戦略的イノベーション創造プログラム
Cross-ministerial Strategic Innovation Promotion Program

Cross-ministerial Strategic Innovation Promotion Program. The third phase of the SIP/ Establishment of smart mobility platform / Subtitle IV-2. Supported Infrastructure and data base 「Realization of Shared Space through Digital Smart Mobility」

March 2025

Tsukuba Smart City Consortium
University of Tsukuba(Lead organization)
Tokio Marine & Nichido Fire Insurance Co.,Ltd.
NIPPON KOEI
NEC Corporation
KDDI CORPORATION
Mitsubishi Electric Corporation

Table of Contents

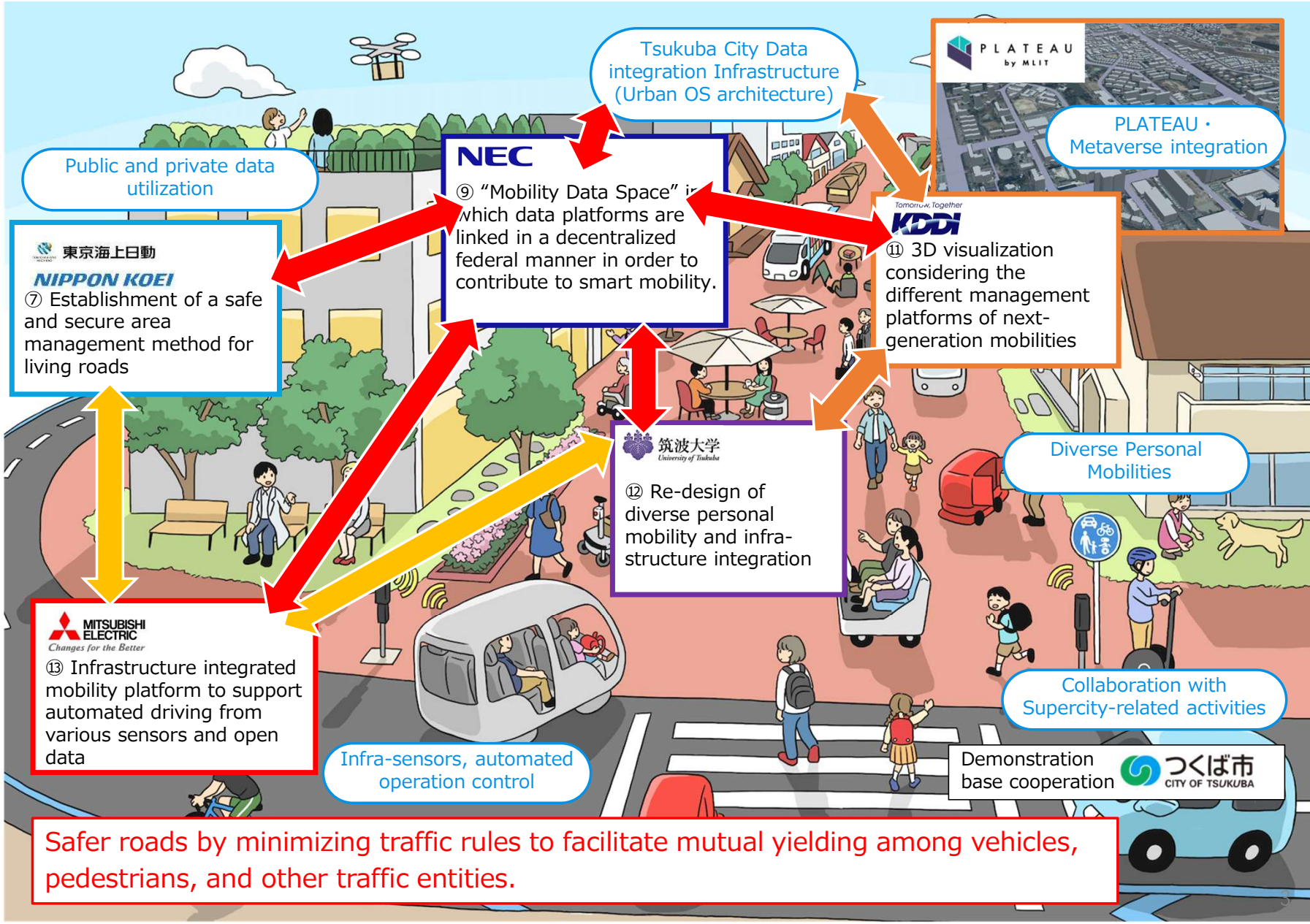
Concept

SIP

Tsukuba Smart City Consortium: Shared Space through Digital Smart Mobility

Partners:
University of Tsukuba (Lead organization), Tokio Marine & Nichido Fire Insurance, NIHON KOEI, NEC, KDDI and Mitsubishi Electric

Feasibility Study Field:
City of Tsukuba



Validation scenario

SIP

Tsukuba Smart City Consortium: Shared Space through Digital Smart Mobility

Partners:
University of Tsukuba (Lead organization), Tokio Marine & Nichido Fire Insurance, NIHON KOEI, NEC, KDDI and Mitsubishi Electric

Feasibility Study Field:
City of Tsukuba

NEC
⑨ “Mobility Data Space” in which data platforms are linked in a decentralized federal manner in order to contribute to smart mobility.

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⑦ Establishment of a safe and secure area management method for living roads

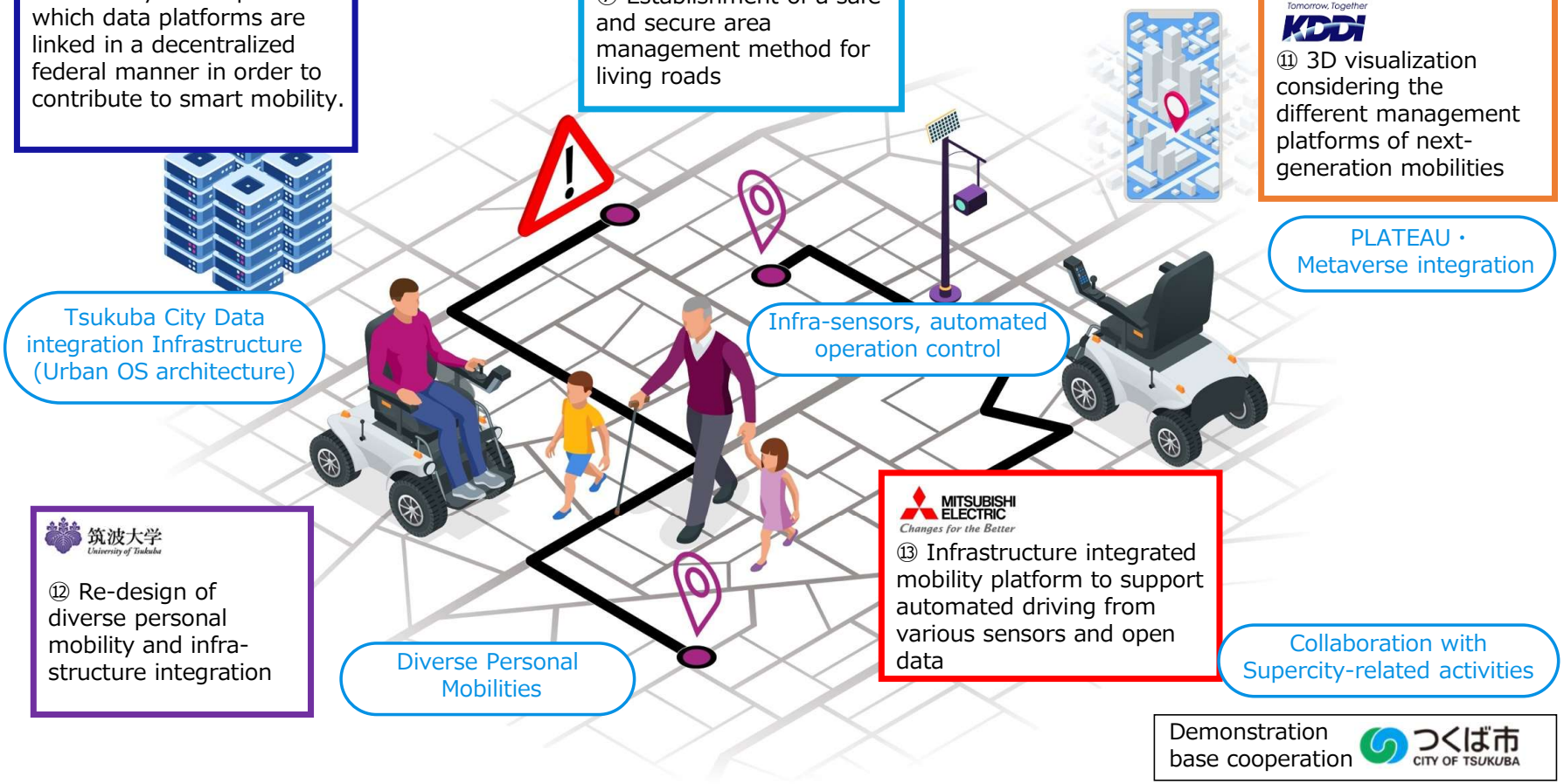
Public and private data utilization

KDDI
⑪ 3D visualization considering the different management platforms of next-generation mobilities

PLATEAU・Metaverse integration

Tsukuba City Data integration Infrastructure (Urban OS architecture)

Infra-sensors, automated operation control



筑波大学 University of Tsukuba
⑫ Re-design of diverse personal mobility and infra-structure integration

Diverse Personal Mobilities

MITSUBISHI ELECTRIC Changes for the Better
⑬ Infrastructure integrated mobility platform to support automated driving from various sensors and open data

Collaboration with Supercity-related activities

Demonstration base cooperation つくば市 CITY OF TSUKUBA

Safer roads by minimizing traffic rules to facilitate mutual yielding among vehicles, pedestrians, and other traffic entities.

2. ⑦ Establishment of a safe and secure area management method for living roads that can be deployed.

Tsukuba Smart City Consortium
Tokio Marine & Nichido Fire Insurance Co.,Ltd.
NIPPON KOEI

⑦Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
SIP Goal

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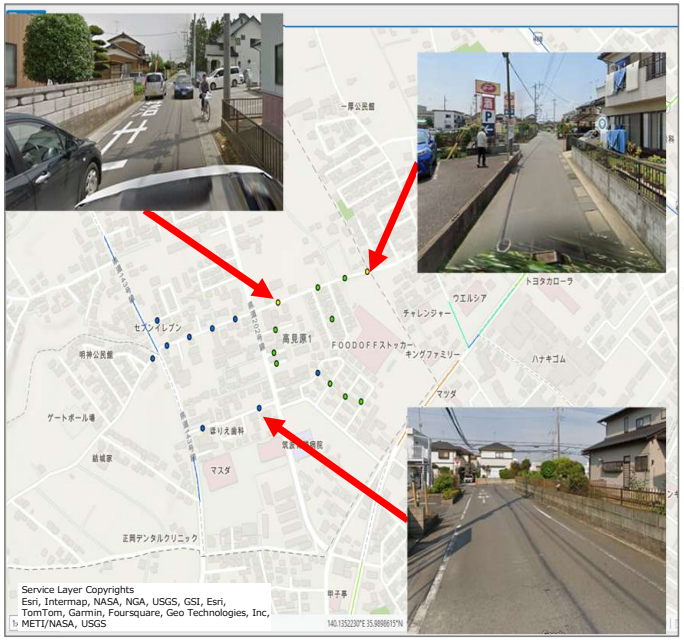
- **What we want to achieve**
  - "Establishment of a safe and secure area management method for living roads" that can be deployed horizontally
- **Realization of safe, secure, and lively road space by bottom-up approach**
  - Based on the risk of accident from both the perspective of vehicles and pedestrians identified by extracting dangerous place using AI risk values and inspection of school route we aim to create safe, secure, and lively road space by taking measures against accident risk places in the area with the participation of schools and students.

Extraction of dangerous place using AI risk value



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Extraction of dangerous place using joint inspection of school route

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Safe, secure, lively road space

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
Roadmap / Implementation Item List

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R&D Item	Main Item	Sub Item	Final Goal	Implementation in FY2024	Scheduled to be implemented in FY2025
⑦-1 Grasp of the current situation of small road in the city and construction of a policy monitoring system	A. Quantitative analysis by dynamic risk	Risk analysis on living roads using public owned data	• Construction of an accident prediction model using public owned data and comparison of private owned data • Organization of data requirements for public data	• Analysis of risk place using ETC 2.0 and DRM data and police accident data • Analysis of the number of sudden occurrence and external factor	• Consideration of accident prediction model based on public owned data • Organization of the difference in accident risk analysis result based on public owned data and private owned data
		AI risk analysis on living roads using private owned data	• Calculation of dynamic risk by an accident prediction model using private owned data • Efficient extraction of accident risk places	• Calculation of AI risk value using private owned data and calculation of risk contribution	• Improvement of AI Risk Value • Extraction of place where the risk value increases under specific condition • Consideration of the express method of the effect before and after the implementation of measures
	B: Effective and reliable joint inspection of school route (social experiment)	Issue organization on safety inspection of school route	• Current issue organization on safety inspection of school route ⇒System development based on the result of organizing issue	• Issue organization based on the interview result with City of Tsukuba	• Continued discussion with City of Tsukuba and elementary and junior high schools
		Development of a system for safety inspection of school route	• Social experiment of a system for safety inspection of school route • Labor saving in schools, PTAs, and city halls by social implementation, and refinement on inspection system of school route	• Development of a system for safety inspection of school route	• Issue organization based on social experiment • Consideration for social implementation
⑦-4 Acquisition of social acceptability and cooperation surrounding local and lively road, and rule making	C: Grasp of the needs to value providers and secure of deployment target	Interview with leading local government	• Verifying whether the examination result can be horizontally deployed, based on the interview result with leading local government	• Interviews with three local governments	• Continuous discussion and exchange of opinions based on the result on inspection system of school route, etc.
	D: Implementation of social experiment	Adjustment with City of Tsukuba	• Social implementation on inspection system of school route • Extraction of risk place based on inspection results and risk analysis results • Realization of lively road space while ensuring safety and security (consideration of flexible operation and regulation based on time of day, etc.)	• Adjustment for a social experiment on inspection system of school route	• Social experiment using inspection system of school route • Extraction of issue for social implementation • Extraction of risk place and consideration of measures
		Adjustment with University of Tsukuba	• Implementation of the measures and verification of the effect for risk place on the campus of University of Tsukuba	• Extraction of risk place using AI risk value • Implementation of the measures	• Verification of the effect after implementation of measures

⑦ Construction of safe, secure, and lively road spaces and transportation systems (⑦-1, ⑦-4) Roadmap/Process

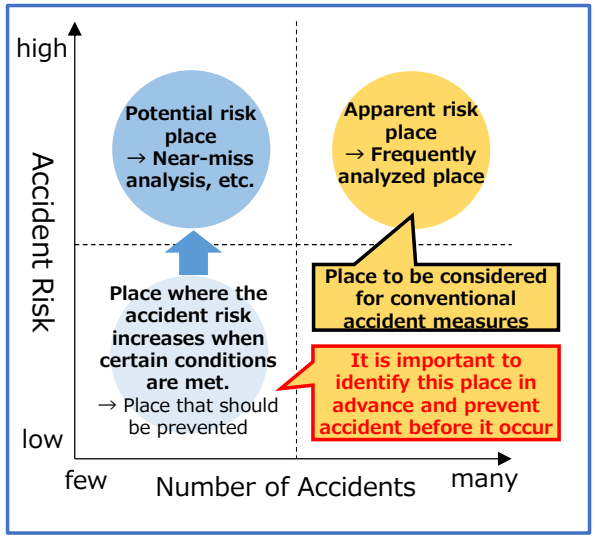
東京海上日動 NIPPON KOEI

R&D Item	Main Item	Sub Item	FY2024	FY2025
⑦-1 Grasp of the current situation of small road in the city and construction of a policy monitoring system	A. Quantitative analysis by dynamic risk	Risk analysis on living roads using public owned data	Analysis of accident risk place using public owned data (ETC 2.0, etc.)	Comparison with the accident risk analysis result of private owned data Organization of the requirement for public owned data
		AI risk analysis on living roads using private owned data	Calculation of AI risk value using private owned data Calculation of risk contribution	Consideration of monitoring method before and after implementation of measures
	B: Effective and reliable joint inspection of school route (social experiment)	Issue organization on safety inspection of school route	Adjustment for social experiment on the inspection of school route	Organization of social experiment result Issue organization of social implementation
		Development of a system for safety inspection of school route	Development of a system for safety inspection on school route	Implementation of social experiment System improvement System improvement for social implementation
⑦-4 Acquisition of social acceptability and cooperation surrounding local and lively road, and rule making	C: Grasp of the needs to value providers and secure of deployment target	Interview with leading local government	Continuous discussion and exchange of opinions based on the result of social experiment on inspection system of school route, etc. Issue organization for horizontal expansion	
	D: Implementation of social experiment	Adjustment with City of Tsukuba	Adjustment for social experiment on the inspection of school route	Implementation of social experiment Consideration and discussion for social implementation
		Adjustment with University of Tsukuba	Implementation of measures on the campus of University of Tsukuba	Verification of the effect after the implementation of measures

Confirmation of accident reduction effect in the demonstration area (City of Tsukuba)

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
Overall Project Objective / Issue in Accident Measures

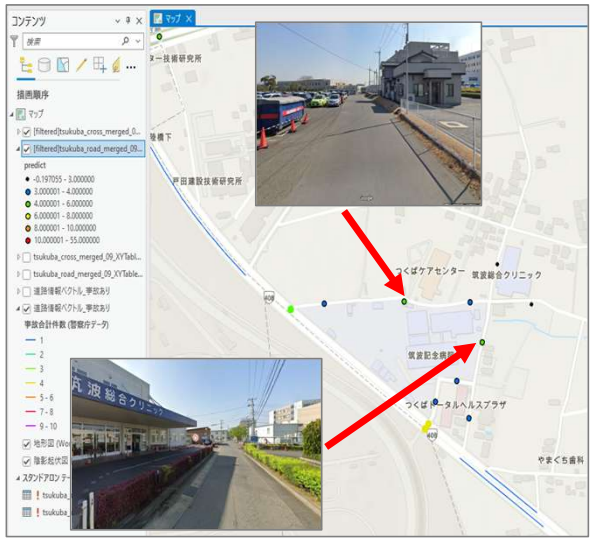
- Due to traffic safety measures, the number of traffic accident fatalities has decreased significantly compared to the peak (16,765 people (In 1970) → 2,610 people (In 2022)).
- However, fatal accidents still occur, and half of the traffic accident fatalities are while walking or riding bicycle. In addition, about half of the fatalities while walking and riding bicycle occur within 500 meters of their homes, so **it is very important to take measures against accidents on living roads near homes**.
- Although accident analysis has been carried out using various types of data, the main places where accident measures are implemented become apparent. Since it is assumed that there is a potential accident risk and **the accident risk is expected to fluctuate, it is necessary to grasp the dynamically fluctuating risk and take effective and efficient measures**. (e.g., traffic increases during evening peak hours, drivers have poor visibility and are unaware of the presence of pedestrians, etc.)
- In accident risk analysis by national and local government, public data (ETC 2.0, DRM data, etc.) have been mainly used. On the other hand, since **it may not be possible to grasp the detailed risk of accidents on living roads, it is important to make maximum use of private data and qualitative opinions of road user**.



Example of accident risk captured in this project

【Issue of DRM Data】
This intersection has a large number of accidents, but since there is no DRM road link, **it is not subject to risk place by analyzing only DRM data**

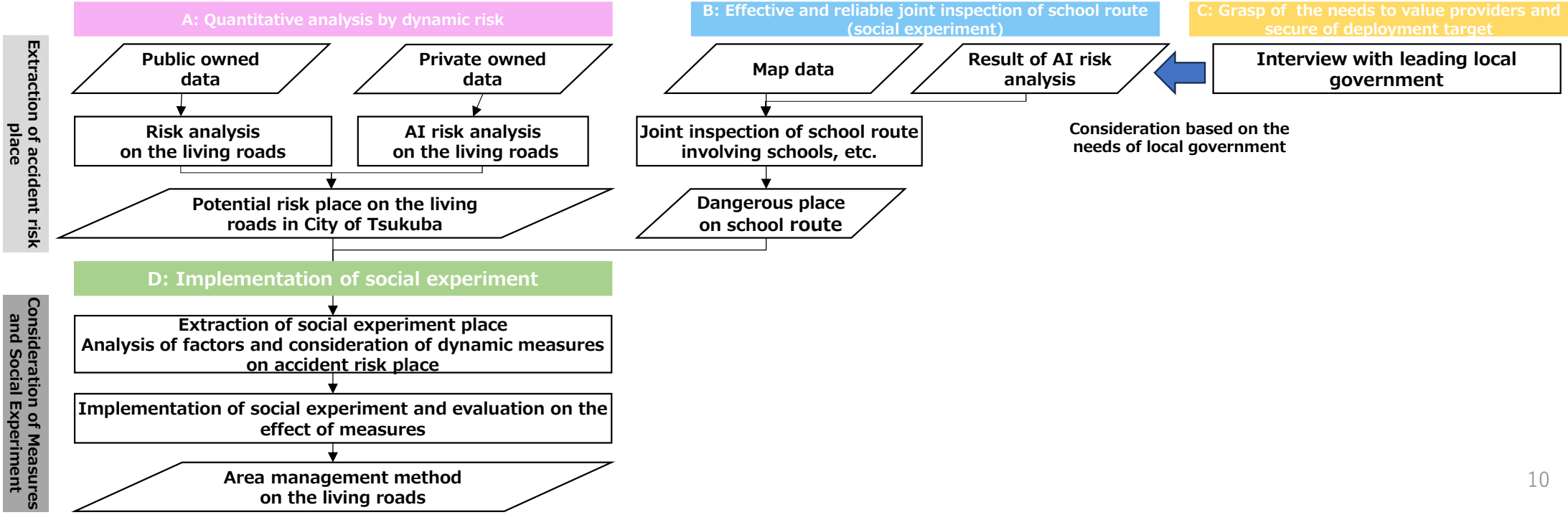
Issue of data analysis on living roads



Result of risk analysis on living roads and around the elementary and junior high school using private data

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
Overall Project Objective / Policy to be aimed at this Project

- **Purpose of R&D :** Aiming to “establishment of a safe and secure area management method for living roads” that can be deployed horizontally
- **Overview of R&D :** Figure below
- **Policy to be aimed at :** We will extract a potential risk place and dynamically fluctuating risk by dynamic risk, and subjective risk place identified from joint inspection of school route. In addition we will extract the condition and place that increase the risk of accident from both parties, and we will consider measures that take into account not only safety improvement but also the creation of liveliness, and we will evaluate the effects of reducing the risk of. We will construct an area management method for living roads that takes into account not only safety but also the creation of liveliness.



⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
A: Quantitative analysis by dynamic risk
～AI risk analysis on living roads using private owned data～

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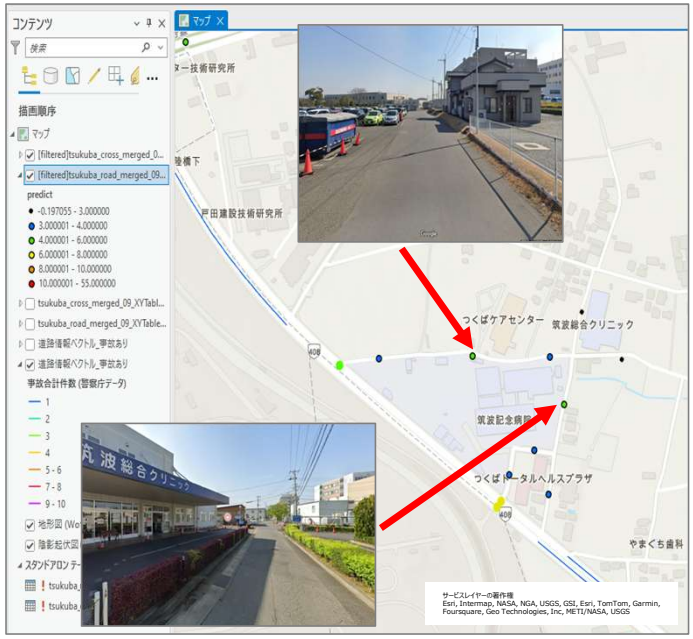
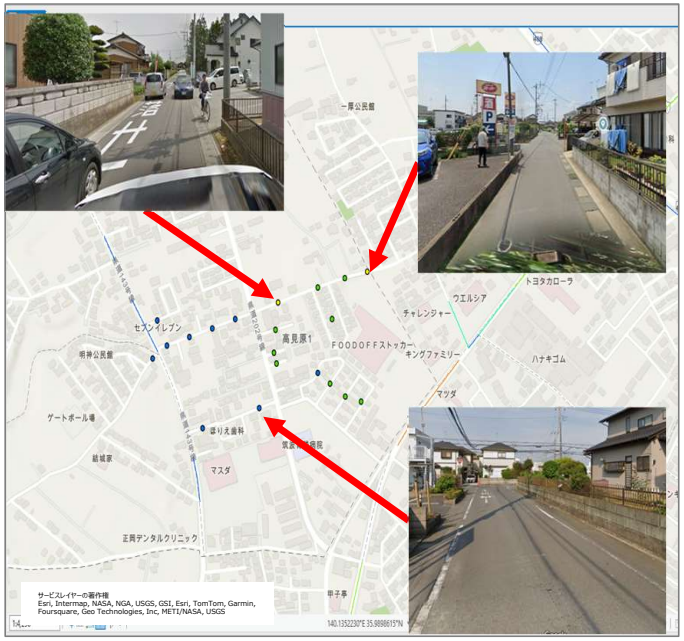
- By combining accident data from Tokio Marine Nichido with external data and utilizing AI, the risk analysis of the Tsukuba area has been conducted.
- New Value Proposition | Uncovers potential danger places not found in government data
  Enables data-driven confirmation of risk factors
  Output matches local residents' sense of danger

Living road near an elementary school



Living road



City road with a width of 5.5-13 meters

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
A: Quantitative analysis by dynamic risk
～AI risk analysis on living roads using private owned data～

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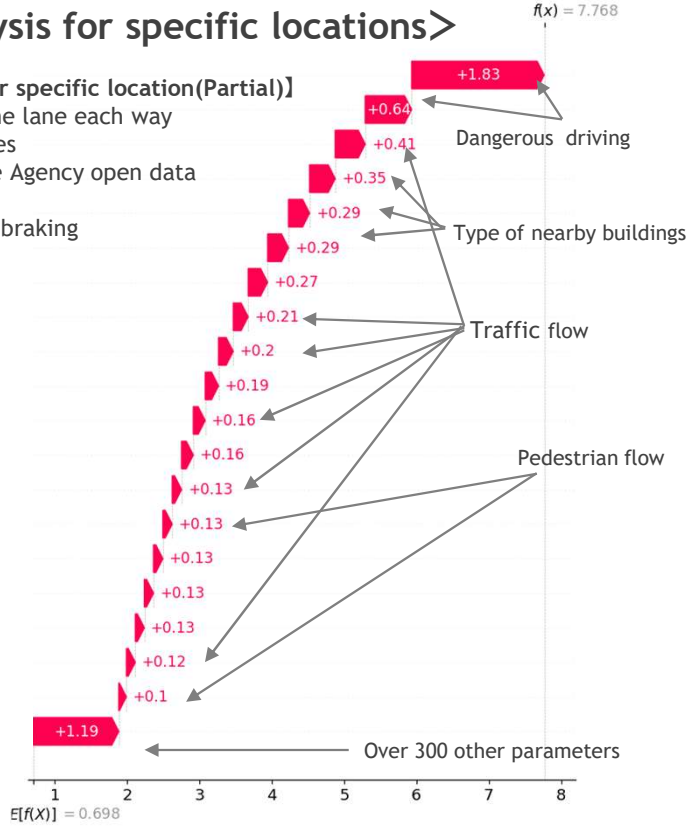
- Following the traffic accident risk analysis, conducting R&D on risk factor analysis
- By visualizing "why the risk is high" in addition to "which areas have high risk," local governments and other entities can implement measures tailored to the issues.

<Risk factor analysis for specific locations>

【Background information for specific location(Partial)】
・City road with over 5.5m, one lane each way
・Shopping center on both sides
・1 accident in National Police Agency open data (2019-2023)
・Frequent rapid steering and braking



<Perspectives on risk factor analysis>

Category	Data item
Road	・Slope ・Width ・Road category ・Speed limit ・Type of nearby buildings
Traffic flow	・Volume ・Speed
Pedestrian flow	・Volume
Dangerous driving	・Rapid braking ・Rapid acceleration ・Rapid steering From dashcam

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
B : Effective and reliable joint inspection of school route (social experiment)

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- Recognizing the issues of analog workflows and qualitative, inspector-dependent school route safety inspections, we developed a system for school route safety inspections. (self-funded by Tokio Marine Nichido, outside the SIP plan).
- The system improves efficiency for all stakeholders through smartphone-based inspections/request creation and PC-based request compilation/management/countermeasure planning/result publication.
- It also enhances requests and countermeasures by displaying AI risk analysis around school routes during safety inspections and countermeasure planning.

Recognizing the issues of school route safety inspections

School PTA
- ✓ Workflow is analog, making the work burdensome
- ✓ The assessment of dangerous places depends on the individual

Board of Education
- ✓ Compilation, confirmation, and reporting are burdensome
- ✓ Communication with stakeholders via Excel is cumbersome

Road Authority
- ✓ Planning countermeasures based on individual request files is inefficient
- ✓ Generating lists and maps of implemented countermeasure locations is burdensome

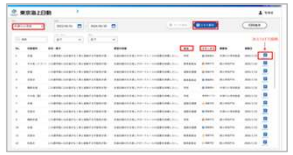
Common
- ✓ Past requested locations and countermeasure locations/details are not integrated as data on a map

System for school route safety inspections

Inspections request creation

…

Compilation Communication



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Planning countermeasures

…

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4) FY24 Achievements/FY25 Plan

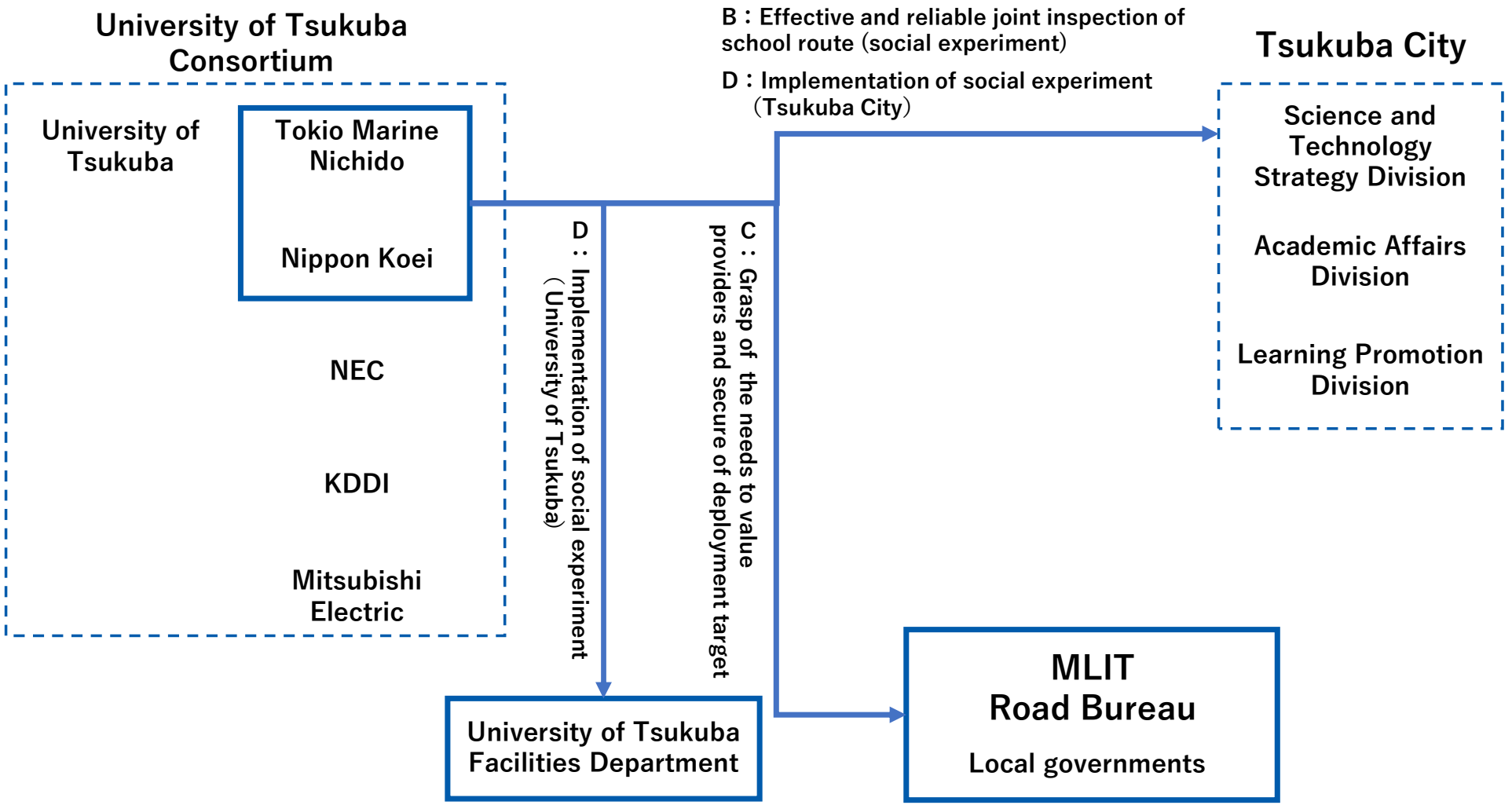
◆ FY24 Achievements

- Toward “Establishment of a safe and secure area management method for living roads” that can be deployed horizontally, we developed two methods: ①AI risk analysis on living roads using private owned data, ②System for school route safety inspections.
- ①AI risk analysis enabled data-driven confirmation of risk factors at dangerous places and yielded outputs aligned with local residents' perceptions. High-risk areas identified on the University of Tsukuba campus led to the addition of traffic safety measures, implemented in February 2025.
- ②System for school route safety inspections, presented to Tsukuba City's elementary and junior high school principals in March 2025, garnered interest from 25 schools by the end of March, confirming its potential for streamlining school operations.
- Coordination is underway with Tsukuba City and its schools for a social experiment using the System for school route safety inspections. Following school endorsements, we are now coordinating the feasibility, scope, and process with Tsukuba City, the Board of Education, etc.

◆ FY25 Plan

- planning to conduct a social experiment in Tsukuba City's elementary and junior high schools using System for school route safety inspections. Based on the results, we will explore its broader implementation.
- To measure the impact of the countermeasures on the University of Tsukuba campus, we will analyze AI risk scores to verify their effectiveness.
- We will analyze the differences between accident risk analysis results using public and private data to identify required public data elements.
- To ensure scalability, we will continue to interview leading local governments and exchange insights with other Consortium (e.g., Oriental Consultants).

⑦ Construction of safe, secure, and lively road space and transportation system (⑦-1, ⑦-4)
Project stakeholders



3. ⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data.

Tsukuba Smart City Consortium
NEC Corporation

⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data

NEC

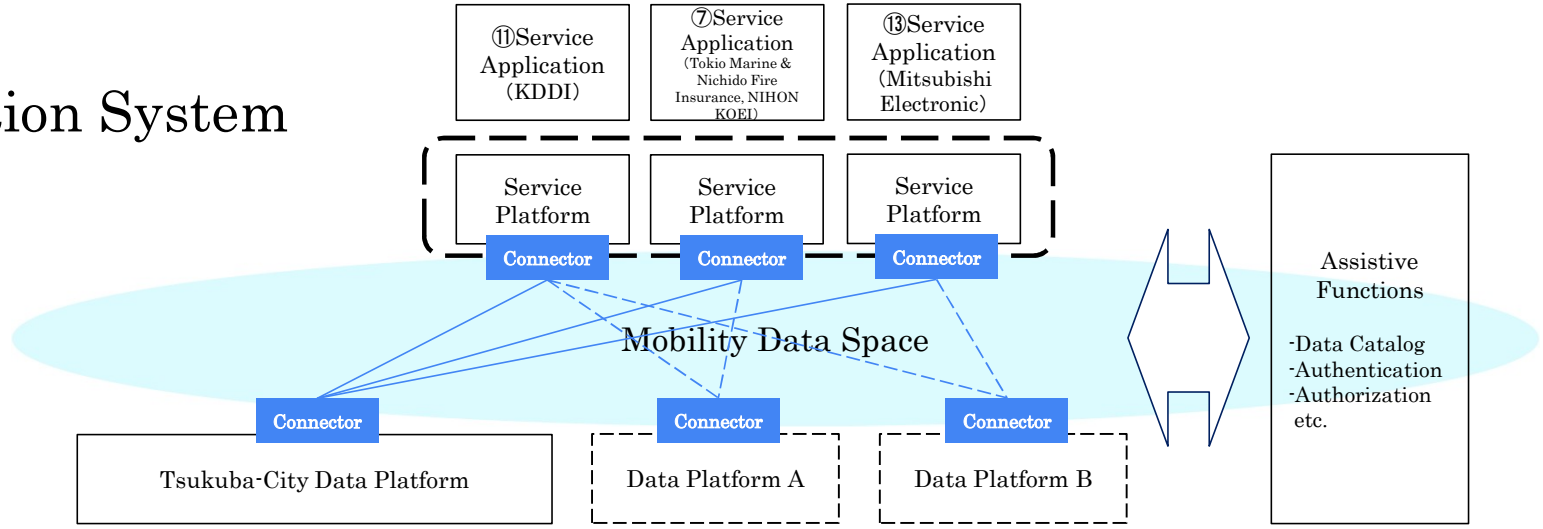
■Overview

- This study aims to do just that is incubation for social implementation of “Mobility Data Space” (technical specification studies, demonstrations, etc.)
- Specifically, we will verify mobility services through demonstrations by Tsukuba Consortium co-implementers, formulate technical specifications (frameworks) for mobility and data spaces, and consider social implementation (organization, structure, etc.).

■Purpose

- As a role model, we aim to implement it through the demonstration of mobility data space in the Tsukuba-City area.

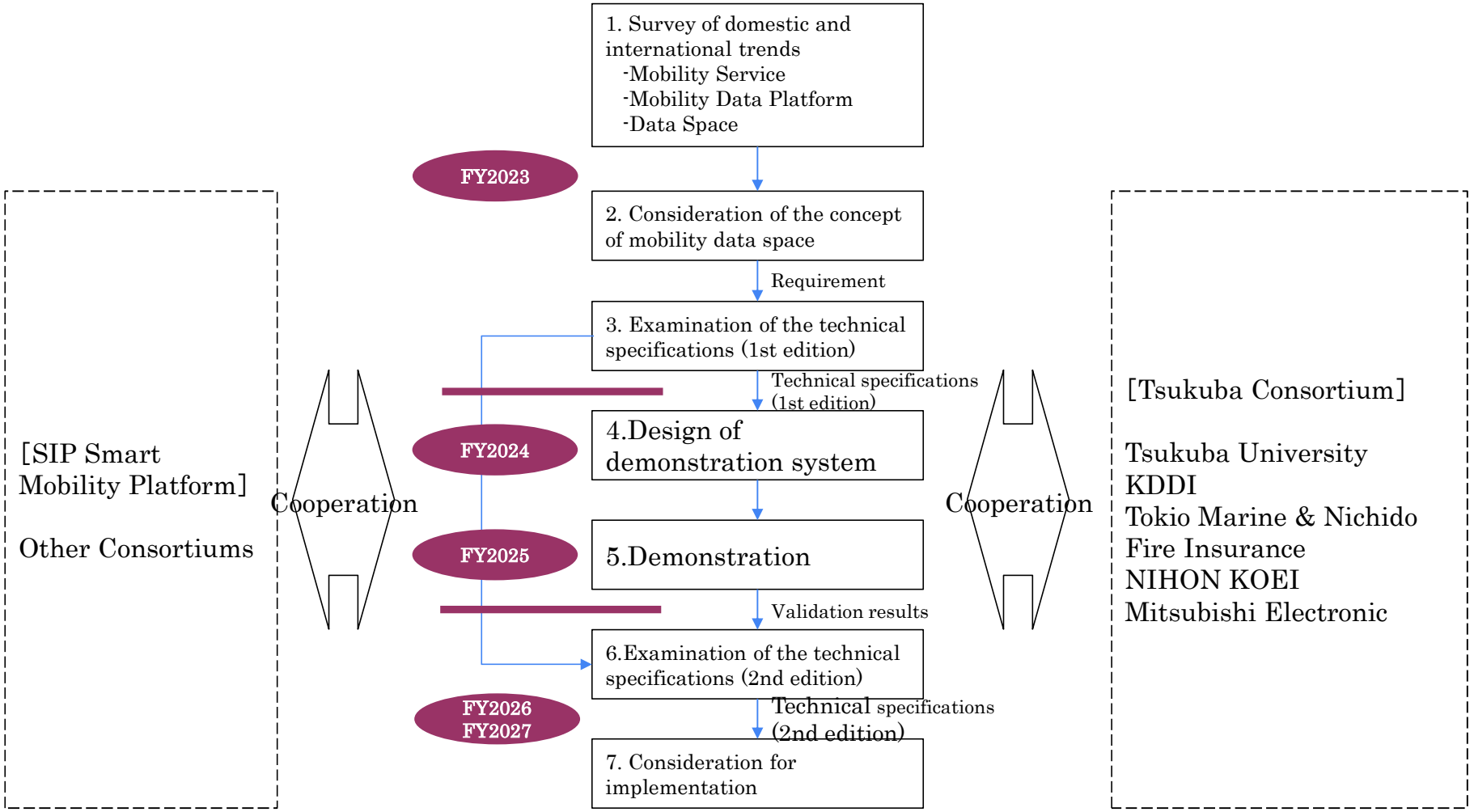
■Overview of the Demonstration System



⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data

NEC

■Specific details and schedule



⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data

NEC

■Achievements in FY2024

- ■ Construction of a demonstration system
  - ■ In accordance with the technical specifications (1st edition), Tsukuba Consortium co-implementers will formulate demonstration specifications for mobility service demonstration.
  - ■ When inputting and outputting semi-dynamic data (required response time; up to a few minutes) expected in the demonstration, a new connector(for Data Space) function will be developed for push-type data exchange by data providers and event notification-type data exchange by data providers.
  - ■ In accordance with the demonstration specifications, a pilot system (demonstration system) for mobility data space will be constructed.

- ■ Connection with data providers
  - ■ Based on the requirements for the mobility service to be demonstrated, the demonstration system has been connected to the data provider(data platform) of the data to be used with the mobility data space.
  - ■ And it has been connected to the "Tsukuba-City Data Platform," which will be an especially important data provider(data platform) in the area.

⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data

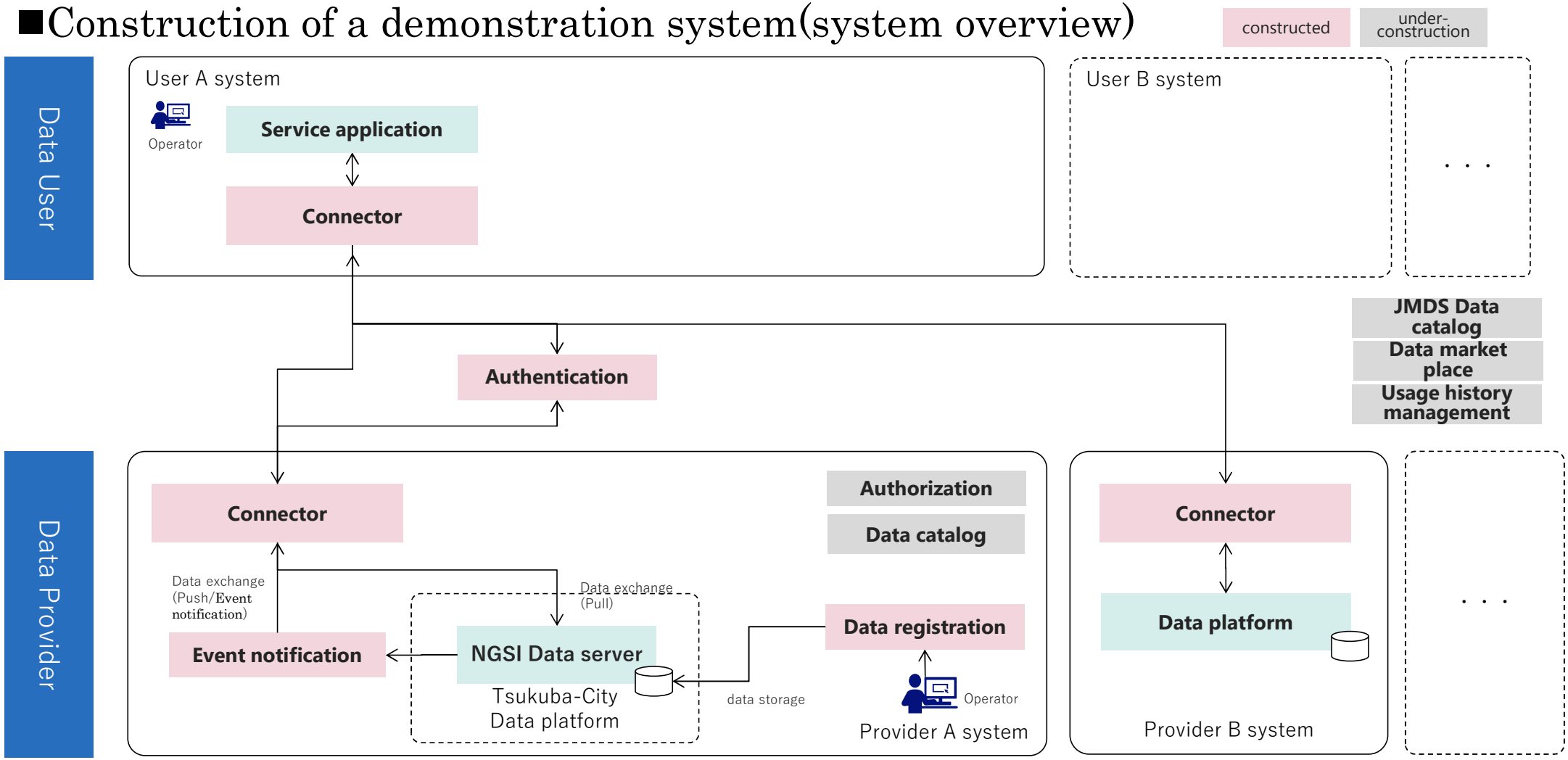
NEC

■Achievements in FY2024

- ■ Considerations for social implementation
  - ■ In order to promote social implementation in Tsukuba-City, we have begun discussions in collaboration with “the Mobility Subcommittee of the Tsukuba Smart City Council” with the aim of collaborating with “the Tsukuba Smart Mobility Service”, which has already begun its work.
  - ■ Through discussions with Tsukuba Consortium co-implementers and potential data providers, we have compiled important considerations for the social implementation of mobility data space in the area.

⑨ Establishment and demonstration of an infrastructure for integration and mutual use of various mobility platforms and related data

■Construction of a demonstration system(system overview)



4. ⑪ Development of mobility-enabled services on urban OS

Tsukuba Smart City Consortium

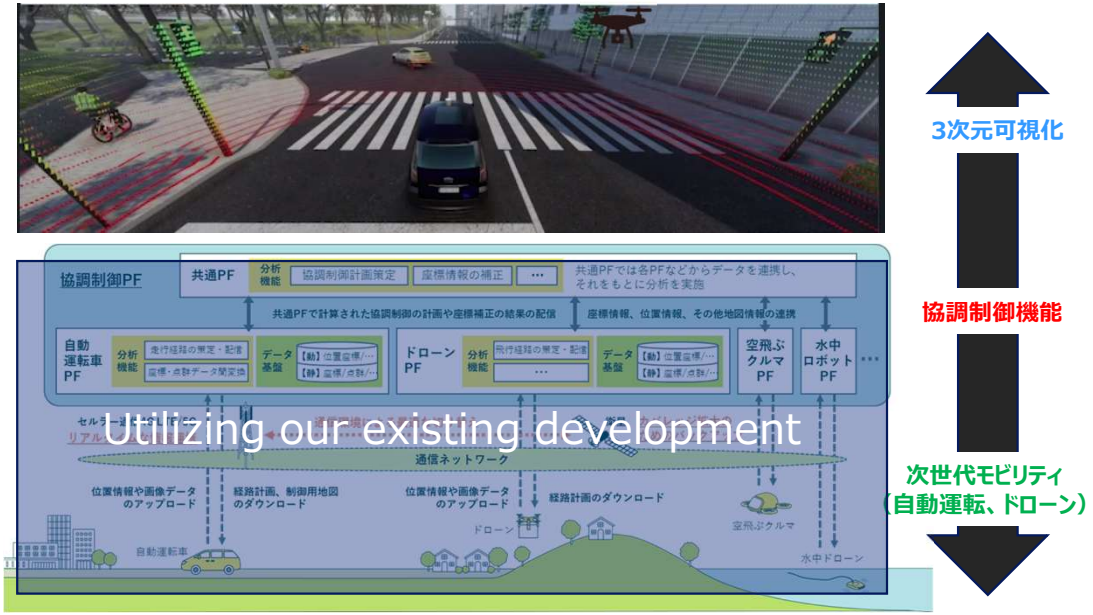
KDDI CORPORATION

Summary

Constructing a mechanism to visualize information on next-generation mobility (autonomous vehicles, drones) in 3D space. Contributing to the consideration of smart city services utilizing next-generation mobility by various businesses and municipalities

Overview of R&D

Three-dimensional information on next-generation mobility (autonomous vehicles, drones)
Constructing a mechanism for visualization in space



What we want to achieve

Businesses and local governments will utilize the results of this research and development (3D visualization)
Creation of an environment that enables consideration of services that link mobility to various industries

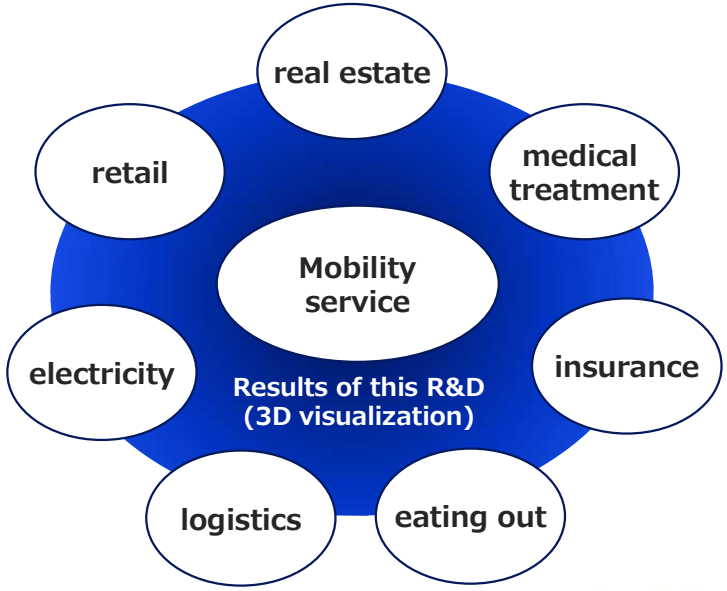


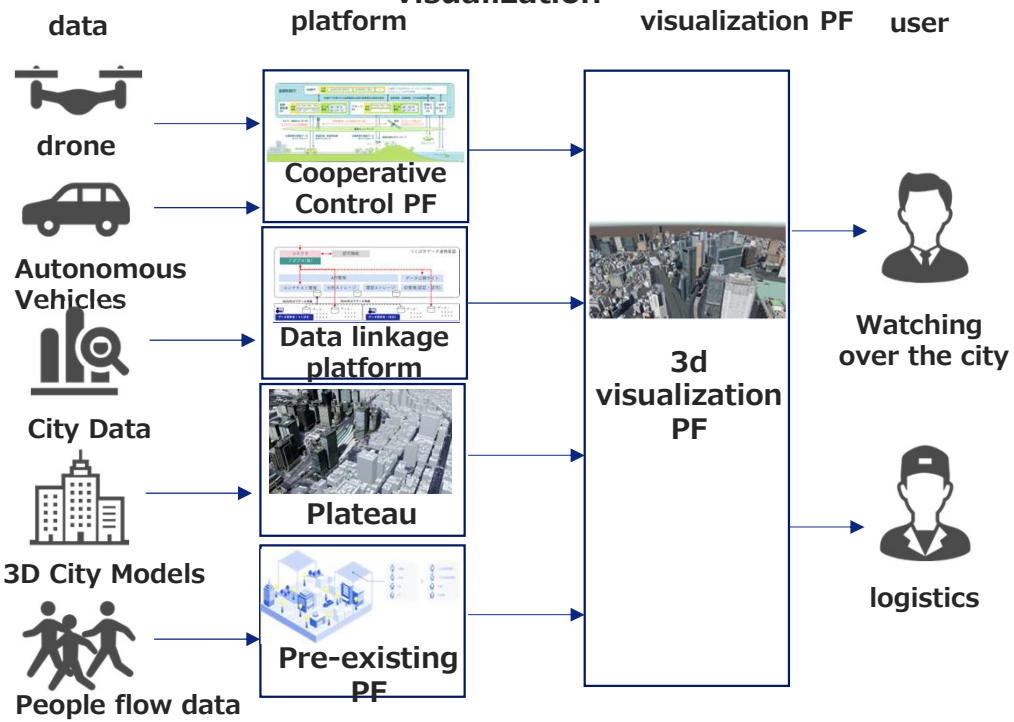
Image of what we want to achieve

System configuration overview and use case discussion

Next-generation mobility and urban data are acquired through existing platforms and Plateau for 3D visualization. Discuss use cases and utilize them for the purpose of operation management of next-generation mobility

System Configuration Overview

Next-generation mobility platform, data linkage platform, Plateau,Linking with existing platforms to perform 3D visualization



Discussion of use cases

For the purpose of operation management of next-generation mobility, infrastructure inspections for municipalities and urban Discussions were held on use cases such as optimization, risk assessment for companies, and store opening strategies

Driving route planning

The driving path of drones and self-driving vehicles
Utilizing the platform in formulation

Operation management

Operation management of drones and self-driving cars
Leverage the platform to do it efficiently

Remote monitoring

Remote monitoring of drones and self-driving vehicles
Use the platform to do it safely

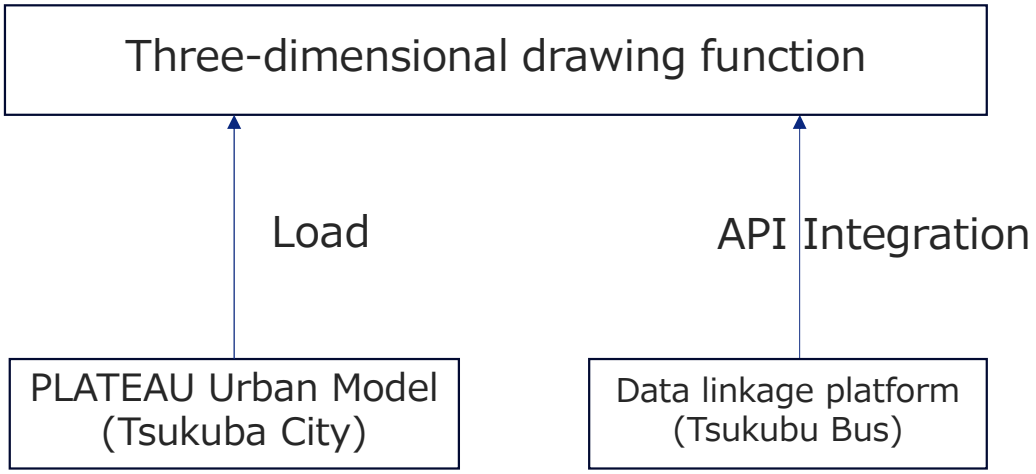
Tomorrow, Together KDDI
au

deliverable

The purpose is to link with the Plateau city model and perform 3D drawing.
Actual integration

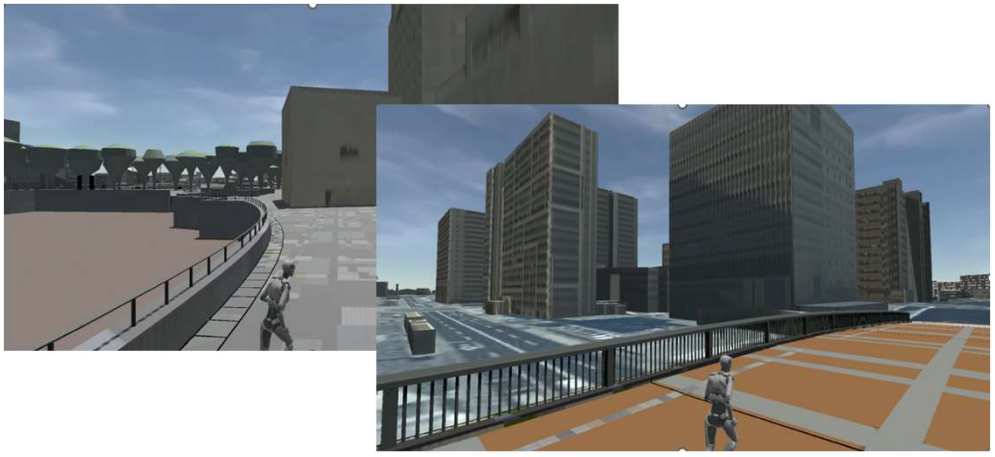
Alignment with the Plateau Urban Model

Load the data of the Plateau city model of Tsukuba City as shown below. Representation of 3D visualization



Collaboration with the Plateau urban model

The state of the collaboration is shown below



Deliverables (2/3)

API linkage with Tsukuba City's data linkage platform to acquire and visualize data (2D) This time, we acquired bus dynamic information on a trial basis

Linking with data linkage infrastructure

The data format of the Tsukuba City Data Linkage Platform is as follows.
It is stored on an NGSI-v2 basis

- エンティティ
  - エンティティID
    - エンティティを識別するための項目
  - エンティティタイプ（Type）
    - エンティティの種別を識別するための項目
- 属性
  - 属性名
    - エンティティが持つデータ項目の名称
  - 属性値
    - 属性の値
- 付加情報(メタデータ)
  - 属性名
    - エンティティが持つデータ項目の名称
  - 属性値
    - 属性の値

NGSIv2推奨は「geo:json」だが、管理用ダッシュボードを利用するため「geo:point」を採用

エンティティ

属性

メタデータ

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{
 "id": "building-nec-headquarter",
 "type": "Building",
 "name": {
  "type": "Text",
  "value": "NEC本社ビル"
 },
 ~ 中略 ~
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  "value": "〒108-8001 東京都港区芝5-7-1"
 },
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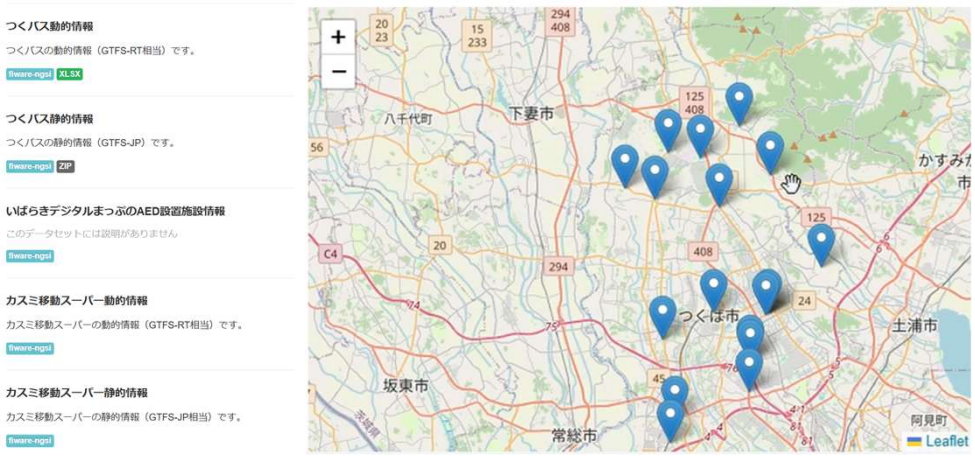
Example of Data Usage

The Tsukuba City Data Linkage Platform stores dynamic information such as Tsukuba buses and Kasumi mobile supermarkets. This time, we acquired bus dynamic information on a trial basis



Deliverables (3/3)

Development is underway to utilize KDDI's human flow data (near-real-time data) for 3D visualization. Based on the human flow data, the population density in the area is assumed to be the appearance of a three-dimensional person walking

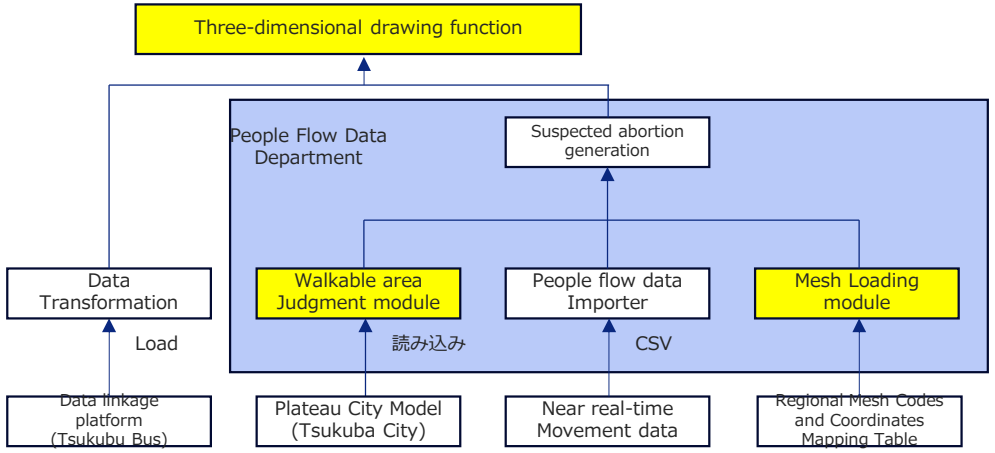
Movement data and visualization images used

KDDI's near-real-time data uses the following data formats. It is assumed that the population density in the area will be expressed by the walking appearance of a three-dimensional person

mesh_code	standard_area_code	datetime	pred_population
5440008312	8220	2024-12-11T02:00:0	31.15
5440009322	8220	2024-12-11T02:00:0	31.15
5440016243	8220	2024-12-11T02:00:0	43.08
5440101821	8220	2024-12-11T02:00:0	33.02
5440110241	8220	2024-12-11T02:00:0	31.9
5440014133	8220	2024-12-11T02:00:0	61.72
5440102024	8220	2024-12-11T02:00:0	45.36

system configuration diagram of human flow

Development completed for the yellow highlight. Pseudo-human flow generation and human flow data importer need to be developed in the future.

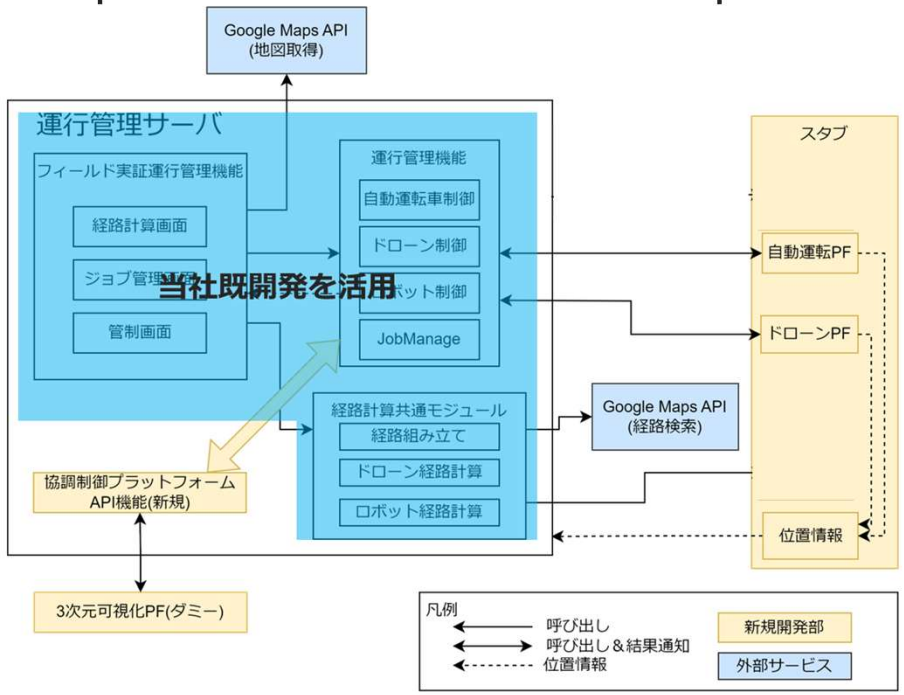


Reference: Development using a separate budget from this project

Apart from this project, we will develop a platform for efficient remote monitoring and operation management of drones and autonomous vehicles. Specifically, this applies to the development of APIs that connect the 3D visualization platform and our existing platform

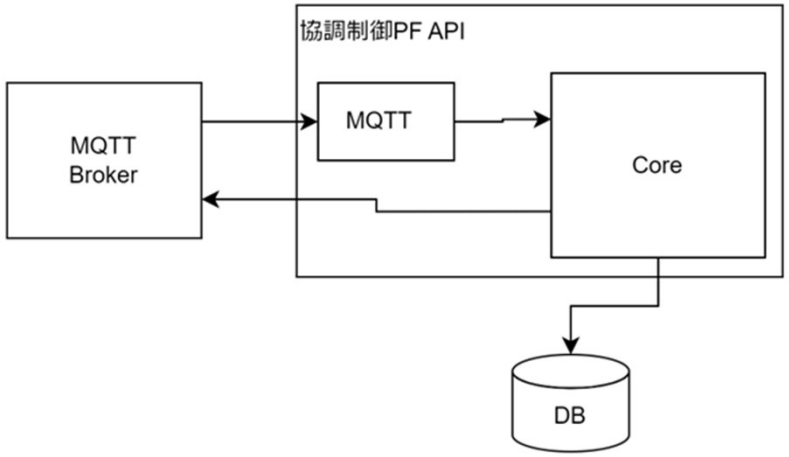
Functional diagram of the development target

Our existing next-generation mobility operation management platform and 3D visualization
Develop APIs and stub functions to connect platforms



API Functional Block Diagram

Demonstrate the API capabilities of the platform. The API consists of an MQTT part that accepts requests from clients and a Core part that is responsible for the actual processing

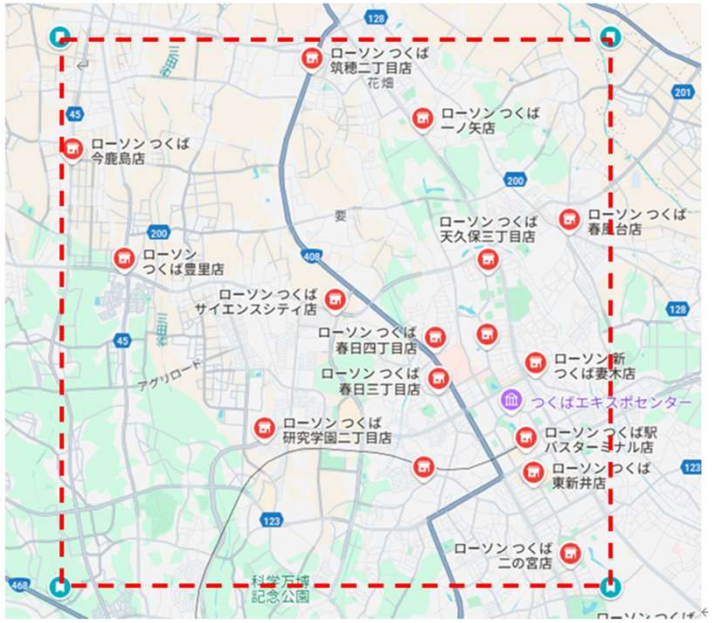


Reference: Development using a separate budget from this project

The stub generation target is the area of Tsukuba City.
Define draft location information as departure and arrival locations for next-generation mobility

Target Area Map

As shown below, the following areas of Tsukuba City are defined as stub generation targets.



location	coordinate
North West	36.136825, 140.037101
northeast	36.136825, 140.126708
southeast	36.064424, 140.126708
south west	36.064424, 140.037101

Target site information (draft)

The following is assumed as an operation base using stubs.

	拠点一覧
convenience store	Lawson Tsukuba Station Bus Terminal Store
	Lawson Tsukuba Higashiarai
	Lawson New Tsukuba Tsumagi
	Lawson Tsukuba Ninomiya
	Lawson Katsuragi Elementary School
	Lawson Tsukuba Research Academy 2-chome store
	Lawson Tsukuba Kasuga 3-chome
	Lawson Tsukuba Kasuga 4-chome
	Lawson Tsukuba Science City
	Lawson Tsukuba Shunpudai
	Lawson Tsukuba Toyosato
	Lawson Tsukuba Kashima
	Lawson Tsukuba Chikuho 2-chome
	Lawson Tsukuba Ichinoya
clinic	Tsukuba Sitia Internal Medicine Clinic
	Tsukuba Center Clinic
	Tsukuba Gakuen Clinic
	Takezono Family Clinic
	South Boulevard Clinic
	Arita Clinic
	Sato Clinic
	Katsuragi Clinic
	Miyamoto Internal Medicine Clinic
	Kengakuen Clinic
	Tsukuba Tsuji Clinic
	Grace Clinic
	Noguchi Internal Medicine Clinic
	Kengakuen Clinic
	Sugitani Medical Clinic
	Department of Internal Medicine, Pulmonology, Minano Clinic
	Kawai Clinic
	Kurata Internal Medicine Clinic
pharmacy	Matsumoto Kiyoshi Tonari Ecute Tsukuba
	Matsumoto Kiyoshi Yoke Town Tsukuba Bamboo Garden
	Sundrug Tsukuba
	pharmacy Nanzando Bamboo Garden Pharmacy
	Wellesia Tsukuba Gakuen Central Store
	Sugi Drug Tsukuba Ninomiya
	Wellesia Tsukuba Gakuen Ninomiya
	Wellesia Tsukuba Tomine Koen-dori
	Wellesia Tsukuba Matsushiro
	Wellesia Tsukuba Research School
	Tsuruha Drug Ajax Tsukuba
	Wellesia Tsukuba Gakuen Azuma
	Wellesia Tsukuba Kasuga 3-chome store
	Akebono Pharmacy Medical Store
	Sugi Drug Tsukuba Amakubo
	Wellesia Tsukuba Kasuga
	Tsuruha Drug Ajax Tsukuba
	Bambi Pharmacy Tsukuba
	Wellesia Tsukuba Research Institute North Store
	Wellesia Tsukuba Tsukuba Sakura
Public Facilities	Tsukuba Station
	Tsukuba City Hall
	70 Block (Nanamaru Park)
	University of Tsukuba (in front of Area 1, University Central)
	University of Tsukuba Hospital
	Ibaraki Prefecture Tsukuba Public Health Center
	Tsukuba City Toyosato Public Health Center
	Tsukuba City Oho Health Center
	Tsukuba City Kasuga Exchange Center
	Koike Community Center
	Far East Nitta Community Center
	Higashihara Community Center
	Nishitanigashiro Public Hall
	Tsukuba City
	Shimana Exchange Center

筑波大学
University of Tsukuba

5. ⑫ Extraction of requirements for vehicles, infrastructure that contribute to re-design

Tsukuba Smart City Consortium
University of Tsukuba

⑫ Extraction of requirements for vehicles, infrastructure that contribute to re-design

1) Requirements elicitation of diverse personal mobility and infrastructure for mobility re-design.

Objective
To enable speed limit relaxation to 10 km/h by implementing a digital safety operator that ensures safety performance equivalent to or exceeding that of a human operator, enhancing user convenience.

Vehicle Speed Control Using GNSS (Geofencing)

・To complete deceleration before entering the speed control zone, the effectiveness of the deceleration start line distance, alert method, and timing was verified.

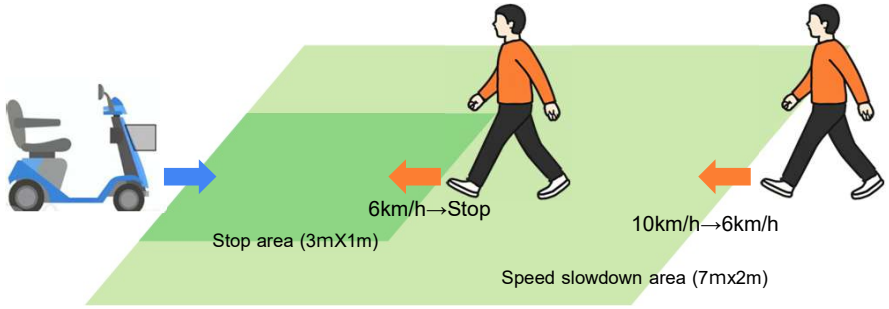
・It was confirmed that approximately 3 meters are required to decelerate from 10 km/h to 6 km/h.

・A simple method for setting speed limit areas was confirmed by combining 3D map data with the road network data.

An example of displaying restricted areas on 3D map.

Vehicle Speed Control Using LiDAR

- Verified deceleration and stop control methods based on LiDAR obstacle detection, achieving both safety and user convenience.
- Implemented two-stage speed control (10 km/h → 6 km/h → stop) by setting deceleration and emergency stop zones.
- This method enabled effective collision avoidance while maintaining smooth and comfortable vehicle operation.



⑫ Extraction of requirements for vehicles, infrastructure that contribute to re-design

2) Establishment of the mobility re-design theory including road shoulders, transfer points, and inflow control.

Objective
Designing service connectivity through the combination of existing mobility resources and their configurations

Example of Technological Alternatives "Micro Mobility“

- Seamless integration with public transportation
- Replacement of multiple user-specific mobility options through shape-shifting
- Automatic guidance and monitoring systems for the elderly and disabled
- Integration with standard wheelchairs
- mobility assistance through power assist

Research Approach

- **Barriers related to systems and regulations**
- **Technological alternatives and the use of special zone systems**
- Verification of problem-solving potential through the incorporation of alternatives

Kondo et al., JSAEM, 25(3): 299-306, 2017 (in Japanese)

6. ⑬ Social systemization of automated driving（Safe and secure mobility operations）

Tsukuba Smart City Consortium
Mitsubishi Electric Corporation

Research and Development Item ⑬ "Social Systemization of Autonomous Driving (Speed Control and Emergency Stop System for Autonomous Driving Mobility)"

Responsible: Mitsubishi Electric Corporation

Research achievements and progress status against the annual plan for the FY2024

【Achievement goals】

To ensure safe and secure mobility on residential and busy streets, we aim to build a mobility platform as shown in Figure 1. This platform will integrate and align with a mobility data space that utilizes information from various sensors installed throughout the city, as well as open data on traffic conditions and weather. The primary focus will be on green slow mobility, such as personal mobility devices. The goal is to publish a reference roadmap for the implementation of mobility support technologies in several cities.

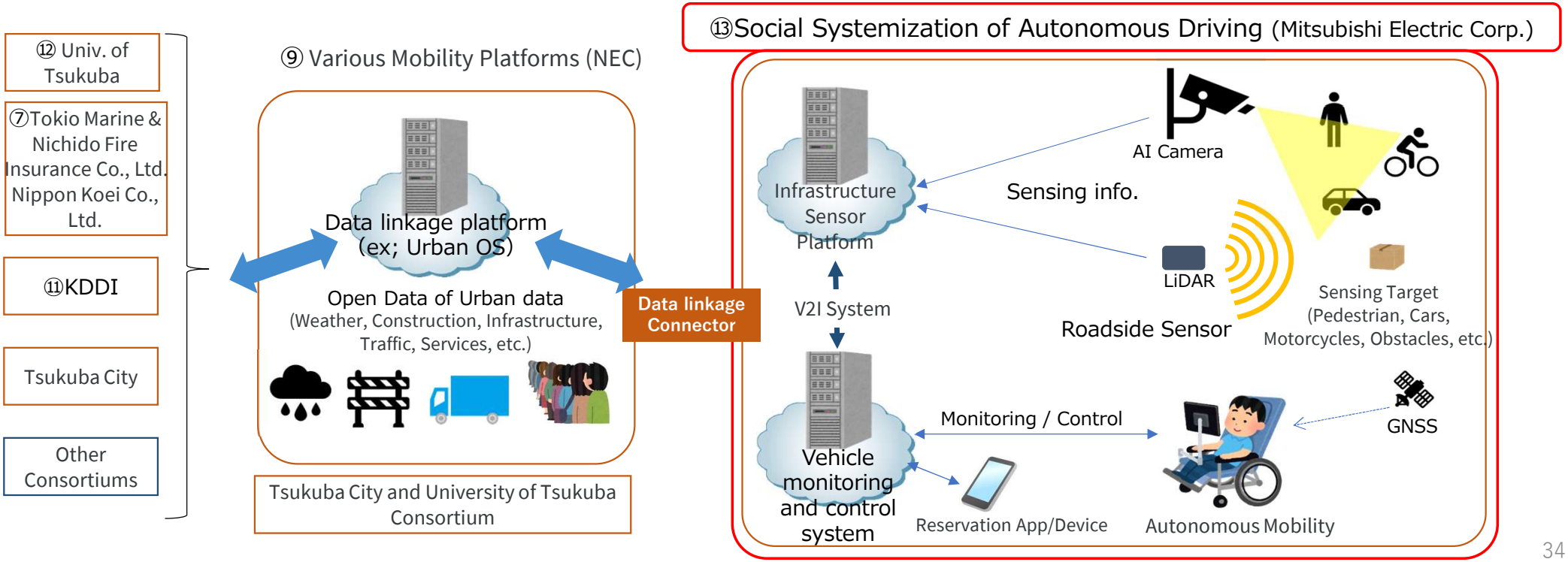


Figure 1: Overview of the Mobility Platform

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【 Progress Status 】

Figure 2 shows the implementation plan and achievements for research and development item ⑬. The blue arrows represent the initial assumptions at the time of proposal, while the red arrows indicate the results. The plan includes the construction of a mobility platform and two demonstration experiments, through which the social acceptability and scope of responsibility for autonomous driving will be examined. In the FY2023, we defined the requirements for the social systemization of autonomous driving, but due to delays in the start, some of the requirement definitions were carried over to the FY2024.

In the FY2024, we defined the requirements for integrating individual sensors and data spaces and concretized the plan. Additionally, we constructed the system which was scheduled in the FY2024 and conducted driving tests on public roads in Tsukuba City.

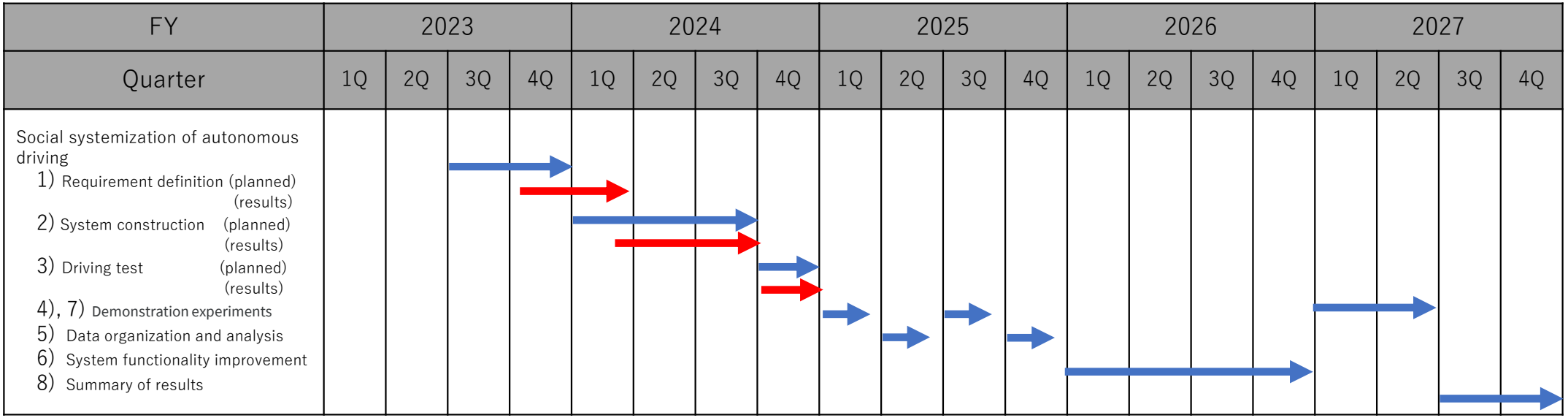

Figure 2: Implementation plan and achievements in research and development item ⑬

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【 Progress Status 】

① System overview

We considered enhancing the risk estimation function for driving mobility by utilizing infrastructure sensors and external data. To acquire external data, we established connectivity with the Tsukuba City Data Linkage Platform and MDS.
We will clarify the data that can be obtained and implement the functionality into the system.

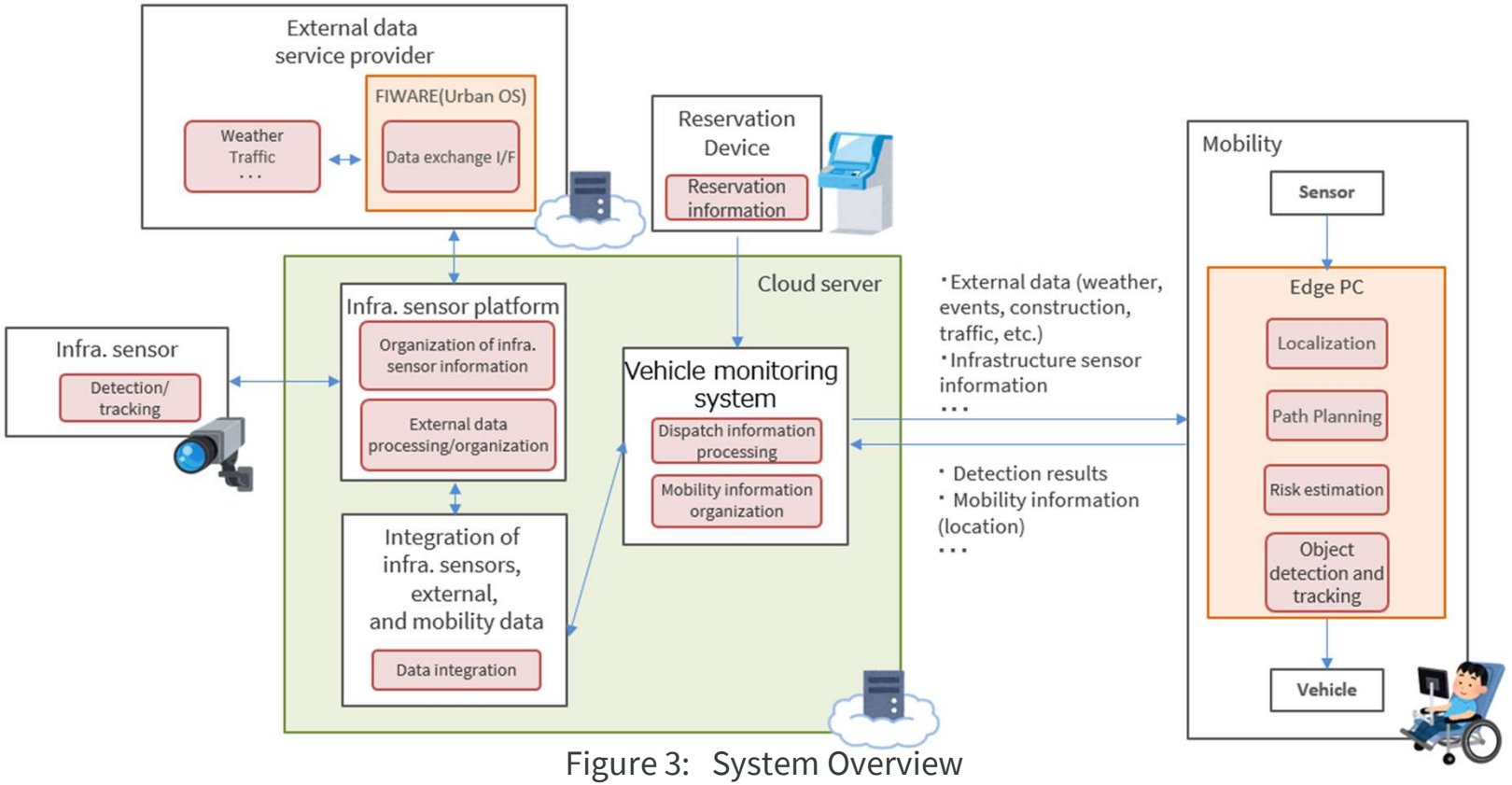

Figure 3: System Overview

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【 Progress Status 】

② Various Functions for Small Mobility

Various sensors were installed on the small mobility to enable it to recognize surrounding objects and environments. Functions for obstacle recognition through edge signal processing and movement range limitation were implemented. During the driving tests, it was confirmed that these functions allowed the mobility to decelerate and stop with consideration for the comfort of the passenger.

③ Infrastructure Sensors and Linkage System

The infrastructure sensor platform has achieved high data compatibility of integration by adopting the same urban OS (FIWARE/Orion) as the Tsukuba City Data Linkage Platform and MDS.
6 infrastructure sensors which were installed around Tsukuba Station reduce data communication volume and processing delays through edge analysis using AI technologies.
The small mobility vehicle installs a function that receives detected obstacle information from infrastructure sensors, determines whether the obstacle positions are dangerous for the passenger, and controls the brakes. It was confirmed that this function worked as expected on the driving route within Tsukuba City.