Working paper ITS-07-04
7th IWG on ITS, 7 November 2023

Initiatives relating to ITS by Road Bureau, MLIT of Japan

ITS Promotion Office
Road Bureau
Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

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Previous efforts by MLIT

1990’

Car Navigation system

Cumulative Shipments
Approx. 105.31 million (2022.3)

1996

VICS (Vehicle Information Communication System)

Providing traffic congestion and regulatory information to car navigation systems to support safe and smooth traffic

Cumulative Shipments
Approx. 75.03 million (2022.3)

2001

ETC(Electronic Toll Collection System)

Nonstop automatic toll collection eliminates congestion at tollbooths

Cumulative new setups
Approx. 78.33 million (2022.3

2011

ITS Spot

- **Dynamic route guidance/safe driving support/ETC, etc.**

Evolution

2015

ETC 2.0

- **Smart investments based on big data**
- **Safety Measures Using Big Data**
- **A smart toll booth where ETC is basic and stress-free**
- **Smart logistics management with high productivity**

Cumulative new setups
Approx. 8 million (2022.3)

VICS(Vehicle Information and Communication System)

- The VICS service started in April 1996.
- Provide real-time information on traffic jams and traffic accidents through car navigation systems.
- Cumulative VICS shipments exceed 75.03 million units (March 2022)

Information collection and processing

Prefectural Police

Road Administrator

Japan Road Traffic Information Center

Vehicle Information and Communication System Center. (VICS Center)

Providing information

FM multiplex broadcasting

Car navigation system allows route selection based on traffic conditions

Parking information (crowded)

Traffic congestion information

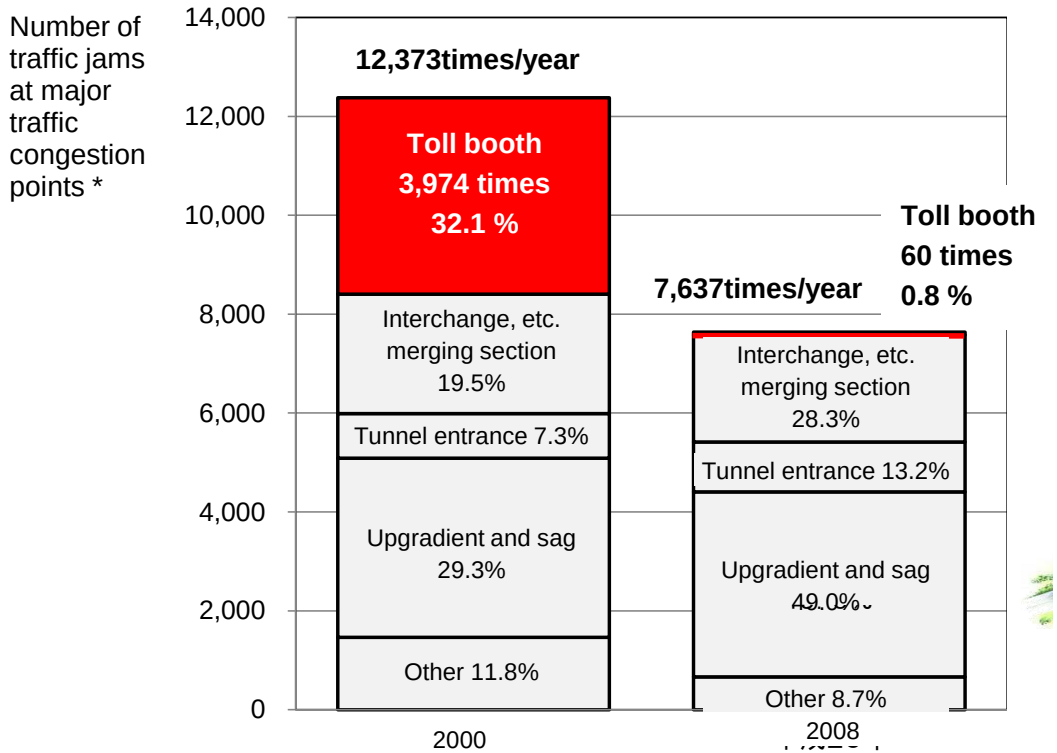
Accident Information

Lane regulation

Effect of introduction of Electronic Toll Collection System (ETC)

- ETC service started in 2001 and gradually expanded, with about 95% usage on highways (April 2023)
- Tollgate congestion, which used to be the biggest cause of congestion on highways, has been almost eliminated by the spread of ETC.
- Promoting the development of smart interchanges dedicated to ETC, which can be developed at a lower cost than conventional interchanges, in order to promote the effective use of highways and the revitalization of local communities

○Traffic congestion on highways



*Traffic jams 30 or more times per year or average traffic jams 2 km or more and traffic jams 5 or more times per year (NEXCO)

normal interchange

- **A lot of labor needed for toll collection**
- **Large construction costs (facilities need to be consolidated to control fee collection expenses)**

smart interchange

〔Direct connection type to main line〕 **〔SA/PA type〕**

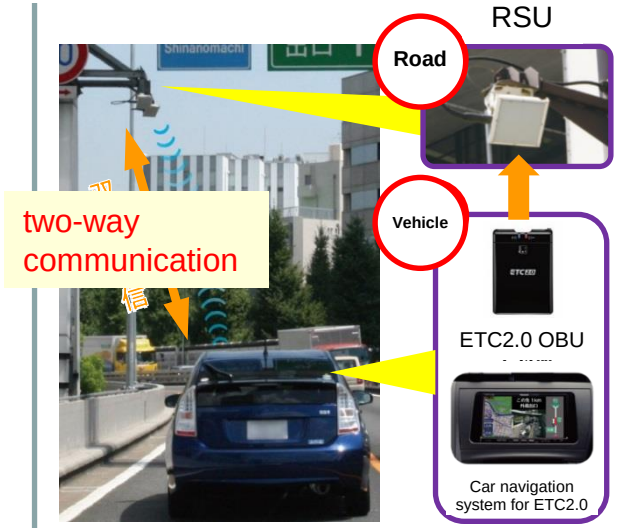
- **Dedicated to ETC, allows for compact design**
- **Labor costs associated with fee collection can also be saved**

***In service: 204 (As of 2022, including construction sites)**

Using big data from ETC 2.0:
Pinpoint traffic congestion control on highways

- Started operation of ETC 2.0 in 2015
- Through two-way communication between vehicles and the road,
  - ✓Providing information on dangerous situations such as widespread traffic congestion and invisible traffic at the points where accidents frequently occur.
  - ✓ Collect big data on vehicles (Position data, acceleration data, etc.) and use it for road measures such as traffic congestion control and traffic safety

Data collection



RSU (as of 2022.4.4)
Expressways: Approx. 1,800
National roads under direct control: Approx. 2,400

OBE (as of the end of 2023.5.3)
Approx. 9.28 million units

Location data
Acceleration data
OBE ID

Data generation

Road administrator

- Speed
- Route
- Sudden brake

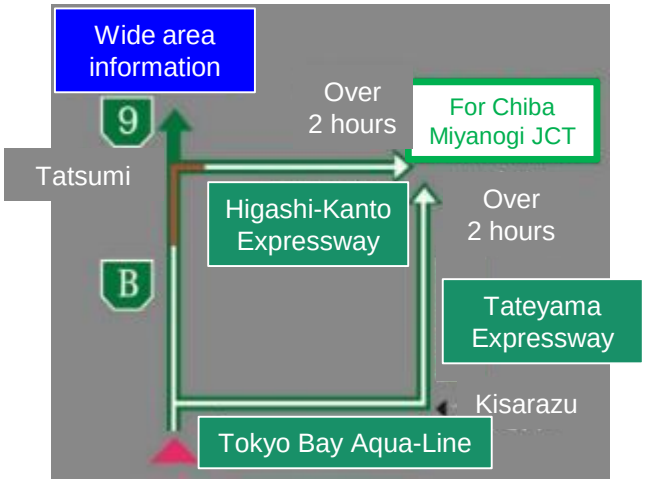
Data utilization

- Data collection
- Traffic safety measures
- Toll policy
- Support for logistics
- Support for public transportation

ETC 2.0 Information Service

Providing Wide Area Information and Images on Routes

Providing congestion information in a wide area



Warnings for dangerous situations such as traffic jams where you can't see the curve ahead in areas where accidents frequently occur

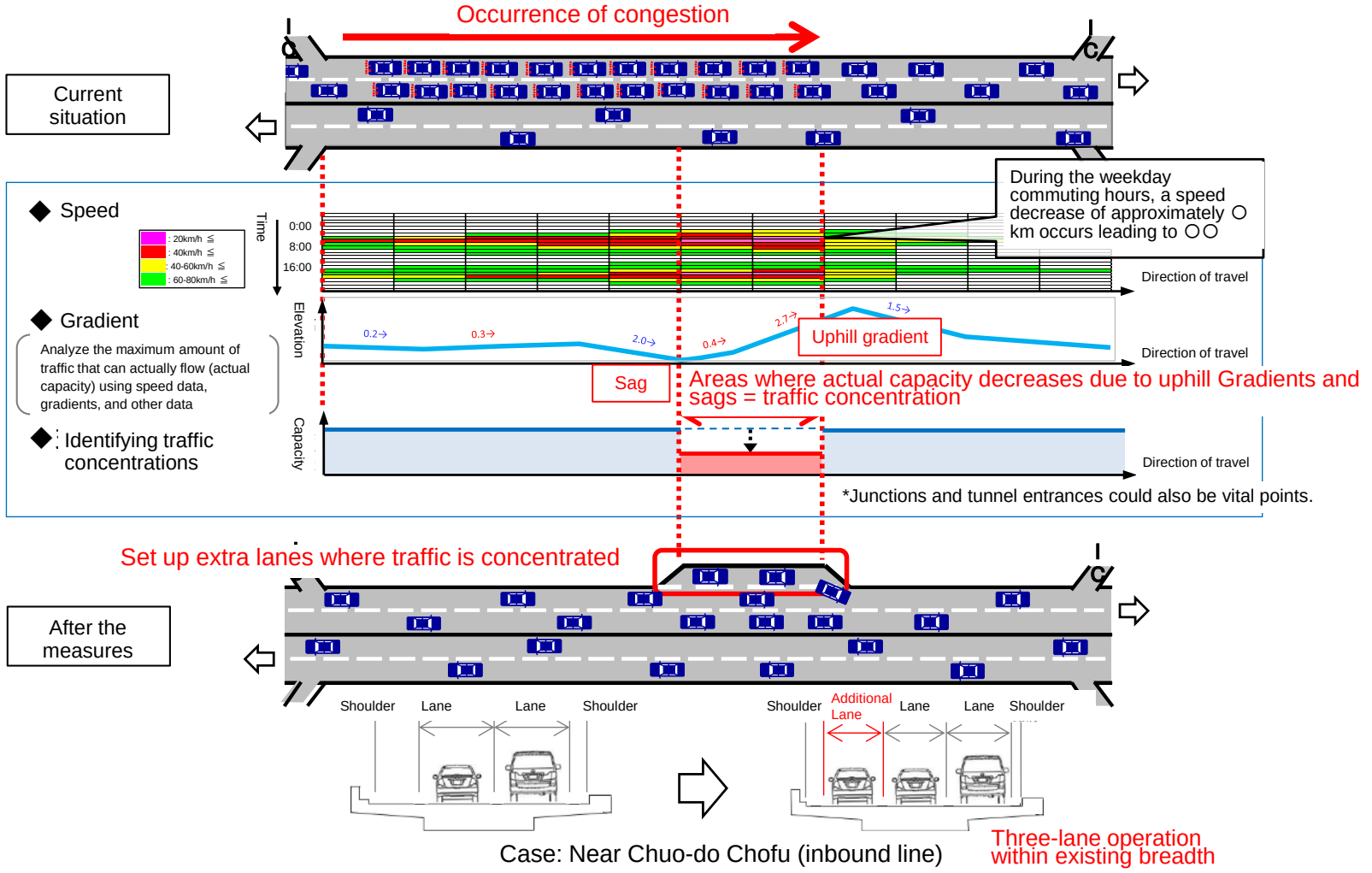
Using big data from ETC 2.0:
Pinpoint traffic congestion control on highways

○ In an effort to maximize the effectiveness of the existing network at the lowest possible cost, we have implemented measures to effectively address structural factors such as uphills and tunnels by using data to identify areas where traffic is concentrated due to slow speeds.

High levels of serious traffic concentration

Identifying locations through data analysis

Smart and pinpoint measures



Case: Near Chuo-do Chofu (inbound line)
Upward direction

Using big data from ETC 2.0: Using big data to improve road safety

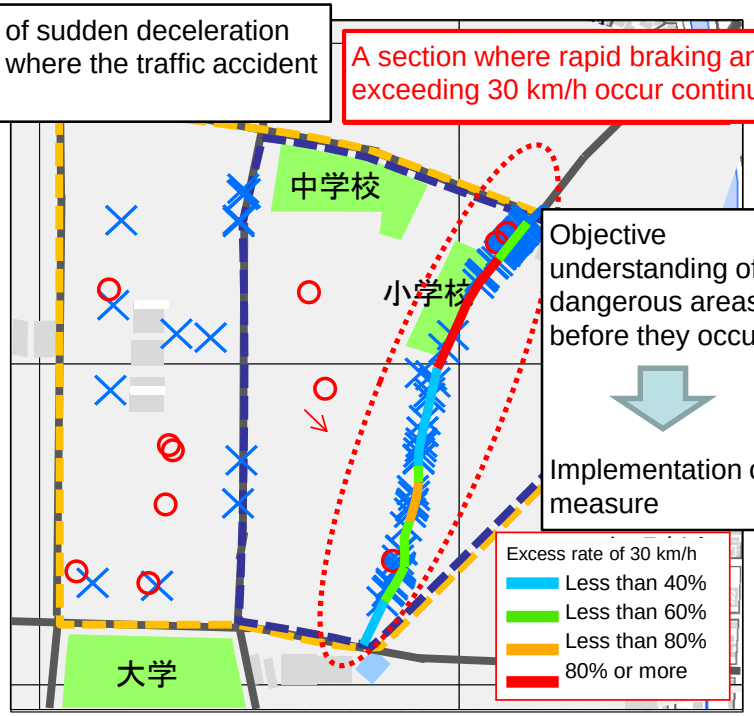
○ Use of big data to identify potential dangerous areas and implement measures to control speed and approach through traffic

■Using big data from ETC 2.0 to identify potential hazards

such as excessive speed, sudden braking, and loopholes

× : The point of sudden deceleration
○ : The point where the traffic accident occurred

A section where rapid braking and exceeding 30 km/h occur continuously



Objective understanding of dangerous areas before they occur

Implementation of measure

■ Planning and implementation of effective and efficient measures

【Examples of countermeasure menus】

Control of curb travel speed


Convex (hump)


Narrow

Difficult entry point


Rising Bollard

Securing pedestrian space


Colored pavement on shoulder

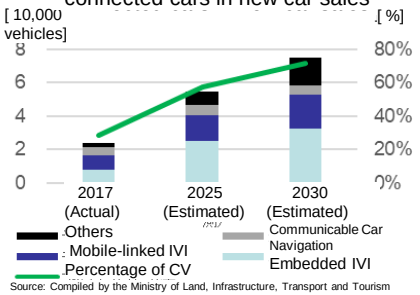
Changing circumstances surrounding road traffic

- In the future, the advancement of on-board sensors and communication and analysis technologies in response to the progress of CASE is expected to diversify the information that vehicles can collect and to further improve the accuracy, freshness and reliability of the data obtained.
- In view of the realization of diverse services, it is necessary to work on creating an implementation environment that enables in-vehicle linkage and utilization of data acquired on the vehicle side, and reviewing the communication methods and functions of the roadside system (such as linking with sensors and adding immediate processing functions).

■Progress of CASE

＜Connected＞

Estimates of the percentage of connected cars in new car sales



Source: Compiled by the Ministry of Land, Infrastructure, Transport and Tourism based on Fuji Keizai's Connected Car Market Current Status and Telematics Strategy 2019

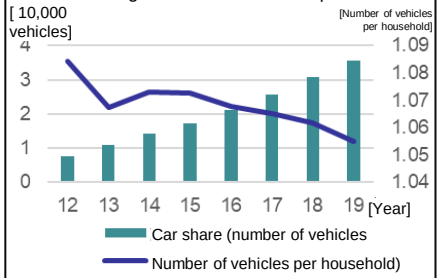
＜Autonomous＞

World's first type designation for automated-driving vehicle (Level 3)

Source: Honda Motor Co., Ltd.

＜Shared＞

Car ownership is on the decline as car-sharing becomes more widespread



Source: Compiled by the Ministry of Land, Infrastructure, Transport and Tourism based on the Annual Economic and Fiscal Report of the Cabinet Office for 2020

＜Electric＞

World's first type designation for automated-driving vehicle (Level 3)

Company	Goal	
TOYOTA	2030	Electric vehicle sales: 8 million
NISSAN	By 2030	Electric vehicle sales: 1 million
HONDA	2030	Electric vehicle sales ratio (in developed countries): 40%
VOLVO	By 2030	100% of electric vehicle sold

■Data diversification

Estimating the vehicle's location and recognizing the surrounding environment
(LiDAR/millimeter-wave radar/camera/gyro/ultrasonic sensor)

Real-time processing
High-speed, high-capacity communications, etc., that communicate data to servers in seconds
(Position/Speed/Image/Failure/Abnormal/Acceleration/Deceleration)

Collaboration and distribution of collected data using APIs, etc.
(Parking lot full capacity information/Public transportation service information/Event information)

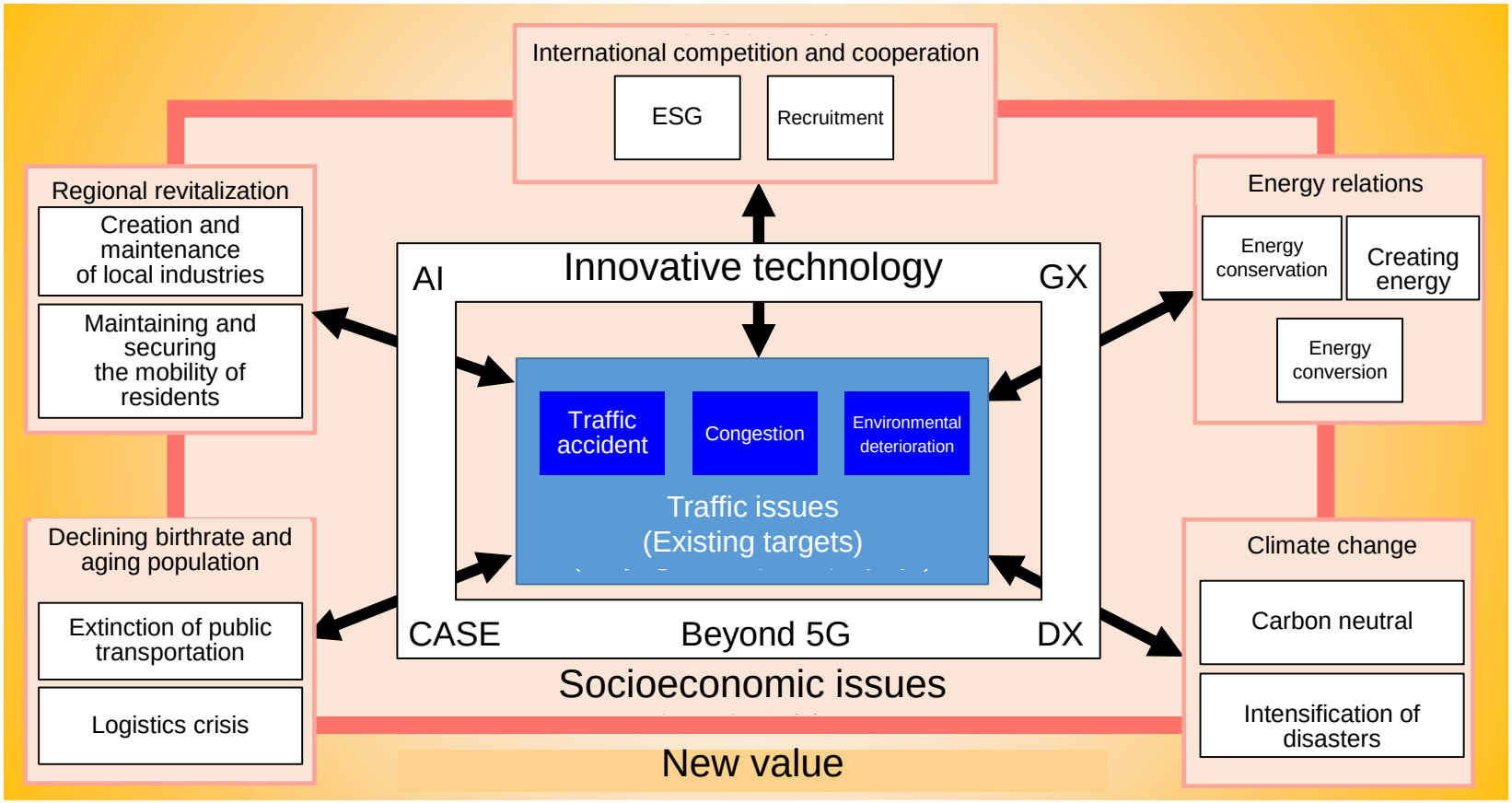
Mutual complement of acquired data to improve reliability

Source: Cabinet Office "SIP Automated Driving Research and Development Plan"

Targeting next-generation ITS

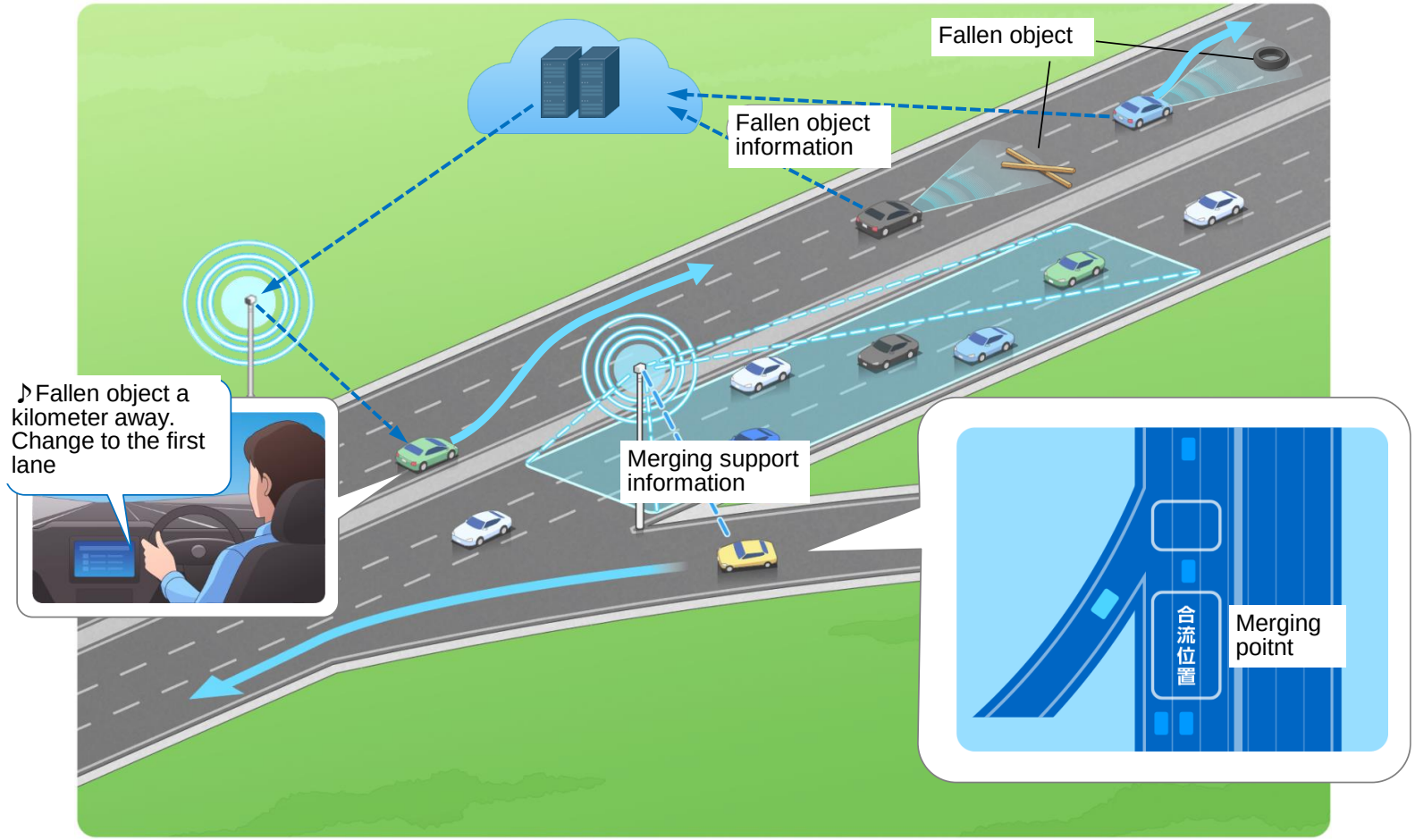
○ With the development and spread of innovative technologies and the maturation and complexity of socioeconomic activities, next-generation ITS will not only solve existing traffic issues (congestion, accidents, and the environment) but also contribute to solving socioeconomic issues.

Targets of next-generation ITS



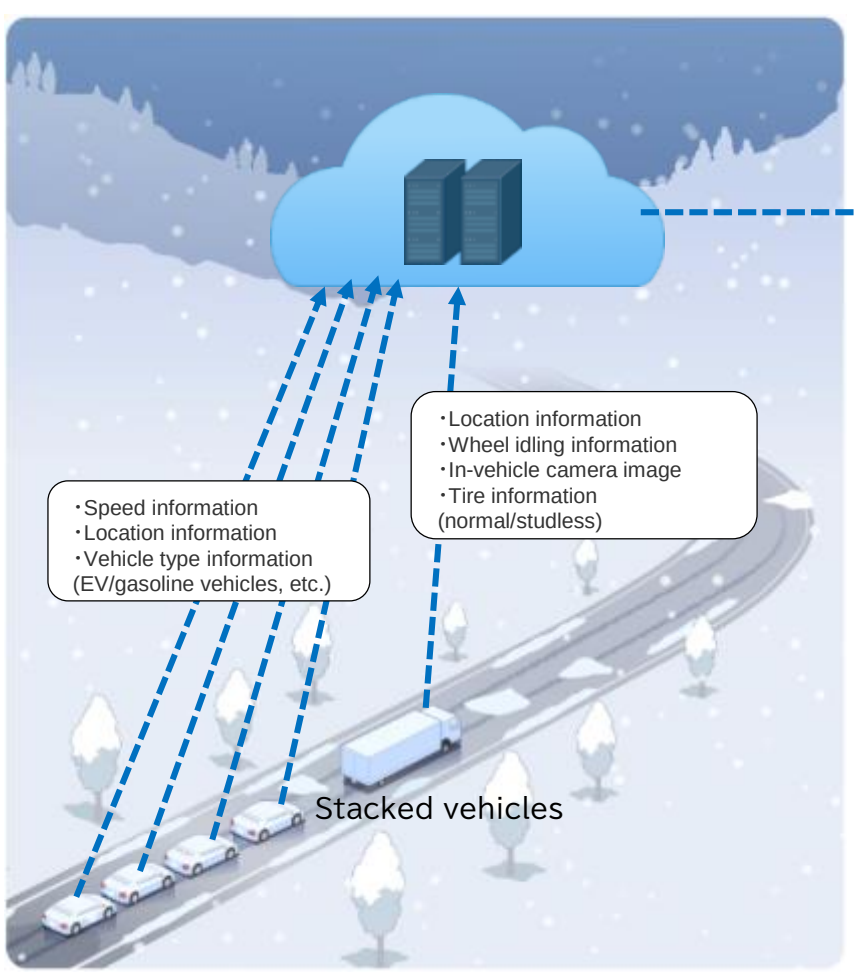
Example 1 of efforts to solve issues: Support for autonomous driving

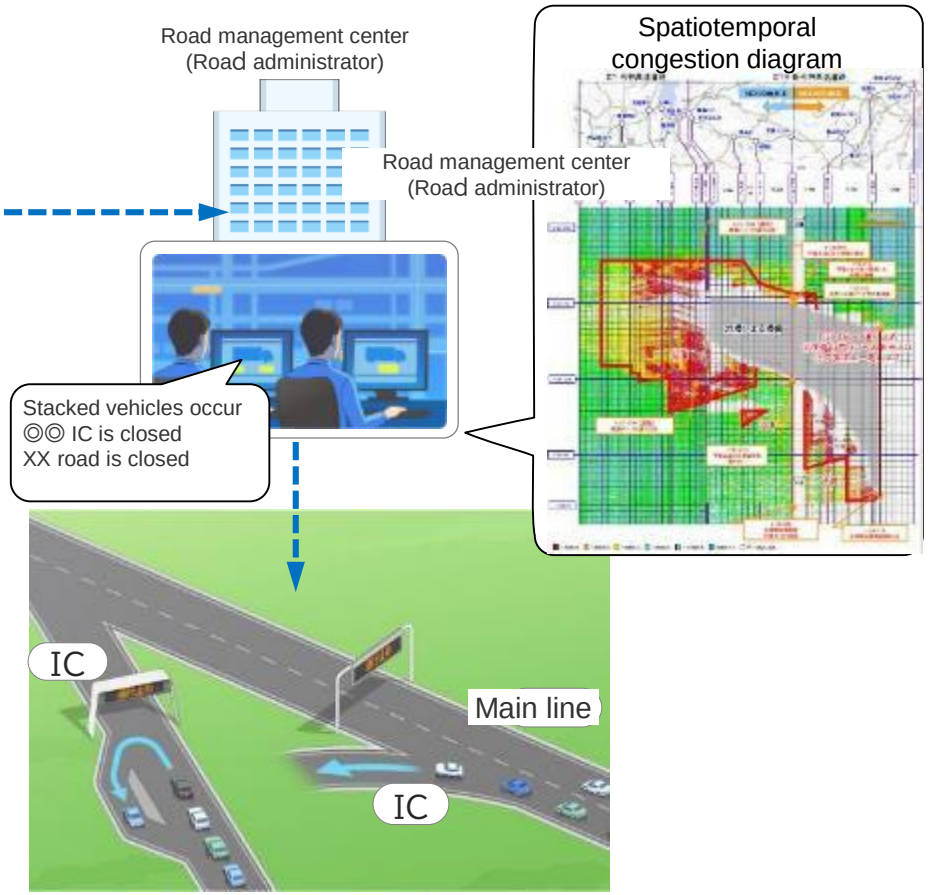
- By using roadside and vehicle sensors to detect and provide information on road traffic conditions and fallen objects, it will contribute to the realization of autonomous driving by supporting smooth merging and safe driving.
- This will contribute to solving social issues of logistics and securing passenger transportation that are difficult to maintain due to labor shortages.



Example 2 of efforts to solve issues:
Accurate, prompt grasp and measure to heavy snow

- When vehicles get stranded during heavy snow, the congestion of vehicles increases, and the longer the measure is delayed, the longer the situation becomes and the more serious it becomes.
- Prevent the spread of damage by combining information on vehicle location and wheel idling to detect signs of stranded vehicles in snow and to detect and respond quickly to their occurrence.

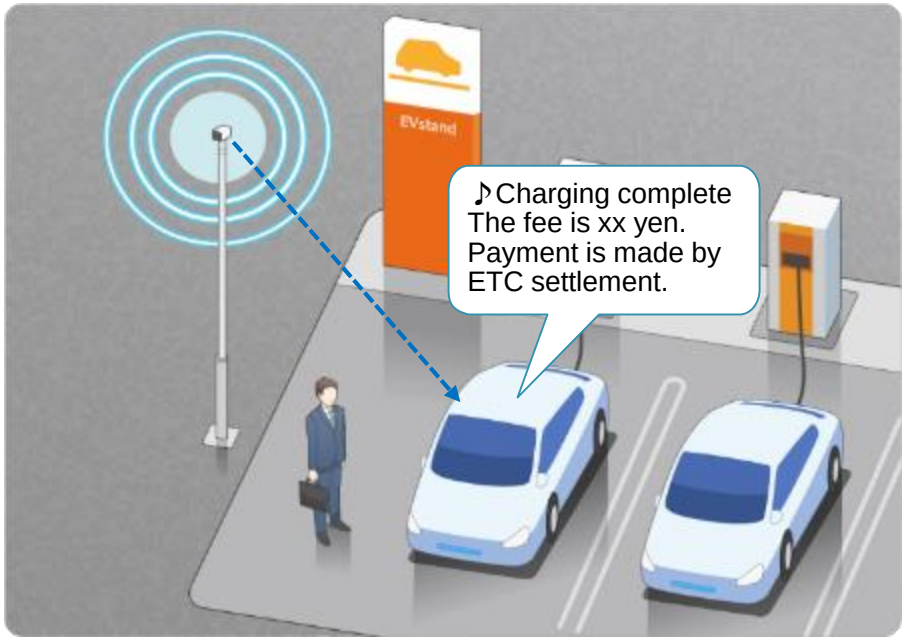




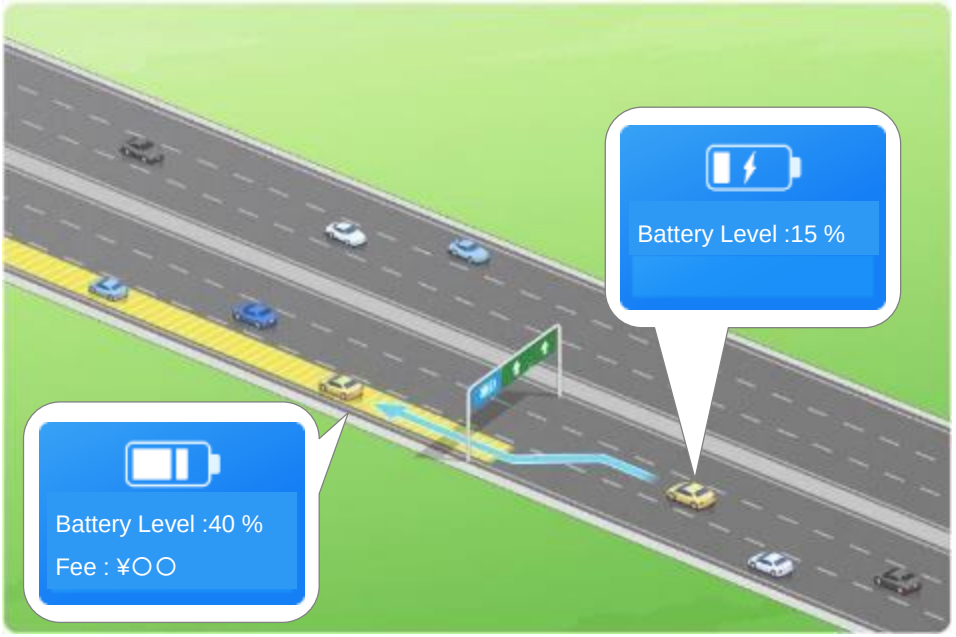
Example 3 of efforts to solve issues:
Contributing to GX (Green Transformation) through the spread of EV vehicles

○ Increased convenience through the realization of ETC settlement of EV charging fees and charging fees with contactless power supply while driving in the future, thereby supporting the spread of EV vehicles and contributing to carbon neutrality.

ETC payment of charging fees



Support for
Dynamic Wireless Power Transfer



Next-generation ITS: Implementing a Digital Infrastructure

Next-generation ITS
Implementing a Digital Infrastructure(Image)

(Self-driving truck operation management through public-private data collaboration

(Wide area communications/Wired Lines)

Arguing points of Next-generation ITS

① Diverse OBE to meet a wide range of vehicles and needs
- Software integration/integration with vehicles
- Ability to expand and update functions
- Diversification of ETC settlement instruments

② Easy-to-use data infrastructure for all parties
- Collection of probe data according to purpose
- Build an environment for data linkage and utilization inside and outside vehicles

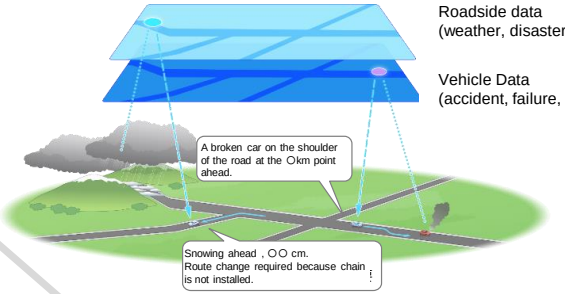
③ RSU compatible with new communication system
- Communication method according to purpose
- Adding sensors and processing functions

Support for merging with expressway interchanges

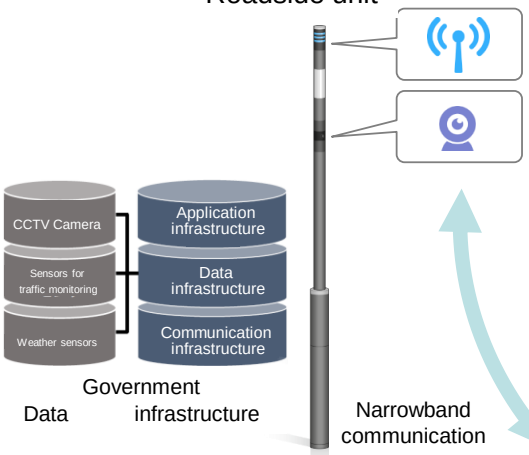
Information on approach speed and location is provided to enable safe merging by collecting traffic information from roadside vehicles and providing it to merging vehicles at merging sections such as highway interchanges.

Provision of look-ahead information using road management sensors

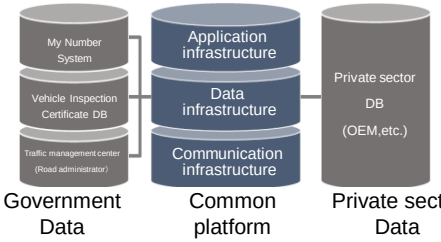
Integrated use of real-time data from vehicles and roadside systems provides safe and comfortable road traffic information.



Roadside unit

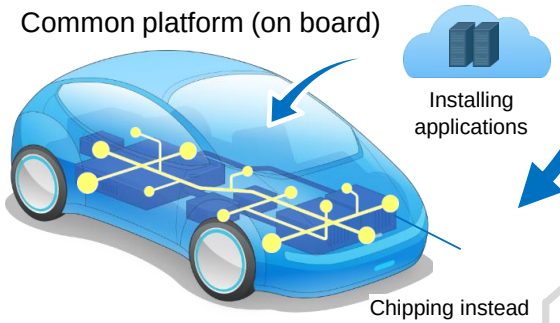


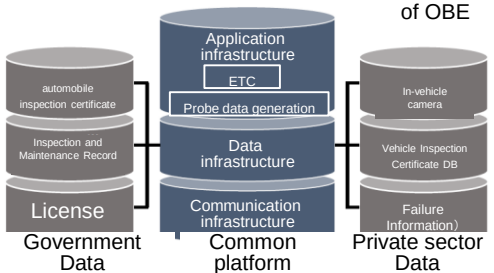
Common platform (exterior)



Wide Area Communications

Common platform (on board)



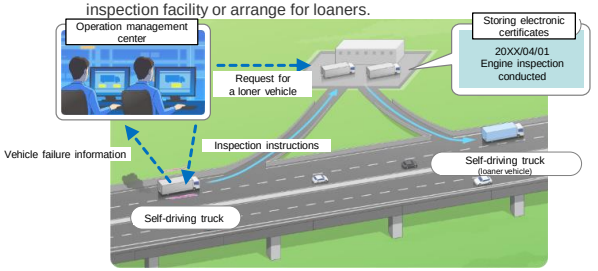


Diversification of ETC payment methods/Private point linkage function, Versatile use of ETC beyond high-speed toll payments

Collaborations between public and private applications allow for the use of a variety of means for making decisions and linking points.
In addition, ETC will be used for more purposes, such as settling parking fees.

Safe and reliable operation management is achieved by immediately transmitting

information about vehicle malfunctions of self-driving trucks to the operation monitoring room and instructing the operator to inspect the vehicles at the nearest inspection facility or arrange for loaners.



Steps to support the spread and expansion of automated driving mobility services (draft)

〇To accelerate automated driving mobility services on ordinary roads,

【 Step 0 】Support for locating your vehicle on a specific route in a limited traffic environment

※1：Mobility services based at roadside stations “Michi-no-Eki” in rural areas

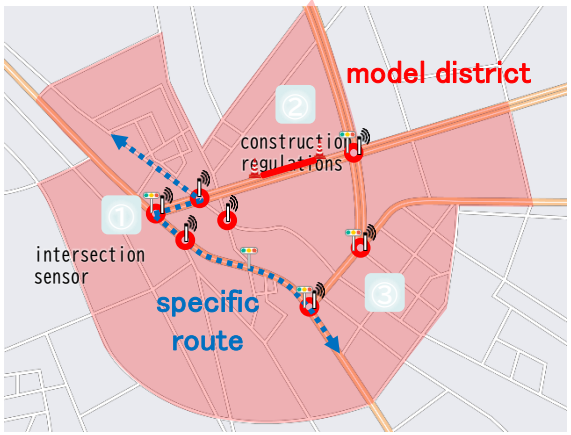
【Step 1】Risk Avoidance Support for Specific Routes in Diverse Traffic Environments

※2：*Bus routes and others in "Machinaka" including ※1

① Assistance in collecting information at intersections ② assistance in developing and updating map information ③ risk reduction through road maintenance and monitoring

【Step 2】Risk Avoidance Assistance in Model Districts of a Certain Size

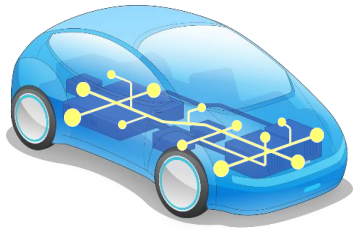
※3：Service areas for demand buses and taxis etc.



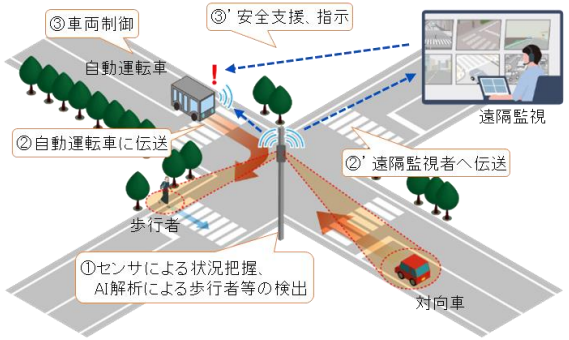
Vehicles

Supporting the adovancement of on-board sensors

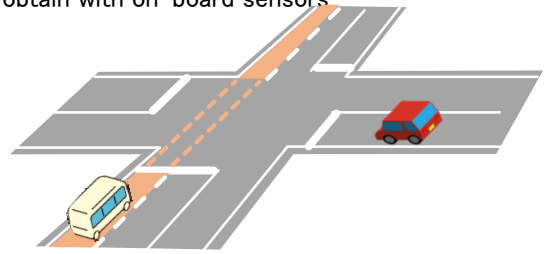
Supporting AI development (learning, etc.)



①Information collecting assistance at intersections

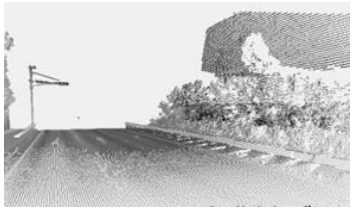


Providing intersection information that is difficult to obtain with on-board sensors

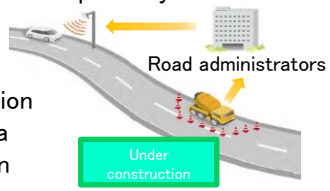


Support automated driving with on-board sensors, such as clear driving locations in intersections

②Maintenance and updating of map information



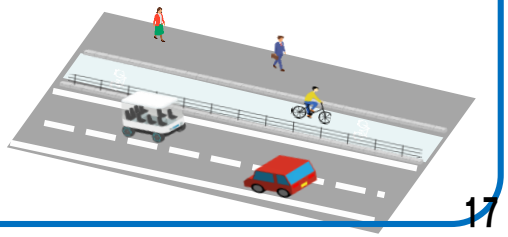
Distribution of construction regulation information (section, lane, etc.) by linking it to high precision 3D maps as dynamic data



Create and update high precision 3D maps from point cloud data such as MMS and construction surveys

③Risk reduction through road maintenance and monitoring

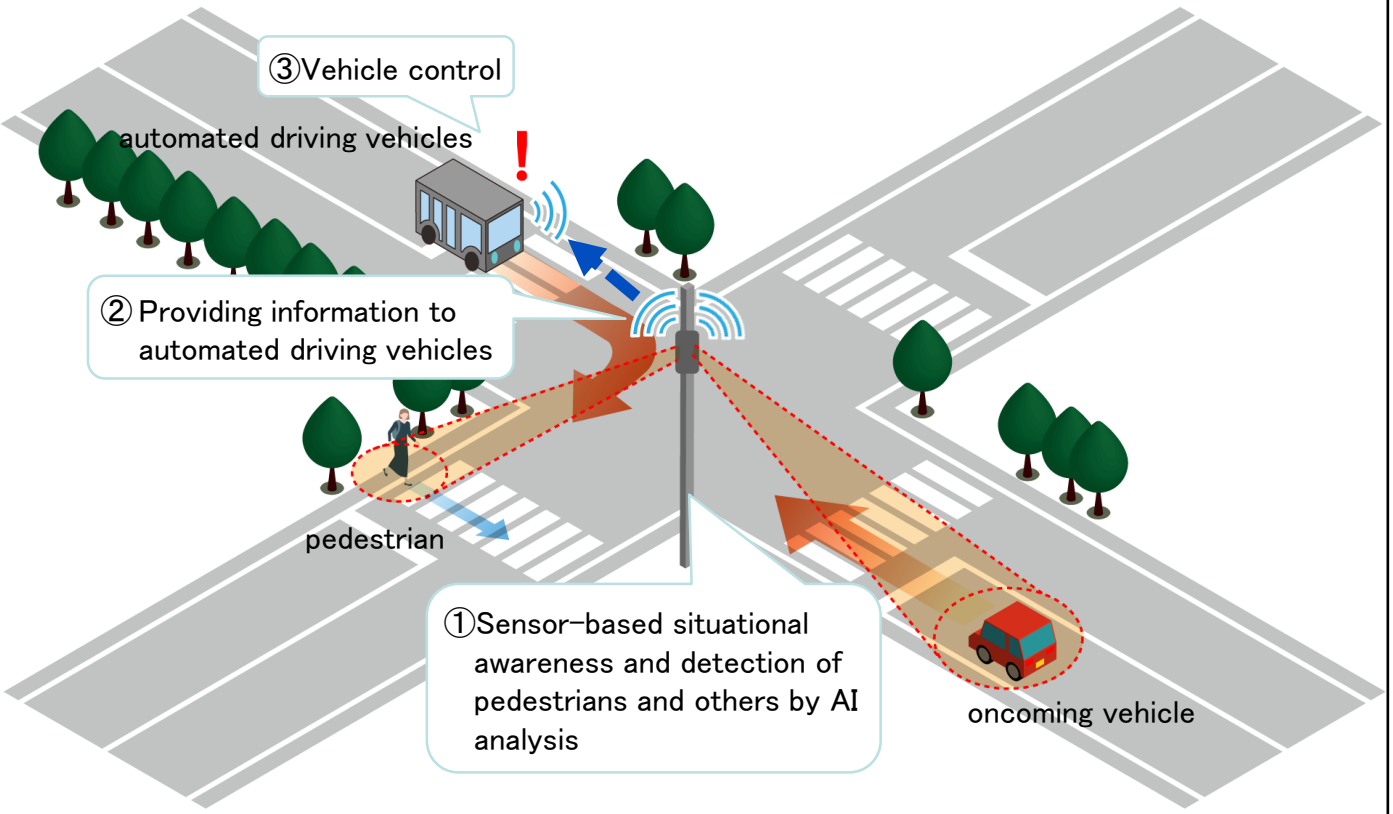
Provide sidewalks and bicycle paths in areas with a high risk of accidents. In addition, exclusive roads for automated driving suitable for vehicles and local conditions will be considered.



Future Initiatives(Support on ordinary roads)

○ Verification of a V2I cooperative system that uses roadside sensors to detect and provide information such as the position and speed of oncoming vehicles, pedestrians, and bicycles, in order to improve the smoothness and safety of road traffic at intersections and other locations on ordinary roads

Intersection sensing (image)



a point of view for consideration

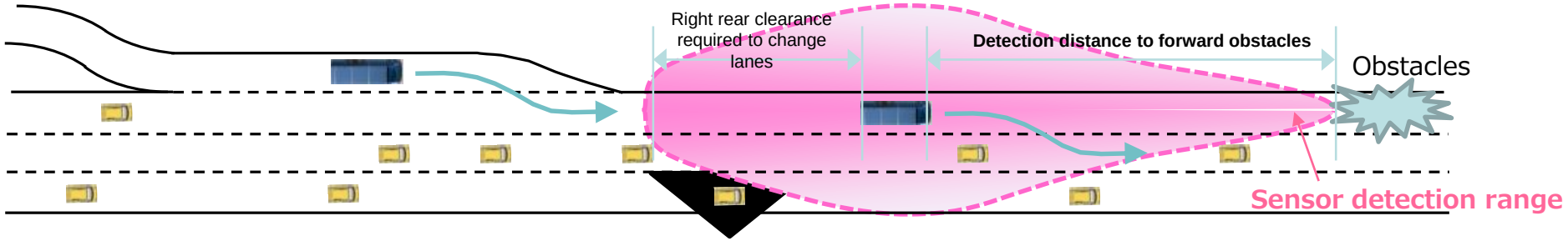
○Building a highly versatile system that can respond flexibly to the development and spread of automated driving vehicles

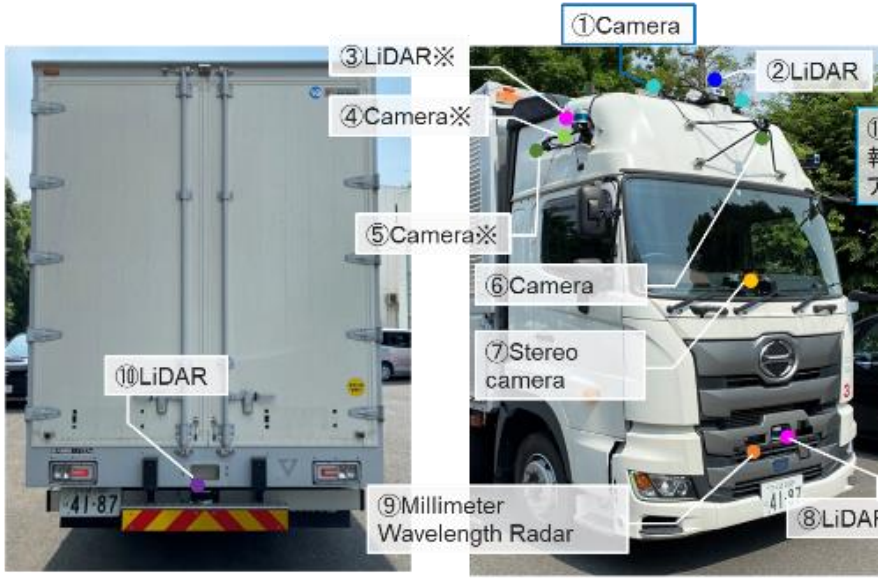
- Verification of the possibility of generating necessary information through AI analysis, etc., utilizing existing facilities (such as road management cameras)
- Verification of the possibility of providing real-time information through V2I communication and stable detection that is not affected by the surrounding environment such as time and weather due to the advancement of sensors

Risks that automated driving trucks find difficult to manage on their own

○ Collaborate with vehicle development to make automated driving trucks a reality and Consider collaborative road vehicle solutions to risks that are difficult to manage alone.

■ RoAD to the L4 Initiatives
Developed a vehicle for evaluating Level 4 automated-driving trucks and identified risks that pose driving challenges





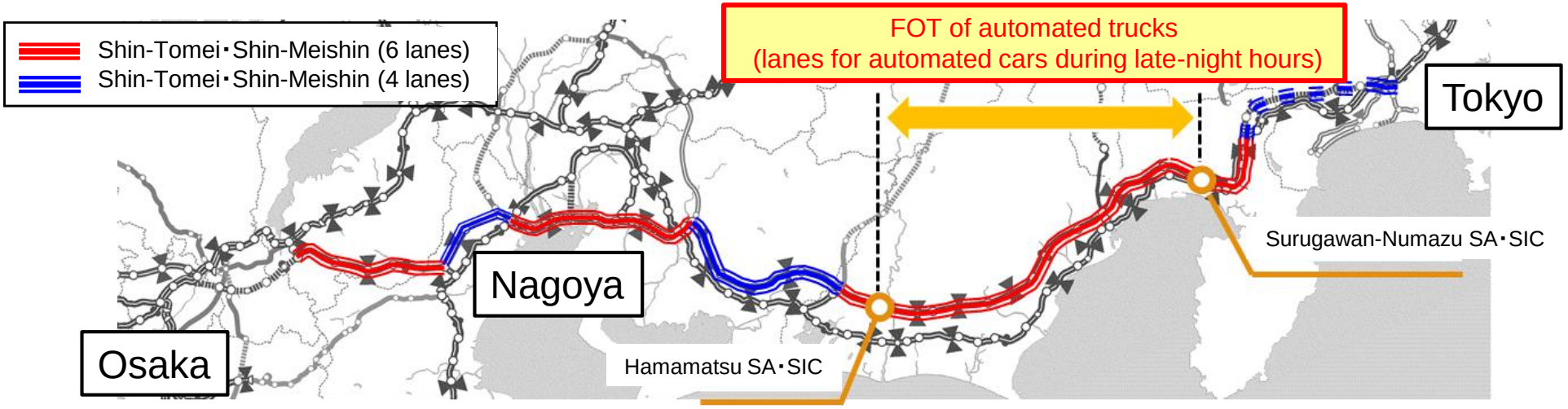
※ 左右に設置

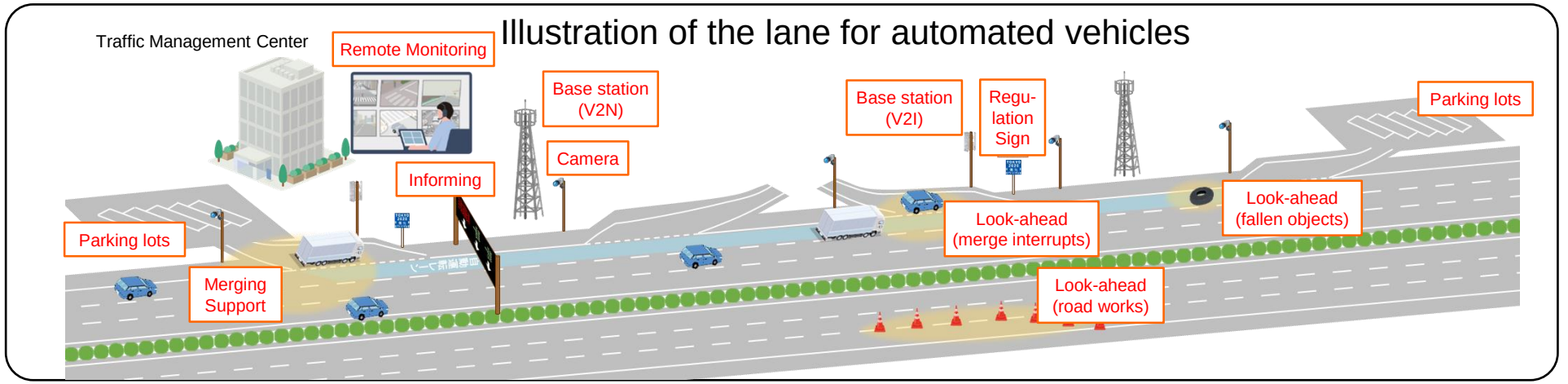
	Risks that are difficult to deal with by vehicles alone	Support menu with infrastructure (example)
Merging	a confluence of automated-driving vehicles	Providing Main Line Traffic Information
Main line	Confluence of general vehicles (interruption)	Notification of approaching automated-driving vehicles by information board
	Lane restrictions (construction, etc.)	Providing Regulatory Information (details)
	Malfunction cars, fallen objects and accidents	Detecting and providing malfunctioning vehicle information
	exit congestion	Generation and provision of congestion information
	Weather (bad weather)	Providing road weather information
	Vehicle malfunctions (stops, accidents, etc.)	On-site processing (applying accident response)

Self driving trucks FOT using automated driving vehicle lane

On the Council for the Realization of the Vision for a Digital Garden City Nation (March 31, 2023), it was shown that **a lane will be set up for automated vehicles on the New Tomei Expressway (between Surugawan-Numazu SA and Hamamatsu SA) during the late night hours in fiscal 2024**.

The function of the lane for automated vehicles should be considered **based on the situation of development and spread of automated driving vehicles**.





Desired functions for automated vehicle lane (draft)

【Merging Support】

Support the merging of automated driving cars onto the main line

【Collecting and Providing look-ahead information】

Collecting and providing information to support the smooth running of automated-driving vehicles (e.g., prior lane changes)

Road works

Fallen Objects

【Notification】

Notification for road users by road information board, signboard, etc.

【Automated-driving trucks parking lots】

Parking lot for arrival and departure of automated vehicles on SA/PA

Overview of the V2I cooperative system

○ V2I cooperative system will provide Level 4 automated trucks with look-ahead information such as merging support information, fallen objects information and road works information on the FOT.

V2I cooperative system（image）