SIP
戦略的イノベーション創造プログラム

自動走行システム
SIP-adus Innovation of Automated Driving for Universal Services

2016 SIP-adus

Development of necessary function for ART information Center

Hitachi, Ltd.

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1. Advanced Rapid Transit (ART) concept

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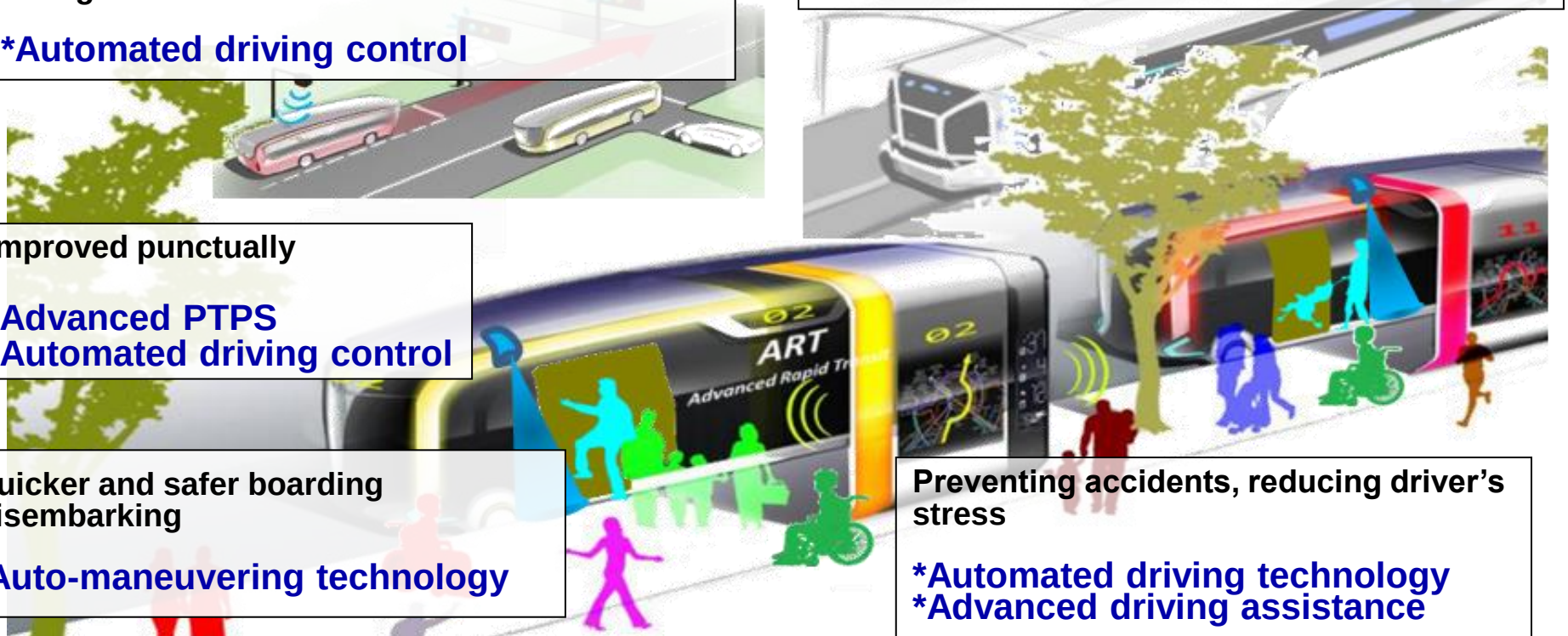
Smooth acceleration control technology with a level of precision suitable eve for Shinkansen bullet trains while preventing passengers from falling over

*Automated driving control

Seamless transit with minimal waiting time

*Organically integrated operation system



Improved punctually

*Advanced PTPS
*Automated driving control

Quicker and safer boarding Disembarking

*Auto-maneuvering technology

Preventing accidents, reducing driver's stress

*Automated driving technology
*Advanced driving assistance

Quicker boarding/disembarking, prevention of passenger injuries

*Wheelchair securing device
*Automated contactless fare collection

Traffic optimization, reducing traffic jams and CO2

*C-ACC
(Cooperative Adaptive Cruise Control)

Source : Cabinet Office, Government of Japan HP

2. Vision of ART Information Center

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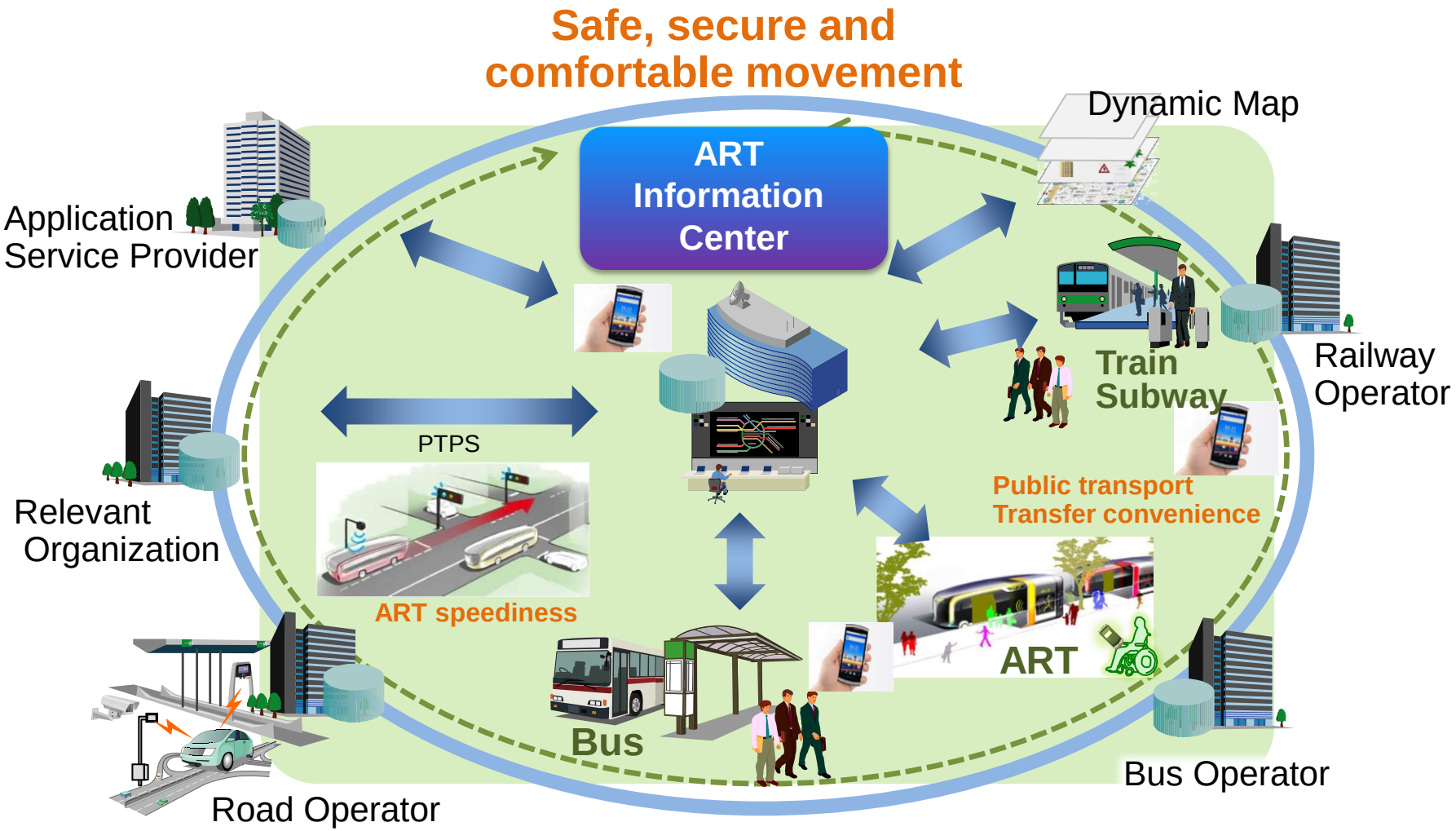
- ART Information Center provides traffic- related data for various utilization with open platform



3. Object and Project summary

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Objectives:

- Clarification of data contents which should be collected and shared
- Consideration about requirements of platform function and prototyping and feasibility studies of the platform

Project summary:

- Consideration about requirements of platform function and prototyping and feasibility studies of the platform
- Research/consideration/development about cooperation with external systems
- Research/consideration/development about utilizations of the ART sensor information

4. 1. Consideration about requirements of platform function and prototyping and feasibility studies of the platform

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Problem investigation

For Bus users
For Bus operators

Use-case study

(Extract)

viewpoint	purpose	Use-case	Contents
Passenger	Smooth moving	Transit guidance	Advanced transit guidance
	Convenience	Bus navigation	Destination announcement
		Information service	Bus congestion information
operator	Improvement of utilization	Passenger support	Wheelchair preparation
		Speediness	Cooperation with PTPS
	safe and secure	Monitoring inside Bus	Emergency detection

Consideration for necessary function of ART information center

- Iot infrastructure
- Data infrastructure
- Open data infrastructure
- APP developer supporting infrastructure
- Operation infrastructure

4. 2. ART information center function structure

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Third Party Apps

Advanced transit support | Bus Operation support | Bus Location system | Bus anomaly detection

..... more

APP developer supporting infrastructure

Software Parts

Tools, Server resource

Sensors

ART

Bus sensors
Cameras

Bus stop

Cameras
Wi-Fi

Gateway

IoT infrastructure

Data infrastructure

Business Intelligence

Service Functions

Data Base

Edit, Process

Data Lake

API

Open data infrastructure

Operation infrastructure

Operation management / Security

ART Information Center PF

External system

Traffic simulator

Transit guidance

Public Transportation

Navigation Service

5.1. Research/consideration/development about cooperation with external systems

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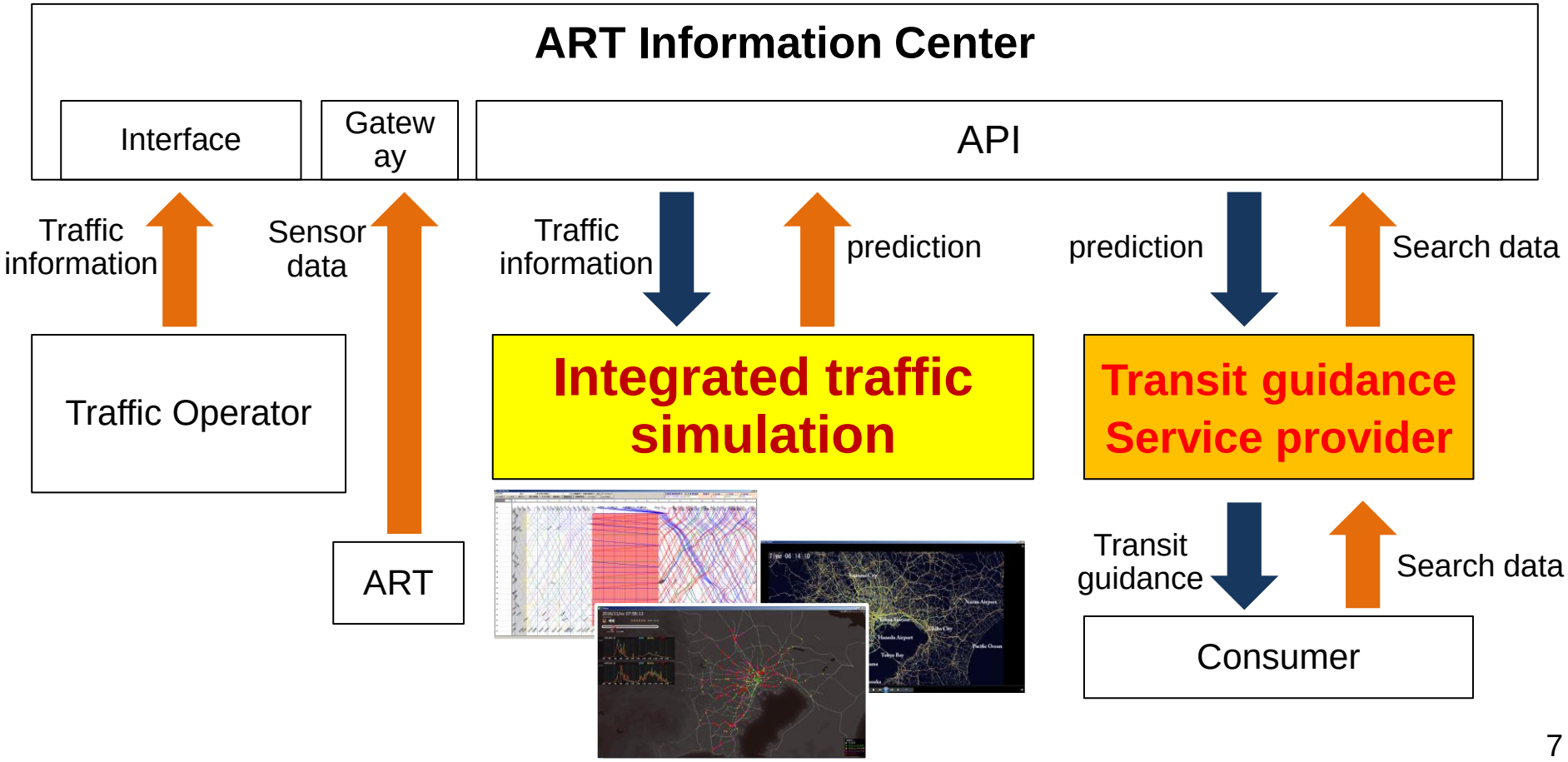
Transit guidance using traffic simulation technology

- **Input traffic simulation result to ART info. Center**
- **ART info. Center provide simulation result to transit guidance APP provider**



5. 2. Consideration of communication method between simulator and other system

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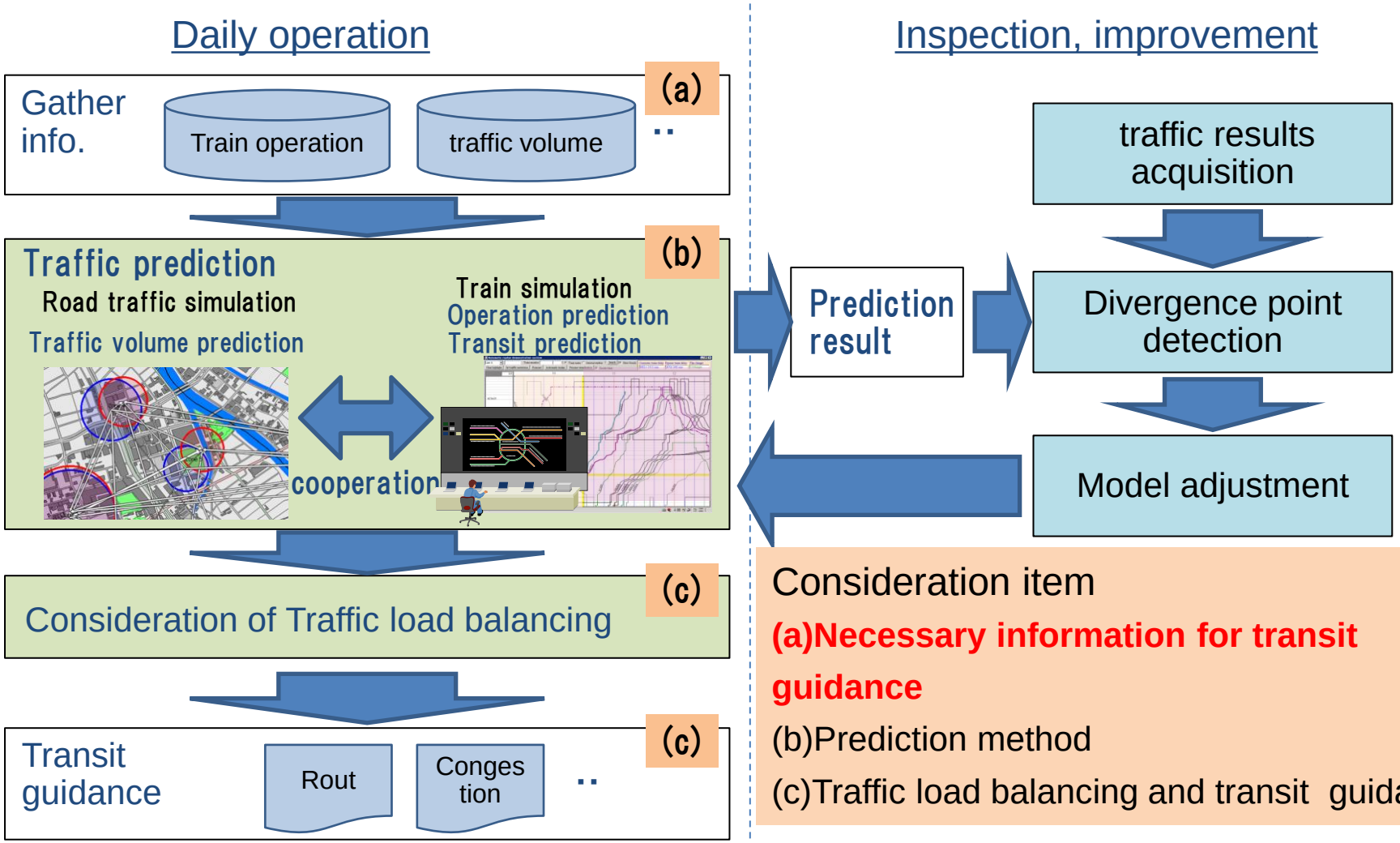
Gathering train operation data and road traffic information in real time.
Simulate and predict the point of congestion
Prediction result will be utilize for traffic load balancing and transit guidance



Consideration item

(a)Necessary information for transit guidance

(b)Prediction method

(c)Traffic load balancing and transit guidance

5. 3. Necessary information for Transit guidance

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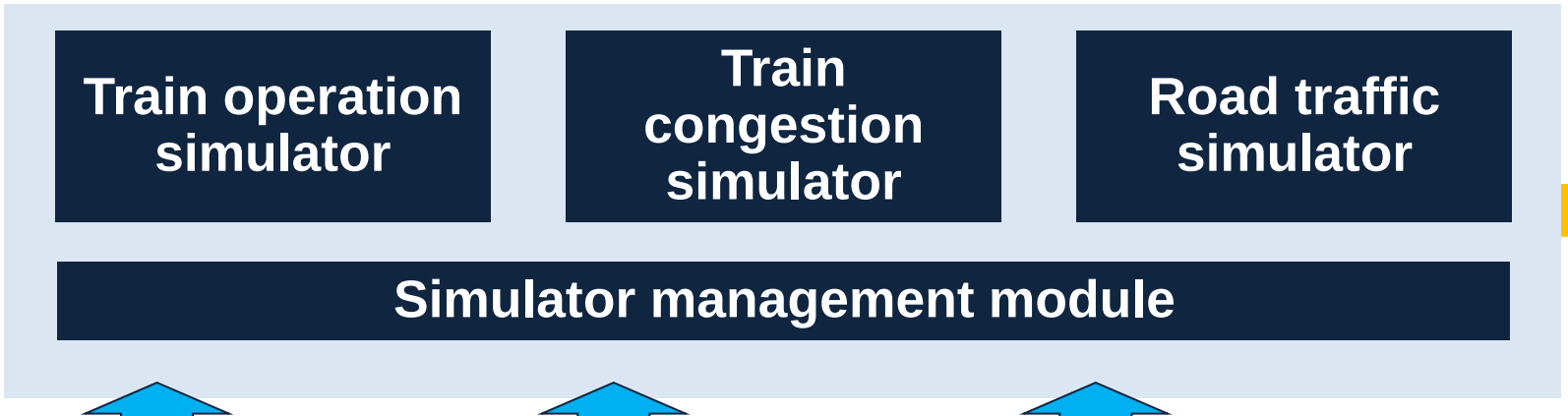
Integrated Traffic Simulation



Operation status
Delay
Speed control
Suspend section

Congestion status
Occupancy
Visitors

History data

Traffic demand
Trip information
Origin Destination
Route
Movement purpose

History data

Road traffic status
Link traffic volume
Travel time
Origin Destination
Speed limitation
Accident

ART information
Number of passengers
Waiting Passengers
Traffic volume

History data

Prediction
Train operation change
Road traffic change
Demand change

Traffic balancing
train/road

Guidance
Information
Timing

6. 1. Research/consideration/development about utilizations of the ART sensor information

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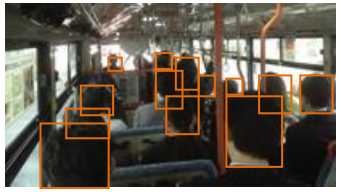
	Item	Use case	Bus sensor
1	Information service	**Bus congestion (Passenger counter)**	**Inside camera**
2		Wheelchair space confirmation	Inside camera Bus stop camera
3		Transit guidance	Bus GPS unit
4	Operation management	Detecting road side parking vehicle	Outside camera
5		Detecting road works	Outside camera
6	Safety management	Bus stop monitoring	Bus stop camera

FY16

Inside Camera

Passenger counter



Next step

Outside Camera

Detecting road side parking vehicle

Detecting road works

Bus-stop Camera

Bus stop monitoring

6. 2 Result of passenger counting by Image processing

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Item	Empty			Full		
Image of Bus inside						
The measurement target (Visual inspection average)	**0.0**	**2.0**	**3.0**	**8.3**	**10.3**	**10.7**
Measurement Result (Average)	**0.0**	**2.0**	**2.7**	**8.0**	**10.0**	**10.3**
Accuracy (standard deviation) (Target : Lower than 2)	**0.0**	**0.0**	**0.6**	**0.6**	**1.0**	**0.6**
Evaluation	N/A	**Good**				

Photograph by cooperation of Keisei bus Co., Ltd.

7. Conclusions

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1) Consideration about requirements of platform function and prototyping and feasibility studies of the platform

- Definition of functions of the platform
- Consideration of requirements about basic functions

2) Research/consideration/development about cooperation with external systems

- Consideration of required information for transit guidance
- Consideration of feasibilities of those transit guidance

3) Considerations of Bus sensors utilization

- Research and analyze about types of sensors
- Consideration of utilization of collected information from those sensors

Next Plan **Proof of Concept (FY17-18)**

- **Verification on the speediness of ART by Advanced PTPS**
- **Verification on the effectiveness of Pedestrian Transfer support system**