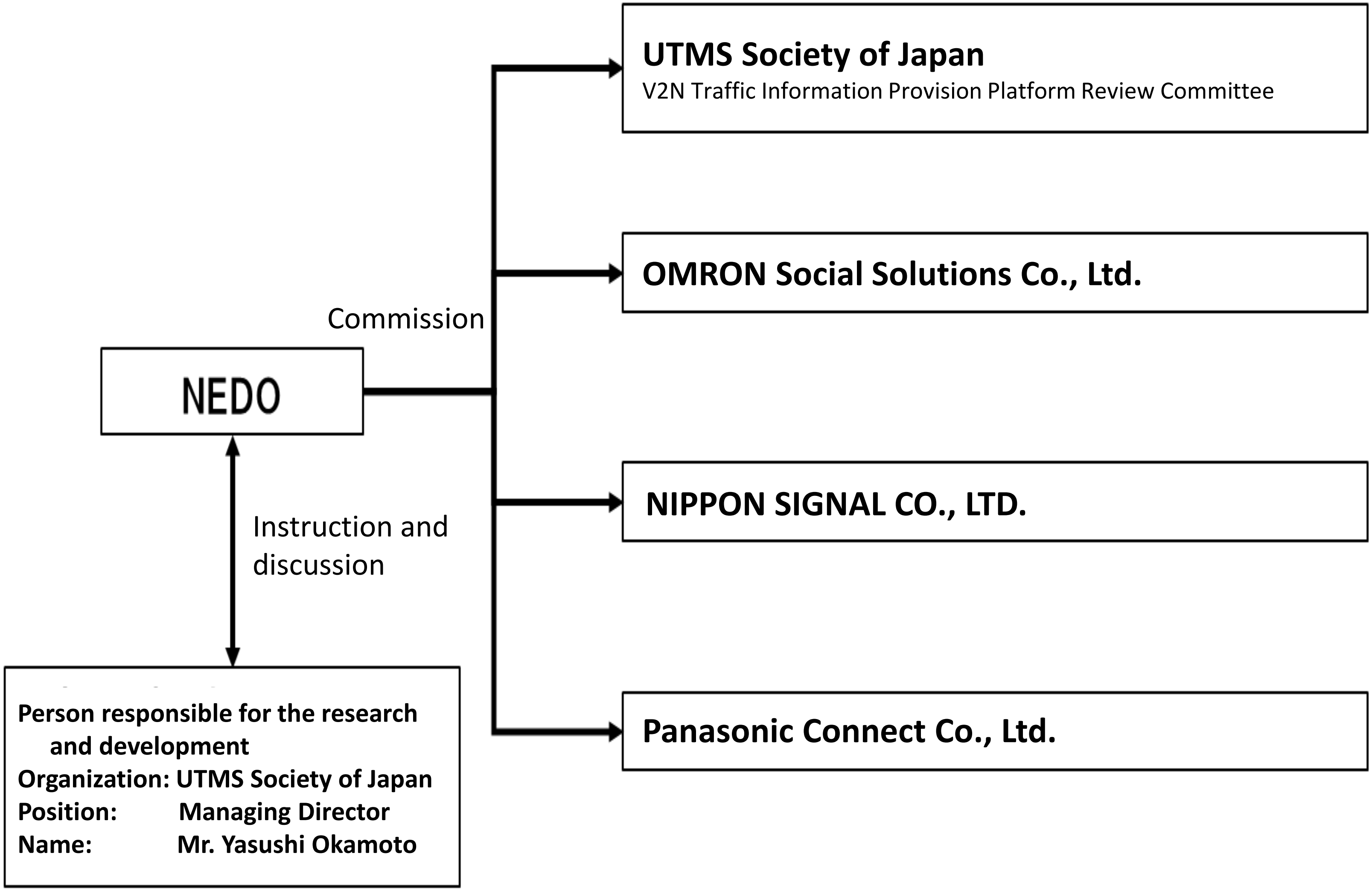
Item No.	Research item	OMRON Social Solutions Co., Ltd. (OSS)		NIPPON SIGNAL CO., LTD. (NS)		Panasonic Connect Co., Ltd. (PCO)	UTMS Society of Japan（UTMS）	Division of tasks for each research item
		Sub-theme 1	Sub-theme 2	Sub-theme 3	Sub-theme 4	Sub-theme 5	Sub-theme 6	
1	Research and development on seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems	○			○	○	○	Since this is a new technology and there are differences in approach, OSS and PCO will each develop technologies for the fixed-time TSDB, compare and examine them, and then integrate and standardize them. NS will be responsible for the "special signal control function" part of the research item 1.
2	Establishment of a SPaT information provision platform for various types of mobilities		○			○	○	OSS is responsible for the equipment to be installed at the prefectural police department side, while PCO is responsible for the equipment on the SPaT information delivery platform side.
3	Standardization of interfaces between the platform and mobilities			○		○	○	NS will examine interfaces for various types of mobilities, and PCO will be responsible for the part related to the SPaT information distribution platform.
4	Diversification of SPaT information provision destinations		○	○	○	○	○	OSS and NS will be responsible for diversification related to pedestrians, while PCO will be responsible for diversification related to delivery robots and micromobility. However, NS will be responsible for improving existing advanced PICS that uses BLE, with a focus on people with visual impairments, while OSS will be responsible for terminals that use LTE (referred to as "V2N-PICS").

2. Overall overview of the research and development



PICS: Pedestrian Information and Communication Systems
Various types of mobilities: See sheet 4.

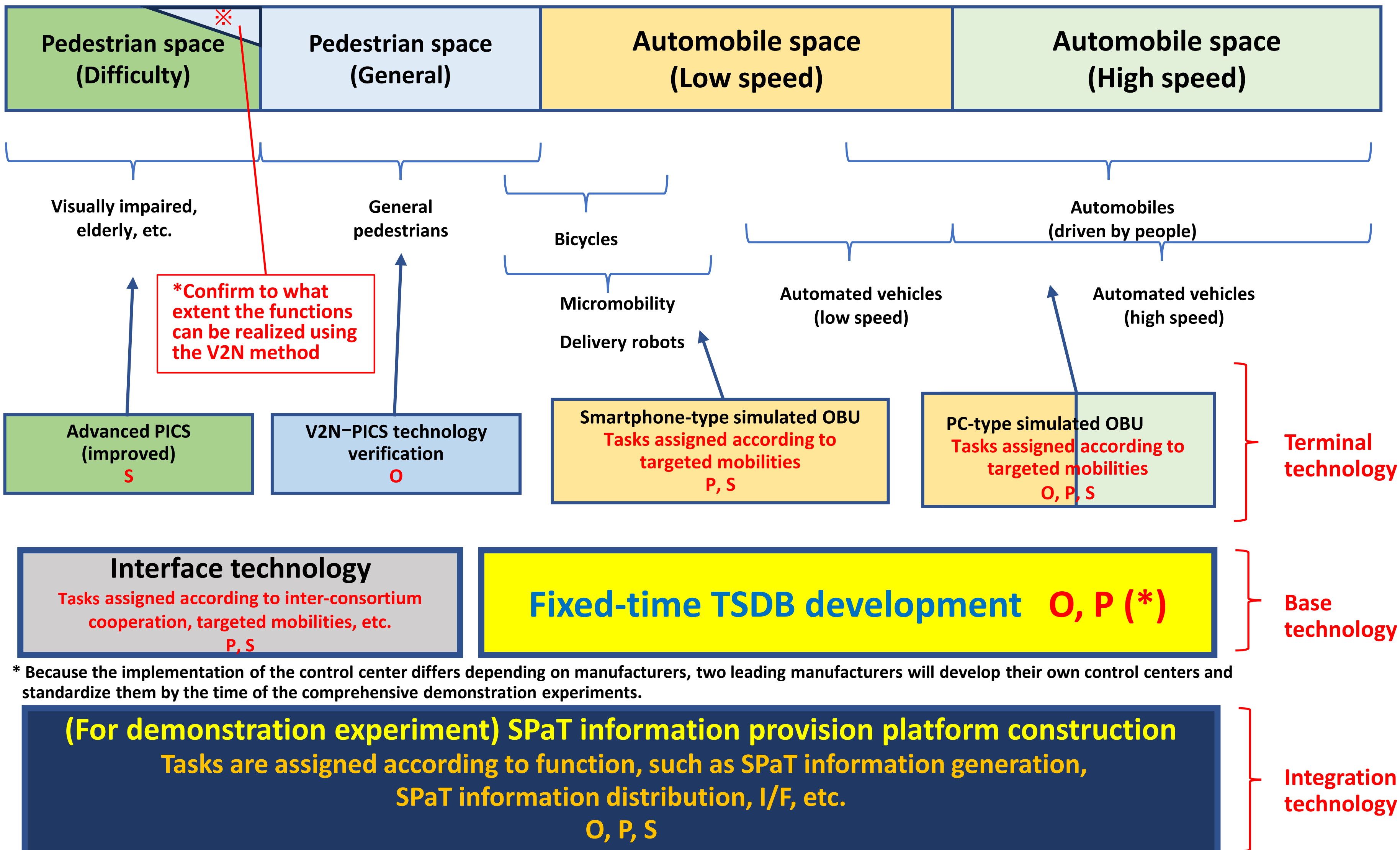
6. Scheme of the research and development system



2. Overall overview of the research and development

- **Targeted mobility diversity and technology development items**

Note) O: OMRON SOCIAL SOLUTIONS, S: NIPPON SIGNAL, P: Panasonic Connect



3. Goal setting

3.1 During the period of the feasibility researches (2023 – 2025)

1 Organization in charge: OMRON SOCIAL SOLUTIONS Co., Ltd.

Sub-theme	Goals
Sub-theme 1 Research and development of low-cost SPaT information generation technology for fixed-time traffic signals	• Preparation of specifications for the fixed-time TSDB (Traffic Signal Information Database) • Preparation of specifications (draft) for the signal light color change information collecting unit • Preparation of specifications (draft) for the SPaT information generation evaluation for fixed-time traffic signals • Implementation of feasibility demonstration experiments to lower the cost of fixed-time traffic signal's SPaT information provision and to confirm its performance • Preparation of a comprehensive interim report including the results of the demonstration experiment and the results of the examination of future issues, etc.
Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information	• Preparation of requirements document (draft) for the installation of the SPaT information delivery platform • Revised version of draft specifications (draft) for the SPaT information distributor • Revised version of common message standards for information between V2N and the control center • Implementation of feasibility demonstration experiments using the SPaT information delivery platform to expand use cases beyond automated driving • Performance verification results for each use case of the SPaT information distribution platform • Cost reduction verification results of the SPaT information distribution platform • Preparation of a comprehensive interim report including the results of the examination of future issues, etc.

3. Goal setting

3.1 During the period of the feasibility researches (2023 – 2025)
2 Organization in charge: NIPPON SIGNAL CO., LTD.

Sub-theme	Goals
Sub-theme 3 Research and development of I/F standardization that enables smooth distribution of SPaT information from the platform to various types of mobilities	• Preparation of common message standards (draft) for information between V2N and the control center • Preparation of specifications (draft) for BLE roadside units • Communication application standards (draft) between BLE roadside units and mobile phones • Implementation of feasibility demonstration experiments
Sub-theme 4 Research and development on the seamless SPaT information distribution in zones with various types of traffic signals, including those with the centralized control-based and non-centralized control-based methods	• Preparation of specifications (draft) for traffic signal controllers • Preparation of guidelines to allow various types of mobilities to utilize SPaT information • Implementation of feasibility demonstration experiments

3. Goal setting

3.1 During the period of the feasibility researches (2023 – 2025)

3 Organization in charge: Panasonic Connect Co., Ltd.

Sub-theme	Goals
Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information	• Preparation of specifications (draft) for upcoming SPaT information provision method and SPaT information database for non-centralized fixed-time traffic signal controllers • Preparation of specifications (draft) for SPaT information distributors (for fixed-time traffic signal controllers) • Preparation of specifications (draft) for the SPaT information distribution platform (including communication interface standards) • Preparation of interface specifications (draft) for upcoming SPaT information provision for various types of mobilities • Preparation of guidelines to allow various types of mobilities to utilize SPaT information • Implementation of feasibility demonstration experiments (Verification of the performance and accuracy of the SPaT information provision platform, and confirmation of its functions)

4 Organization in charge: UTMS Society of Japan

Sub-theme	Goals
Sub-theme 6 Research on diversified needs of the SPaT information provision platform, etc.	• Finalization of the documents with the (draft) notation in sub-themes 1 to 5 through committee deliberations, etc. • Preparation of survey reports on news about various types of mobilities

3. Goal setting

3.2 During the period of the full-scale researches (2026 – 2027)
(No change in organizations in charge)

Sub-theme	Goals
Sub-themes 1–5	• Preparation of guidelines for the construction of a SPaT information database • Implementation of comprehensive demonstration experiments (at about 2 locations) • SPaT informaStion provision to commissioned parties who have met the conditions for cooperation • Preparation of revisions (draft) to various documents based on the results of the comprehensive demonstration experiments
Sub-theme 6	• Coordination of participants in the comprehensive demonstration experiments • Finalization of draft specifications, draft standards, etc. revised under sub-themes 1–5 (Approval by the Committee) • Preparation of an integrated report

4. XRL

Item		Target	Current status (*)
TRL	Seamless SPaT information provision in zones containing a variety of traffic signals, including centralized and non-centralized traffic signals	7 or higher	6
	Establishment of a traffic SPaT information provision platform for various types of mobilities	7 or higher	6
	Standardization of interfaces between the platform and mobilities	7 or higher	5
	Diversification of traffic SPaT information provision destinations	7 or higher	5
BRL		7 or higher	4
GRL		6 or higher	5
SRL		6 or higher	3

*Self-assessment at the end of February 2025

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5. KPI

Stage	KPI
At the interim point of the SIP Third Phase	• Completion of mobility support technology development and technology evaluation • Concretization of mobility support technology specifications • Confirmation of reduction in accident risks based on statistics of accidents caused by missed signals, etc. in the demonstration area
At the end of the SIP Third Phase	• Formulation of plans for commercialization of mobility support technologies • Release of reference roadmaps for implementation of mobility support technologies in several cities • Confirmation of reduction in accident risks based on statistics of accidents caused by missed signals, etc. in several cities
After completion of the SIP Third Phase (for reference)	• Commercialization of mobility support technologies • Implementation of mobility support technologies in several cities • Reduction in the number of traffic accidents

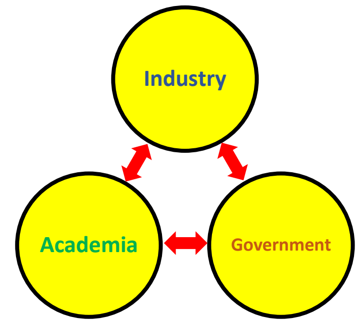
KPI for data linkage

- Standardization of interfaces for data linkage of traffic SPaT information provision platforms
- Promotion of the use of traffic SPaT information provision platforms by other contractors and mobility service providers

6.1 Development of an industry-government-academia system

V2N Traffic Information Provision Platform Review Committee

Classification	Position	Company/organization name
Administrative organizations	Committee member	National Police Agency
Traffic infrastructure manufacturers		OMRON SOCIAL SOLUTIONS CO., LTD. Kyosan Electric Manufacturing Co., Ltd. KOITO ELECTRIC INDUSTRIES, LTD. Sumitomo Electric Industries, Ltd. NIPPON SIGNAL CO.,LTD. Panasonic Connect Co., Ltd
Automobile manufacturers, etc.		SUBARU CORPORATION Toyota Motor Corporation Nissan Motor Co., Ltd. Honda Motor Co., Ltd. DENSO CORPORATION
Operators of mobility providers		BOLDLY Inc. Advanced Smart Mobility Co., Ltd. KYOSERA Communication Systems Co., Ltd. Rakuten Group, Inc. ROBOT DELIVERY ASSOCIATION Micromobility Promotion Council
Map-related companies, etc.		Google Japan G.K. Tomtom Sales B.V. ZENRIN CO., LTD. LY Corporation NAVITIME JAPAN Co., Ltd.
Telecommunications carriers, etc.		NTT DOCOMO, INC. SoftBank Corp. KDDI CORPORATION KYOCERA Corporation NEC Corporation
Related organizations		Japan Automobile Manufacturers Association, Inc. Japan Road Traffic Information Center VEHICLE INFORMATION AND COMMUNICATION SYSYTEM CENTER
Cooperation of commissioned parties		Consortium for Research and Development of Traffic Accident Prevention Support
Administrative organizations	Observer	Cabinet Office
Researchers at universities, etc.		Institute of Industrial Science, the University of Tokyo, Nagoya University



To be reflected

- WG on Infrastructure for Automated Driving
- WG on the Protection of Pedestrians, including the Elderly, etc.
(Observed by NPA)

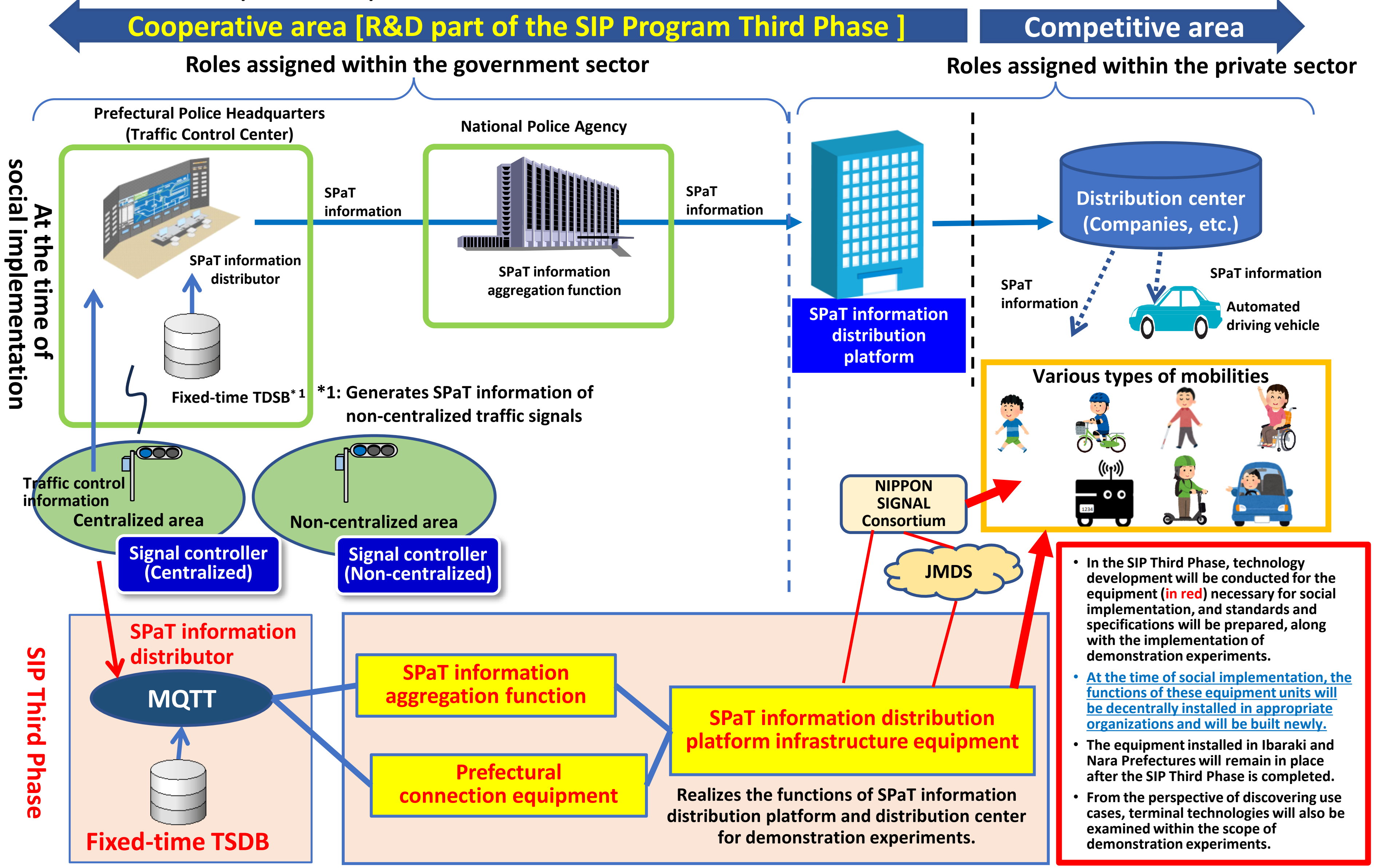
The above working groups installed within the UTMS Society of Japan will examine the details.

Discussions on the realization policy for SPaT information provision

Meetings will be organized and held by the NPA.

6. Efforts towards social implementation

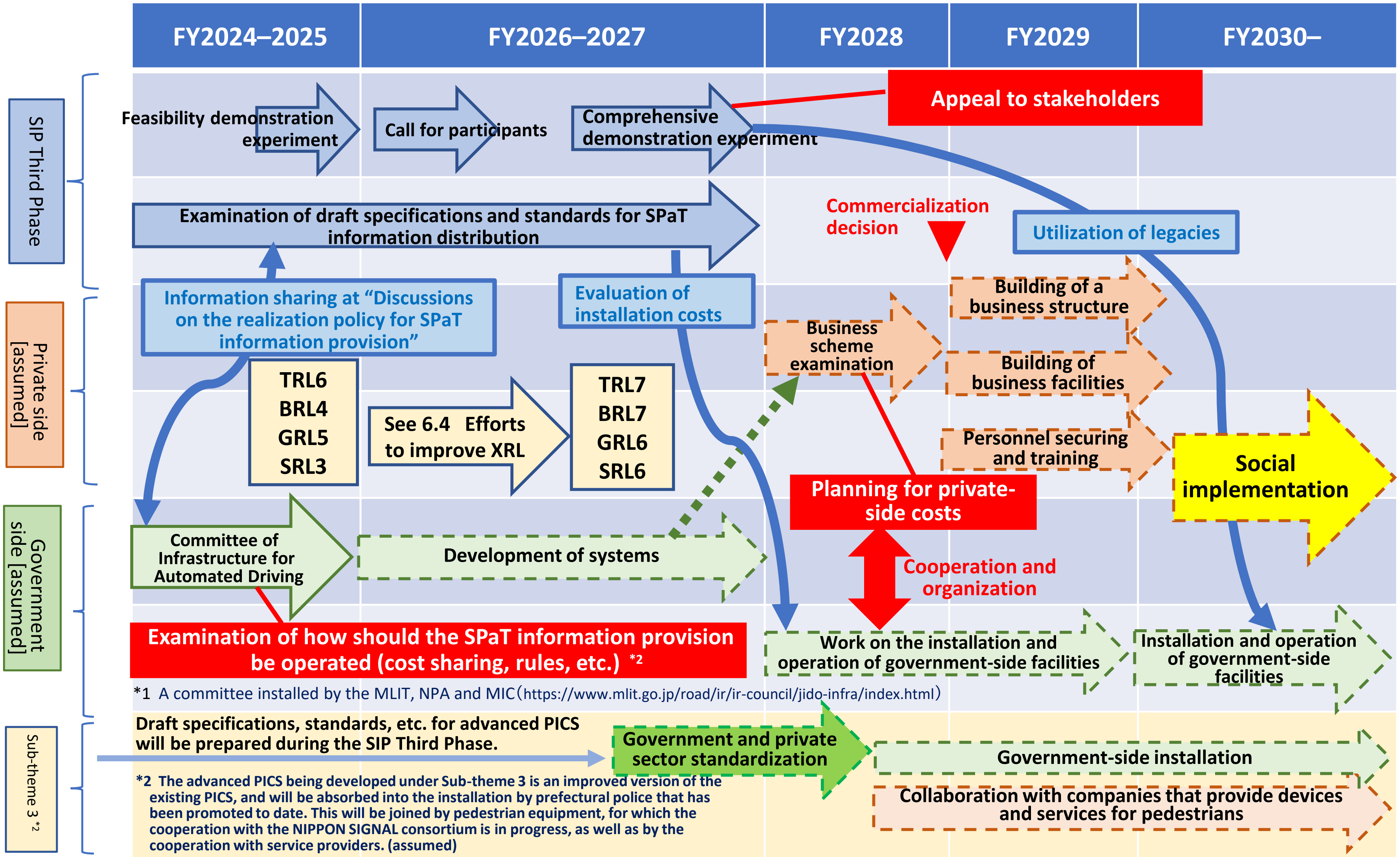
6.2 Relationship between the draft system configuration and role assignment at the time of social implementation and the contents of development in SIP phase 3



MQTT: Distribution device using MQTT, a lightweight, low-power message communication protocol for IoT.

6. Efforts towards social implementation

6.3 Social implementation roadmap (assumed)



: Assumed schedule (This may change depending on the results of the SIP Third Phase, Committee of Infrastructure for Automated Driving, etc.)

6. Efforts towards social implementation

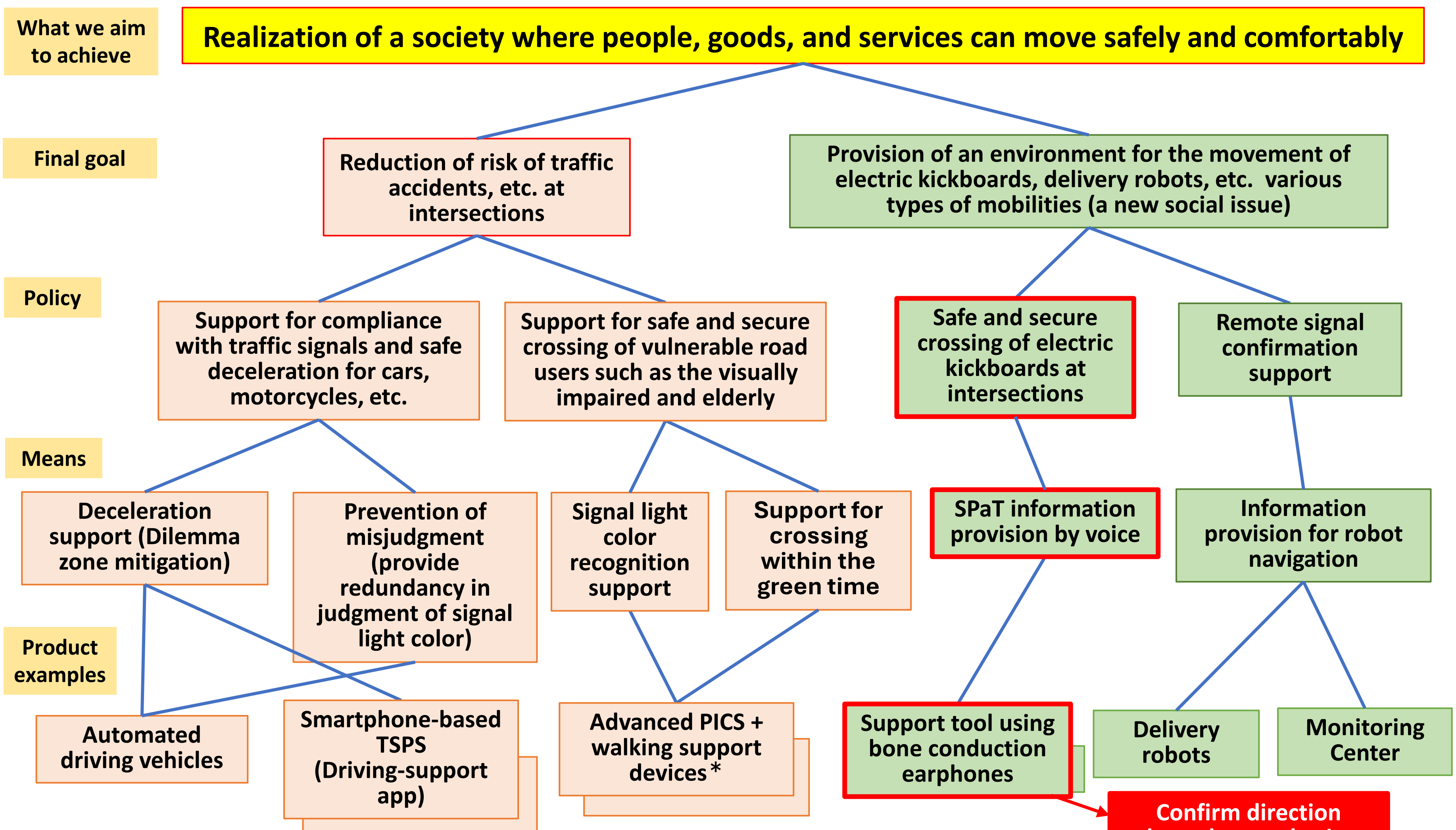
6.4 Efforts to improve XRL

	Reasons for these self-assessment	Self-assessment	Prospects for achieving goals	Target
TRL	The initial plan has been maintained and the desired results have been achieved in terms of technology. However, issues remain with special controls, etc.	6	A path to concrete commercialization can be mapped out by conducting technical verification based on use cases after comprehensive verification experiments, etc.	7
BRL	The specific profit structure has not been fully mapped out from the business model examined in the SIP Second Phase. Clarification of government-side policies is currently awaited. Meanwhile, minimal prototyping, etc. have been realized.	4	Preparation for formulating a business plan will be completed when government-side policies are clarified through the "Committee of Infrastructure for Automated Driving," etc.	7
GRL	A certain level of demonstration was carried out during the SIP Second Phase, and the current situation is its extension. However, for example, there is a need for further examination on system-related issues such as the positioning of "traffic information" under the Road Traffic Law.	5	Conditions for formulating an introduction plan will be in place for the part of the non-competitive area which the government will develop when the government-side policies are finalized through the "Committee of Infrastructure for Automated Driving," etc.	6
SRL	During the SIP Third Phase, needs survey is being conducted, and the cycle of hypotheses and verification is being repeated through committee activities that involve stakeholders.	3	Through comprehensive verification experiments, feedback based on use cases can be obtained.	6
HRL	Through the activities of a working group installed within the UTMS Society of Japan, information is being shared with companies that have the potential to be engaged in the SPaT information provision field. However, since this is a new field, the extent of its effectiveness is still in the verification stage.	3	It is possible to transfer technology to employees of companies that could become stakeholders by holding symposiums, etc., in addition to the installation of the working group. However, there are concerns about the aging of the industry, so questions remain about the possibility of involving younger people.	4

• HRL is a metric that is not included in the specifications of this project.

6. Efforts towards social implementation

6.5 Ripple effects (anticipated)



* See *2 of sheet 17

6. Efforts towards social implementation

6.6 Approaches related to user reviews (Appeal to stakeholders)

Degree of user involvement

	FY2024	FY2025	FY2026	FY2027
Information dissemination and issue examination by the committee				
Needs survey	Paper ↔ Interview ↔			
Demonstration experiment				
User evaluation of the demonstration experiment				

- The feasibility demonstration experiment is a technology verification by the UTMS Consortium, while "a preliminary user review" will be conducted in preparation for the comprehensive demonstration experiments.
- In the comprehensive demonstration experiments, experiments will be conducted based on use cases, then "a user review toward social implementation" will be implemented.

Preliminary interviews are being conducted with candidate participating companies
- Delivery robots
- Micromobility

Inquiries to committee members, etc.

Recruitment of additional participating companies

Feasibility demonstration experiment

Preparation and collaboration with participating companies (app creation, etc.)

Comprehensive demonstration experiments

Evaluation by committee members, etc.

Preliminary user review

Evaluation by participating companies, etc.

User review toward social implementation

Holding of a symposium (UTMS Seminar) and implementation of questionnaire

7. Goals and direction of the demonstration experiments

7.1 Overview of the feasibility demonstration experiment

Goal: Confirmation of reliability (accuracy, delay, availability, etc.) of V2N-based SPaT information provision technology

FY2024 Preparation for the feasibility demonstration experiment

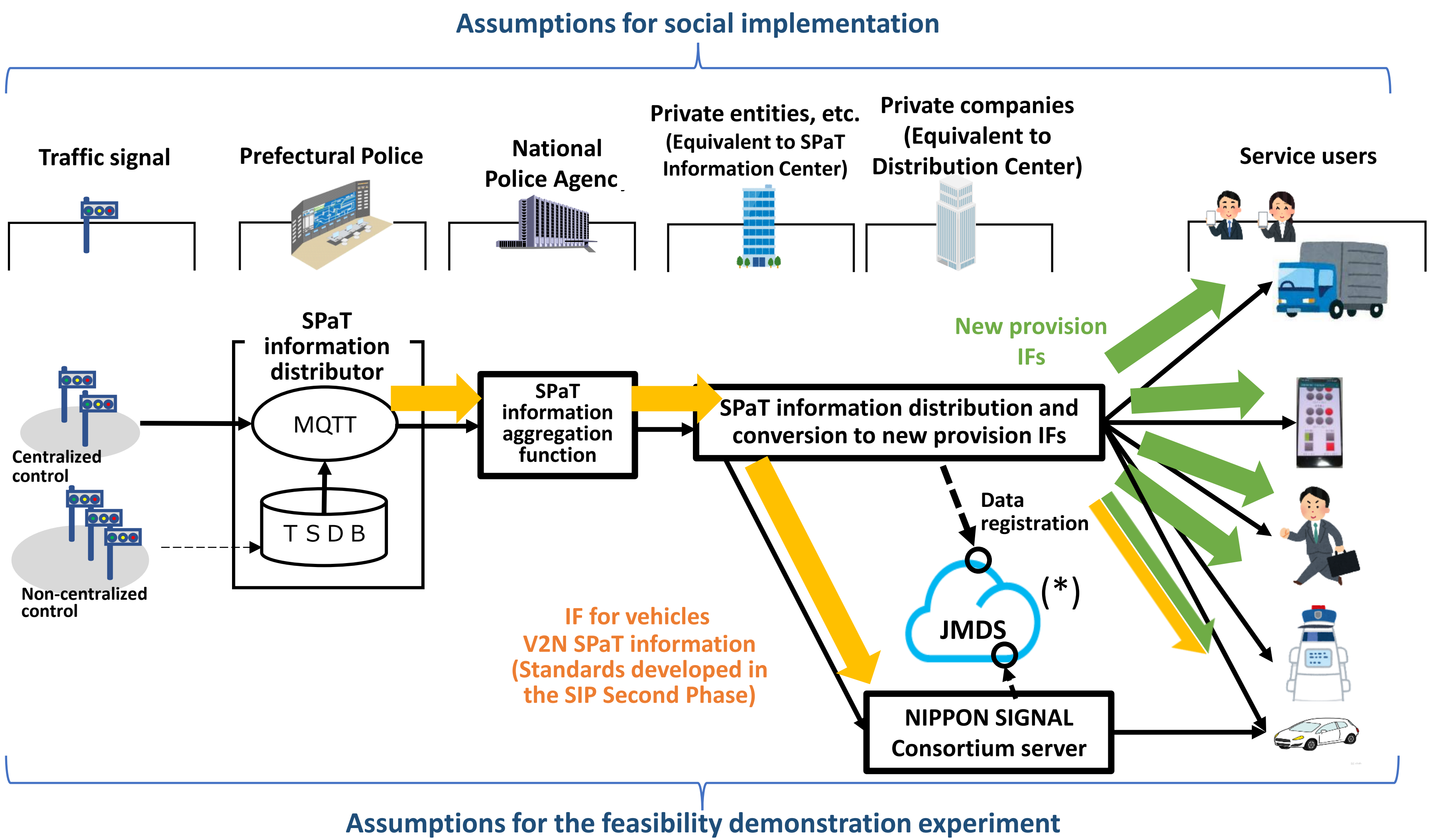
- **On-premise demonstration experiment (if there are any issues to be addressed)**
- **Preparations for inter-consortium cooperation with NIPPON SIGNAL Consortium and NTT Data Consortium (JMDS)**

FY2025 Implementation of the feasibility demonstration experiment

- **Implementation of public road demonstration experiments using simulated OBUs, etc. in Ibaraki and Nara Prefectures**
  - ✓ **Driving experiments by consortium members and experiment participants selected through needs surveys, etc. (Verification by developers and a preliminary user review)**
  - ✓ **For simulated OBUs, those using a smartphone (assuming pedestrians) and those using a PC (assuming automobiles) are planned to be prepared.**
- **Implementation of inter-consortium cooperation**

7. Goals and direction of the demonstration experiments

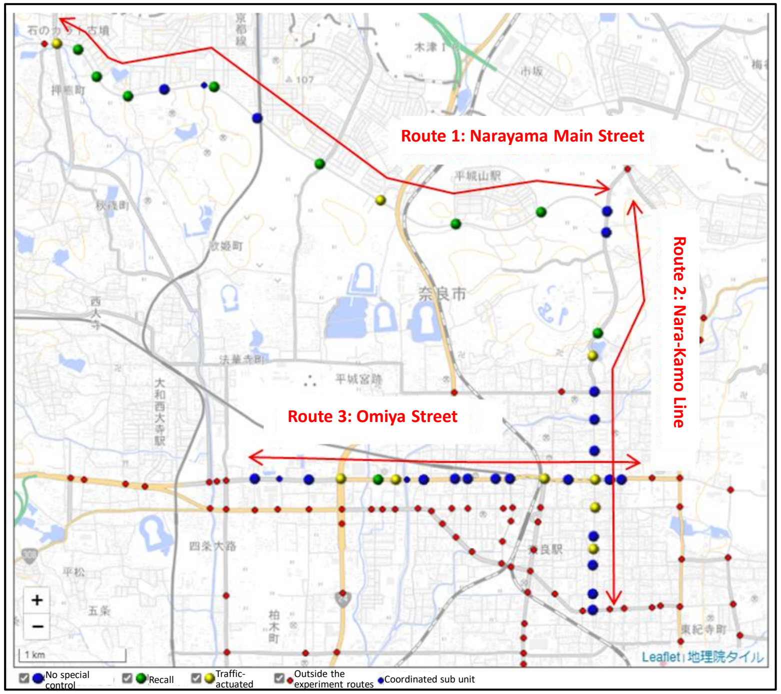
7.2 Draft system configuration for the feasibility demonstration experiment [under examination]



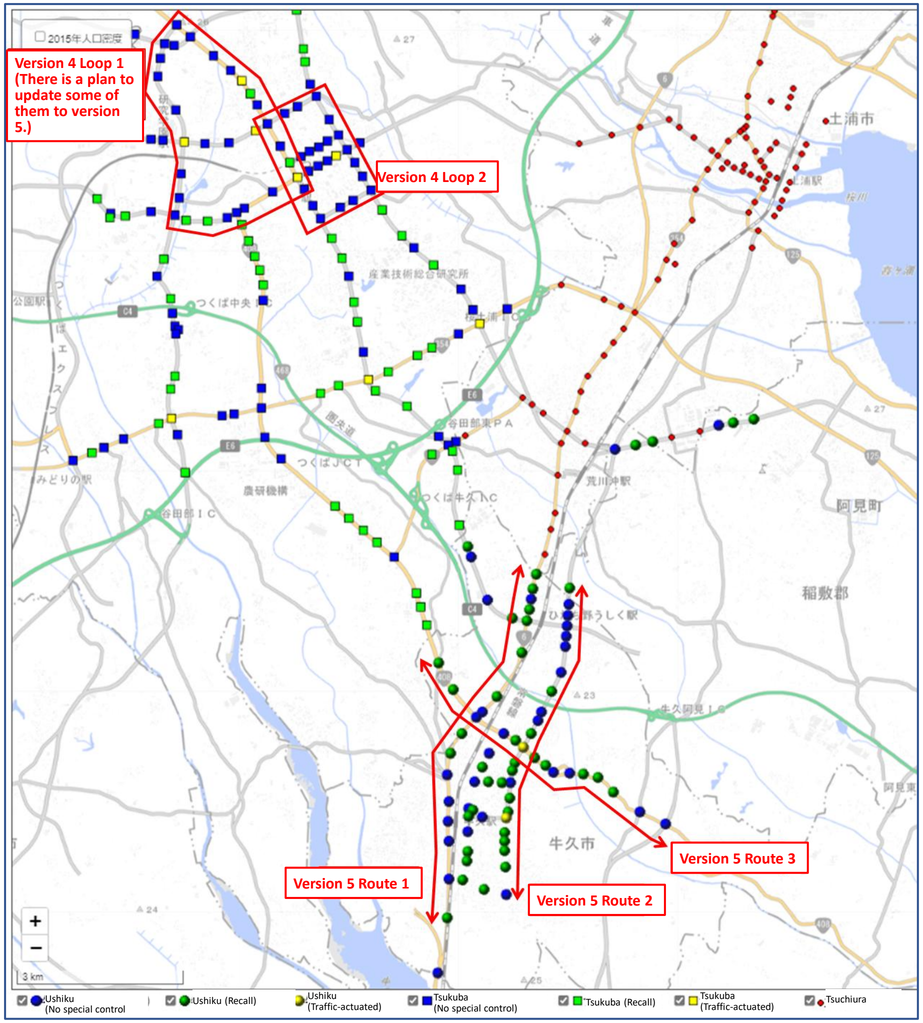
* As for the cooperation with JMDS, intersection management information on the intersections targeted for the experiment will be registered in JMDS. JMDS is used as a portal to reach the SPaT information distribution PF, and from that PF, SPaT information is provided. The NIPPON SIGNAL consortium will cooperate with JMDS as one equivalent to the SPaT information distribution center.

7. Goals and direction of the demonstration experiments

7.3 Location, etc. of the feasibility demonstration experiment



Nara Prefecture (Nara City) • • • Scheduled to be conducted at 108 intersections



Plotted on the Geographical Survey Institute map. (Using the website of Dr. Kenji Tani's laboratory, Saitama University)

Ibaraki Prefecture (Tsukuba City and Ushiku City) • • • Scheduled to be conducted at 167 intersections

Terminology BOX

Traffic signal controller (Version 4):
Signal control in 1-second increments. Time synchronization from the traffic control center, SPaT information error within a few seconds.

Traffic signal controller (Version 5):
Signal control in 0.1 second increments, time synchronized by GPS, SPaT information error within 0.3 seconds.

7.4 Overview of the comprehensive demonstration experiments

Response to (1)
- Deepening of cooperation between the NIPPON SIGNAL Consortium, JMDS, etc.

Goal: Confirmation of the level of completion toward social implementation and the understanding of service and operational issues

(1) Those related to the cooperation with other platforms
- ✓ Confirmation of cooperation focused on long-term system operation

(2) Those related to various types of mobility
- ✓ Understanding of the level of completion toward social implementation
- ✓ Confirmation of the effectiveness (value) of the service from the user's perspective

User review for social implementation

Response to (2) [in the pedestrian space]
- Experiments using smartphone terminals (app for V2N-PICS technology verification)

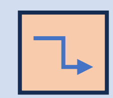
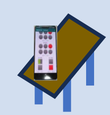
[Free movement within the experimental zone]
- Experiments using the advanced PICS for the visually impaired, elderly, etc.

[Crossing at predetermined intersections]
[Utilization of the JARI test site, etc.]

Response to (2) [in the automobile space]
- Experiments using equipment (details to be examined) installed in mobilities
- [Driving on predetermined public road courses]

◆Implementation issues
- ✓ Coordination of participants such as companies and groups through public recruitment, relative consultation (utilizing needs surveys), etc.
- ✓ Cooperation of general participants, such as organizations for people with visual impairments and the elderly
- ✓ Securing of budget necessary for distribution of smartphone terminals, on-board devices, etc.

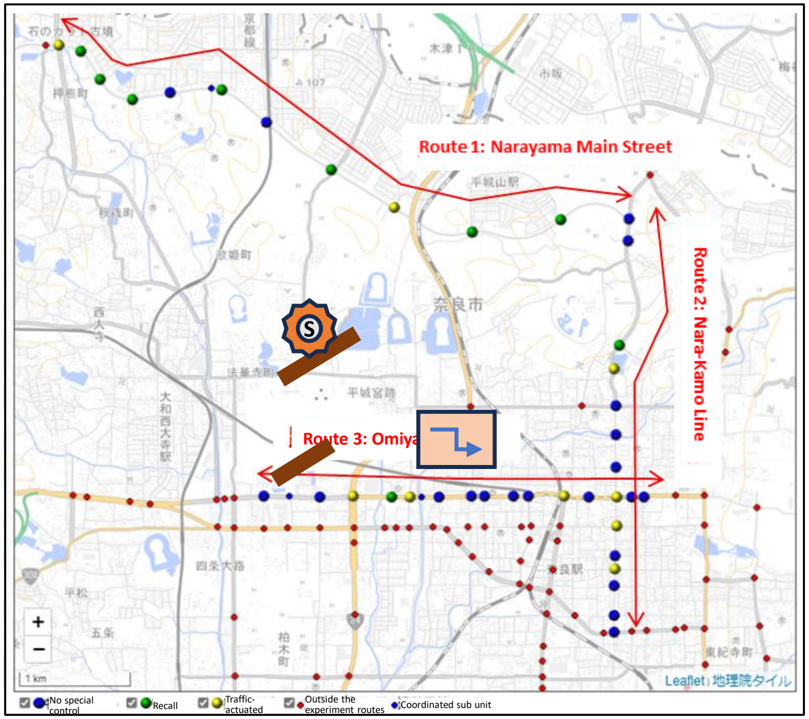
7.5 Types of the comprehensive demonstration experiments

Type	Experiment method	Assumed participants	Icon	Place of Implementation
1	Driving experiments on test courses using an application that utilizes SPaT information installed by participants	[Assuming final users of SPaT information in the automobile space, such as automated driving vehicles, delivery robots, etc.]		Ibaraki, Nara, JARI
2	Driving experiments on test courses using a simulated OBU (PC type or smartphone type) prepared by the UTMS Society of Japan	[Assuming SPaT information providers such as map providers, mobility information providers, etc.]		Ibaraki, Nara
3	Movement experiments in the SPaT information provision zone using a simulated mobile device (smartphone type, V2N-PICS) prepared by the UTMs Association	[Assuming SPaT information users, such as general pedestrians, micromobility users, etc. in pedestrian spaces]		Ibaraki, Nara
4	Crossing of intersections using the advanced PICS (improved version)	[Assuming people with visual or hearing impairments, elderly pedestrians, etc.]		Ibaraki
5	Indoor SPaT information provision service experiment utilizing the advantages of the V2N method which can receive SPaT information remotely	[Using remote monitoring, and assuming experiences by a wide range of people] (Expecting to expand recognition)		Remotely (*)

* Taking advantage of the characteristics of the V2N method, implementation at remote monitoring centers and symposiums is being examined.

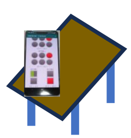
7. Goals and direction of the demonstration experiments

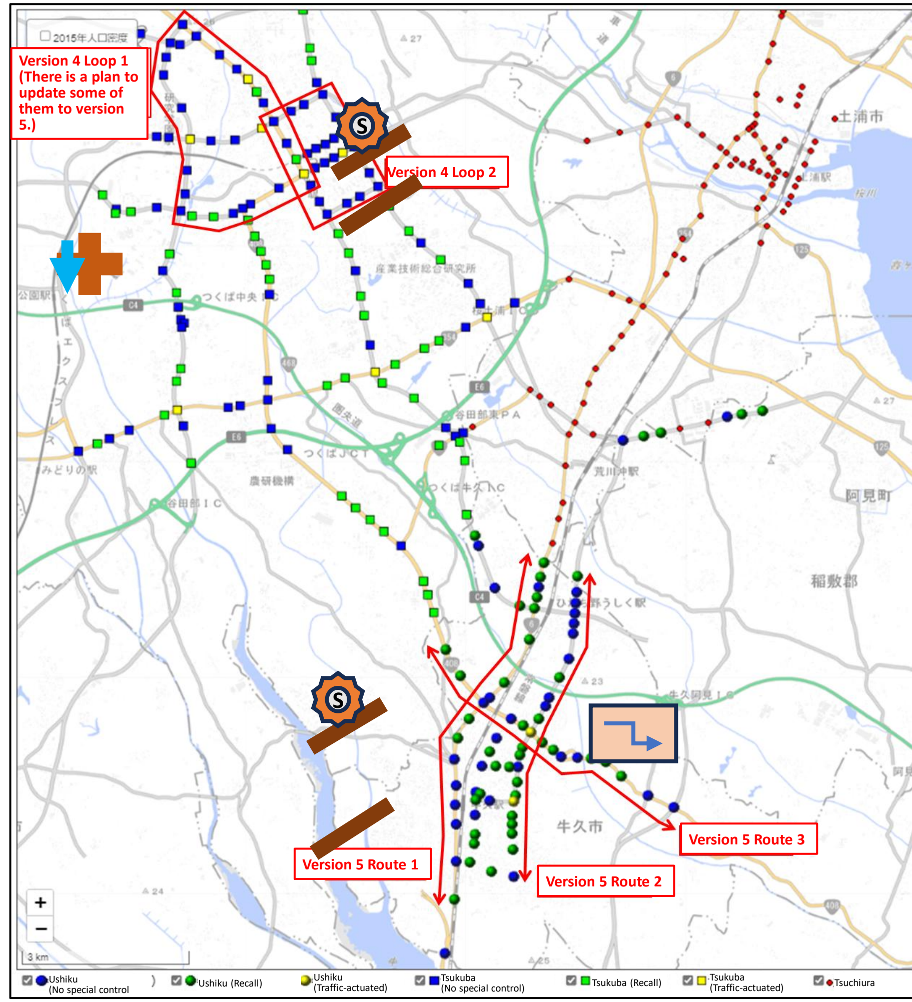
7.6 Allocation of demonstration experiments at the experiment sites (assumed)



Nara Prefecture (Nara City) • • • Scheduled to be conducted at 108 intersections

Remote indoor





Plotted on the Geographical Survey Institute map. (Using the website of Dr. Kenji Tani's laboratory, Saitama University)

Ibaraki Prefecture (Tsukuba City and Ushiku City) • • • Scheduled to be conducted at 167 intersections

: See previous sheet

8. External environment

1. Evaluation

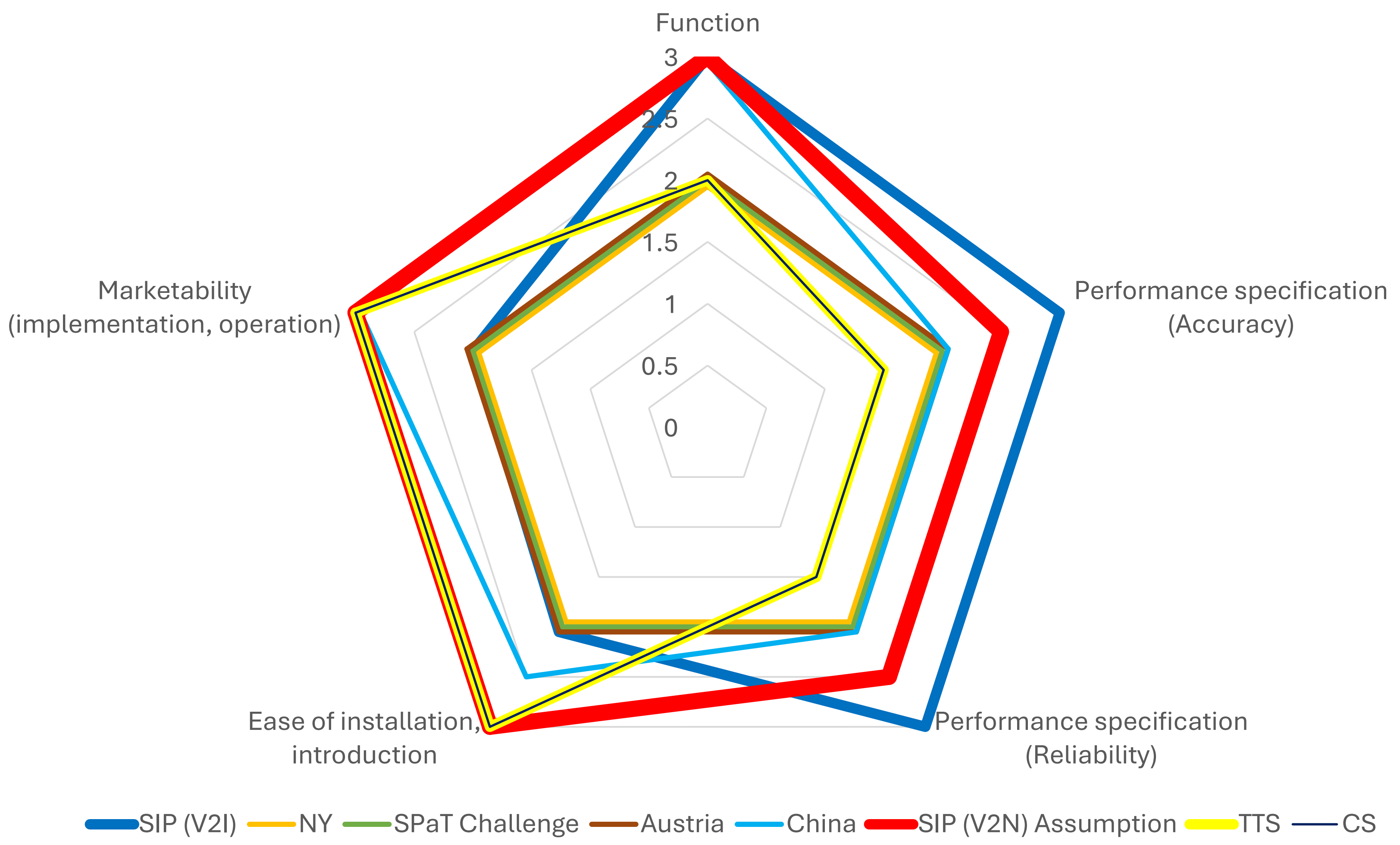
- Overseas, the promotion of technology development, standardization, etc. related to traffic safety and security, including SPaT information, is also planned.
- In such circumstances, activities that takes into account the spread of various types of mobilities seem to have become more apparent compared to what they were during the SIP Second Phase up to 2022, and a trend also exists globally that is in line with the direction of the SIP Third Phase.
- V2I-based SPaT information provision using ITS roadside units was put into practical use ahead of other countries in the world.
- The activities that leverage these assets to utilize SPaT information in automated driving were something one step ahead in terms of technology (see the following two sheets) even during the SIP Second Phase as a result of the demonstration experiment that implemented this technology in the actual traffic environment set up in the Tokyo Waterfront area during the SIP Second Phase with open participation from home and abroad.
    - ✓ Achieved the level sufficient for practical application in terms of functions, accuracy, etc., by introducing absolute time, applying 0.1 second processing time in the traffic control system, etc.

If the response to various types of mobilities improves as a result of the achievements of the SIP Third Phase, it makes it possible to respond to international interest in safety and security, which further ensures our having been one step ahead during the SIP Second Phase.

2 Global Benchmark (FY2022, during the SIP Second Phase)

Evaluation axis	Target of evaluation								Evaluation approach
	SIP V2I	NY City, USA	SPat Chal-lenge, USA	Austria	China	SIP V2N	TTS, Inc., USA	CS, Inc., USA	
System	V2I	V2I	V2I	V2N V2I	V2N V2I	V2N	V2N	V2N	
Function	◎	○	○	○	◎	◎	○	○	In the case where basic functions such as the number of remaining seconds and signal indication are satisfied, a grade of ○ (Score* 2) was given. For the systems in China that provide many use cases and for the systems in the SIP that support special controls such as traffic-actuated control, extra points were given with a grade of ◎ (Score 3). * Score: See the following sheet.
Performance specification (Accuracy assurance)	◎	○	○	○	○	○ ↓ ●	△	△	Using TSPS that has already become commercially available in Japan as a benchmark, V2I systems that are assumed to be of equal level are given a grade of ◎, while V2N systems that are slightly inferior are given a grade of △ (Score 1). For the systems in the SIP, whose accuracy was improved with a view to automated driving, additional points were given, with V2I and V2N given grades of ◎ and ○, respectively. The V2N in the SIP, however, was changed from ○ to ● because improvement is expected by the end of the project.
Performance specification (Reliability)	◎	○	○	○	○	○ ↓ ●	△	△	V2I was given a grade of ◎, and the V2N with many processing systems on the route to the vehicle, such as telecommunication carriers, was given a grade of △. For the systems in the SIP with fail-safe mechanisms added, extra points were given, with V2I being given a grade of ◎ and V2N being given a grade of ○. The V2N in the SIP, however, was changed from ○ to ● because improvement is expected by the end of the project.
Ease of installation and introduction	○	○	○	○	●	◎	◎	◎	V2I was given the rank of ○, considering the relative difficulty of scaling up. V2N was given a grade of ◎, considering that commercialization has already been achieved in the United States. For China, a grade of ● was given, in consideration of its being somewhere between the two.
Marketability Introduction Operation	○	○	○	○	◎	◎	◎	◎	◎ was given to TTS and CS in the U.S., which are already in commercial use, and to China, which has a high affinity with 5G. Among the systems in the SIP, V2N was given a grade of ◎ because it is similar to methods already in commercial use, and V2I was given a grade of ○ because it is considered to be on par with V2I in overseas countries.

2 Global Benchmark (FY2022, during the SIP Second Phase)

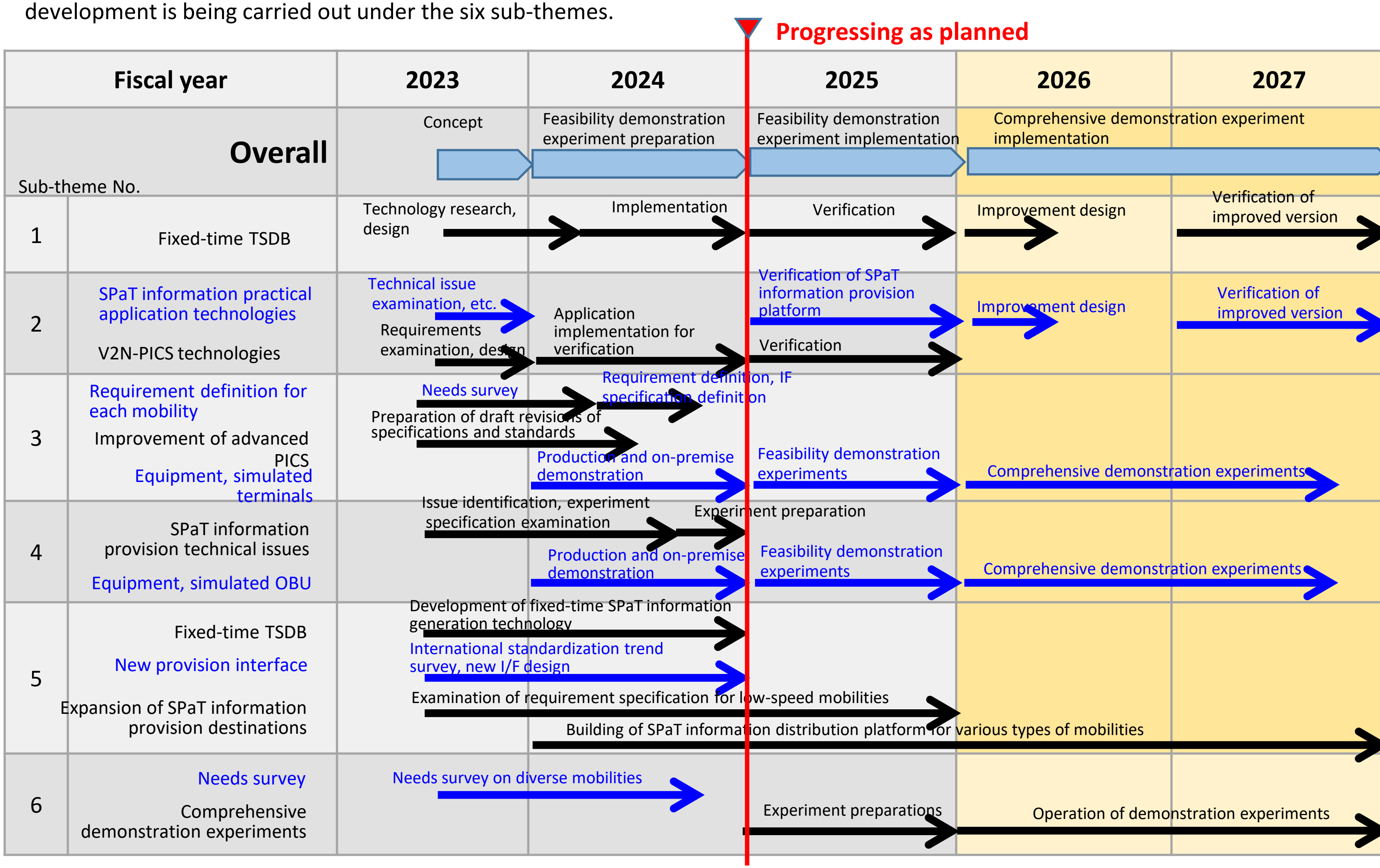


A graph of the previous slide using the following scores. ◎: 3 ●: 2.5 ○: 2 ▲: 1.5 △: 1

9. Progress

9.1 Overall roadmap

Research items will be carried out from FY2023 to FY2025 to confirm the establishment of necessary technologies through feasibility demonstration experiments. In FY2026 and FY2027, various types of mobilities will be involved as users to practically verify the effectiveness of the SPaT information provision platform in comprehensive demonstration experiments. Specifically, research and development is being carried out under the six sub-themes.



9. Progress

9.2 Main items implemented, main issues, and items to be implemented in or after FY2025 for each sub-theme

Sub-theme 1 Research and development of low-cost SPaT information generation technology for fixed-time traffic signals

Main items implemented	Main issues	Items to be implemented in or after FY2025
• Development of fixed-time TSDB equipment and its installation (for experiments) at Nara and Ibaraki Prefectural Police Departments to conduct a preliminary verification • Development of equipment for the signal light color change information collecting unit and its installation at two intersections under Nara Prefectural Police.	• Confirmation of whether the equipment designed to reduce installation costs has the performance, etc. required for the use cases	• Verification of performance, etc. based on the experiment plan and evaluation of feasibility based on the results.
• The fixed-cycle TSDB was developed in parallel by two companies in the consortium, each of which created its own specification document.	• Standardization of specifications	• Preparation of draft unified specifications, based on the results of experiments conducted by two companies, and examination by the committee
• For the overall technical development in Sub-theme 1	• Evaluation of lower costs	• Evaluation from outside the consortium (the National Police Agency, etc.) of whether the “reduction in SPaT information provision costs” set as a goal for this sub-theme has been achieved.

Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information

Main items implemented	Main issues	Items to be implemented in or after FY2025
Installation of a SPaT information provision platform • Nara Pref. (Installation on a larger scale) • Ibaraki Pref. (New installation) Installation by each prefectural police	• Platform technology verification	• Verification of accuracy, operation rate, etc. of SPaT information • Identification of issues related to platform operation and preparation of draft countermeasures
Development of a smartphone app for V2N-PICS technology verification	• Verification of whether V2N SPaT information is effective for supporting the crossing of pedestrians at intersections, etc.	• User reviews

9. Progress

9.2 Main items implemented, main issues, and items to be implemented in or after FY2025 for each sub-theme

Sub-theme 3 Research and development of I/F standardization that enables smooth distribution of SPaT information from the platform to various types of mobilities

- Requirement definition
Opinion survey on mobility, etc. that use walking space

→

- Definition of various requirements according to use cases

→

Preliminary user reviews and reflection of the results

- Improvement of advanced PICS
Examination of interfaces
Prototyping of equipment prototyping and on-premises verification

→

- Technical feasibility in real-world environments
- Actual use when in service
- Operation of data such as static information

→

- Implementation of demonstration experiments in the field
- User reviews (assuming service providers) and reflection of the results

Sub-theme 4 Research and development on the seamless SPaT information distribution in zones with various types of traffic signals, including those of centralized and non-centralized control systems

- Examination of SPaT information generation for the controls (that were excluded from the scope of the Second Phase)
- Technical verification of SPaT information generation
Prototyping of equipment based on experiment specifications and technical verification in the premises
- Identification of the feasibility, etc. of various provision methods examined in the Second Phase

→

- Resolution of technical issues arising from technical demands based on use cases and restrictions on signal control

→

- Verification of accuracy, operation rate, etc. of SPaT information
- Identification of issues related to platform operation and preparation of draft countermeasures

9. Progress

9.2. Main items implemented, main issues, and items to be implemented in or after FY2025 for each sub-theme

Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information

Main items implemented

- Development and verification of SPaT information generation technology for fixed-time traffic signals

On-premises verification of the fixed-time TSDB method

✓ The accuracy and availability were verified, and the establishment of the technology for the latest version of traffic signals is now in sight.

Field data verification

✓ Verification including accuracy and operational procedures was carried out to increase the feasibility.

- Building of SPaT information provision platform for various types of mobilities

Examination of use cases and requirement specifications for SPaT information distribution for new users

✓ Examined use cases and requirements

Building of a SPaT information distribution platform and environment for the feasibility demonstration experiments

✓ Finalized the framework for IFs for the feasibility demonstration experiments, and proposed revised versions of the new provision IF and common IF.

✓ Prepared the environment for the feasibility demonstration experiments. Built an environment that can receive SPaT information using the IF designed in SIP Second Phase.

Main issues

Development and verification of SPaT information generation technology for fixed-time traffic signals

✓ In the case of the earlier version of traffic signals, errors exceeding the accuracy target occasionally occurred ⇒ Identify the conditions under which these errors occur and examine the conditions for avoiding them in operation.

✓ Detailed information on offset tracking does not exist in the traffic signal management record, making it impossible to replicate offset tracking operations ⇒ To be dealt with by retrieving the control execution history.

- Building of SPaT information provision platform for various types of mobilities

✓ It is necessary to expand the usage scenes for use cases that utilize SPaT information.

⇒Examine usage scenes through preliminary user reviews, etc.

Items to be implemented in or after FY2025

- Development and verification of SPaT information generation technology for fixed-time traffic signals

On-site data verification

✓ To continue verification using on-site data wherever possible

- Implementation of user reviews
- Building of a SPaT information distribution platform

✓ New IFs and functions will be released for the unit used to prepare the environment for the feasibility demonstration experiment. These will be treated as the final system for the feasibility demonstration experiment, and will be used for various verifications.

9. Progress

9.2. Main items implemented, main issues, and items to be implemented in or after FY2025 for each sub-theme

Sub-theme 6 Research on diversified needs, etc. of the SPaT information provision platform

Main items implemented

- Implementation of domestic and overseas surveys, questionnaire surveys and interview surveys of companies that are expected to become stakeholders when working towards social implementation

Main issues

Finalization of SPaT information requirements (draft) for each use case

Items to be implemented in or after FY2025

- Deepening of analysis through deliberations by the V2N Traffic Information Provision Platform Review Committee, user reviews, etc.

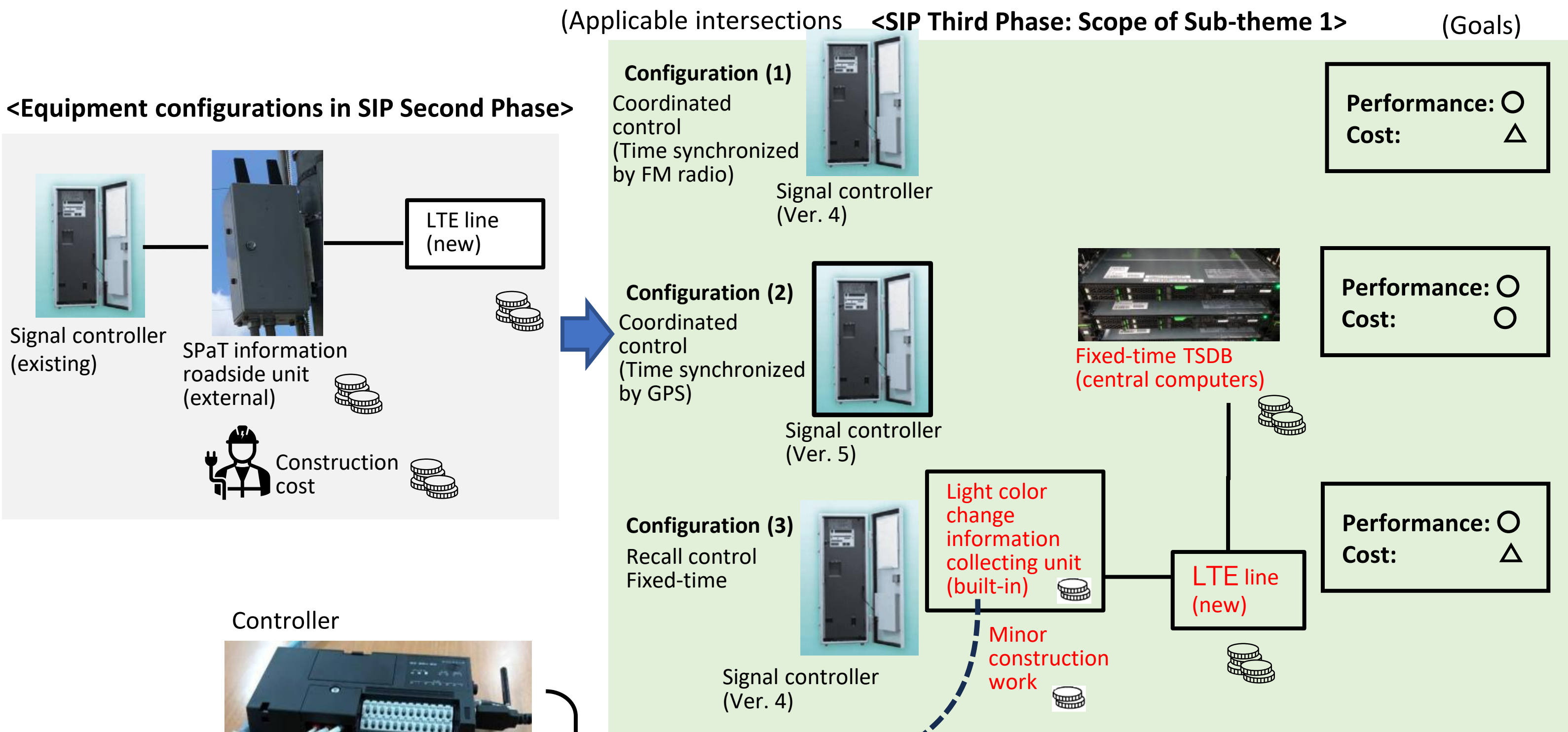
9. Progress

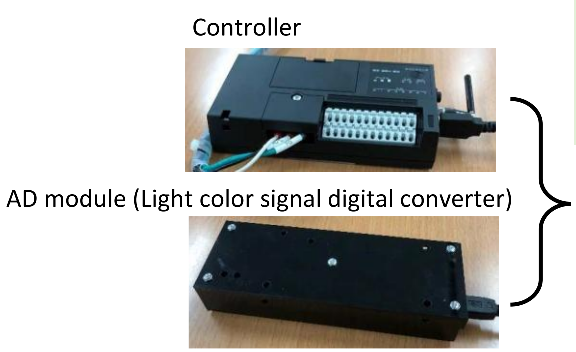
9.3 Sub-theme 1 Research and development status of low-cost SPaT information generation technology for fixed-time traffic signals

1. Sub-theme goals

Reduction in cost for providing SPaT information of fixed-time traffic signals using the fixed-time TSDB

- **Lowering of costs with configurations that do not require additional equipment or communication (configurations (1) and (2))**
- **Lowering of costs with inexpensive additional equipment and minor construction work (Configuration 3)**





Terminology BOX

Fixed-time traffic light: A traffic signal that turns on each signal light in a predetermined sequence and for a predetermined number of seconds. Settings can be made for each day type and time of day.

Coordinated control: Signal control that turns on signal lights at a predetermined time and adjusts the green start timing (offset) with adjacent intersections.

9. Progress

9.3 Sub-theme 1 Research and development status of low-cost SPaT information generation technology for fixed-time traffic signals

2 Results for FY2024

• Development of equipment based on the draft specifications and installation of equipment for experiments

Each equipment was installed in each control center and connected to the signal controller to perform behavior confirmation.

Specification	Equipment, etc.	Location of equipment installation
Draft specifications for Fixed-time TSDB (February 22, 2024 version)	IA server, OS: Linux, DB: Oracle	In the Nara Prefectural Police Traffic Control Center In the Ibaraki Prefectural Police Traffic Control Center
Draft specifications for the light color change information collecting unit (March 22, 2024 version)	Embedded equipment (controller + AD module)	Nara Prefectural Police: 2 units inside a traffic signal controller

・Preliminary verification results

Preliminary verification was conducted at local intersections in Nara Prefecture in preparation for the 2025 feasibility demonstration experiment (the difference in timing of the light color change was measured by photographing the signal light color on the simulated OBU screen and the actual signal light). It is expected that the target performance can be achieved, and the preparations for the feasibility demonstration experiment are judged to have been made.

Configuration	Signal controller			Signal color change information collecting unit	Number of intersections tested	SPaT information error	prospects of achieving the target performance
	Version	Time synchronization	Operation				
(2)	5	GPS	Coordinated		2	100 ms or less	○
(1)	Ver. 4 or earlier	FM radio	Coordinated		2	1 sec or less	○
(3)	Ver. 4 or earlier	FM radio	Coordinated	○	1	100 ms or less	○
(3)	Ver. 4 or earlier	None	Fixed-time	○	1	100 ms or less	○

The verification of SPaT information provision of push-button-actuated and traffic-actuated signals in the configuration (3) is scheduled for FY2025.

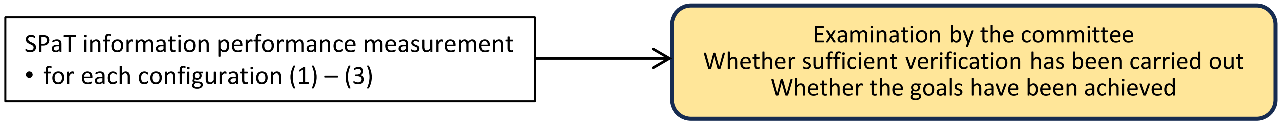
9. Progress

9.3 Sub-theme 1 Research and development status of low-cost SPaT information generation technology for fixed-time traffic signals

3 Schedule for FY2025

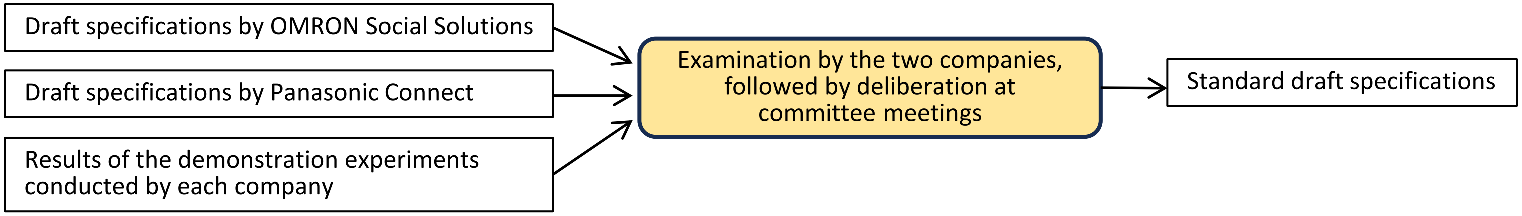
- **Verification of performance, etc. through feasibility demonstration experiments**

The feasibility of the fixed-time period TSDB will be evaluated by measuring performance, etc., based on the experiment plan prepared in FY2024.



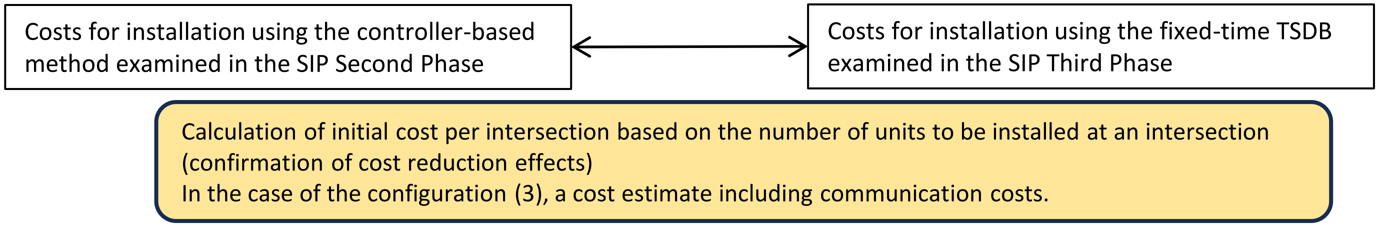
- **Standardization of TSDB specifications**

In the feasibility demonstration experiment of the fixed-time TSDB, experiments will be conducted with equipment developed based on specifications prepared by each of the two companies in the consortium. Subsequently, based on the results of the demonstration experiment, the specifications will be unified and a standard specification will be prepared.



- **Evaluation of lower costs**

Cost estimates will be made and evaluated by the National Police Agency to see whether the "reduction of SPaT information provision cost" set as a goal in this Sub-theme has been achieved. Because the installation cost varies depending on the number of intersections where the equipment is installed and the use of the light color change information collectors, an installation model will be examined in advance, after which cost estimates will be made for the installation model.

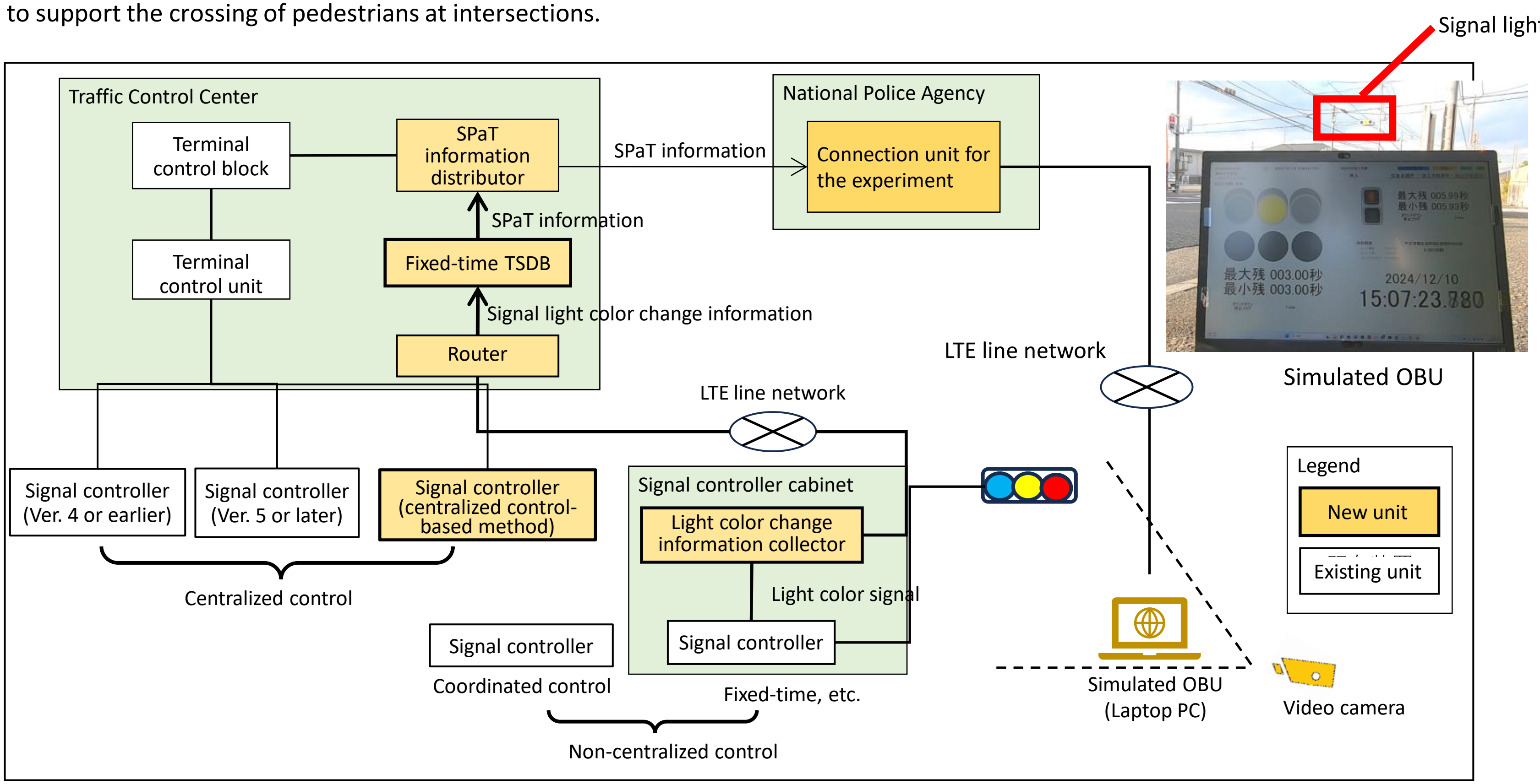


9.4 Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information

1 Sub-theme goals for 2024

The goal is to bring the SPaT information provision platform to a practical level. The systems for the feasibility demonstration experiments and comprehensive demonstration experiments to be conducted from FY2025 will be installed in FY2024. Based on the results of the examination in FY2023, the systems will be installed so that demonstration experiments using various types of mobilities can be conducted in certain areas.

In addition, as a use case other than automated driving, a smartphone app will be developed to verify V2N-PICS technology, which aims to support the crossing of pedestrians at intersections.

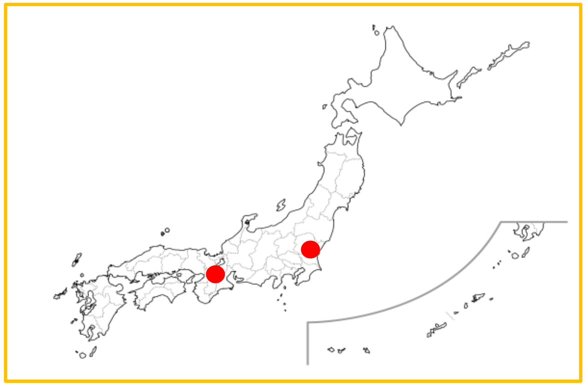


System configuration diagram (schematic diagram) of the SPaT information provision platform and verification equipment

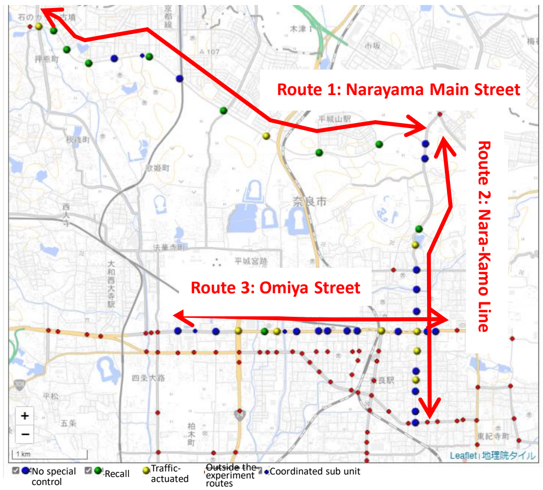
9.4 Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information

2 Installation of SPaT information provision platform

In Nara Prefecture, where the SIP Phase Two demonstration experiment was conducted, two additional experimental routes were prepared in the SIP Phase 3. In Ibaraki Prefecture, which was newly designated as a demonstration experiment location, SPaT information provision was implemented at over 150 intersections, in which three routes that provide highly accurate SPaT information and two routes that remain with old-type signal controllers were prepared. These installations were implemented by the respective prefectural police departments.

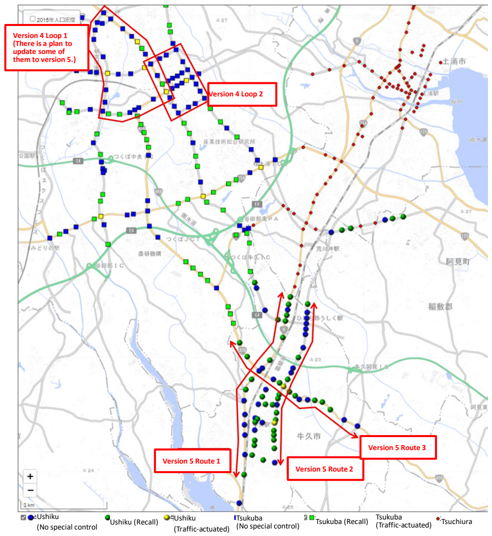


Demonstration experiment locations



Plotted on the Geographical Survey Institute map. (Using the website of Dr. Kenji Tani's laboratory, Saitama University)

Nara Prefecture (Nara City)



Ibaraki Prefecture (Tsukuba City and Ushiku City)

Details of installation	Nara Prefectural Police	Ibaraki Prefectural Police
SPaT information distributor	Improvement of existing unit	New installation
Signal controller upgrade to Ver. 5	5 intersections	8 intersections
Number of intersections with SPaT information provision	108 intersections (Note 1)	167 intersections (Note 1)
Number of routes tested by driving and number of intersections	3 routes, 32 intersections	5 routes, 91 intersections

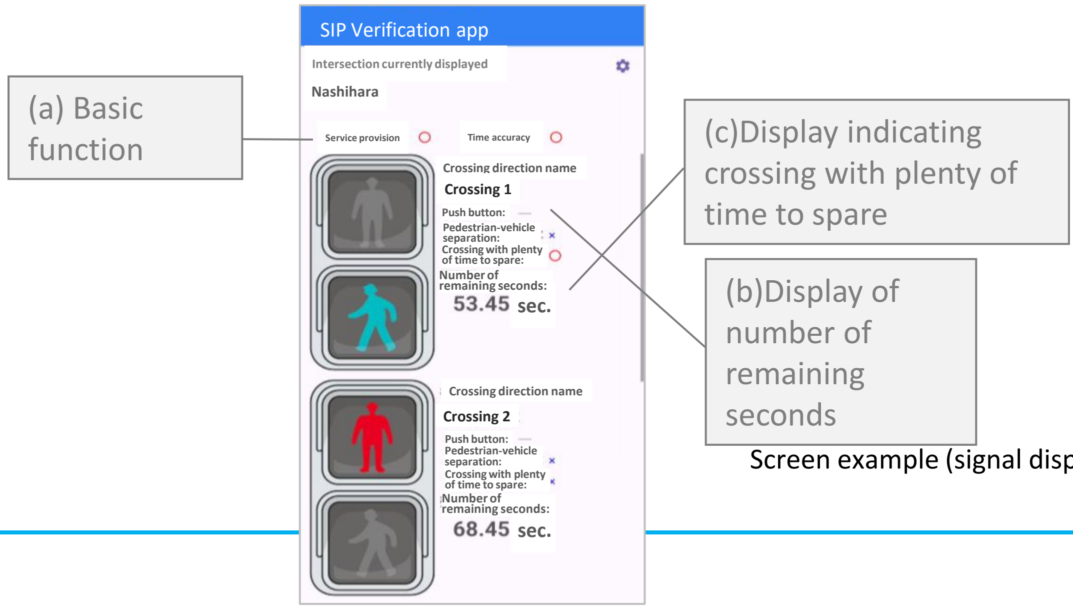
Note 1: The number of intersections where SPaT information is scheduled to be provided. SPaT information cannot be provided in cases where the operation of traffic-actuated signals is complex.

9.4 Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information

3 Development of smartphone app for V2N-PICS verification

In order to conduct a technical verification of whether it is possible to support the crossing of pedestrians using an application (V2N-PICS) that uses SPaT information distributed using the V2N method, a smartphone application for the feasibility demonstration experiments was developed using the Advanced PICS as a reference. A preliminary test was completed in Nara Prefecture.

Function item	Function overview
(a) Basic function	The application can start and end services appropriately. It can provide information on only the directions that have been set in advance.
(b) Display of number of remaining seconds	The display of the signal light color and number of remaining seconds for each direction is correct. (The minimum number of remaining seconds is displayed.)
(c) Display indicating crossing with plenty of time to spare	The app can display "crossing with plenty of time to spare" according to the walking speed setting (slow, somewhat fast, fast).
(d) Information provision by audio and vibration	The app can notify smartphone app users (pedestrians) via audio and vibration (notification sound and vibration).



Screen example (signal display screen)

9. Progress

9.4 Sub-theme 2 Research and development of practical application technology for V2N-based SPaT information

4 Schedule for FY2025

・**SPaT information provision platform technology verification**

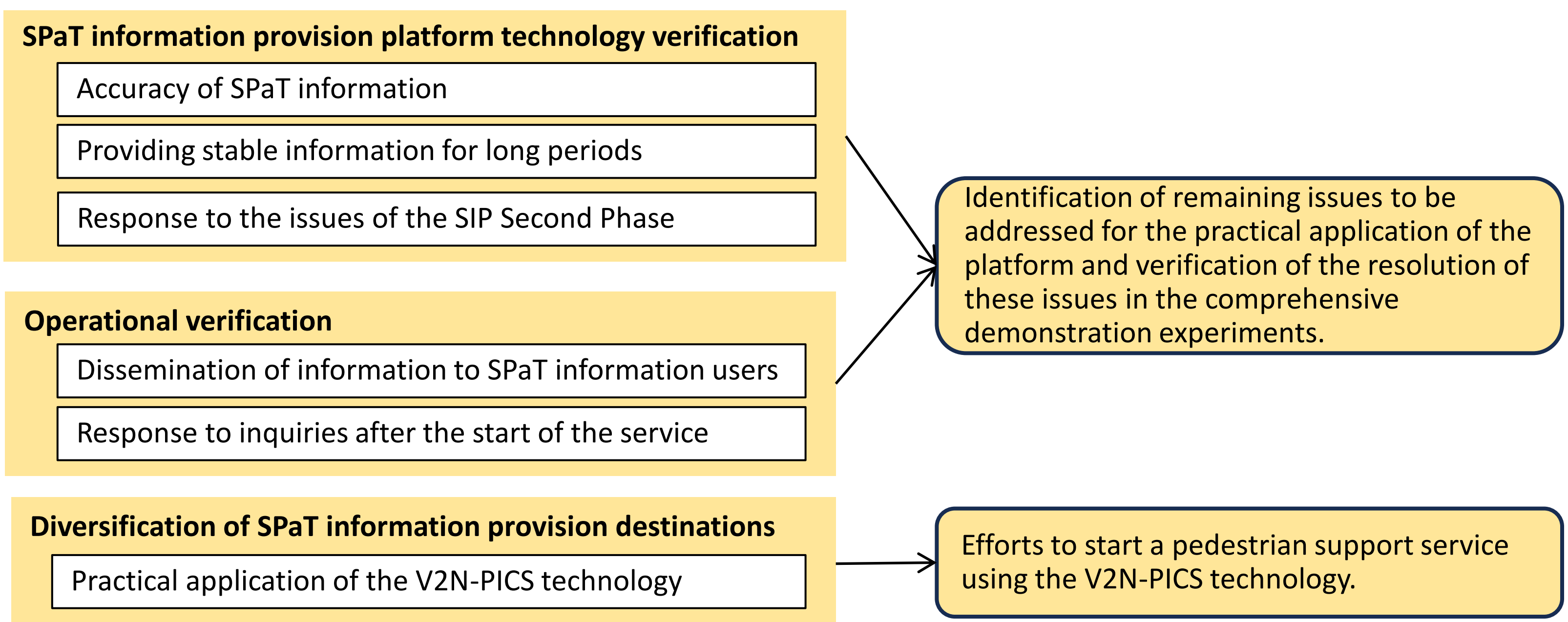
The accuracy of SPaT information and operation rates, etc., which are requirements for the Platform will be verified. Whether appropriate measures have been taken in response to the issues raised in the SIP Second Phase will be confirmed.

・**Verification of the operation of the SPaT information provision platform**

Verification of operations of the service will be conducted, such as disseminating information to SPaT information users before the start of the service and responding to inquiries after the start of the service, issues raised will be identified, and countermeasures will be prepared towards the comprehensive demonstration experiments starting in 2026.

・**Efforts towards the diversification of SPaT information provision destinations**

Committee members will evaluate the V2N-PICS smartphone app to determine whether it is possible to put it into practical use.



9. Progress

9.5. Sub-theme 3 Research and development of I/F standardization that enables smooth distribution of SPaT information from the platform to various types of mobilities

Survey of support recipients and examination of requirements definition, etc.

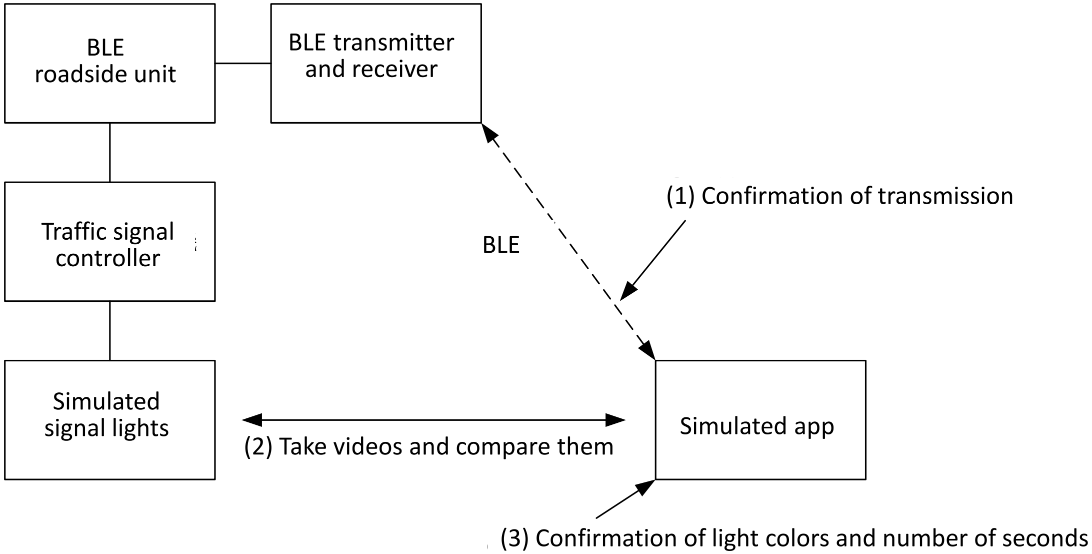
A survey to define requirements for the SPaT information provision for various types of mobilities was implemented in collaboration with Sub-theme 6.

For people with visual impairments, a survey of the opinions of support groups, etc. was conducted.

Improvement of advanced PICS

Information provision through expansion of the existing advanced PICS was examined as one of the means of providing information to various types of mobilities.

A prototype with an expanded interface was created to be able to provide information including SPaT information. Technical verification was carried out through on-premise testing.



Configuration for on-premises testing

9. Progress

9.6 Sub-theme 4 Research and development on seamless SPaT information distribution in zones with various types of traffic signals, including those of centralized and non-centralized control systems

Traffic-actuated control in response to a multiple number of push buttons or vehicle detectors (green indication only when requested)

Specifications required for SPaT information provision were identified, and equipment was prepared according to the identified specifications to verify that SPaT information provision is possible.

(a) Examination results

Examination revealed that, depending on communication delays, there are times when it is unknown whether the light color is red or green.

(b) On-premises verification

To confirm primarily that it is possible to calculate the light color and number of remaining seconds in response to a multiple number of push buttons and vehicle detectors, a prototype device was built based on the controller-based generation method, and on-premises verification was implemented to confirm the calculation capability in each signal control system.

Whether or not it is possible to respond to tasks in each of SPaT information generation methods

SPaT information generator	Control center	Traffic signal controller connected to control center	Traffic signal controller not connected to control center	SPaT information roadside unit connected to traffic signal controller	Fixed-time TSDB
Whether it is possible to generate SPaT information					
• Local control	–	–	○	○	×
• Centralized control	○	○	–	–	–
Operation monitoring					
• Operation monitoring 1 (Normal/abnormal)	○	○	○	×	×
• Operation monitoring 2 (Whether it is operating as scheduled)	○	○	○	×	×
• Light color monitoring (Match between SPaT information and signal light color)	×	×	○	○	×
Additional functional items for existing equipment					
• Interface support for recall requests	○	–	–	–	–
• Calculation of light color and number of remaining seconds according to recall operation	○	○	○	○	–
Additional functional items for local equipment					
• Function additions or equipment replacement for traffic signal controllers	–	○	○	–	–
• Communication line additions for intersections	–	–	○	○	–
• Equipment installation at intersections	–	–	–	○	–

On-premises testing

9. Progress

9.6 Sub-theme 4 Research and development on seamless SPaT information distribution in zones with various types of traffic signals, including those of centralized and non-centralized control systems

Interlocked intersections [intersections where signals are passed directly between two intersections (master unit and slave unit) to synchronize them]

The possibility, etc. of generating SPaT information at interlocked intersections were identified and equipment was built according to the identified specifications, followed by verification whether it is possible to provide SPaT information.

a) Examination results

Whether it is possible to generate SPaT information was clarified for each combination.

Combination pattern

Control method: Centralized control/local control (for master unit and slave unit each)

Interlock method: Interlocking slave unit function, signal light interlocking, multiple intersection control, multiple intersection control interlocking function

SPaT information generator:

(Generated from master unit behavior information and slave unit set-up)

Control center, traffic signal controller (master unit)

(Generated from slave unit behavior information)

Traffic signal controller (salve unit), SPaT information roadside unit (connected to slave unit), fixed-time TSDB

Differences by interlocking method

	Interlocking slave unit function	Signal light interlocking	Multiple intersection control	Multiple intersection control interlocking function
Slave unit configuration	Independent of master unit	Same as master unit	Integrated with master unit	Integrated with master unit
Slave unit control	Interlocked with master unit	Same as master unit	Independent of master unit	Interlocked with master unit
Equipment used	Standard product	Standard product	Dedicated to multiple intersection control	Dedicated to multiple intersection control

9. Progress

9.6 Sub-theme 4 Research and development on seamless SPaT information distribution in zones with various types of traffic signals, including those of centralized and non-centralized control systems

b) On-premises verification

In order to confirm that it is possible to calculate the light color and number of remaining seconds according to the slave unit, verification was conducted using a desktop calculation assuming SPaT information is generated at a control center that uses the master unit's behavior information. Also, a prototype equipment was built assuming SPaT information is generated by a traffic signal controller that uses the slave unit's behavior information, and the equipment's operation was verified.

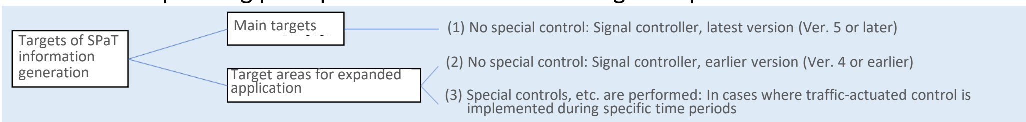
Whether or not it is possible to respond to tasks in each of SPaT information generation methods

SPaT information generator	Control center (Desktop calculation)	Traffic signal controller connected to control center (master unit)	Traffic signal controller connected to control center (slave unit)	Traffic signal controller not connected to control center (slave unit) (On-premises testing)	SPaT information roadside unit (slave unit)	Fixed time TSDB
Operation monitoring						
• Operation monitoring 1 (Normal/abnormal of slave unit)	●	○	○	○	×	×
• Operation monitoring 2 (Whether slave unit is operating as scheduled)	×	×	○	○	×	×
• Light color monitoring (Match of slave unit SPaT information and light color	×	×	○	○	○	×
Additional functional items for existing equipment						
• Calculating the synchronization point of slave unit from SPaT information (scheduled) of master device	○	○	–	–	–	○
• Calculating the scheduled number of seconds of slave unit's synchronization step from master unit's synchronization point	○	○	○	○	○	○
• Calculating slave unit's calendar	○	○	–	–	–	–
• Preparing slave unit's operation (multi-pattern/remote/independent) timetable	○	○	–	–	–	–
• Preparing and outputting slave unit's SPaT information	○	○	–	–	–	–
Additional functional items for on-site equipment						
• Function addition to master unit (traffic signal controller)	–	○	–	–	–	–
• Function addition to slave unit (traffic signal controller)	–	–	○	○	–	–
• Communication line addition to slave unit (traffic signal controller)	–	–	–	○	○	–
• Equipment installation at salve unit intersection	–	–	–	–	○	–

9.7 Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information

1 Development and verification of SPaT information generation technology for fixed-time traffic signals

[Goal] Develop technology to generate accurate SPaT information in an inexpensive and rational manner based on the operating principle that fixed-time traffic signals operate based on timetable information



SPaT information distributor
(Fixed-time TSDB method)

[Progress] On-premises verification of SPaT information generation technology using the fixed-time TSDB method has been completed; moving on to field data verification

- [Accuracy verification] Although there are some issues [(1)] in the on-premises verification, the accuracy targets (latest version of traffic signals: ±300 ms, earlier version of traffic signals: ±1 second) have been achieved!
- [Reliability verification] Conducted 63 consecutive days of operation testing during on-site verification Achieved 90% SPaT information operation rate!

⇒ **On-premises verification found that the technology establishment is now in sight**

List of on-premises verification results

Verification item		Verification results: Traffic signal Latest version (without traffic-actuated control)	Verification results: Earlier version (without traffic-actuated control)
Basic verification	Time accuracy	Within ±0.1 sec.	Difference of around +0.5-0.8 sec.
Accuracy	Videotaping accuracy verification	Within ±0.2 sec. (95 measurements)	Error of around +0.4 – 0.8 sec. (95 measurements)
	Log match verification	All matched (5835 cycles)	99.8% matched * Issues during tracking
Availability	SPaT information operation rate	100% operating rate during continuous operation at 19 intersections for 1,512 hours	

- [Feasibility verification]
  Accuracy verification and operational procedure verification were additionally conducted using field data.
  - As part of operational procedure verification, issues were identified, including the process of obtaining data such as traffic signal management records and control execution history.

⇒**Accuracy is expected to be achieved** based on preliminary verification at two intersections in Nara Prefecture. **Some issues [(2)] were identified in the procedures**.

List of field data verification implementation status

#	Traffic signal type	Special notes	Accuracy verification: Log verification	Accuracy verification: Videotaping accuracy verification
1	Latest version Company B	No traffic-actuated control	Error of within 0.1 sec. (4180 cycles) ➡ Preliminary verification completed	Scheduled for March or later (expected to achieve)
2	Latest version Company B	Without traffic-actuated control With nighttime flash	Error of within 0.1 sec. (3128 cycles) ➡ Preliminary verification completed	Scheduled for March or later (expected to achieve)

[Issues and responses]

Issue 1: In the earlier version, an error exceeding the accuracy target occurred in the cycle start time during offset tracking.
→As this issue occurs only in limited cases, countermeasures are being examined, including conditions for avoiding it during operation.

Issue 2: Detailed information on offset tracking does not exist in the traffic signal management records.
→To be resolved by retrieving control execution history and automatically reflecting it in the TSDB. The effectiveness will be determined in field verifications through FY2025.

Terminology BOX

Signal controller latest version (Ver. 5 or later): Control is performed in 0.1-second increments, and GPS is used for time synchronization.
Signal controller earlier version (Ver. 4 or earlier): Control is performed in 1-second increments, and FM radio is used for time synchronization.
Special control: Indicates that recall control, various traffic-actuated controls, and control by interlocking slave units are implemented.
Time correction: A function that synchronizes the time of signal controllers with a specific time source. Note that time correction is implemented as standard for the latest version of traffic signals.

9.7 Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information

2 Building of SPaT information distribution platform for various types of mobilities

[Goals]

(1) Develop usage scenes and SPaT information provision methods for automated delivery robots (remotely controlled small vehicles, etc. treated as pedestrian) as new traffic participants.

(2) Examine specifications for a SPaT information distribution platform for demonstration experiments that implement new SPaT information provision interfaces with a view to the entry of new users, and materialize those specifications.

[Progress]

(1) Examination of use cases and requirement specifications for SPaT information distribution for new users: Tentatively completed

Contributed to the expansion of usage scenes through the examination of three use cases and their requirement specifications, namely the use cases for monitoring and operational personnel of automated delivery robots and the use case for electric kickboard users, in collaboration with the surveys and TIPF Committee (4 meetings) under Sub-theme 6

⇒ **A demonstration app** for use in delivery robots will be prepared and utilized in the advanced **user reviews** for the next fiscal year.

Use cases to expand new uses will be continuously explored via TIPF Committee, etc.

(2) Building of a SPaT information provision PF and environment for feasibility demonstration experiments

- **Finalization of the framework for IFs for the feasibility demonstration experiments**

The following IFs were proposed by taking advantage of the activities of the WG on Infrastructure for Automated Driving and V2N-SWG (9 or more activities) in the UTMS Society of Japan.

- Proposed two standards as new SPaT information provision IFs for (1) new intersection management information and (2) signal light remaining number of second information.
- Proposed a revised version of the common IFs for the four standards for which solutions were presented to the five issues with the center-to-center IFs identified during the SIP Second Phase.

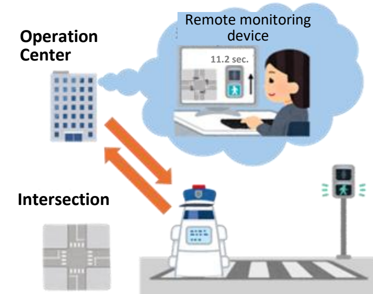
⇒ Currently, **specifications for the SPaT information platform is being examined**.

- **Preparations of an environment for the feasibility demonstration experiments (partly built)**

To be able to start the feasibility demonstration experiments as soon as possible, a device to be connected to prefectures[*1] that implements the common IF developed in the SIP Phase Two and a device acting as SPaT information distribution center that serves as the base for the SPaT information distribution platform were constructed. It was confirmed that SPaT information can be distributed and received via a mobile closed network.

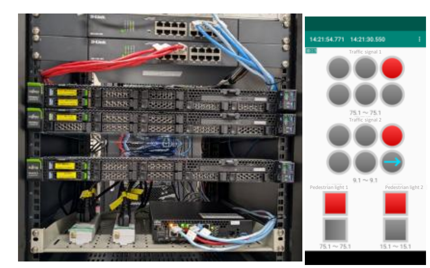
⇒ By means of updates to the software of the constructed devices, **new IFs and functions will be updated in September 2025 to conduct various verifications in the feasibility demonstration experiments.**

*1: Contents of the partially revised common IFs are implemented.



Automated delivery robot usage scene example

List of use cases and requirement specifications



Rack-implemented constructed device and an example of the app that received SPaT information

9. Progress

9.7 Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information

3 Results of use case examination for SPaT information utilization

To expand the use scenes of SPaT information, use cases were examined for monitoring and operational personnel of remote-controlled small vehicles, these personnel of automated delivery robots that travel on roadways during demonstration experiments, etc., as well as for users of specific small motorized bicycles, in collaboration with the surveys under the Sub-theme 6.

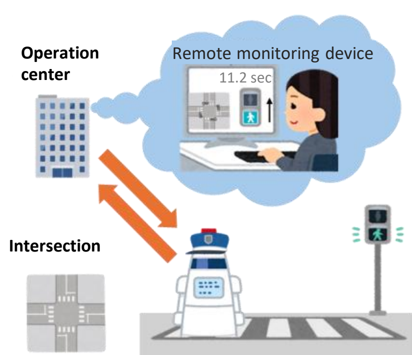
Use case name	Support for accurate road crossing decisions for monitoring and operational personnel of automated delivery robots (UC 1)	Intersection passage support for monitoring and operational personnel of automated delivery robots travelling on roadways (UC 2)	Support for intersection passage decisions for users of specific small motorized bicycles (UC 3)
Traffic participants	Remote-controlled small vehicles – treated as pedestrians (automated delivery robots)	Automated delivery robots travelling on roadways – treated as vehicles	Operators of specific small motorized bicycles
Information user	Monitoring and operational personnel	Monitoring and operational personnel	Operators of specific small motorized bicycles (electric kickboards, etc.)
Assumed scene	• The use of traffic signal's number of remaining seconds of as supplementary information **can support accurate decisions** of automated delivery robots **on whether or not to cross** when they cross an intersection, contributing to their safe operation. • During the green signal indication, it has **the effect of shortening delivery times**. • During the red signal indication, it can **shorten monitoring time (reduces monitoring burden)**, which is equivalent to signal wait time.	• When an automatic delivery robot stops at a stop line, the camera image, etc. may be blocked by the vehicle in front, making it impossible to recognize the light color. By using the light color and the number of remaining seconds of the signal as supplementary information, it is possible to accurately recognize the signal operation, **which reduces the monitoring burden on monitoring and operational personnel** and contributes to safe operation.	• Electric kickboards have a maximum speed of 20 km/h, which is a speed range that has not been experienced much, making intersection passage decisions difficult. Utilizing SPaT information to provide stopping assistance can prevent aggressive passage through intersections and **contribute to safe driving**.
Effectiveness of use	• Safe intersection crossing of automated delivery robots • Shortening of delivery times of automated delivery robots • Shortening of the time taken by monitoring and operational personnel to monitor intersection crossing	• Safe intersection passage of automated delivery robots • Reduction of monitoring burden on monitoring and operational personnel	• Safe intersection passage of specific small motorized bicycles

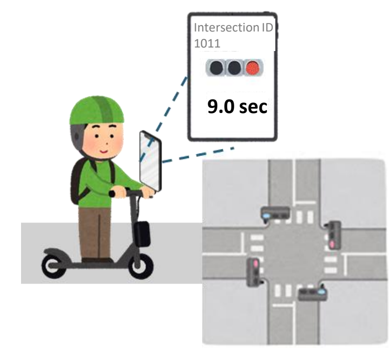
9.7 Sub-theme 5 Research and development to expand applications of the SPaT information database of fixed-time signal controllers and to expand the use of SPaT information by recipients of the information

4 Results of examination of requirement specifications for each use case of SPaT information utilization

Requirement specifications were examined for use cases of SPaT information utilization in cooperation with the surveys under Sub-theme 6.

Use case name		Support for accurate road crossing decisions for monitoring and operational personnel of automated delivery robots (UC 1)	Intersection passage support for monitoring and operational personnel of automated delivery robots travelling on roadways (UC 2)	Support for intersection passage decisions for users of specific small motorized bicycles (UC 3)
SPaT information required	Physical range	1 intersection to be crossed	1 intersection to be crossed	1 intersection to be crossed
	Timing	Pedestrian signal End of green and red timing	Vehicle signal Light color change timing	Vehicle signal End of green and red timing
	Time range	Time during which crossing is scheduled (for 2 cycles)	Time during which passage is scheduled (for 2 cycles)	Time during which passage is scheduled (for 2 cycles)
Data request	Request timing	To be requested at necessary timings By and large approximately 30 meters before the intersection	To be requested at necessary timings By and large approximately 30 - 150meters before the intersection	To be requested at necessary timings By and large approximately 30 - 150meters before the intersection
	Receiving location	Operation center Remote monitoring system installation location	Operation center Remote monitoring system installation location	On a terminal on a micromobility
Accuracy, etc.	Accuracy	**1 – 3 sec** (Around 1 sec is desirable)	**1 – 3 sec** (Around 1 sec is desirable)	**1 sec**
	Failure notification	Around 15 sec is allowable	Around 15 sec is allowable	No answer
Remarks:		Sidewalk up to 6 km/h	Roadway up to 20 km/h	Roadway up to 20 km/h





9. Progress

9.8 Sub-theme 6 Research on diversified needs, etc. of the SPaT information provision platform

- **Specification of requirements based on needs survey**

Use case

Item	Comprehensive demonstration experiment
Use cases assumed in advance	"Automated driving," "driving support," "pedestrian crossing support," "unmanned delivery robots intersection passage support," " low-speed mobility intersection passage support"
Use cases identified in the needs survey	"Route guidance for automobiles and bicycles," "efficiency improvement of delivery robot operation management"

The characteristics of these use cases are that SPaT information is used to improve the smoothness of driving and reduce travel time, and that these use cases refer to SPaT information along a route collectively.

Need for accuracy of SPaT information

- Autonomous driving: Same as SIP Phase 2, ±300 ms as requested by the Japan Automobile Manufacturers Association
- Low-speed mobility: Most responses were ±1 sec, but some responses allowed ±3 sec.

Since double-checking with image recognition is a prerequisite, there is a view that even large errors can be tolerated.

Other comments

- It would be good to provide SPaT information together with traffic congestion information.
- Information on approaching emergency vehicles is necessary for automated driving. Wouldn't distribution via V2N be more effective than other methods?
- Wouldn't it be possible for recipients to provide information on traffic signal abnormalities?
- Wouldn't it contribute to safe operation if information on accidents, road conditions, etc. were collected and provided?

9. Progress

9.8 Sub-theme 6 Research on diversified needs, etc. of the SPaT information provision platform

- **Specification of requirements based on needs survey**

Requirements for SPaT information for each use case (draft)

Will confirm appropriateness through committee deliberations, etc.

New mobilities

Use case name (UC name)	Necessary information (geographical scope)	Necessary information (timing/time range)	Accuracy requirement	Approach to failure notifications
Delivery robot crossing support (remote monitoring personnel/robot support	Intersection to be crossed (next intersection)	End of green/red timing Time during which crossing is scheduled /(for 2 cycles)	3 seconds*1 (1 – 3 seconds)	15 seconds*1 (without notification is also acceptable)
For bicycles Route guidance and bicycling support	Entire route	End of green/red timing Until the scheduled time of completion of the route	3 seconds*1	15 seconds*1 (without notification is also acceptable)
Riding support for micromobility users	1 intersection to be passed	End of green/red timing Time during which passage is scheduled /(for 2 cycles)	<u>1 second*2</u>	<u>1 second*2</u>
Route guidance for vehicles/motorcycles	Entire route	End of green/red timing Until the scheduled time of completion of the route	1 second*1	<u>7 seconds*1</u>
Vehicles/motorcycles Driving support for drivers	2 intersections to be passed	End of green/yellow/red timing Time during which passage is scheduled /(for 2 cycles)	<u>0.3 seconds*3</u>	<u>0.5 seconds*3</u>

- **The underlined part requires re-examination for consistency in requirements, etc.**

***1 These were set as draft requirements based on questionnaire and interview surveys (multiple answers)**
***2: The requirements were estimated based on questionnaire surveys**
***3: These were presumed to be responses based on the assumption that JAMA requirements could be met. UC accuracy requirements are estimated to be approximately 1 to 3 seconds**

➡Accuray requirement: Estimated to be approximately 1 second (1 second is the expected value, with a maximum of 3 seconds)

***By meeting the JAMA requirements (0.3 seconds), all UCs can be supported.**

10. International activities

ITS World Congress (September 18, 2024, Dubai) (International dissemination of activities in the SIP Third Phase)

SIS 75 SPaT information provision to mobility terminals (providing information on signal light colors of green, yellow and red as well as the number of remaining seconds

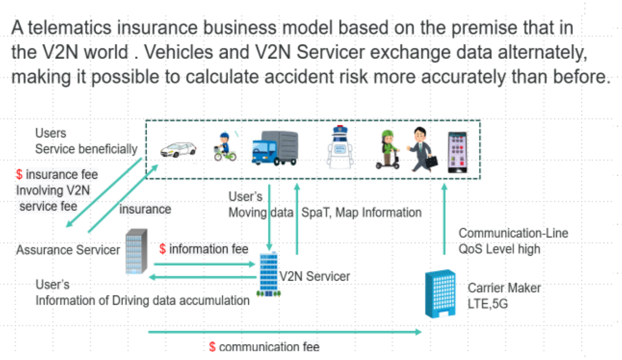
National Police Agency	**Initiatives in the SIP Second and Third Phases, and DSSS**
NIPPON SIGNAL Consortium	**Safety awareness (motorcycles, railroad crossing, VRU(Vulnerable Road User))**
UTMS Consortium	**SPaT information utilization (expansion targeting isolated intersections, development of business models)**
Boem (AUSTRIA-TECH)	**C-Roads deployment**
SUE BAI (Honda R&D Americas, Inc.)	**Reducing accidents through community development to create an environment that makes people happy**

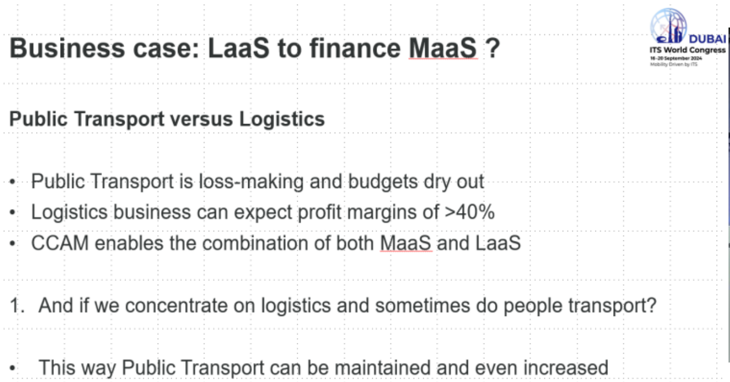
Question: How is SPaT information constructed for isolated intersections? (Austria-Tech)

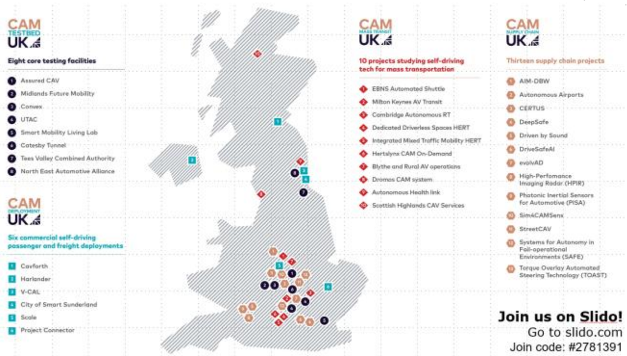
➡The response was that the construction of a TSDB that takes advantage of cost benefits and issues in the event of abnormalities are currently being examined, and that standard specifications are being developed with the aim of constructing a SPaT information database in each prefectural police department.

10. International activities

ITS World Congress (September 19, 2024, Dubai) (International dissemination of activities in the SIP Third Phase)
SIS 68 International collaboration with Europe (requested by the University of Tokyo Consortium in the SIP Third Phase)
(Business models, value chain concept, and use cases for SPaT information provision in Japan)







From left

Kimihiko Nakano (Univ. of Tokyo)	**Introduction of CooL4 Kashiwanoha**
JERON Bueker (Switzerland)	**Laas (logistics management efficiency improvement**
Mark Cracknell (UK)	**Consultant bringing together industry, academia, and government)**

Group discussion
What do you think are the challenges for social implementation?
➡ Three answers from the UTMS Consortium
(1) Boundary points of responsibility between the government and private sectors
(2) Strict quality requirements from stakeholders (one failure in 1 billion operations)
(3) Determination of the value and price for SPaT information