Safety System for Track Maintenance Vehicle Operation of Shinkansen

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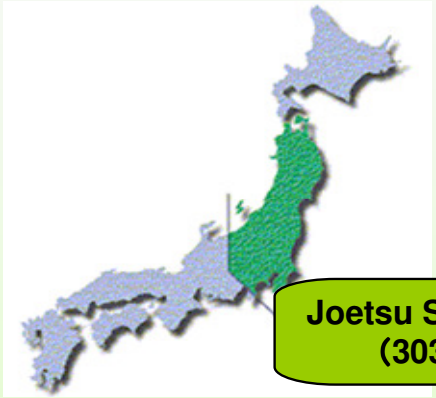


Akita Shinkansen (127.3km)

(Mini Shinkansen)*

To Shin-Hakodate

Extension to Shin-Aomori

Shin-Aomori

Hachinohe

Yamagata Shinkansen (148.6km)

(Mini Shinkansen)*

Akita

Morioka

Joetsu Shinkansen (303.6km)

Shinjo

Yamagata

Sendai

Extension to Toyama (Hokuriku Shinkansen)

Niigata

Tohoku Shinkansen (631.9km)

To Toyama

Joetsu

Fukushima

Takasaki

Nagano

Omiya

Ueno

Tokyo

Nagano Shinkansen (117.4km)

*Mini Shinkansen: Conventional lines converted for through Shinkansen service

Now	Route length	Mini Shinkansen 1052.9km + 275.9km
Future	Route length	Mini Shinkansen 1194.4km + 275.9km

Railway track maintenance

Separation train operation and rail maintenance.

Reasons:

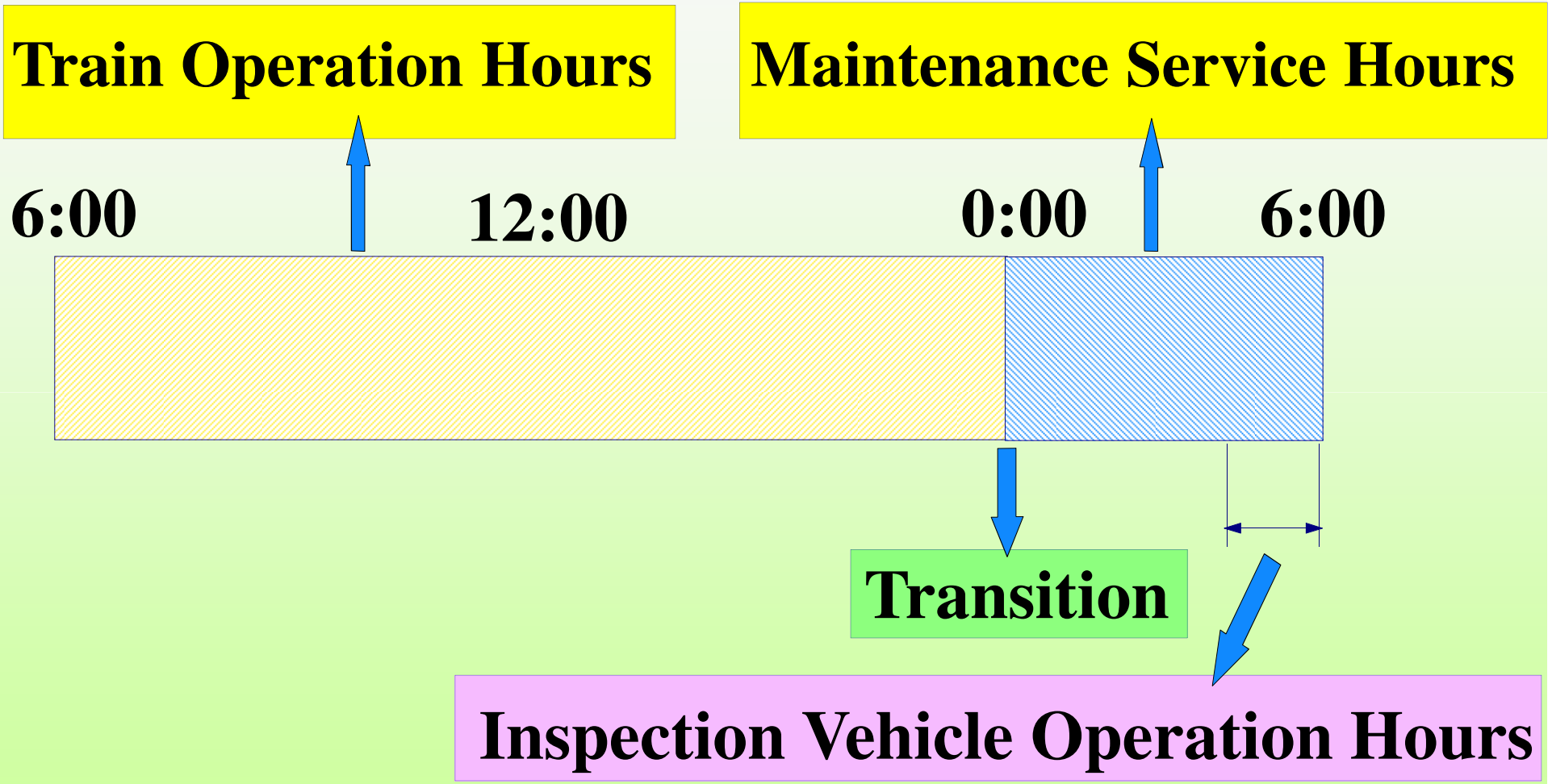
Extensive maintenance equipment.

Trains run up to 275 km/h.

Goal:

Total prevention of collisions.

Track Schedule



Inspection Vehicle Functions

Inspection vehicles verify:

- the end of maintenance service hours, and

- whether any obstacles were left on train lines.

Conventional Inspection Vehicle

Reasons for improvement

(1) Fewer maintenance service hours.

(2) Fewer personnel willing to work at night.

(3) Rising costs.

New inspection car specifications

- Detection of obstacles on tracks

- Automated operation

Time frame :

1991 ~ 1995	Basic development
1995 ~ 1997	Rework for practical application

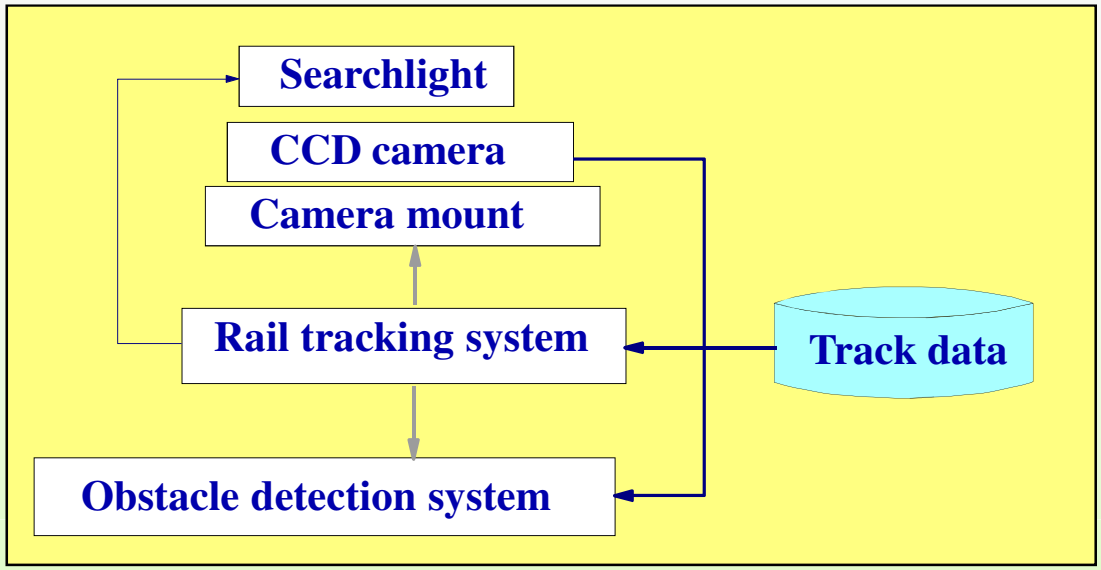
New inspection Vehicle

Key Technologies

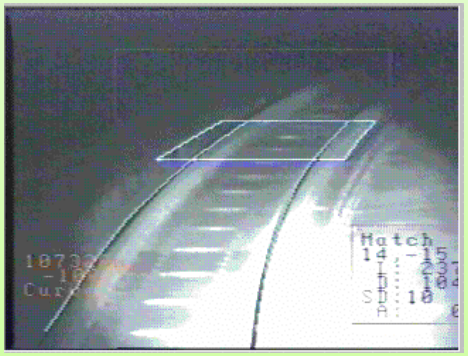
- Obstacle detection by computer image processing

- Built-in automated control system

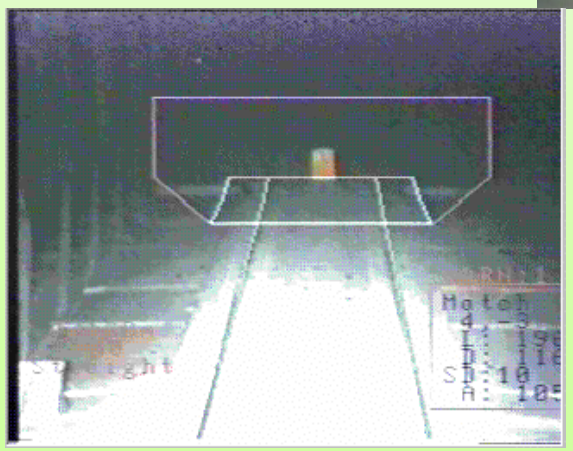
Obstacle Detection System



Special Searchlight

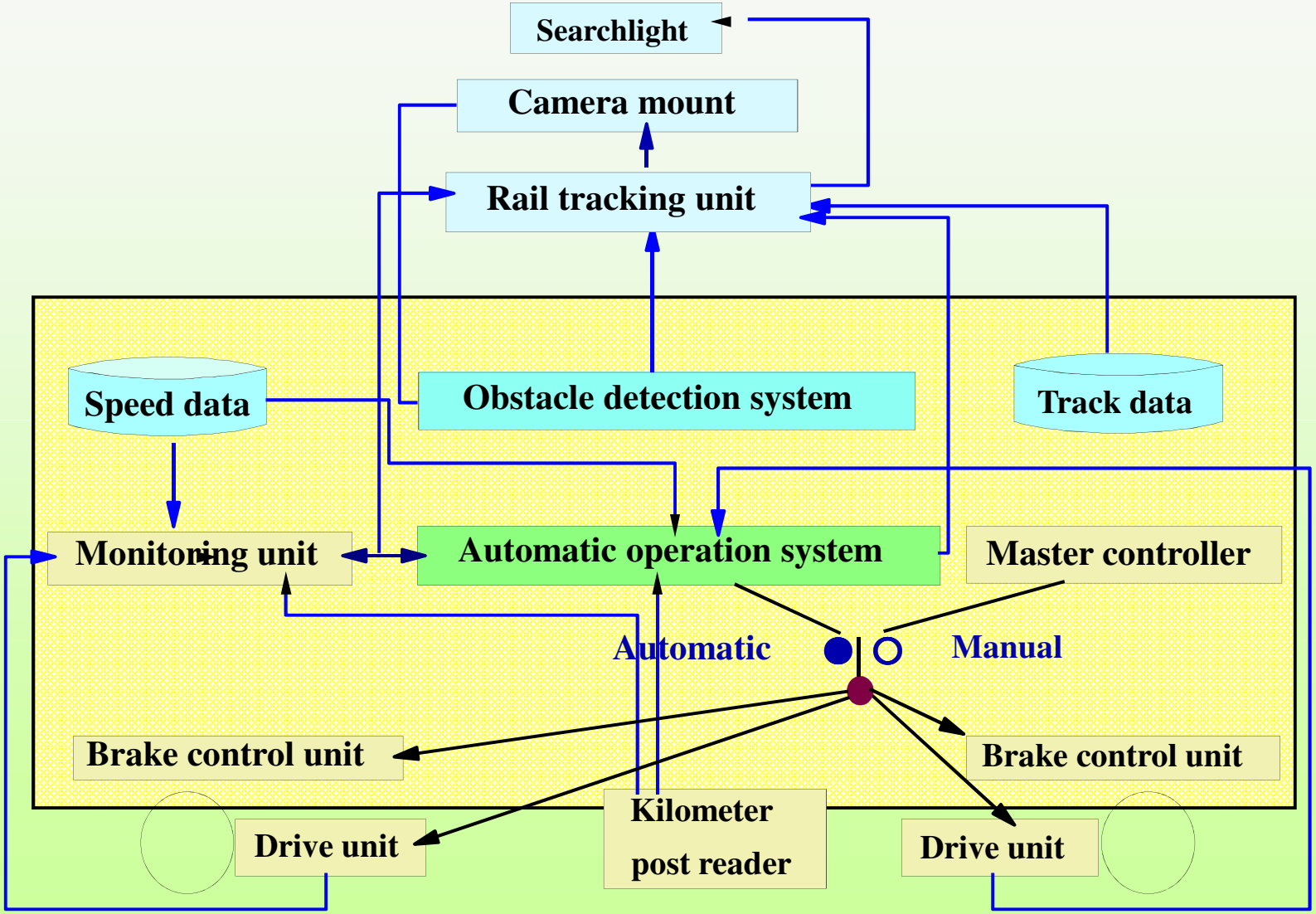


Computer image processing for curved track



Example of obstacle detection

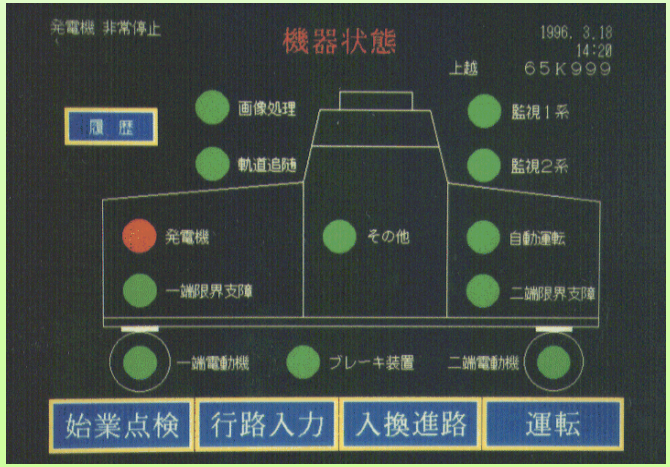
Architecture of On-Board System

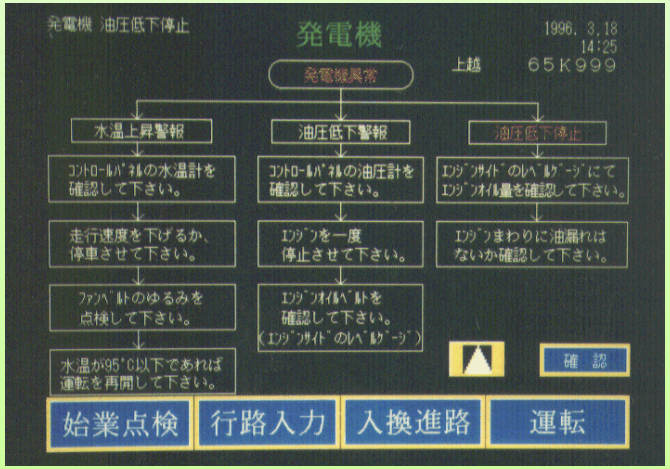


Additional features

Swivel-type control center

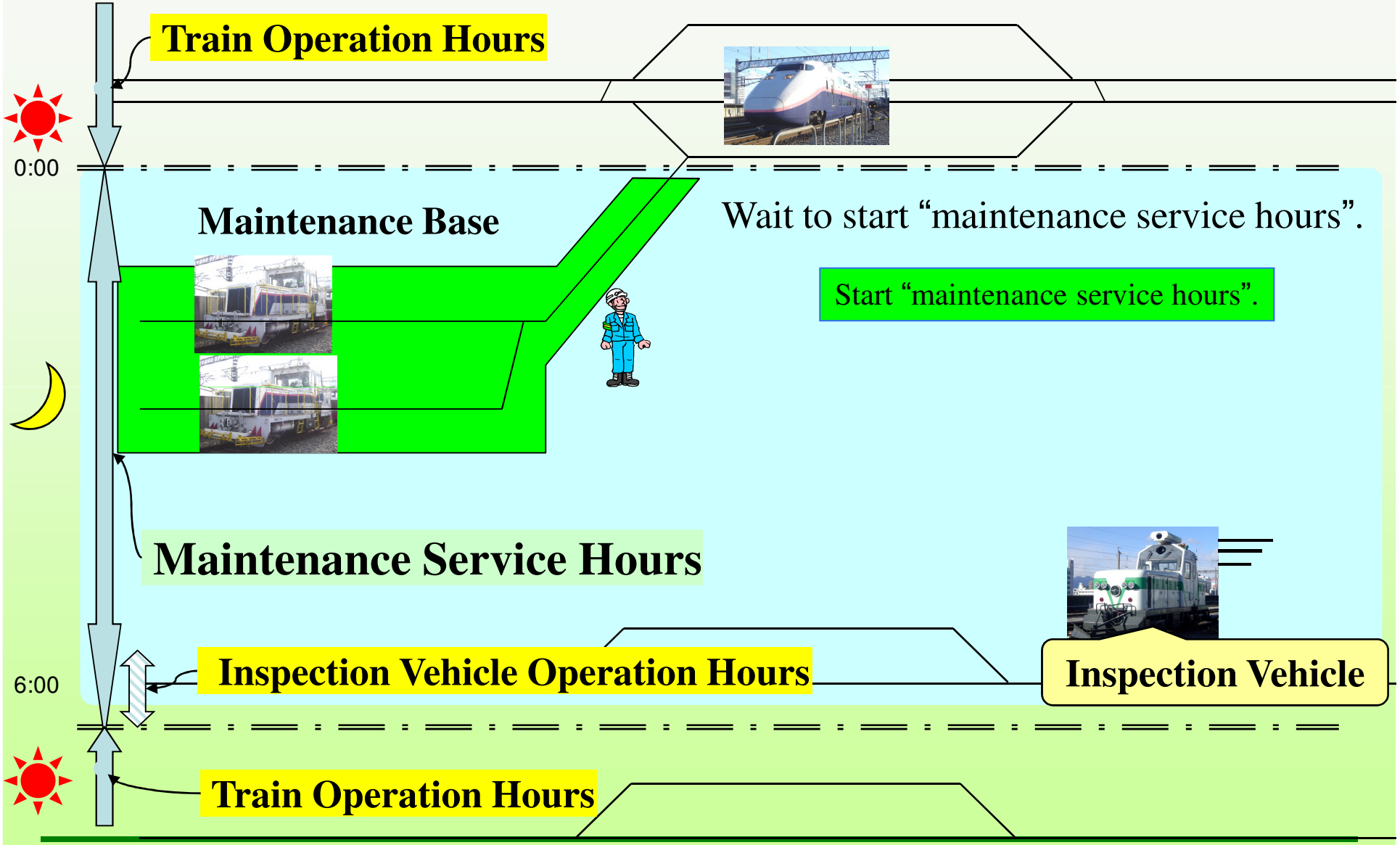
Remote Control



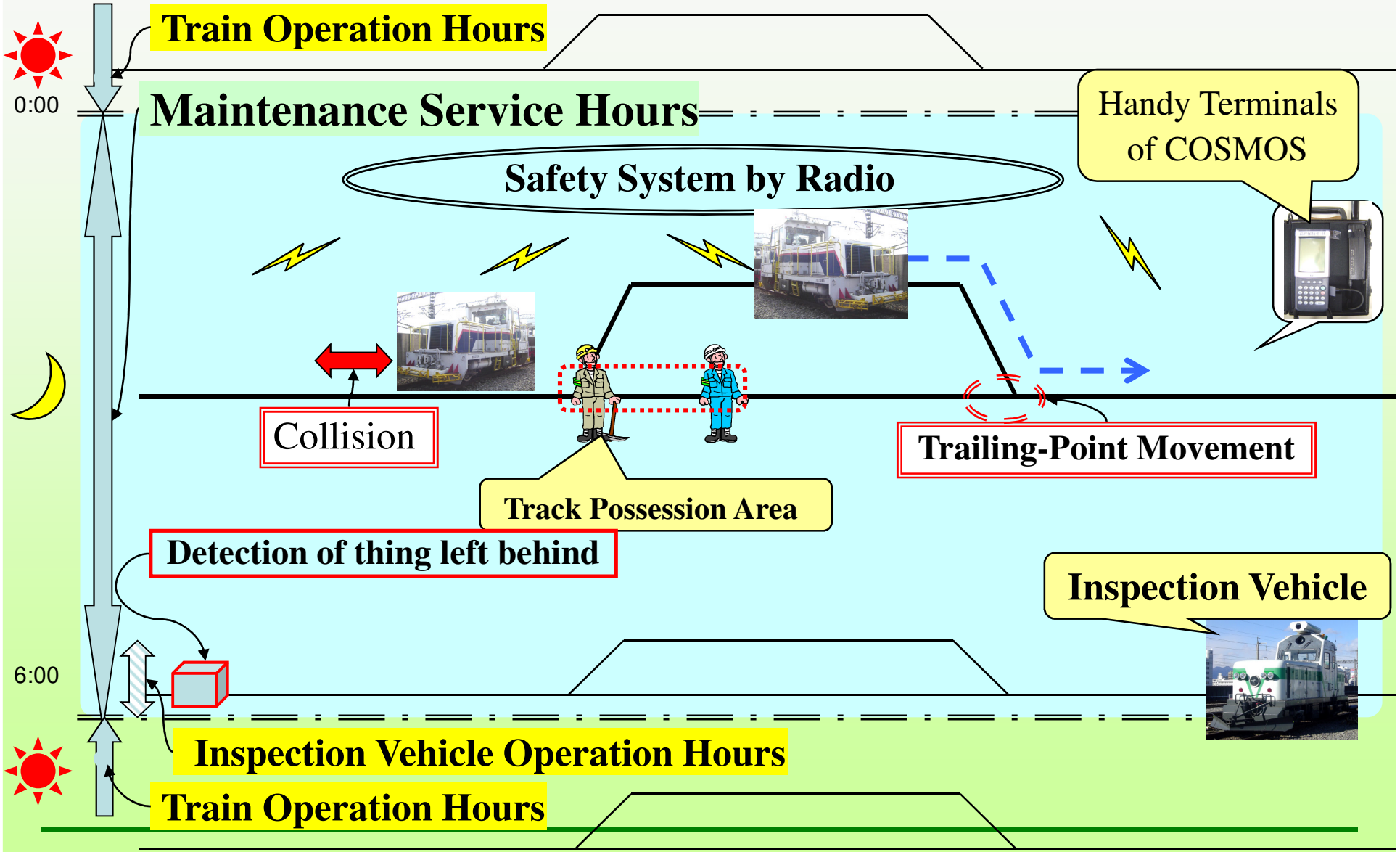


Emergency procedure panel

Maintenance Work in Shinkansen



Maintenance Service Hours



Background of Development

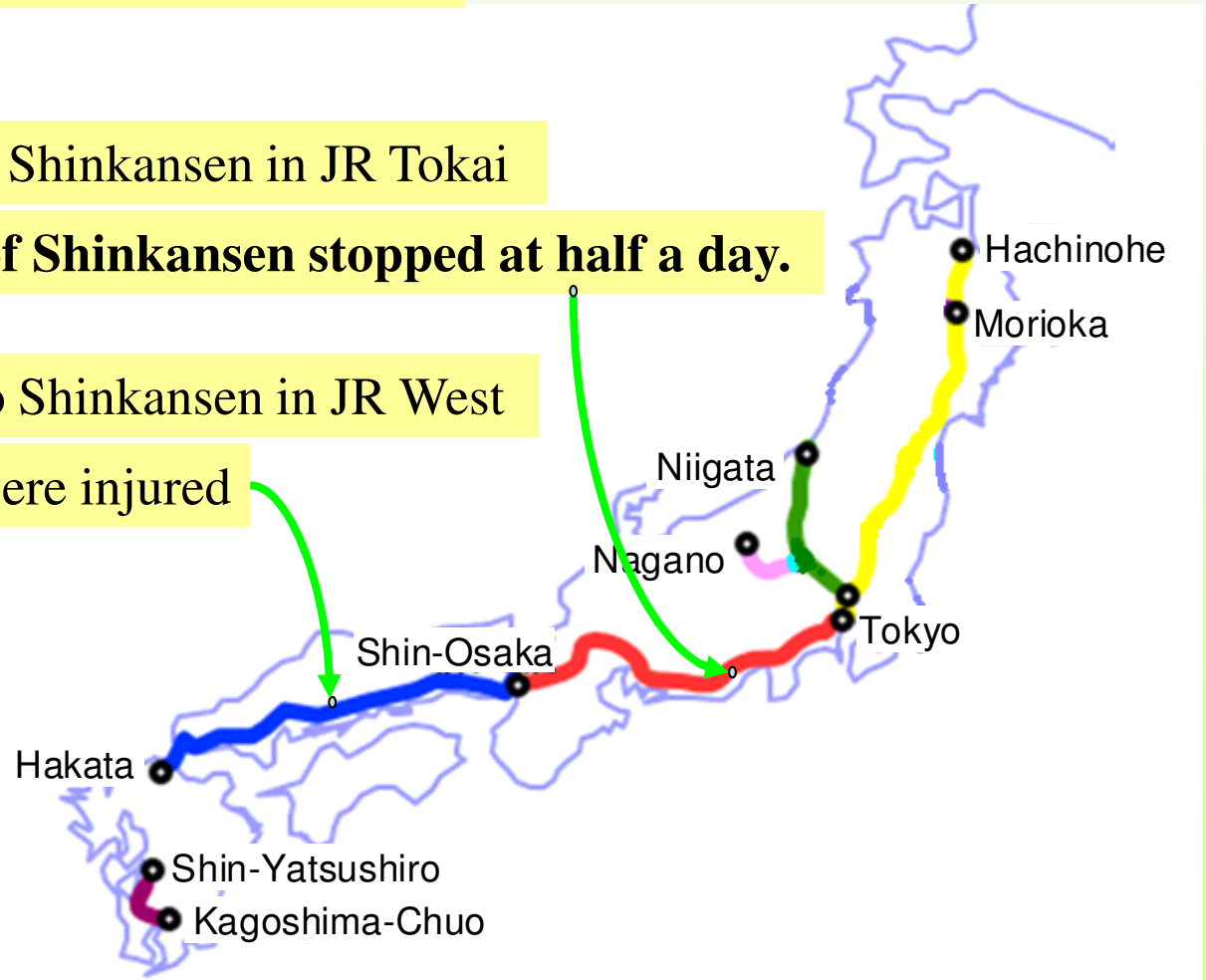
Collision of maintenance vehicle in Shinkansen

1. August 6, 1993 : Tokaido Shinkansen in JR Tokai

The operation of Shinkansen stopped at half a day.

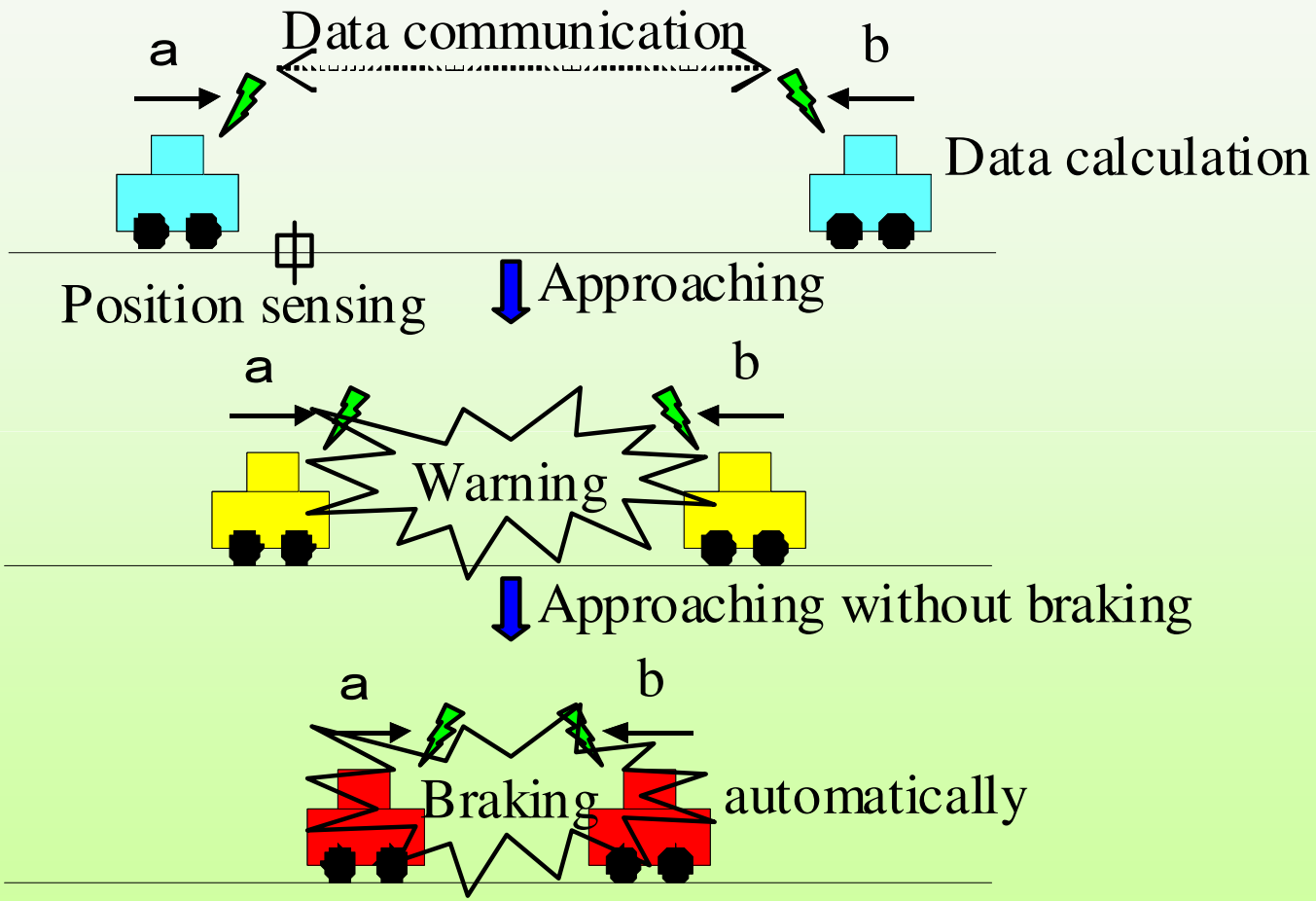
2. Septembe 3**, 1998 : Sanyo** Shinkansen in JR West

3 persons were injured



The Function of Safety System for Track Maintenance Vehicle

Collision prevention function

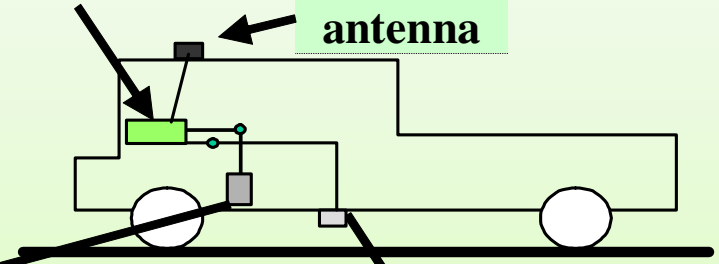


Position Detection System for Maintenance Vehicle

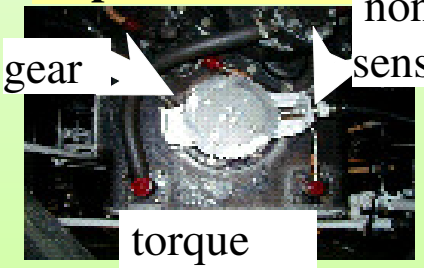
A track maintenance vehicle

A track maintenance vehicle transceiver

GPS antenna



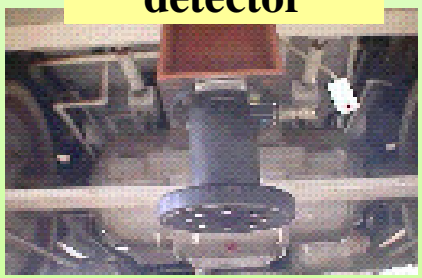
Speed sensor



kilometer post

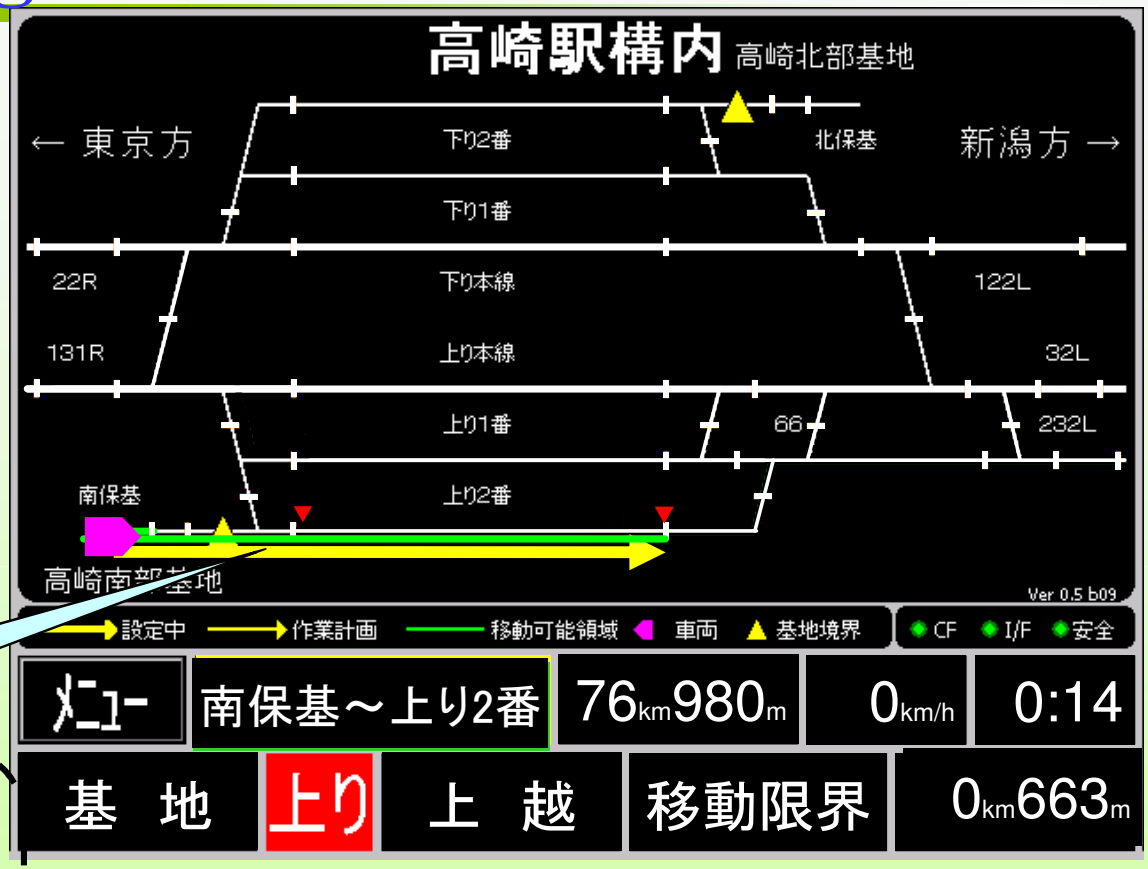
・It placed every 1 kilometer

kilometer post detector

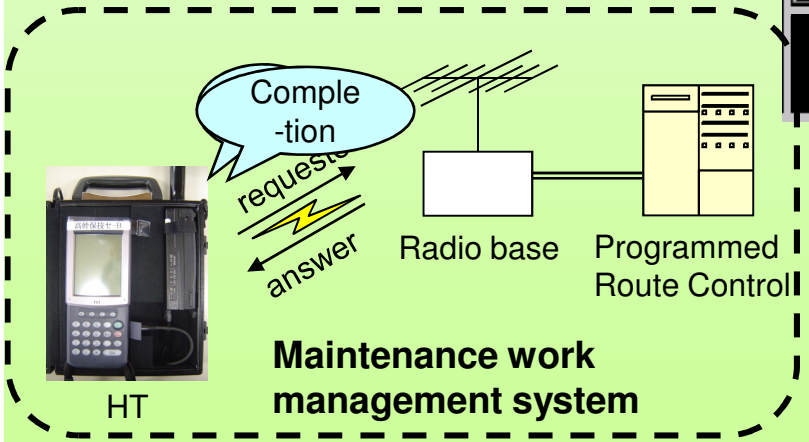


・It corrects the position error every 1 kilometer

Operation Image （Route setting～Route restoring）



Turning of switch



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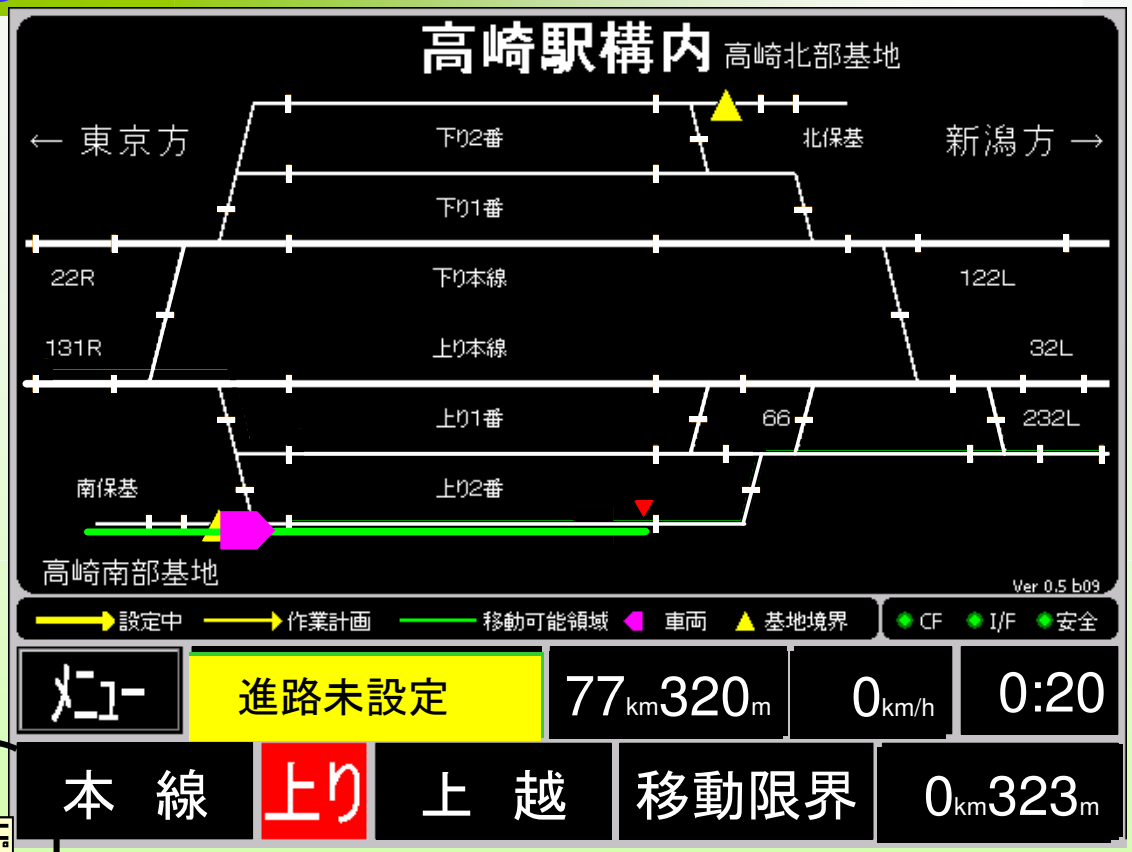
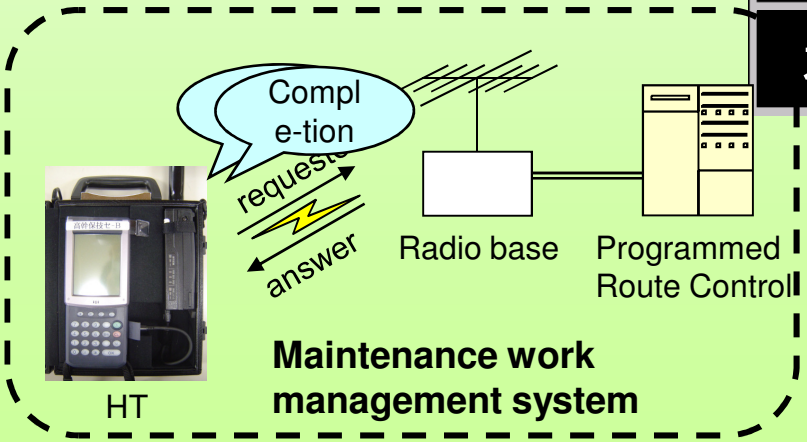
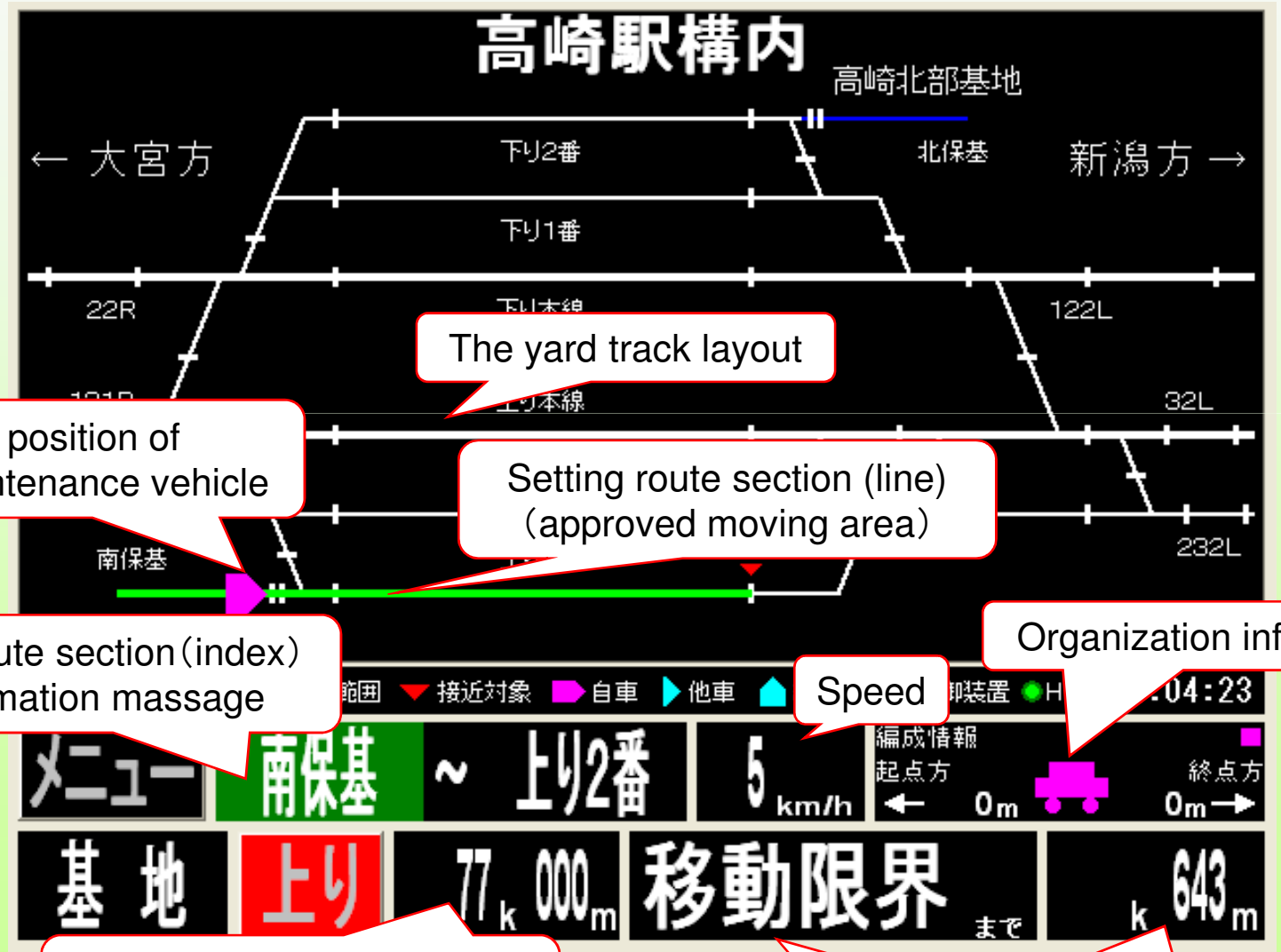




Example of Cab Monitor Display



The yard track layout

Lives position of track maintenance vehicle

Setting route section (line) (approved moving area)

Setting route section (index) or information massage

Organization information

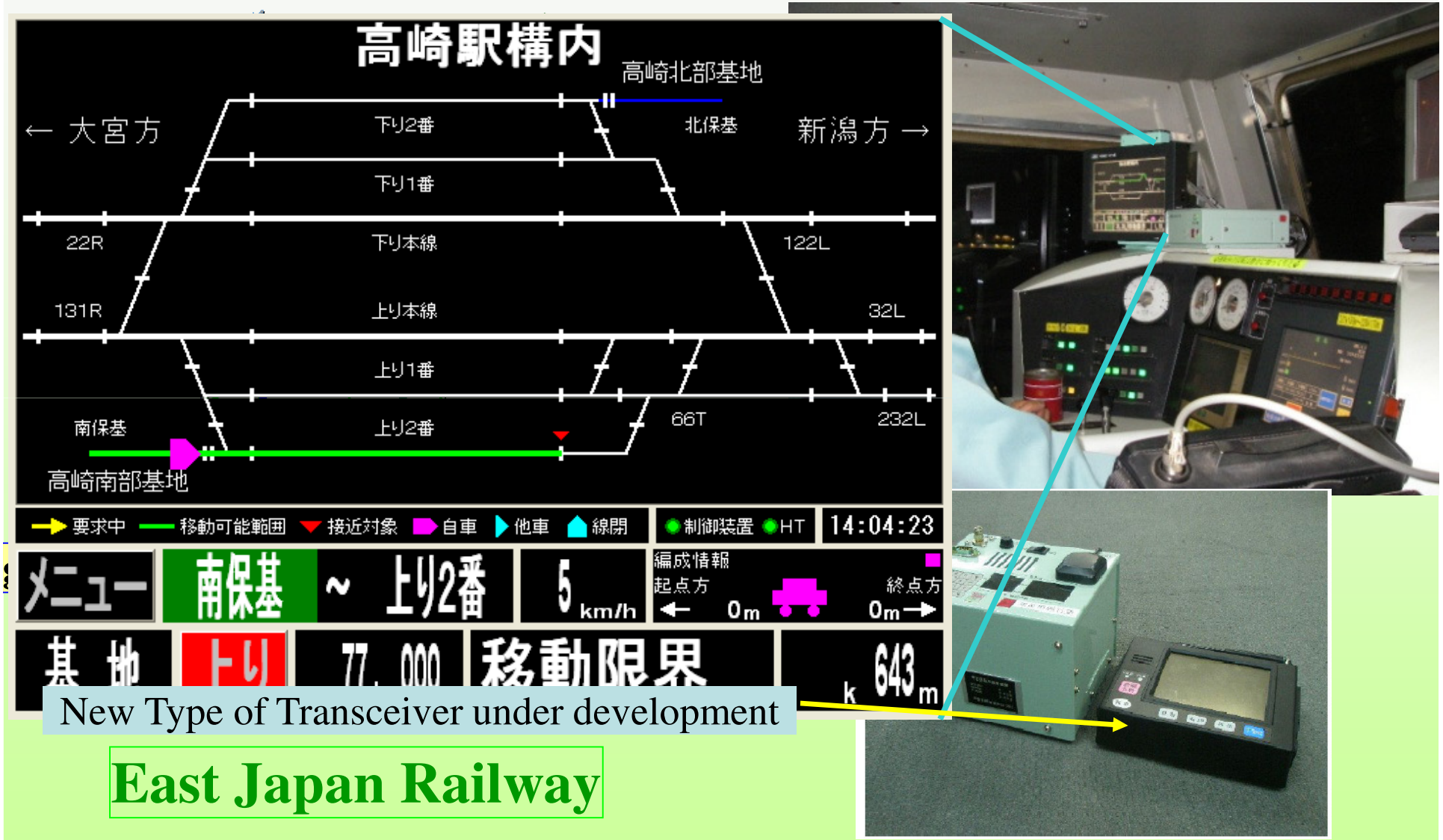
Speed

Kilometer position of track maintenance vehicle

Limit object

Remainder distance

CONCLUSION



New Type of Transceiver under development

East Japan Railway

Thank you very much for kind attention.

Shinkansen safety

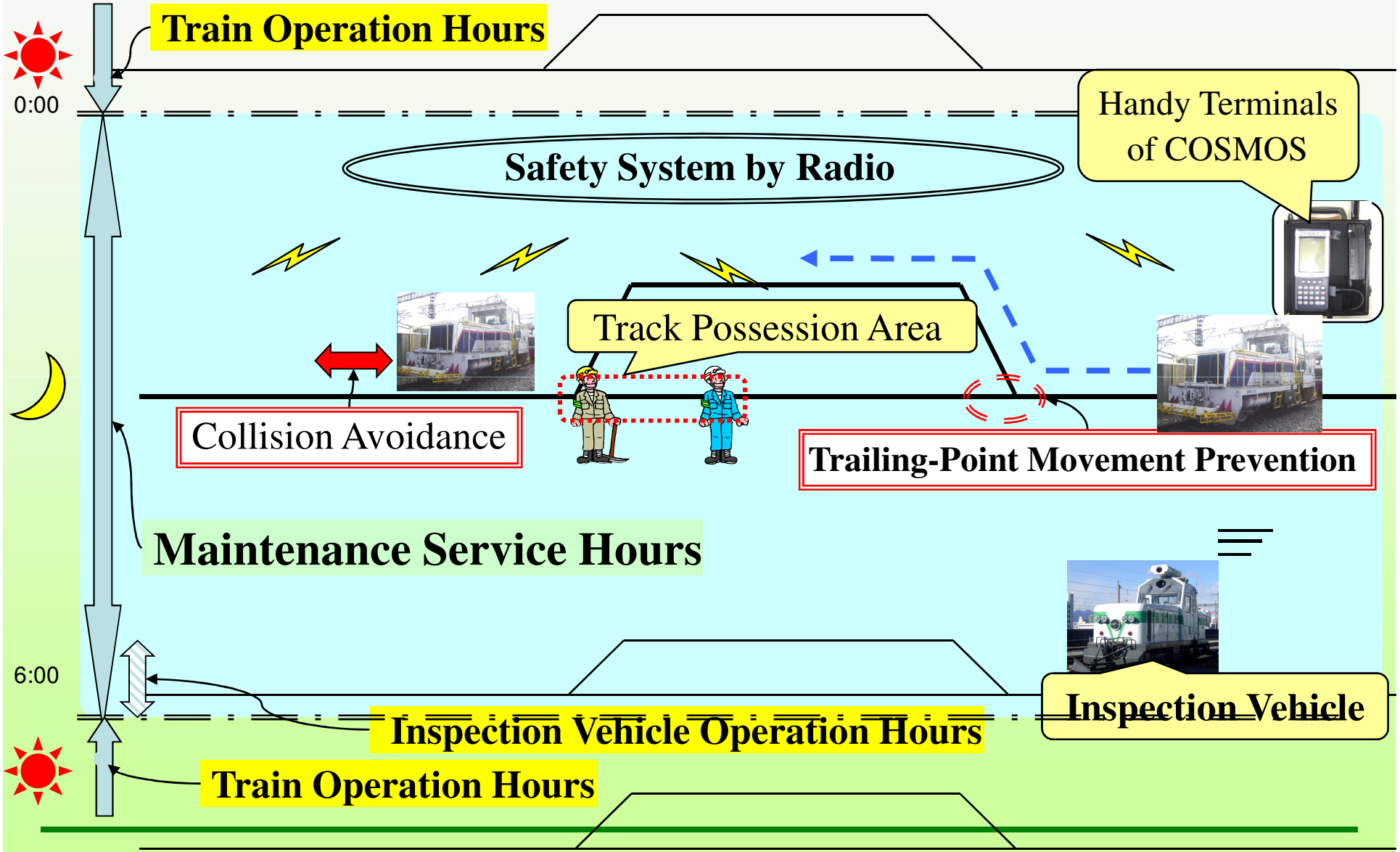
1. Automatic Train Control (ATC).

2. Elimination of level crossings.

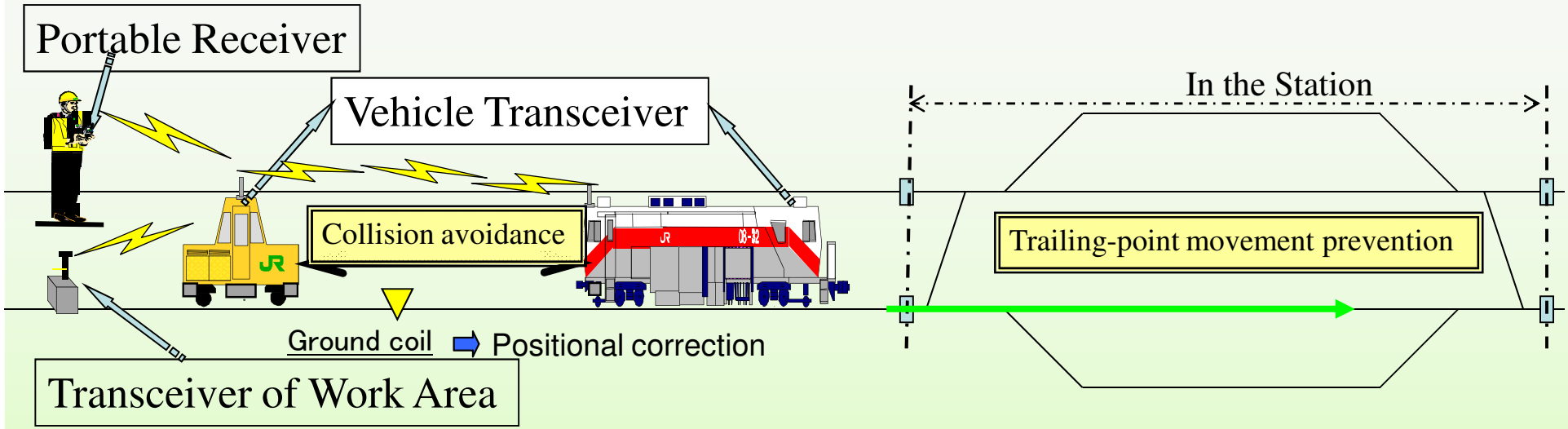
3. Highly reliable equipment.

4. Optimal maintenance system.

Maintenance Work in Shinkansen



Outline of Safety System for Track Maintenance Vehicle



- Calculation distance + Correction of Ground coil = Position Detection
- Data communication by radio (speed, position and direction)

+

- Import routing information from Handy Terminal
- Database including turnout positions

Provide warning and braking by calculating relative distance and relative speed

- Recognition of lives position and setting route
- Automatically stop before a non-approved area

- Collision avoidance function
- Prevention function of going into Work Area
- Approach warning function for track engineer

- Advancement prevention function outside approved area
- Trailing-point movement prevention function

Displayed on the cab monitor (track layout, lives position, route information) → Improvement of man-machine interface

Detecting Obstacles 400 m ahead

Detection System for Obstacle on the Shinkansen track


SPENO