DYNAMIC MAP PLATFORM

2021

SIP-adus Workshop2021
Dynamic Map

Dynamic Map Platform Co.
Current Initiatives and Future Developments

Company Profile

Founding	June 13, 2016.
Head office	Kinzo Building 6F, 4-1-21 Muromachi, Nihonbashi, Chuo-ku, Tokyo
Representative	President and Representative Director　Hiroyuki Inahata
Shareholders	**Fund** • NCJ • Japan Infrastructure Initiative • Mitsubishi UFJ Capital **Satellite Manufacturing Company** • Mitsubishi Electric **Surveying Company** • PASCO • Aisan Technology **Map Company** • Zenrin • IncrementP • Toyota Mapmaster **Automobile Company** • IISUZU • SUZUKI • SUBARU • DAIHATSU • TOYOTA • NISSAN • HINO • HONDA • MAZDA • Mitsubishi Motors **総合商社** • Mitsui & Co.

An "all-Japan system" with the backing of the Japanese government and companies representing various industries working in unison.

History

June 2016	Established as Dynamic Map Platform Planning Co.
June 2017	Changed the company name to Dynamic Map Platform Co. and became an operating company.
Oct. 2017.	Certified as a public survey planning organization by the Ministry of Land, Infrastructure, Transport and Tourism
Mar. 2019.	Completed the construction of 29,205 km of Japan Highway
Apr. 2019.	Ushr Inc. acquisition process completed
Sept. 2019.	Our high-precision 3D map data is used for the first time in mass-produced vehicles

Business Description

Generate, maintain, and provide high-precision 3D data for automotive and multi-purpose applications

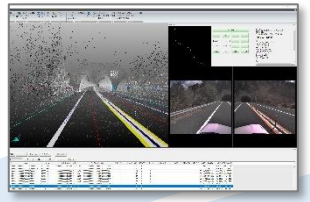
Technical support

MITSUBISHI ELECTRIC Changes for the Better / PASCO World's Leading Geospatial Group / AISAN TECHNOLOGY CO.,LTD. / ZENRIN / Increment P FEEL THE SPACE / mapmaster

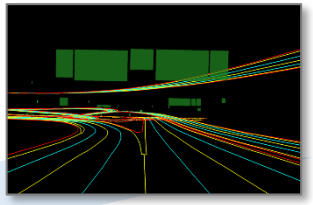
Position correction technology

Generating point cloud data using a mobile mapping system

Geocoding from point cloud data



Integration of various data



Business domain of Dynamic Map Platform

Realization of 3D position common Platform

"High-precision 3D map data" Cooperative domain

Sstellite positioning → Measure ment → Mapping → Integration

Sstellite positioning	Measure ment	Mapping	Integration
Position correction	Point cloud generation Position correction	Geometriza tion Point cloud generation Position correction	Data integration Geometrizati on Point cloud generation Position correction

Competitive Domain

Processing

Addition

data integration
Geometrizati on
Point cloud generation
Position correction

Use in the field of automated driving

Support for specification development

ISUZU / SUZUKI / HINO / HONDA / SUBARU / DAIHATSU / mazda / MITSUBISHI MOTORS / TOYOTA / NISSAN MOTOR CORPORATION

Utilization for multiple purposes

- MaaS
- Disaster prevention and mitigation
- Social infrastructure maintenance and management, etc.

基盤構築支援

INCJ / JII Japan Infrastructure Initiative / MUFG 三菱UFJキャピタル / MITSUI&CO.

About Ushr.Inc

Development, maintenance and sales of HD map data of the same level as DMP in North America

Adopted and put into practical use in General Motors' mass-produced vehicles for the first time in the world

High-level computer science personnel

Ushr
A DMP Group Company

Company name	Ushr Inc.
Head office	38701 W. Seven Mile Road Suite 170 Livonia, MI 48152 USA
Business Description	Development and sales of high-precision maps for automatic driving
Major shareholders (Before acquisition)	• General Motors Ventures • EnerTech • Emerald Technology Ventures • Forte Ventures • GeoDigital
History	• 2014 Start of U.S. and Canadian highway map maintenance (GeoDigital era) • 2016 GeoDigital Automotive established • 2017 GeoDigital Automotive spun off and renamed Ushr. • Completed HD Map (130,000 mile, single lane version) for GM Super Cruise • 2018 First startup to win GM Innovation Award; added 75,000 miles of HD Map • 2019 Lane by Lane Map release begins.

Strengths of our Group

We have integrated the outstanding software development capabilities and superior manufacturing processes of our group company, Ushr Inc.
We have built a system that enables us to provide the global market with superior, next-generation, high-precision 3D map data (HD maps).

- High accuracy of cm class
- High quality and low costs Manufacturing Process
- Specifications to meet OEM requirements
- According to customer requirements Customization
- Japan and North America Adoption Experience

Provides highly accurate, high quality, cost-effective data

Data/Coverage Provided

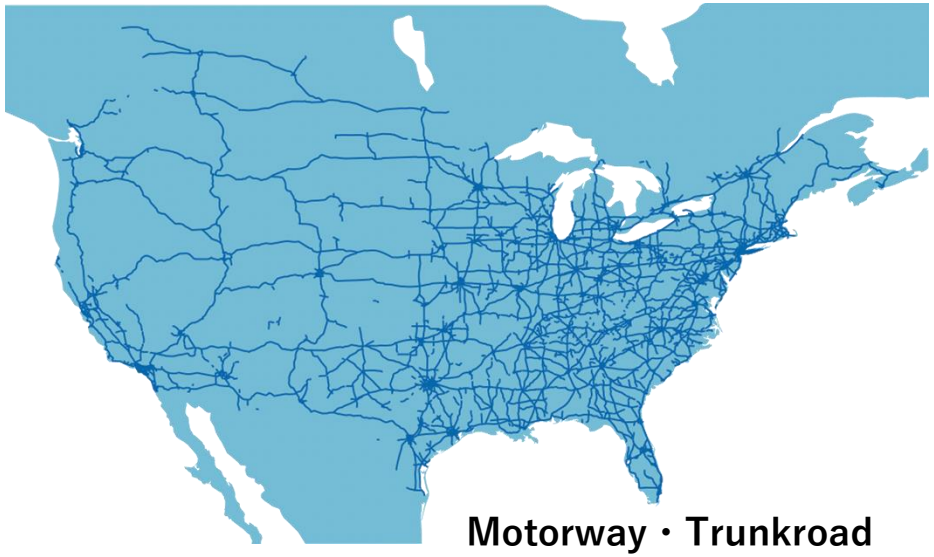
Providing high-precision 3D map data (HD map) of Japan and North America, expanding coverage sequentially.

JAPAN

Highway

31,777km～

North America



Motorway・Trunkroad

200,000mile～

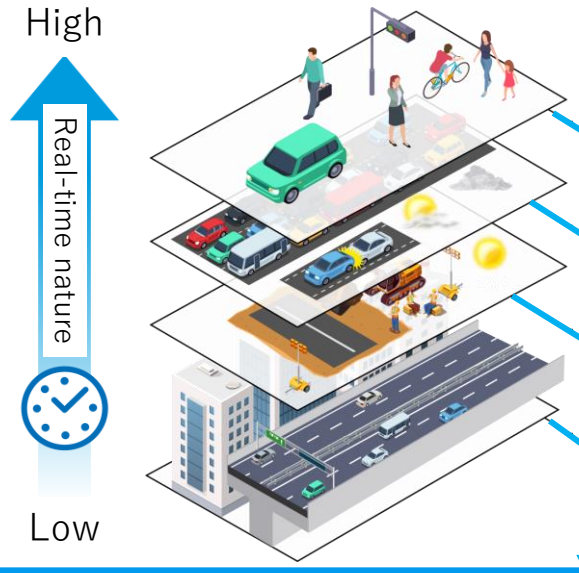
As of March 31, 2021. Distances shown are upper and lower line lengths. North America is provided by Ushr Inc.

Approaches to the development of updating technology for high-precision 3D base maps

-Report on the results of the second phase of the SIP project-

Dynamic maps and high-precision 3D map data

DYNAMIC MAP PLATFORM



"Dynamic map" = real-time data with dynamic information superimposed on static information

Dynamic information

Information on surrounding vehicles, surrounding pedestrians, traffic lights, etc.

Semi-dynamic information

Traffic accident information, traffic regulation information, traffic jam information, narrow area weather information, etc.

Semi-static information

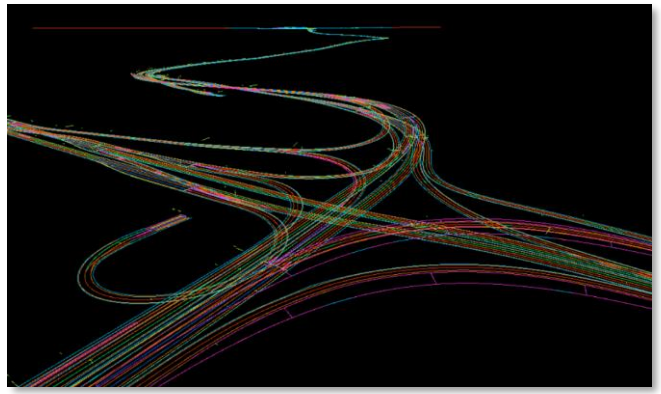
Traffic regulations, road construction schedules, wide-area weather forecast information, etc.

Static information (high-precision 3D map data (HD map))

High accuracy of cm class

With 3D location information

Road Structure Information related to road structure



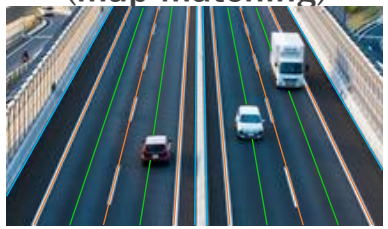
対象地物名	地物事例
区画線	道路鋲 減速帯 ←ゼブラゾーンの枠
多重区画線	
路肩縁	壁 縁石 ガードレール ガードケーブル ボックスビーム 側溝 ラバーポール クッションドラム バリケードブロック
道路標示	東京方面 ←ゼブラゾーン内
道路標識	非常駐車帯 50 登坂車線 SLOWER TRAFFIC 本線 THRU TRAFFIC 横浜 Yokohama 町田 Machida 4 出口1km EXIT ETC/一般 ETC車
信号機（本体・補助信号）	
信号機（矢印灯）	

The main role of high-precision 3D map data

High-precision 3D map data (HD map) is essential for the components of automatic driving (recognition, judgment, and operation).
It plays an important role in advanced "self-positioning" and "recognition of the surrounding environment.

Cognition
(maps, communication, sensors)

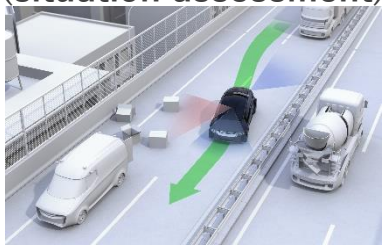
Self location estimation
(map matching)



Peripheral vehicle recognition
(omnidirectional)

Judgment
(Control/Artificial Intelligence)

Operation plan
(situation assessment)

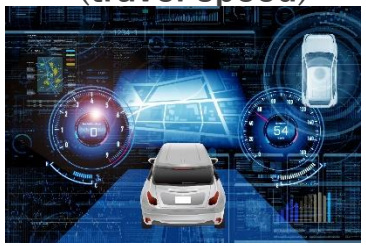


Operation plan
(action plan)

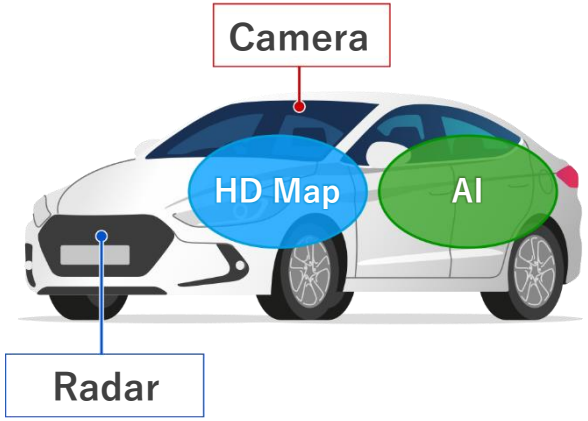
Operation
(Hydraulic and electric monitor)

Vehicle control
(steering amount)

Vehicle control
(travel speed)



Positioning technology

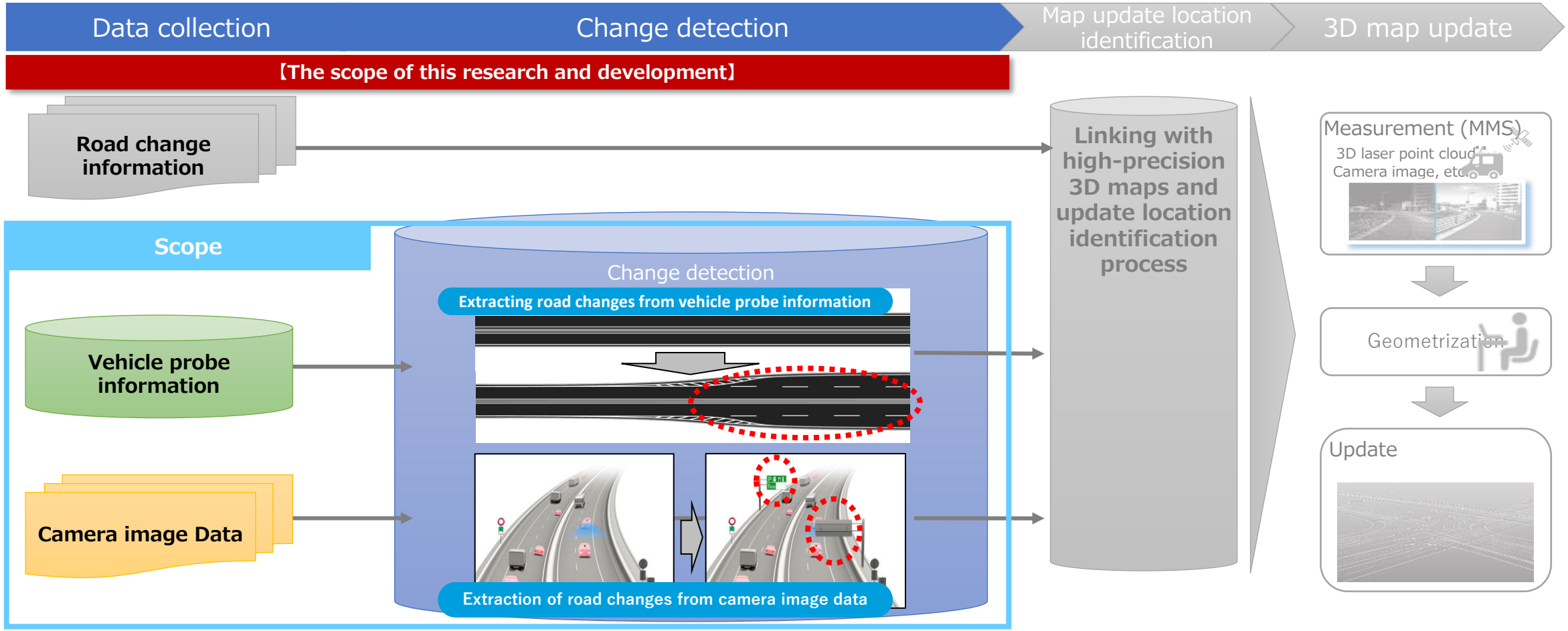


Necessity of updating technology development and outline of efforts

DYNAMIC MAP PLATFORM

To continue to support automated driving, it is essential to constantly update data and close the gap with reality.

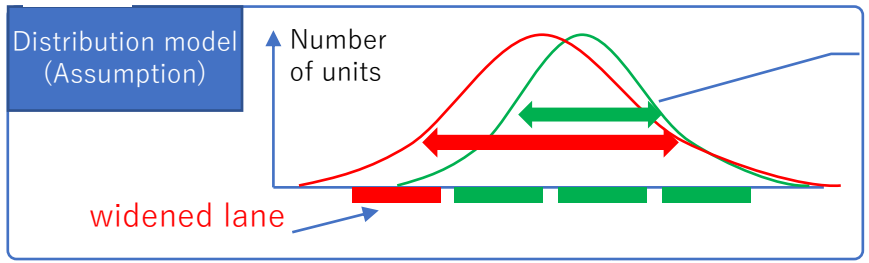
- Data update issues
  Information on road changes from road administrators alone is not sufficient for organizing and grasping information on changes such as new installation/removal of traffic signals and road signs that do not involve changes in road structure.
- Initiatives
  Consideration of technology to identify updated locations using vehicle probe information and camera images, aiming to shorten the update cycle and improve the automatic driving function



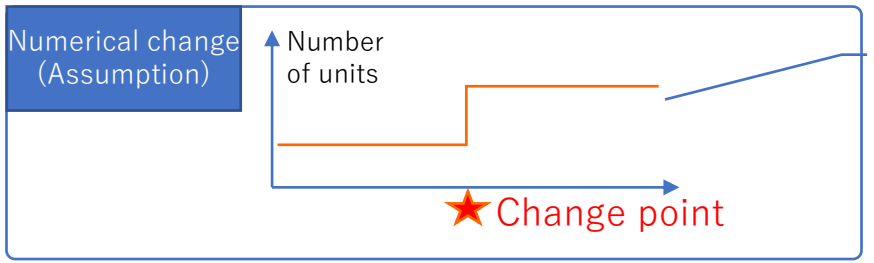
Results of technological development

Road change point extraction using vehicle probe information #1

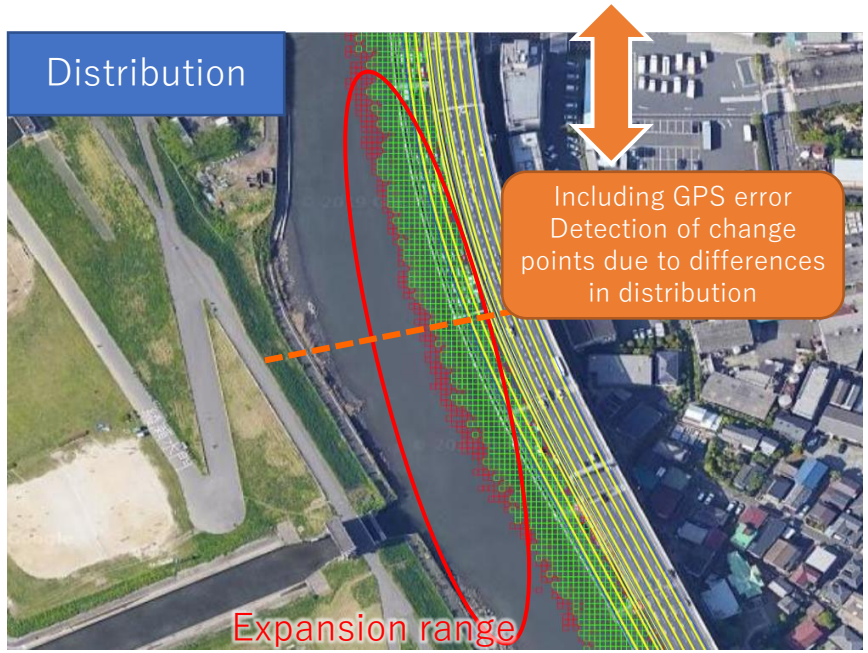
Aggregate vehicle probe information over a certain spatial and temporal range and detect points with large changes in the distribution model and numerical values as road change points.

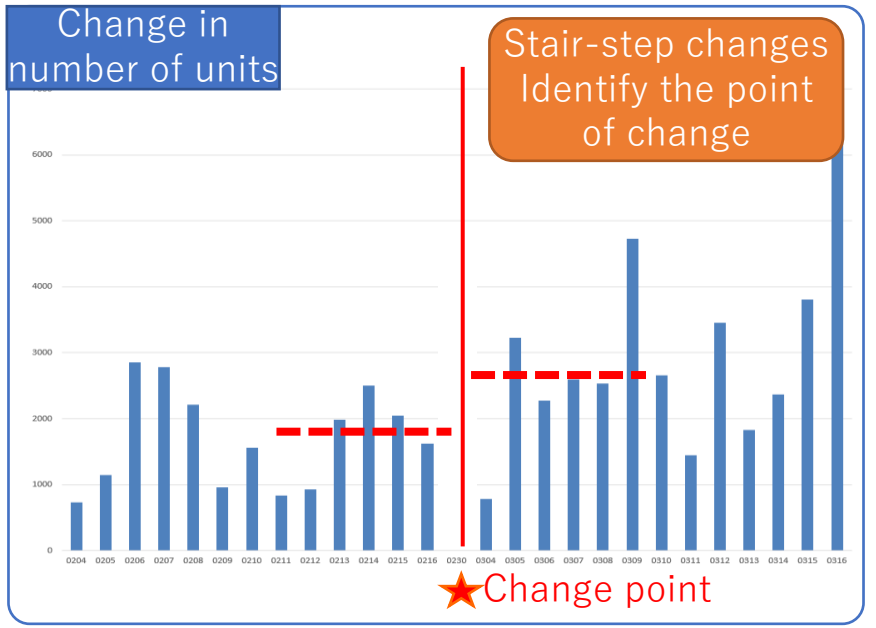


Detecting changes due to differences in the spatial distribution of vehicles caused by road widening



Detect changes due to differences in traffic flow (number of vehicles) caused by road widening





Confirmed the possibility of understanding road changes caused by vehicle probe location information in areas with a good positioning environment.

Results of technological development

Road change point extraction using vehicle probe information #2

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Verify whether the events that are expected to occur in vehicle probe information when road changes occur can be covered as change information necessary for updating.

◇ Verification Results

Change information		Basic attribute		Vehicle probe information items										Change detection Possibility
Contents	Change scale	Acquisition time	Lon. and Lat.	Accelerator pedal stroke	Brake pedal stroke	Winker	Handle angle	Direction of travel	Vehicle speed	Acceleration	Angular velocity (Rotational direction)	Geomagnetism (car turning around)	Engine speed (running/stopping)	
Increase/decrease in number of lanes	L	○	○	○	○	○	△	□	○	△	△	△	△	H
widening (of a road)	L	○	○	○	○	○	△	□	○	△	△	△	△	H
Change the location of branching and merging	M	○	○	△	△	○	△	□	△	△	△	△	△	H
New construction, abolition, and modification of physical structures	S	○	△	△	△	△	△	□	△	△	△	△		M
Creation, elimination, or modification of zebra zones	M	○	○	△	△	○	△	□	△	△	△	△	△	H
Change the solid/dashed line and color of the parcel lines.	S	○	△	△	△	△	△	□			△	△		M
Establishment, abolition, or modification of emergency parking zones	S	○	△					□	△				△	L
Repainting plot lines	S	○	△	△	△	△	△	□			△	△		M
New installation, abolition, or modification of signs	S	○	△	△	△			□						L
Establishment, abolition, or modification of signs	S	○	△	△	△			□						L
Installation, abolition, and modification of traffic signals	S	○	△	△	△			□					△	L

The amount of change in latitude and longitude is The amount of change in latitude and longitude is small, and the numerical change is There is little clear correlation with road changes.

【Notes】
◎：Items where changes are expected to be noticeable
△：Items for which changes may be detectable
□： Items that may be used in the process of processing

It was determined that it would be difficult to cover all the information necessary for updating high-precision 3D maps with the current vehicle probe information alone.
The first step is to use the "technology to extract road change points using Dashcam.

Results of technological development

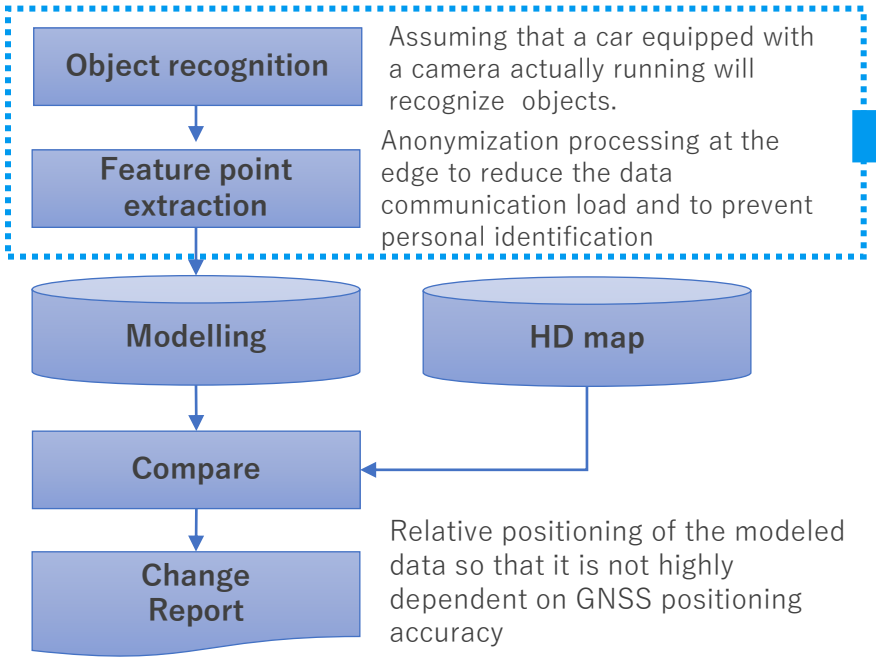
Extraction of road change points using dashcam #1

DYNAMIC MAP PLATFORM

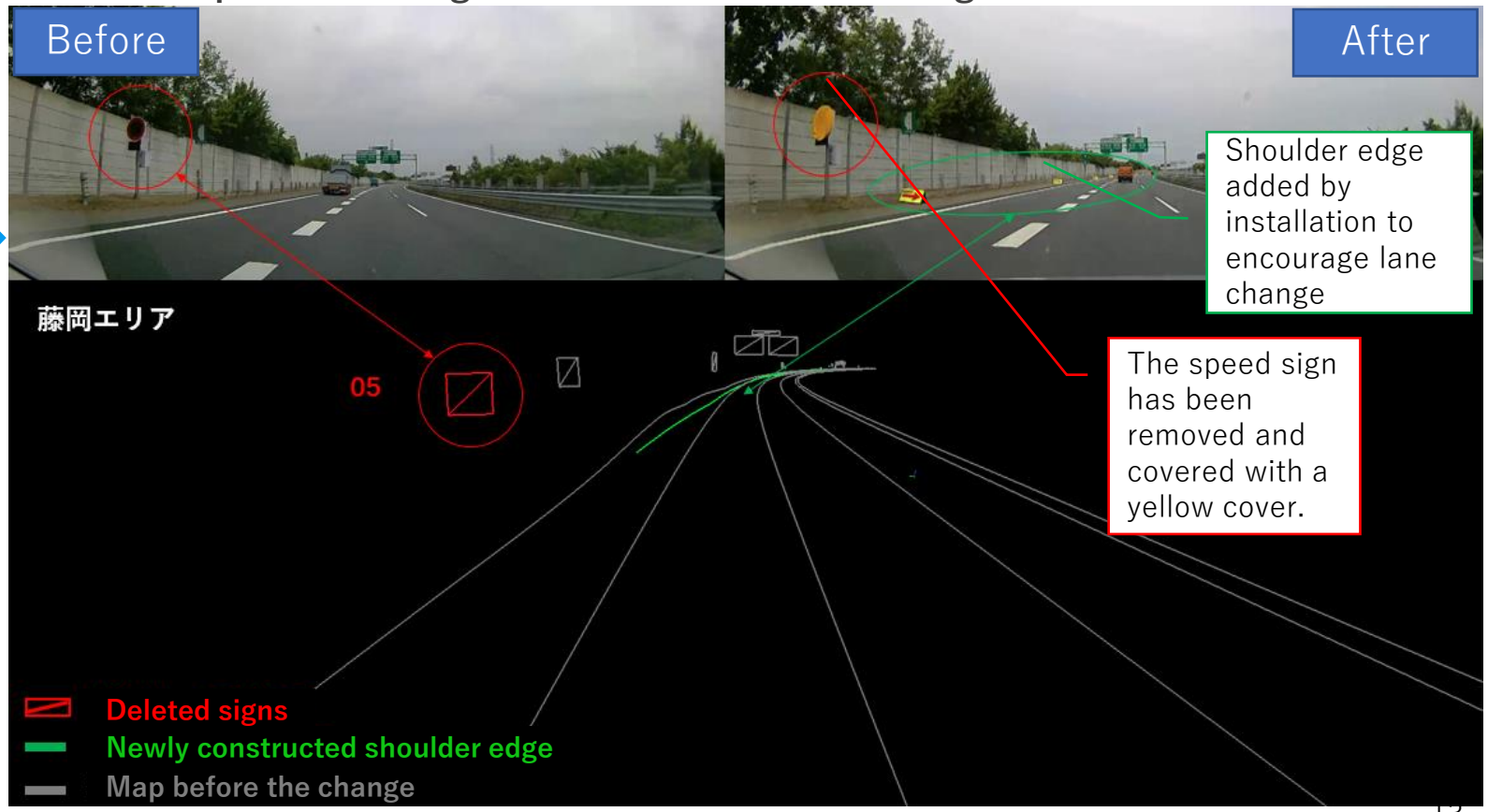
- We demonstrated road change point detection by comparing the camera image data before and after the change.
- Using an off-the-shelf dashcam, compare the feature points at a level that can be extracted by the edge side before and after the change.

Since it was confirmed that changes in geological features such as shoulder edges and road signs can be extracted, we will consider applying this method to data updating.

Change Point Detection Pipeline



Example of "road sign" deletion and "shoulder edge" addition detection



In this development, feature points were extracted from the Dashcam images on the server side for comparison and verification.

Results of technological development

Extraction of road change points using dashcam #2

DYNAMIC MAP PLATFORM

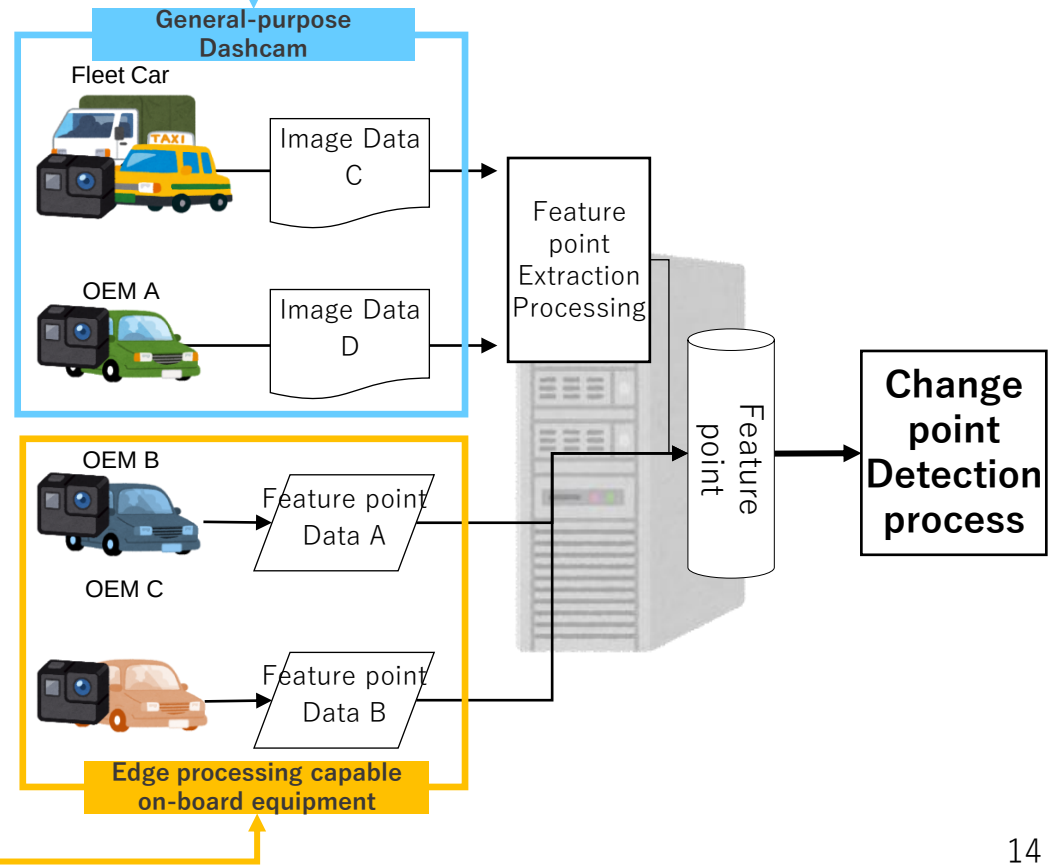
- In order to achieve this goal, we are working on the specifications of Dashcams necessary for detecting change points and aim to start using them on roads dedicated to automobiles in FY2010 (light blue).
- On the other hand, with an eye to future deployment (general roads/Global), a method to collect data widely from cameras, etc. mounted on general vehicles is necessary. In order to reduce the data communication load and ensure anonymity, we have organized the requirements for feature points to be extracted at the edge. In the future, we will approach standardization organizations and construct an image data collection scheme (yellow).

Recommended equipment specifications

Requirements for Road Change Point Extraction Technology			Required Sensors	Required Functions	Recommended specs
The ability to recognize geographic objects from camera image data.	Geographical objects must be present in the image.		Camera	Angle	Horizontal 118~135 degrees
	The resolution must be high enough to recognize geographic objects.		Camera	Resolution	HD（1280*720）
A function to recognize geographic objects from camera image data.	Ability to estimate driving trajectory.	Absolute position must be obtained.	GNSS	Coordinate values	(Open sky) 5 m or less (Urban area) 20m or less
		Relative position is obtained. (The amount of displacement must be obtained.)	GNSS	Speed	2Hz
			IMU	Angular velocity and acceleration	100Hz*
			Odometer	Distance traveled	50Hz*
			Camera	Angle of view, resolution, and Frame rate	22Hz

Requirements for feature point data (overview)

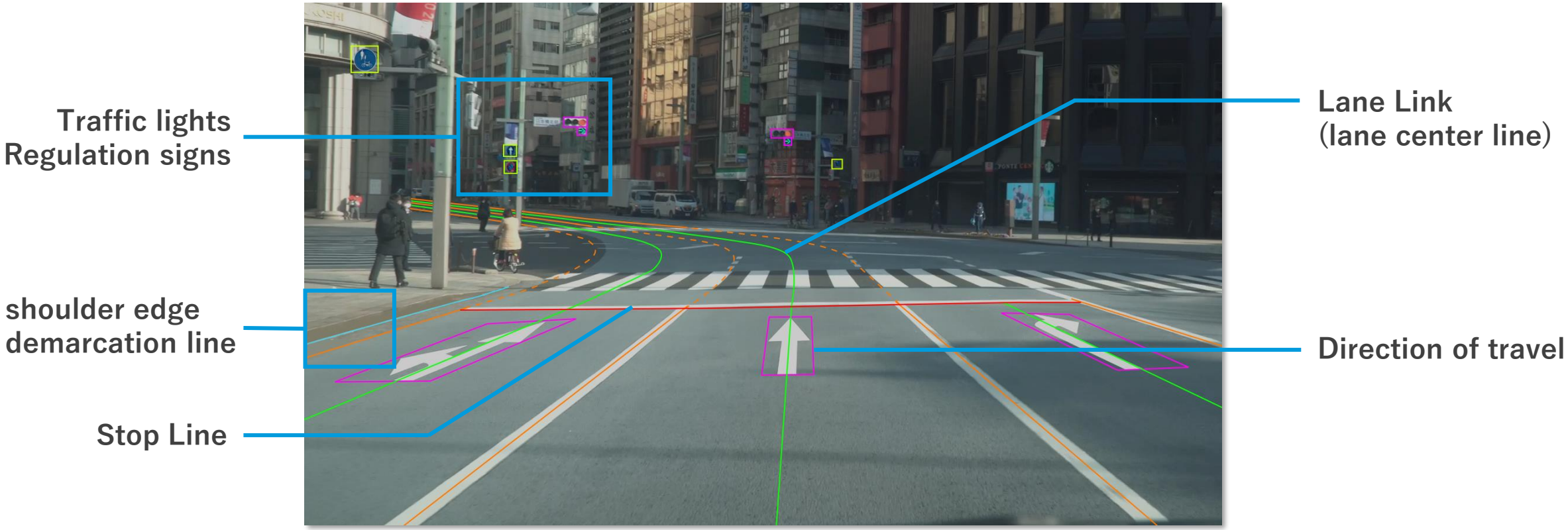
	Items and Contents	Acquisition unit
Geographical data	Geodetic data and its confidence information	High frequency (reference: 0.1s,)
Position, Velocity, Time	Data on vehicle position, speed, time, etc.	High frequency (reference: 0.1s,)
Camera parameters .	Parameters for camera mounting position, focal length, etc.	Low frequency (Reference: 1h)



Future Business Development

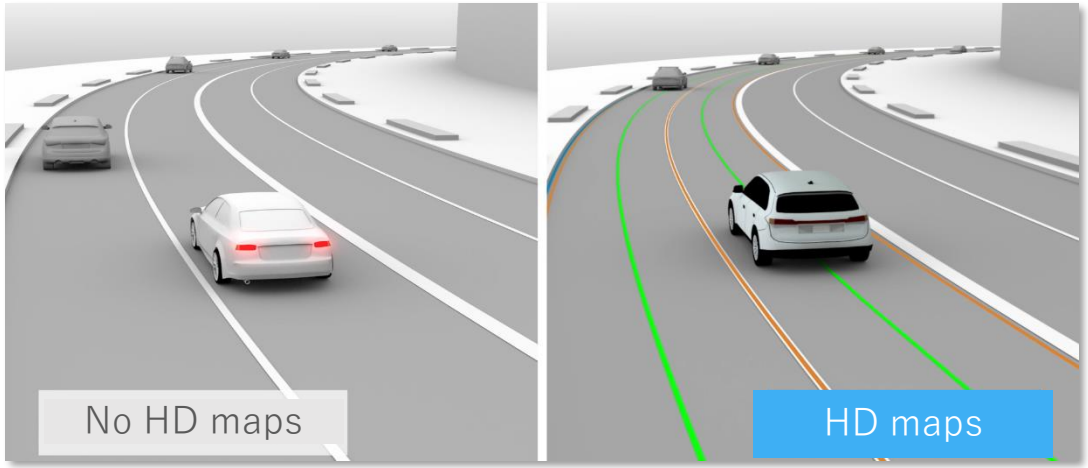
About the Next Generation HD Map

Carefully selected geographic objects and attribute information that are considered important for autonomous driving as well as advanced driving support systems.
It includes 3D data such as traffic lights and regulatory signs of real geographic objects and lane links (lane centerlines) of virtual geographic objects.

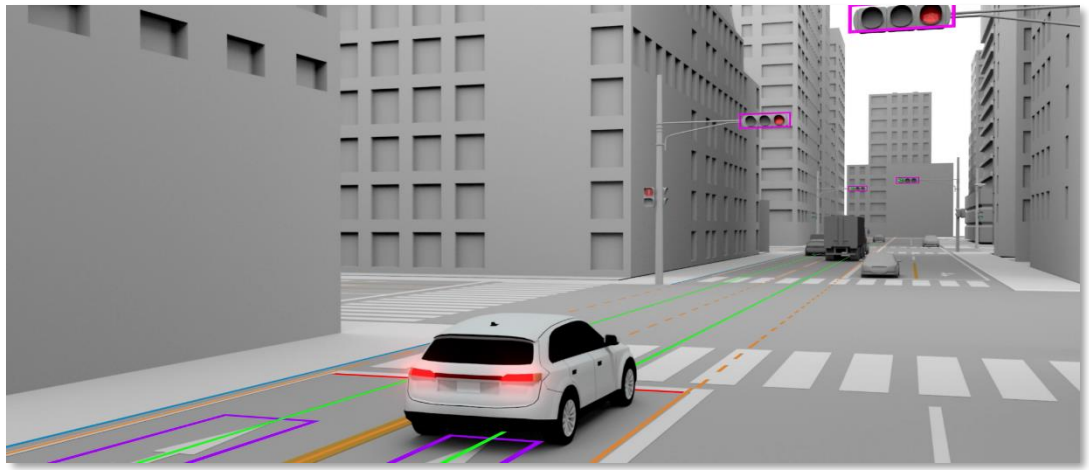


※This is a part of the recorded information. Specifications are subject to change.

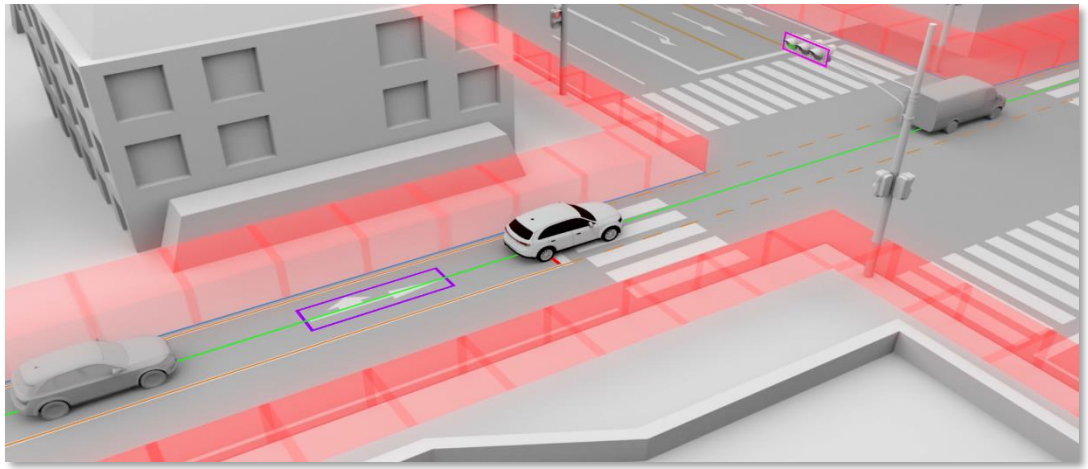
Next Generation HD Map Use Cases



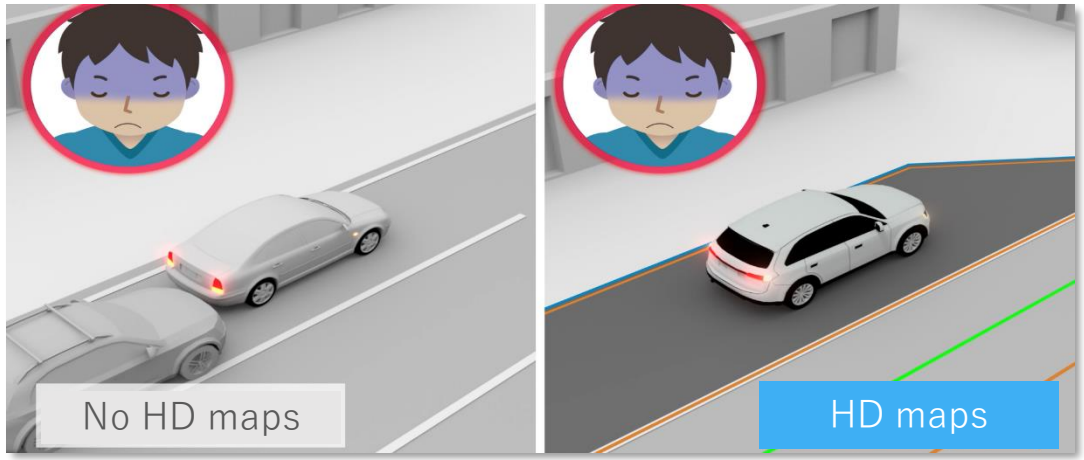
Anticipate the shape of the road ahead. Steadily enter the curve.



Understand signal information correctly and determine when to stop



Keep track of prohibited areas. To prevent traffic accidents



Automatically stop the car at a safe position in case of emergency

Business Policy

In response to the resolution of social issues and the rapid increase in demand, the next generation high-precision 3D map data (next generation HD map) will be introduced in Japan from FY2023, for the advancement and spread of advanced driving support systems and automatic driving.

Expanded coverage (General road support)

Advanced ADAS Realized on More Roads

Cost Performance

For a wide range of vehicle

Global Format

Easy deployment in Japan and many other countries and regions

Not only on expressways and exclusive roads, but also on ordinary roads, advanced driving support systems and autonomous driving can be used in our daily lives.

Expanded coverage

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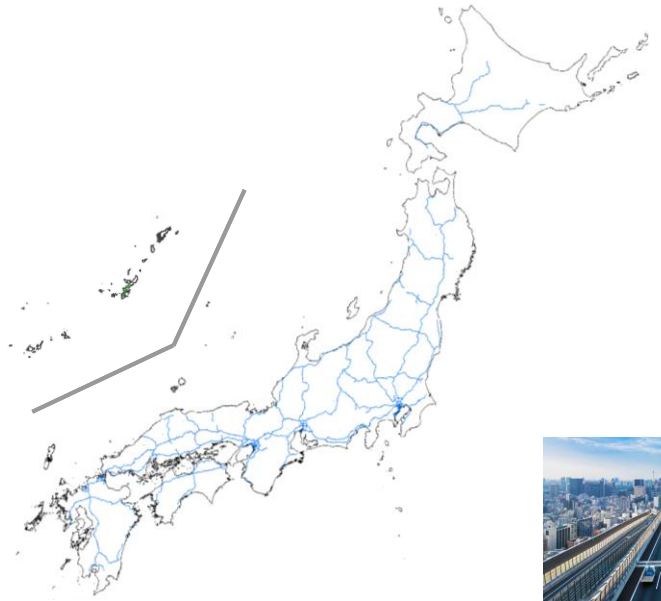
Not only on highways and dedicated roads, but also on ordinary roads, advanced driver assistance systems and autonomous driving are now used on a daily basis.

FY2020



Highway

31,777km

FY2023

Highway・National road

約80,000km

FY2024～

Highway・National road・Major local roads

約130,000km

※ Images are for illustrative purposes only. The distances shown are the length of the upper and lower lines. The routes and distances are subject to change.

Cost Performance

Ushr Inc.'s technology, which is proven in North America, is deployed in Japan. We have introduced unified formats and specifications, integrated manufacturing processes, and introduced tools to automate the drawing process.
Unified format and specifications, integrated manufacturing processes, and introduced tools to automate the diagramming process. We have achieved a significant reduction in data production costs while maintaining high quality.

Ushr
A DMP Group Company

North American group of experts from various fields, including automakers, NASA, map and locator manufacturers A group company

World's first and richest adoption record

Proprietary automation tools

Low-cost manufacturing operations

DYNAMIC MAP PLATFORM

Curbing Japan's Data Manufacturing Costs

The price of data provision has been drastically lowered, enabling the data to be installed in more vehicles by reducing vehicle development costs and improving development efficiency.

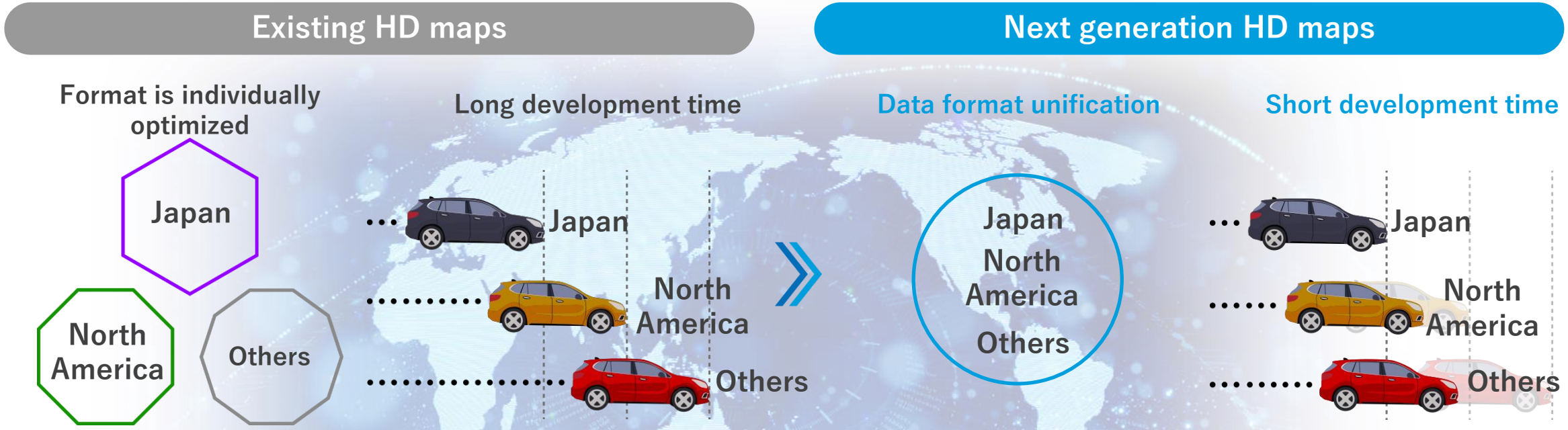
Data supply price

Vehicle Development Cost / **Development efficiency**

Installed in more vehicles

Global Format

Unify the data format of high-precision 3D map data (HD map), which currently differs between Japan and North America. The customer can reduce the burden of system development and evaluation of vehicles that occurs in each region. This contributes to shortening the development period.



In addition to contributing to the global advancement and widespread use of all kinds of advanced driver assistance systems and automated driving, we will provide HD maps globally with our group company, Ushr Inc.

The data format for North America owned by Ushr Inc. is used as the standard.
The data format is based on Ushr Inc.'s data format for North America and is optimized for each region according to the road conditions of each country.

この地図で、
クルマは未来を走る。

高精度な先進運転支援システムや自動走行で必要とされる高精度な地図データ。

より多くの道で、より多くの国で、より多くのクルマで、安心/安全で快適なドライブを叶えるために。

国境も古い常識も超えてクルマ社会の未来に貢献するために。

EOF