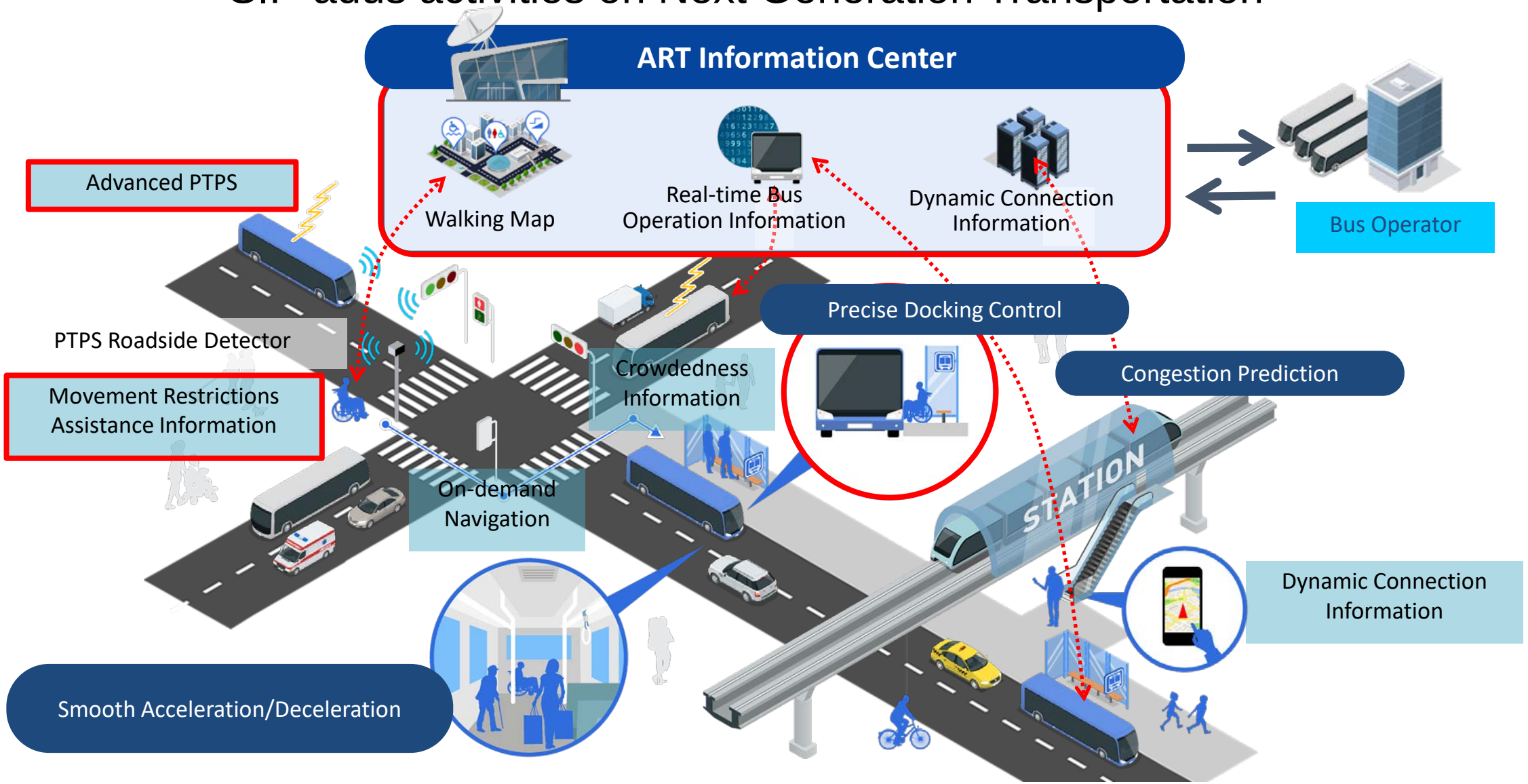
Lectern Session 1734 : Practical Challenges in the Operation of Low-Speed Automated Shuttle Vehicle Systems

Automated Public Transport System with Accessibility Services and Infrastructure Cooperation

- Practical Challenges of Automated Driving technology and service for Public transportation in SIP-adus -

Masayuki Kawamoto
SIP-adus/ University of Tsukuba
January 16, 2019

SIP-adus activities on Next Generation Transportation



ART: Advanced rapid Transit

Automated Precise Docking Control

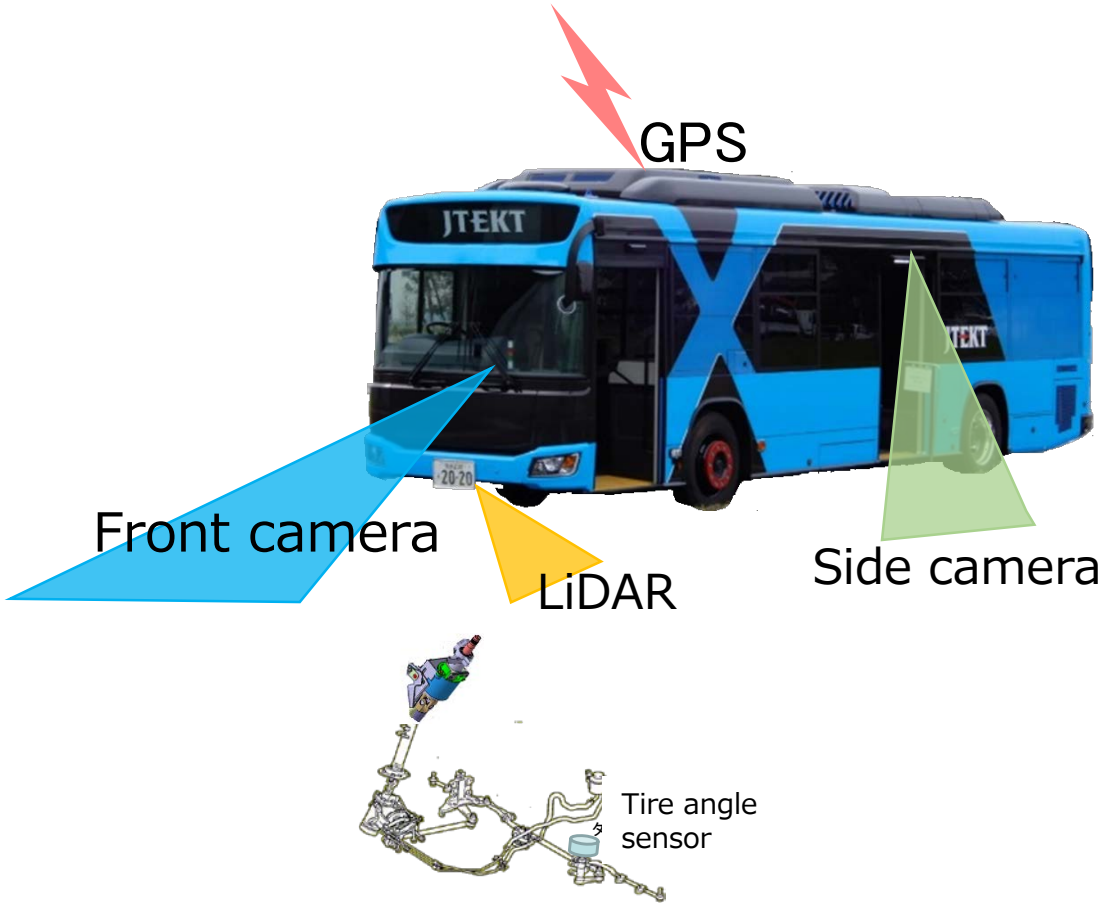
Sensor fusion technology : Vehicle position, surroundings (pedestrian, bicycle and others)
Control technology : Integrated control of steering and braking

① Smooth embarkation at station

② Robust control in various environments

③ Smooth braking and steering control

④ Cooperative docking control with driver



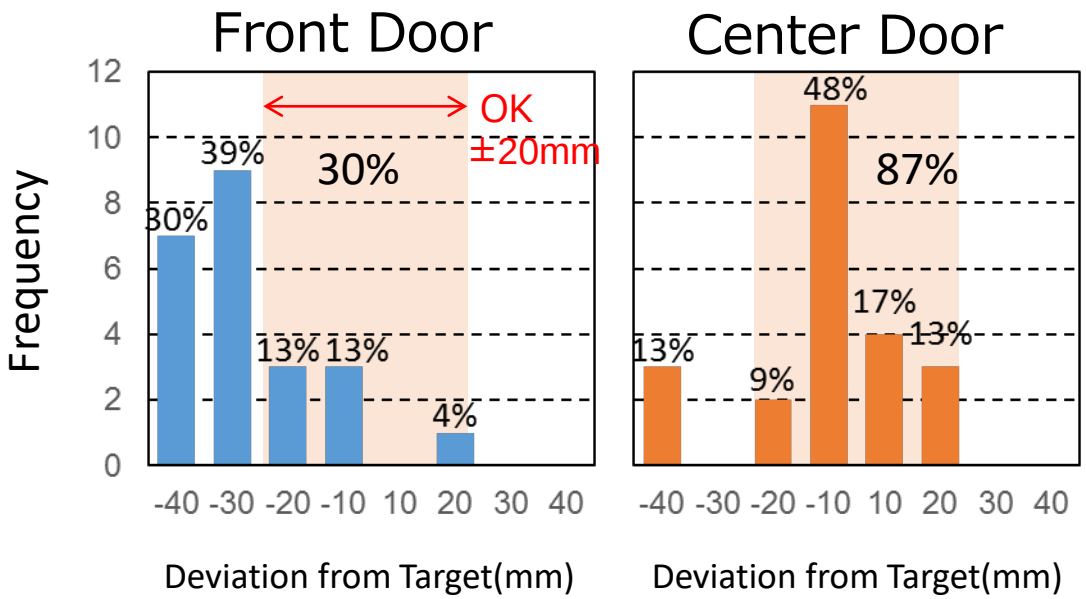
Automated Precise Docking performance test

In addition to optical(camera & Lidar) feedback control,
mechanical looseness compensation is considered in steering system

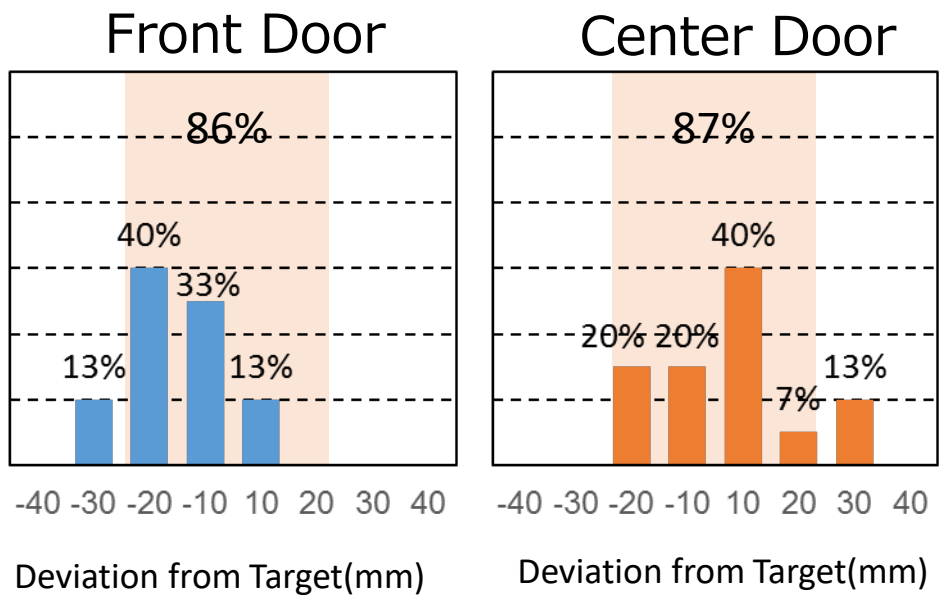
Mechanical looseness compensation in steering system

Pulling over (lateral) distance : 2.4m

No Mechanical looseness compensation in steering system



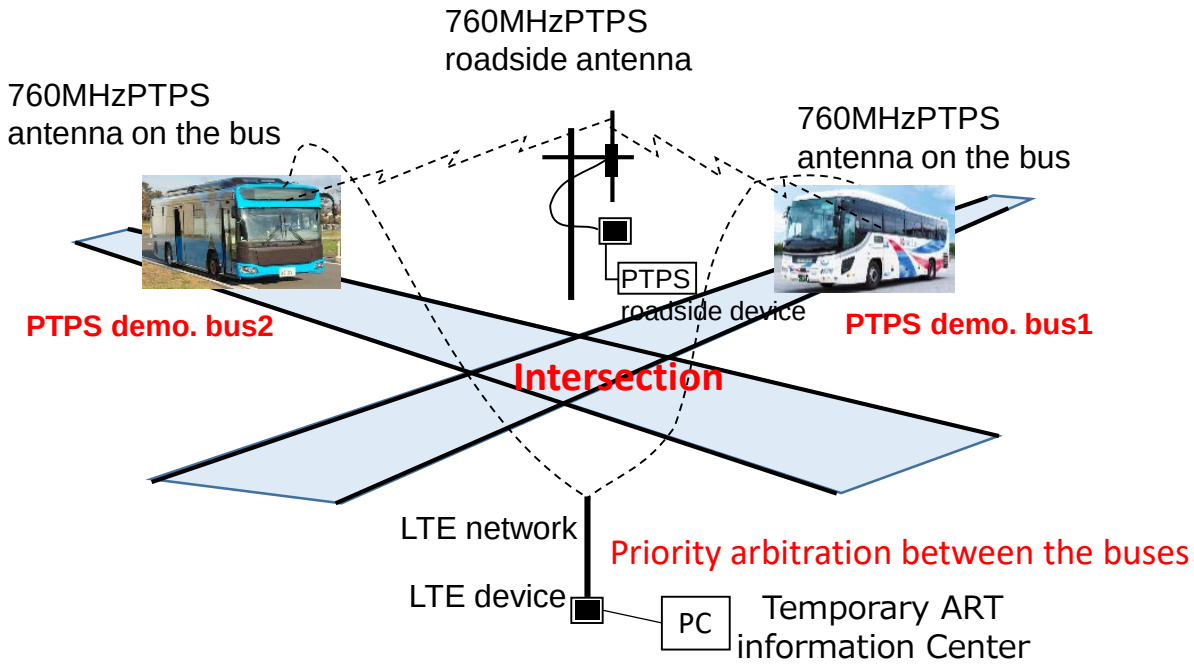
Mechanical looseness compensation in steering system



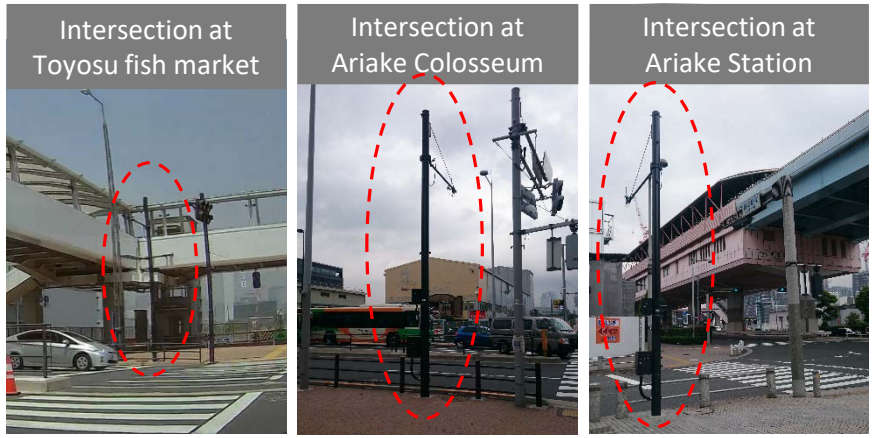
Public Transportation Priority System (PTPS)

by 760MHz Radio Wave beacon

Not only responding a bus but also prioritize buses which are approaching in same time at same intersection

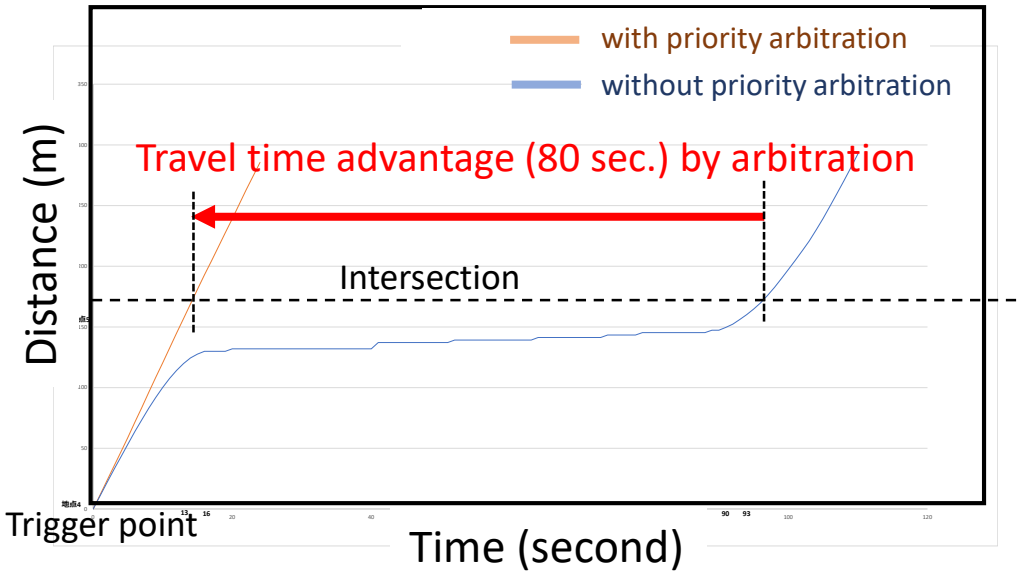


Field Operational Test at Tokyo bay area

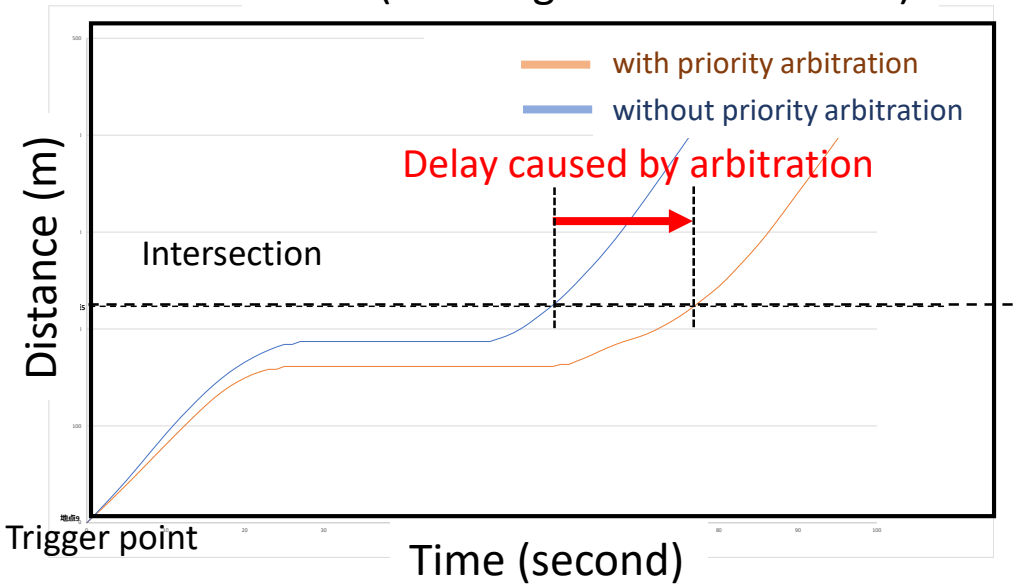


Result of Public Transportation Priority System FOT

Bus 1 (on the target street)



Bus 2 (Crossing direction to Bus1)

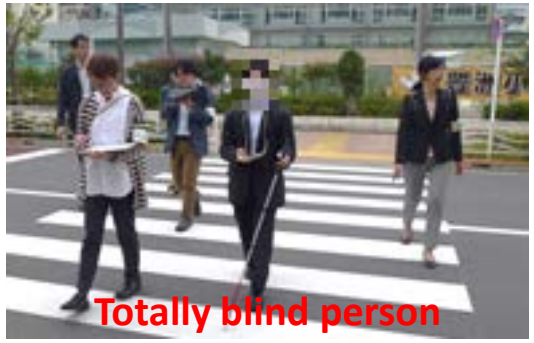


Bus 1	Travel time		PTPS operation	
	Without PTPS	Without PTPS	Number of Activation	The mean of green time extension
Outward Trip	577	518	15	5.6
Homeward Trip	382	348	7	6.6

About 10% of travel time was reduced

Mobility as a service : Accessibility Support System around Mobility Users

Several types of users

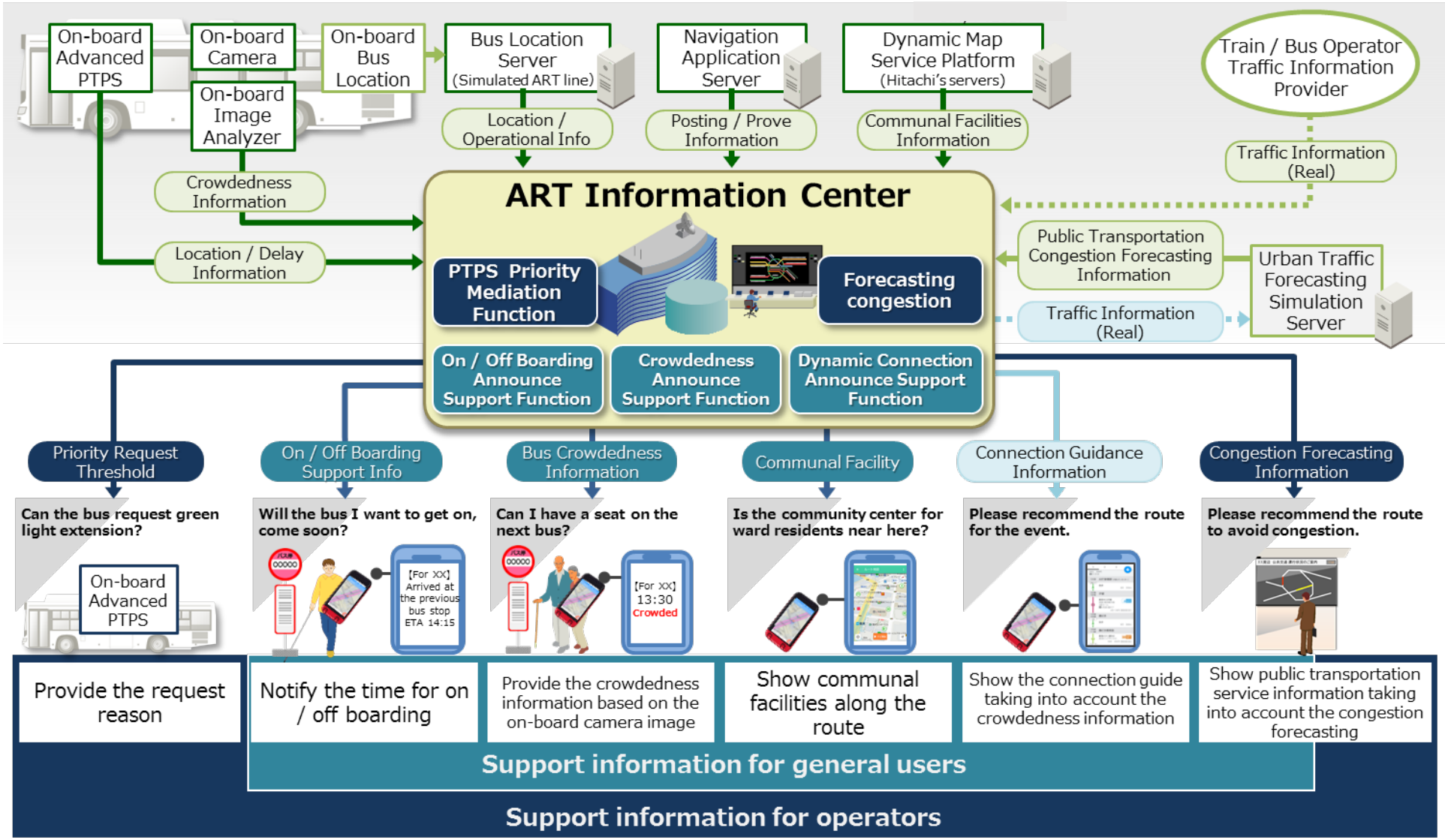


Initial setting view of Accessibility support device

Select your type

Different guidance will be provided for different type of users

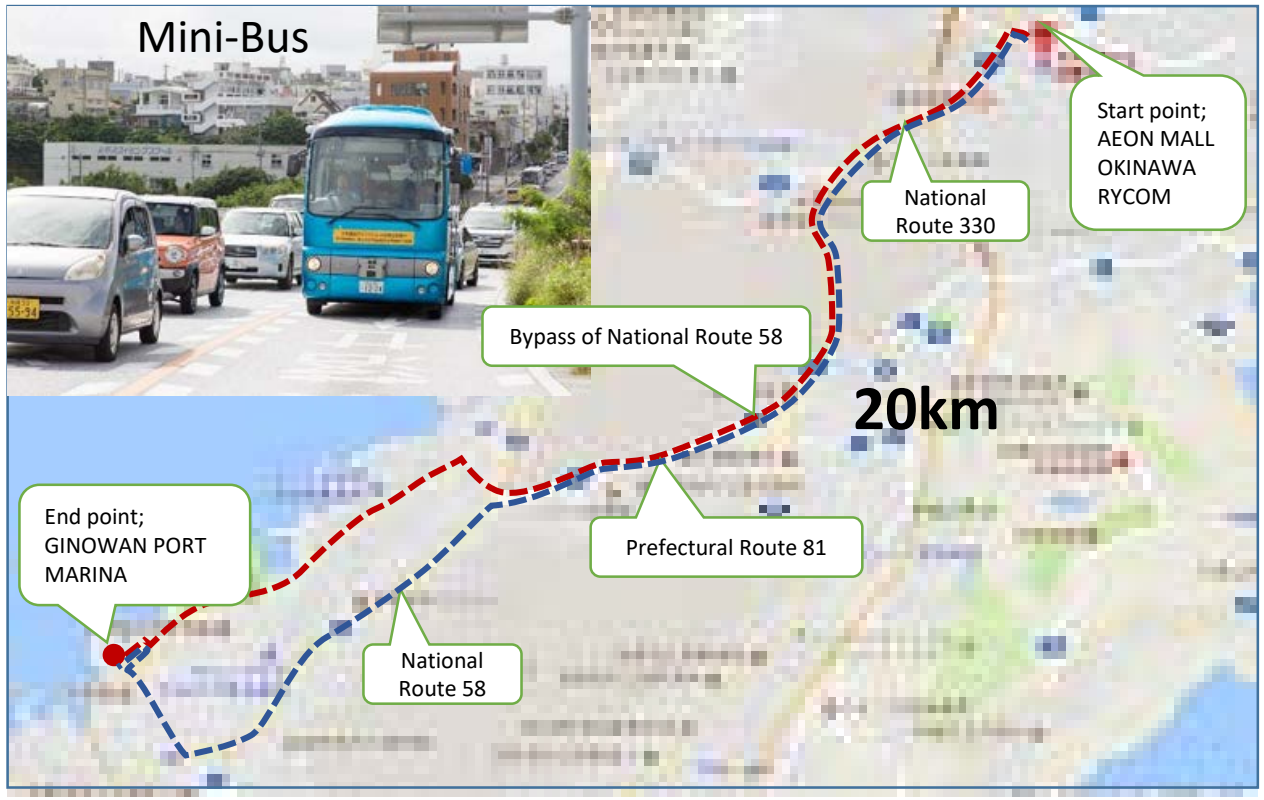
MaaS Information Center for Demonstration



ART: Advanced rapid Transit

SIP-adus Automated Bus Field Operational Test in Okinawa

October 31 – December 13, 2017



General perception was good but the driver needed to override at intersections, lane change situations and so on.

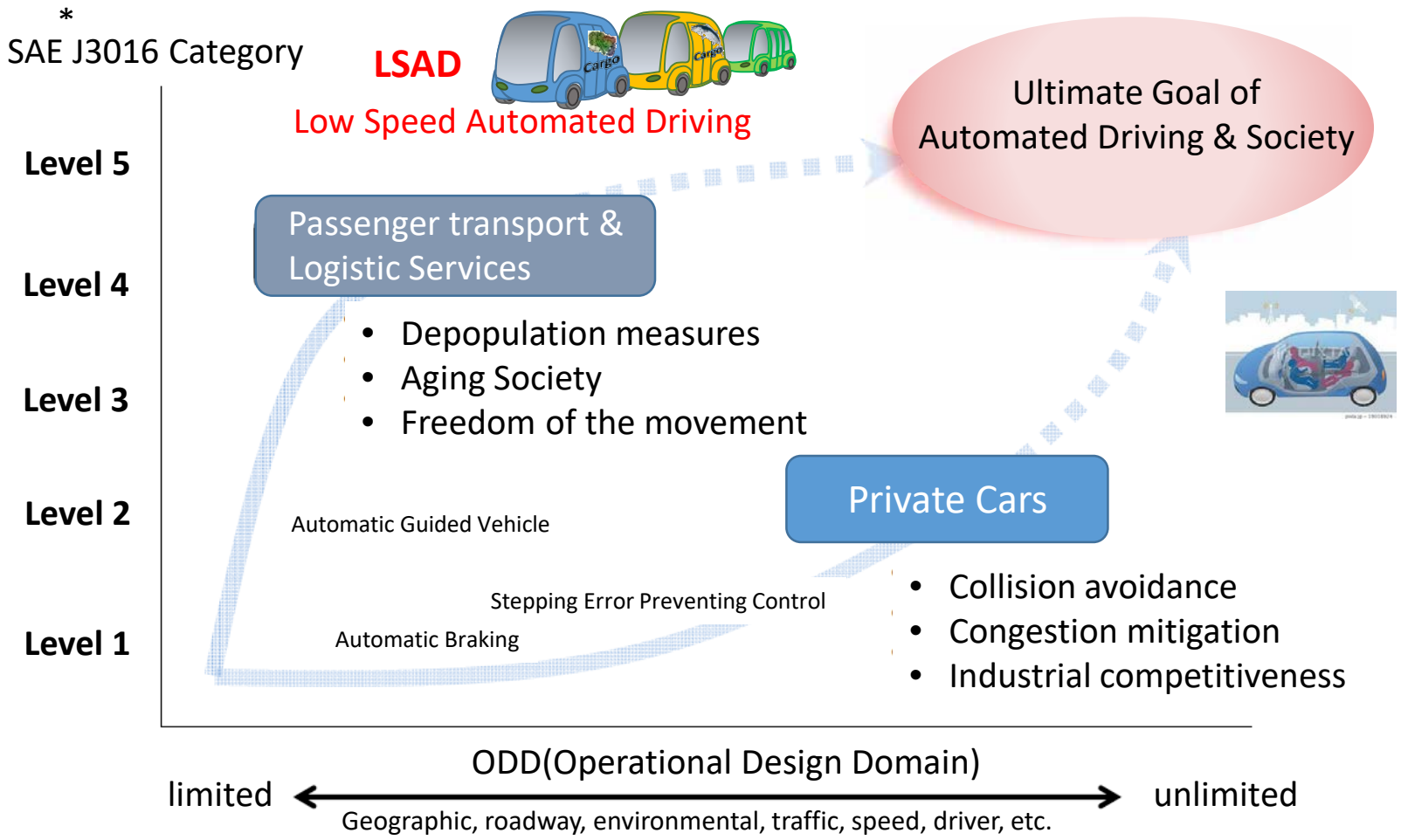
January 8 – March 7, 2019

Large size Bus

Focus on practical applications of automated driving ;
Precise Docking and Smooth Acceleration and Deceleration

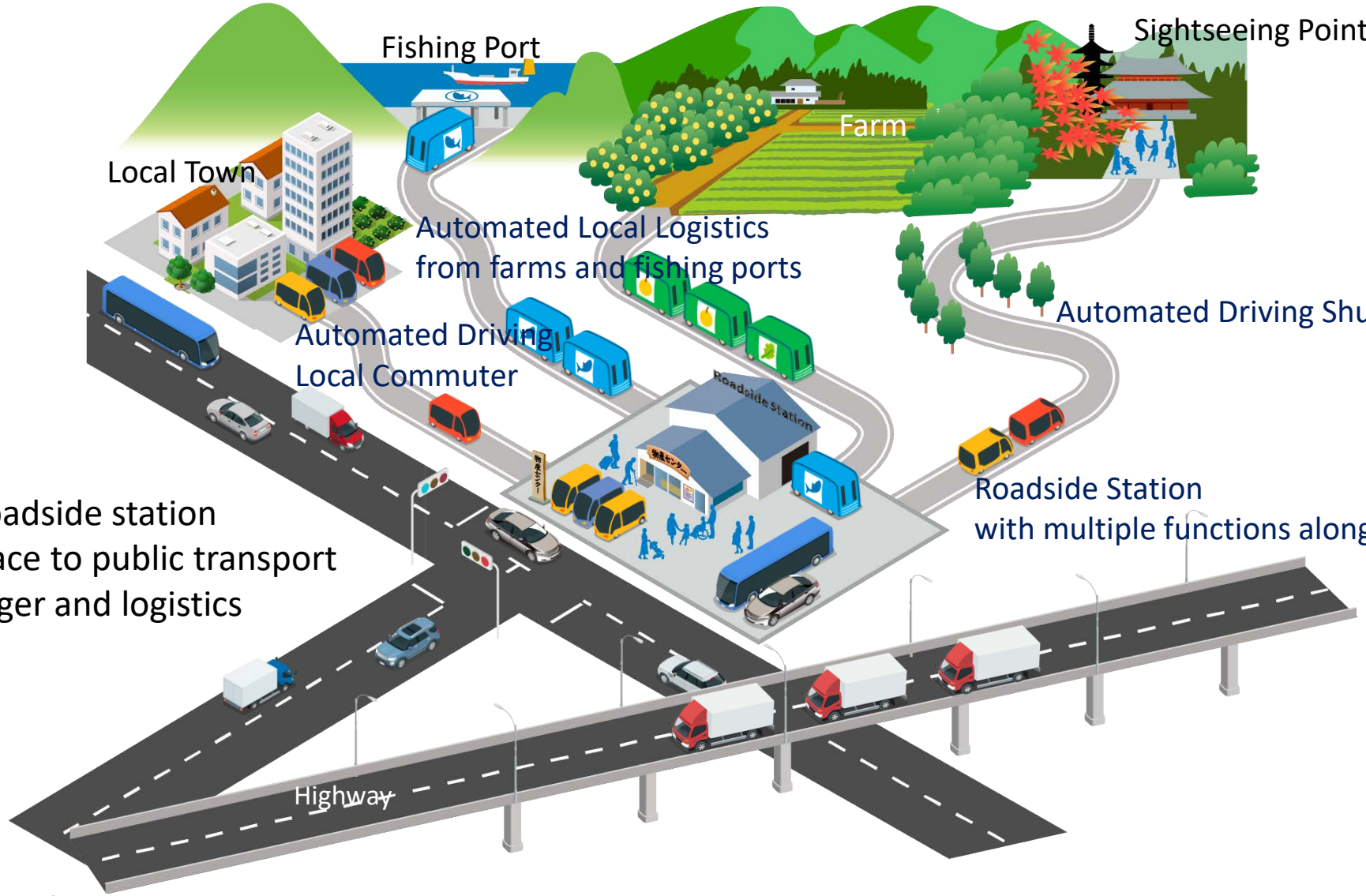
Automated Driving Technologies

LSAD for the First/Last mile application would be a practical path



*SAE (Society of Automotive Engineers)

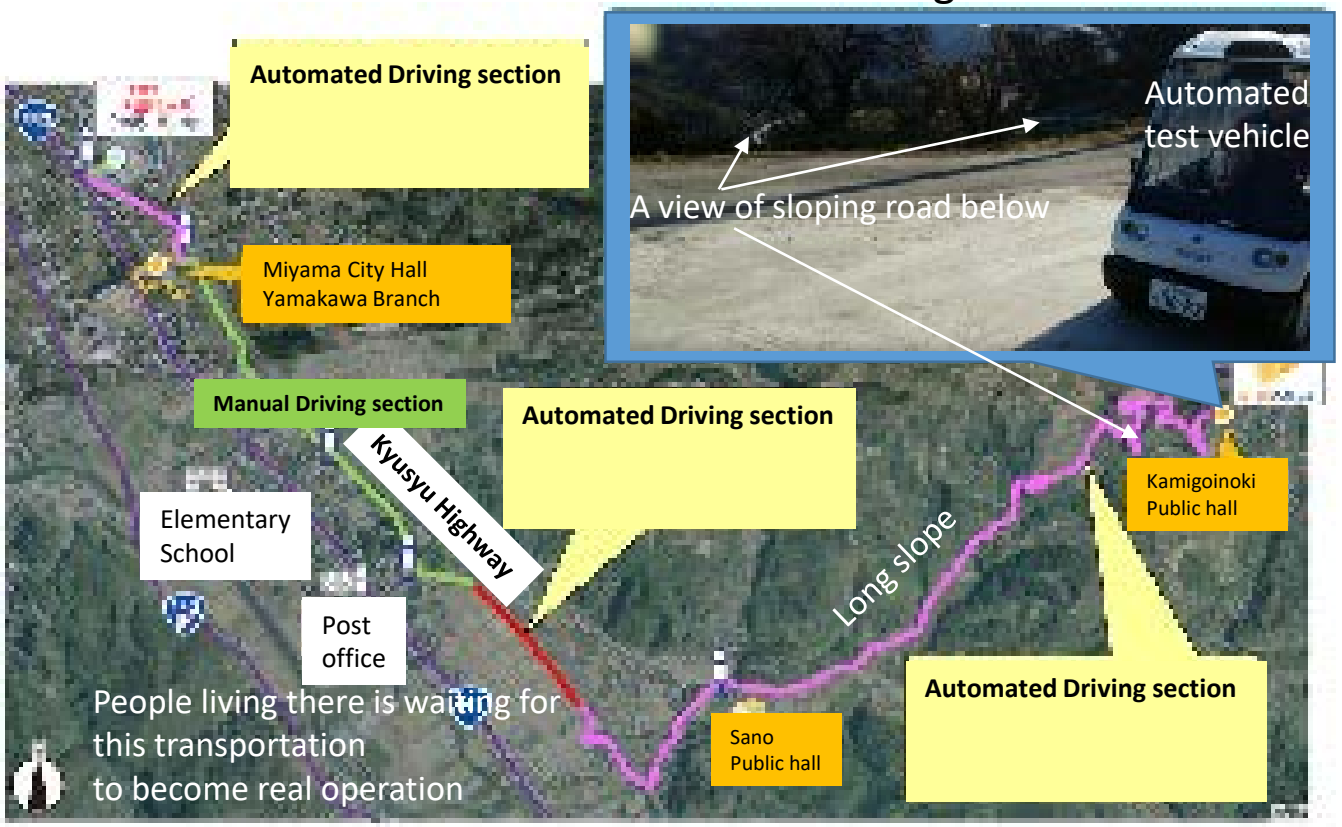
Low speed Automated Driving Shuttles in rural area using temporally occupied dedicated roads



Slow and Short distance Automated Mobility works well at the specific situations

Transportation to high altitude village Demonstration at mountain area in Fukuoka, Japan

Partial Automated Driving with human driver



Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

Similar needs as San Francisco

Next Challenge
First/Last-mile Low Speed Automated Vehicle is required to run at residential area

Most of residential roads are unsystematic mixed traffic situation
between cars and pedestrian on narrow space

Typical residential road in Japan

Huge challenges will be required to introduce last-mile mobility in this kind of space and change to more systematic traffic environment

One of the ideal situations: Shared Space in Europe

Systematic safety with mutual eye contact and consciousness between tram driver and pedestrian

Human driving Tram will be important. Question is future possibility of automated driving shuttle in this situation

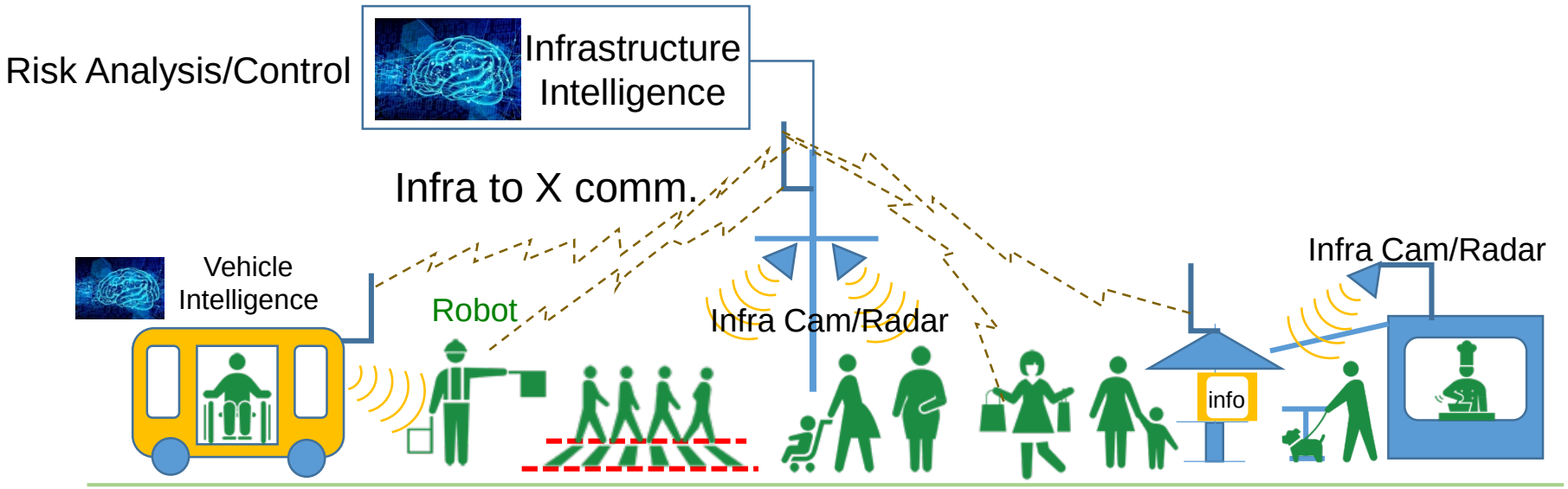
Strasbourg, France

Future Work: Cooperation with Smart Infrastructure

To expand Operational Design Domain for Low Speed Automated Shuttle in First/Last mile public space

Smart Environment

Mobility service by LSAD should be one of the parallel options between walking, running, bicycle …… at the same space.

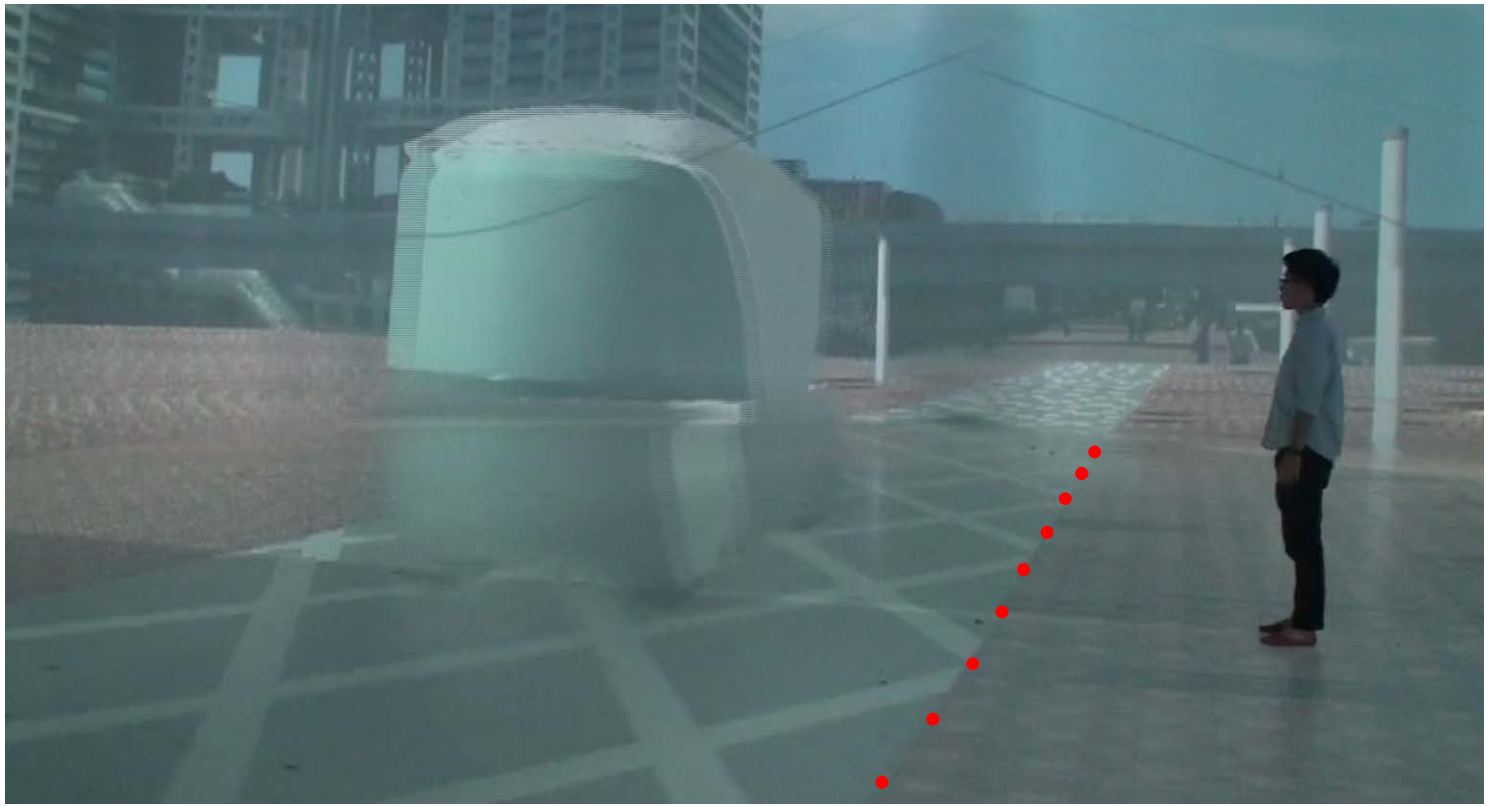


LSAD Shuttle
(Low Speed Automated Driving)

Space Sharing between
Pedestrian and Low Speed Automated Shuttle

Pedestrian acceptance and feeling evaluation with low speed shuttle in shared space

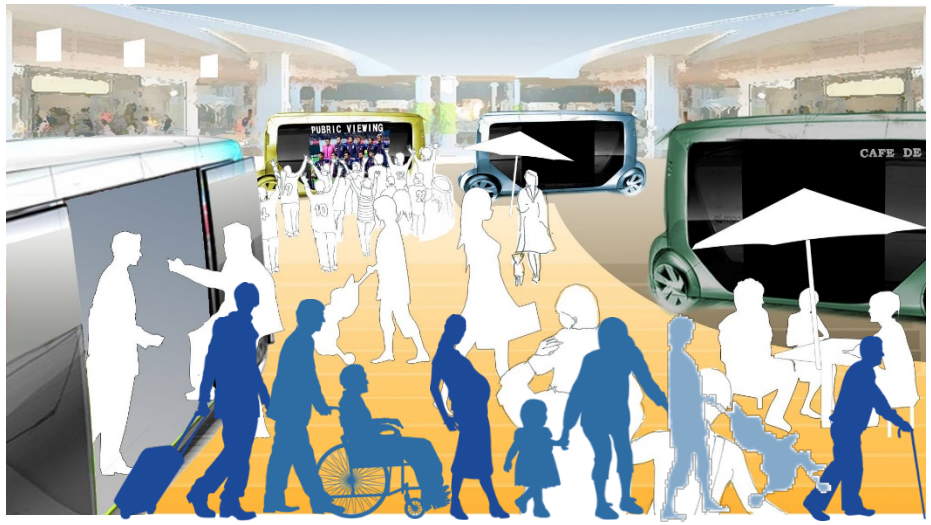
Depending on vehicle speed, shape/color of vehicle and safety clearance



Empowerment Studio
at University of Tsukuba

Additional effects will be also evaluated on infrastructure such as roadside warning light

Thank you for your attention



Masayuki Kawamoto
SIP-adus/ University of Tsukuba
January 16, 2019

kawamoto.masayuki.gn@un.tsukuba.ac.jp