LiDAR for Trespass Detection and Railway Crossings

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LiDAR for Trespass Detection and Railway Crossings

Japan Railroad Crossing Improvement Promotion Law

1960

70,000 railroad crossings in Japan

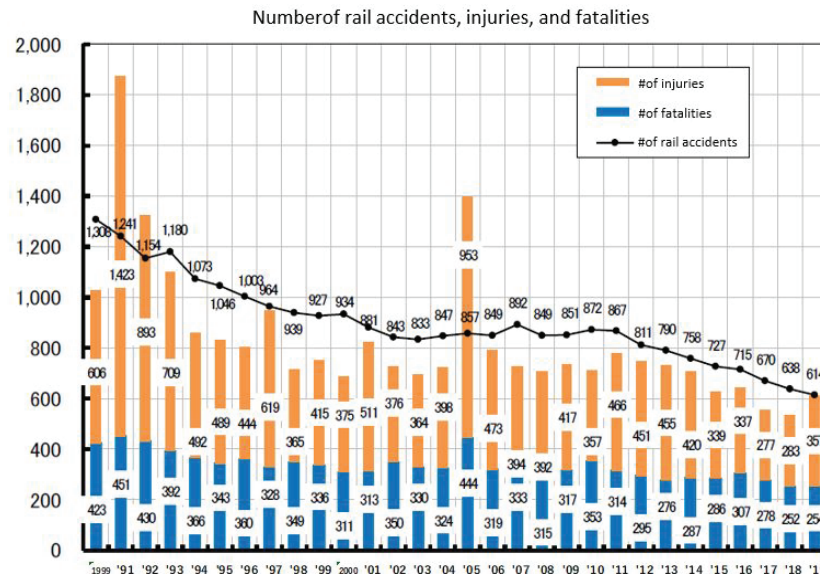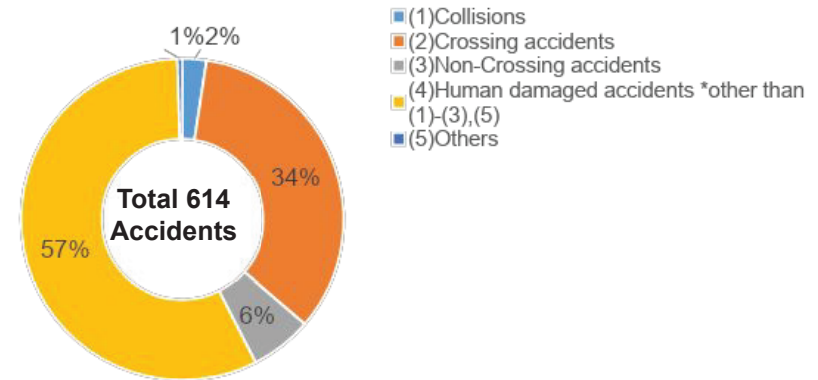2019

33,004 railroad crossings in Japan

Rail Accidents in Japan

- There were 614 rail accidents in Japan in FY 2019. (Apr 2019 – Mar 2020)
- 34% of them occurred at railroad crossing.

Number of rail accidents, injuries, and fatalities

Percentage of rail accidents by type, FY 2019

Total 614 Accidents

34%

6%

57%

1% 2%

- (1)Collisions
- (2)Crossing accidents
- (3)Non-Crossing accidents
- (4)Human damaged accidents *other than (1)-(3),(5)
- (5)Others

Reference: Ministry of Land, Infrastructure, Transport and Tourism of Japan Website,<https://www.mlit.go.jp/tetudo/content/001367471.pdf>
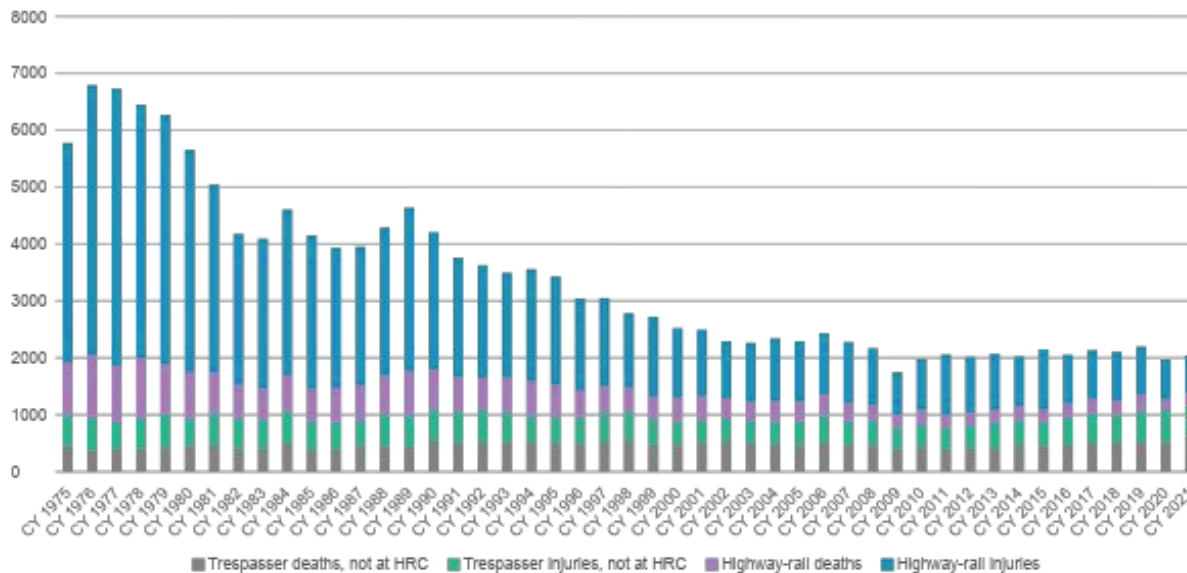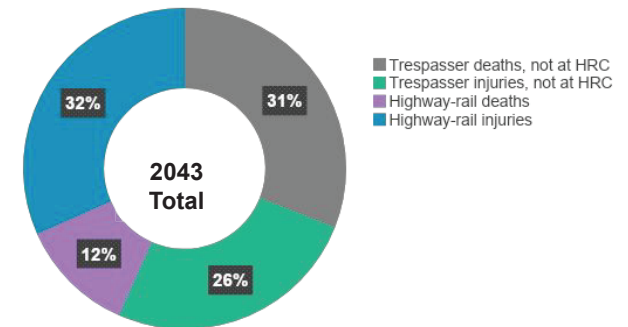
Grade Separations and Rail Accidents in US

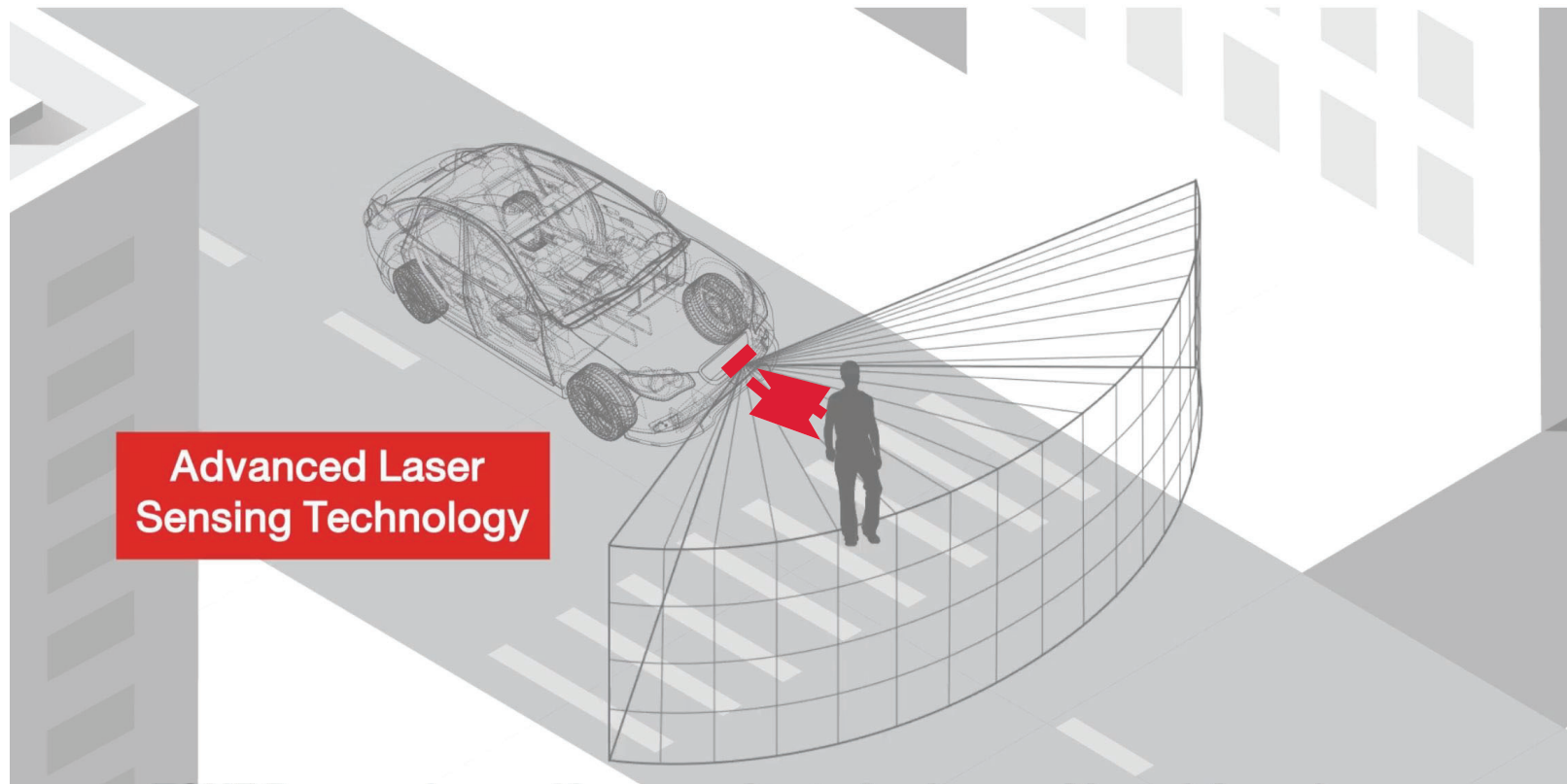| 1975	2022
208,999 railroad crossings in USA	126,844 railroad crossings in USA

Grade Crossing/Trespassing Deaths & Injuries

Legend: Trespasser deaths, not at HRC | Trespasser injuries, not at HRC | Highway-rail deaths | Highway-rail injuries

CY 2021

2043 Total

- Trespasser deaths, not at HRC — 31%
- Trespasser injuries, not at HRC — 26%
- Highway-rail deaths — 12%
- Highway-rail injuries — 32%

Source: FRA USA Stats 1975-2021

Automobile sensor utilizing Light Detection and Ranging (LiDAR)

Advanced Laser Sensing Technology

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LiDAR Based Perimeter Monitoring

Coverage of the Zone D Laser Sensor

Range of distance measurement

200 ft

Range of object detection

R = 200-300 ft max
Depending on reflectance

100 ft

Range of detection with 10% reflectance

R = 100 ft min

190˚ detection
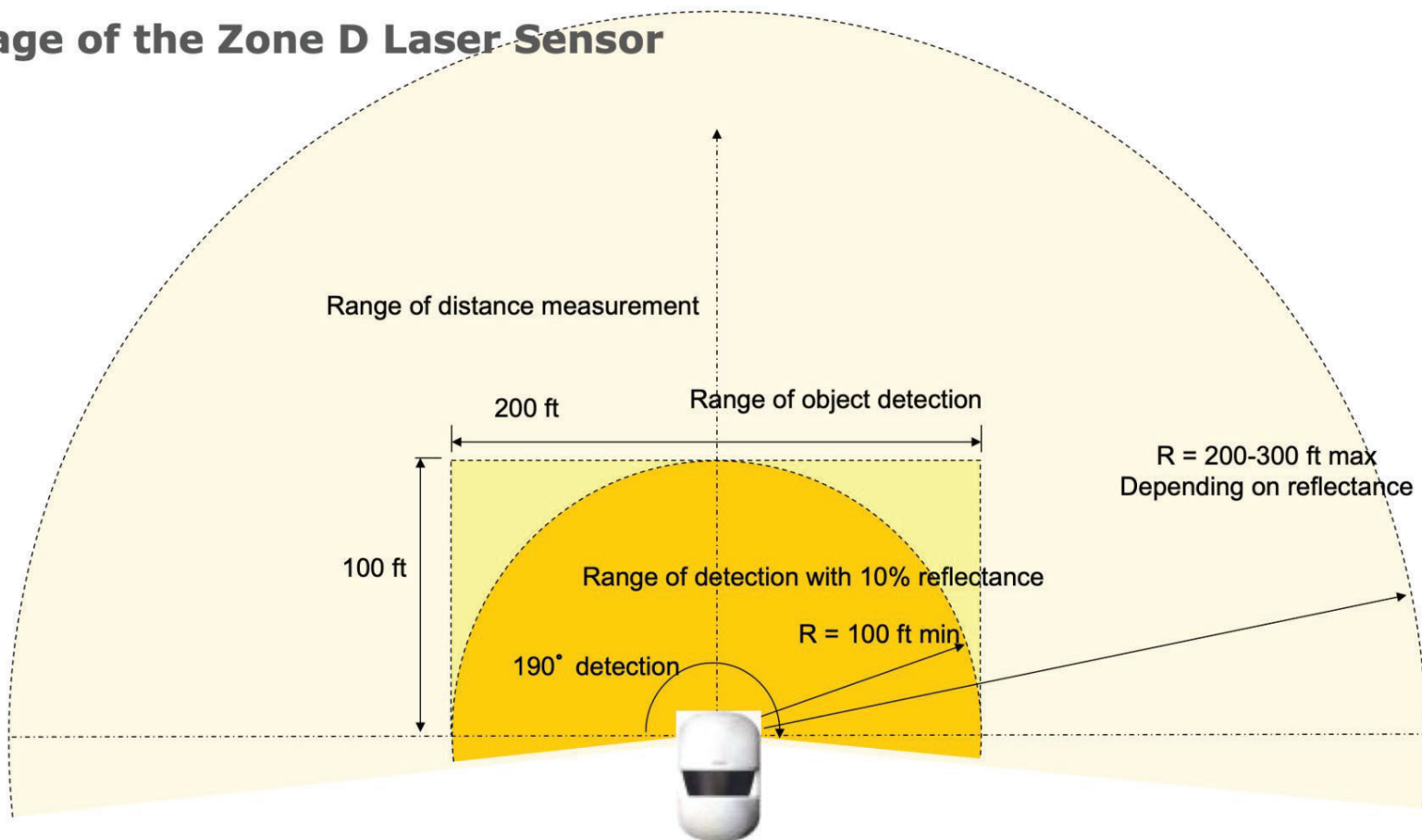
Characteristics of a Laser Sensor

- 190 degrees of coverage
- Angle resolution: 0.25°=> 780 pulses in one pass
- Scan time: 33 ms

Scanning angle
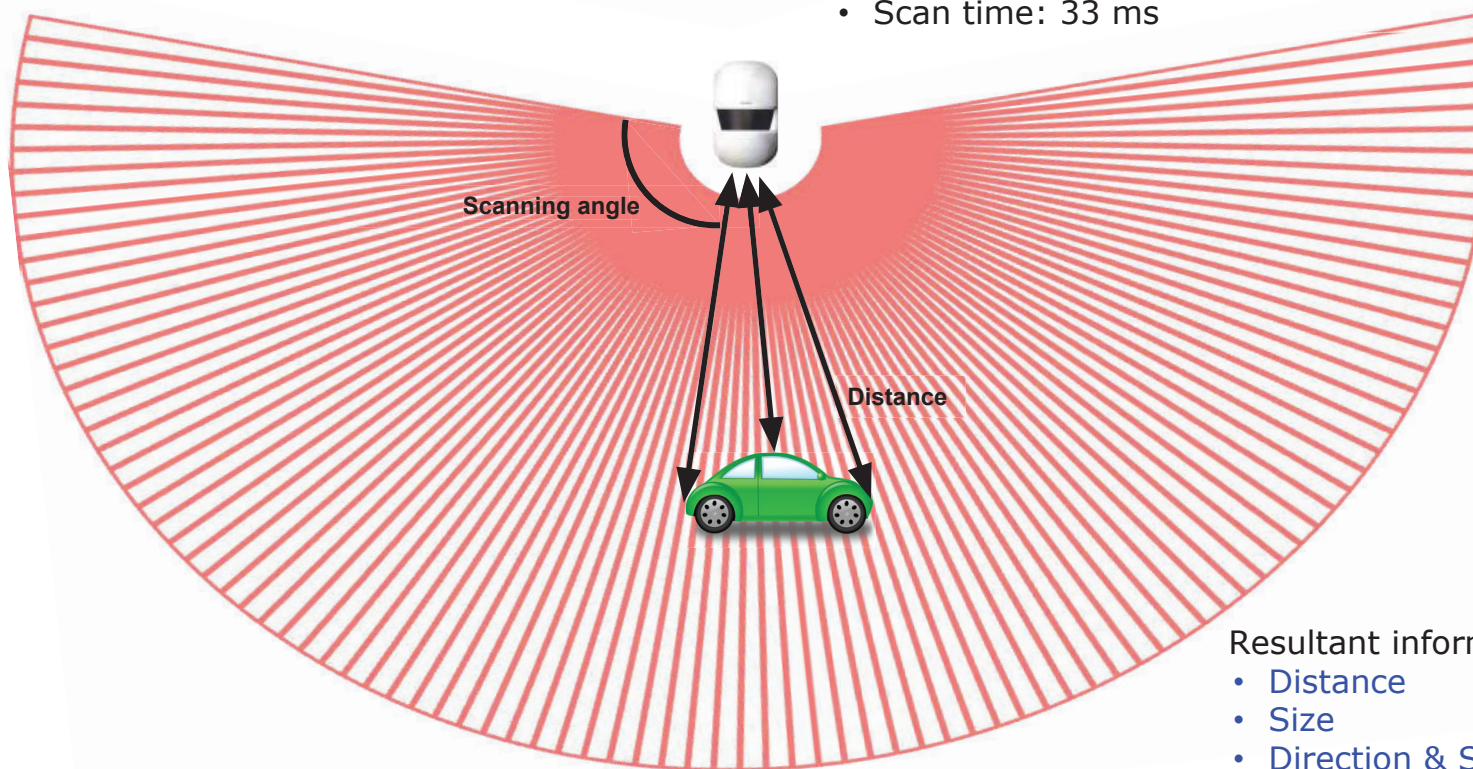
Distance

Resultant information details:
- Distance
- Size
- Direction & Speed of Travel

Functions of a Laser Sensor


Zone 3

Zone 2

Zone 1
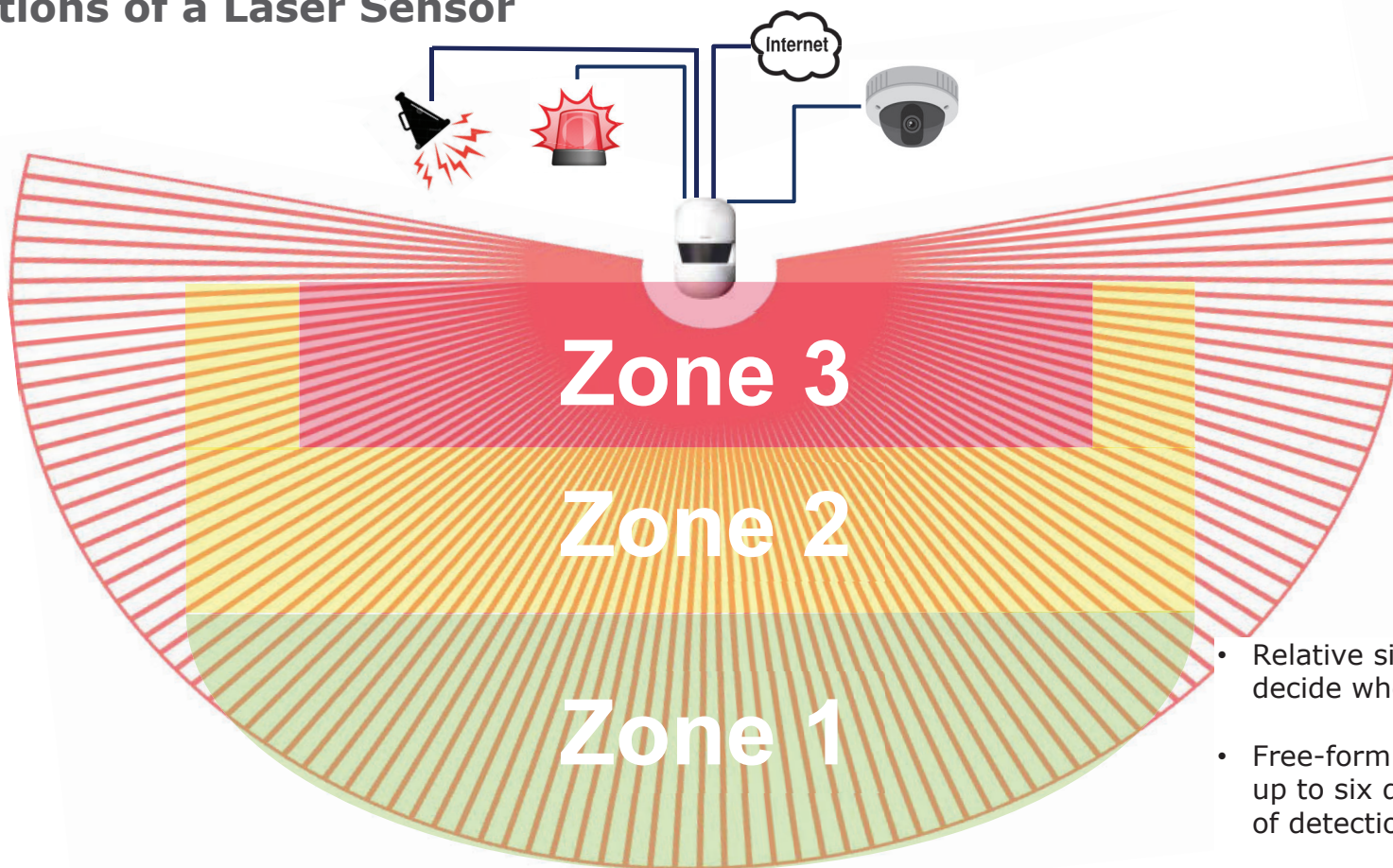
- Relative size of objects to decide whether to alarm

- Free-form ability to define up to six different areas of detection

- Can configure six different levels of alarm and resultant actions

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Use Case

UTILITY SECURI~~TY~~

Utilities have large footprints with critical infrastructure. Security of these facilities ensure business continuity and access to critical national security needs like water and electricity.

Camera

Laser

Camera

Laser
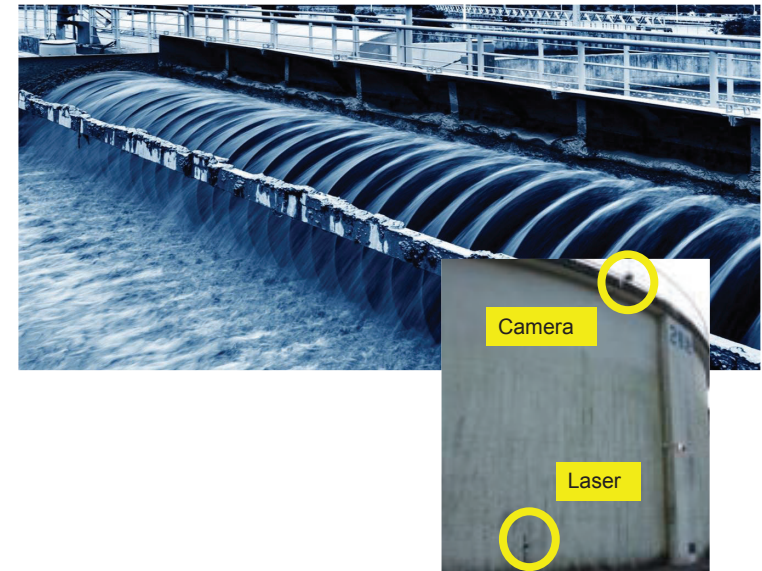
? Problem

How to monitor large areas against potential intrusion without:
o Large costs
o Information Overload

Solution

LiDAR sensor tied to PTZ Camera allows:
o Minimize costs of large numbers of cameras
o Provide critical info to Security
o Real-time tracking of intruders

Use Case

AIRPORT SECURITY

Airports have large footprints with critical infrastructure as well. Security of these facilities ensures access to critical national security needs including transportation and commerce.

Problem
- How to protect large airports from terrorism and intruders.
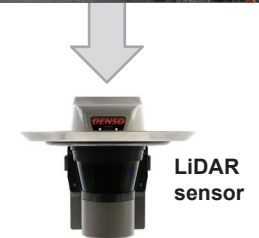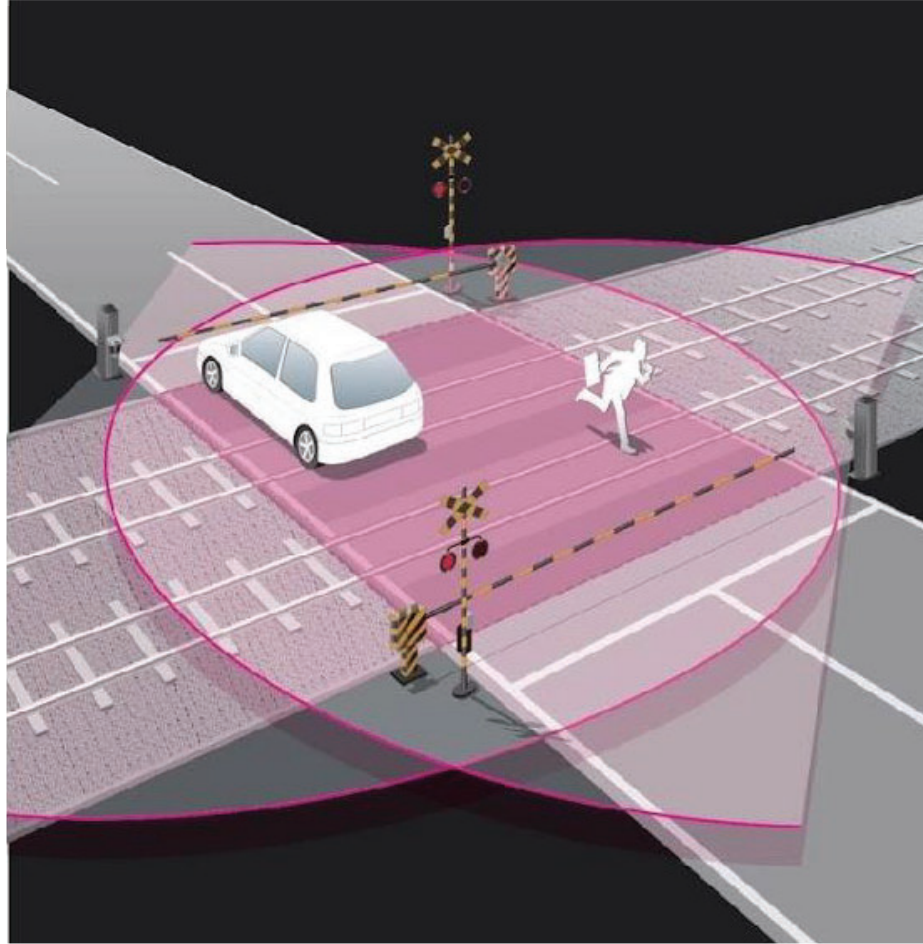- Require devices that work in all weather conditions, especially fog.

Solution
LiDAR sensor mounted horizontally
- monitors large coverage area of fencing without information overload to security staff
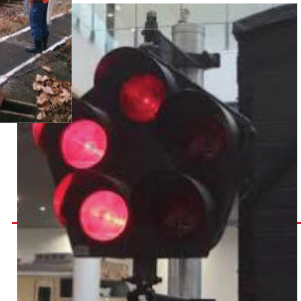
Use Case

GRADE CROSSINGS

- When a train approaches, a signal is sent to the LiDAR sensor.

- The LiDAR sensor detects an invasion in the railroad crossing while gates closed.

- LiDAR sensor turns on a warning light to notify the driver of danger.

- Action taken to notify conductor or system. Can be visual, electronic, or integrated with PTC.
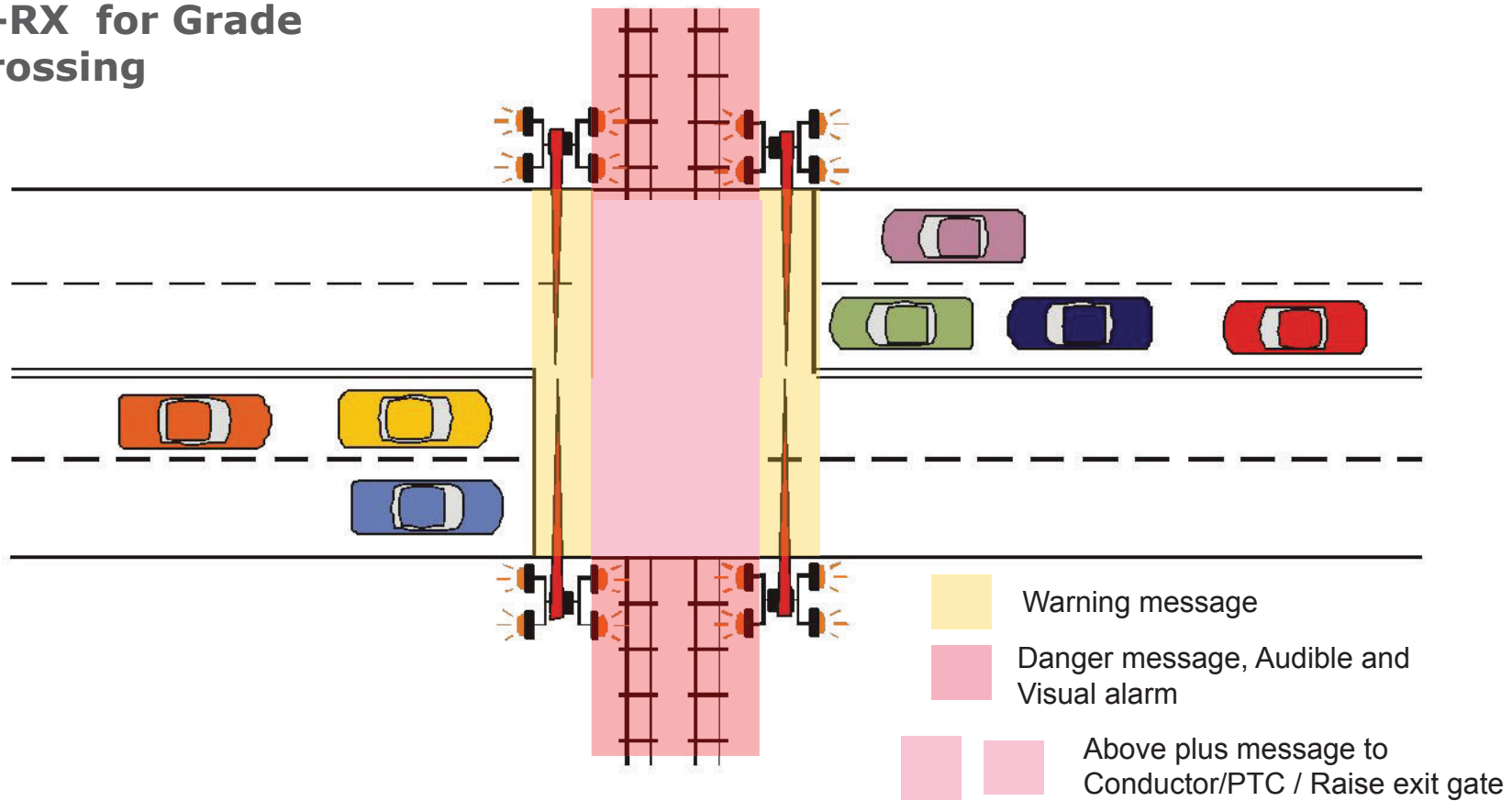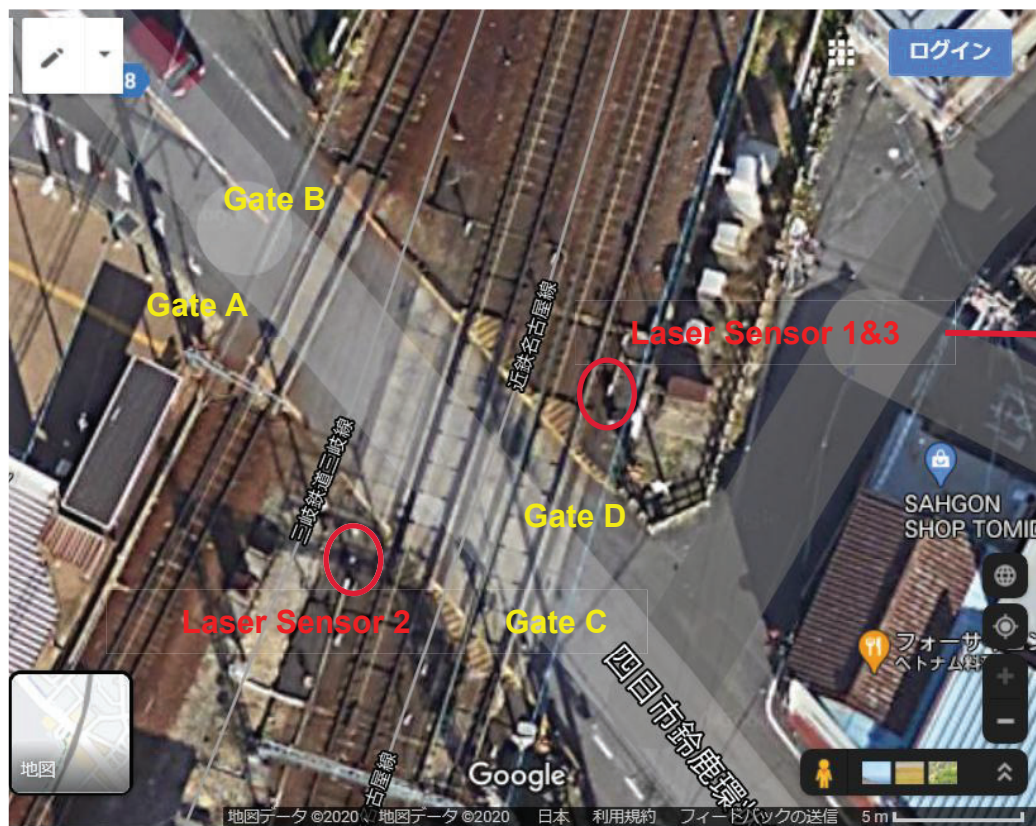

LiDAR

LiDAR sensor

Warning light

LiDAR

Signal to approaching train

Denso Wave Zone D-RX for Grade Crossing

Warning message

Danger message, Audible and Visual alarm

Above plus message to Conductor/PTC / Raise exit gate

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LiDAR at Four-Quadrant Gate – Typical Configuration

*Near Kintetsu Tomita Station,
Mie, Japan*
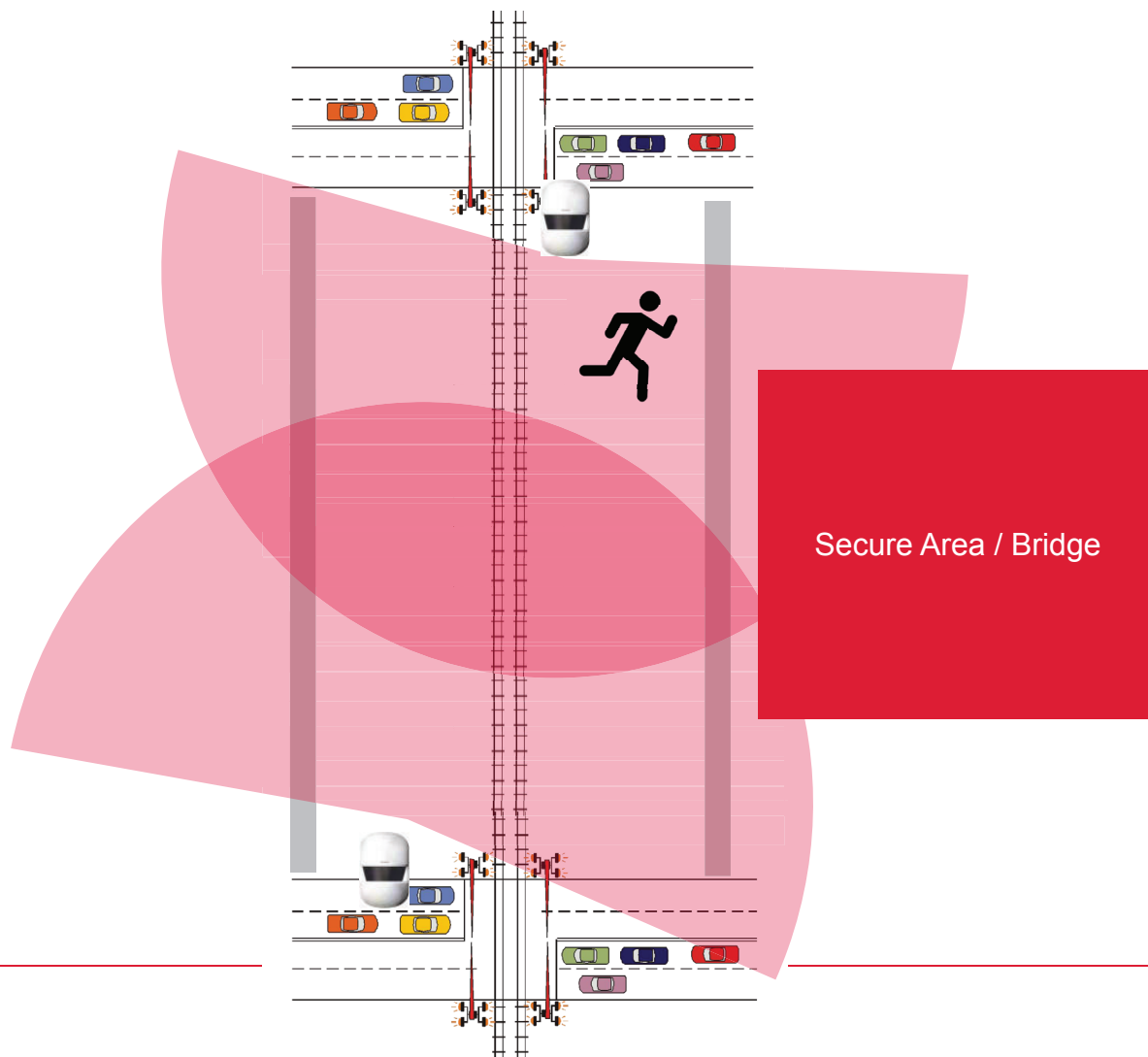
# LiDAR at Four-Quadrant Gate – Typical Configuration

LiDAR sensor for Safety, Security, and Suicide Prevention

- Identify trespassers who enter the ROW from grade crossing

- Audible and visual alarms can be generated

- Tie into Video camera and security system for archiving, alarming, and identification

Secure Area / Bridge

LiDAR sensor for Safety, Security, and Suicide Prevention

- Identify trespassers who access the railroad ROW

- Audible and visual alarms can be generated

- Tie into Video camera and security system for archiving, alarming, and identification

Secure Area / Bridge
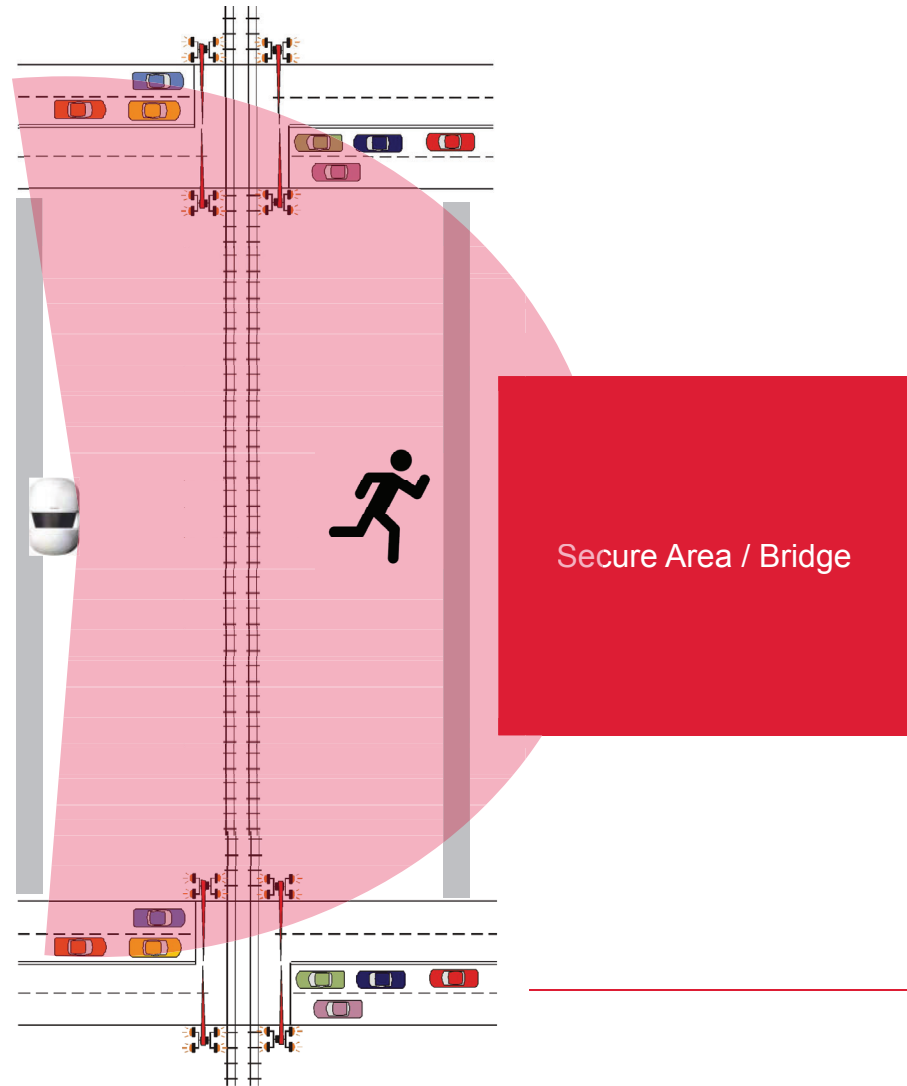
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LiDAR for Platform Safety and Suicide Prevention

- Audible & visual warning if passenger gets too close to safety gate

- Prevents train from leaving if someone inside of safety gate

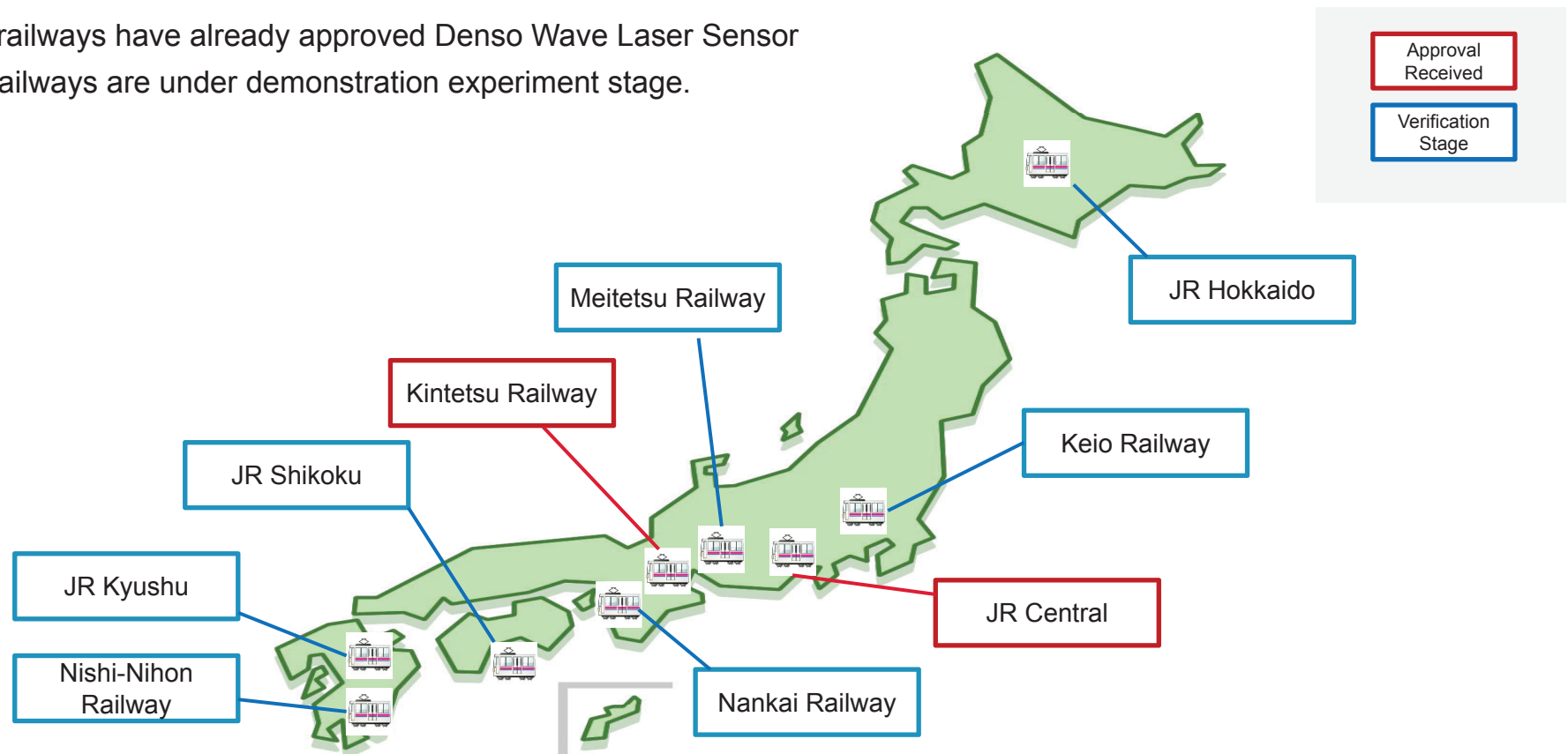- Identify if someone jumps or is pushed onto the tracks

Laser Sensor in Japan Rail Network

- 2 railways have already approved Denso Wave Laser Sensor
- 7 railways are under demonstration experiment stage.

Approval Received

Verification Stage

JR Hokkaido

Meitetsu Railway

Kintetsu Railway

Keio Railway

JR Shikoku

JR Kyushu

JR Central

Nishi-Nihon Railway

Nankai Railway

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Demonstration by Nishi-Nippon Railway

- Number of object detection by 2 different devices (ZONE-D and Photoelectric device)
- July 2019 – April 2020
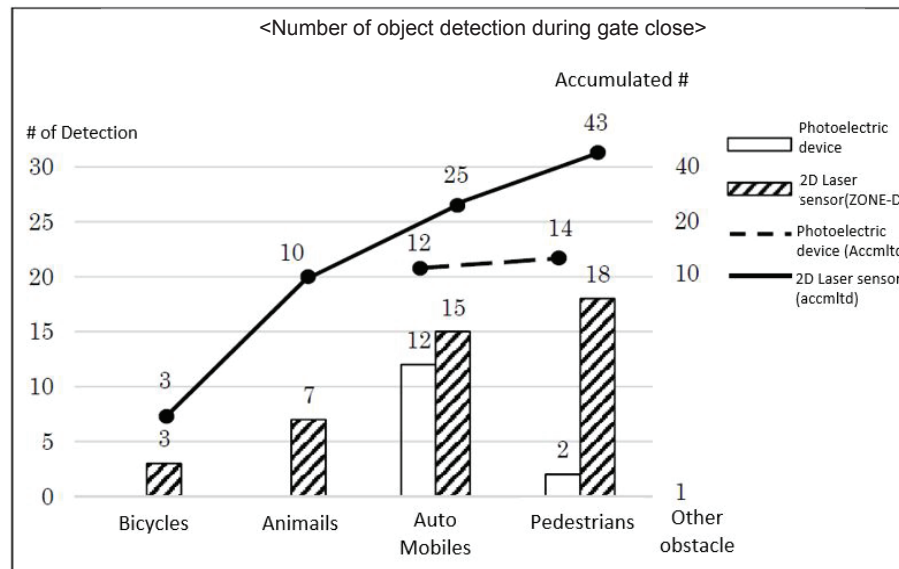
2D laser sensor (Zone-D) never missed any objects during demonstration period. *

   *Confirmed by images taken by network camera

36

ZONE-D's detectability is 3 times higher than photoelectric devices

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