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OCTOBER 1 - 6, 2023

IRSC 20

INTERNATIONAL RAILWAY SAF  
"Recharging railway  
CAPE TOWN, O



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**East Japan Railway Union (JREU)**

IRSC2023

**With the prospect of a safe operation in mind, how to aim for driver-only and driverless operation considering real workplace conditions**

**JREU National Office**

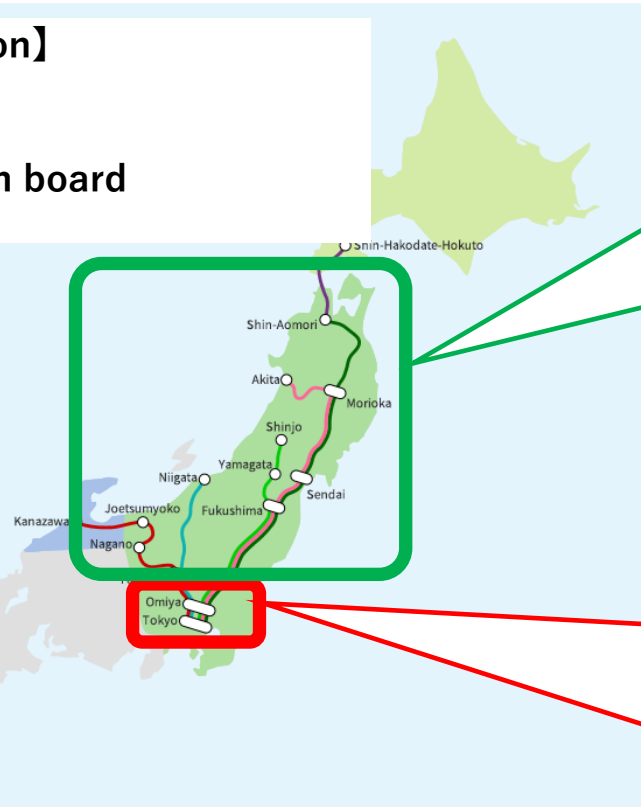
# 1. Driver-only operation

○JR East announced that driver-only operation in the Tokyo metropolitan area (limited lines) will be introduced around 2025-2030

**【Driver-only operation】**

No conductor

Only driver will be on board



Driver-only operation is common on regional routes (1-6 cars)



Driver-only operation in the Tokyo metropolitan area will be introduced (mainly over 7 cars)



Yamanote

Keihin-Tohoku  
Negishi

Nambu

Yokohama

Joban

**First driver-only operation in Tokyo for JR East**

# 1. Driver-only operation

## ○ Necessary equipment for long driver-only trains

Camera to check passengers getting on & off

Platform doors



Command room – in trains calling function

Monitor screen to check passengers getting on & off





ATO (Automatic Train Operation Equipment)

Long driver-only trains (up to 10 cars) have a proven track record on other companies' lines  
▶ If well equipped, it is possible to do a driver-only operation with 15 cars.




# 2. Driverless operation

【Driverless operation】

Crew who is not qualified to drive will be on board, but the driver will not be on board.

| Autonomous driving level<br>(IEC62267)      | Image of the crew form  | Current status in Japan                                       |
|---|---|---|
| <b>GoA4</b><br>Autonomous driving           | No crew<br>  | Some new transportation systems<br>(Yurikamome, etc.)         |
| <b>GoA3</b><br>Autonomous driving with crew | Crew: Evacuation guidance<br>(Crew is on the train, but the frontal cab is unmanned)<br>(Crew does not have a train driver's license.)<br> | Some monorails (Disney Resort Line)<br>→ "Driverless driving" |







Between GoA2 (Driver-only driving) and GoA3 (Driverless driving)  
There is a technical gap

|  |  |  |
|--|--|--|
| <b>GoA2</b><br>Semi-autonomous driving | Driver: Driving + evacuation guidance<br>(Mainly autonomous driving by ATO)<br>(The conductor is often not on board.)<br>        | Lines with almost no level crossings<br>(Subway, etc.)<br>→ "Long driver-only driving" |
| <b>GoA1</b><br>Non-autonomous driving  | Conductor: Evacuation guidance<br>Driver: Driving maneuver<br>(Manual operation under the restrictions of security devices)<br> | Lines with level crossings (many JR lines)   |
| <b>GoA0</b><br>Visual driving          | Conductor: Evacuation guidance<br>Driver: Driving maneuver<br>(Manual operation with only the driver's attention)<br>           | Streetcars   |

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| <b>GoA2.5</b><br>Automated driving with attendant to<br>perform emergency stop operations, etc. | Crew : Emergency stop operation<br>+ Evacuation guidance<br>(Crew performs emergency stop<br>operation in the driver's cab)<br>(Crew does not have a train driver's license.)<br> | No case studies (compiled by the Ministry<br>of Land, Infrastructure, Transport and<br>Tourism)<br>→ JR East's immediate goals<br>"Driverless driving" |
| <b>GoA2</b><br>Semi-autonomous driving  | Driver: Driving + evacuation guidance<br>(Mainly autonomous driving by ATO)<br>(The conductor is often not on board.)<br>  | Lines with almost no level crossings<br>(subway, etc.)<br>→ "Long one-man operation"   |
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# 2. Driverless operation

## ○ Division of roles between humans and machines

|  | GoA1<br>(Non-autonomous driving) | GoA2.5<br>(Autonomous driving with attendant to perform emergency stop operation, etc.) | GoA3<br>(Driverless driving) |
|--|----------------------------------|---|------------------------------|
| Keeping platform safe                            | Conductor                        | Platform doors  | Platform doors               |
| Checking the time                                | Conductor                        | Crew  | ATO                          |
| Departure operation                              | Driver                           | Crew  | ATO                          |
| Acceleration/Deceleration                        | Driver                           | ATO   | ATO                          |
| Stop the train                                   | Driver                           | ATO   | ATO                          |
| Checking Signal and Speed Limits                 | Driver                           | ATO   | ATO                          |
| Prevention of signal profanity and over speeding | ATS · ATC                        | ATC   | ATC                          |
| Forward safety check                             | Driver                           | Crew  | Monitoring camera            |
| Evacuation guidance                              | Conductor<br>Driver              | Crew  | Crew                         |

ATO takes on the role of driver and autonomously operates within ATC speed limits



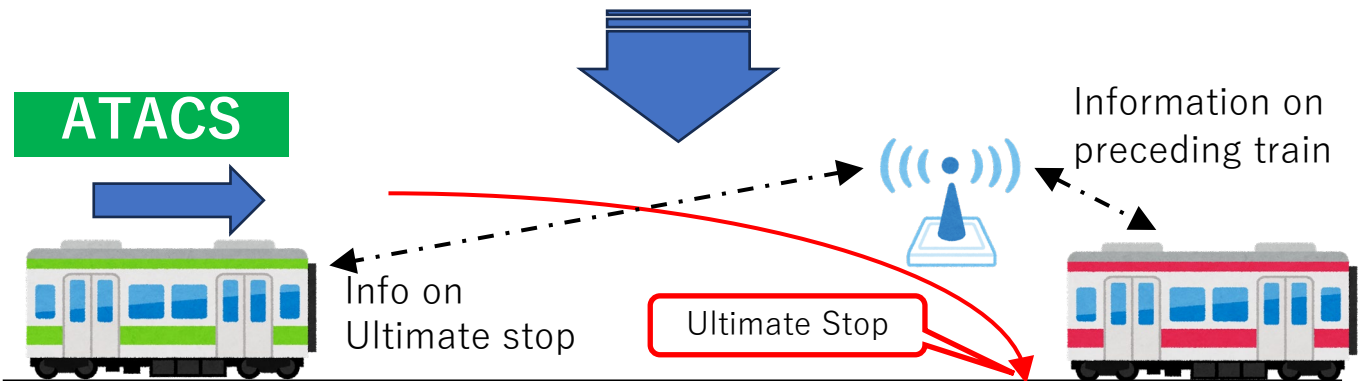
# 2. Driverless Operation

## ○ Preparing for the introduction of ATO

【Conventional Lines】 Promote the introduction of wireless train control systems (ATACS)



- Since the speed is limited in "block system", detailed speed control is not possible.
- Requires enormous ground equipment such as track circuits and traffic lights.



- Detailed and continuous speed control according to the "distance to the preceding train" is possible.
- Since it is communicated wirelessly, ground equipment can be greatly reduced.

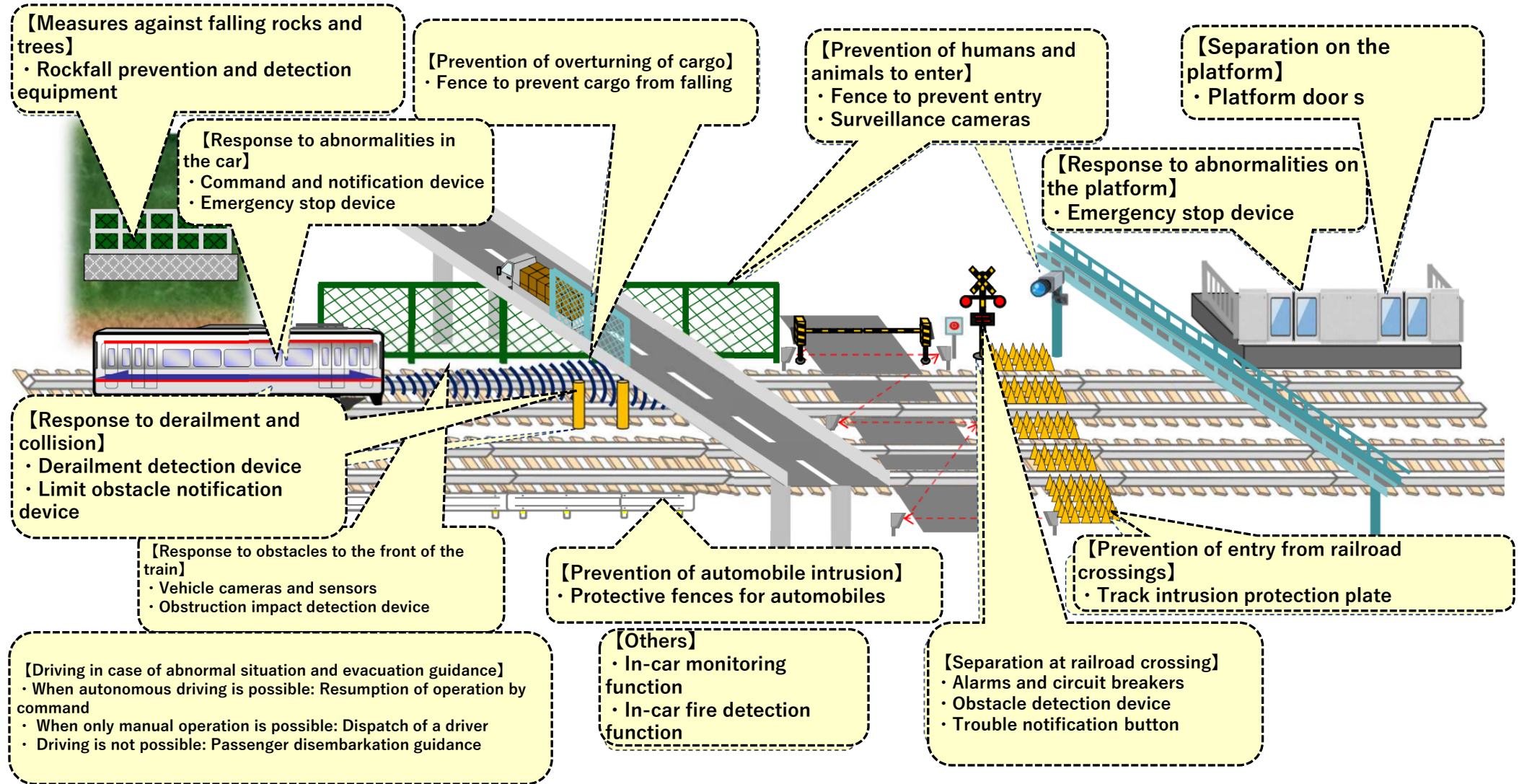
【Shinkansen】 Autonomous Driving Test using a not-in-service train



- Temporary ATO installed on Shinkansen cars and automatically ran between stations and depots

# 2. Driverless operation

○ The issue is "response in case of emergency", especially "isolating the incident from the surrounding environment"



# 2. Driverless driving

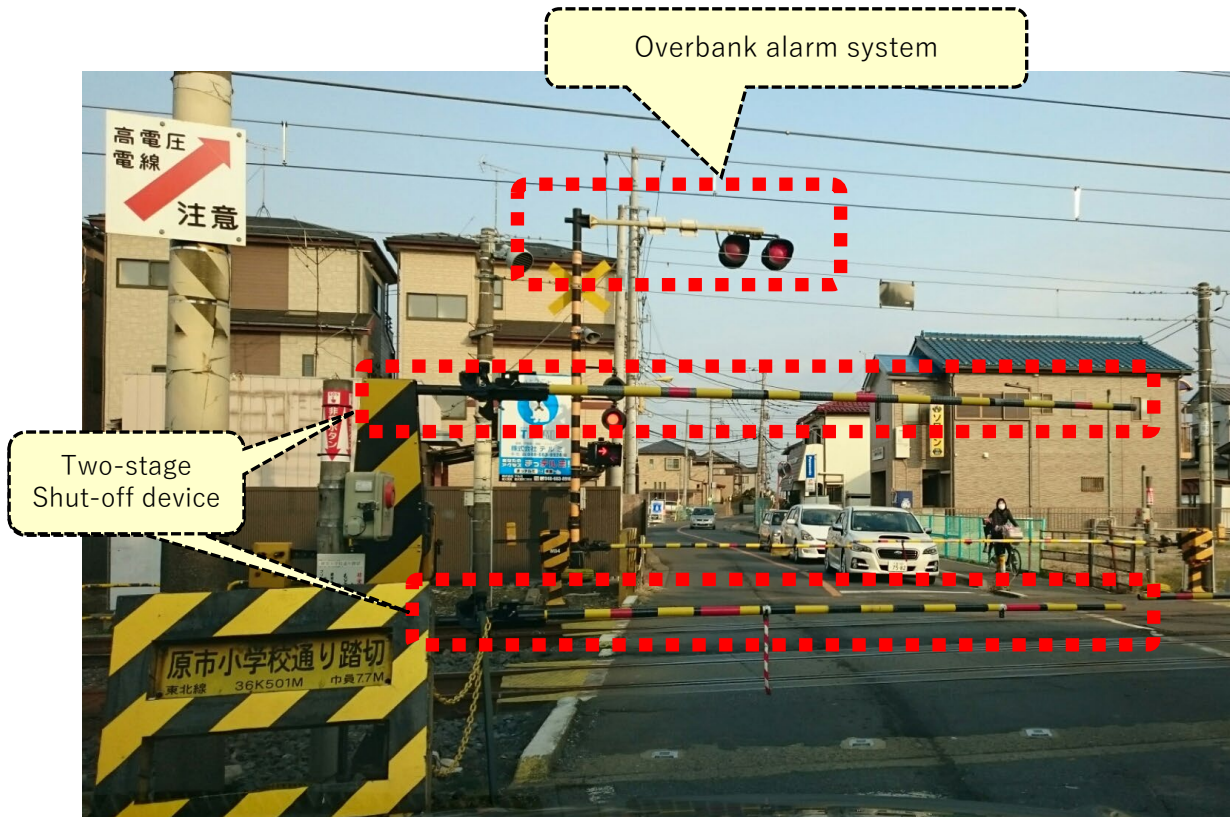
The issue is "response in case of emergency", especially "isolating the incident from the surrounding environment"

| Index                                      | Specific measures                           |
|--|---|
| Prevention of entry: people and animals    | Entry barrier                               |
|  | surveillance camera                         |
| Separation on the platform                 | Platform doors                              |
| Response to abnormalities on the platform  | Emergency stop device                       |
| Prevention of entry from railway crossings | Road intrusion guards                       |
| Separation at level crossings              | Alarms and circuit breakers                 |
|  | Obstacle detection device                   |
|  | Trouble notification button                 |
| Vehicle intrusion prevention               | Automotive protective fence                 |
| Prevention of overturning of cargo         | Cargo fall prevention fence                 |
| Measures against falling rocks and trees   | Rockfall prevention and detection equipment |

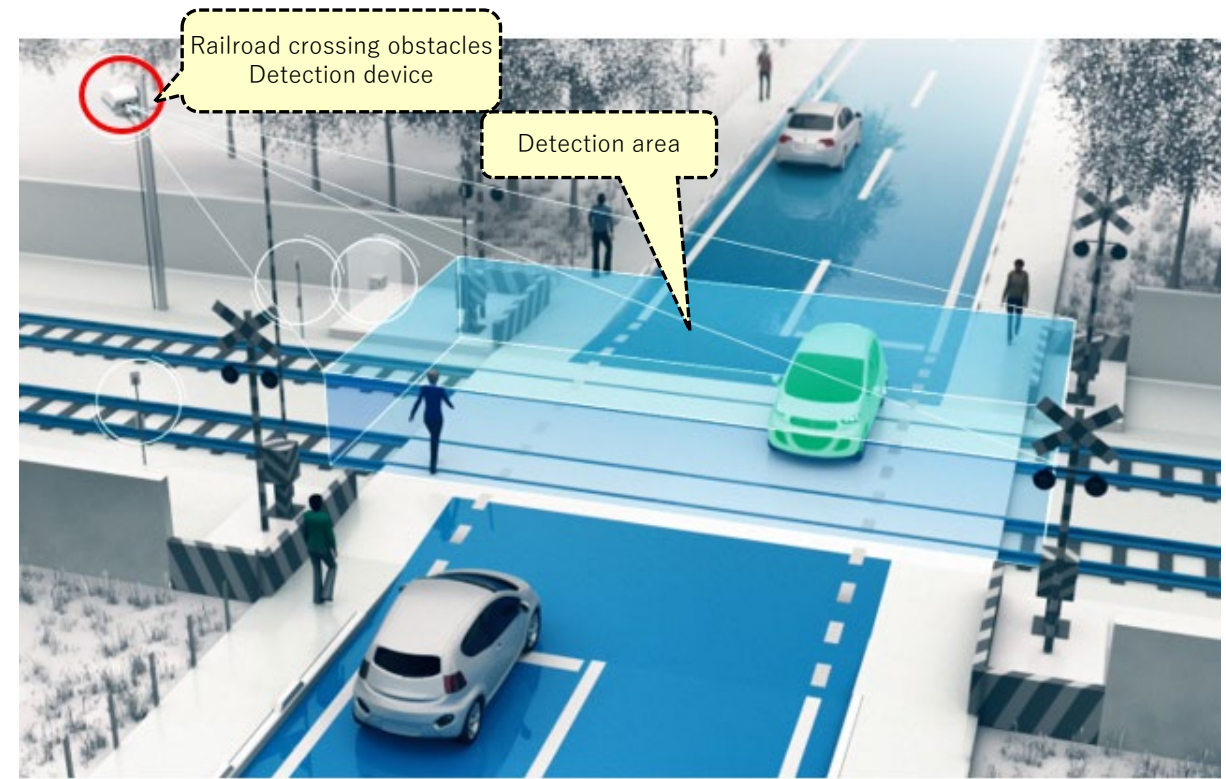
| Index  | Specific measures   |
|--|---|
| Derailment and collision correspondence            | Derailment detection device   |
|  | Device for clearance disorder alarm                                     |
| Obstruction in front of the train<br>Responding to | Vehicle Cameras & Sensors   |
|  | Obstruction impact detection device                                     |
| Response to abnormalities in the car               | Command and notification device   |
|  | Emergency stop device   |
| other  | In-car monitoring function  |
|  | In-car fire detection function  |
| Abnormal driving, Evacuation guidance              | When autonomous driving is possible: Resumption of operation by command |
|  | When only manual operation is possible: Dispatch of a driver            |
|  | Driving is not possible: Passenger disembarkation guidance              |

# 2. Driverless driving

The issue is "response in case of emergency", especially "isolating the incident from the surrounding environment"



Collision countermeasures with large vehicles



Countermeasures against impacts with automobiles and pedestrians

## 2. Driverless driving

- First, introducing driverless driving on "routes without level crossings"  
Then, introducing even on "lines with level crossings"?



The only level crossing on the JR Yamanote Line will be abolished in 10 years,

Which making it easier to introduce driverless driving



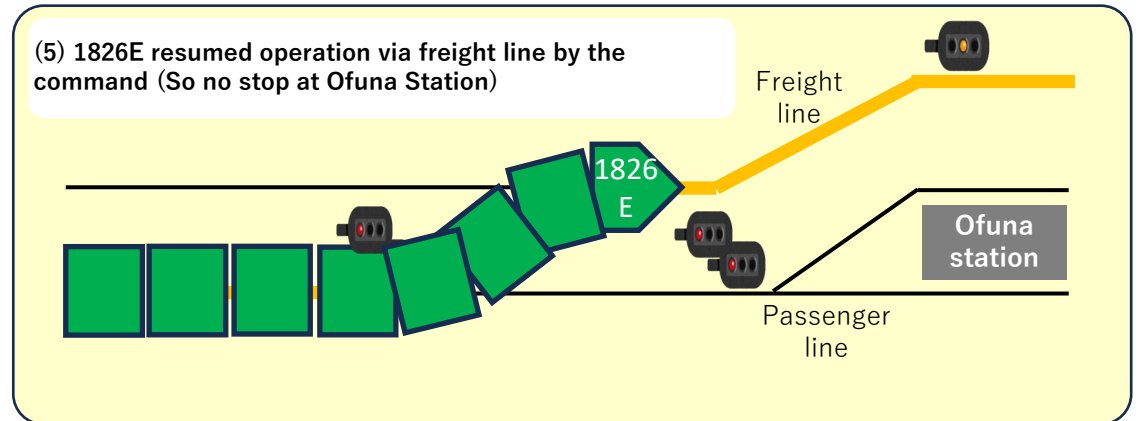
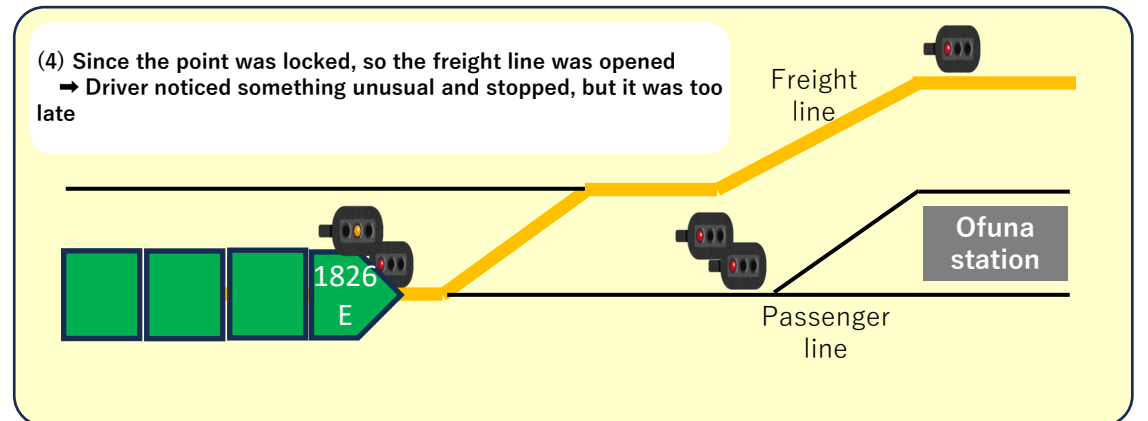
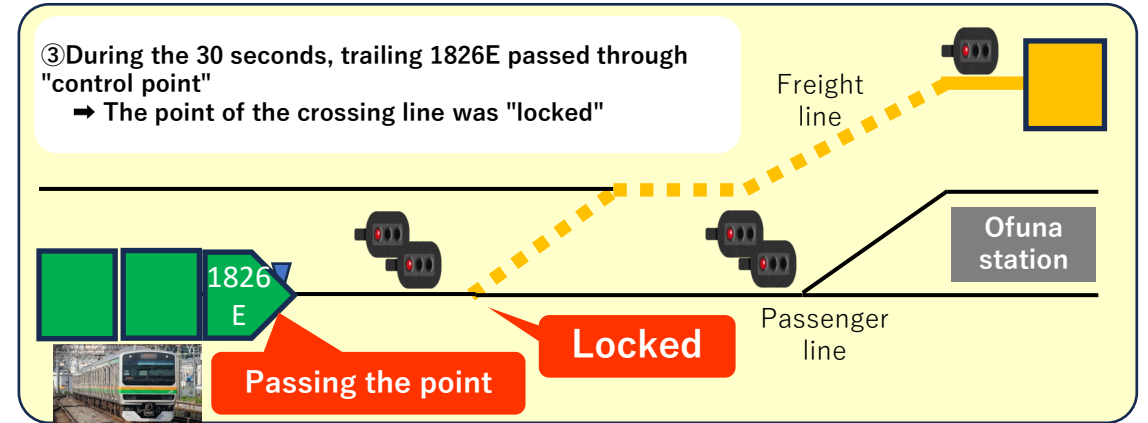
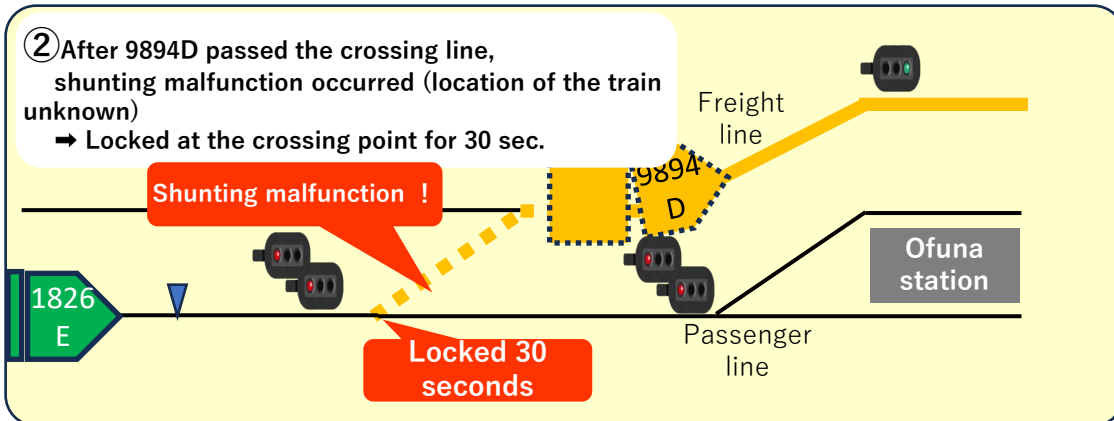
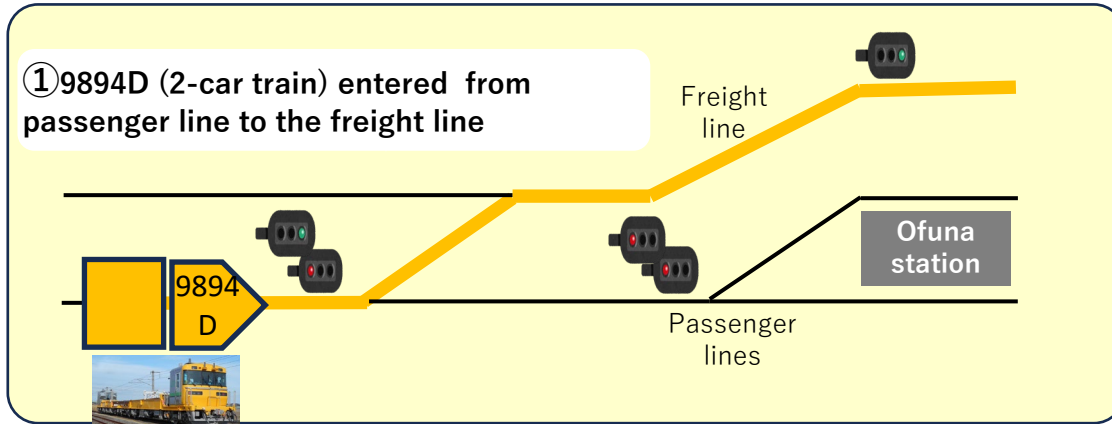
ATO try-out has started on the JR Kashii Line (Kyushu), on lines with railroad crossings,

**In driverless operation, it is important to respond to abnormal situations and to improve the traffic environment with all parties involved**

# 3. Disturbing events

- Problems that cannot be prevented by the system  
~ Case (1) Shunting malfunction of Kiya E195 series ~

【Shunting Malfunction】 ..."The track circuit cannot detect the presence of the train"



# 3. Disturbing events

○ Troubles that cannot be prevented by the system ~ Case (1) Shunting malfunction of Kiya E195 series ~

**【Information found later】**

- ◆ Shunting malfunction is prone to occur when "short trains of 1-2 cars" pass through "railway tracks that are not usually used" and on "rainy days"
- ◆ In the 3-4 years since the introduction of the Kiya E195 series, this malfunction had occurred more than 130 times (information was not shared within the company therefore no countermeasure)
- ◆ "In a state where shunting malfunction had occurred, if the Kiya E195 series had stopped, there could have been a train collision" said some people worrying about the worst.



**Kiya E195 series (railcar for rail transport) 2-car train**

**Even if the system evolves, such events have occurred again and again!  
Keenly aware of the importance of education and succession of skills so  
that we can respond to failures and irregularities**

# 3. Disturbing events

○The Importance of “isolating the incident from the surrounding environment” ~Case (2) Autonomous operating bus accident~

【Issues of driverless driving on railways】

- Response in case of emergencies
- Isolation from the surrounding environment
- A device that detects obstacles at level crossings and stops trains
- Sensor technology to detect obstructions in front

In considering the challenges of autonomous driving on railways, consideration of autonomous bus collision accidents is important

【Autonomous operating bus accident】  
In August 2021, at the Tokyo Paralympic Village, an autonomous bus trying to turn right at an intersection without traffic lights collided with a pedestrian (visually impaired athlete) who tried to cross the road.

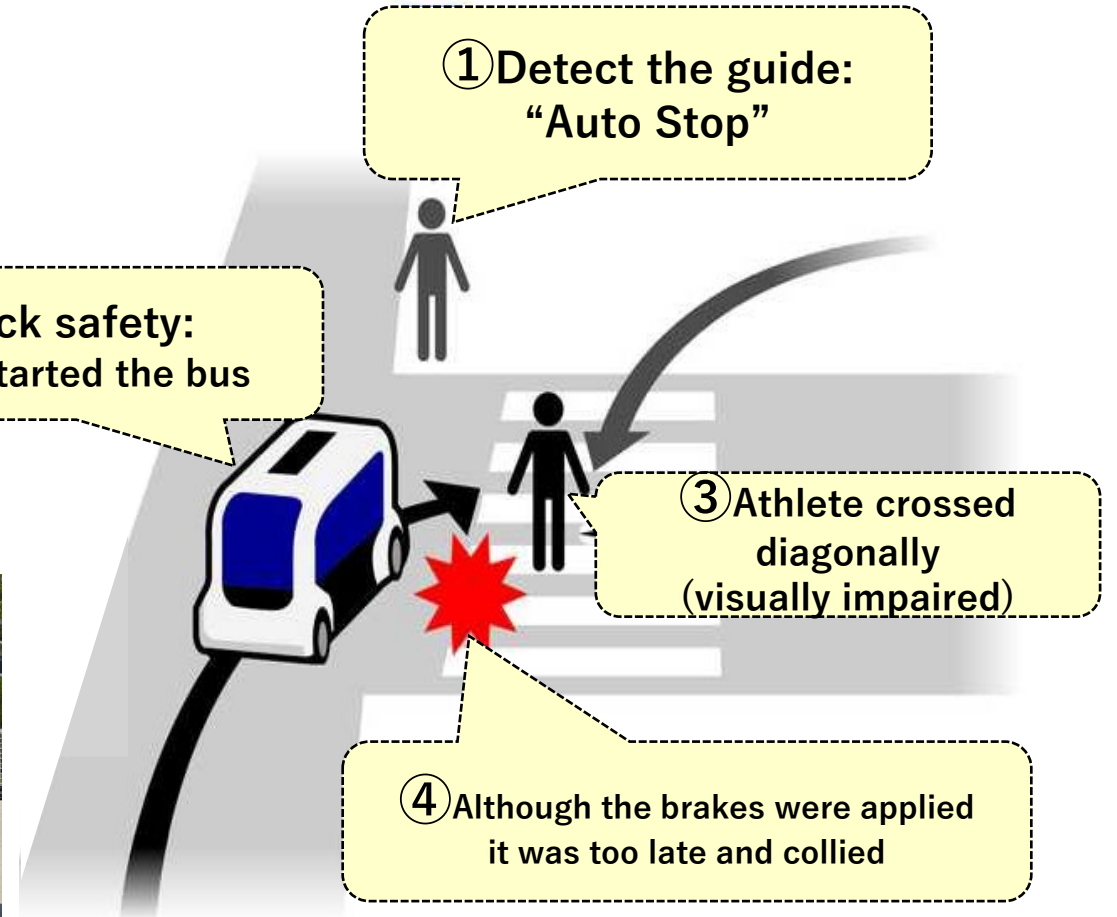


② Check safety:  
Operator started the bus

① Detect the guide:  
“Auto Stop”

③ Athlete crossed diagonally  
(visually impaired)

④ Although the brakes were applied  
it was too late and collided





# 3. Disturbing events

○The Importance of "isolating the incident from the surrounding environment" ~Case (2) Autonomous operating bus accident~

【Recurrence prevention measures】

Increase the number of staff on the vehicle

Increase the number of guide personnel and separate vehicle personnel from pedestrian personnel

Inform pedestrians traffic rules

Accelerate, decelerate, and stop manually, and increase the volume of the warning sound

【President of Toyota Motor Corporation】  
"Safety is not something that can be ensured by pedestrians, operators, or guidance staff alone, but it is necessary to work on improving methods and mechanisms in a trinity of forces."

◆The same for railways, issues and recognition to be solved when considering operating driverless on lines with level crossings  
◆Measures based on an environment with an unspecified number of people is also necessary (crime countermeasures such as knives and arson in the car, etc.)

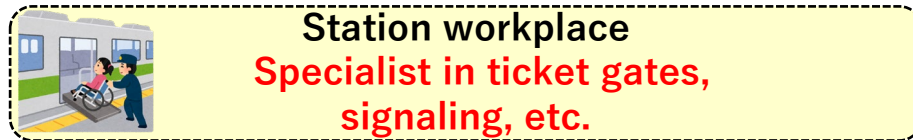
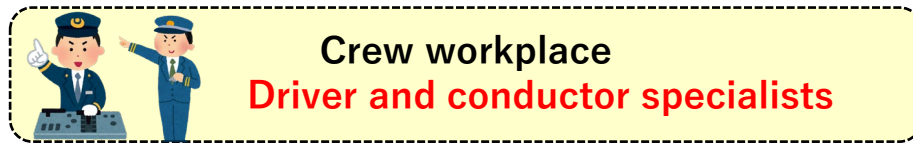
When autonomous driving of railways  
"Improving the functionality of vehicles," "isolation from the surrounding environment," and "understanding customers and local communities" are essential

# 4. Finally ~Excessive "fusion and collaboration" becomes a risk~

○ The driver, the "last bastion" of safety, is no longer the "last bastion"

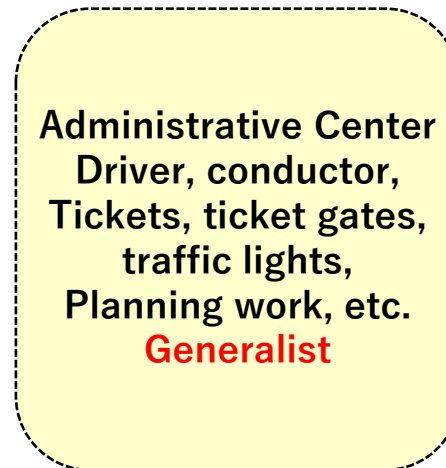
- ◆ JR East is pressing a "control center" that integrates crew workplaces and station workplaces.
- ◆ Until now, drivers have been "specialists in train operation", but with the establishment of a general center, aiming to be a "specialist who performs not only driving, but also station operations and event planning work"
- ◆ The company equates train operation and event planning saying "both are important"

## 【Former workplace】



Fusion  
and  
cooperation

## 【Current workplace】



【Harmful effects of excessive "fusion and collaboration"?】

I was worried about other tasks while driving a train, and an incident occurred where I operated a tablet terminal while on board!

→ Decreased safety awareness and professionalism, The deterioration of technology and skills is in crisis!

Reply to communications related to planning work while on board



We will not look away from the reality that the culture of "self-discipline" has become a mere figure, but try to prevent accidents and aim to re-establish safety!

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**Thank you for your attention!**

**JREU National Office**

