Session: "Regional activities & FOTs"

Enhancing mobility & sustainability in urbanized area

Takashi Oguchi

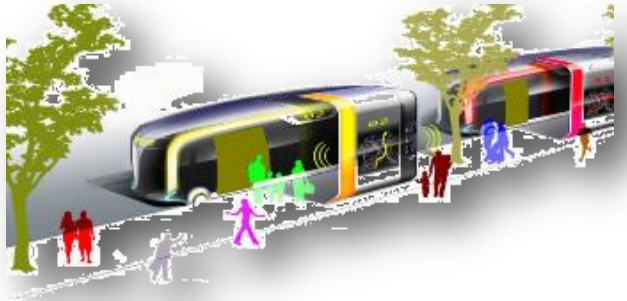
assigned as the leader
of the "Next Generation Urban Transport WG" of SIP-adus

Professor of "Traffic Management & Control"
and Deputy Director of
Advanced Mobility Research Center (ITS center),
Institute of Industrial Sciences (IIS),
the Univ. of Tokyo (UTokyo)

東京大学
生産技術研究所
Institute of Industrial Science,
The University of Tokyo
東京大学
THE UNIVERSITY OF TOKYO

Goal and Exit Strategy of SIP-adus

1. Ensuring **safety** and **traffic jam reduction** on the road
2. **Development and deployment** of **ADS**
   (**A**utomated **D**riving **S**ystem)
3. Realization of advanced next generation public bus services especially for elderly and handicapped users (Advanced Rapid Transit: **ART**)



Surface Road Transport or Traffic Operations

[Classical] Hierarchical road network (operations) concept

Classification based on the main function of roads

Roads outside town: function for inter-urban(city, tow) connection

Roads inside town: multi-functions supporting activities inside towns, cities, urbans

Layers for both **outside**/**inside**

major trunk roads

trunk roads

supplementary trunk roads

lanes, paths

Top layer: massive vol., high speed
←→ should strongly avoid congestion

[Roads outside town] Major function is "traffic"

Highway

Different quality of "traffic" function for different Layers & traffic demands

- Main and long trip routes need higher volume/higher speed service required
- Just connection function requirement for steep mountainous villages

[Roads inside town] Traffic function +access/egress & space providing

Street/ Avenue

(urban) main avenues: form frameworks of urban area
+ relatively high speed/high volume traffic; ***limited access*** function

(urban, dense)non-trunk roads: + space providing & full access function; ***minimized traffic*** function

Performance Oriented & Functional Hierarchy of Roads

classification

traffic function from automobiles	outside town	inside town	access control (AC) from others	access control (AC) roadside faci.
traffic	A_R	A_U	fully access control (FAC)	
	B_R	B_U	partial access control (PAC)	
	C_R	C_U	No control	PAC
access	D_R	D_U		No control
stay	-	E_U		

Significance of Access - others: grade separation of crossing roads

Control execution: - roadsides: limit access to/from roadside facilities

OUTSIDE TOWN

connecting levels \ traffic function	traffic (motor-ways)	access B_R	access C_R	access D_R	stay –	stay –
I Metropolitan areas	◎					
II Metropolitan area & Upper Urban Area(s)	◎					
III Upper & Lower Urban Areas or Lower Urban Areas	○	◎	△	–	–	–
IV Lower Urban Area & Small Area(s)	–	–	◎	–	–	–
V Small Area & Community Area(s)	–	–	–	◎	–	–
VI (Inside Communities)	–	–	–	–	table of Us	–

CAV Introduction for both personal cars & commercial fleets to enhance **high volume/high speed transport** to be **safer and more efficient**

First/Last service needed for depopulated area

Performance Oriented & Functional Hierarchy of Roads

classification

traffic function from automobiles	outside town	inside town	access control (AC) from others	access control (AC) roadside faci.
traffic	A_R	A_U	fully access control (FAC)	
	B_R	B_U	partial access control (PAC)	
	C_R	C_U	No control	PAC
access	D_R	D_U		No control
stay	-	E_U		

Significance of Access control execution: - others: grade separation of crossing roads
- roadsides: limit access to/from roadside facilities

INSIDE TOWN

connecting levels \ traffic function		traffic (motor-ways) A_U	B_U	C_U	access D_U	E_U	stay (F_U)
I	Metropolitan areas only	–	–	–	–	–	–
II	Only between Upper Urban Areas	◎	○	–			
III	Upper & Lower Urban Areas or Lower Urban Areas	○	◎	△			
IV	Lower Urban Area & Small Area(s)	–	–	◎			
V	Small Area & Community Area(s)	–	–	–	◎	–	–
VI	Inside Communities	–	–	–	△	◎	モール

Urban **dense** travel **demand** enhances public transport (**PT**) **advantages**

Next Generation Urban Transport

Missions of Next Generation Urban Transport WG

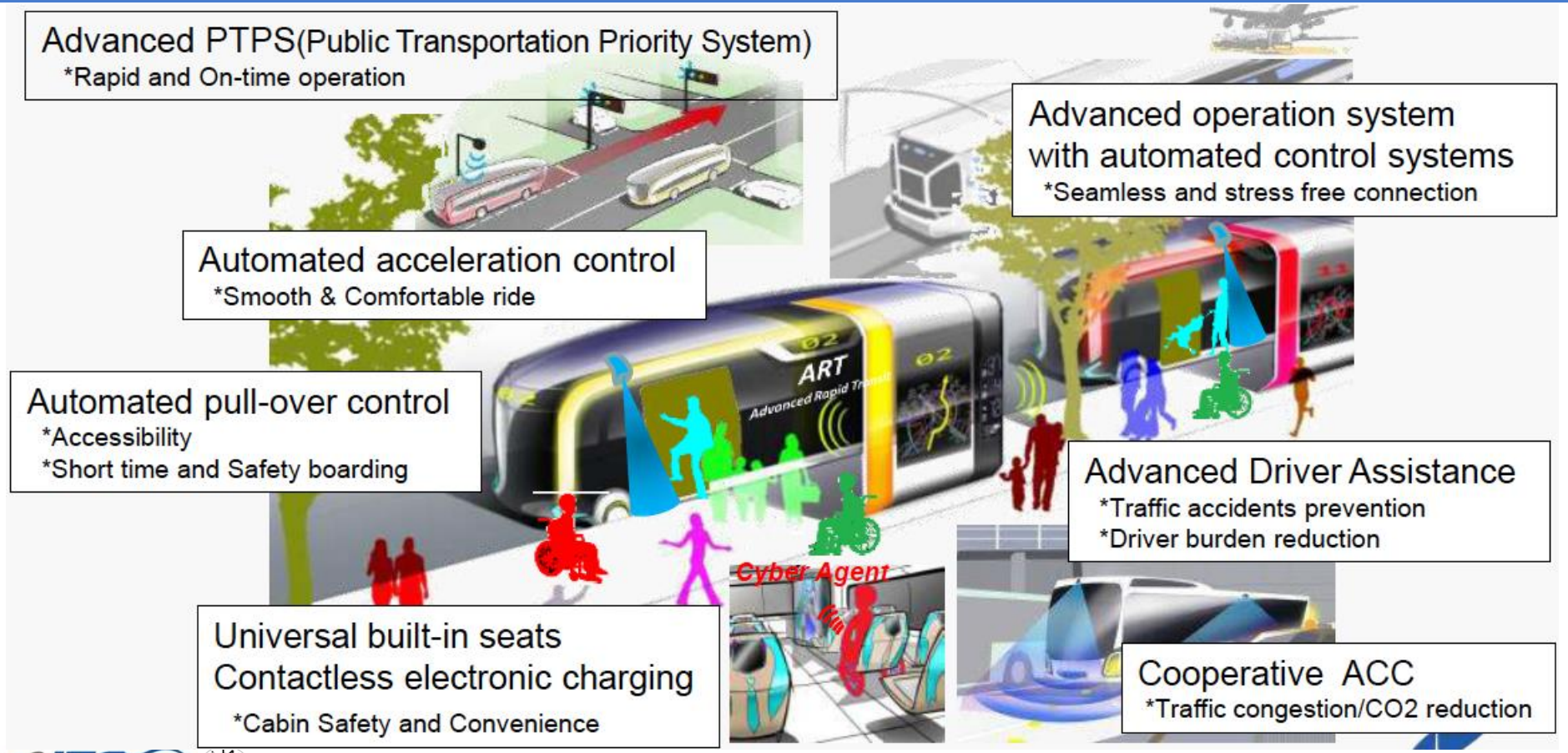
For "Ensuring safety and **traffic jam reduction** on urban roads" ...

- Enhancement of **surface public transport (PT) function** for ensuring safety of vulnerable users (disabled & aged)
  - Increased level & quality of services of **PT**
  - **ART**: Advanced **Rapid** Transit ← BRT
    - automated pull-over control (precise docking)*
    - smooth & comfortable vehicle control *
    - priority service for public transit (PTPS)
    - seamless fare-payment, quick & safe boarding for wheel-chairs
    - integrated services with seamless & stress-free connections
    - universal information provision service including vulnerable users
- Showcase for **Olympic/Paralympic Games 2020 Tokyo**
  - travel demand concentration prediction; including congestion avoidance campaign

→ to promote ART in other urban areas in Japan, and abroad ***!!***

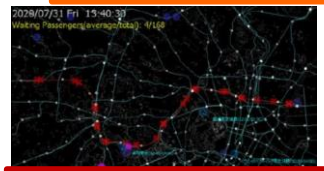
* Automated Driving technology application parts

Next Generation Urban Transport: concept of ART



Research items on ART

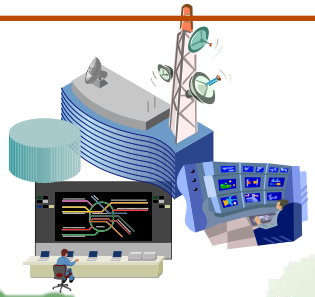
ART Information System



Congestion Estimation

Peds convenience & safety support

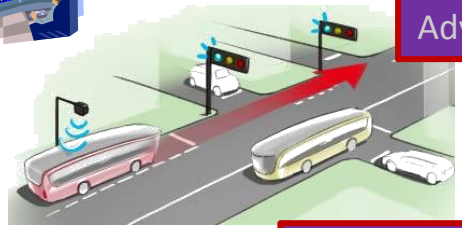
Central Info. management agent



Advanced PICS

ART Information center

Info. sharing w/bus location



Advanced PTPS Infrastructure

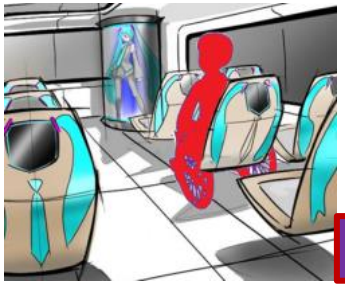
Rapidness establishment w/A-PTPS

ART vehicle development

Sensing & control for ART precise docking

Control & actuator for ART precise docking

Advanced PTPS on-board system



Digital signage
On board personal agent

ART boarding service assistance

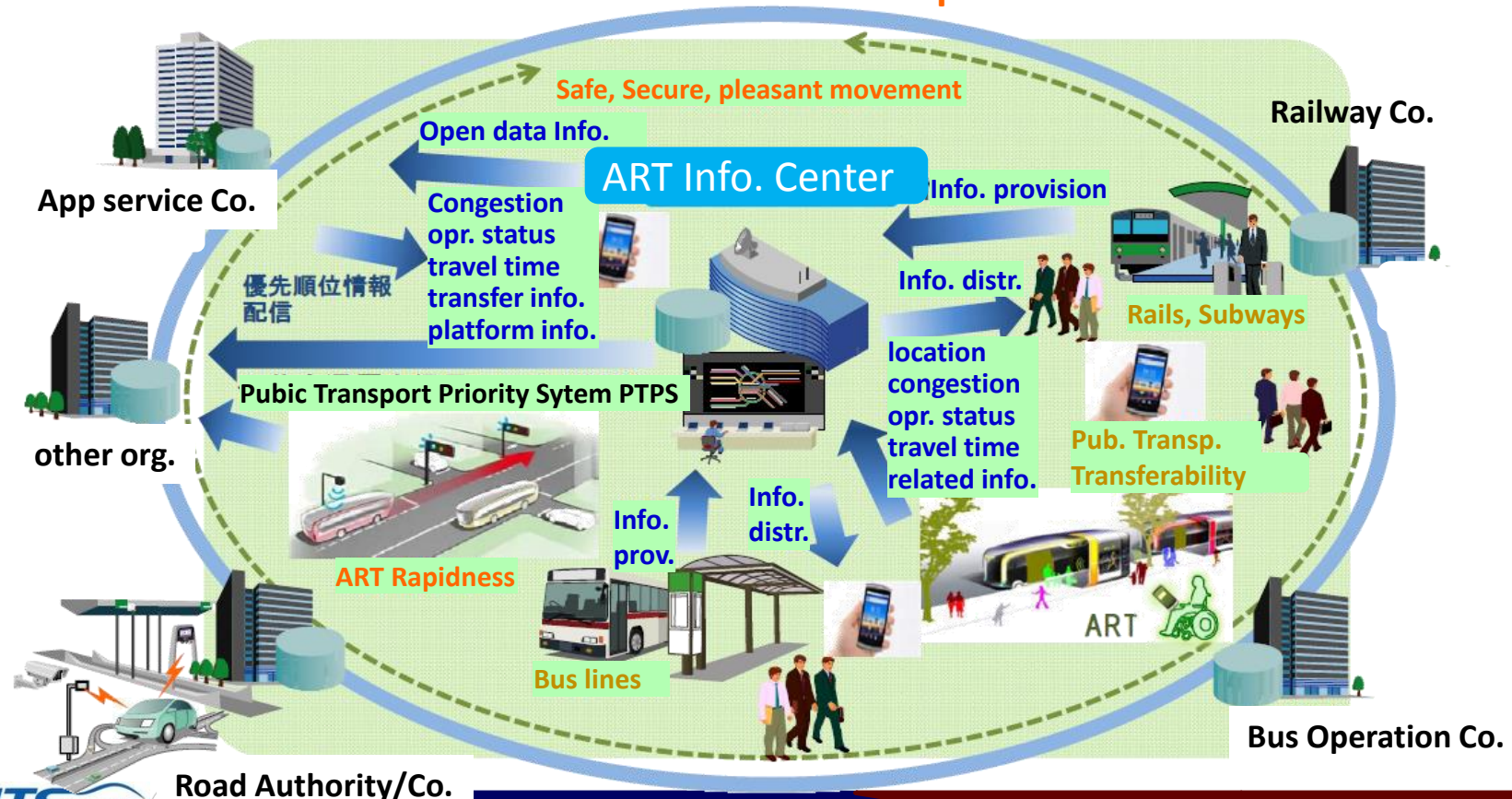
Automatic precise docking

Dangerous gap between bus & platform for wheel-chair or visual impaired persons.

Docking technology to fill the Gap

ART Information center

Core information for ART operation



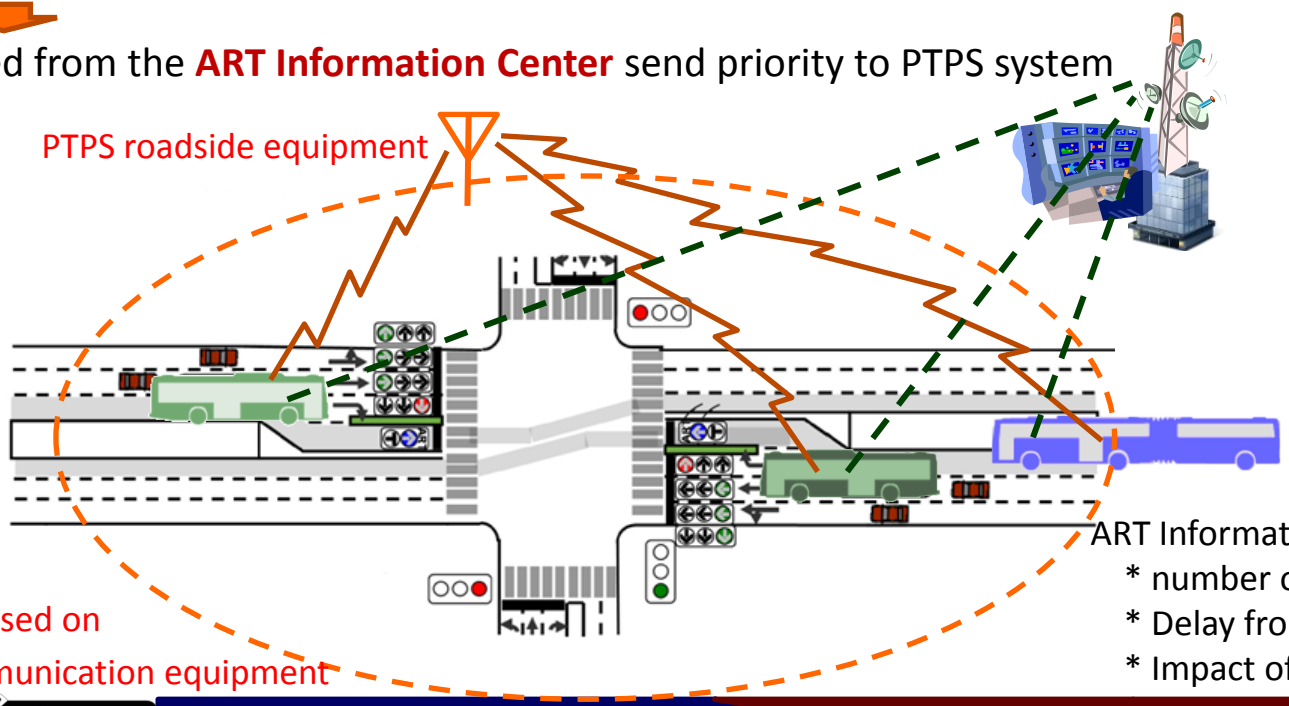
Enhanced PTPS that uses 700MHz band

ART Information Center Use Case 1

All buses: Request priority to pass a intersection at a certain distance from the intersection

ART Information Center: Rank priority and mediate priority requests

Buses instructed from the **ART Information Center** send priority to PTPS system



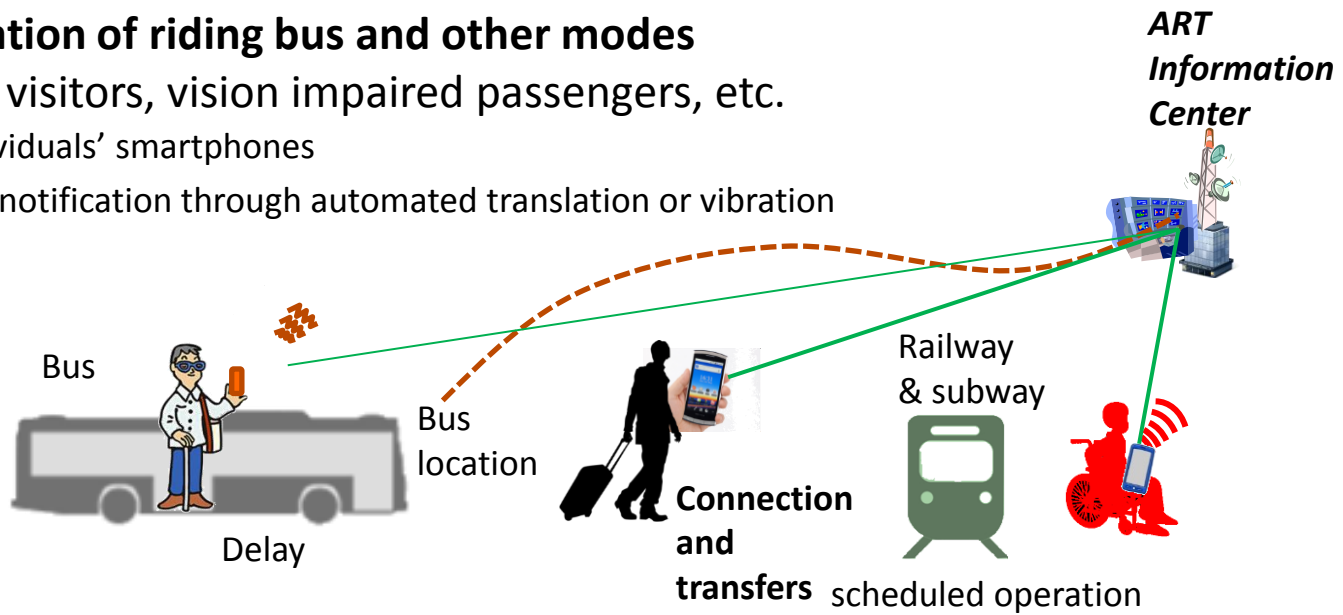
ART Information Center
* number of passengers
* Delay from scheduled time
* Impact of delay etc.

Transfer improvement

ART Information Center Use Case 2

- **Dynamic transfer information**
  - Arrival time prediction
  - Historical data learning(deep learning)
    + present traffic congestion state
- **Connection information of riding bus and other modes**

  For overseas visitors, vision impaired passengers, etc.
  - Send information to individuals' smartphones
  - Smartphones to provide notification through automated translation or vibration



Bus usage information for individuals

ART Information Center Use Case 3

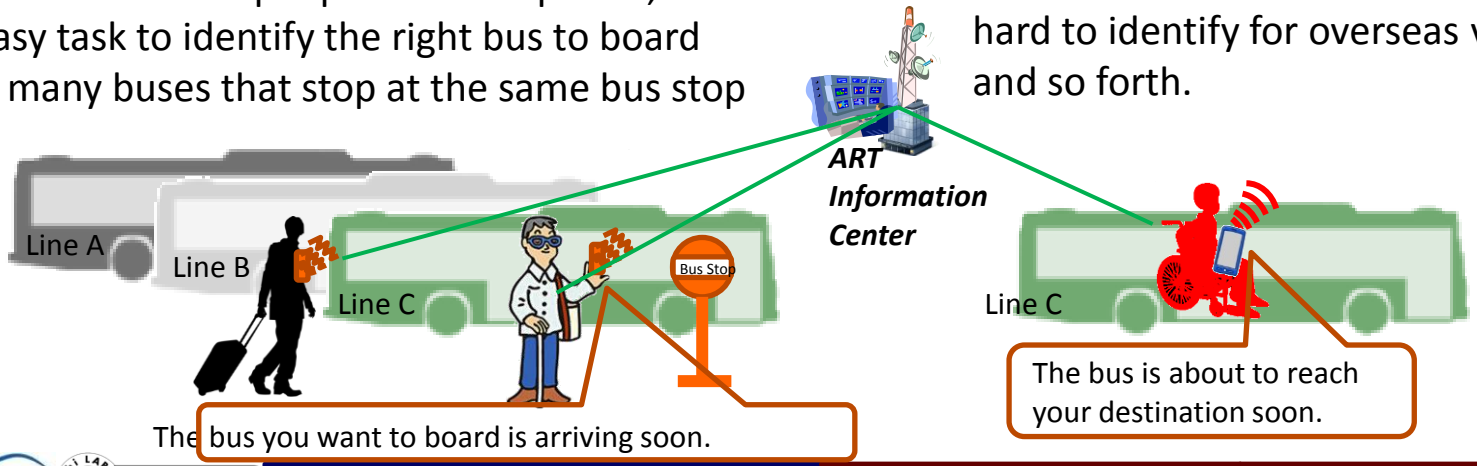
Enter departure point, arrival point in the travel plan app (prior to start of travel)

The system functions that receive this input will:

1) Notify the intended bus arrival at the bus stop to the waiting passengers (ensuring the wrong bus is not boarded by mi
2) Notify the alighting destination bus stop to the passengers on board (ensuring passengers do not forget to exit)
3) Send notices to smartphones translated into mother tongue by an installed app

For overseas visitors or people vision impaired,
it is no easy task to identify the right bus to board
from the many buses that stop at the same bus stop

Some bus stops have names that are
hard to identify for overseas visitors,
and so forth.



1st Automated Bus FOT in Okinawa

Shore road

Press released on 26 Dec., 2016 : announced that FOT held in Okinawa in March 2017

Automation introduced to Small Bus

- speed, steering automated | no brake
- almost no disturbance
- except parked vehicle avoidance

Surface Street | Nanjo-city, Azama-Sansan beach

1st FOT in Okinawa (March): Automated bypassing a stopping vehicle

* a bus developed by "Advanced Mobility Co., Ltd. (a start-up by IIS, UTokyo)
supported by SB Drive (Softbank group), the Robot "Pepper" helps the demo:-)

1st FOT in Okinawa (March): Precise docking to a bus stop

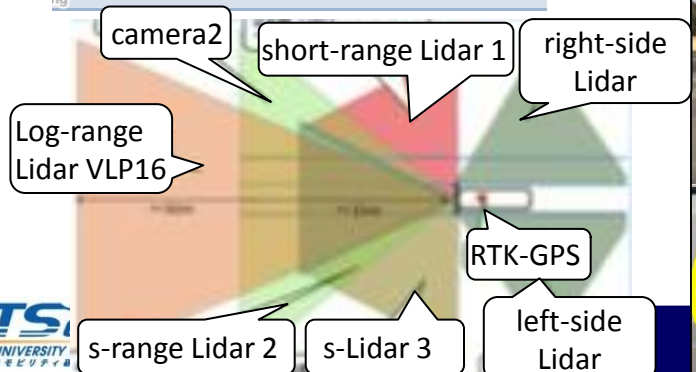
Shore road

2nd FOT at Ishigaki in Okinawa (press released June, 2017)

Isolated island

- Mainly Social acceptance survey

Ishigaki Island: total course length 16km



- speed, steering automated | no brake
- signalized intersection passage,
- moderate traffic volume

2nd FOT at Ishigaki in Okinawa: traffic environment

Isolated island

3rd FOT plan in Nov. 2017, with O-ART committee

City area

- Okinawa prefecture: the worst congested capital cities
  → establish "Roadmap towards new traffic environment"; 6 challenges
  - (one of them) dedicated bus introduction
- "**O-ART** committee" starts: ART will be introduced including Nat'l route #58

Press released on 27 Oct., 2017: implementation of AI image processing will be tested in Dec.

Brand-new bus
- equipped with EBS (electric brake system) automatically controlled
- additional sensors

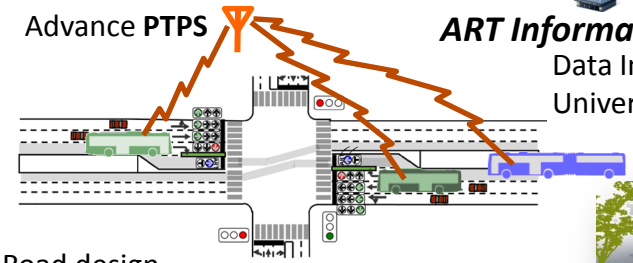
Integrated sustainable multi-modal-transport systems

INSIDE TOWN Urban/Metropolitan area

Enhancement of quality & levels of services of surface **PT**

Transfer supports

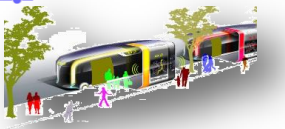
Advance **PTPS**



ART Information Center

Data Integration

Universal info. provision



Road design

Re-allocation of roadways

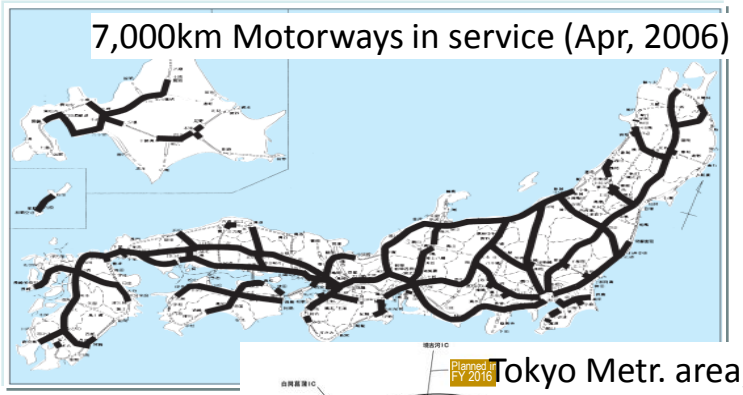
Quick/smooth stop & start

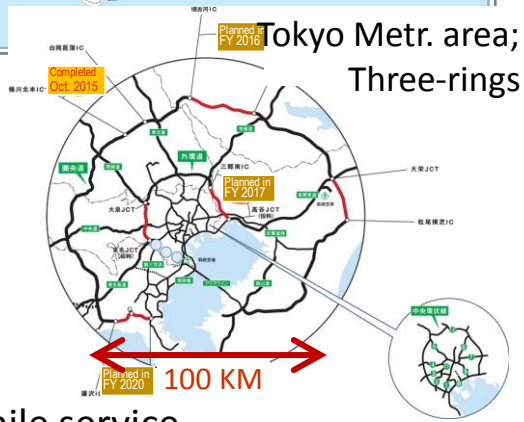
OUTSIDE TOWN - Safe & High-speed/fidelity enhancement on Motorways

Air transport

Water transport

Railway system
High-speed rail





Tokyo Metr. area; Three-rings

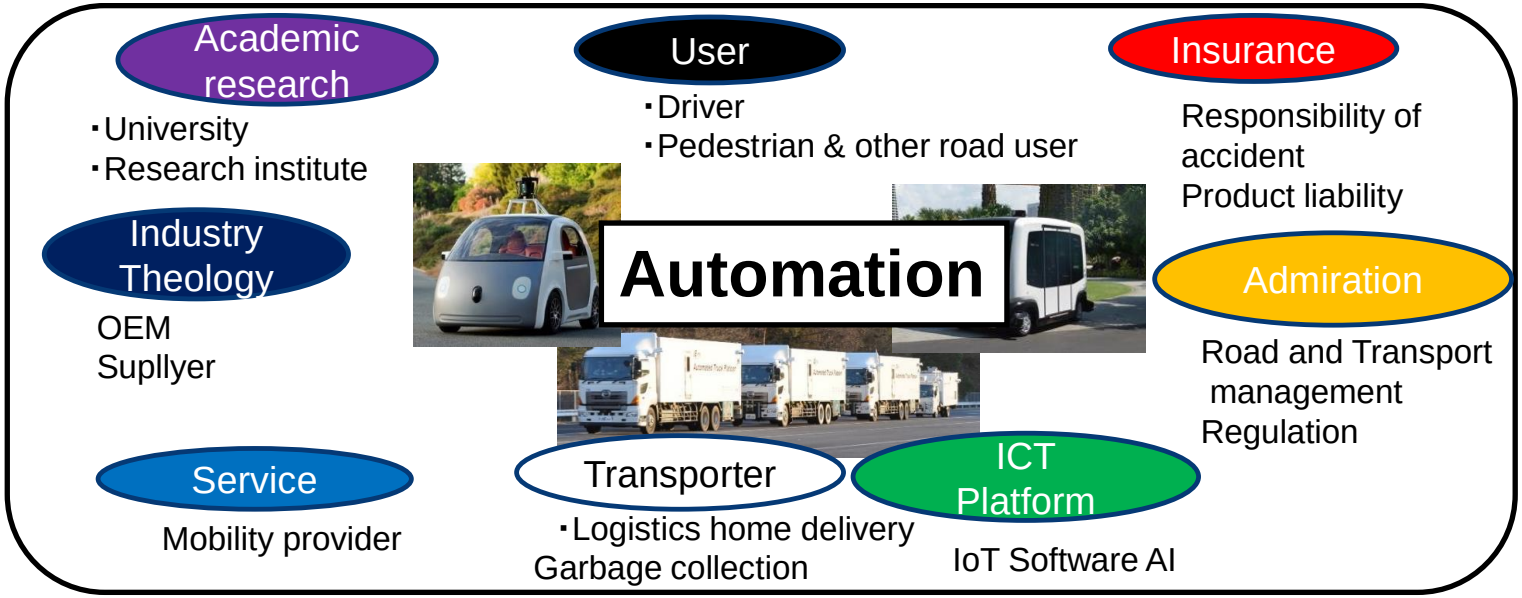
Local/depopulated area

Last-one-mile service

Integrated sustainable multi-modal-transport systems

Establishment of **"ECOSYSTEM"** for any automated driving systems

- harmonized co-existence of industries, organizations & citizens

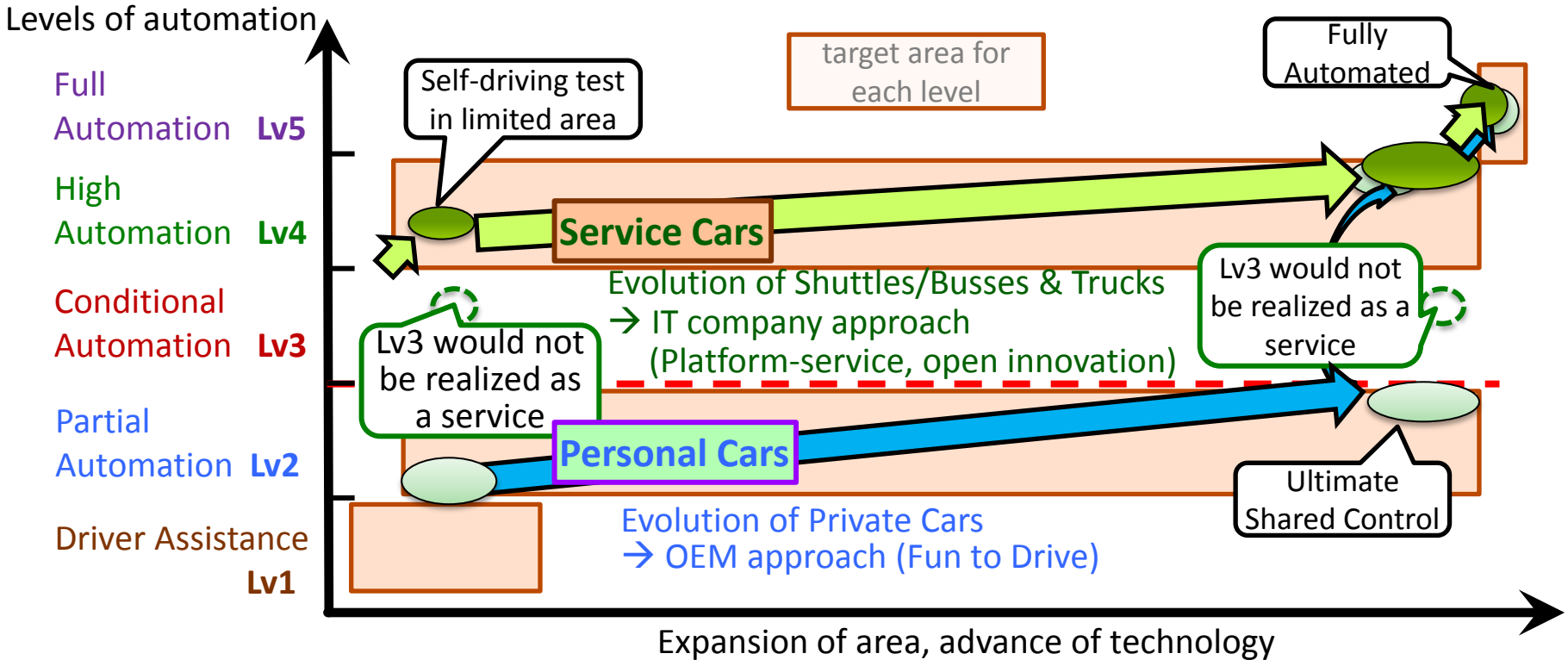


All of these partners should be committed, and benefited.

- To ensure ***social acceptability***, the establishment of ECOSYSTEM is essentially crucial.

Roll of CAVs for such integrated sustainable systems

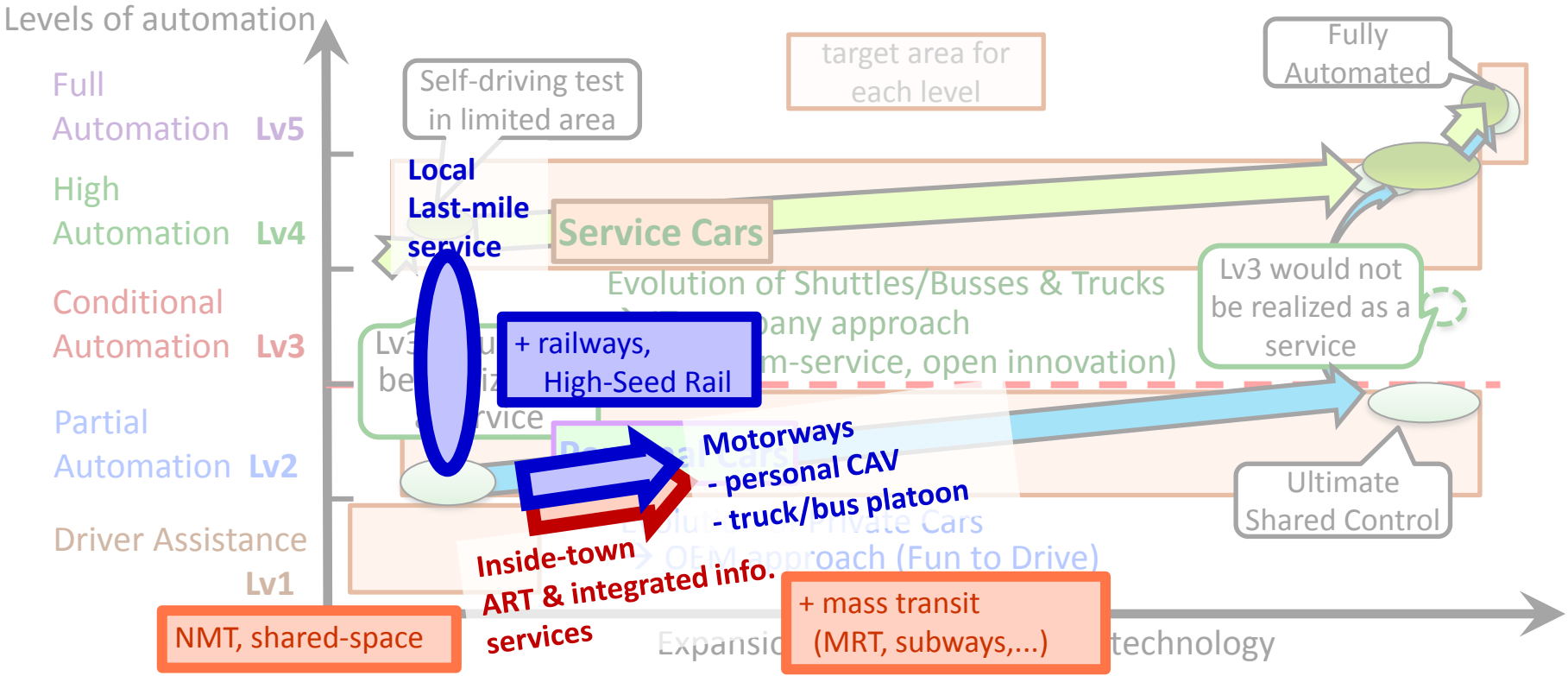
- Need oriented, social problem solving, dedicated & focused introduction



Proposal written in entrusted study by ITS center, UTokyo in FY2016
Report available: http://www.sip-adus.jp/wp/wp-content/uploads/cao_2016_cao1-11_01.pdf

CAVs development should be harmonized with Urban Plan

[realized in 2020] **Lv2 ART**, limited-area **Lv4 service, Lv2 personal CAV & platoons** on Motorways
with checking social acceptance, urban plan, legal/financial issues...



Remarks

- **CAV** should **NOT** be the **GOAL**
  → one of the tools to enhance ***Social Welfare***

- But **CAV** should be the strongest tips
  to improve ***accessibility & mobility***

- Space(National/Reginal/Urban/Local) Planning should be **changed**
  with **CAV** introduction

→ Needs for ***integrated transport system plan***
harmonized with the "Space Planning",
considering levels/stages of **CAV** developments/implementations