Automated Driving Services in Rural Area

Toshimasa Nakagawa

Senior Researcher, ITS Division

National Institute for Land and Infrastructure Management

Ministry of Land, Infrastructure, Transport and Tourism

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Today's Presentation

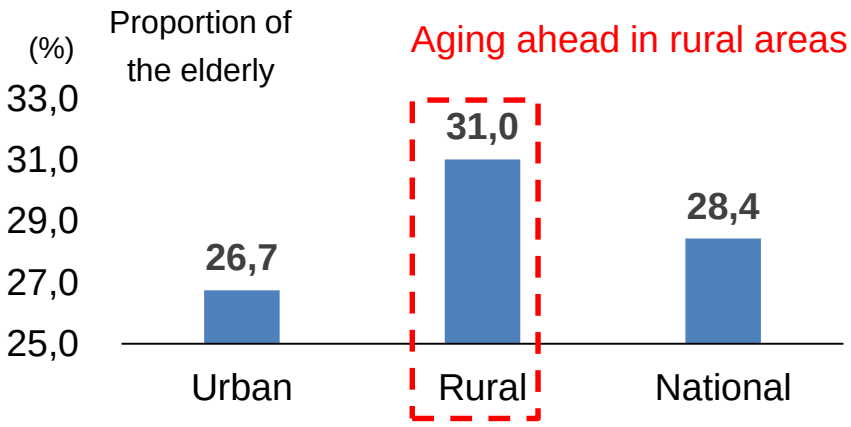
- FOTs of Automated Driving Services in Rural Area
- Deployment of Automated Driving Services in Rural Area
- Future Issues

FOTs of Automated Driving Services in Rural Area

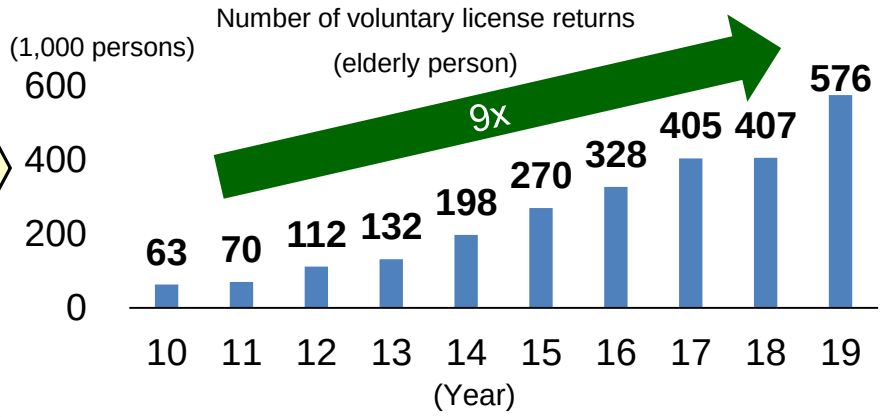
Background

- In rural areas of Japan, securing the means of transportation for the elderly is a major issue due to a decrease in the number of licensed drivers, and a decline of local public transportation.

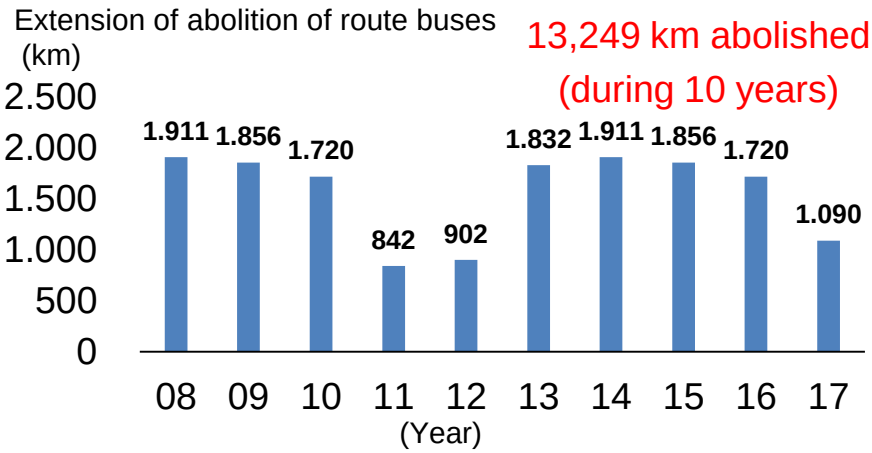
Japan is the world's most aging society



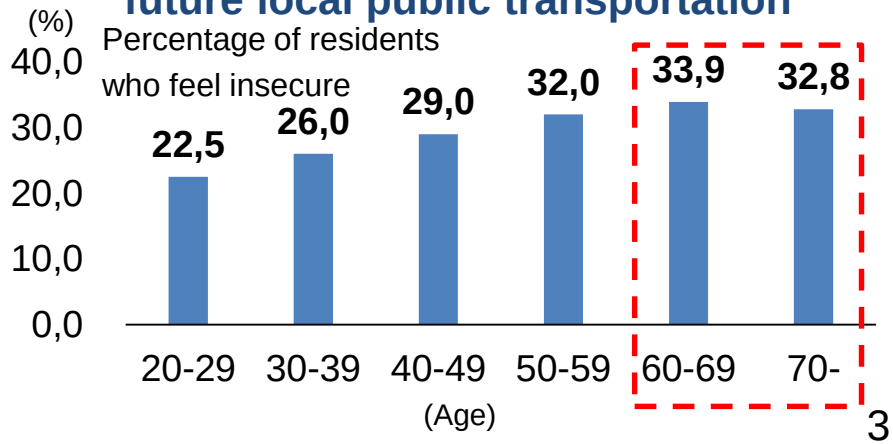
The number of elderly people without a driver's license is increasing.



Depletion of local public transportation

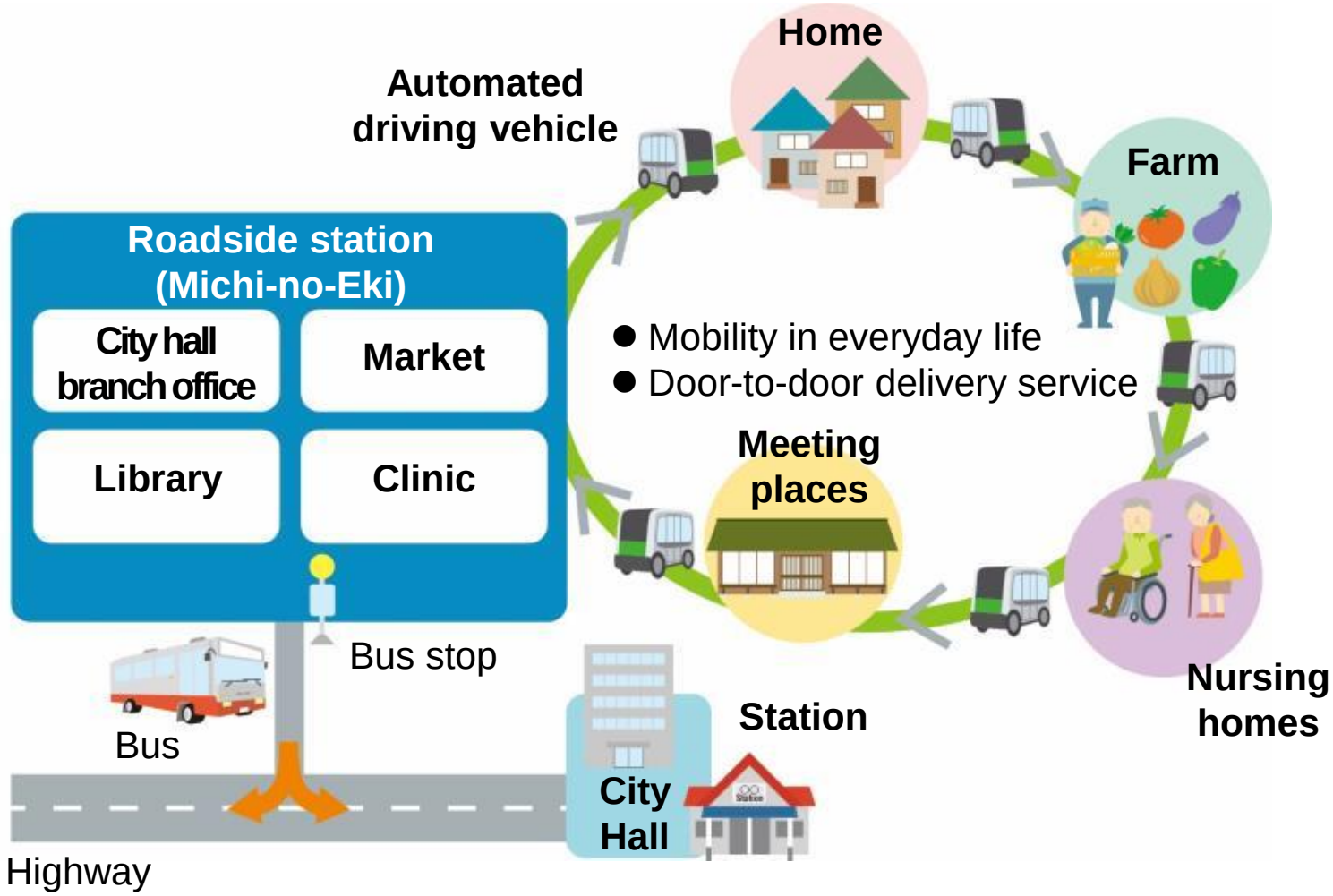


Elderly people are anxious about future local public transportation



Objectives

- To secure a transportation to a living base in rural area
- In rural areas of Japan, roadside station plays a role as a living base, which is called **“Michi-no-Eki”**.



Example of Michi-no-Eki (Michi-no-Eki “Akagi-Kougen”)

Building (appearance)

Parking lot

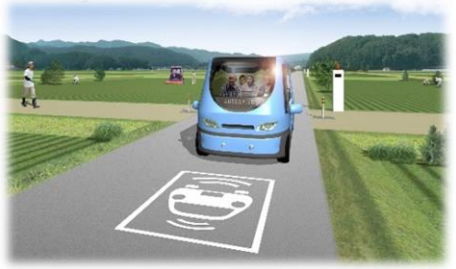
Store

Rest space

Step and Schedule of FOTs

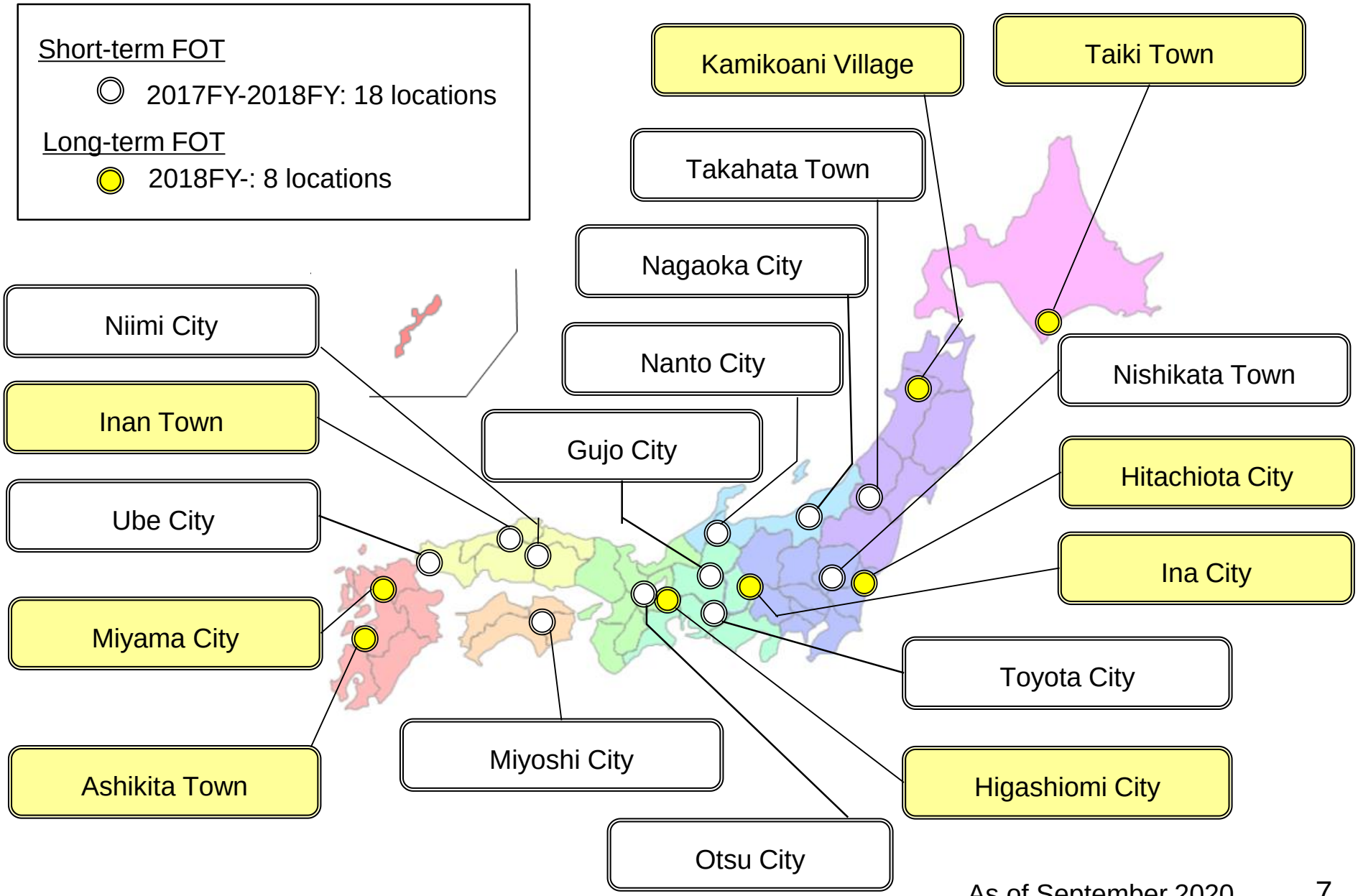
- A series of FOTs have been started in 2017.
- “Short-term FOT (1 week)” and “Long-term FOT (1 month)”.

Stage	FOTs
First stage (2017FY-2018FY)	Short-term FOT (1 week) — 18 locations • Technical verification and business model examination about automated driving service
Second stage (2018FY-)	Long-term FOT (1 month) — 8 locations • Building a business model for a deployment of automated driving service



Deployment of automated driving service based on Michi-no-Eki

Location of FOTs



As of September 2020

Vehicle used in FOTs

Microbus-type vehicles

1) DeNA Co., Ltd.

Autonomous-vehicle technology

- Uses GPS and IMU to recognize its own position

Capacity: 6 persons
Speed: 10km/h

2) Advanced Smart Mobility Co., Ltd.

Road-to-vehicle communication (R2V) technology

- Uses GPS, magnetic markers and gyroscopic sensors

Capacity: 20 persons
Speed: 35km/h

Passenger-type vehicles

3) Yamaha Motor Co., Ltd.

Road-to-vehicle communication (R2V) technology

- Detects magnetism from embedded electromagnetic induction lines

Capacity: 4-6 persons
Speed: 12km/h

4) Aisan Technology Co., Ltd.

Autonomous-vehicle technology

- Refers to a pre-prepared, high-precision 3D map, and LiDAR

Capacity: 4 persons
Speed: 40km/h

GPS: Global Positioning System IMU: Inertial Measurement Unit

Technical verification viewpoint

Road and traffic


Typical road in rural area

- Road structure (Straightness, grade etc.)
- Road management (demarcation lines, planted trees etc.)

Environmental condition

- Weather condition (rain, snow etc.)
- Communication conditions (GPS reception)

Cost


Install electromagnetic induction line

- Cost for vehicle
- Cost for V2I infrastructure

Public acceptance

- Comfort (speed, psychological impact etc.)
- Convenience (route, frequency etc.)

Effect and benefit on region


Combined transport of passengers and cargo

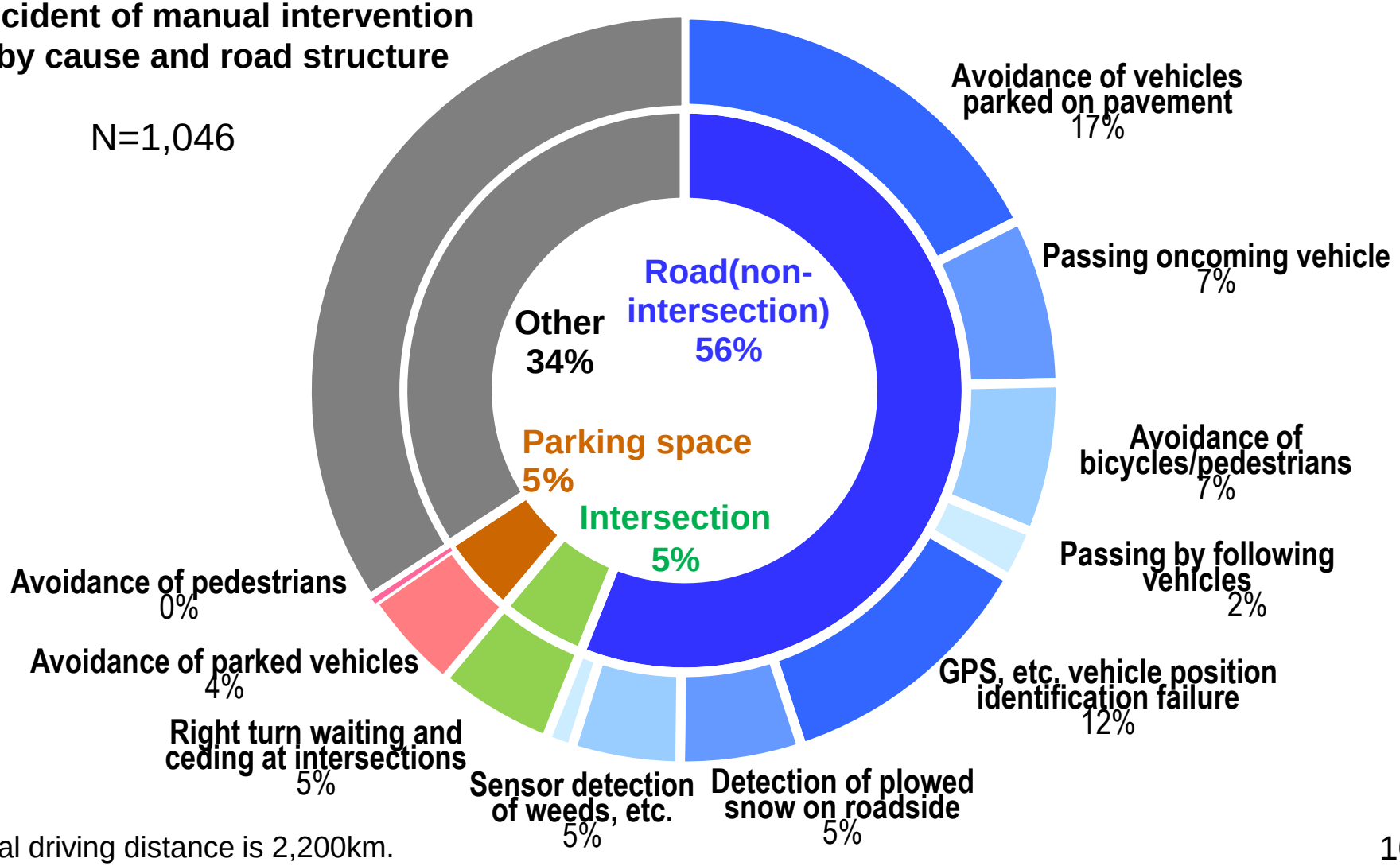
- Opportunity for the elderly to go out
- Opportunity for shipping agricultural product etc.

Result of FOTs (Number of manual intervention)

- Manual intervention have been resulted from the detection of parked vehicles and pedestrians etc. on roads in mixed traffic environments.

Incident of manual intervention by cause and road structure

N=1,046

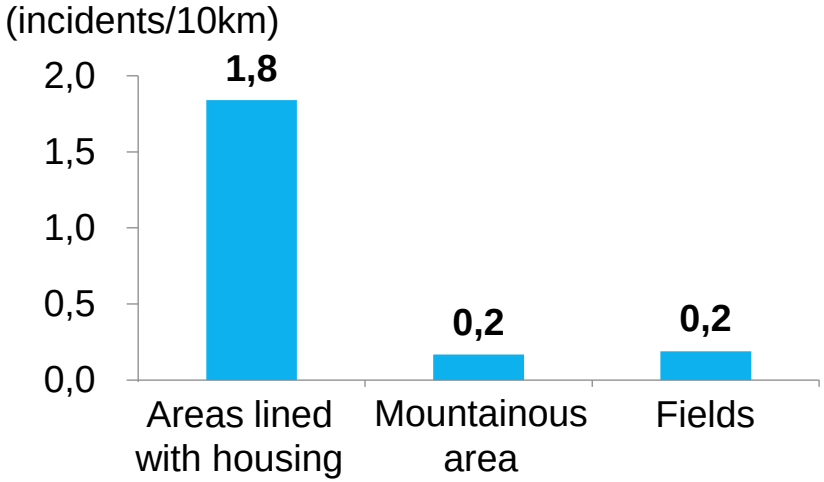


* Total driving distance is 2,200km.

Result of FOTs (Verification from road and traffic viewpoint)

- Vehicles parked on road, pedestrians, and bicycles caused manual intervention.

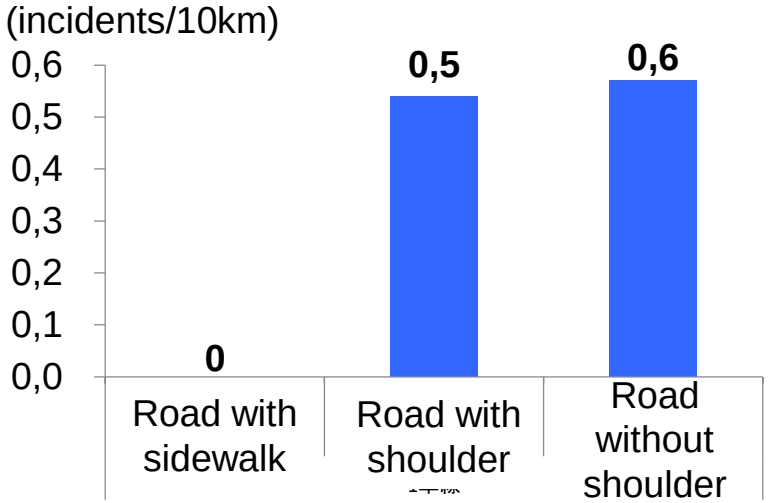
Vehicle parked on road



▲ Avoidance of vehicles parked on roads

▼Manual intervention due to parked vehicles

Pedestrian/bicycle

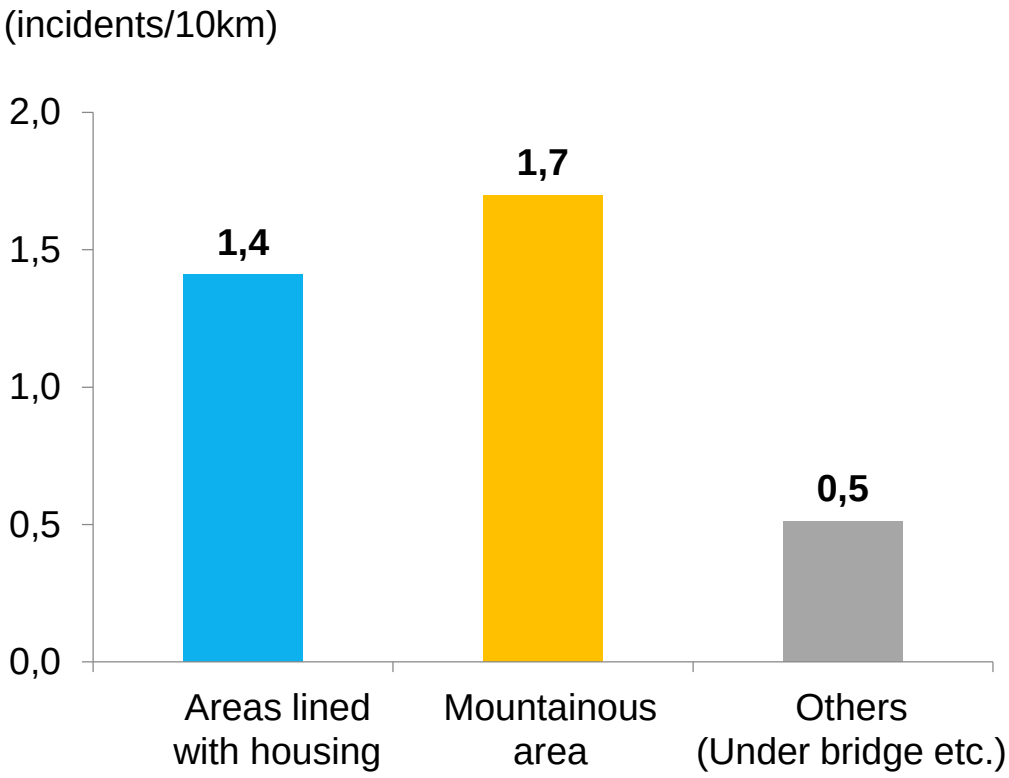


▲Incidence of pedestrian/bicycle avoidance

▼Manual intervention to avoid pedestrians

Result of FOTs
(Verification from environmental condition viewpoint)

- GPS accuracy reduced in mountainous areas and sensor performance deteriorated due to bad weather (snowfall, fog).



▲Number of incidents of position identification failures when using high-accuracy GPS

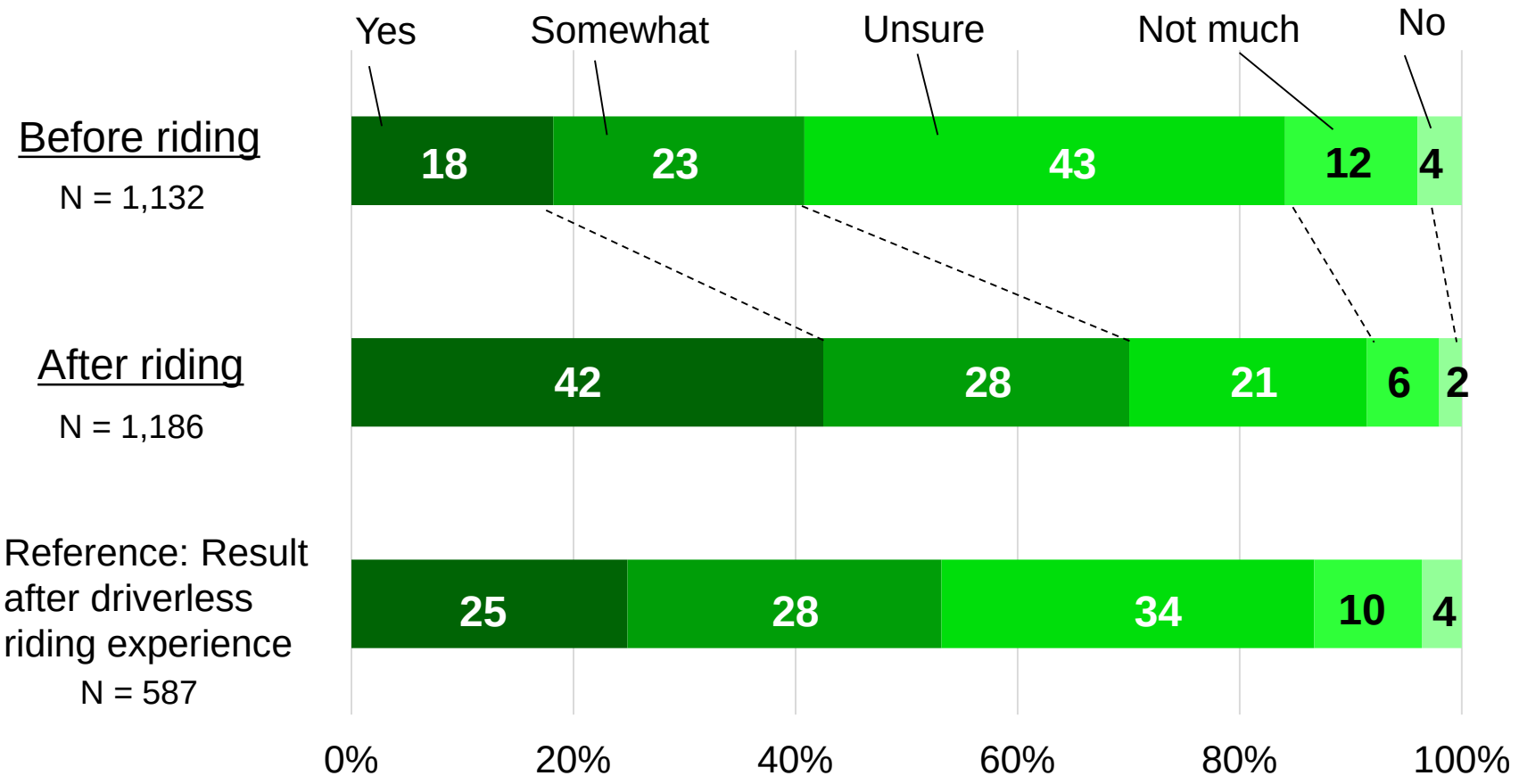
▼Reduce GPS reception accuracy in mountainous areas

▼Detect snowfall by LiDAR

Result of FOTs
(Verification from public acceptance viewpoint)

- More passengers put their trust in automated driving technology after riding.
- More of them put their trust in automated driving technology even though they experience driverless automated driving.

Q. Do you think automated driving technology can be trusted?



Result of FOTs (Effect and benefit on region)

Securing new means of shipping agricultural products to ‘Michi-no-Eki’

Test drive to automated driving vehicle by elementary school students

Securing new means of transportation to the clinic

Develop routes to tourist spots (orchards)

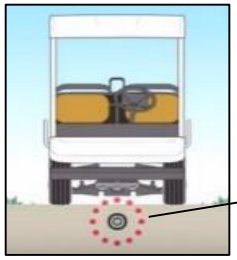
Deployment of Automated Driving Service in Rural Area

Deployment of automated driving service at Michi-no-Eki “Kamikoani” (Overview)

■Vehicle

＜Vehicle＞

＜V2I technology＞



Electro-magnetic induction line

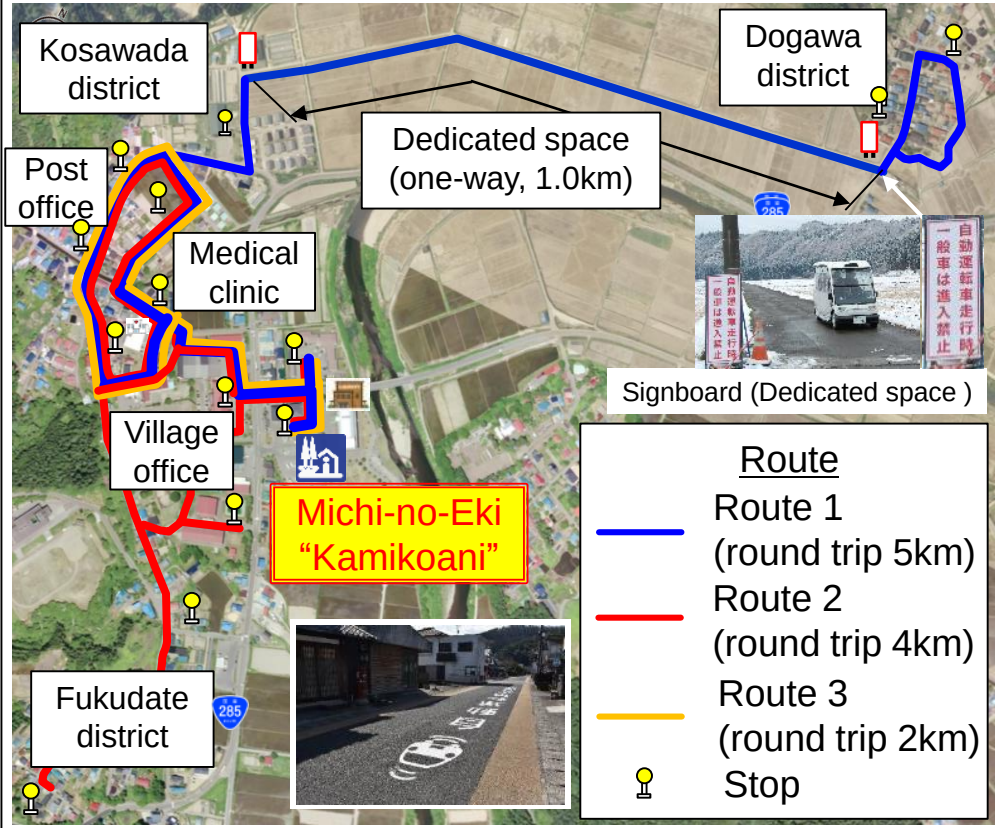
- 7 persons (Capacity), 12km/h (Speed)
- Driver only monitors operation and does not operate the vehicle.
- Electromagnetic induction lines are installed in the pavement to guide the vehicle.

■Administrative structure

Operating entity	Local NPO
Services	Mobility service
Fare	200 JPY/trip (equivalent to 1.6 EUR/trip)
Schedule	Mainly on-demand service

■Driving route

- 3 routes based on Michi-no-Eki
- Total length approximately 4km (one way)
- 1.0 km dedicated space for automated driving

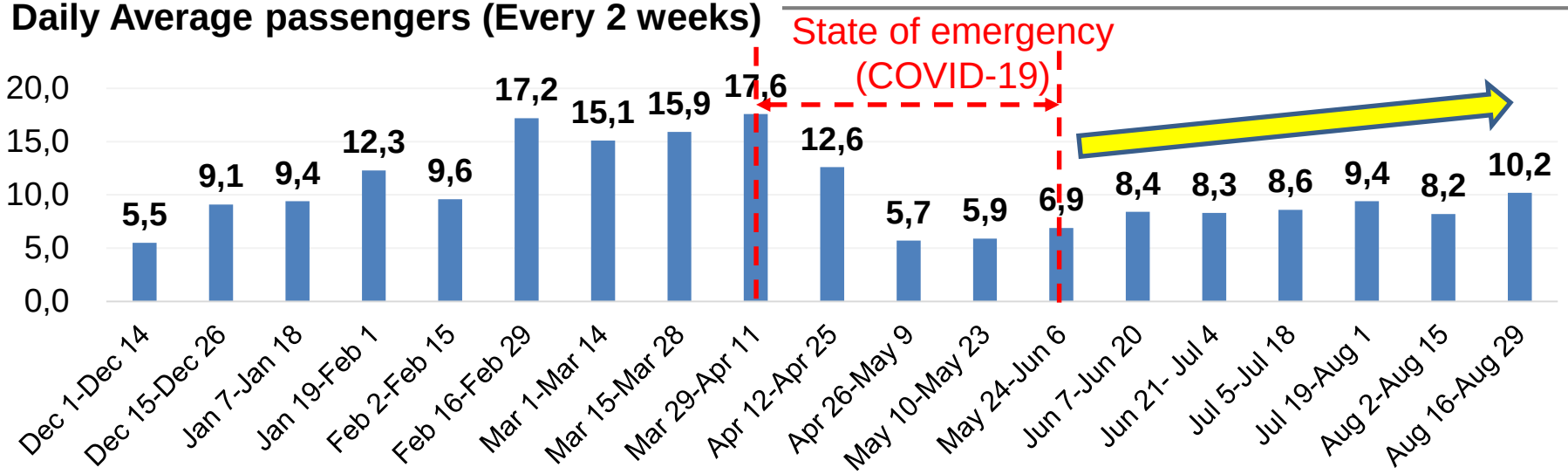


Automated driving service has been deployed in November 2019.

Deployment of automated driving service at Michi-no-Eki “Kamikoani” (Usage after deployment)

- Passengers are gradually recovering after a state of emergency on Covid-19.

Daily Average passengers (Every 2 weeks)

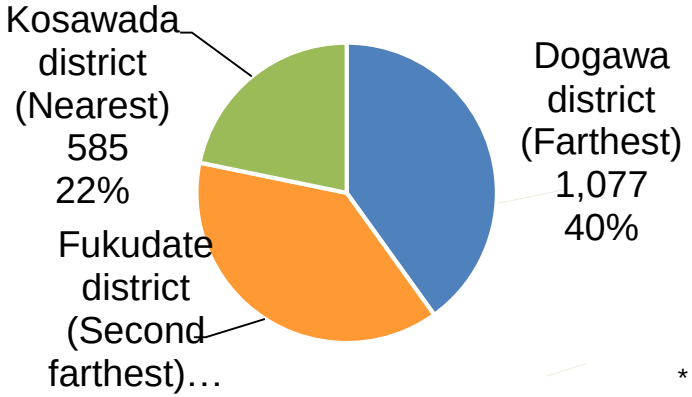


Analysis

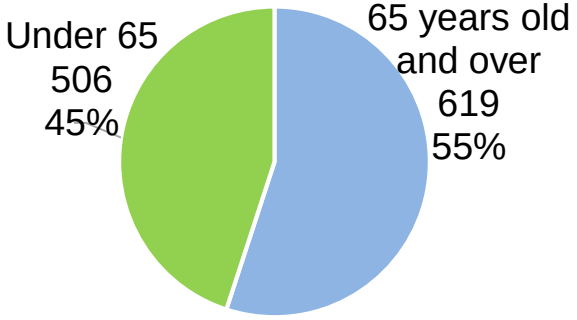
- Affected by weather

Weather	Daily passengers
Good	11 persons
Bad	9 persons

- High needs for long-distance use



- High needs of the elderly



* Share of 65 years and over in the village is 51%

Deployment of automated driving service at Michi-no-Eki “Kamikoani” (Efforts to boost ridership)

Increase of demand service

【Before】 Mainly regular services		【After】 Mainly Demand service	
8:00	Regular	8:00	Demand
	Demand		Regular
12:00	Regular		Demand
	Regular	12:00	
	Demand		Demand
16:00	Regular	16:00	

New route to meet local needs

Extend the route to the village’s sole convenience store

Cooperation with community

Local people gave nickname to the vehicle and created original sticker.

Cooperation with Michi-no-Eki

Distribute a coupon to the passenger

Install plug-in stand exclusive for the vehicle

Future Issues

Future Issues

- Objectives for implementing automated driving services in rural areas
  - By 2025: Expansion of coverage area and scope
  - By 2030: Implementation at 100 locations nationwide
- Improvement of road environment for automated driving
  - Dedicated space for automated driving vehicle
  - Supporting infrastructure for automated driving
- Development of vehicles that can operate in rural areas
  - Reduction in vehicle purchase cost
  - Ease of maintenance
- Lateral deployment of knowledge for sustainable implementation
  - Efforts to promote the use of automated driving service
  - Efforts to reduce operating cost

Thank you for your kind attention.

Contact
Toshimasa Nakagawa
ITS Division, National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism
nakagawa-t92wz@milt.go.jp