Nagoya University COI-NEXT
My-mobility Co-creation Center

Toward the Society of No Mobility Divide

Social Implementation Projects of Smart Local Mobility at Nagoya University

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Research Background

～Current status of local public transportation in Japan～

- Most areas in Japan except for Tokyo and Osaka metropolitan areas are quite **car-dependent** and the service level of public transportation is low, resulting in that those who don't use private cars are forced to **low mobility**.
- The car-dependent transportation system also has social issues such as **congestion, accidents, air pollution and green-house-gas emission**.
- Even when autonomous vehicles become widespread, **mass transit is indispensable** to cities because of low capacity of automobiles.
- But public transportation except heavy rail in big cities has been facing the **continuation crisis due to decrease both in users and drivers**.

Still sustainable

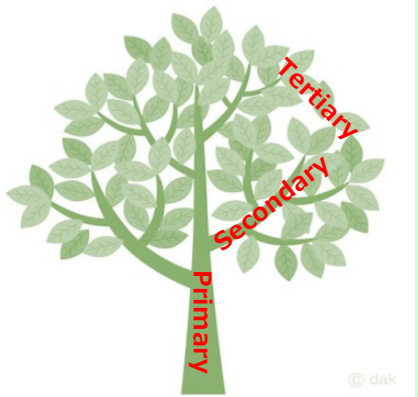
Trunk : **primary**
e.g., commuter rail, subway, arterial bus

Difficult to maintain

Branch : **secondary**
e.g., bus, taxi, drive/pick-up by family

No service by PT

Leaf : tertiary
e.g., walk, bicycle, drive/pick-up by family



3 National Projects on Mobility Service

1. **COI** (Center of Innovation) is a **9-year** academia/industry research program funded by MEXT and JST (Japan Science and Technology Agency).
   - NU COI started in 2013 granted about **¥500M/y**.
2. **COI-NEXT** replaced COI in 2021 as a **10-year** program.
   - NU COI-NEXT started in 2022 granted about **¥200M/y**.
3. Cabinet Office started **SIP** (Cross-ministerial Strategic Innovation Promotion Program) / **Building Smart Mobility Platform** in 2023 as a **5-year** program.

Nagoya University COI

Mobility Innovation Center
～Empowering an aging society through advanced mobility～

Project Leader
Mr. Kuroyanagi, Shigeru (Toyota)

Research Leader
Dr. Morikawa, Takayuki (NU)

Information Platform Research

Daily Healthcare Platform Research

AGC Inc.

Mobility Research

ICT Infrastructure Research

KDDI Research, Inc.

名古屋大学 NAGOYA UNIVERSITY

Toyota Motor Corp.
Toyota Central R&D Labs
Aichi Prefecture
Nagoya City
AIST
Tokyo University of Agriculture and Technology
Aichi Prefectural University

Cooperative Research

Toyota City
Kasugai City
Kota Town

Sustainable Platform Research

Panasonic Corp.

FY 2013 – FY 2021

Technologies and Systems for Social Implementation

Infrastructure for drive assist and autonomous driving

Personal mobility using **vehicle location estimation technology** with **wide-ranging applications.**

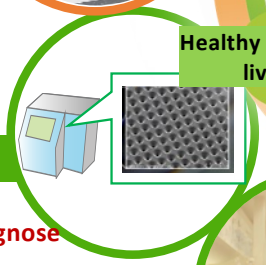
Driving safety and review systems

T-connect app to **analyze safety levels of driving and encourage behavioral changes.**

Elderly datasets

Dealer-installed pedal error prevention systems using **datasets** of **human traits such as aging vision and driving behavior.**

Intellectual Glass



A **bio-device** that can **easily diagnose cancer patients**
(→ applied to diagnostic equipment).

Walking Assistance Robot

(2)

Slocal Autonomous Vehicle Legislation

Local **last-mile transportation services** (including **legislation**) **instituted in and created by the region.**

(1)

Mobility Blend (MB)

MaaS to supplement existing modes of transportation with **new modes for the elderly in inconvenient areas.**

Creating a system with situations where **residents want to get out together.**

(3)

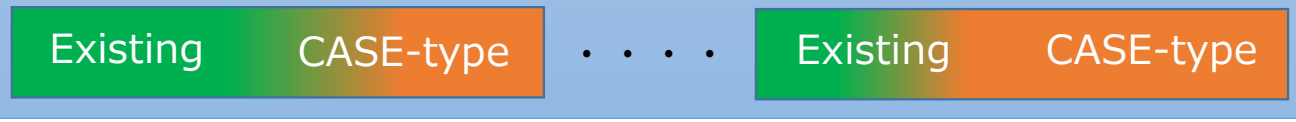
Cyclic health span extension program

A **healthy activity promotion program** to **prevent frailty/decline in cognitive function** (incl. a system for **rotating senior human resources**).

(1) Mobility Blend

Mobility services in rural areas such as semi-mountainous areas, suburban areas and small towns.

- Improve local mobility by blending existing travel modes and newly introduced services with CASE technologies.
  - CASE : Connected, Autonomous, Shared, and Electric
- Combine CASE-type modes according to local circumstances such as the degree of aging, depopulation, and driver shortages



Realize innovation with low-cost, non-disruptive mobility improvements by blending CASE-type transportation with existing travel modes

(2) Slocal Autonomous Vehicles

Realize earlier implementation with SAE Level 2 - 4 autonomous vehicles that drive below 20 km/h in specific areas for better coordination with people and society.

- **Services**
  - Offers driverless transportation service mainly for the transportation-poor such as the elderly in rural areas.
    - The last-mile service from transit stops
    - Shared transporters within a community
  - Can also be used for advanced urban transportation systems
    - Automated redistribution for car-sharing systems
    - Automated valet parking
- **Driving Performance**
  - Cooperative movement with surrounding traffic
  - Communication with surrounding traffic and people

Slocal Autonomous Vehicle Platforms

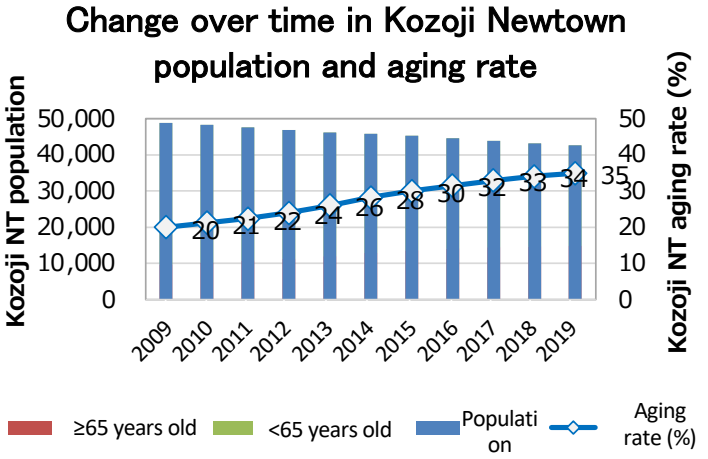
Convert "Green Slow Mobility" (EV driving below 20km/h) into autonomous.

Golfcart

Minibus

Pilot Study in an “Aging Newtown”

Kozoji Newtown in Kasugai City

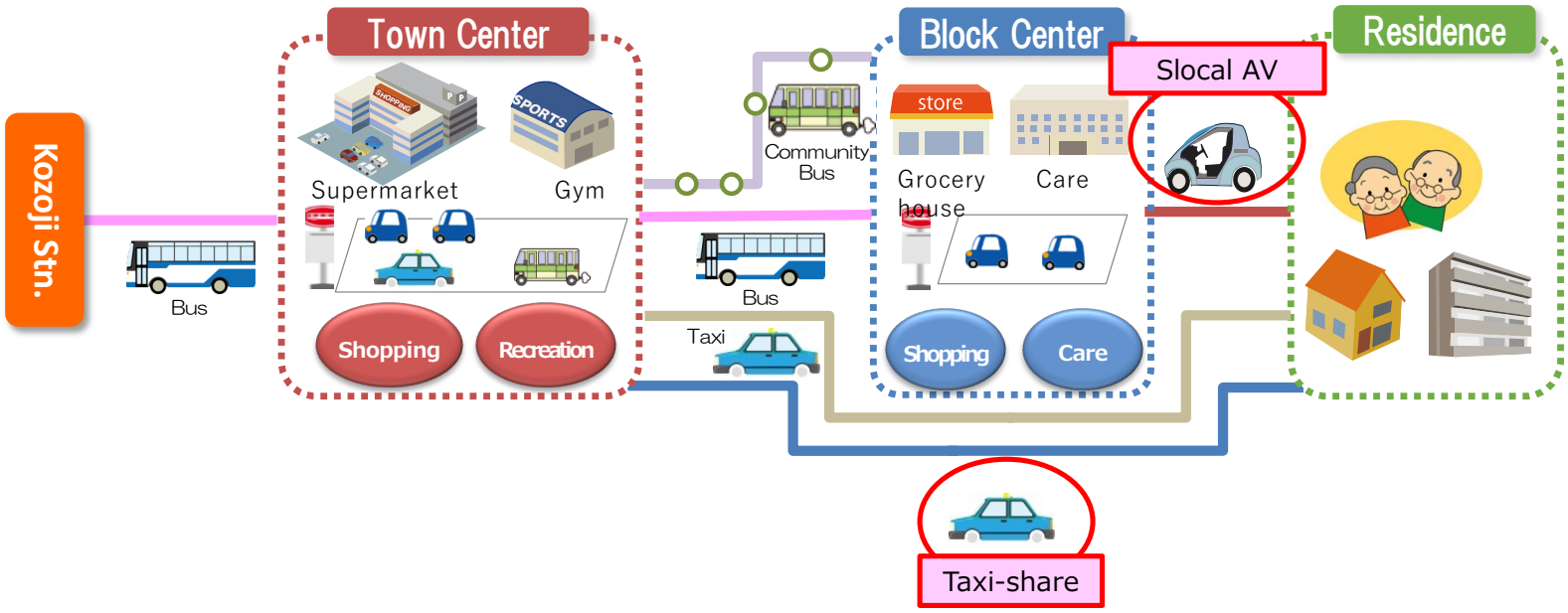


- The town has no train station, and buses are the only public transportation available.
- Decreasing frequency of bus service, greater numbers of the elderly giving up their driver’s licenses, and hilly streets of the last-mile are mail issues.
- Transportation operators face driver shortages.

Deployment of Mobility Blend

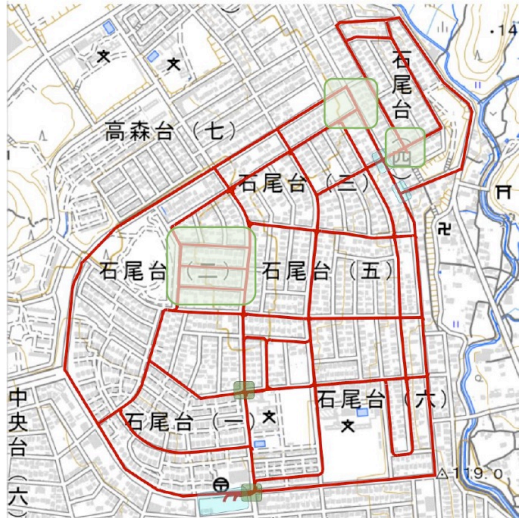
① Introduce **Slocal Autonomous Vehicles System** for last-mile service.

② Introduce **taxi-share** system.



Last-mile Autonomous Vehicle Operation by Residents' NPO at Kozoji Newtown

Started on February 1, 2023



COI-NEXT (FY2022 - FY2031)

My-mobility Co-creation Center for Sustainable Region

Vision: Super-mobile society where everyone can go, meet and participate

Major Participants of NU COI-NEXT

Research Institutes

- Nagoya U.
- Aichi U. of the Arts
- AIST
- Gifu U.
- Tokai U.
- NSRI

Transport Operators

- Central Japan Railway
- Tokyu
- Nagoya Railroad
- Tokyu Bus

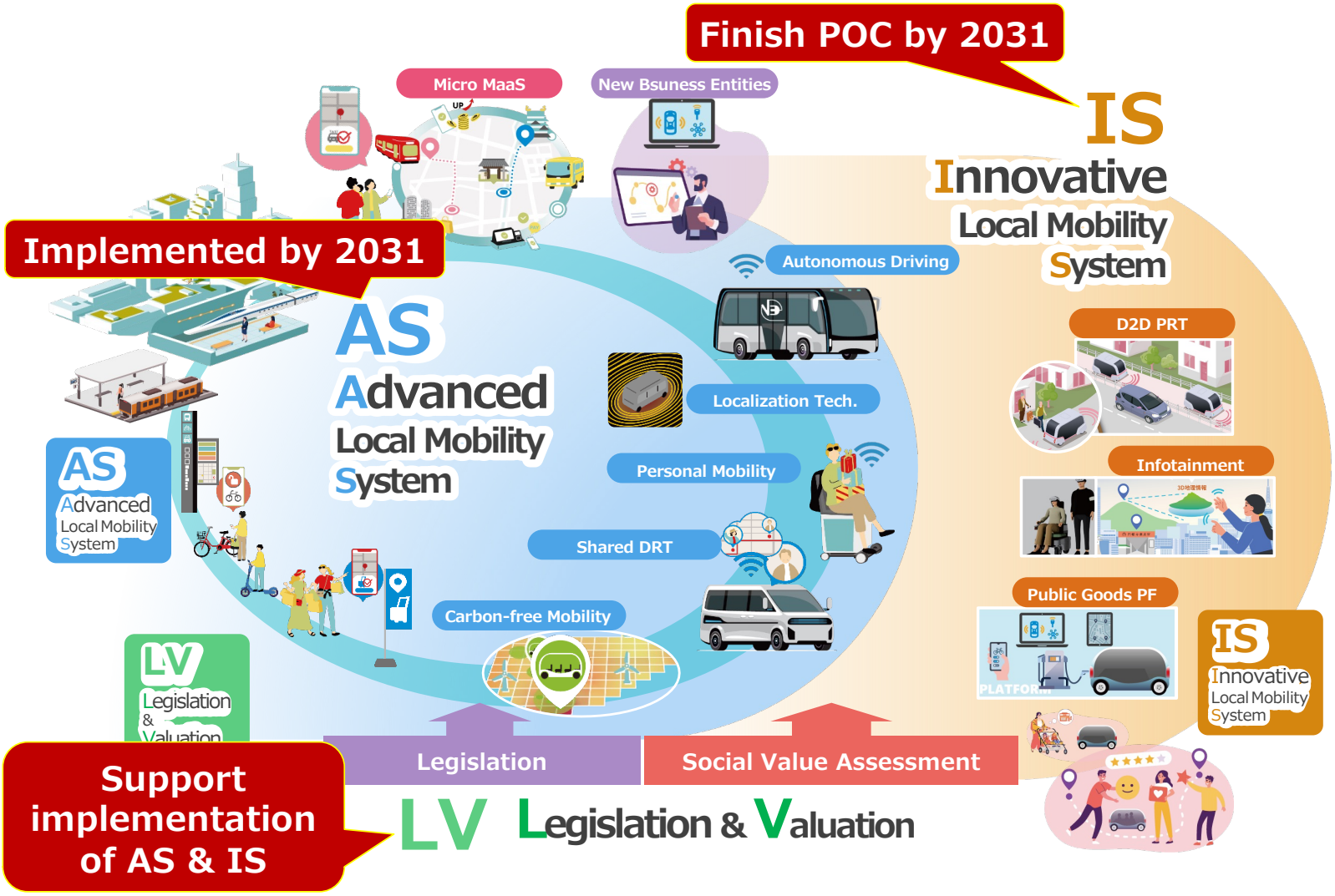
Other Private Companies

- Yamaha Motor
- KDDI

Public Sectors

- City of Nagoya
- Gifu City
- Kasugai City
- Central Japan Economic Fed.

AS, IS, and LV


Finish POC by 2031
IS
Innovative
Local Mobility
System
Micro MaaS
New Bsuness Entities
Implemented by 2031
Autonomous Driving
AS
Advanced
Local Mobility
System
Localization Tech.
D2D PRT
Personal Mobility
Infotainment
Shared DRT
Public Goods PF
Carbon-free Mobility
AS
Advanced
Local Mobility
System
LV
Legislation
&
Valuation
IS
Innovative
Local Mobility
System
Legislation
Social Value Assessment
Support
implementation
of AS & IS
LV Legislation & Valuation

Test Fields to Implement AS

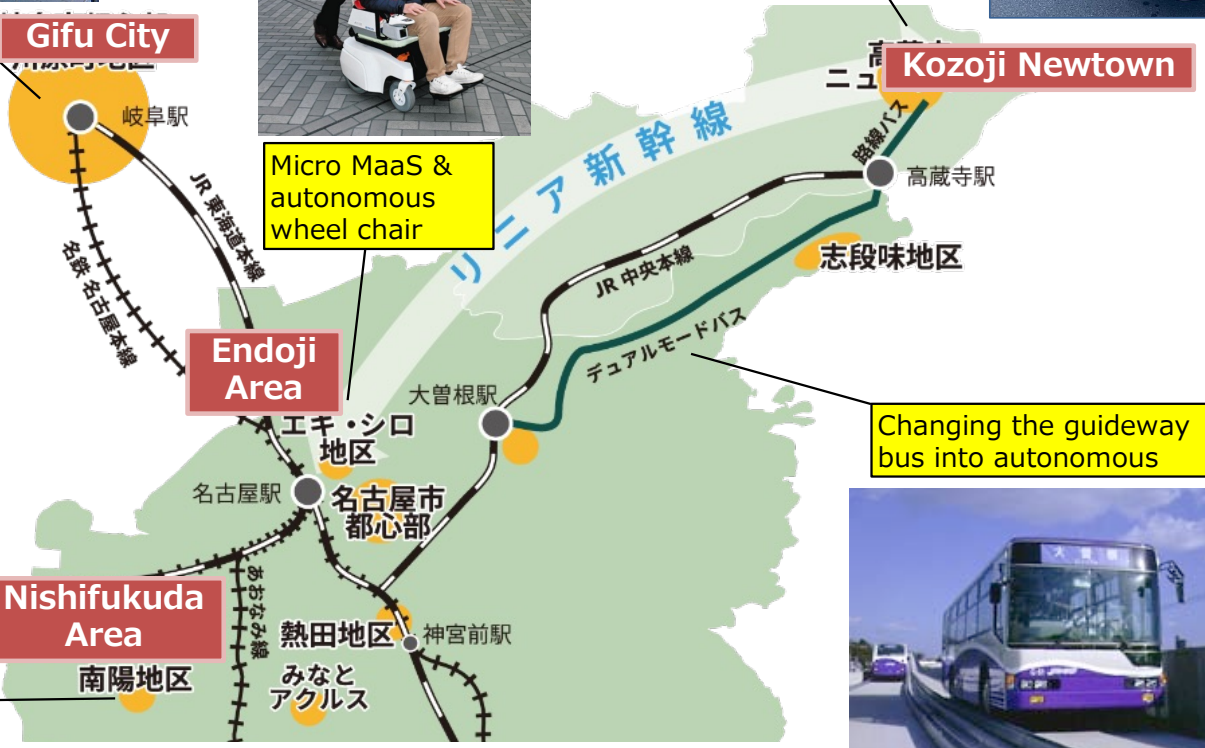
Autonomous bus

Micro MaaS & autonomous wheel chair

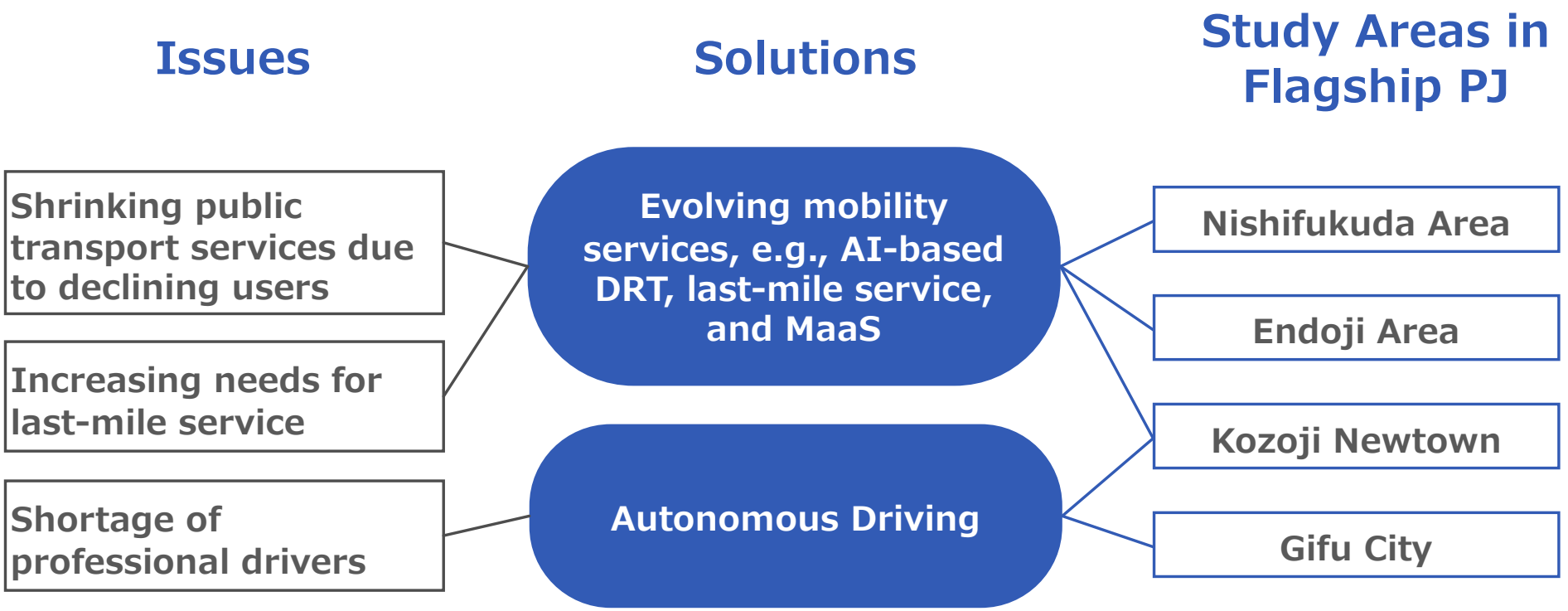
New business entity & faster autonomous car

Micro MaaS & shared DRT

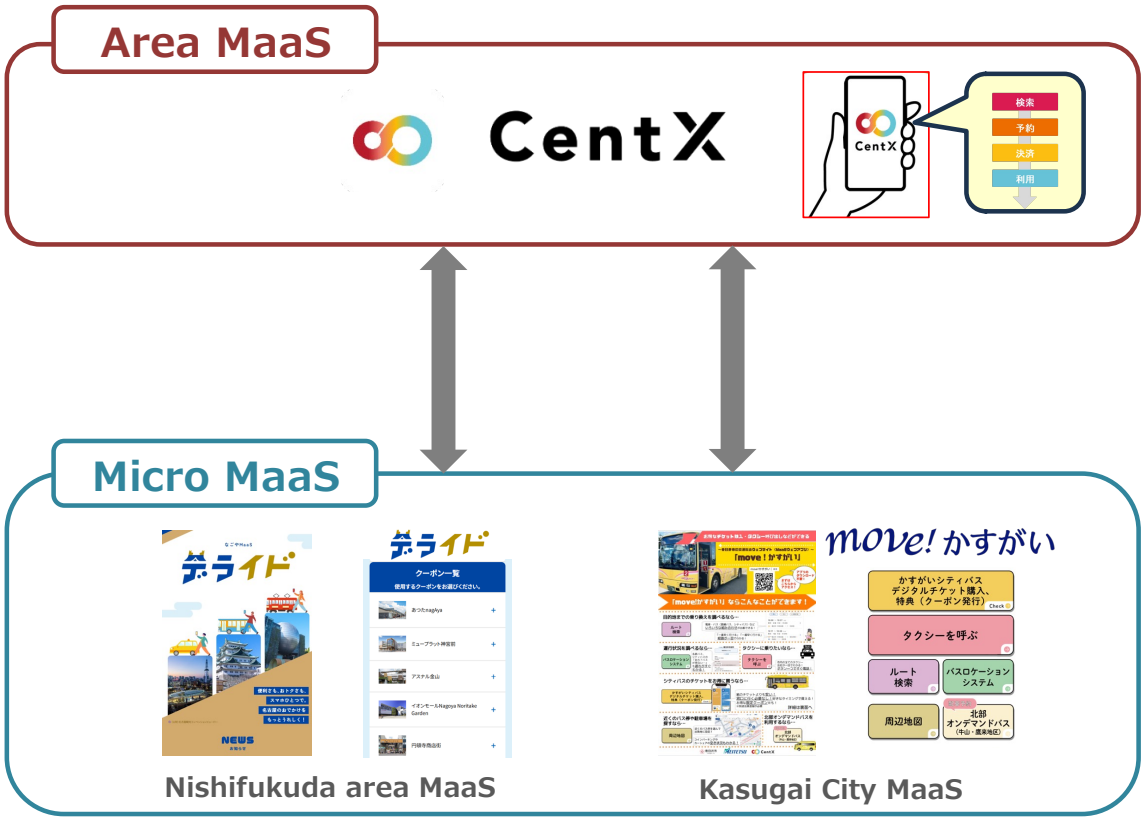
Changing the guideway bus into autonomous



AS in Test Fields



Double Layer MaaS



Covers whole metropolitan area

Includes payment function

Provided as a native application

Nagoya Railroad offers “CentX” in Nagoya Metropolitan Area

Covers a small district

Co-creates secondary transport services with residents and local businesses

Depends Area MaaS on payment function

Provided as a web application

Associates with “CentX” in Nagoya Metropolitan Area

Micro MaaS

◆Nishifukuda MaaS

- Mobility services such as AI-based DRT are cocreated by residents, transit operators, academia and municipality.

◆Kasugai MaaS

- Post-pay discount is applied by using multiple transport modes such as rail, bus, bike-sharing and car-sharing.
- QR-code is used for post-payment and discount.

Development of Faster AV than “Slocal”

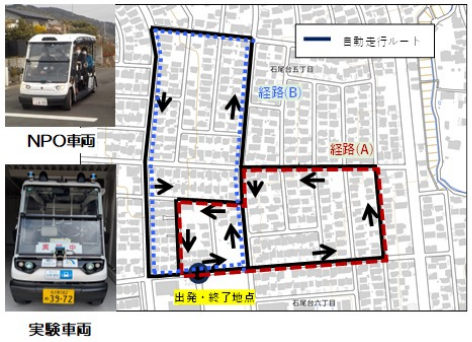
Convert ordinary passenger cars into autonomous.

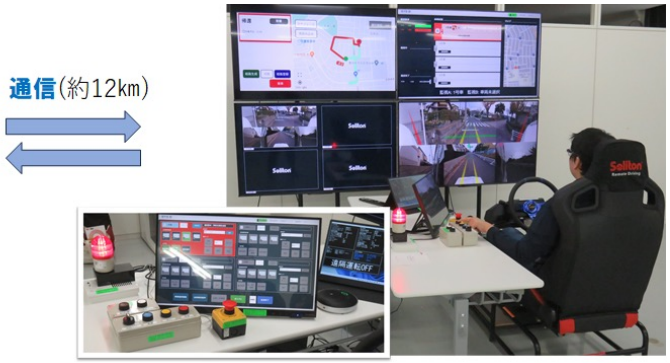
Minivan

Van

Remote Assistant System for L4

- Remote assistant system was developed to realize **no safety driver** operation
  - Remote operators manipulate **assistance buttons** when needed.
- The system was demonstrated for **the first time in Japan** in December 2024
  - A L2 AV at Kozoji Newtown was assisted by an operator located 12km away from the vehicle
  - **No assistance by the safety driver on board** was needed for the three-day demonstration.





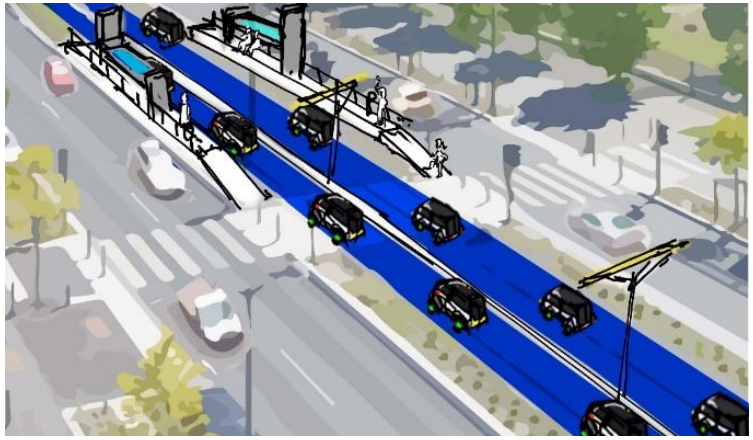
Technological IS: D2D-PRT

Door-to-Door Personal Rapid Transit (D2D-PRT):

① Small autonomous vehicles (2-4 seaters)

② Platooning on arterial roads

③ Slocal autonomous service on city streets



Platooned AV on arterial roads

Depot at terminal areas

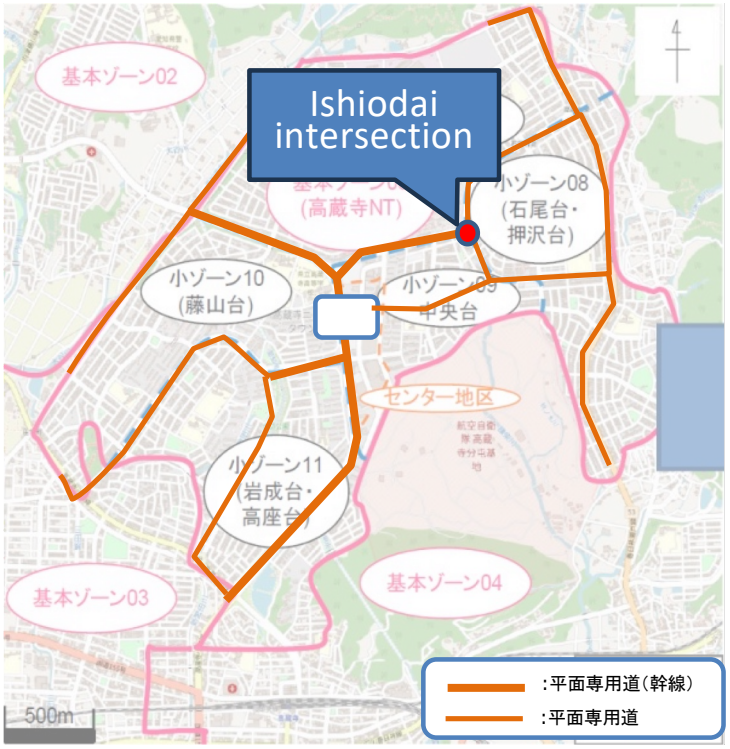
Simulation Study of D2D-PRT

Kozoji Newtown

Opened: 1971
Population: 40,000
Rate of aging: 40%
Public transport: Bus and Taxi

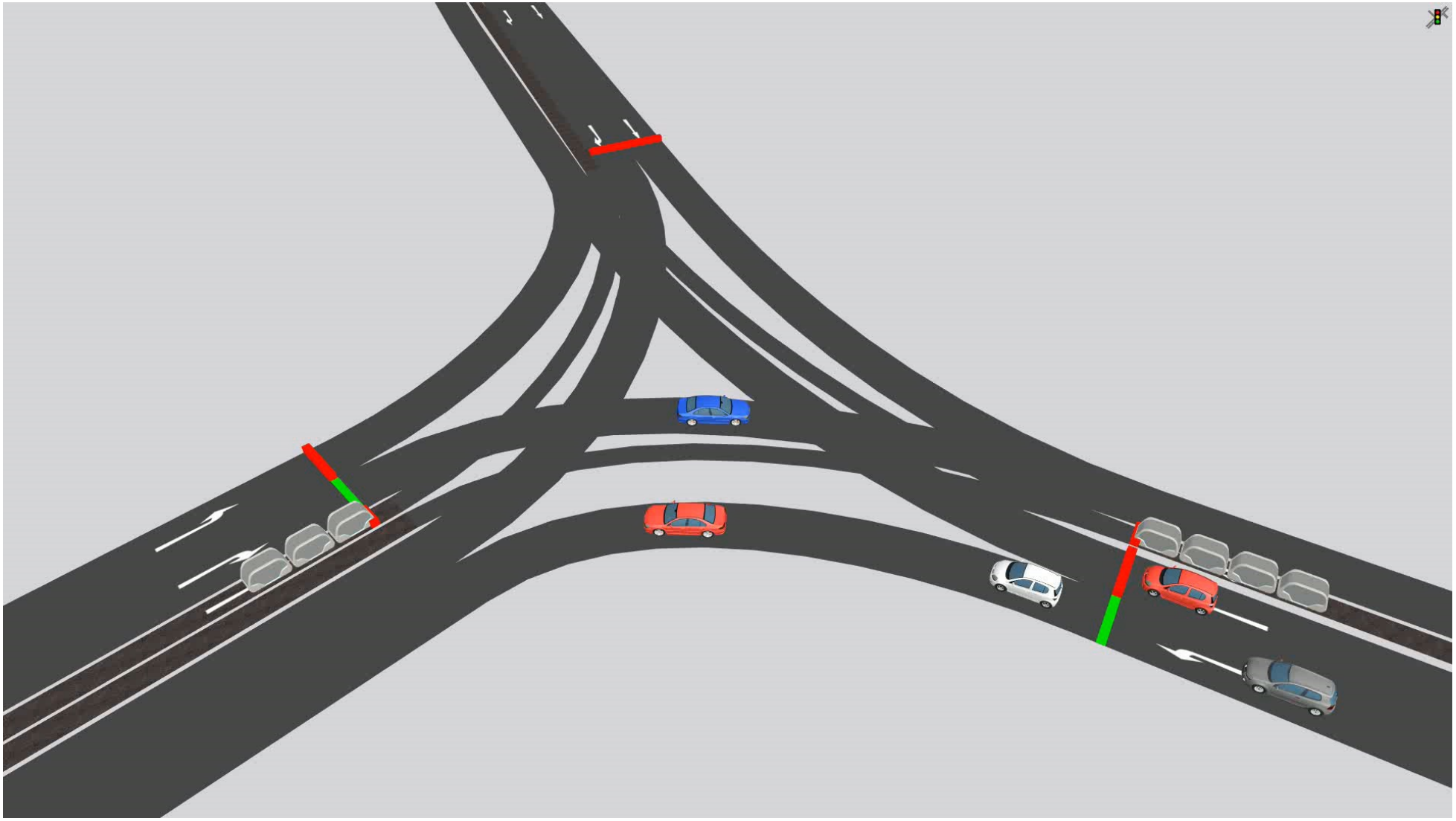
Simulation study of D2D-PRT introduced at Kozoji Newtown:

- Dedicated lane on trunk roads
- Required numbers of PRT vehicles: 95
- Traffic simulation at major intersections: following page



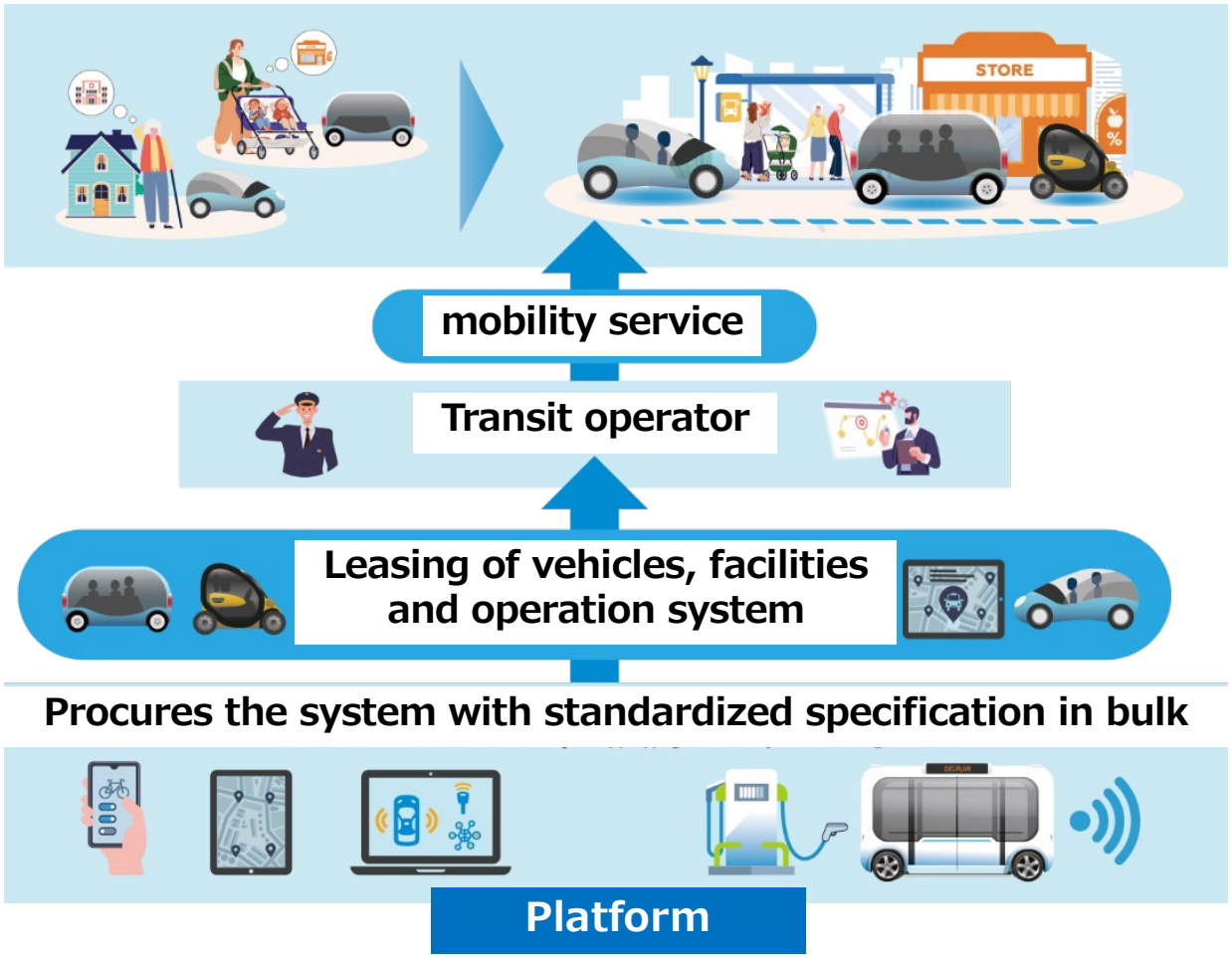
Proposed PRT Root at Kozoji Newtown

Traffic Simulation at Ishiodai Int.



Institutional IS: Public Goods PF

Public goods platform for smart local mobility



- Transit operators can procure **autonomous public transport system at lower cost**.
- **Maintenance** of the autonomous system is **performed by the platform**.
- Domestic manufactures and system engineering firms may enter the market more easily.

The first version of the proposal will be made public this month after three-year discussion by researchers.

Nagoya University SIP

Building Smart Districts Utilizing Advanced Mobility Systems

FY 2023 – FY 2027

Project Organization

MAKE NEW STANDARDS. 東海国立大学機構 | NAGOYA UNIVERSITY

collaboration

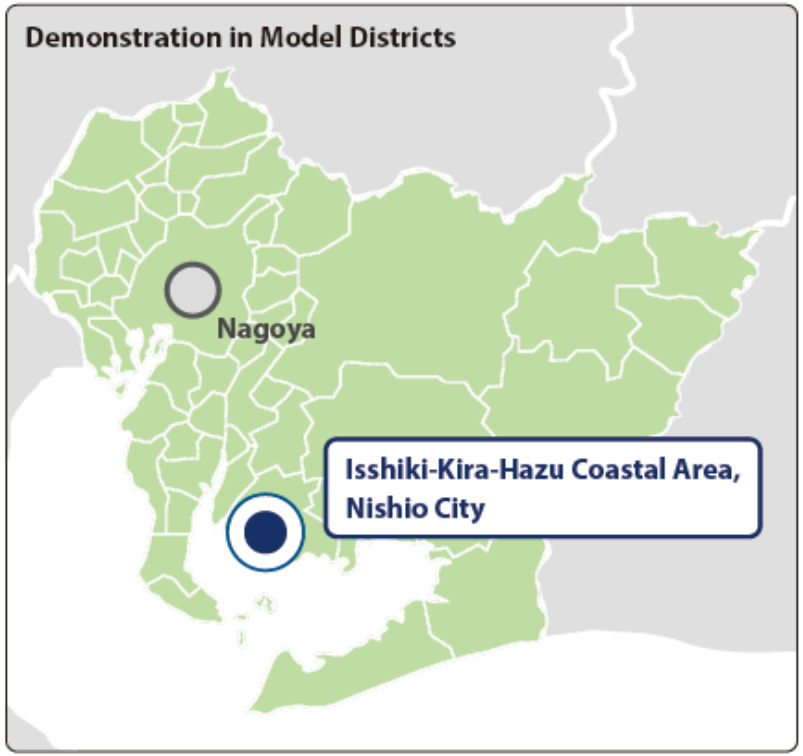
SIP Other SIP projects

collaboration
- Digital Twin ・ Urban OS Platforms
- Fields ・ Categorize ・ Horizontal Expand
- Social Acceptance of New Technologies

Project Themes

- Advancement of Local Mobility Services
- Social Systemization and Prototype Developmentof Automated Vehicles
- Development of Evaluation Tools for Urban Function Accessibility
- Promotion of International Collaboration

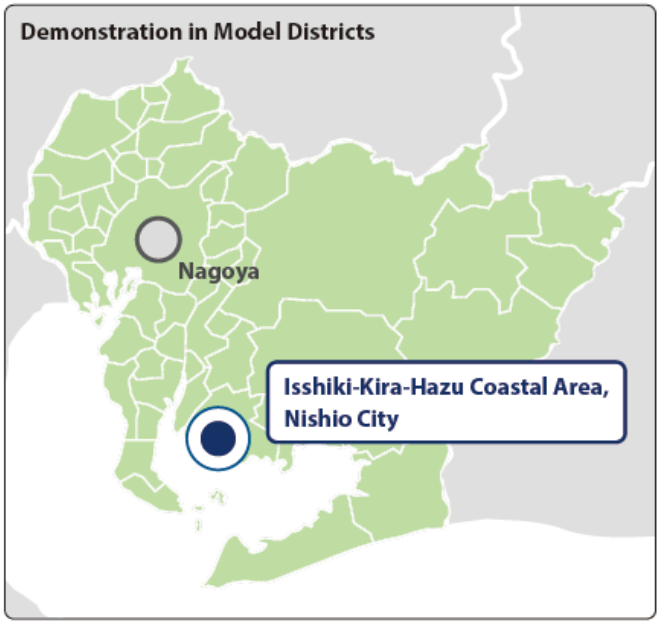
Demonstration in Model Districts

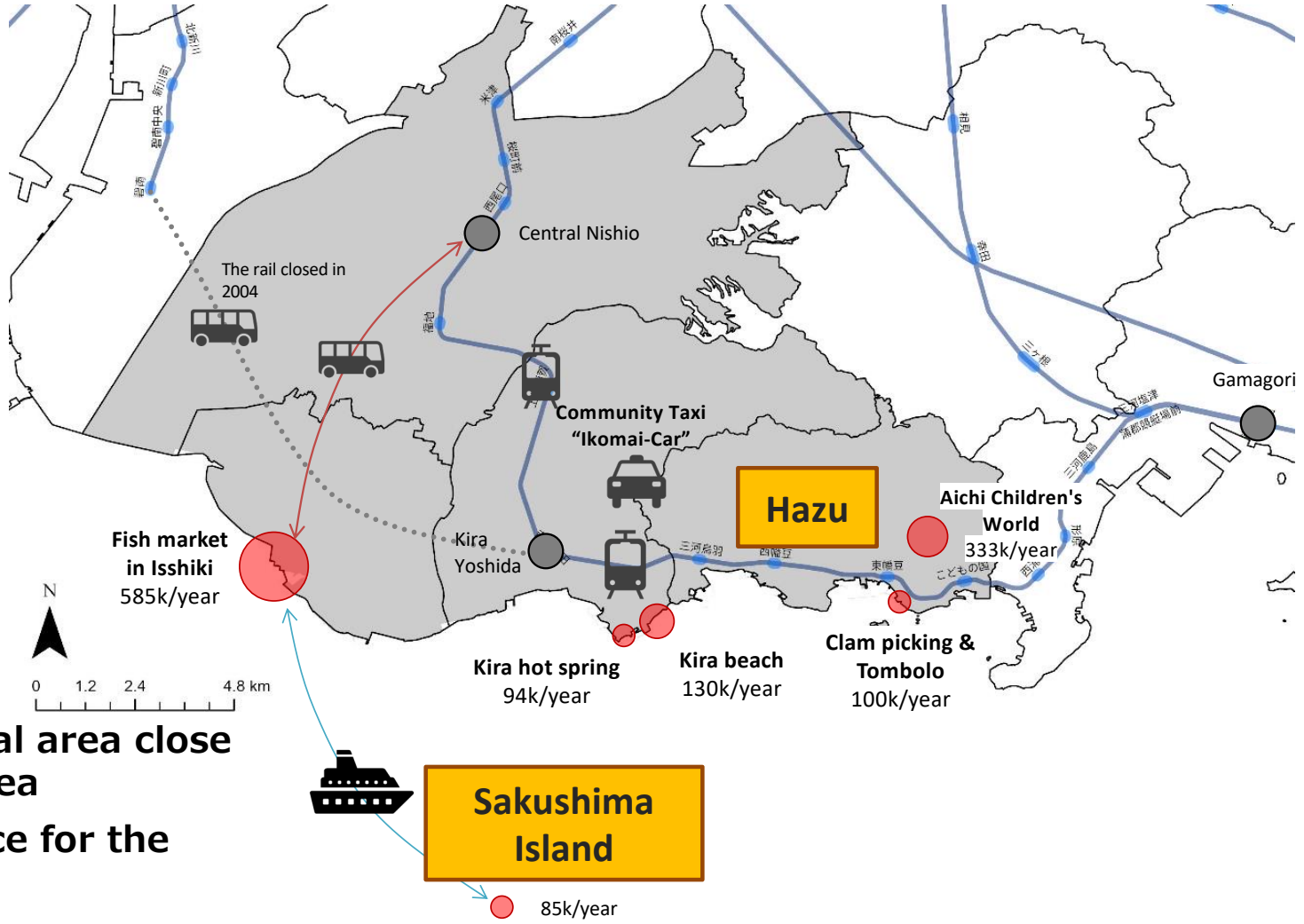


Research Focuses of NU SIP

- **Mobility hubs in rural areas**
  - Local mobility resources such as community taxi, shared-bike and automated distributors are gathered at the physical hub and also digitally combined by MaaS software.
- **Digital payment methods in rural areas**
  - Simple digitization of payment for those mobility resources.
- **Area's accessibility index "LIPT"**
  - Livability Index by Public Transport (LIPT) is proposed to assess the accessibility of areas.

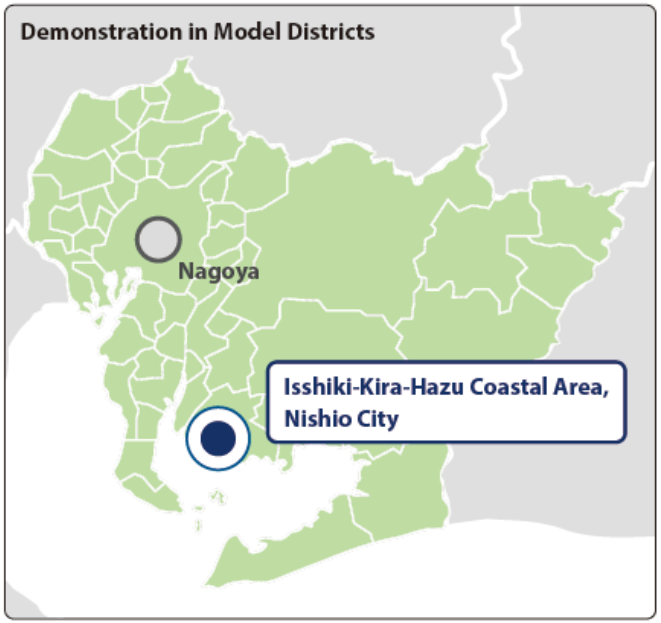
Transport Network in Isshiki-Kira-Hazu Area

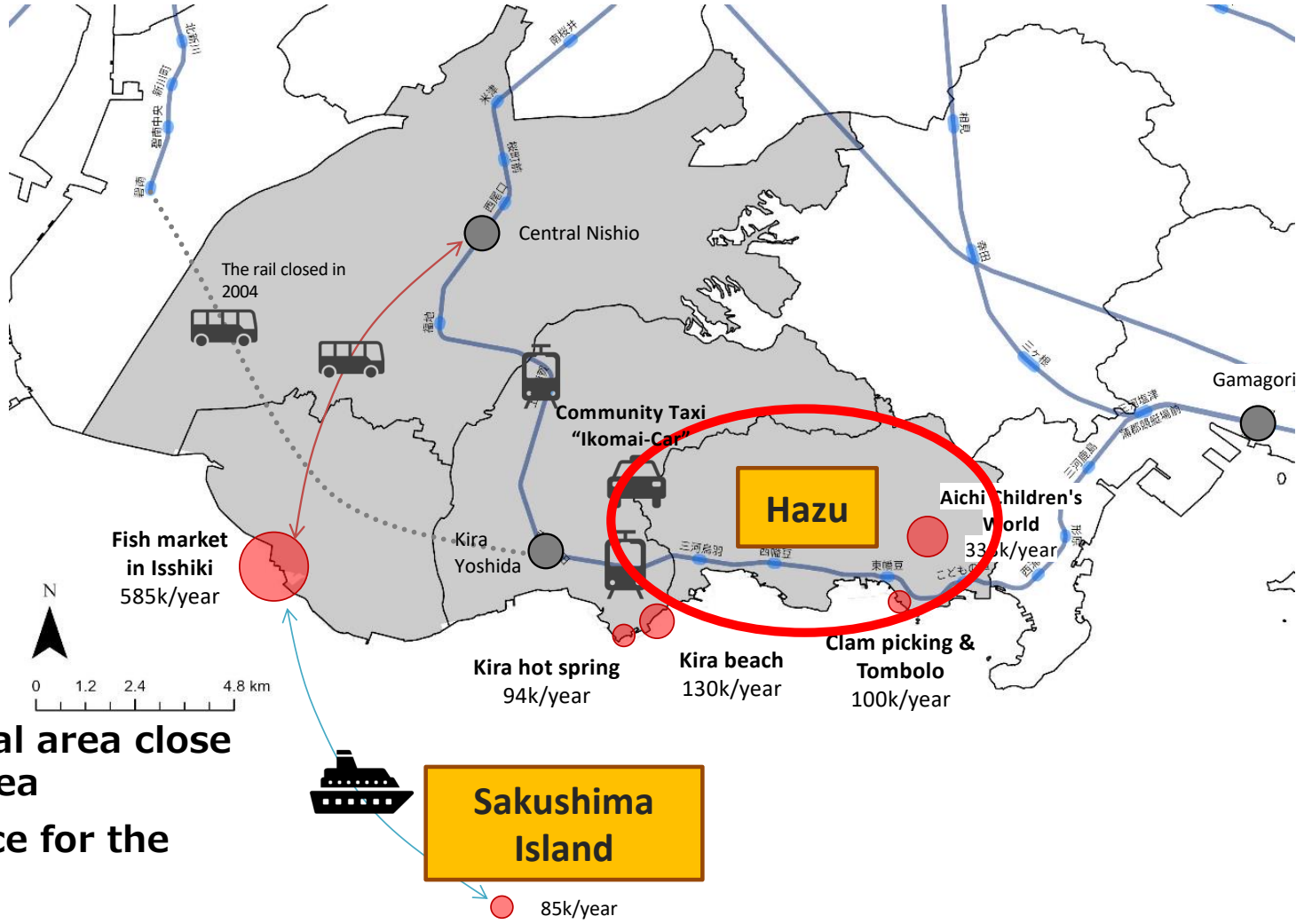




- **Residential and recreational area close to Nagoya Metropolitan Area**
- **Secondary transport service for the local rail is poor**
- **Car trips are dominant**

Transport Network in Isshiki-Kira-Hazu Area





- **Residential and recreational area close to Nagoya Metropolitan Area**
- **Secondary transport service for the local rail is poor**
- **Car trips are dominant**

Mobility Hubs at a Rail Station

モビリティ
Eステーション
Mobility E Station

Solar panels and batteries independent from the grid power supply

Community Taxi “Ikomai Car”

What is “Ikomai Car"?

- On-demand transport service for residents using taxi-cabs
- Fixed price access to designated locations (commercial facilities, medical institutions, public facilities, etc.) in the vicinity
- The municipality pays the difference from the actual fare

Improvement of “Ikomai Car”

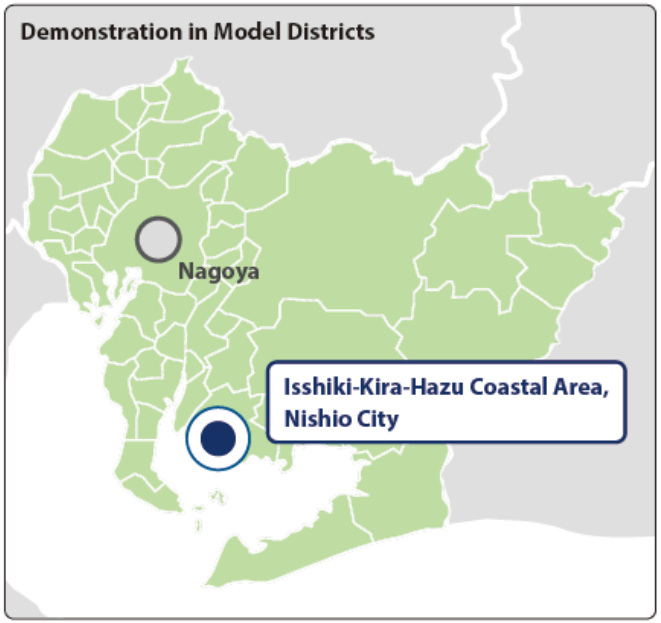
Issues

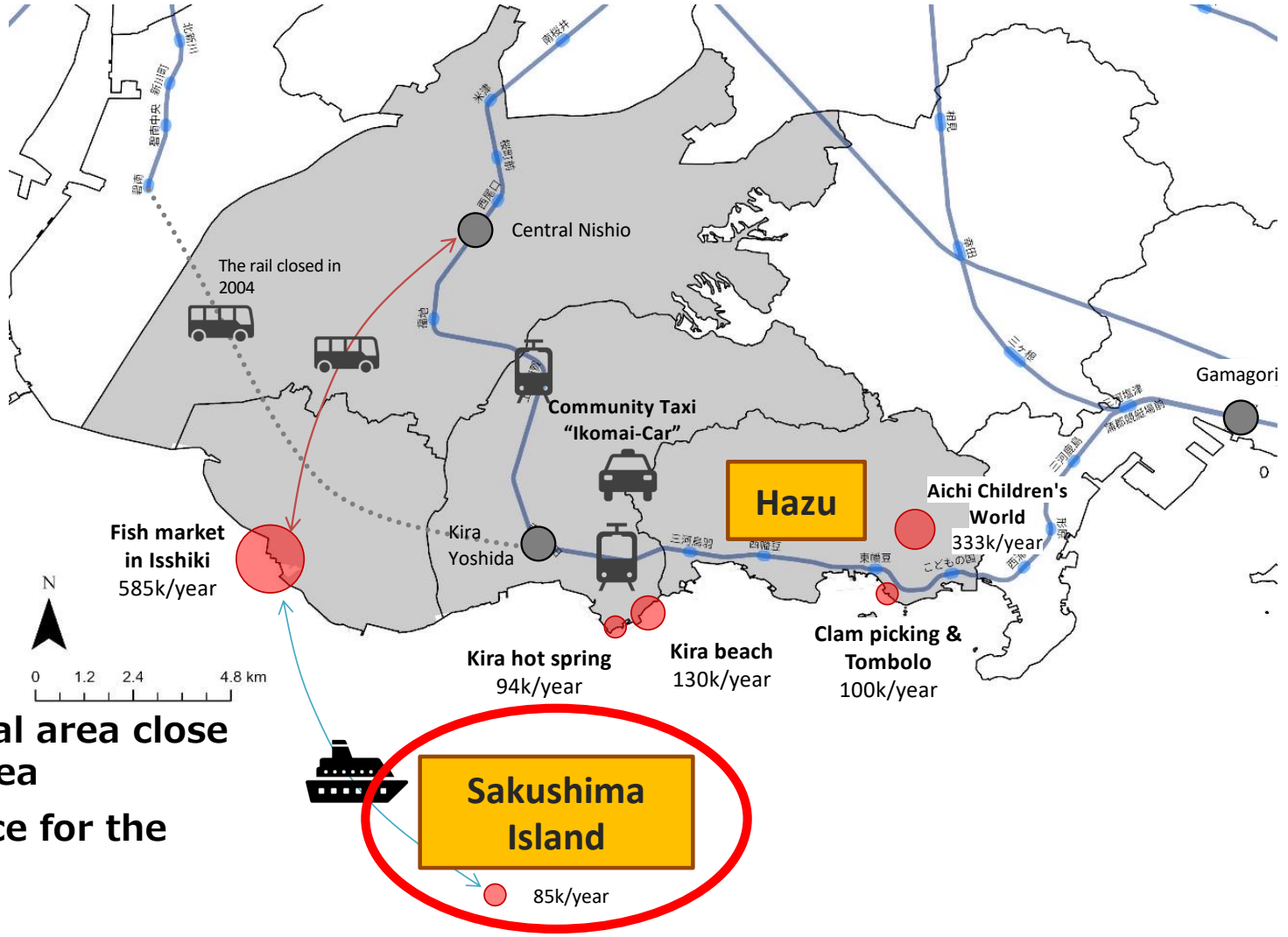
- Conventional reimbursement tickets were paper-based
  - Administrative burden of manually entering, calculating, and settling paper ticket information between taxi operators and the city
- No taxi office in the Hazu area that requires long distance dispatching

Improvement by the SIP Project

- Newly developed “Digitati" system for digitizing (QR-coding) settlement tickets
  - Significantly reduce the administrative burden of confirming users and settling usage amounts between operators and the government via paper tickets
- One taxi-cab waiting in front of the Hazu Mobility E Station
  - Respond immediately to vehicle dispatch requests from within the district.

Transport Network in Isshiki-Kira-Hazu Area





- **Residential and recreational area close to Nagoya Metropolitan Area**
- **Secondary transport service for the local rail is poor**
- **Car trips are dominant**

Sakushima Island

Improvement of Transport Service on a Remote Island

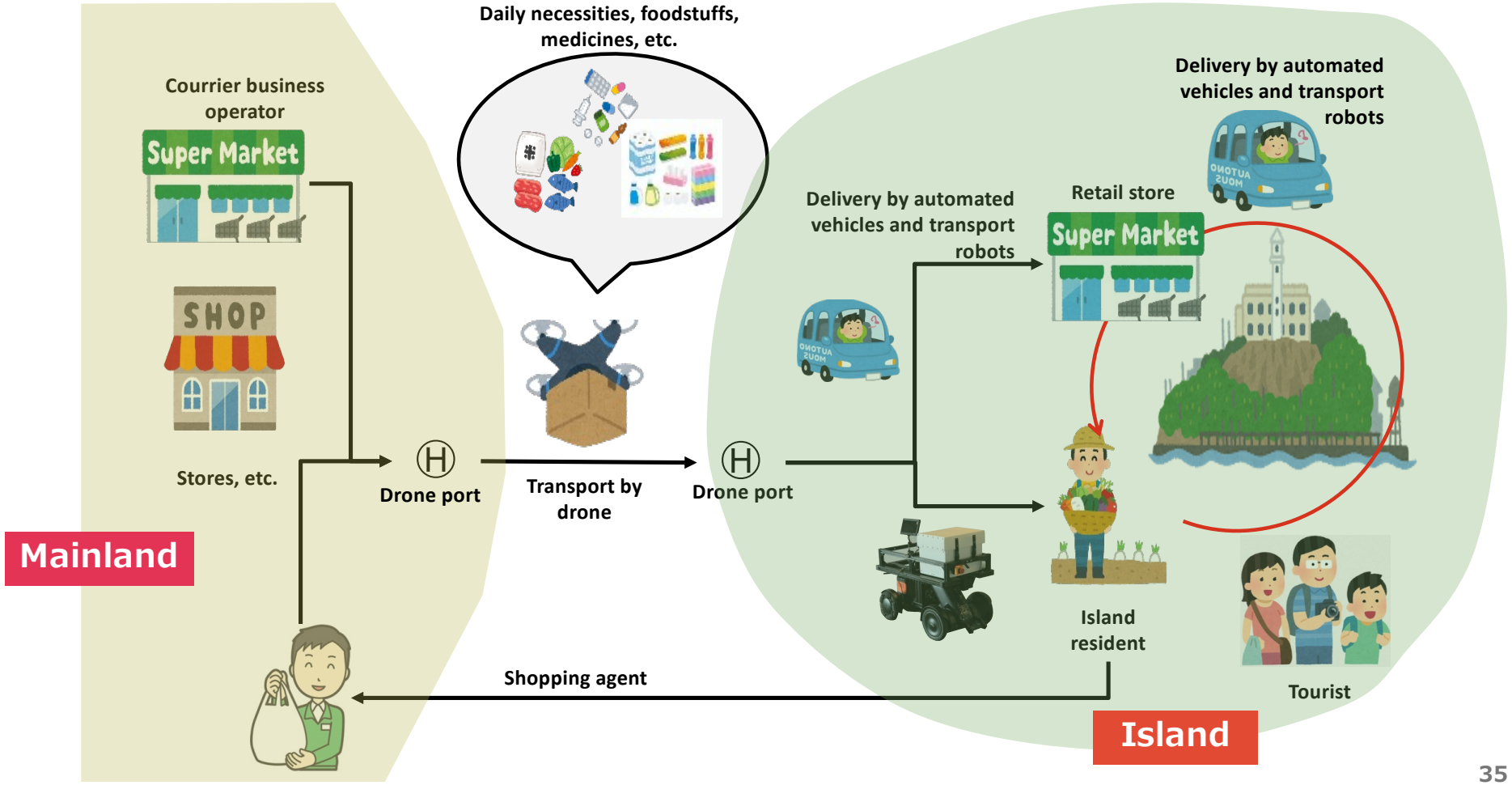
Sakushima Island

- Population 180
- 85,000 tourists/year
- Access by ferry from Isshiki Port (7 services/day, 20 minutes)
- No public transport exists on the island

Goods transport by drone and automated vehicles to deliver passengers and goods within the island

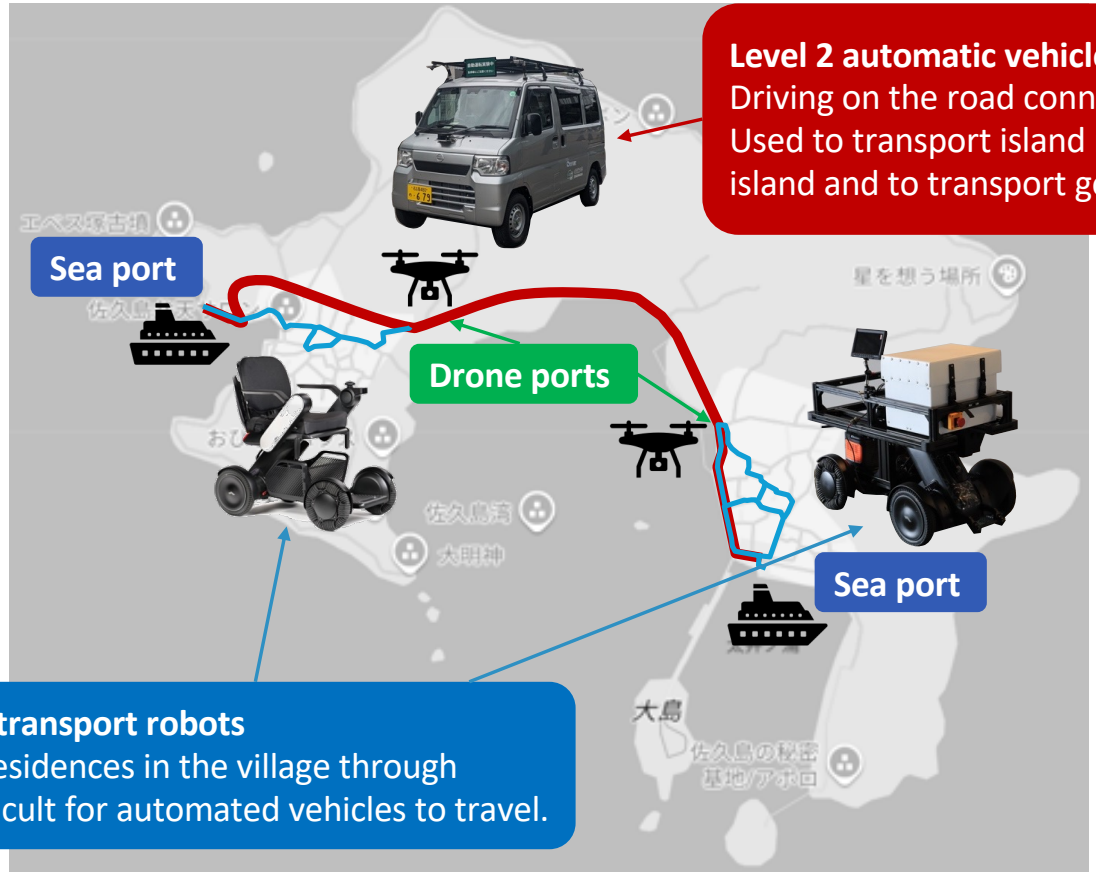
- One month pilot project combining mainland/island transport (ferry and drone) and intra-island automated transport
- Seek to form a mobility hub that connects various modes

Goods Delivery by Drone + Automated Vehicles



Goods Delivery by Drone + Automated Vehicles

- Between mainland and Sakushima: Ferry and Drone
- On the island: Delivery by a combination of automated vehicles



Level 2 automatic vehicle
Driving on the road connecting the two villages.
Used to transport island residents and tourists around the island and to transport goods.

Automated wheelchair and transport robots
Transport goods to private residences in the village through narrow roads where it is difficult for automated vehicles to travel.

Livability Index by Public Transport

London's PTAL

Public transport service frequency around assessment point

London's ATOS

Travel time to facilities by public transport

Our LIPT

Feasibility of a return trip to facilities by public transport

LiPT

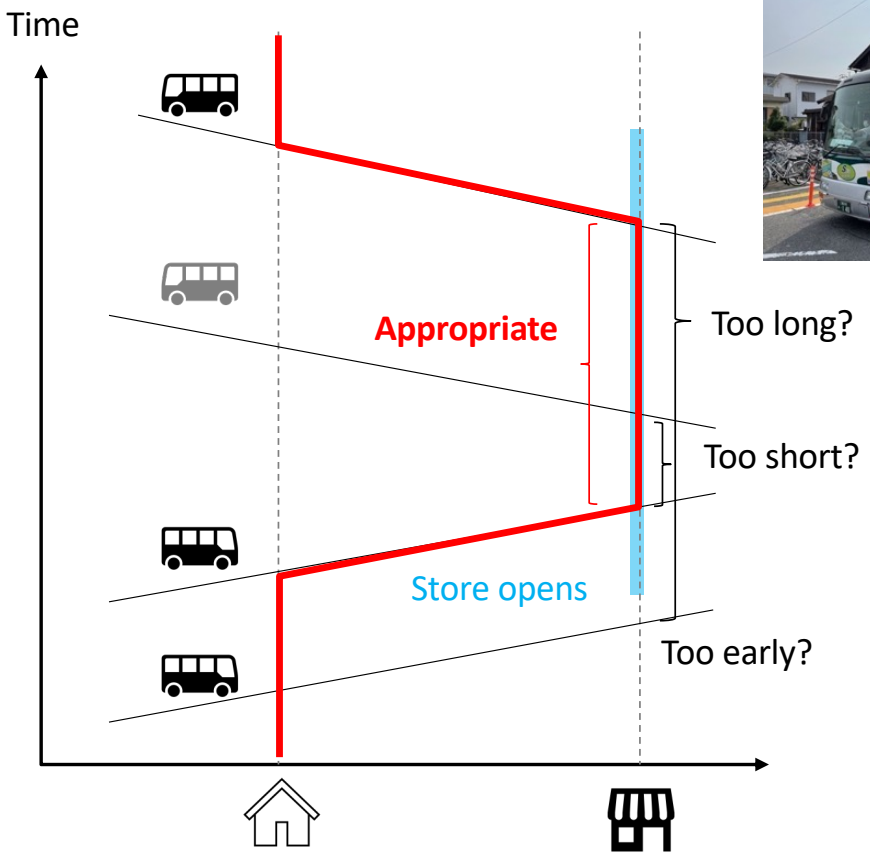
Livability Index by Public Transport

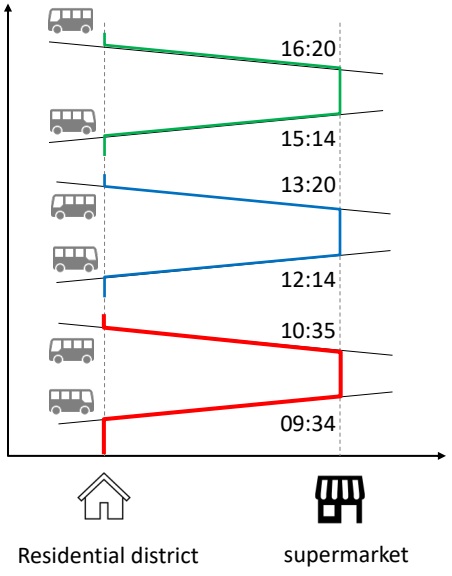
A simulator to assess accessibility of the spot using GTFS data

LIPT can assess the feasibility of making a return trip with reasonable activity time at the livability destinations, e.g., hospitals and shops.

Consideration of Appropriate Activity Duration

- Assess the possibility to **access, spend an appropriate time, and return** from the life faciolities



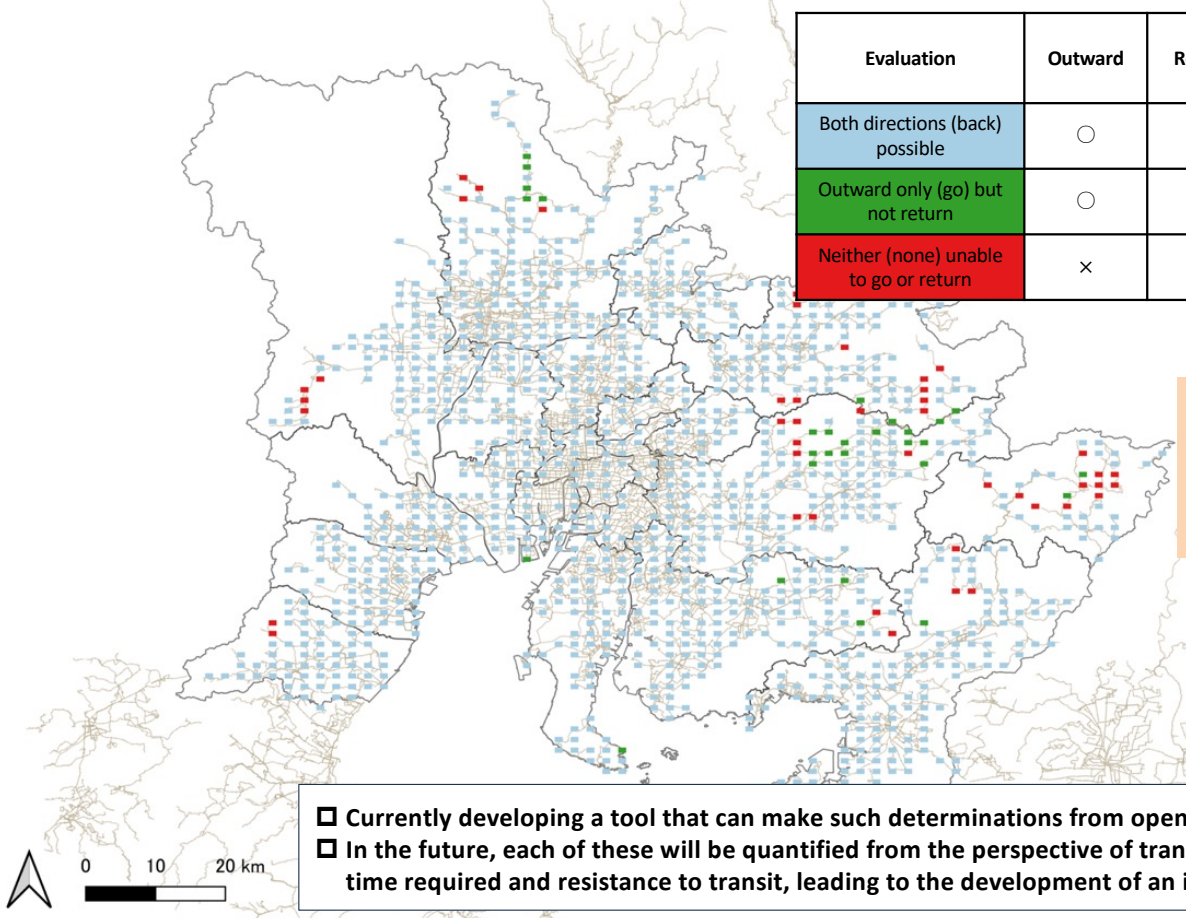


Trial Calculation for Shopping Activity

Feasibility of accessing a supermarket at around 10 AM by public transport, staying there for 50 mins, and returning with the current services

Evaluation	Outward	Return	All meshes (n=2403)	Within bus area (n=1292)
Both directions (back) possible	○	○	2139	1219
Outward only (go) but not return	○	×	112	29
Neither (none) unable to go or return	×	-	152	44

For bus stop coverage area, trip chain not feasible in 73 sites (5.7%), even when not vacant.



- **Currently developing a tool that can make such determinations from open data (Second LIPT-sim tool)**
- **In the future, each of these will be quantified from the perspective of transportation behavior, such as time required and resistance to transit, leading to the development of an indicator (LIPT index)**

Hayauchi et al,. (2025) “Towards a Livability Index by Public Transport (LIPT): Conceptual Framework and Tool Prototyping”, to be presented at CASPT and Transit Data

Thank you very much for your kind attention.