13th Japan ITS Promotion Forum

Automated Driving System

Next Generation Transport

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University of Tsukuba

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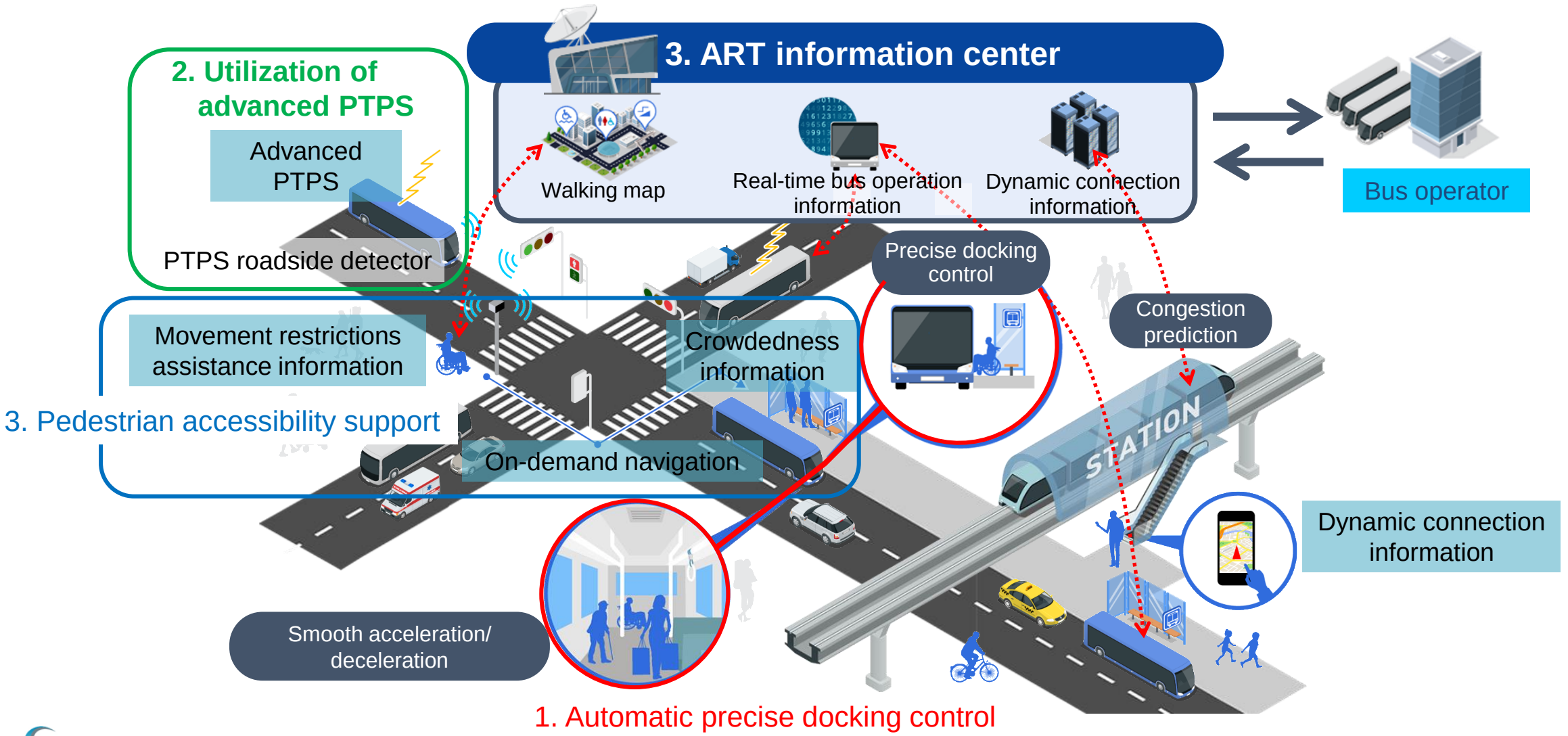
SIP

Cabinet Office

0. Overview of Measures for Next Generation Transport



Automatic Precise Docking Control

Automatic Precise Docking Control

Sensor fusion technologies: positioning using the road surface and features around the bus, learning control

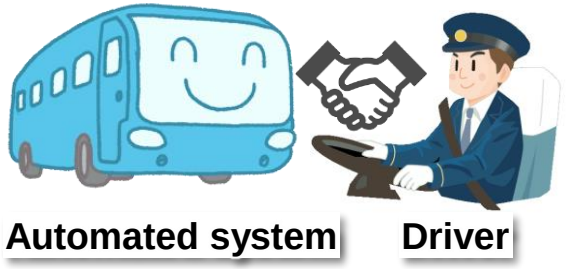
Vehicle control technologies: integrated control of steering and braking

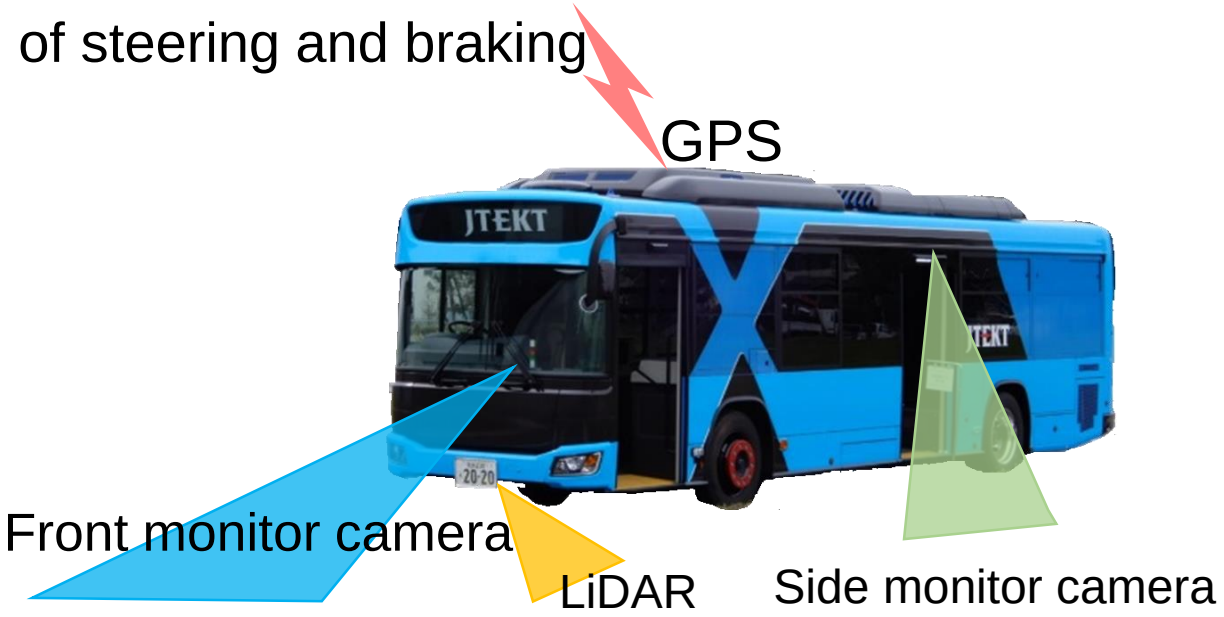
(1) Precise docking control that allows smooth boarding/exiting

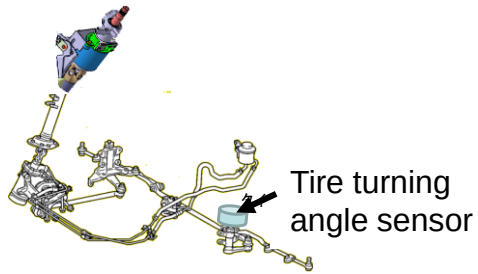
(2) Robust control to cope with any situation

(3) Smooth braking and steering control

(4) Coordination control between the system and driver during precise docking



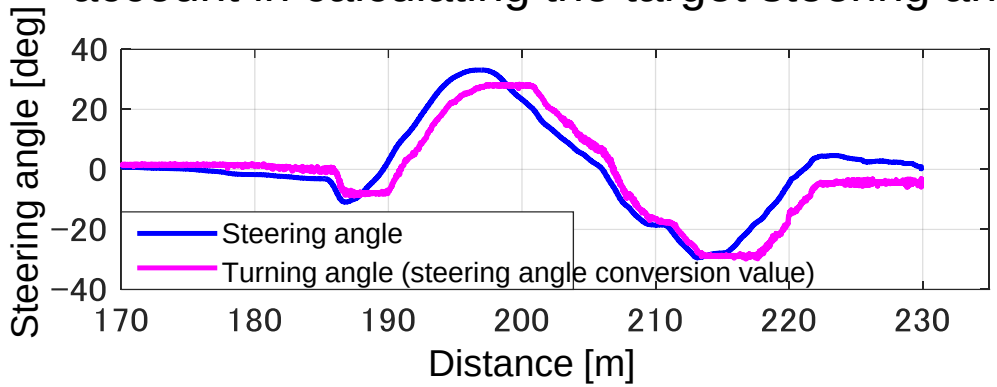




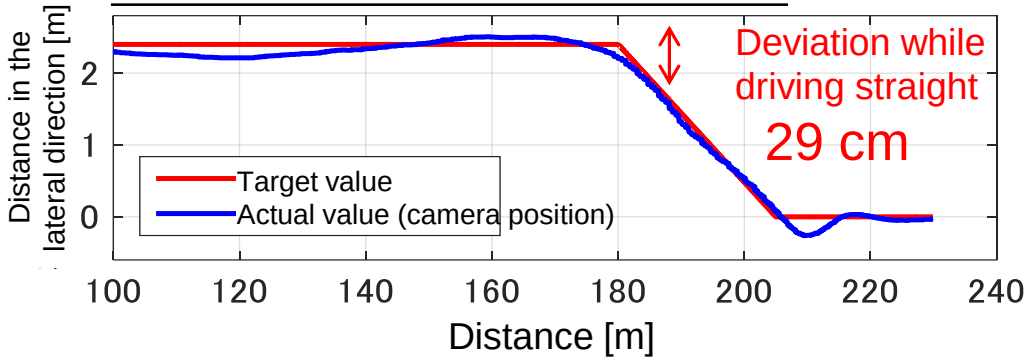
Automated Precise Docking Control
Control by taking into account the backlash of the steering system (1)

Correlation between the steering angle and tire turning angle

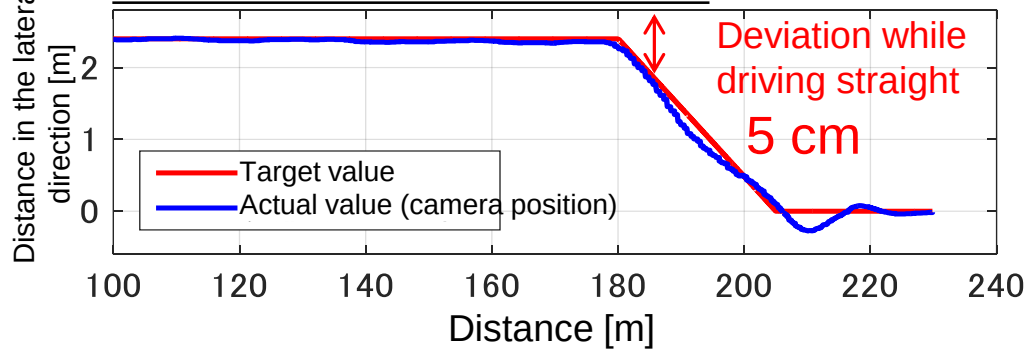
⇨ The backlash was estimated at about 11 deg of the steering angle and was taken into account in calculating the target steering angle.



Backlash not taken into account



Backlash taken into account



Precise docking results of pullover (by 2.4 m)

	Backlash of steering system taken into account	
	No (N = 23)	Yes (N = 15)
OK (both the front and middle doors)	30%	73%
NG (including NG on one door)	70%	27%

Target accuracy of precise docking: ±20 mm

◎ The control by taking into account the backlash of the steering system was found to be effective.

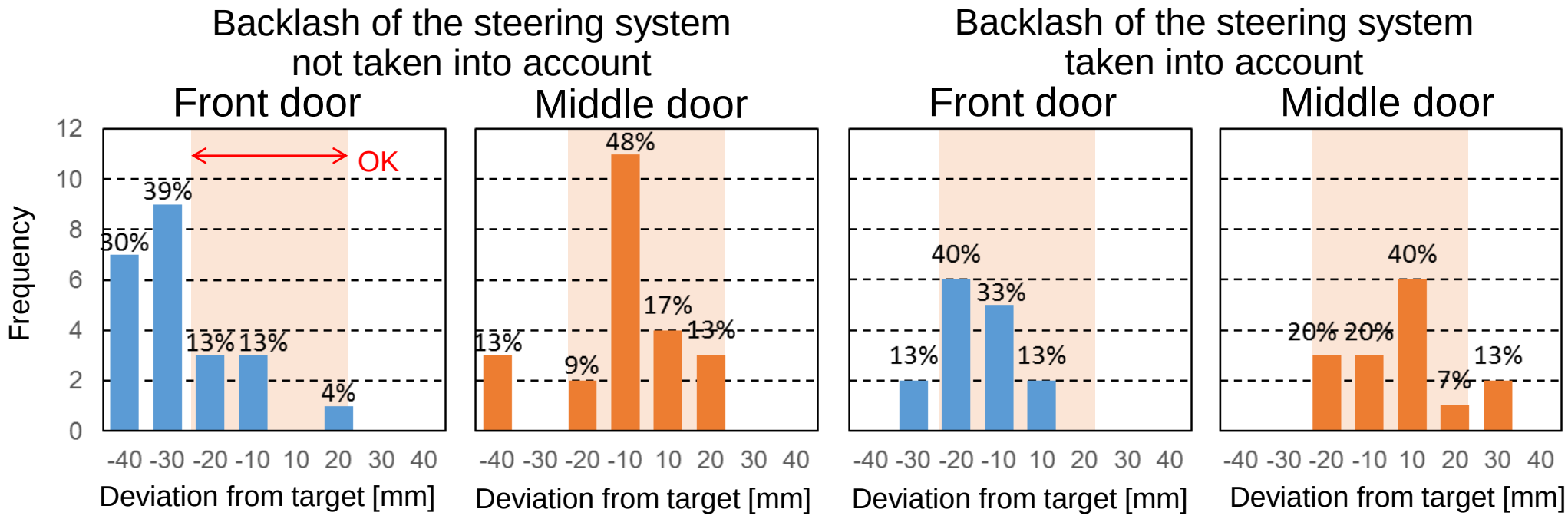
Automated Precise Docking Control

Control by taking into account the backlash of the steering system (2)

The mechanical backlash in the steering system is compensated through the steering angle control, in addition to automated precise docking based on sensor fusion using cameras and LiDAR sensors.

The above control was built into a vehicle for the FOT.

Precise docking results of pullover (by 2.4 m)



2

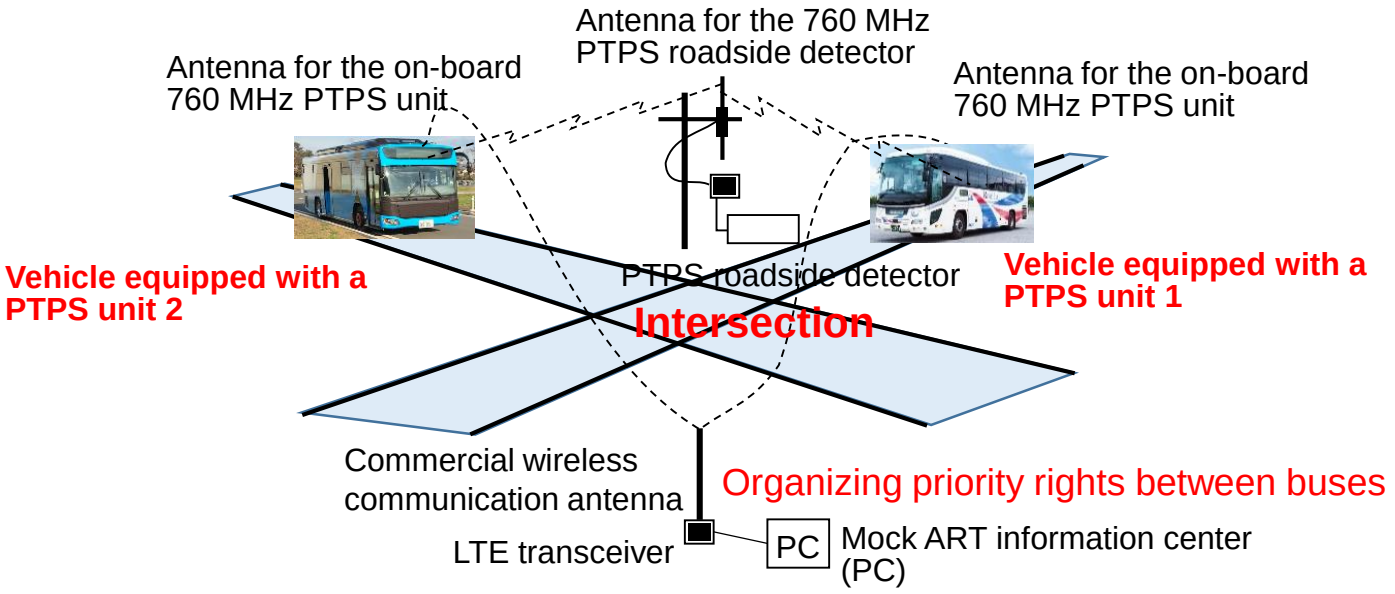
Utilization of Advanced PTPS

Verification of ART Rapidness by Utilizing Advanced PTPS

Large-scale FOT in FY2018

Verification was conducted on the rapidness improvement effect, etc. mainly on public roads using buses. Advanced PTPS roadside detectors were installed at three locations on Loop Road No. 2.

▼ Image of the experiment

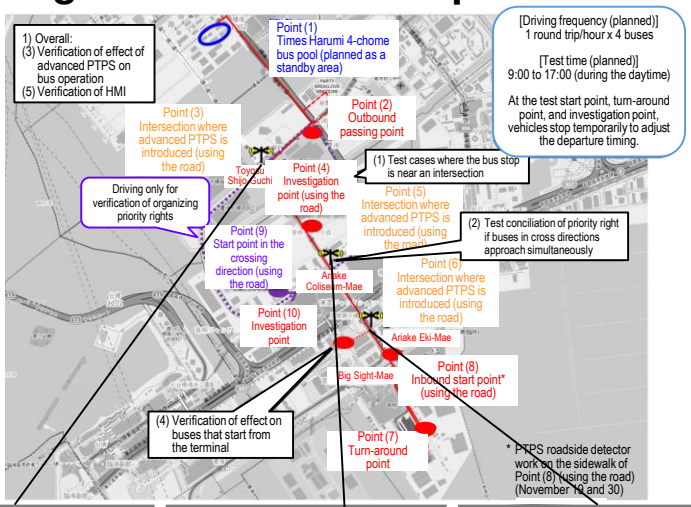


▼ Verification of HMI

It is possible to pass through an intersection by deceleration.

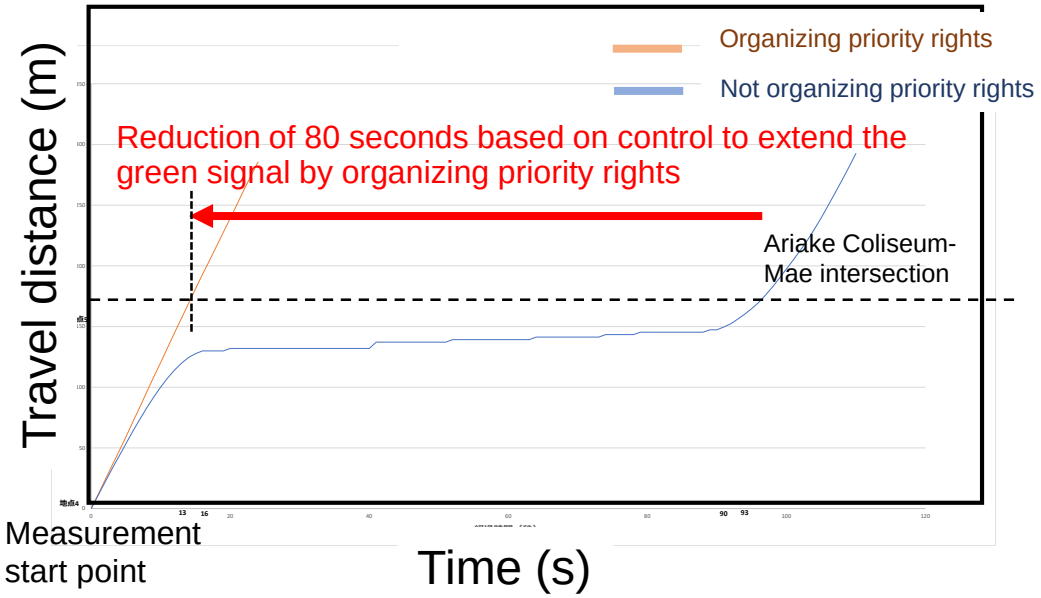
Advanced PTPS: a public transport priority system using 760 MHz radio-wave beacons

▼ Driving course used in experiment

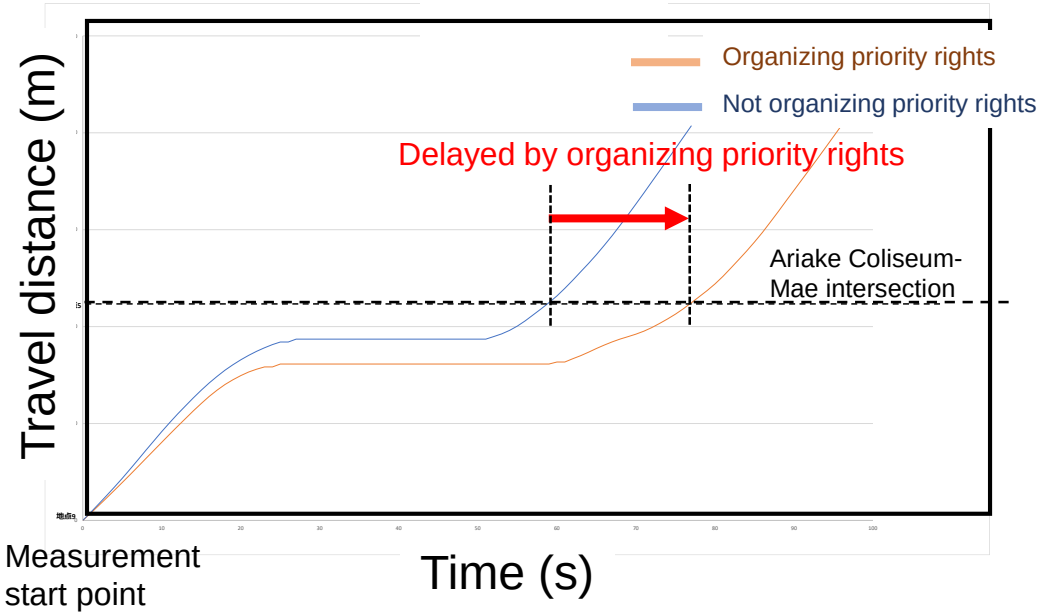


Verification of Effect of Advanced PTPS on Bus Operation

Bus 1 (driving on Loop Road No. 2)



Bus 2 (driving in the direction intersecting that of Bus 1)



Bus 1	Driving time		PTPS operation status	
	Before introducing PTPS	After introducing PTPS	Operation frequency	Average time of green signal extension
Outbound	577	518	15	5.6
Inbound	382	348	7	6.6

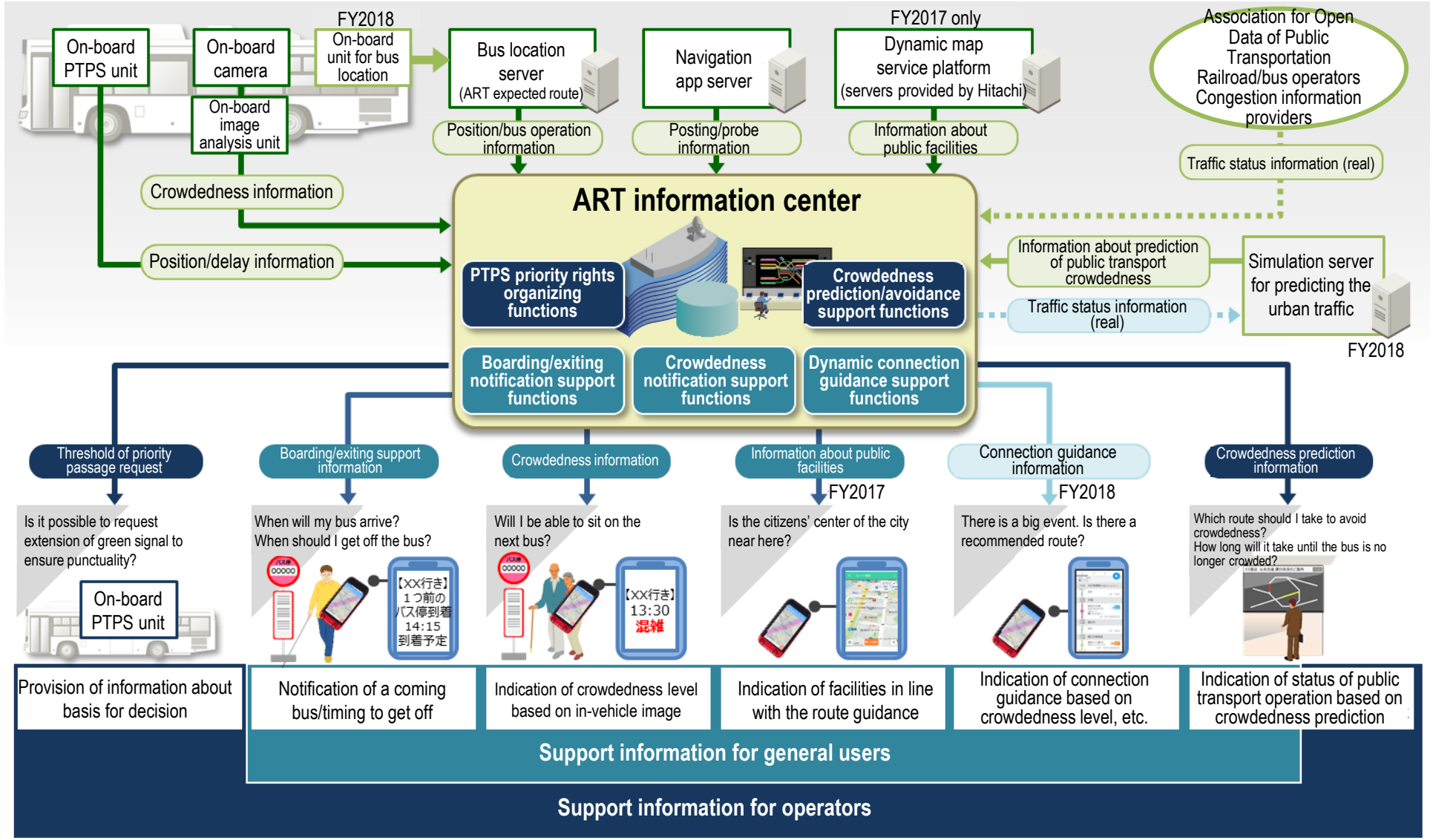
The driving time was reduced by about 10%.

3

ART Information Center/Pedestrian Accessibility Support

Development and FOT-based Verification of the ART Information Center Functions

The ART information center receives and accumulates information from on-board units installed in buses, etc., and provides information in an appropriate format.



ART: Advanced Rapid Transit

FOTs Related to Pedestrian Accessibility Support (1)

Large-scale FOTs on bus boarding/exiting/crowdedness guidance and route guidance depending on the needs

The overall evaluation of participants was high.

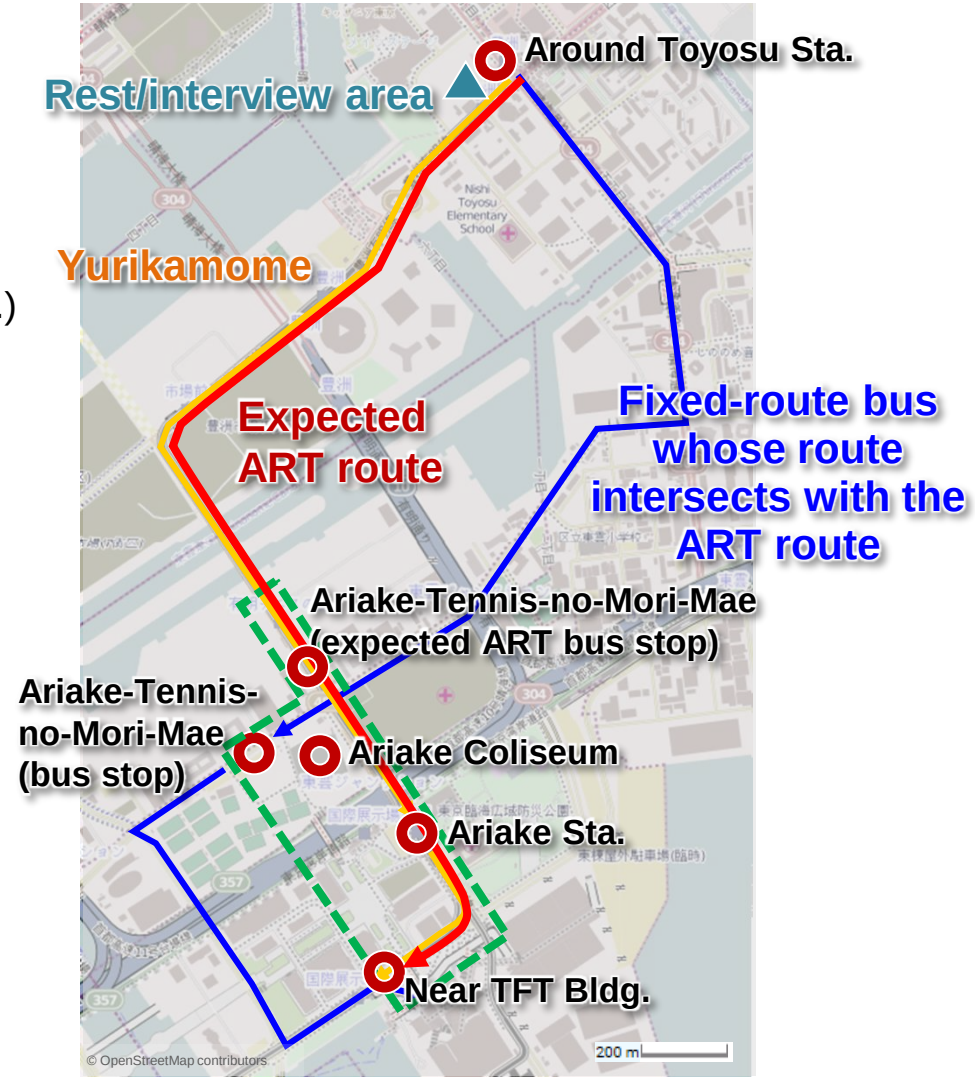
Number of FOTs: **25**

Participants: **42** Staff: **218** Observers: **26**

(The numbers are cumulative totals.)

The following evaluation points were scored from 1 to 5 by the participants (in a questionnaire survey).

Evaluation point	Average evaluation score
Is the **boarding/exiting support** notification useful?	4.2
Is the **crowdedness information** useful?	4.0
Is the personal navigation more useful than conventional navigation?	4.2
Do you want to **use** the personal navigation **in the future**?	4.7
Would you recommend personal navigation to others?	4.2
Total	**4.3**



FOTs Related to Pedestrian Accessibility Support (2)

Verification by participants with various physical attributes


Electric wheelchair user


Stroller user


Person with visual impairments (completely blind)


Person with visual impairments (amblyopic)


Elderly person


Manual wheelchair user

Setting of physical attributes

- Stroller
- Electric wheelchair
- Amblyopia
- Manual wheelchair
- Completely blind
- Frail

Route search appropriate for the attributes

Route guidance

Expected virtual ART bus stop (near TFT Bldg.)

In cooperation with: Keisei Bus Co., Ltd., Bureau of Transportation, Tokyo Metropolitan Government

Initiatives toward Social Implementation of the SIP Research Results

Distribution of “personal navigation” to testers (http://corporate.navitime.co.jp/topics/pr/201811/13_4630.html)

Top screen

Attributes selection screen

Route display screen

- The walking route guidance for people who face restrictions in transportation depending on their needs, which is the result of SIP research in FY2018, was distributed to testers for the Toyosu and Ariake areas (from November 13).
- Testers can experience almost the same functions as personal navigation such as route suggestion by taking the barrier and barrier-free information into account and speech guidance.

Provision of “Yasashii-chizu,” a data gathering app (http://corporate.navitime.co.jp/topics/pr/201811/30_4634.html)

Top screen

Screen for posting comments

Screen for viewing posted information

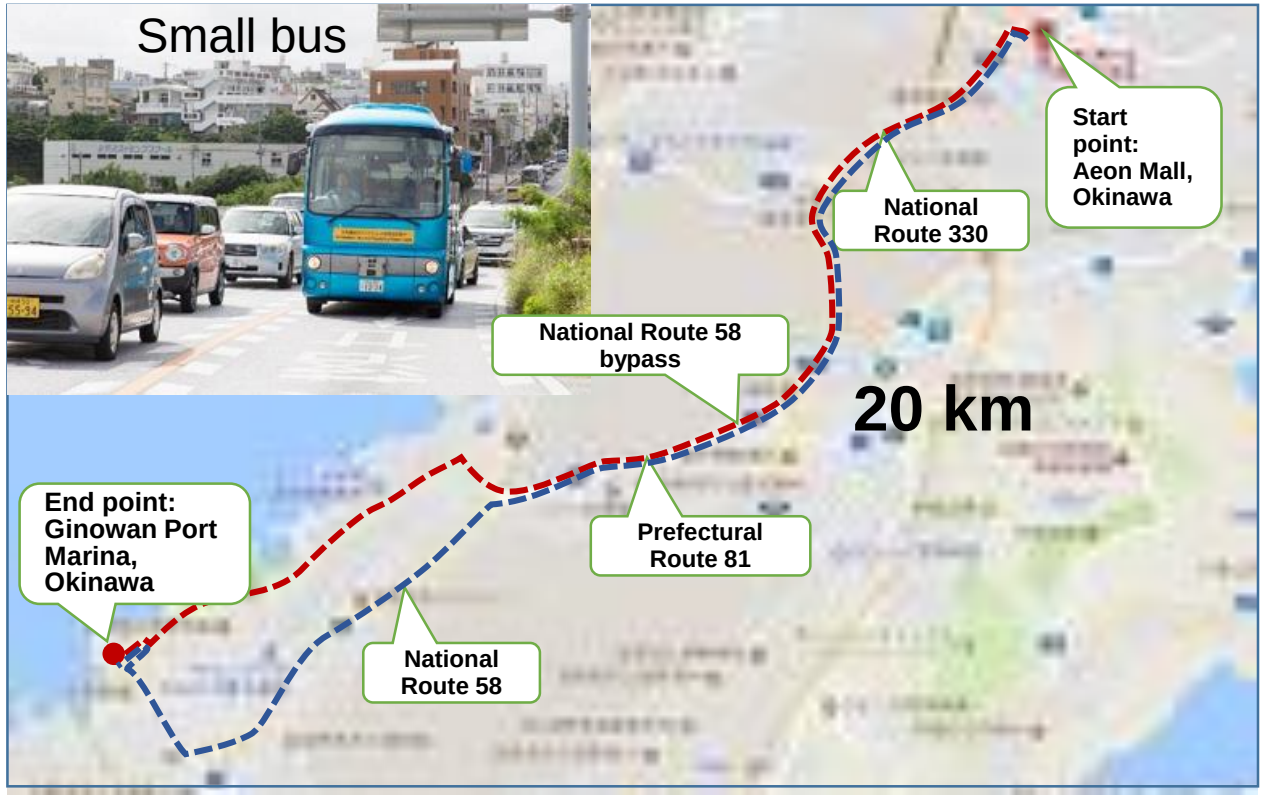
- A data gathering app whose prototype was developed in FY2017 to provide the barrier and barrier-free information and enable the posting of comments about sidewalks was significantly improved in FY2018 and made available (from November 30).
- Operability was enhanced based on a simple design to enable simple operation by various users including persons with visual impairments.

4

FOT of Automated Driving Buses in Okinawa

FOT of Automated Driving Buses in Okinawa

From October 31 to December 31, 2017



This FOT aimed to achieve automated driving equivalent to Level 4. The drivers took over in complicated situations such as intersections and lane change. The users' feedback was generally favorable.

From January 8 to March 7, 2019

Large bus

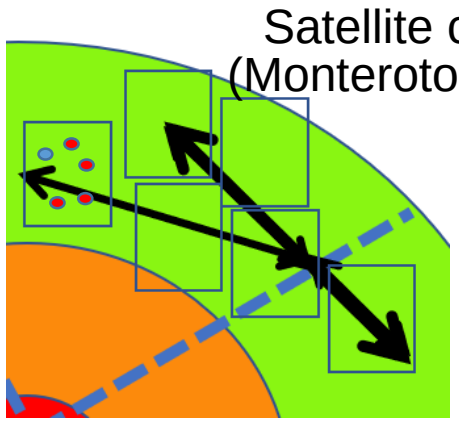
An FOT is underway focusing mainly on highly feasible automated driving applications such as automated precise docking and smooth acceleration/deceleration.

5

Developments in Other Countries

Professor Alessandrini
University of Florence, Italy

Trial calculation of business cases for car sharing and ride sharing services



- Population: 40,000
- Commuters to Rome: 8,000

Assuming that the services are used by 56% of commuters to Rome and 28% of people who use mobility in the city

Break-even: no profit

The following services that were requested in the questionnaire survey were added.

1. Parcels: 46%
2. Shopping: 38%
3. Laundry: 21%
4. Breakfast: 16%

Profit of 1.9 million yen/year/vehicle based on trial calculation

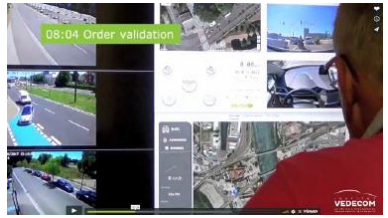
Ms. Nadege Faul
VEDECOM, France

The company built its own parking lot near the entrance. Mobility on the premises was provided by small automated driving shuttles.

New parking lot

Infrastructure cooperation

Remote monitoring (1 person/vehicle)



A right turn lane for automated driving vehicles only

User service

Vehicles used

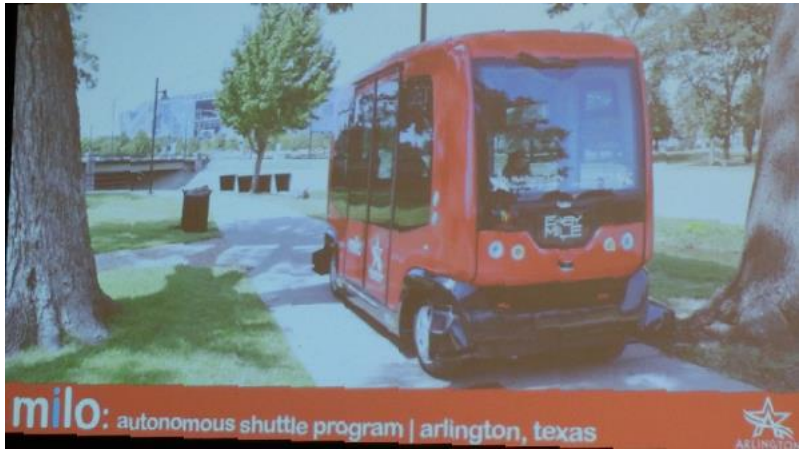
EZ10 EasyMile

Twizy VFLEX

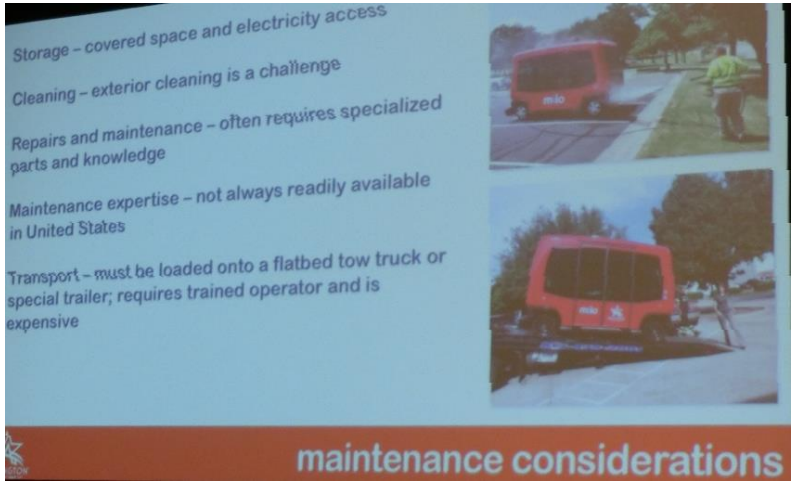
Icristal Lohr

TRB (Transportation Research Board) 2019

One of the topics from the session “Practical Challenges in the Operation of Low-Speed Automated Shuttle Vehicle System”



- There was a report from “milo,” an FOT of mobility using small automated driving vehicles in Arlington, Texas.
- In this FOT, the EZ10 of EasyMile is used. This is one of the ordinary FOTs that are being conducted around the world. The behind-the-scenes story of the FOT, which is not mentioned in usual presentations, was reported.
- Specifically, the report discussed huge costs such as unexpected public relations expenses (e.g., vehicle wrapping), maintenance and transport of vehicles, and making roads wider for driving the EZ10, as well as the difficulty of communication with EasyMile in France for repair and inspection. It was also pointed out that the cost of using high-precision GPS (RTK-GPS) is high.



Other Topics

AAA's FOT of automated driving shuttles in Las Vegas had to be terminated.

http://www.aaahoponlasvegas.com/

2019/02/08 (Fri.) 3:09

Unfortunately federal regulators have shut down a lot of the AV Shuttle operations on public streets.
We expect this to change in the next couple of weeks.

Nevada Governor's Office of Economic Development

IEEE Newsletter (February 12)

"Why Are Protesters Physically Attacking Waymo's Driverless Taxis?"

http://view.media.ieee.org

Many people are excited about autonomous vehicles. They could decrease traffic congestion, reduce the number of accidents, and improve mobility for the elderly and disabled. But critics have decried the early deployment of such technology, which has resulted in at least one death.

Driverless cars seemed to reach peak hype in late 2017, according to *Ars Technica*. Expectations were high, and 2018 was a year of designing, building, and testing the vehicles. Since the fatal Uber accident, however, many observers have been wondering if driverless cars are ready to hit the streets.

Summary

1st Phase SIP-adus Next Generation Transport WG

1. We implemented automated precise docking control in the new initiatives using state-of-the-art sensors and control technologies for automated driving. These initiatives have attracted global attention again as the “exit” of practical automated driving technologies.

2. We became the first in the world to conduct an FOT to organize priority rights in public transport in the intersecting direction by using the advantages of radio-wave beacon type PTPS.

3. We started initiatives to develop systems for public transport mobility services and offer accessibility support for mobility, etc., which have attracted much attention recently, from the beginning of the 1st phase (2014), and have worked on FOTs.

4. We conducted verifications to meet local needs in different parts of Japan such as FOTs of automated driving buses in Okinawa and automated driving services using roadside stations across Japan as the centers.

5. As we look at global developments, the issues of automated driving technologies have been gradually identified. It may be time to return to where we started and review the approach.

SIP

Thank you

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February 27, 2019

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Thank you for supporting the 1st Phase SIP-adus.
We would appreciate your continued support for the 2nd Phase.