“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.

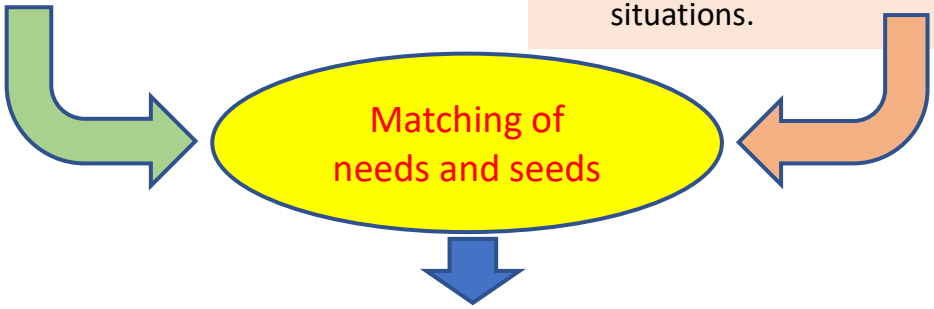
April 2026

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.

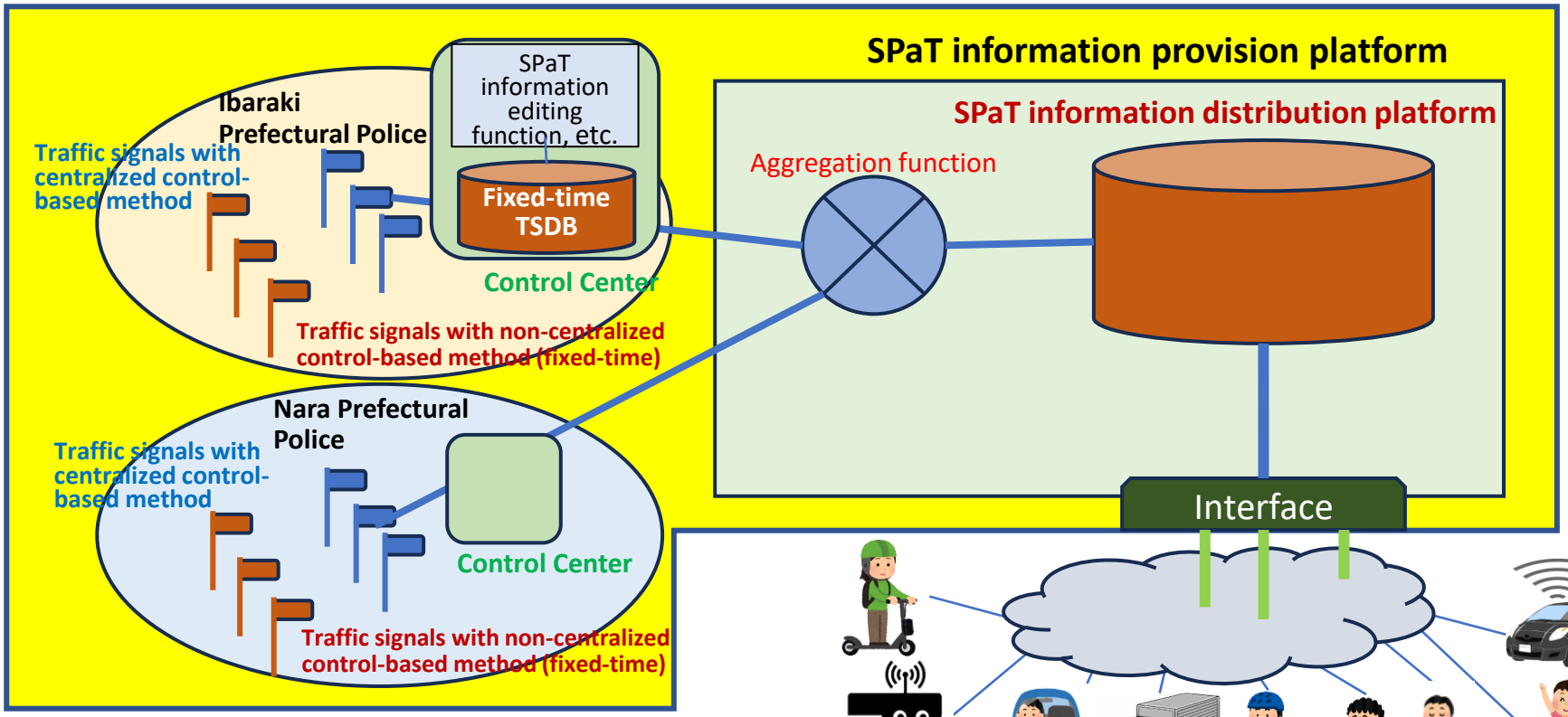
- In the second phase of the SIP Program, research and development were conducted on V2N-based traffic signal information [hereafter SPaT (signal phase and timing) information] provision technology for automated vehicles, and certain results were achieved, although some issues remain to be solved.
- By utilizing this technology, it is possible to improve safety and smoothness of various types of mobility 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 mobility, 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**
    - ✓ **Establishing a fixed-time TSDB and developing measures to ensure its accuracy**
  - ✓ **Establishment of a SPaT information provision platform**
    - ✓ **Establishing operation across multiple prefectures**
    - ✓ **Building 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 mobility	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 mobility, 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 mobility	In order for various types of mobility 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 “non-centralized control-based method” is a method in which an independent signal controller performs control according to control parameters stored in the signal controller without being connected via communication lines.
*2	Special signal control functions	Functions that enable special signal control such as push-button-actuated traffic signals. Technical measures are required to enable the provision of SPaT information.
*3	PICS	Abbreviation for PICS (Pedestrian Information and Communication System). This is a system designed to help elderly people and people with disabilities move around safely by providing accurate and reliable information about intersections by voice. Starting in fiscal year 2020, an advanced version of PICS was introduced. This system utilizes Bluetooth to transmit pedestrian signal information to smartphones and other devices, and also allows users to extend the green signal by operating their smartphones or other devices.
*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.

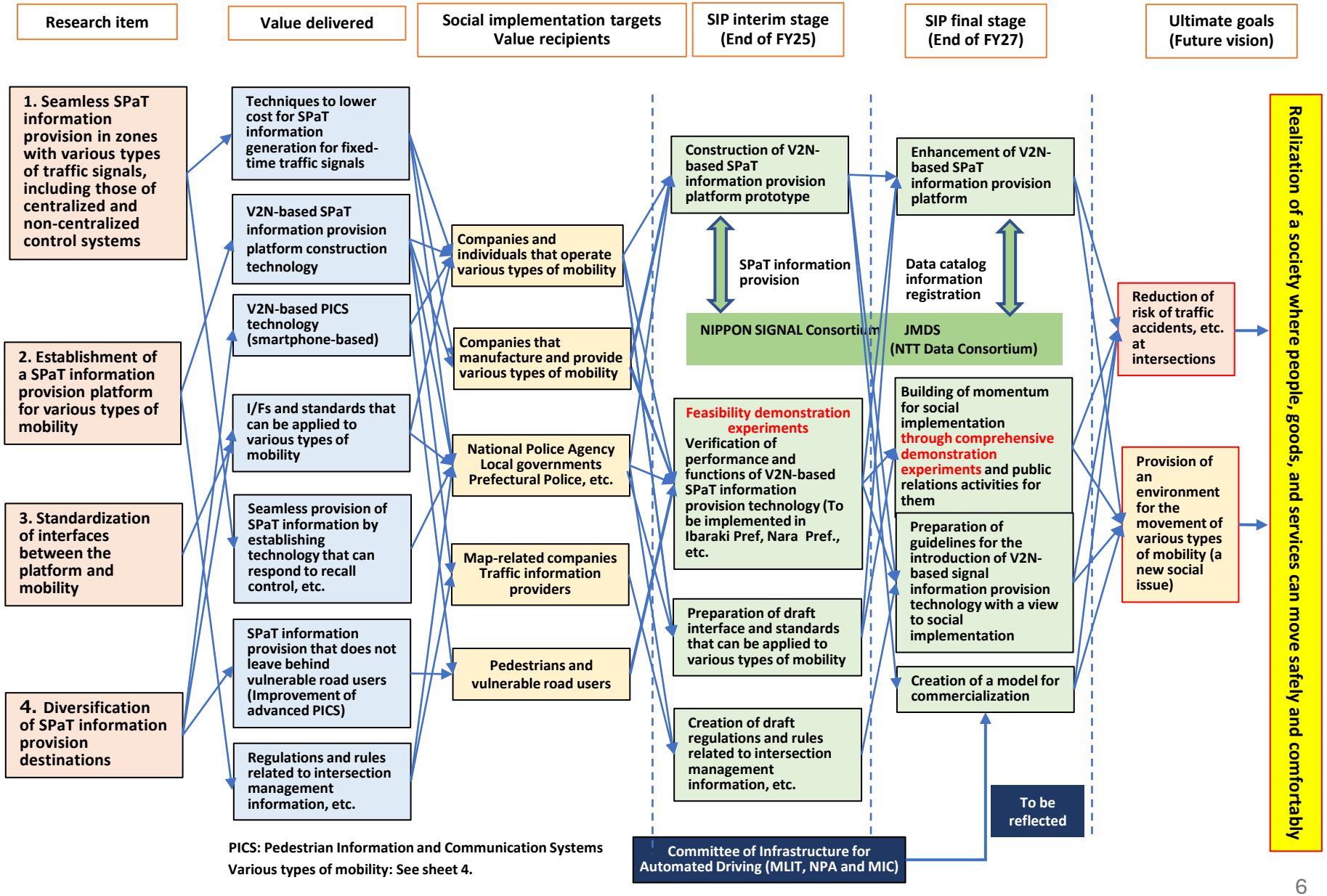
Two technology developments related to PICS are outlined as follows. For details, refer to Sections 9.4 and 9.5.

	V2N-based PICS technology development	Improvement of advanced PICS
Purpose	Basic verification of whether V2N SPaT information using LTE communication can be utilized to support pedestrian crossing (sometimes abbreviated as V2N-PICS).	Enhancement of Bluetooth-based pedestrian signal information services to extend their availability to micromobility devices and delivery robots.
Main development items	A smartphone application for verification supporting V2N pedestrian signal information	BLE roadside unit (communication standard upgraded to BLE 5.0) connectable to traffic signal controllers (Version 5) and a verification application.

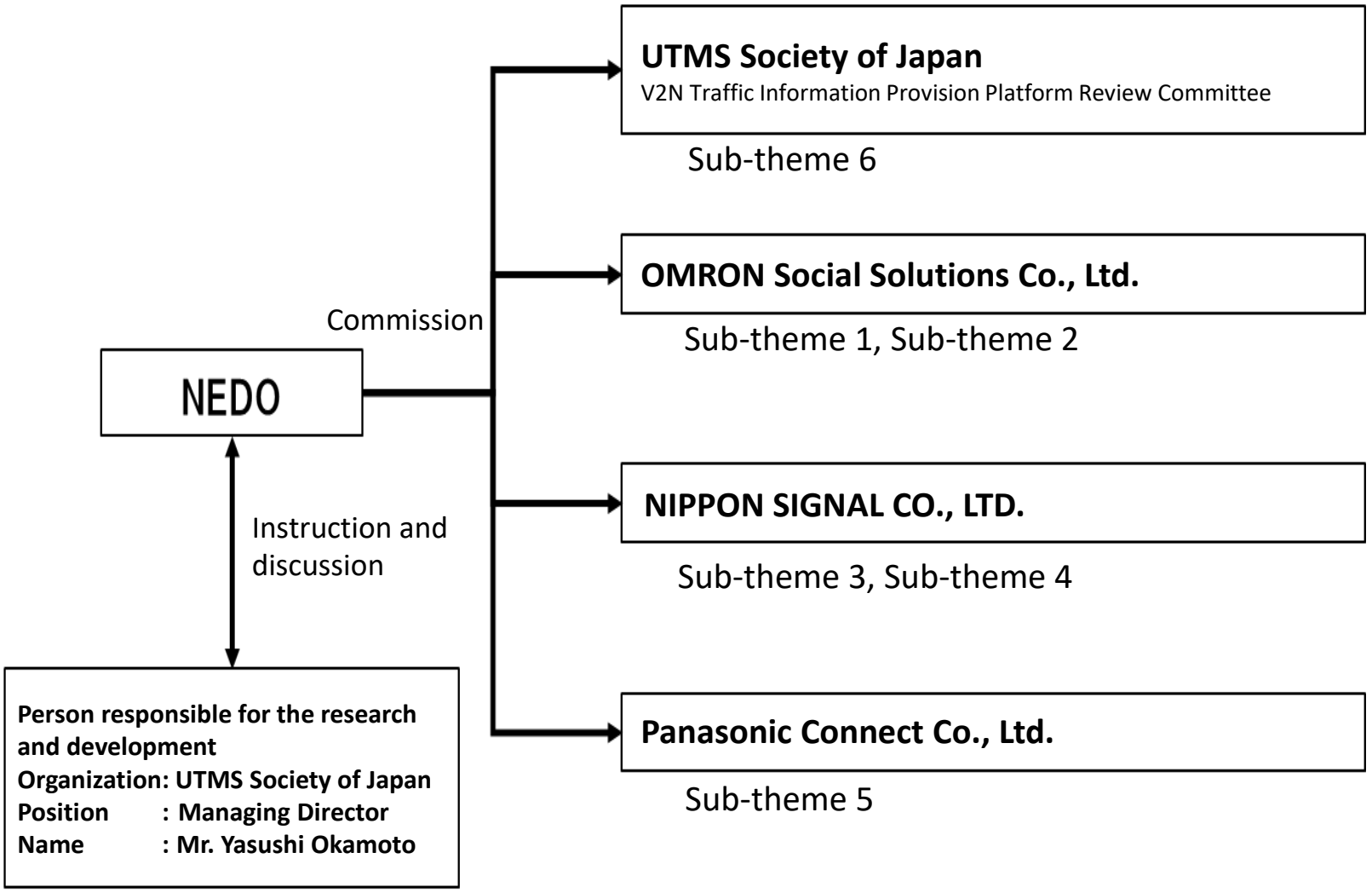
2. Overall overview of the research and development (Correlation between research items and sub-themes)

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 mobility		○			○	○	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 mobility			○		○	○	NS will examine interfaces for various types of mobility, 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 (Relationship between research items and ultimate goals)



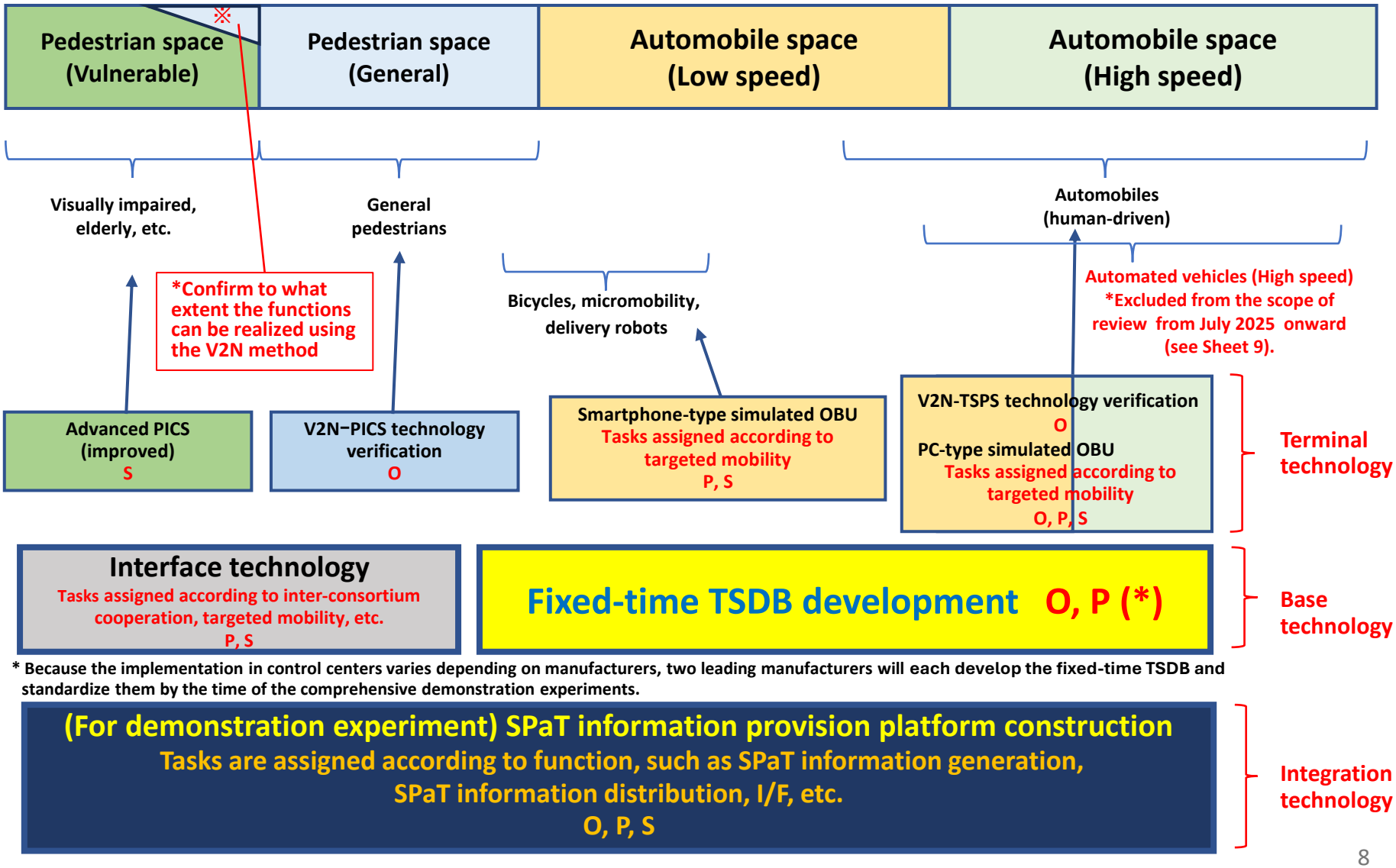
2. Overall overview of the research and development (Scheme of the research and development system)



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



* Because the implementation in control centers varies depending on manufacturers, two leading manufacturers will each develop the fixed-time TSDB and standardize them by the time of the comprehensive demonstration experiments.

2. Overall overview of the research and development

- **Revision of the targeted mobility**
  Based on the explanation provided by the National Police Agency at the third meeting of the Committee of Infrastructure for Automated Driving held on July 9, 2025, it was decided that subsequent discussions would exclude automated vehicles from the scope of examination (with the exception of new low-speed mobility such as delivery robots), and instead focus on a diverse range of mobility, including drivers, pedestrians, and new forms of micromobility, as the targets of SPaT information provision.

○Explanation by the National Police Agency at the third meeting of the Committee of Infrastructure for Automated Driving (July 9)

- In light of the current status of the deployment of automated driving technologies, for the time being**, SPaT information will be provided at locations where it is required by automated driving buses utilizing vehicle-to-infrastructure (V2I) technologies**.
- With regard to the method of providing SPaT information, **the V2I method will be adopted as the basic principle**, based on the premise that such information is to be provided at locations where automated driving buses utilizing V2I technologies require it.
- **As for the provision of SPaT information via the V2N method**, **guidelines will be compiled** so that the results of accumulated research and studies to date can be utilized in social implementation.

https://www.mlit.go.jp/road/ir/ir-council/jido-infra/index.html

○Future approach under the third phase of the SIP (Decided at the V2N Traffic Information Provision Platform Review Committee)

- Desk-based technical examination for automated vehicles have been completed, except for special controls. For some of these special controls, it is difficult to meet the requirements of the Japan Automobile Manufacturers Association (JAMA) for automated vehicles under the current specifications. Therefore, we intend to conclude the technical examination by presenting proposed revisions to the specifications (including measures to prevent the signal light color from becoming indeterminate at the start of the recall phase).
- Examination of specifications, communication standards, message set standards, intersection management information, and guidelines will continue.
- In order to allow a wide range of traffic participants—including various types of mobility and pedestrians—to experience this technology and to collect their feedback, we will strengthen efforts to encourage more users to participate in experience sessions during the feasibility demonstration experiments.
- During the comprehensive demonstration experiments, we will explore whether it is possible to establish a mechanism that allows a broad range of general users to access the fixed-time TSDB and SPaT information distributor deployed in Ibaraki and Nara, with a view to establishing them as long-term legacies. (Releasing APIs and sample source codes, etc., are under consideration.)

3. Goal setting

3.1 During the period of the feasibility demonstration experiments (2023 – 2025)

Item No.	Research Item	Goal	
1	Seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems	Development of SPaT information provision technology for fixed-time traffic signals	Evaluation of a prototype fixed-time TSDB Standardization of specifications for fixed-time TSDB
		Development of SPaT information provision technology for signal controls that were excluded from the scope of the project in the second phase of the SIP	Provision of SPaT information of intersections implementing recall 2 or 3 control and of coordinated sub units, etc.
2	Establishment of a SPaT information provision platform for various types of mobility	Evaluation of SPaT information generation Specification examination, establishment, and evaluation of the SPaT information provision platform	
3	Standardization of interfaces between the platform and mobility	Preparation of a draft for the standardization of the interfaces enabling various types of mobility to obtain SPaT information from the SPaT information distribution platform	
4	Diversification of SPaT information provision destinations	Provision of SPaT information to people with visual impairments	People with visual impairments (Improvement of advanced PICS)
		Provision of SPaT information to pedestrians, delivery robots, micromobility, etc.	Pedestrian crossing support (V2N-PICS technology) Examination of use cases for driving support Examination of use cases for various types of mobility

3. Goal setting

3.2 During the period of the comprehensive demonstration experiments (2026 – 2027)

Research Item	Goal
Research Items 1 – 4	• Preparation of guidelines for the construction of a SPaT information database • Coordination of participants in the comprehensive demonstration experiments • Implementation of the comprehensive demonstration experiments (Ibaraki and Nara Prefectures) • SPaT information 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 • Finalization of the revised draft specifications, draft standards, etc. (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 mobility	7 or higher	6
	Standardization of interfaces between the platform and mobility	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 2026

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

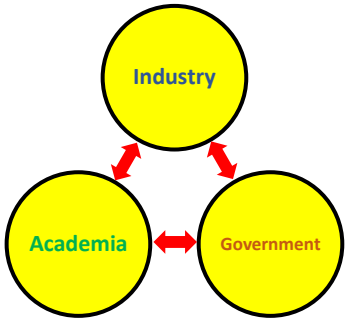
- Standardization of interfaces for data linkage of traffic SPaT information provision platforms
- Promotion of the use of traffic SPaT information provision platforms by other contractors and mobility service providers

6. Efforts towards social implementation

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)

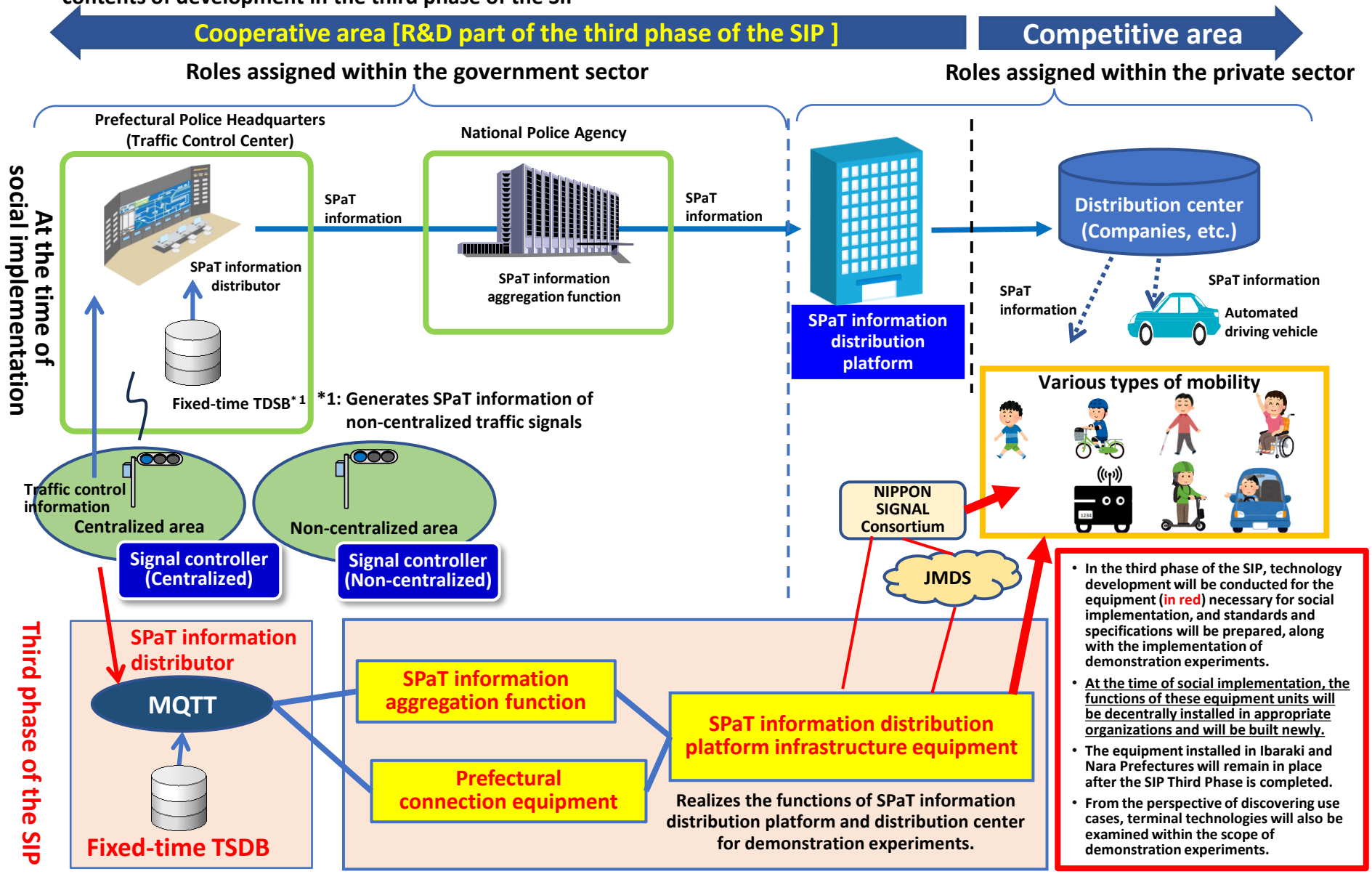
The above working groups installed within the UTMS Society of Japan will examine the details.

Discussions on the realization policy for SPaT information provision

Meetings will be organized and held by the NPA.

6. Efforts towards social implementation

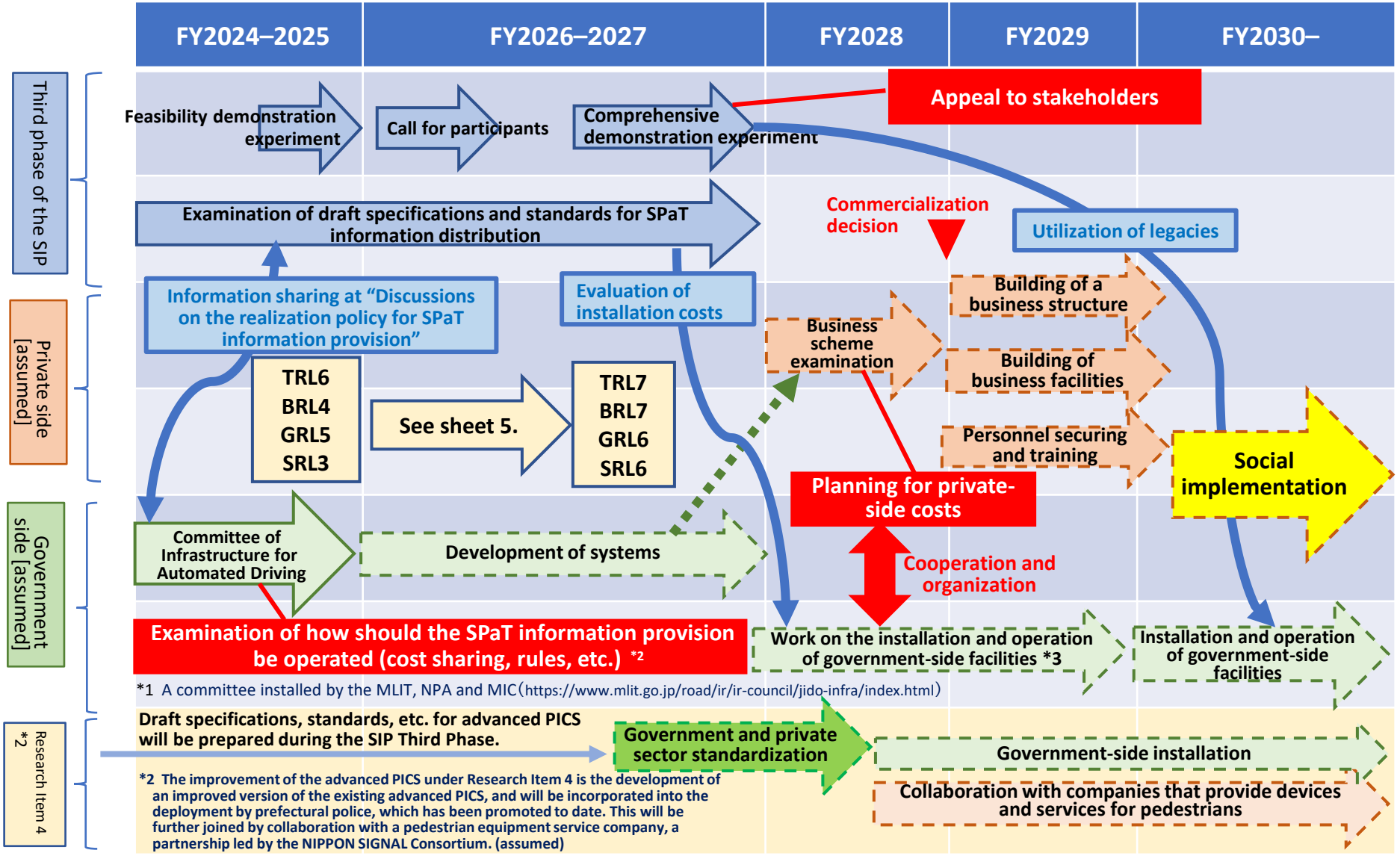
6.2 Relationship between the draft system configuration and role assignment at the time of social implementation and the contents of development in the third phase of the SIP



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)

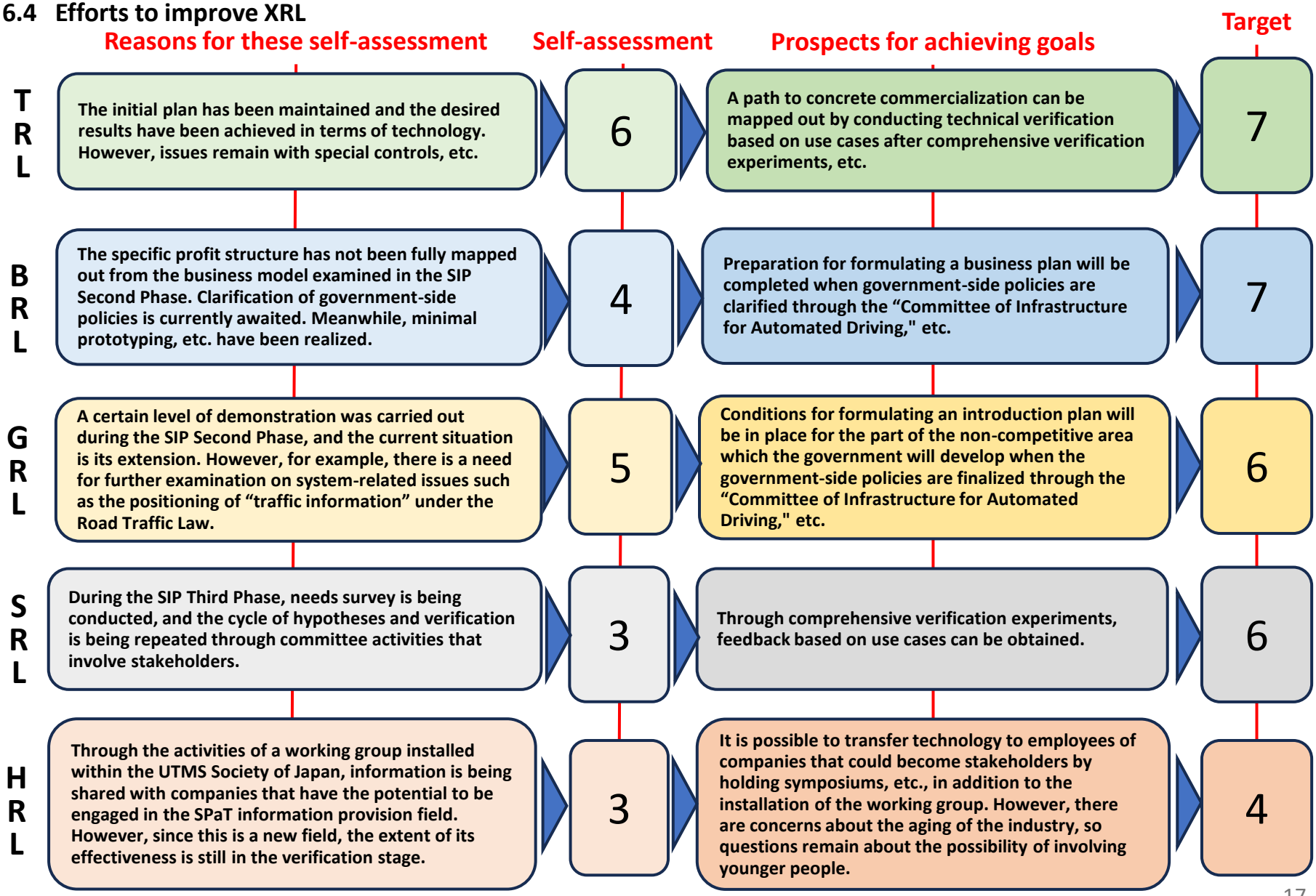


: Assumed schedule (Subject to change depending on the results of the third phase of the SIP, Committee of Infrastructure for Automated Driving, etc.)

*3 It is expected that the budget for government facility installation will be secured not only by the National Police Agency but by the government as a whole.

6. Efforts towards social implementation

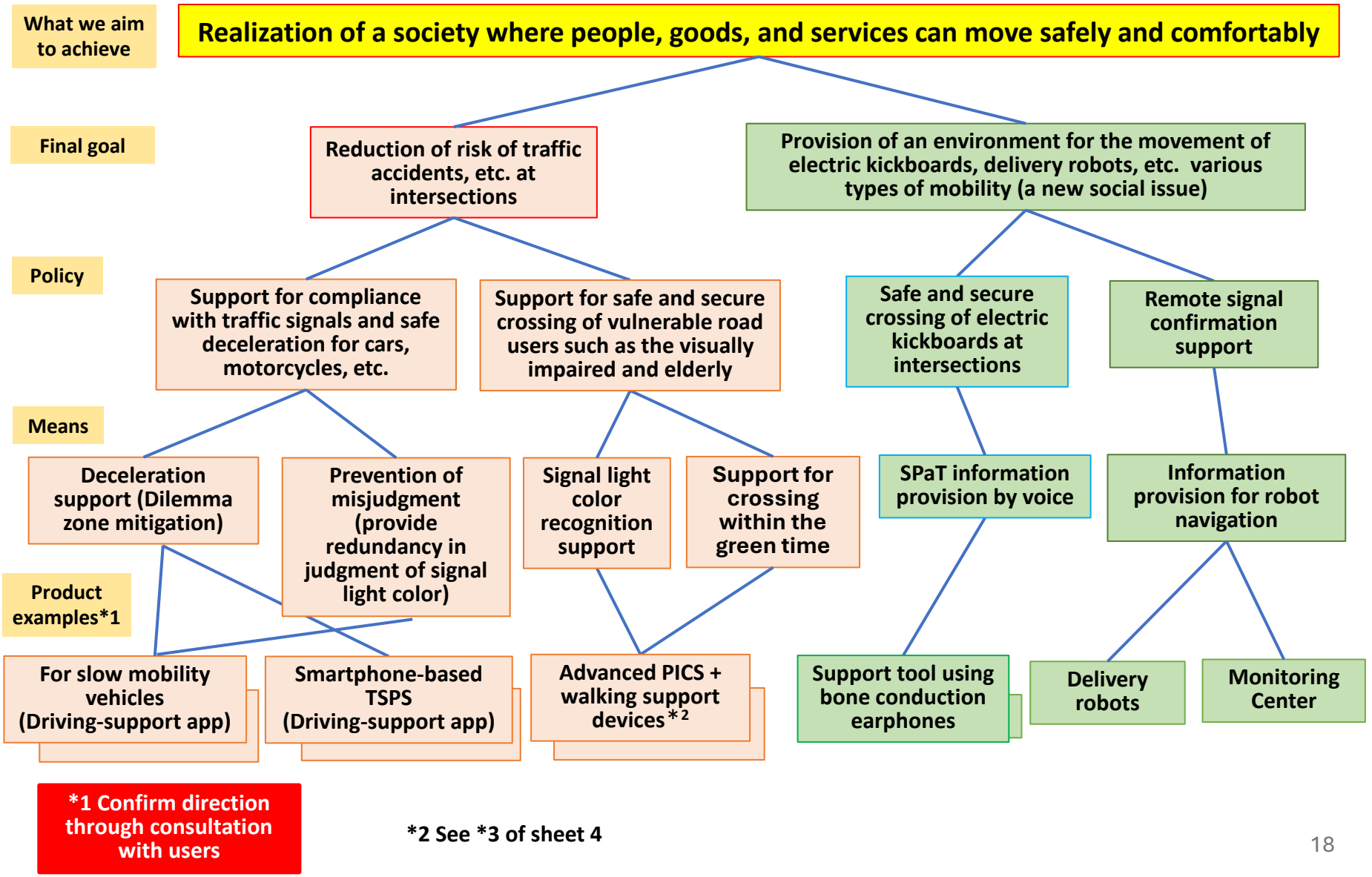
6.4 Efforts to improve XRL



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

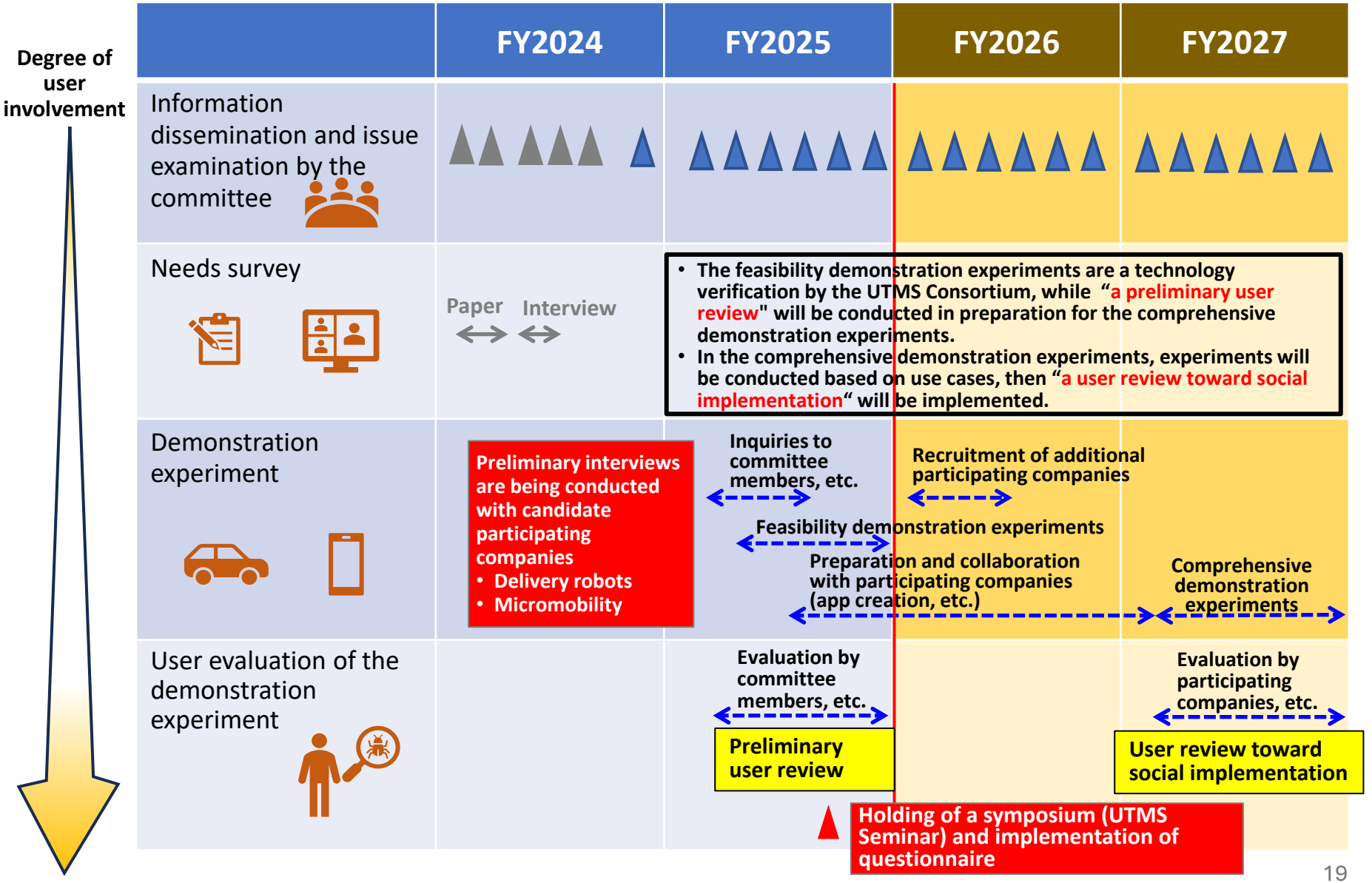
6. Efforts towards social implementation

6.5 Ripple effects (anticipated)



6. Efforts towards social implementation

6.6 Approaches related to user reviews (Appeal to stakeholders)



7. Goals and direction of the demonstration experiments

7.1 Overview of the feasibility demonstration experiments

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

FY2024 Preparation for the feasibility demonstration experiments

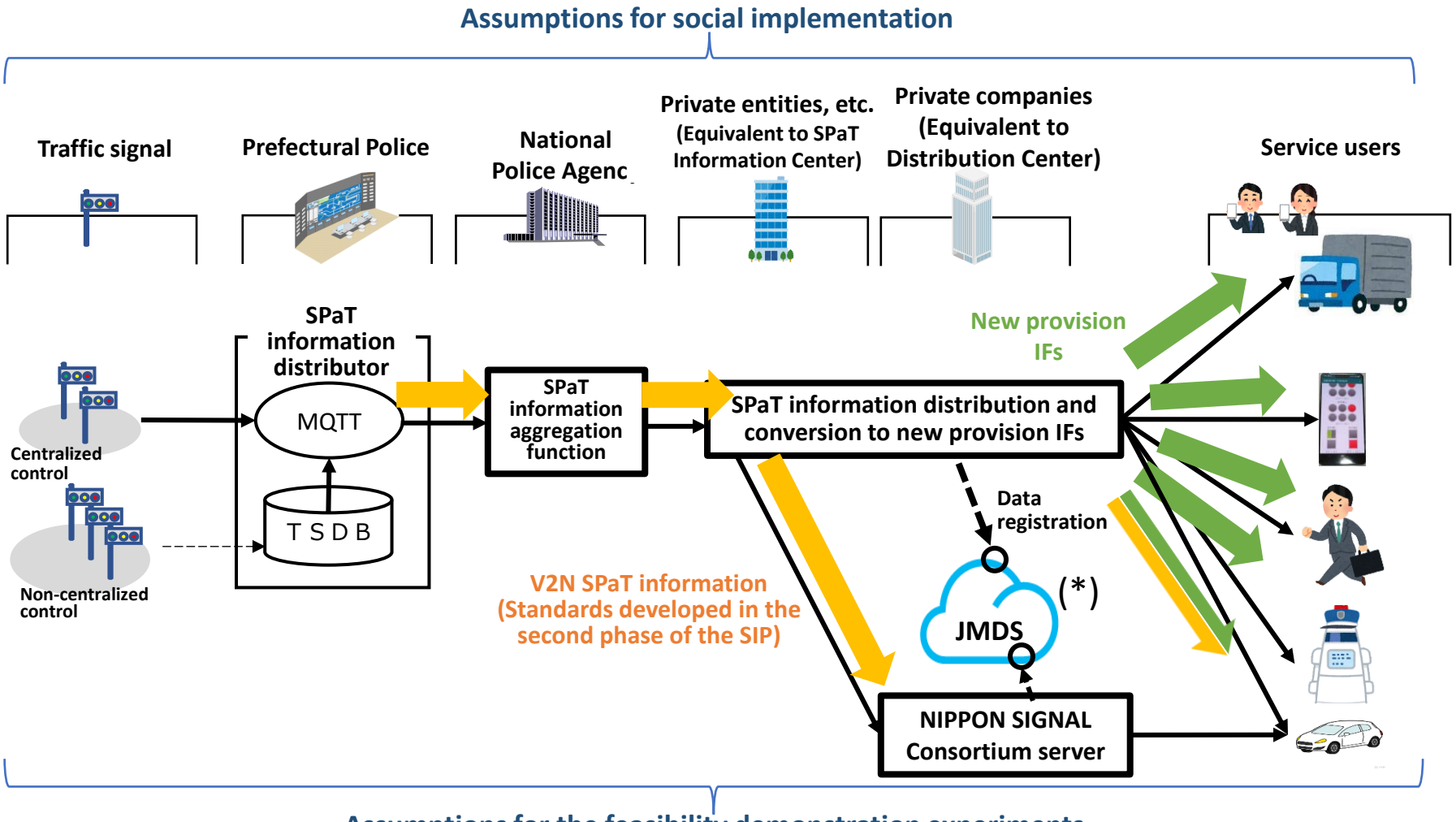
- On-premise demonstration experiment (if there are any issues to be addressed)
- Preparations for inter-consortium cooperation with NIPPON SIGNAL Consortium and NTT Data Consortium (JMDS)

FY2025 Implementation of the feasibility demonstration experiments

- Implementation of public road demonstration experiments using simulated OBUs, etc. in Ibaraki and Nara Prefectures
  - ✓ Events and other related activities involving the consortium members and participants in the demonstration experiments selected through needs surveys, etc., providing opportunities to experience the large-scale demonstration experiments. (Verification by developers and a preliminary user review)
  - ✓ For simulated OBUs and other devices, smartphones (for pedestrians) and PCs (for automobiles) were prepared.
- Implementation of inter-consortium collaboration

7. Goals and direction of the demonstration experiments

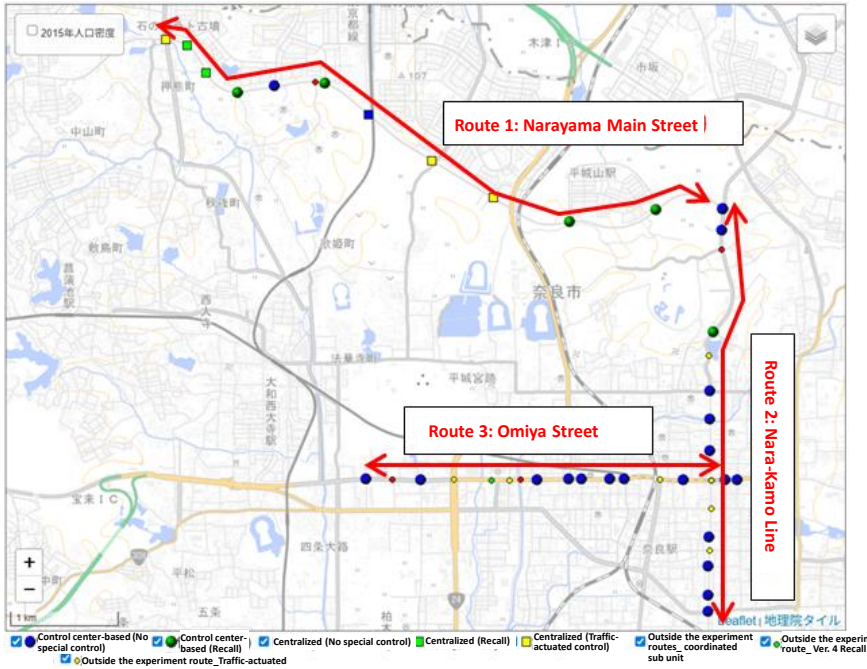
7.2 System configuration for the feasibility demonstration experiments



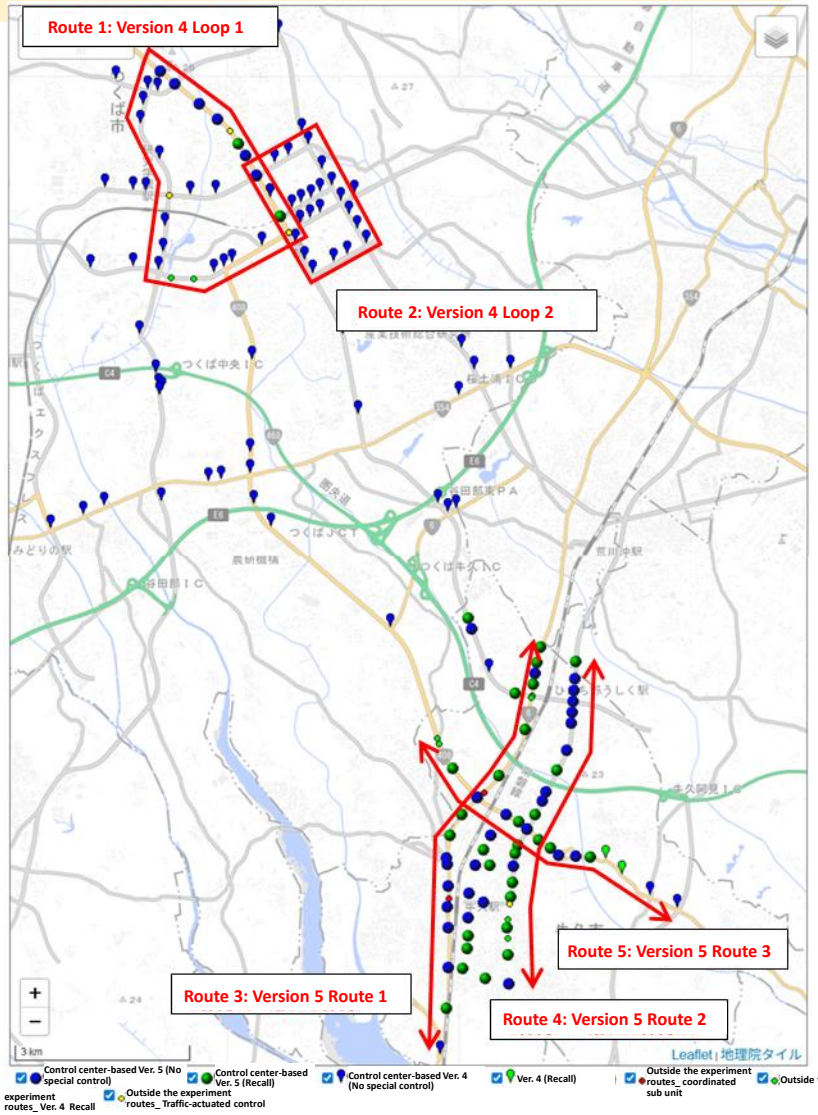
* Regarding the cooperation with JMDS, the feasibility was examined of registering intersection management information for the target intersections in JMDS, using JMDS as a portal to provide access to the SPaT information distribution platform, and providing SPaT information from that platform (preliminary examination only).
The NIPPON SIGNAL Consortium will cooperate with JMDS, acting as the equivalent of the SPaT information distribution center.

7. Goals and direction of the demonstration experiments

7.3 Location, etc. of the feasibility demonstration experiments



Nara Prefecture (Nara City) • • • Conducted at 109 intersections



Ibaraki Prefecture (Tsukuba City and Ushiku City) • • • Conducted at 162 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 synchronization by GPS, **SPaT information error within 0.3 seconds.**

7. Goals and direction of the demonstration experiments

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.**

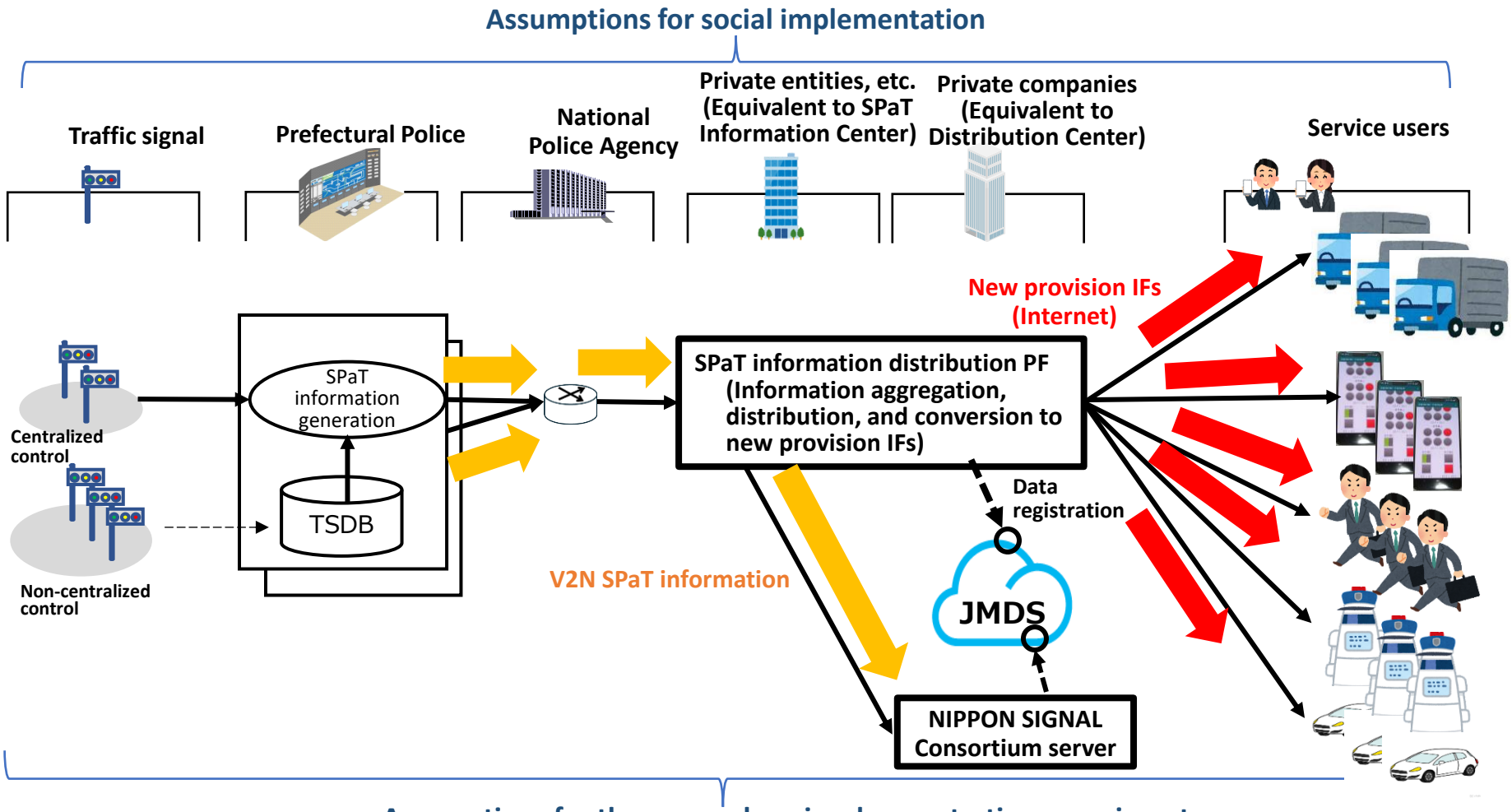
[Crossing at predetermined intersections]

Response to (2) [in the automobile space]
- **Experiments using equipment (details to be examined) installed in mobility**
- **[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. Goals and direction of the demonstration experiments

7.5 System configuration for the comprehensive demonstration experiments (Draft) [under examination]



*Implementation items for FY2026 – 2027 (Under examination)

- Connection to the Internet
- Development of applications aligned with social implementation in collaboration with user companies
- Creation and release of APIs available to a broad range of users (including the holding of app contests)
- Cooperation with JMDS

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 mobility seem to have become more apparent compared to what they were during the second phase of the SIP by 2022, and a trend also exists globally that is in line with the direction of the third phase of the SIP.**
- **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 second phase of the SIP 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 second phase of the SIP 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 mobility improves as a result of the achievements of the third phase of the SIP, it makes it possible to respond to international interest in safety and security, which further ensures our having been one step ahead during the second phase of the SIP.

8. External environment

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

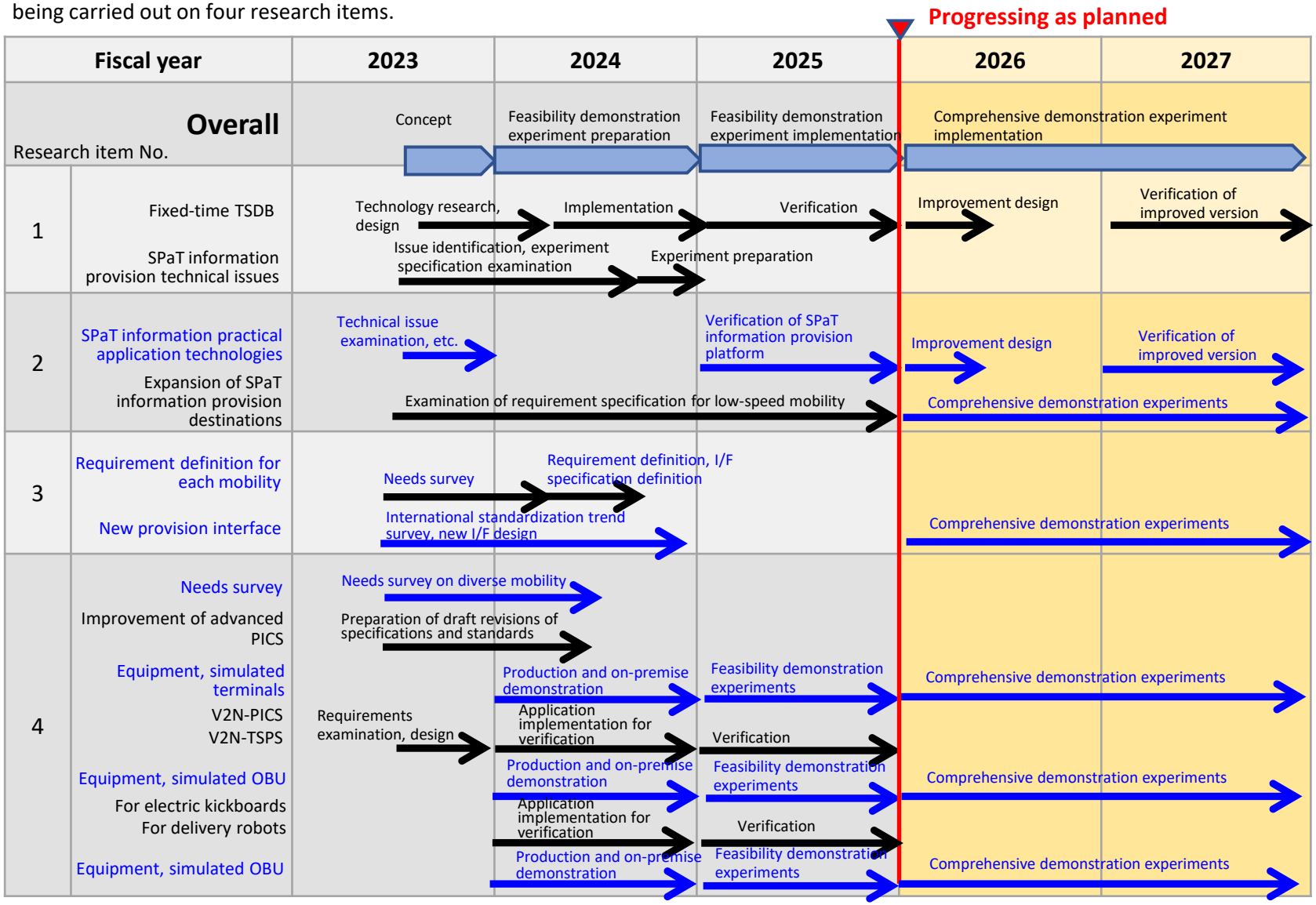
Evaluation axis	Target of evaluation								Evaluation approach
	SIP V2I	NY City, USA	SPaT Chal-lenge, USA	Austria	China	SIP V2N	TTS, Inc., USA	CS, Inc., USA	
System	V2I	V2I	V2I	V2N V2I	V2N V2I	V2N	V2N	V2N	
Function	◎	○	○	○	◎	◎	○	○	In the case where basic functions such as the number of remaining seconds 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.

Note: Benchmark symbols are presented in descending order of evaluation, as follows: ◎ > ● >○ > ▲ > △

9. Progress

9.1 Overall roadmap

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



10. Results and progress

10.1 Progress overview

Item No.	Research item	Goal		Progress summary
1	Seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems	Development of SPaT information provision technology for fixed-time traffic signals	Evaluation of a fixed-time TSDB prototype Standardization of fixed-time TSDB specifications	Conducted evaluations through the feasibility demonstration experiments Conducted standardization of the specifications Examined ways to lower costs
		Development of SPaT information provision technology for signal controls that were excluded from the scope of the second phase of the SIP	Provision of SPaT information of intersections implementing recall 2 or 3 control, SPaT information of coordinated sub units, etc.	Examined issues concerning the implementation of SPaT information provision on recall 2 and recall 3 functions, coordinated sub-units, etc., and examined the implementation using the control center-based method
2	Establishment of a SPaT information provision platform for various types of mobility	Evaluation of SPaT information generation Specification examination, establishment, and evaluation of the SPaT information provision platform		Developed draft specifications for the traffic SPaT information provision and SPaT information distribution platforms Established the platforms and conducted evaluations
3	Standardization of interfaces between the platform and mobility	Preparation of a draft for the standardization of the interfaces enabling various types of mobility to obtain SPaT information from the SPaT information distribution platform		Prepared a draft standardization proposal for connections between the NIPPON SIGNAL Consortium and JMDS
4	Diversification of SPaT information provision destinations	Provision of SPaT information to people with visual impairments	People with visual impairments (Improvement of advanced PICS)	Conducted evaluations through the feasibility demonstration experiments in collaboration with stakeholders and other relevant parties
		Provision of SPaT information to pedestrians, delivery robots, micromobility, etc.	Pedestrian crossing support (V2N-PICS technology) Examination of use cases for driving support Examination of use cases for various types of mobility	

10. Results and progress

10.2 Research item 1 Seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems

10.2.1 Development of SPaT information provision technology for fixed-time traffic signals

1. Summary of implementation details

During the second phase of the SIP, the controller-based method for providing V2N-based SPaT information from fixed-time traffic signals was devised and verified. However, issues in terms of cost and technology have been identified for practical implementation. Therefore, lowering of costs will be pursued depending on the type of signal control and controller version, by adopting configurations that do not require additional equipment or communication lines (Configurations 1 and 2), as well as by using low-cost additional equipment that require minimal construction work (Configuration 3).
After conducting experiments to verify the accuracy of SPaT information using the equipment developed and installed in FY2024, the specifications were standardized based on draft specification documents prepared by the two companies that developed the TSDB prototypes.

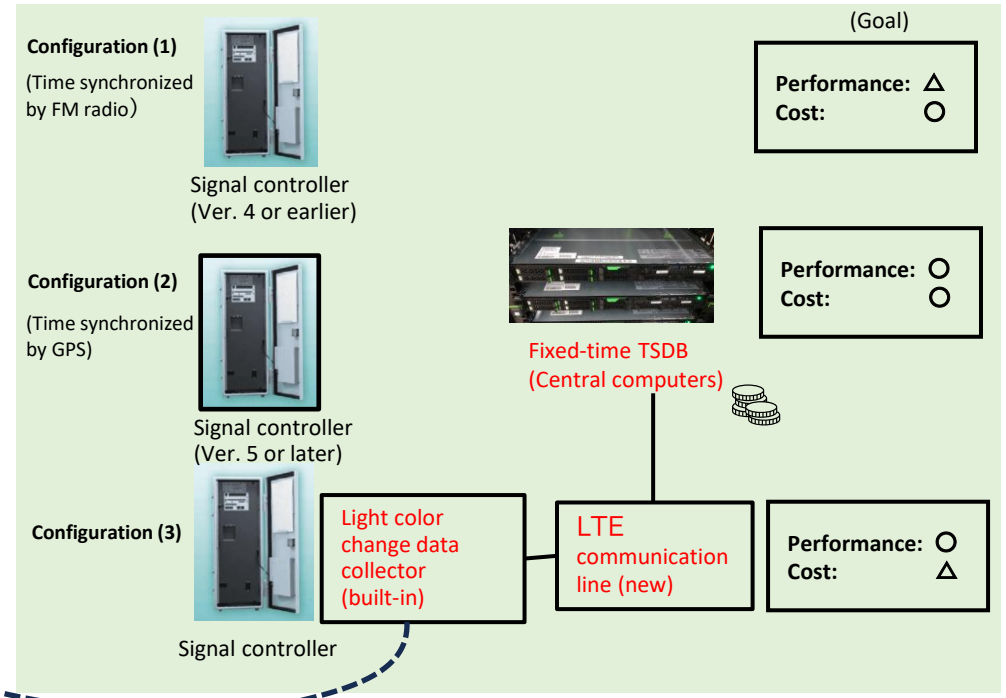
Installation percentages by signal control type and applicable fixed-time TSDB configurations

Signal control type	Installation percentage (%)	Signal controller	
		Ver. 4 or earlier	Vers. 5 or later
Coordinated control	20.3	(1)	(2)
Fixed-time	40.9	(3)	(2) *1
Push-button-actuated, etc.	23.3	(3)	(3)
Other *2	15.4		

*1 Signal control changed from fixed-time to coordinated control
*2 Includes fully-actuated, bus-actuated, railroad-actuated

Controller

A/D module (Digital conversion section for traffic signal color signals)



Configuration diagram of fixed-time TSDB unit

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.

10. Results and progress

10.2.1 Development of SPaT information provision technology for fixed-time traffic signals

2 Results for FY2025

(1) Results of accuracy verification of SPaT information

Accuracy verification of signal information generated by a fixed-time TSDB was conducted at seven intersections in Nara Prefecture and two intersections in Ibaraki Prefecture (the difference in timing of signal color changes was measured by photographing both the simulated OBU display and the actual traffic signal). It was confirmed that the measurement results from the two companies that developed the fixed-time TSDB were within the target error range.

Summary of fixed-time TSDB experimental results

Configuration	Controller			Signal light color change data collector	Number of intersections tested	Tested by (1)		Target error	Measurement results (seconds)	Result
	Version	Time synchronization	Operation			OSS	PCO			
(2)	5	GPS	Coordinated		4	○	○	Within 0.3 s	-0.17–0.17	○
(1)	4 or earlier	FM radio	Coordinated		2	○		Within 2 s	0.08–0.87	○
(3)	5	GPS	Coordinated	○	1	○		Within 0.3 s	-0.07–0.12	○
(3)	4 or earlier	None	Fixed-time	○	1	○		Within 0.3 s	-0.1–0.06	○
(3)	5	GPS	Coordinated (2)	○	1	○		Within 0.3 s	-0.04–0.13	○

Note (1) OSS: OMRON Social Solutions Co., Ltd., PCO: Panasonic Connect Co., Ltd.
Note (2) Intersection with push-button-actuated and traffic-actuated signal control

(2) Experimental results (excluding accuracy)

Test item	Test method	Result
Accuracy verification during long-term operation	Comparison of the signal controller's control history (2 months) with SPaT information	Confirmed that the error is within the target
SPaT information provision status when using signal light color change data collector	Evaluation at two intersections over a one-month period (ratio of the number of SPaT messages not provided to the total number of signal cycles)	Ratio of SPaT messages not provided is less than 0.01%
Evaluation of real-time verification function	At intersections in Configuration (3), comparison of provided signal information with signal color change timing to verify real-time error verification	Confirmed that the function operates effectively

10. Results and progress

10.2.1 Development of SPaT information provision technology for fixed-time traffic signals

(3) Standardization of TDSB specifications

Taking into account the draft specifications from the two companies, the results of the feasibility demonstration experiments, and lowering of costs at the stage of practical implementation, a draft specification integrating the fixed-time TSDB and the SPaT information distributor was prepared. Key considerations during the standardization are as follows.

Key considerations during the preparation of draft specifications

Item	Considerations during the preparation of draft specifications
Number of non-centralized signal controllers: 4096	The number of intersections processed per second under peak load and the size of accumulated data were considered.
Specification of the signal light color change data collector	The device is essential for providing SPaT information for push-button-actuated signals and legacy fixed-time signal controllers, and its performance has been verified through experiments
Integration of fixed-time TDSB and SPaT information distributor	The ultimate goal is to enable the provision of SPaT information of all signalized intersections in all prefectures. In the first phase, the number of signalized intersections providing signal information over the first five years after implementation is estimated, assuming that in most prefectures, SPaT information can be provided by a single device.

3 Plan for FY 2026

The development goals for the fixed-time TSDB initially planned have been largely achieved. Going forward, items to be implemented to further enhance the completeness of technical and operational aspects are being examined.

- **Examination of adding intersections for demonstration experiments**

SPaT information experiments for signal controllers from three other companies that have not yet been tested → Improve the completeness of the fixed-time TSDB

- **Experiments to transition version 5 fixed-time intersections to coordinated control**

SPaT information provision experiments through the transition of version 5 fixed-time intersections to coordinated control → Resolve method- and implementation-related issues associated with the transition to coordinated control

- **Response to other issues identified in the feasibility demonstration experiments**
  Examine additional issues identified in the feasibility demonstration experiments, such as responses to communication failures and handling of configuration changes in signal controllers.

10. Results and progress

10.2 Research item 1 Seamless SPaT information provision in zones with various types of traffic signals, including those of centralized and non-centralized control systems

10.2.2 Development of SPaT information provision technology for signal controls that were excluded from the scope of the second phase of the SIP

1. Examination of the provision of SPaT information of recall 2 function, recall 3 function, coordinated sub units and others

(1) Overview of implementation

By FY2024, activities verified that traffic signal controllers are capable of generating and providing SPaT information.

In FY2025, an examination of issues in the recall functions was conducted.

(2) Examination of issues

Issues in the recall functions:

- When recall requests are accepted until immediately before the next phase is executed, there are situations on both the main road and minor road where it becomes indeterminate whether the red signal will continue or the green signal will start.

→ This does not satisfy the use case requirements for automated driving (redundancy through both camera-based signal recognition and SPaT information).

Proposed measures

	Proposed measures	Impact
Option 1	Permit the signal indication (light color) to become indeterminate for applications other than automated driving.	• Although cases where a request is made immediately before the next phase is executed are rare, in operations where preparation is made assuming the start of a green signal, this may result in incorrect information.
Option 2	• Discontinue the recall function. • Modify the signal phases of the recall function, so that no timing occurs in which the signal indication (light color) becomes indeterminate.	• Modifying the existing control may have an impact on traffic. • It is difficult to implement this at all locations.
Option 3	Modify the specifications of the traffic signal controller for automated driving, and restrict the acceptable range of request timing, so that no timing occurs in which the signal indication (light color) becomes indeterminate.	Waiting time may increase depending on timing (the impact is smaller than that of Option 2). New development will be required due to specification changes.

10. Results and progress

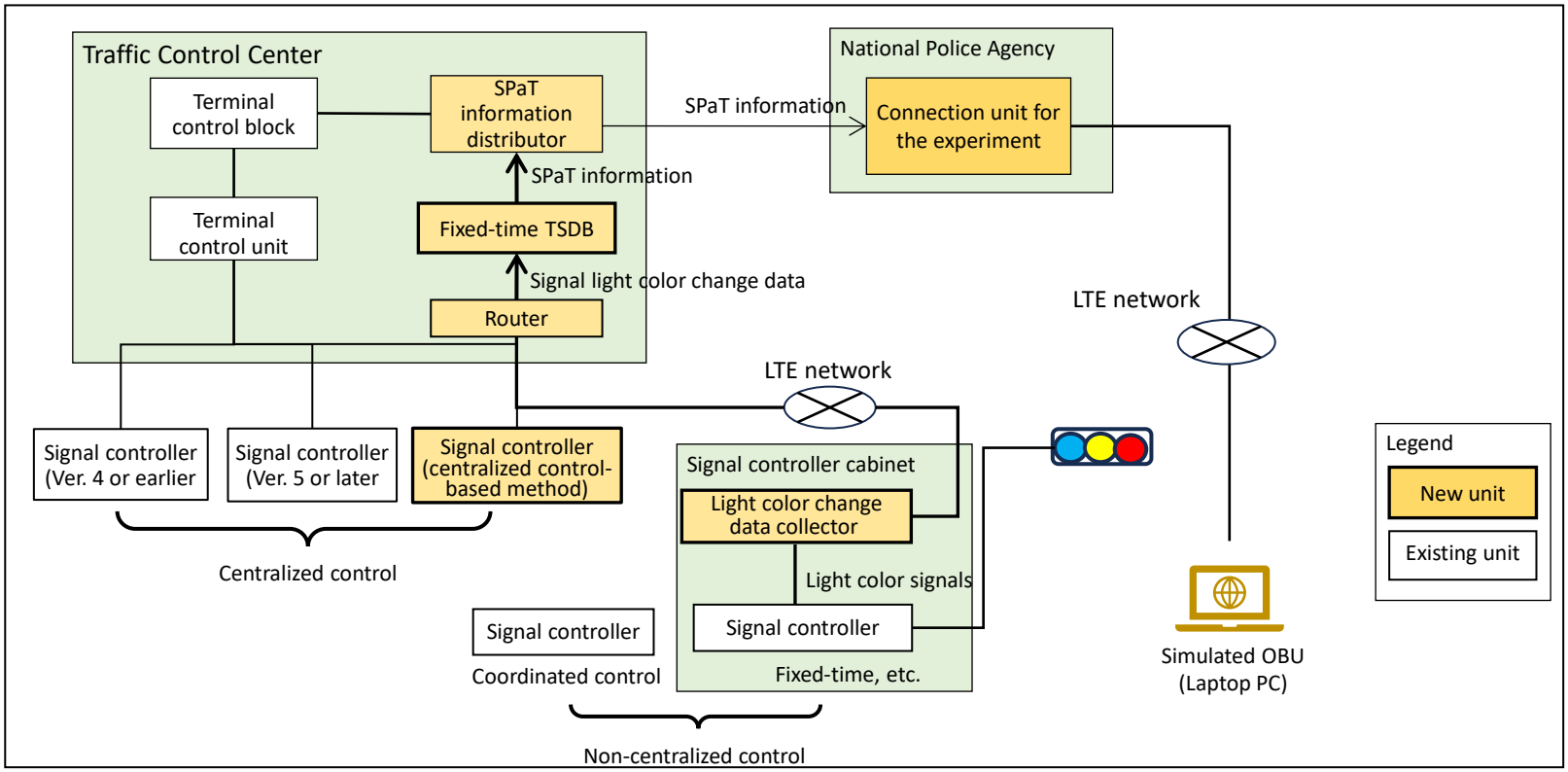
10.3 Research item 2 Establishment of a SPaT information platform for various types of mobility

10.3.1 Development of the smart mobility platform / Research and development of a general traffic signal information provision platform using V2N”

1. Summary of implementation details

The goal is to bring the SPaT information provision platform to a practical level. Among the platforms that were installed in FY2024, the system-level completeness on the traffic control center side will be evaluated.

As the first implementation item, the operational availability of the SPaT information provision was measured, and improvements were considered for intersections with low availability. As the second implementation item, the SPaT information errors of Version 4 or earlier (legacy) signal controllers covered by SPaT information provision in the third phase of the SIP were estimated, and methods for improving these errors were examined.



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

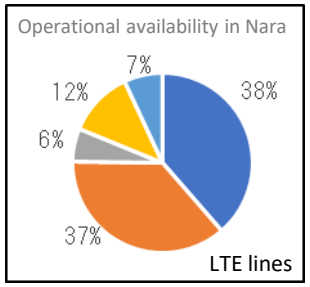
10. Results and progress

10.3.1 Development of the smart mobility platform / Research and development of a general traffic signal information provision platform using V2N”

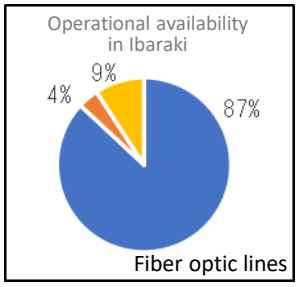
2 Results for FY2025

(1) Measurement of operational availability

The operational availability was defined as the proportion of valid signal data over the entire period, and measurements were conducted accordingly. Differences between fiber optic and LTE communication lines used between signal controllers and traffic control centers result in slight variations in operational availability due to differences in communication error rates; however, an overall availability of 95% or higher has been achieved.



Measurement period: 8 days
120 intersections (*)



Measurement period: 3 days
168 intersections (*)

Measurement results (Percentage of intersections by operational availability)

* The intersections for which the measurement was conducted include those used for technical evaluation and therefore differ from the number of intersections providing SPaT information at the end of the fiscal year.

Operational availability classification

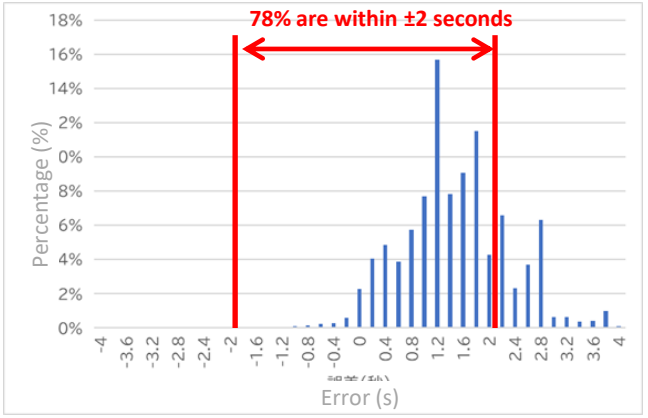
Color	Operational availability	Daily non-provision time
	100%	None
	About 99.4–99.9%	1 cycle (about 150 s) or less
	About 98.1–99.8%	2 cycles (about 300 s) or more
	About 96.4–99.6%	Multiple instances of a few seconds of non-provision (e.g., intersections with push-button actuated traffic signals)
	About 84.0–99.7%	Other

(2) Estimation of SPaT information errors in Version 4 and earlier signal controllers

Version 4 or earlier signal controllers periodically synchronize their clocks with the central computer; however, due to low synchronization accuracy, errors occur in the SPaT information.

Clock errors were estimated based on the timing of communication messages transmitted from the signal controllers to the central computer, and signal timing error estimation was performed accordingly. Overall, the error is approximately within ±4 seconds, with 78% of the errors falling within ±2 seconds. In addition, since the errors tend to be biased in the positive direction, it is possible to reduce the error by applying a negative correction to the SPaT information.

(A positive direction error indicates that the SPaT information is delayed.)



SPaT data error distribution in Version 4 and earlier signal controllers

10. Results and progress

10.3.1 Development of the smart mobility platform / Research and development of a general traffic signal information provision platform using V2N”

(3) Re-examination of intersections providing SPaT information

As part of the feasibility demonstration experiments in fiscal year 2025, a re-examination was conducted to identify intersections where signal information will be newly provided, as well as those where such provision is not feasible.
The following table shows the installation status at each control center as of the end of fiscal year 2025.

Installation status at each control center

Installation items	Installation details, Nara Pref.	Installation details, Ibaraki Pref.	Remarks
SPaT information distributor	Installed in 2022 Improved in 2024	Installed in 2024	
Number of intersections providing SPaT information	109 intersections	162 intersections	For verification from the perspective of SPaT information generation (verification across various types of intersections)
Number of routes and intersections for field tests	3 routes, 32 intersections	5 routes, 88 intersections	For verification from the perspective of use cases

3 Plan for FY2026

To ensure effective verification results in the comprehensive demonstration experiments, the addition of intersections for the demonstration experiments will be considered. Furthermore, as ensuring the quality of SPaT information is essential for the practical deployment of the SPaT information provision platform, measures to improve quality will be examined.

- **Examination of the addition of intersections for the demonstration experiments**

Examination of additional experimental routes not requiring terminal installation (i.e., intersections under centralized control), considering participant accessibility and road conditions. → To obtain effective verification results in the comprehensive demonstration experiments

Quality improvement of provided SPaT information

Continuous monitoring of operational status (availability, failures, etc.)
Development and application of tools to improve the efficiency of SPaT information verification at intersections → To identify feasible methods for ensuring quality in practical deployment

10. Results and progress

10.3.2 Specification examination, establishment, and evaluation of the SPaT information provision platform

1. Summary of implementation and results

(1) Implementation details

An infrastructure will be developed to provide SPaT information with the objective of improving safety and traffic flow at intersections for **all traffic participants**, including not only vehicles but also pedestrians, micromobility users, and delivery robots. In this demonstration, specification examination, materialization and verification will be conducted for an experimental SPaT information distribution platform equipped with SPaT information provision interfaces (hereinafter referred to as the "provision IFs") for newly participating users. Specifically, the implementation items are as follows:

- Examination of communication interfaces (proposal of new provision IFs) and examination of revised versions of common interfaces that addressed identified issues (FY2024)
- Specification examination of the SPaT information distribution platform (compatible with the new provision IFs) (FY2024–2025)
- Production of the SPaT information distribution platform and building of an environment for the feasibility demonstration experiments (FY2024–2025)
- Field verification of the functionality and performance, etc. of the SPaT information distribution platform (FY2025)

(2) Results topics

a. Development of new provision IFs and examination of a revised version of the common IFs that addressed identified issues

➡ Proposed new provision IFs (two standards) and revised versions of the common IFs (four standards)

b. Specification examination of the SPaT information distribution platform (compatible with the new provision IFs)

➡ Examined the specifications of the platform and prepared draft specification documents

c. Production of the SPaT information distribution platform and building of an environment for the feasibility demonstration experiments

➡ Produced the SPaT information platform and implemented the system with a configuration designed for social implementation.

d. Field verification of the functionality and performance of the SPaT information distribution platform

➡ Verified continuous operation under a configuration intended for social implementation and achieved support for multiple distributors

➡ Confirmed reduction in data transmission delay and fault information transmission delay, etc.

➡ Also demonstrated the effectiveness of the new provision IFs

(3) Future Work

In preparation for the comprehensive demonstration experiments, confirmation will be made to check if there are any operational problems.

List of developed draft standards and specification

[Draft Standards]
- Draft experimental message specification for V2N SPaT information provision
- Draft communication application specification between the SPaT Information Distribution Center and on-board units for demonstration experiments

[Draft standards / revised versions of common IFs]
- Draft communication application specification between the SPaT Information Center and the SPaT Information Distribution Center
- Draft communication application specification between the SPaT Information Center and the Signal Information Distribution Center
- Draft common message specification for V2N and inter-center information
- Draft communication application specification between SPaT information distributors and the SPaT information aggregation system (Reference)

[Draft Specification Document]
- Draft specifications for the SPaT information distribution platform

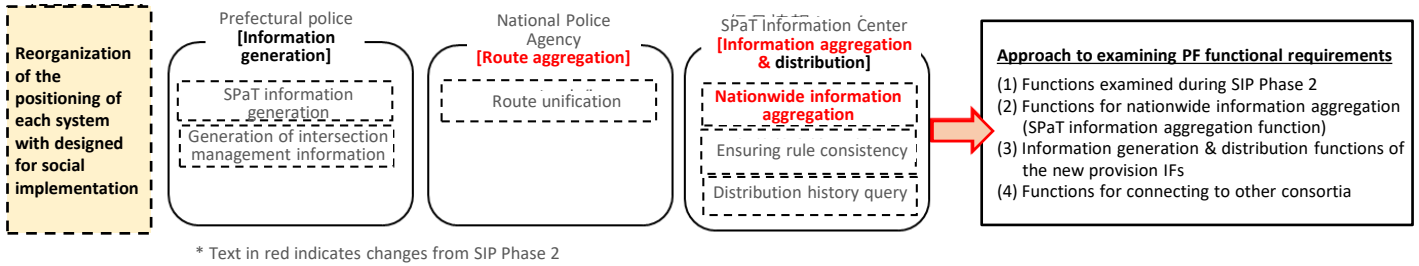
10. Results and progress

10.3.2 Specification examination, establishment, and evaluation of the SPaT information provision platform

2. Description of implemented items

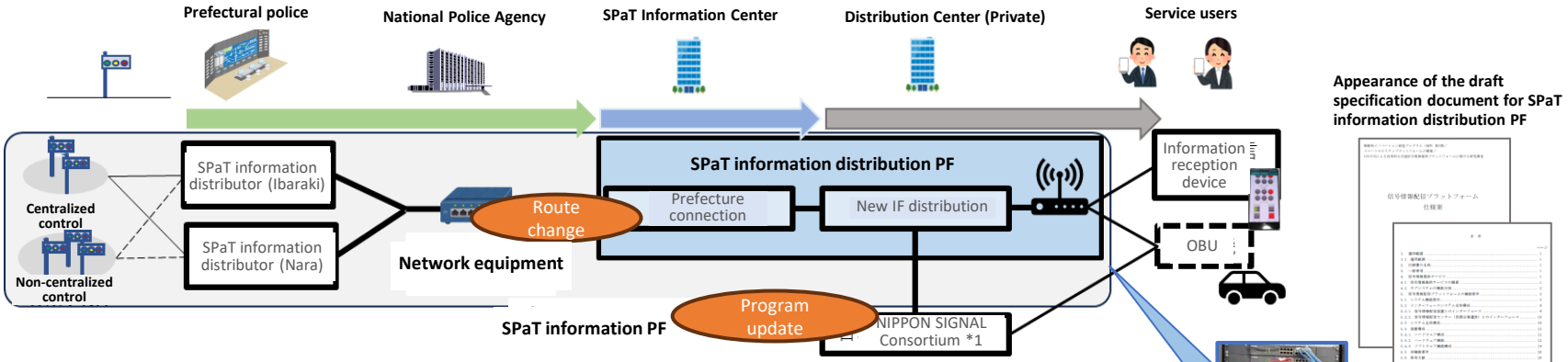
(1) Specification examination and system development of SPaT information distribution PF

- Taking into account factors such as reducing data transmission delay and costs associated with social implementation, the positioning of each system were re-examined and reorganized to provide SPaT information without passing through the relay servers installed at the National Police Agency during the second phase of the SIP.



* Text in red indicates changes from SIP Phase 2

- Based on the revised positioning, the specifications for the SPaT information distribution platform were re-examined, and a draft specification document (28 pages) was prepared. The document is intended to serve as a reference material for the equipment specifications of the SPaT Information Center.
- The experimental infrastructure for the feasibility demonstration experiments (e.g., experiential events) was established by implementing the system, including rerouting the National Police Agency's network devices and developing and updating the software for the SPaT information distribution platform.



Overall view of the established experimental infrastructure

External view of the rack-mounted SPaT information distribution PF

Appearance of the draft specification document for SPaT information distribution PF

10. Results and progress

10.3.2 Specification examination, establishment, and evaluation of the SPaT information provision platform

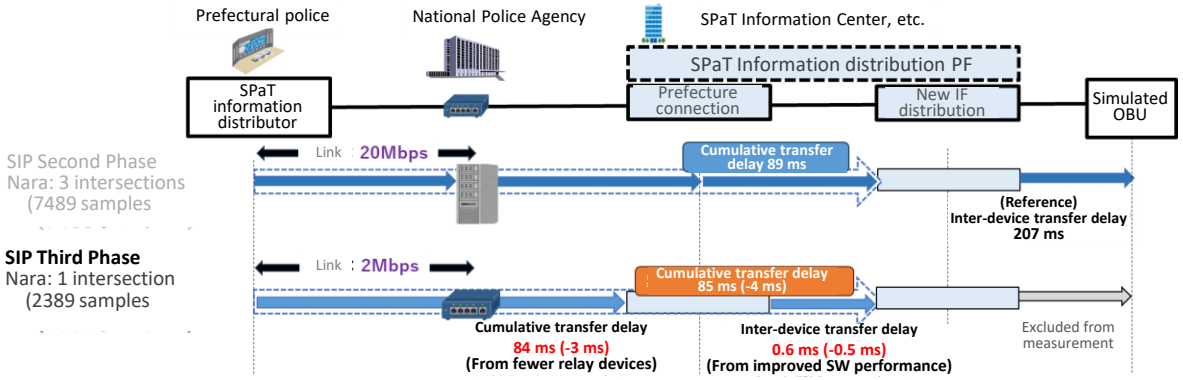
2. Description of implemented items

(2) Field verification of the functionality and performance, etc. of the SPaT information distribution platform

Basic function verification, performance verification, and abnormal-condition operation verification of the SPaT information distribution platform were conducted.

Compared to Phase 2 of SIP, the results are excellent and the technology has matured.

Verification type	Verification details	Verification results
Basic function verification	**Verification of support for the changed interface** • Confirmation that upcoming SPaT information does not have a "Retain" function • Confirmation of the deletion of measurement data **Verification of the nationwide SPaT information aggregation Function** • Discarding of upcoming SPaT information in test mode	Completed
Performance verification	**Delay time verification** • Measurement and verification of cumulative delay time of upcoming SPaT information **Verification of operational availability** • Measurement and verification of operational availability of upcoming SPaT information	• Delay time reduced by 4 ms through measures such as reducing relay devices • Operated for 2 months: Operated without any downtime of the SPaT information distribution PF • Excellent operational availability of 99.9% or higher for information provision (Both the control center-based method and the TSDB-based method)
Abnormal-condition operation verification	• Operation during inter-center failure • Verification of transmission delay during inter-center failure	• Supporting the installation of multiple traffic signal information distribution devices in a single prefecture • Delay in receiving fault information reduced by 4 ms through IF simplification



Delay time comparison with SIP Phase 2

10. Results and progress

10.3.2 Specification examination, establishment, and evaluation of the SPaT information provision platform

2. Description of implemented items

(3) Verification of new provision interface

The new provision interface aims to provide SPaT information through a more user-friendly interface for new users of SPaT information, particularly those who use pedestrian SPaT information.

[Issues with the current format (Barriers for new entrants)]

1) The current format includes quasi-static information, such as the relative positions of signal heads, within dynamic information (i.e., upcoming SPaT information), making the extraction process cumbersome.
2) Pedestrian SPaT information presents challenges such as the difficulty of identifying crossing paths, the overlap of reference information, and the lack of scalability for two-stage crossings.

[Verification details of the new provision interface]

- New intersection management information: In addition to intersection locations, the relative positions of signal units are represented as quasi-static information.
- Information on the number of remaining seconds for signal light colors: Represents the color of each signal head and its remaining seconds via signal head IDs.

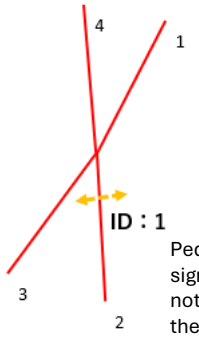
  ➡ Contributes to improved usability and readability in identifying pedestrian traffic signals.

[Verification results of the new provision interface]

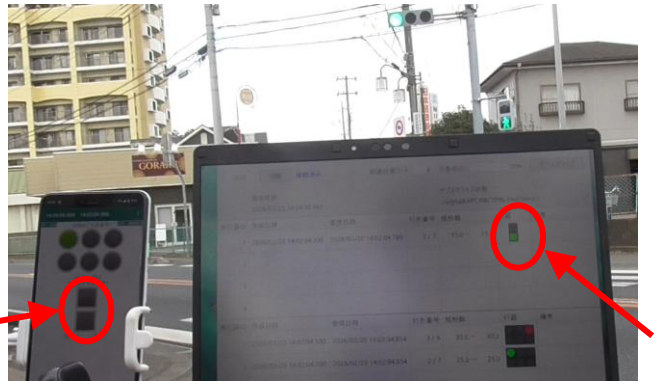
Example: Ibaraki Prefecture 7096: Kashiwada Fumikiri Iriguchi (Kashiwada Railroad Crossing Entrance) (single crosswalk)

- The new intersection management information indicates that only Pedestrian Signal ID:1 crosses Direction 2.

  ⇒By obtaining Pedestrian Signal ID:1 from the signal color/remaining seconds information, the pedestrian signal information for the crosswalk can be easily identified.



Pedestrian traffic signal information is not displayed from the upcoming SPaT information.



Pedestrian traffic signal information is displayed from the signal color/remaining seconds information.

At the site, from the position of Direction 3 (where a user crosses), there is a crosswalk on Direction 4 in the left-turn direction. However, the pedestrian traffic signal information for crossing Direction 4 cannot be obtained from the upcoming SPaT information.
On the other hand, the signal color/remaining seconds information allows for easy retrieval of the pedestrian SPaT information via the unique Pedestrian Signal ID:1.

10. Results and progress

10.4 Research item 3　Standardization of interfaces between the platform and mobility

1. Implemented items and summary of results

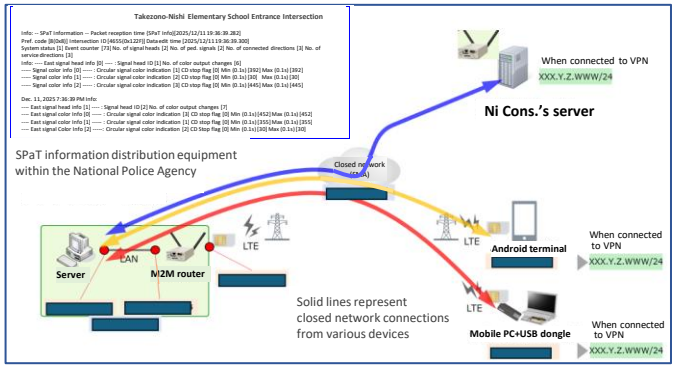
(1) Implementation details

- By establishing interconnection with related consortia, it becomes possible to add on additional value to SPaT information provision.
- In fiscal year 2025, established the connection environment between the NIPPON SIGNAL Consortium's server (hereinafter "Ni Cons. server") and the SPaT information distribution platform in Kasumigaseki and conducted verification in preparation for the experience session in Tsukuba.
- Implemented internal design for the connection with the NTT Data Consortium's JMDS.

(2) Implemented items

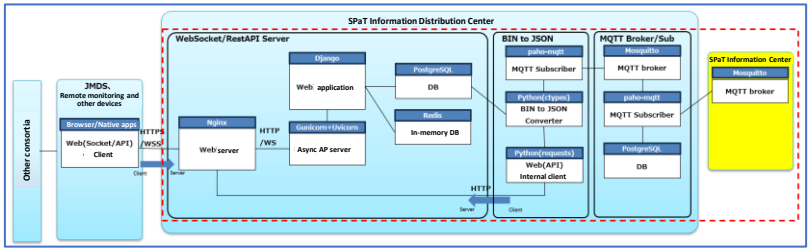
Connection with the NIPPON SIGNAL Consortium

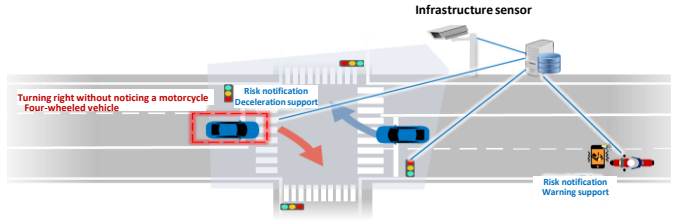
- Installed an M2M router on-premises within the NIPPON SIGNAL Consortium to enable L2TP, IPsec, and MQTTS communications.
- Established an information transmission and reception environment and demonstrated interoperability during the trial event.



Connection with JMDS

Developed the architectural design for the WebSocket/REST API conversion functionality, and explored a conversion method capable of flexibly supporting standard communication protocols for external devices.





(※)JMDS　Japan Mobility Data Space

10. Results and progress

10.4 Research item 3 Standardization of interfaces between the platform and mobility

2. Description of implemented items

(1) Implemented items

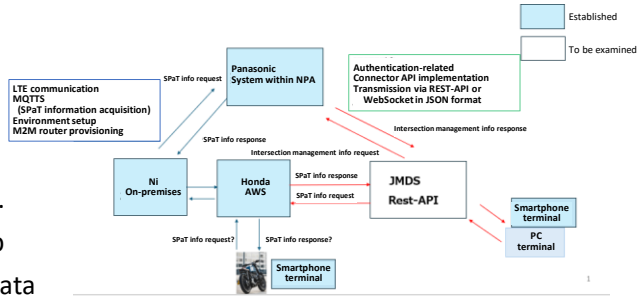
Developed a Man-Machine Interface (MMI) PoC for end-users via JMDS.

Based on the JMDS entry point (login screen), designed a mechanism encompassing end-user screen transitions and protocol conversion via WebSockets and REST APIs.

(2) Results and summary

Part 1: Completion of connection with the Ni Consortium's server

- Confirmed that SPaT information for a single intersection was transmitted in response to a request from the Ni-Consortium's server.
  Confirmed the operation through aging tests exceeding one month.
  The diagram on the right shows the Ni-Consortium's conceptual system configuration.
- Currently evaluating the potential for enabling end users' evasive actions through app notifications, based on risk assessment derived from two- and four-wheeled vehicle data and from traffic signal states determined from SPaT information.



Part 2: Examination with a view to interconnection with JMDS

Completed the architectural design assuming various protocols and data formats intended for future interconnection with the Japan Mobility Data Space (JMDS). Plan to finalize technical details, including the feasibility of connection, in coordination with relevant stakeholders.

10. Results and progress

10.5 Research item 4 Diversification of SPaT information provision destinations

10.5.1 People with visual impairments (Improvement of advanced PICS)

(1) Implementation details

By the end of fiscal year 2024, developed message specifications and conducted on-site technical verification using a prototype.

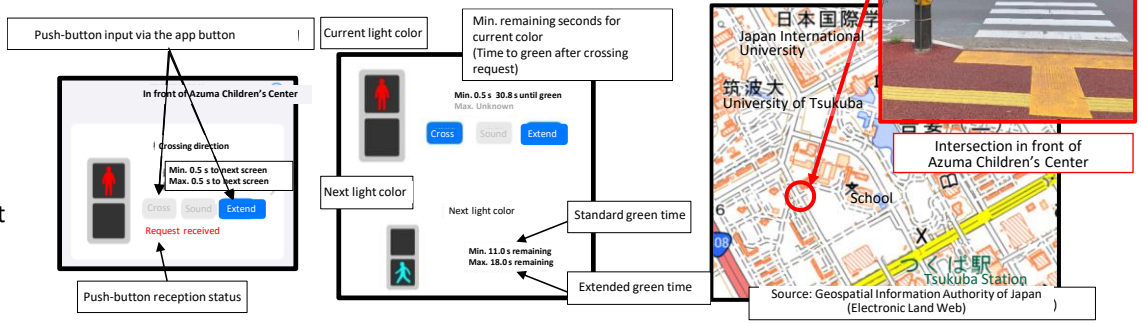
In fiscal year 2025, installed equipment and conducted user reviews in real-world environments..

(2) Implemented items

Conducted a feasibility demonstration experiment at the “Azuma Children’s Center” intersection in Tsukuba City, Ibaraki Prefecture.

Verified the following via the evaluation app.

- Voice notification of the intersection name when approaching
- Voice notification of signal color changes
- Confirmation of input/reception for crossing and extension requests
- Confirmation of the remaining seconds of current and next signal color



(3) Questionnaire survey results

- **Effectiveness of Providing SPaT information**

  Over half of the respondents found it highly effective.

  As free-form feedback, many users noted that the push-button operation via the app (an inherent feature of the Advanced PICS) was effective.

- **Utilization of remaining-second countdowns**

  Provider’s intended use cases:

  (1) Allowing users to determine if it is possible to finish crossing within the remaining green or flashing green time.

  (2) Allowing users to identify the exact wait time for pedestrians (e.g., to prevent delays in starting by allowing users to prepare to cross)

=> Over half of the respondents confirmed that the information is useful for purposes (1) and (2)

Field test

(4) Collaboration with other consortia

Conducted joint experiments with small mobility vehicles from the CYNERDYNE Consortium.

Third phase of the SIP: Cybernic Smart Mobility that contributes to re-design)

10. Results and progress

10.5.2 Pedestrian crossing support (V2N-PICS technology)

1. Implementation details

Improved some functions of the V2N-PICS application developed in the previous fiscal year.

Also conducted user reviews of pedestrian crossing support during a user experience event.

2. Implemented items

(1) Field test results

Conducted operational testing of the improved verification app at the Azuma-nishi intersection in Tsukuba City, Ibaraki Prefecture.

Confirmed the provision of crossing support information for the intersection that fell within the coverage area, based on the user's current location and SPaT information.

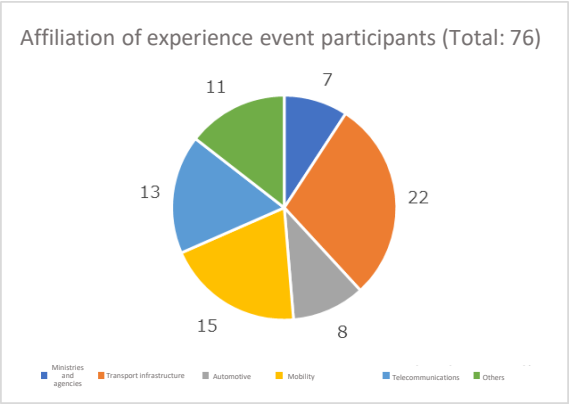
a) Current signal color

b) Visual, auditory, and vibrotactile notifications indicating whether it is safe to cross with a sufficient margin

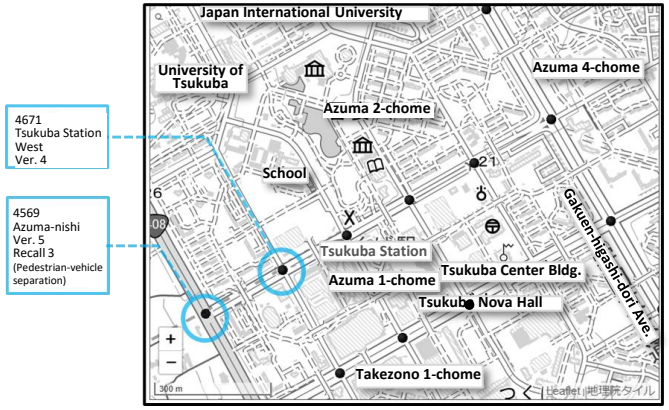
c) Provision of intersection information (push-button status and pedestrian-vehicle separation)

(2) Results of user experience event

A total of 76 participants, primarily members of the V2N Traffic Information Provision Platform Review Committee, took part in the experience event. Participants were lent smartphones equipped with the V2N-PICS application. After experiencing the pedestrian crossing support at two intersections near Tsukuba Station, they completed a survey.



Affiliation of experience event participants



Target Intersections for Crossing Support Experience (Around Tsukuba Station)

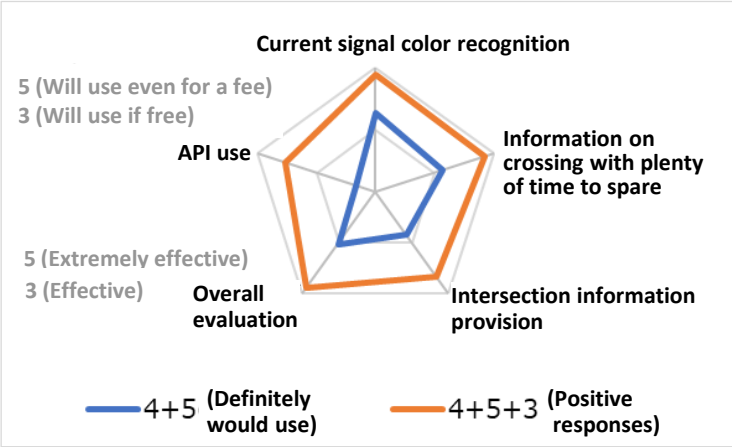
10. Results and progress

10.5.2 Pedestrian crossing support (V2N-PICS technology)

Respondents rated five items on a five-point scale. Positive evaluations (scores of 3 or higher) relative to the total number of responses are shown in the chart. While the overall ratings are high, the percentage of higher ratings (4 and 5) was relatively low for certain items, such as API use. The free-form comments and requests focused largely on practical implementation, which have been organized into a list of future considerations.

Survey items and evaluation methodology

Survey item	5-point scale criteria				
	1	2	3	4	5
Current signal color recognition	Needs improvement		Good		Exceeds expectations
Information on crossing with plenty of time to spare	Not effective		Effective		Extremely effective
Intersection information provision	Not effective		Effective		Extremely effective
Overall evaluation	Not effective		Effective		Very effective
API use	Not required		Will use if free		Will use even for a fee



V2N-PICS survey results

■Feedback and requests for practical implementation

- Regarding the feasibility of "crossing with sufficient time to spare," it would be ideal if information is provided by automatically detecting the individual's walking speed.
- It would be helpful if intersection information (especially for those with pedestrian-vehicle separation) includes voice notifications and information on crosswalk lengths.
- Since there are concerns about the effort of launching the app each time and the risks of distracted walking, it would be beneficial if the information is provided via smartwatches or similar devices.
- It would be ideal if the pedestrian SPaT information for each user could be automatically switched by utilizing gyro sensors and other technologies.
- It would be easier to understand if the information is displayed on map apps or integrated into navigation apps.
- It would be highly appreciated if the system could automatically send a crossing request when the user approaches a push-button intersection.

3. Plans for FY2026

Based on the results of the user experience sessions, functional improvements and enhanced smartphone app usability are planned, for which a large number of requests and feedback were received for practical application.

10. Results and progress

10.5.3 Driving support (V2N-TSPS technology)

1. Summary of implementation details

The "Committee of Infrastructure for Automated Driving," held by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), the National Police Agency (NPA), and the Ministry of Internal Affairs and Communications (MIC), decided in July 2025 to adopt the V2I method for SPaT information intended for automated driving. Meanwhile, the V2N method was positioned as a means to provide value to general vehicles (other than automated vehicles), pedestrians, and other road users. In response to these changes in the landscape, "Driving Support (V2N-TSPS Technology)" was added to the research item. By providing traffic signal information via LTE networks instead of optical beacons for the Traffic Signal Prediction Systems (TSPS), which has already been put into practical use, services can now be offered on routes where advanced infrared beacons are not installed. This is expected to expand both the service coverage and the number of users.

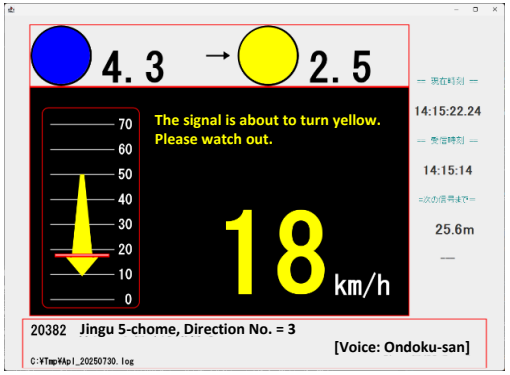
In FY2025, a prototype was developed to implement the three TSPS services (Signal passing support, Red light deceleration support, and Signal change starting support) through SPaT information provision via V2N instead of advanced infrared beacons, and confirmed its effectiveness through driving tests and user experience events.

2. Results for FY2025

(1) Overview of V2N-TSPS Application

In order to complete software development within the short timeframe leading up to the user experience event scheduled for October, a new software was developed that implements the three TSPS services by utilizing real-time location and SPaT information output from the already- developed simulated on-board unit software. An implementation example of the "Red Light Deceleration Support" service is shown below. Note that the screen interface was developed for testing purposes; the driver operates the vehicle by listening to voice-guided support messages without the need to look at the screen.

Example of Red light deceleration support



Sample screen of Red light deceleration support

10. Results and progress

10.5.3 Driving support (V2N-TSPS technology)

(2) Driving test results

Driving tests were conducted on eight test routes in Nara and Ibaraki Prefectures. The target intersections and the directions for which the support is provided were identified, and the accuracy of the distance to the stop line and the precision of SPaT information were confirmed, which was followed by the confirmation of the validity of the voice guidance timing and content of support messages. The percentage of each of primary support message services provided are as follows (based on driving results at a cumulative total of 384 intersections):

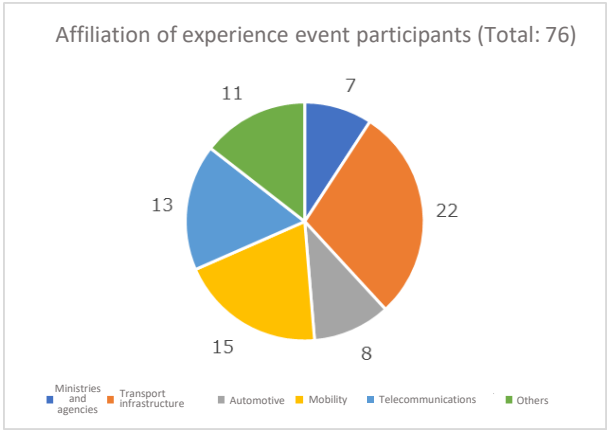
The percentage of primary support message services provided

Support function	Support message content	Percentage of service
Signal passing support	“You can pass at the recommended speed.”	46.6%
Red light deceleration support	“Please drive carefully and pay attention to the signal.”	3.2%
	“Please watch for the red light.”	14.1%
Signal change starting support	“The signal will turn green soon.”	14.1%

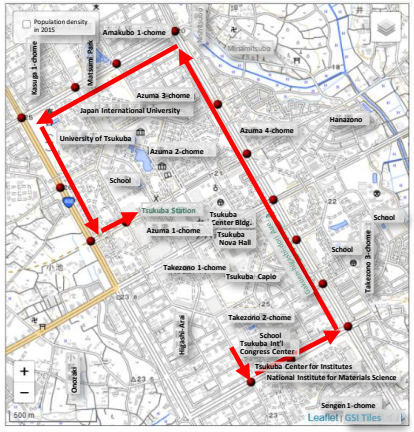
Note) The "recommended speed" is defined as a range between the regulatory speed minus 10 km/h and the regulatory speed.

(3) User Experience Event Results

A total of 76 participants, primarily members of the “Traffic Information Provision Platform Review Committee” , took part in the user experience event. Participants rode in large taxis along a demonstration route consisting of 15 intersections around Tsukuba Station. After experiencing the support messages voiced according to the situation, they completed a questionnaire.



Affiliation of experience event participants



Demonstration driving route (Tsukuba City)

Scene from the in-vehicle demonstration

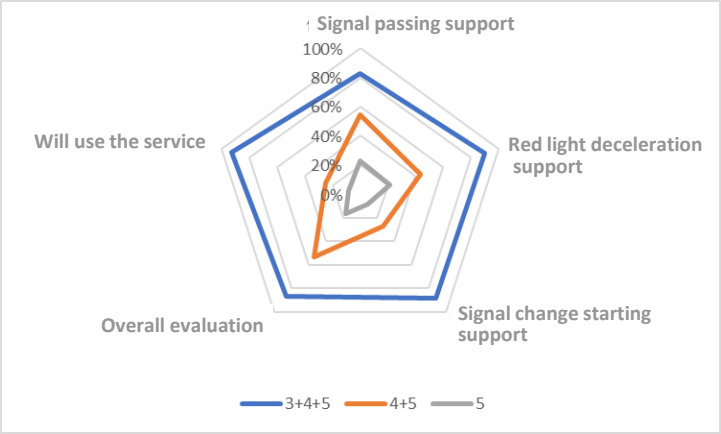
10. Results and progress

10.5.3 Driving support (V2N-TSPS technology)

Respondents rated five items on a five-point scale. Positive evaluations (scores of 3 or higher) relative to the total number of responses are shown in the chart. While the overall ratings are high, the percentage of higher ratings (4 and 5) was relatively low for certain items, which are considered areas for improvement toward practical implementation. In addition, a total of 52 free-form comments and requests were received, which were classified into five categories and organized as items for future consideration.

Survey items and evaluation methodology

Survey item	5-point scale criteria				
	1	2	3	4	5
Signal passing support function	Not required		Good		Definitely would use
Red light deceleration support	Not required		Good		Definitely would use
Signal change starting support	Not required		Good		Definitely would use
Overall evaluation	Equivalent to current TSPS		Has potential, but difficult to judge		Experienced clear improvements over current TSPS
Service use	Not required		Will use if free		Will use even for a fee



V2N-TSPS survey results

3. Plans for FY2026

Based on the results of the user experience events, “Driving support use case examination” will be continued to better address end-user needs during the comprehensive feasibility experiments, along with the planning of implementation items to support application development toward practical implementation.

- **V2N-TSPS prototype improvements**

Response to free-form comments and requests
Development of the smartphone version

→ Increase the number of long-term participants in the comprehensive demonstration experiments designed to stimulate end-user demand—a prerequisite for practical implementation (participants use their own smartphones to experience driving assistance firsthand.)

- **Environment configuration for smartphone application development**

Development of SDK for Android smartphones (sample programs)

→ Support the development of smartphone applications using V2N SPaT information (to shorten development time and improve development efficiency)

10. Results and progress

10.5.4 Utilization for electric kickboards

(1) Overview of implementation

Based on discussions with an electric kick kickboard sharing service providers and other stakeholders, the following use case has been assumed: "Electric kickboards operate at a maximum speed of 20 km/h, a speed range many users are not accustomed to, which makes judging intersection crossings difficult. By providing signal stopping support through the utilization of SPaT information, reckless intersection crossings can be deterred, contributing to safer riding."

(2) Implementation details

1) App for electric kickboards

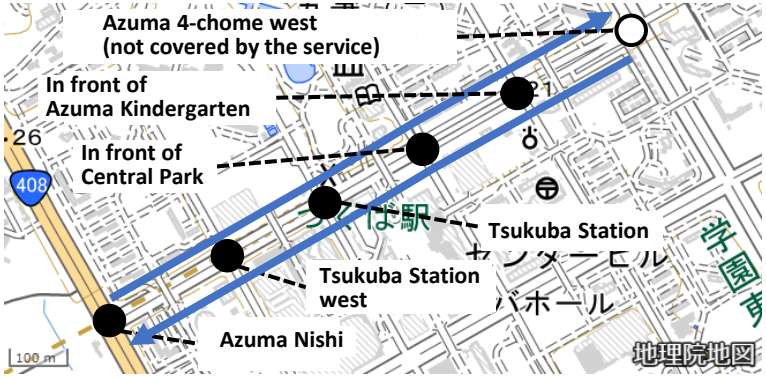
Based on the vehicle's location and SPaT information, the app determines whether it is possible to safely pass through an intersection and provides five types of voice guidance.

a) Readout of signal unit, color, and remaining seconds
b) Stopping assistance and prompts to proceed
c) Guidance for green light start
d) Notification of invalid SPaT information
e) Warning announcement for wrong-way driving

Experience session conducted with screen off and voice-only

2) Verification method (Overview of the demonstration during the experience session)

- Demonstration conducted using electric kickboards brought in by the providers
- Verification conducted with staff members selected from among the providers' employees served as riders
- Verification on a one-way route of approximately 1 km, from Azuma 4-chome west to Azuma West



○ Sample voice guidance

• In front of Azuma Kindergarten	You can proceed straight through
• In front of Central Park	Please stop at the stop line
• Tsukuba Station	The light has turned green
• Azuma Nishi	End of course

10. Results and progress

10.5.4 Utilization for electric kickboards

(2) Implementation details

3) Verification results

Rating ★★★★☆ 4.1 (Evaluated by 8 participants from 2 sharing service providers)

[Positive comments]

- Voice guidance on signal colors, remaining seconds, and stopping instructions provided a sense of security.
- Linking smartphone apps with insurance, etc. gave users a clear image of a viable product.

[Negative comments]

The alert *"SPaT information invalid. Please check the traffic light."* caused anxiety.

(Incident occurred due to a communication error between traffic signals and the control center

➡ This highlights that the sense of security depends entirely on reliable SPaT information.)

[Requests/related comments]

- Would also like to receive additional driving support information (designated lanes, two-stage turns, warnings for being caught in by left-turning vehicles).
- Would like to receive alerts even at intersections without SPaT information provision (e.g., "Please follow the traffic lights while riding").
- Appreciated the wrong-way driving alert feature, as well
- The wrong-way driving alert feature was also highly appreciated.
- Would like the voice guidance not to be distracting.

Kickboard app experience session

4) Estimated effectiveness report

Based on the results of this experiment, the effectiveness of the examined use cases was successfully validated.

5) Future work

With the rise in reckless crossings and accidents at intersections involving electric kickboards, there are high expectations for safe riding support apps that utilize SPaT information. Furthermore, integrating such apps and linking them to insurance coverage during use is expected to further raise safety awareness and motivation for safe riding. From these dual approaches, the research aims to contribute to the riding safety of micro-mobility.

10. Results and progress

10.5.5 Utilization for delivery robots

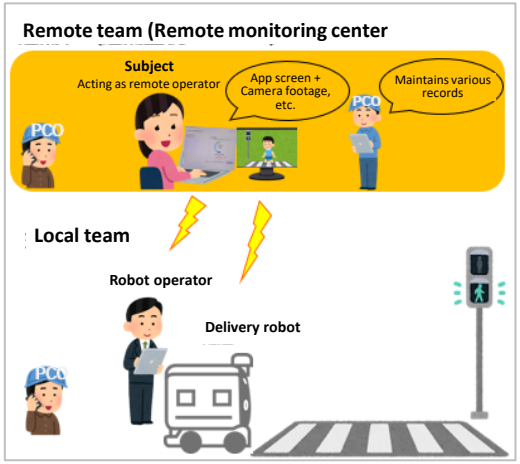
(1) Overview of implementation

Based on discussions with delivery robot operators and manufacturers, the following use case has been assumed:
"The provision of crossing support through the utilization of SPaT information will contribute to assisting remote operators of delivery robots in determining when to have the robot start crossing, improving the operational efficiency of robots (when they can arrive at a green light thanks to SPaT information), and creating capacity for the operators to handle other operations and tasks (when robots arrive at a red light)."

(2) Implementation details

1) App for delivery robots (SPaT information display app)

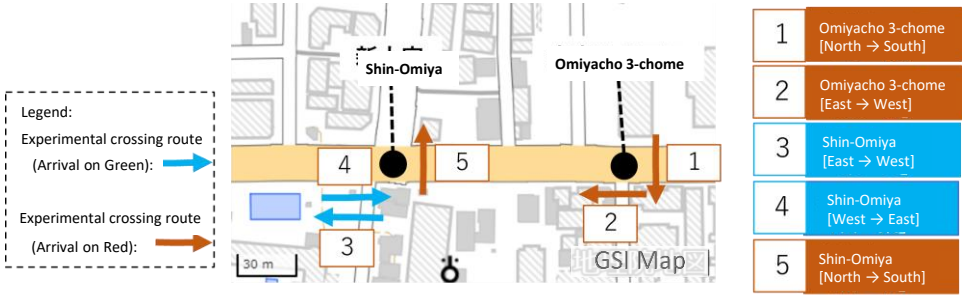
Determines whether crossing the intersection is possible based on SPaT information, and provides guidance through screen displays and voice notifications.



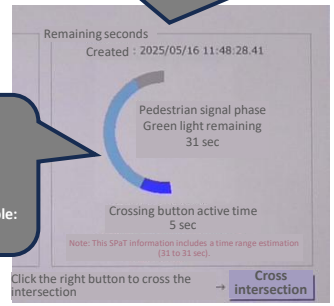
2) Verification method (Over view of verification demonstration)

- Participants were divided into a "Remote Team" (subjects acting as remote operators of the delivery robot) and a "Local Team" (on-site robot operators).
- On-site robot operators controlled the delivery robot via manual operation.
- Subjects simulated remote monitoring and control of the delivery robot using the operational environment, communication devices, and the SPaT information display app.

- Test runs were conducted at intersections on National Route 369 in Nara City, Nara Prefecture, taking approximately 20 minutes per lap.
- A total of four runs were performed: two without SPaT information and two with SPaT information.



Remaining seconds display
- Blue : Green light duration (Crossing allowed)
- Light blue : Green light duration (Crossing NOT allowed
- Gray : Flashing green light duration (Crossing NOT allowed)
- Red : Red light duration



〇 Voice guidance examples
- 10 seconds before changing from Red to Green
  "Signal will turn green in 10 seconds."
- When Green light begins:
  "The light is green. Crossing is allowed."
- When Green light is active but crossing is no longer possible:
  "Crossing is not allowed. "

10. Results and progress

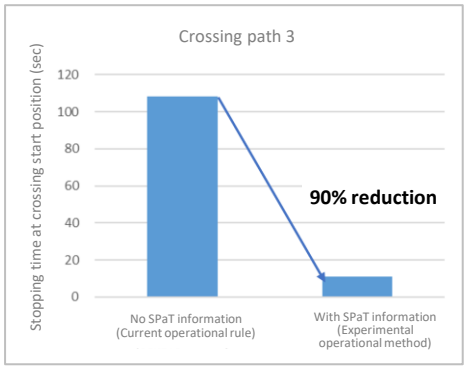
10.5.5 Utilization for delivery robots

(2) Implementation details

3) Use case verification

Upon arrival on a green light: Unnecessary stopped time at intersections was reduced by up to 90% (Chart on the right).

Upon arrival on a red light: Screen-gazing time was reduced by up to 69 seconds (an 85% reduction).



Comparison of stopped time at crossing start position (sec)

4) Verification results (Interview results)

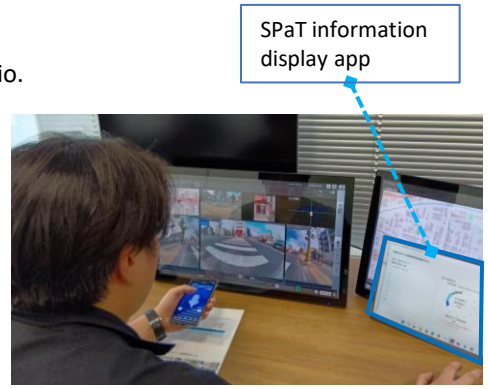
Rating ★★★★★ 4.5 (Evaluated by 2 subjects)

[Positive comments]

- Would like to use this app in real-world operations as well.
- Felt that SPaT information is useful for the smooth operation of delivery robots.

[Negative comments]

- The amount of information displayed was too large, and there was a lag between the video and audio.
- Felt confused and burdened by the operational differences between daily tasks and this verification.



Verification using the SPaT information display app

[Requests and related comments]

- Would like to see the early addition of a touch function and embedding into the monitoring screen.
- The indicators were very easy to see.

5) Report on effectiveness estimation

Based on the results of this experiment, the effectiveness of the examined use cases was successfully validated.

Some subjects expressed a desire to use SPaT information in actual operations.

6) Future work

Information delivery methods that consider operational aspects will be examined by improving the app's displayed information and voice notification timing.

11. Relations with stakeholders

Large-scale feasibility demonstration experiments stakeholder participation

◯ Date and time: October 7–8, 2025

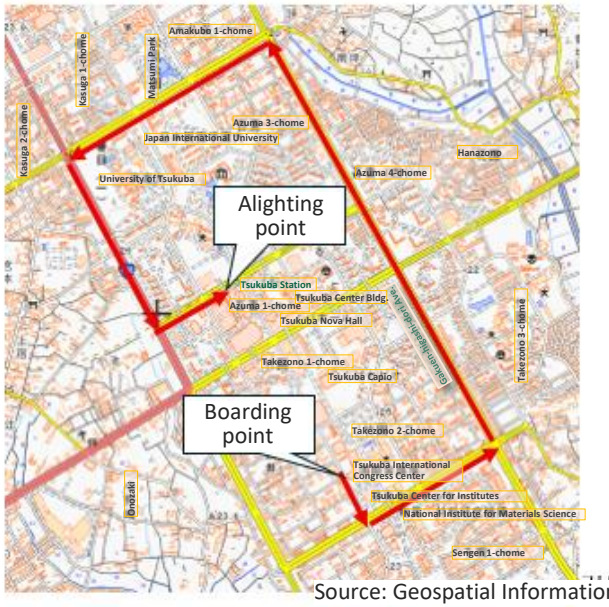
◯ Location: Tsukuba City, Ibaraki Prefecture

◯ Content of the review by participants from the Committee

- Experience of safe driving support through vehicle driving
- Experience of services for pedestrians
- Experience of systems for visually impaired users
- Experience of services for micro-mobility in collaboration with CYNERDYNE
- Experience of services for electric kickboards
- Experience of services for bicycles
- Experience of services for remote monitoring operators

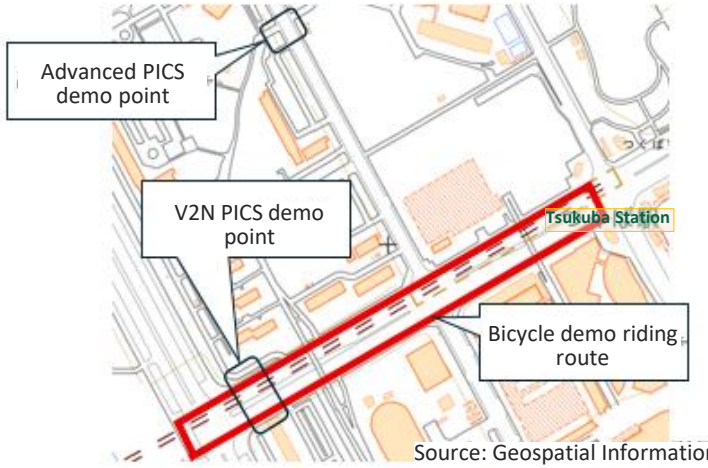
◯ Participants (77 individuals from 25 companies/organizatior

- Government agencies
- Traffic infrastructure manufacturers
- Automobile manufacturers, etc.
- Mobility service providers
- Map-related companies, etc.
- Telecommunications business operators
- Related organizations



Source: Geospatial Information Authority of Japan (GSI)

Demo route for SPaT information provision



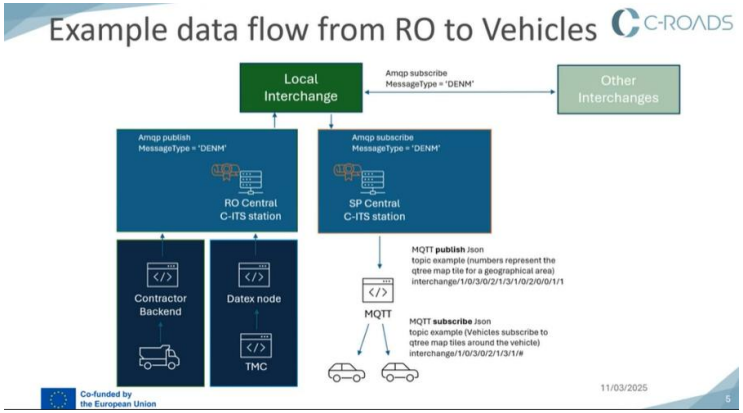
Source: Geospatial Information Authority of Japan (GSI)

Other demo points

12. International initiatives

Promoted the significance the conference theme as the UTMS Consortium; requested presentations from two international experts (US & Europe), and successfully realized them

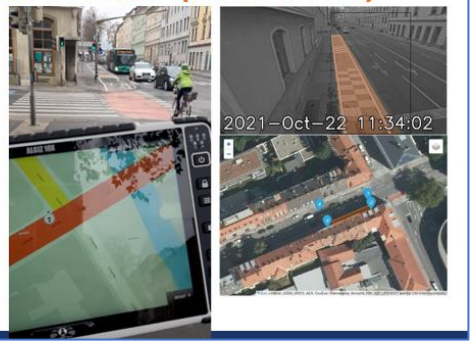
ITS World Congress (August 27, 2025, Atlanta, USA)
(Global dissemination of activities in the third phase of the SIP)
SIS24: Enhancing Intersection Safety
(How do we improve safety within intersections?)
From left: Mr. Mattin Böhm (Europe), Ms. Hatasaki (NIPPON SIGNAL Consortium), Mr. Kato (National Police Agency), Mr. Takayanagi (UTMS Consortium), Ms. Valerie Shuman (USA), Mr. Hiyama, SIP, Cabinet Office, Government of Japan



SPaT information platform
Utilizes the AMQP protocol between intersections and MQTT between the center and on-board units
 # Bulk data reception via command

HLN Animal or Person on the Road (HLN-APR)

- Bicycle approaches the signalised intersection in the blind spot of a right turning vehicle
- Video detection (min. speed, direction)
- Warning information via ITS-G5 (for drivers of a vehicle)
- In future C-ITS equipped bicycles?



In Europe, on-board terminals for bicycles are installed by default. (Blind spot information and SPaT information display terminals are mounted on bicycles)

- Intersection Status
- Signal Priority (Preemption)
- Vulnerable Road User Requests
- Traveler Warnings
- Traffic Signal Management/Optimization
- Cooperative Perception

The four-pillar project in the US (Focusing on cooperative perception)