

Tokyo Metro's Initiatives for Punctual Operations

Tokyo Metro Co., Ltd.

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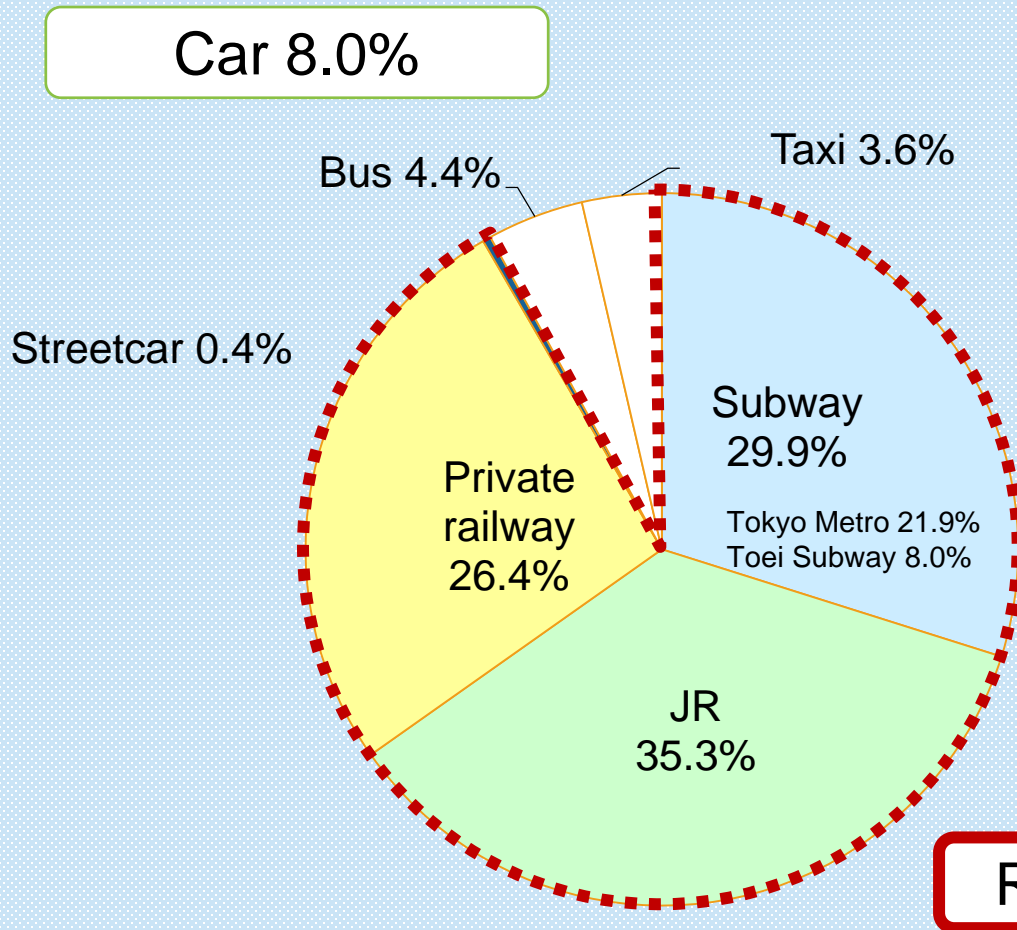
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3 Ratio of passengers by type of public transportation in Tokyo's 23 wards

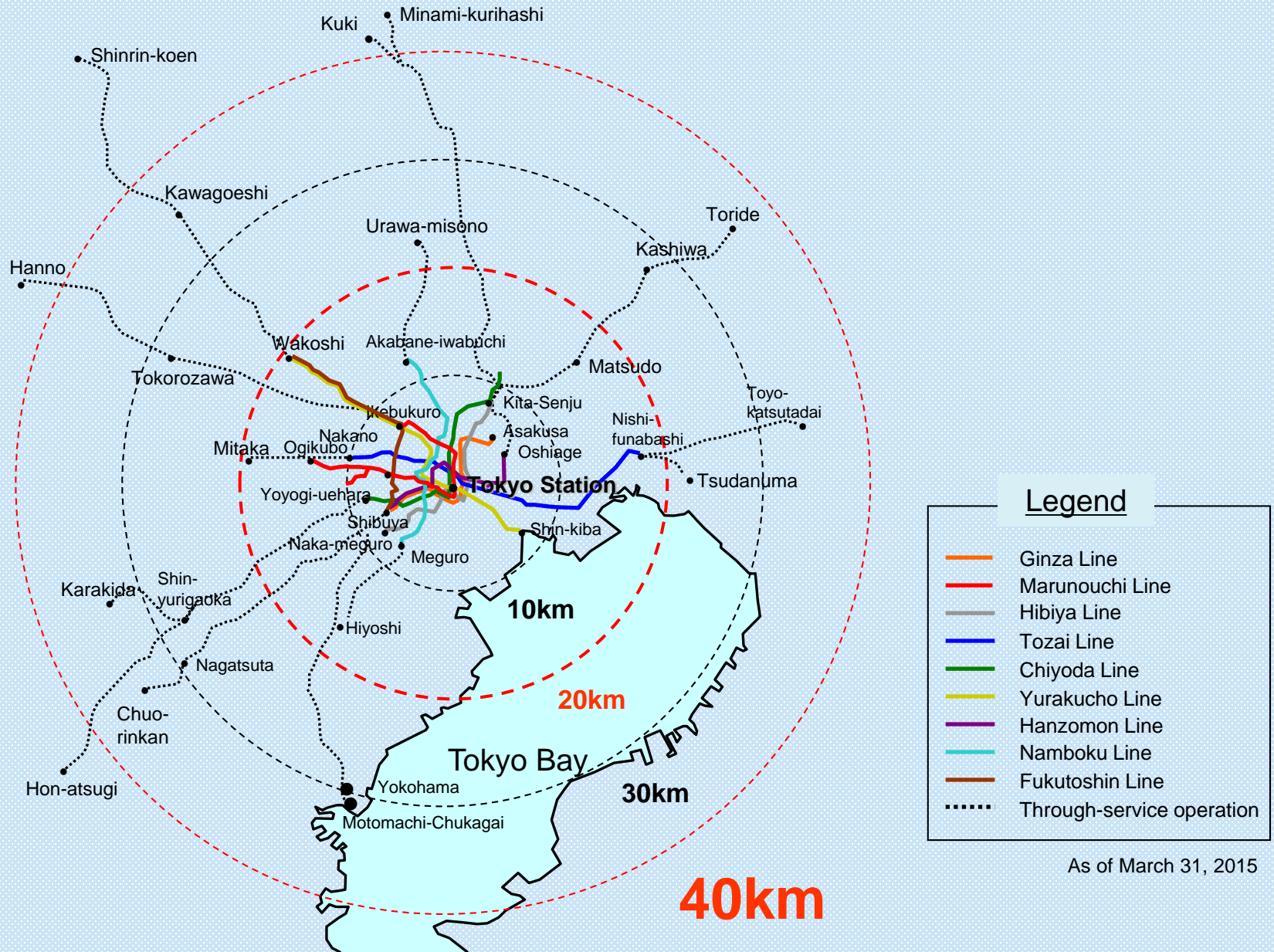
The ratio of railway users to the total number of public transportation users in Tokyo 23's wards is very high at 92% compared to 8% for bus and taxi.



Means of transportation	Passengers carried(in 1,000 persons)		Ratio (%)
	Annual	Daily average	
Subway	3,108,334	8,516	29.9%
JR	3,678,320	10,078	35.3%
Private railway	2,749,355	7,532	26.4%
Streetcar	38,233	105	0.4%
Bus	456,812	1,252	4.4%
Taxi	375,132	1,028	3.6%
Total	10,406,186		

FY2010

4 Reciprocal through-service operation expanded to 40km-zone from Tokyo Station



5 Example of initiative for stable operation: Tozai Line

Today, we will present our past and future initiatives for stable operation on the Tozai Line.



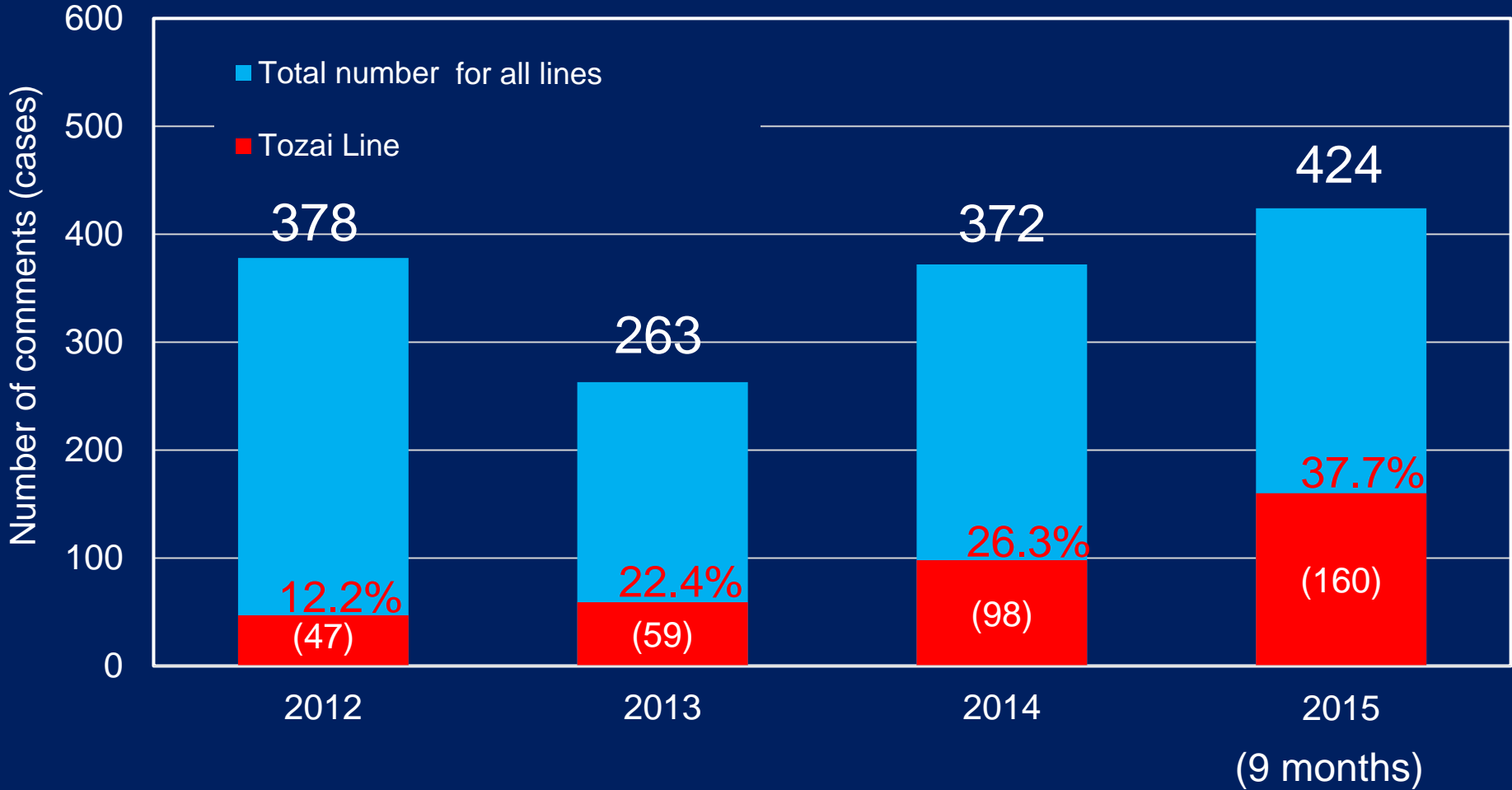
Line Name	Route Length (km)	Headway during morning rush hours
Ginza Line	14.3	2' 00"
Marunouchi Line	27.4	1' 50"
Hibiya Line	20.3	2' 10"
Tozai Line	30.8	2' 15"
Chiyoda Line	24.0	2' 05"
Yurakucho Line	28.3	2' 30"
Hanzomon Line	16.8	2' 10"
Namboku Line	21.3	3' 45"
Fukutoshin Line	11.9	3' 20"

Line Name	Route Length (km)	Morning rush hours	
		Congestion rate	Headway
Tozai Line	30.8	200%	2' 15"

6 Number of comments received concerning train delays

The number of comments received concerning train delays is increasing, indicating great demand for measures to prevent delays. Especially, the Tozai Line shows a significant increase in such comments, partly due to its high congestion rates.

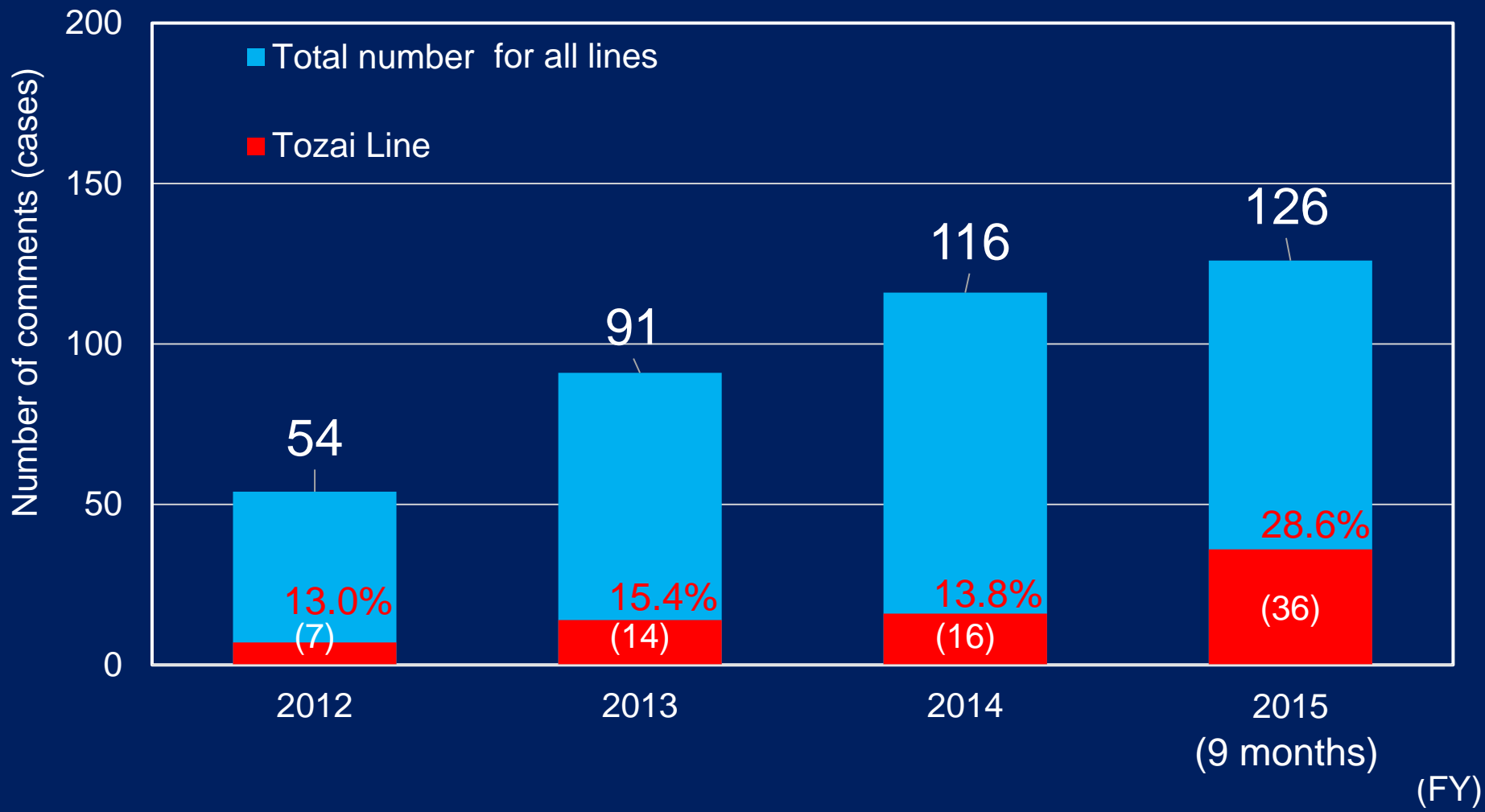
Number of comments received concerning train delays



7 Congestion rate target in Japan and number of comments on congestion mitigation

The target congestion rate set by the Japanese government for morning rush hours is 180%. The congestion rate on the Tozai Line is the highest in the Tokyo metropolitan area at 200%, and the Tozai Line receives many requests for improvements.

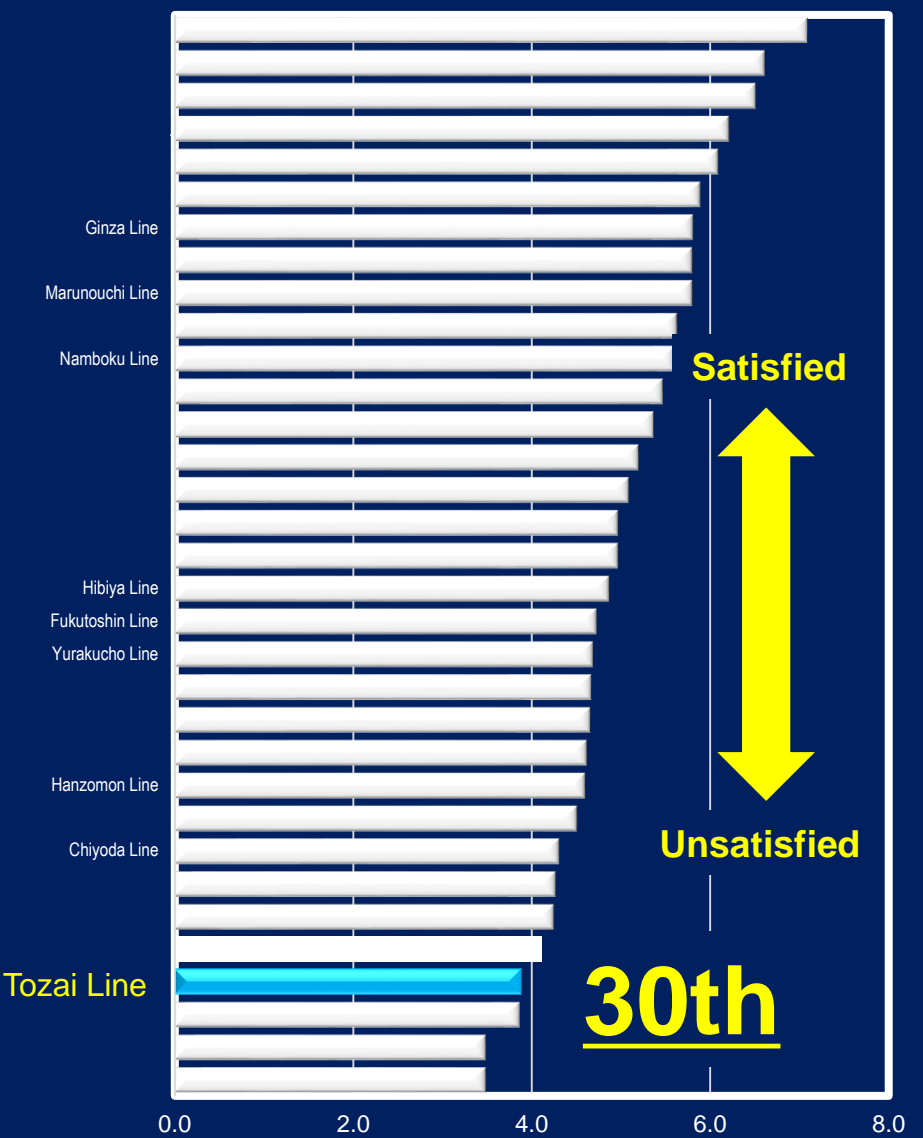
Number of comments on congestion mitigation



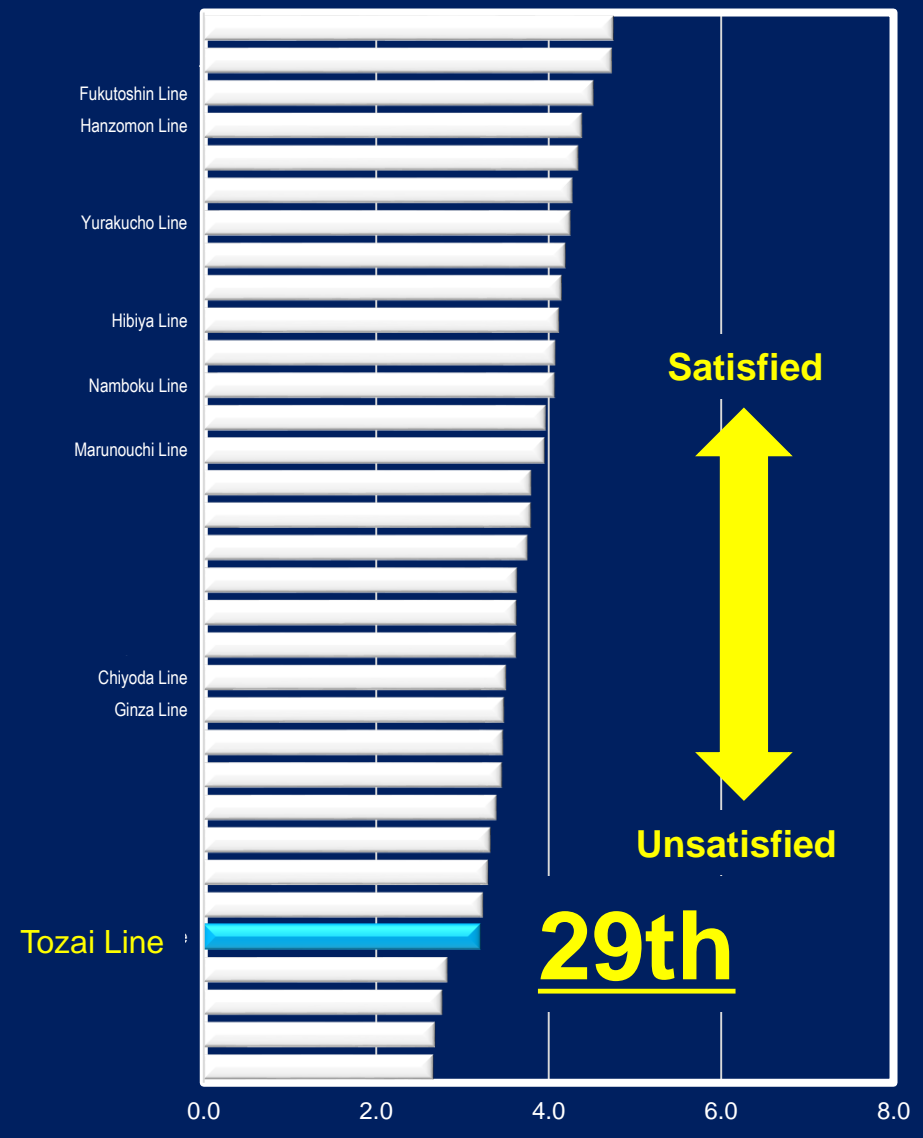
8 Survey results on passenger needs (conducted in Sep. 2015; 10,183 respondents; rating on a scale of 1 to 10)

Among the 33 major lines within 30 km from central Tokyo, passengers' evaluation of the Tozai Line with regards to train delays and congestion rates was very low, with the Tozai Line ranked 30th for delays and 29th for congestion. It is essential to make continuous efforts for improvements.

(1) Level of satisfaction regarding delay



(2) Level of satisfaction regarding congestion



I. Measures to prevent delays (Tozai Line)

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10 Travel route and time search apps

Many passengers use search apps. Passengers' needs for punctuality is high due to the availability of information that includes transfer information.

Departing at 11:11 Arriving at 11:50 ¥ 240 Transfers 2 times

Departing at 11:11



17 minutes
7.1km

Asakusa

Timetable

Tokyo Metro Ginza Line bound for Shibuya

Departing at 11:28
Arriving at 11:31



4 minutes
1.6km

Ginza

Timetable

Tokyo Metro Hibiya Line bound for Naka-meguro

Arriving at 11:35
Departing at 11:37



13 minutes
5.5km

Kasumigaseki

Timetable

Tokyo Metro Marunouchi Line bound for Ogikubo

Arriving at 11:50

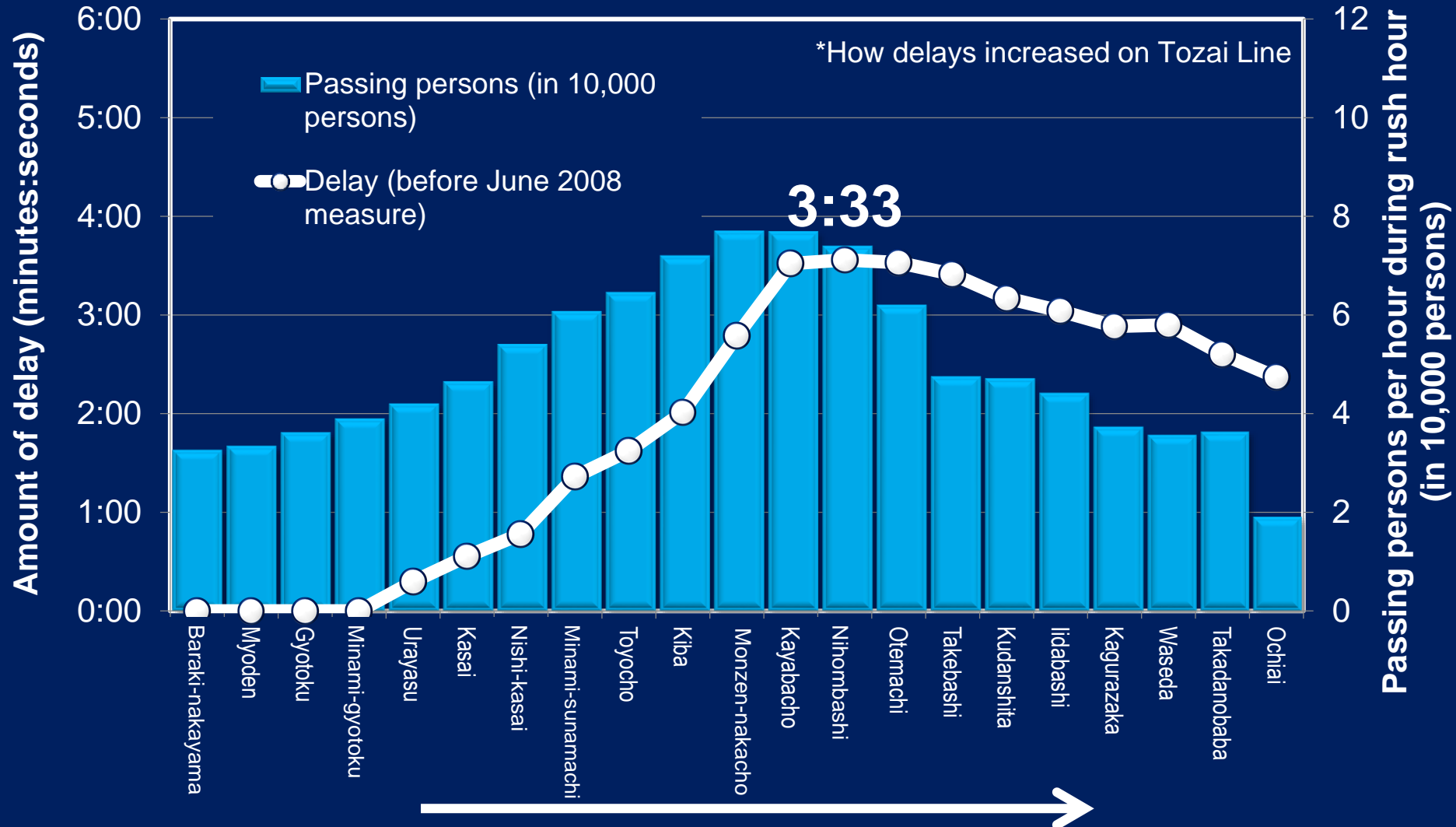
Shinjuku-sanchome

Timetable

11 Delays during the morning rush hour on the Tozai Line (June 2008)

Tokyo Metro has established functions to acquire and record the departure and arrival times of all trains (in seconds) at all stations. As of June 2008, delays increased due to increases in the number of passing persons, recording a maximum delay of 3 minutes 33 seconds.

Morning rush hour monthly average (1 hr.) (without trouble)



12 Measures taken to prevent delays

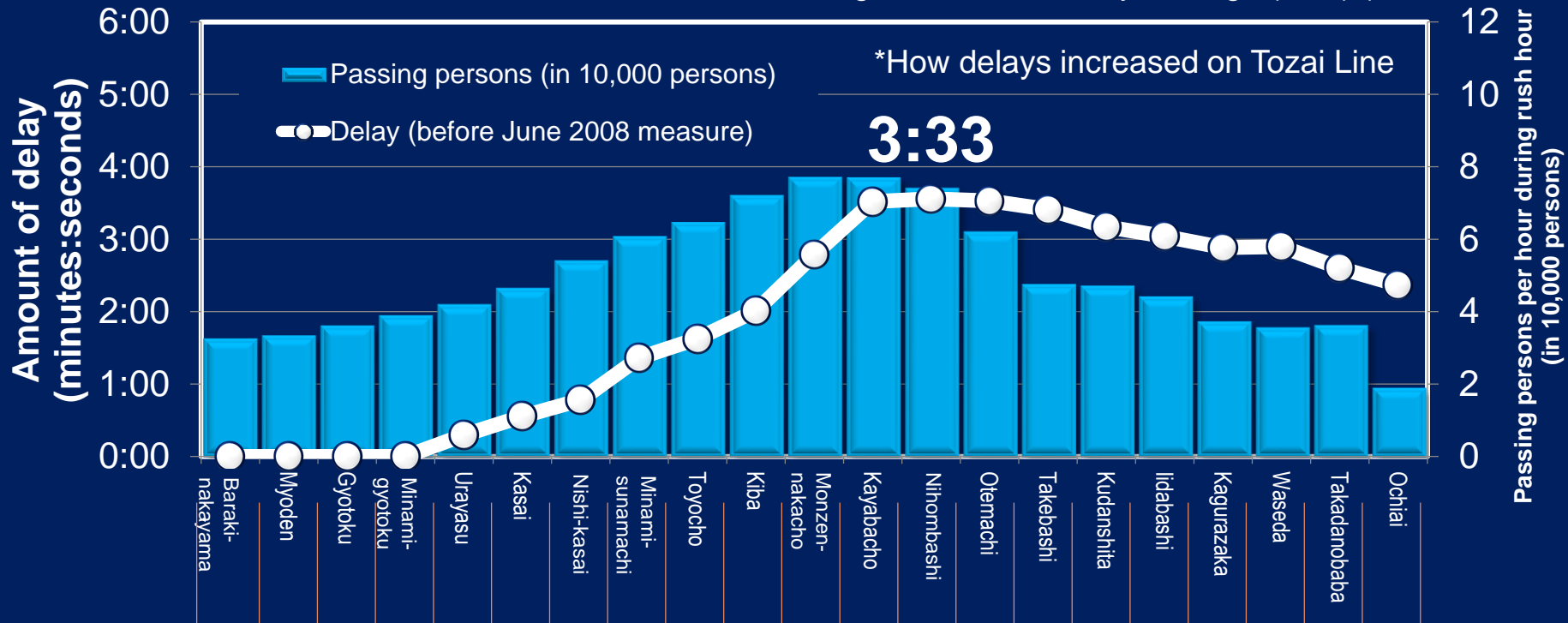
Measures taken include deployment of staff to assist passengers getting on and off trains at stations where dwell time is often extended, improvement of signal equipment in sections with excess travel time between stations, and introduction of train cars with wider doors.

Item	Expected effect
◆ Increase the number of staff to assist passengers getting on and off trains	<ul style="list-style-type: none">Stations between Nishi-funabashi and Otemachi 167 persons → 244 persons
◆ Signal equipment improvements	<ul style="list-style-type: none">Between Nishi-kasai and Minami-sunamachiBetween Monzen-nakacho and Kayabacho
◆ Introduction of cars with wider doors	<ul style="list-style-type: none">Introduced 13 trains with wider doors (18 trains in total)Used mainly during morning rush hours

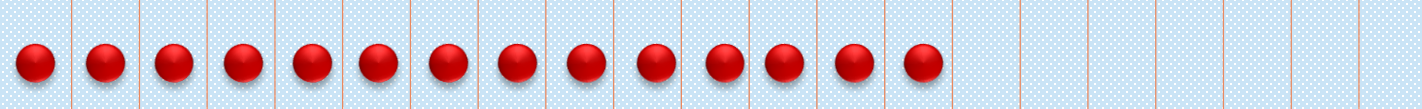
13 Delays during the morning rush hour on the Tozai Line (June 2008)

These measures were implemented at the stations below.

Morning rush hour monthly average (1 hr.) (without trouble)



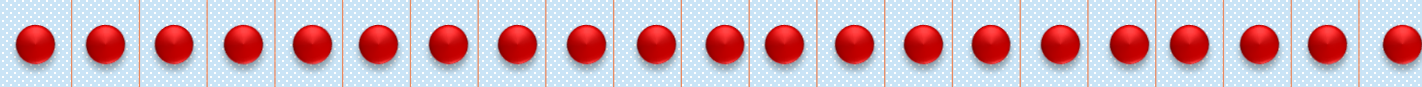
Deployment of staff to assist passengers getting on and off trains



Improvement of signal equipment



Introduction of cars with wider doors



14 Effect of staff assisting passengers getting on and off trains
(prevent them from getting caught in doors and to prevent doors from reopening)



Video

15 Improvement of signal equipment (adding intermediate codes)

Improved signal equipment (addition of intermediate codes) has made trains which used to stop less likely to stop, thereby reducing travel times between stations and enhancing stability.

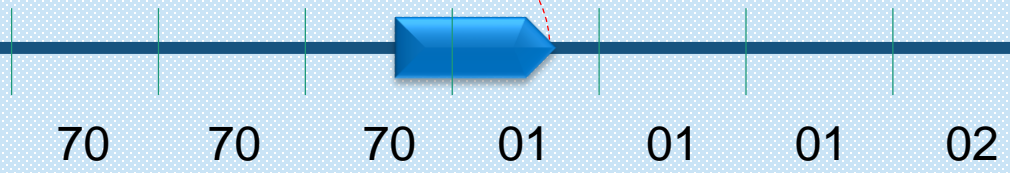
Before improvement

Monzen
-nakacho

A train stops between stations if the station dwell time of the preceding train is extended.

Permissible dwell time: **70** seconds

Kayabacho



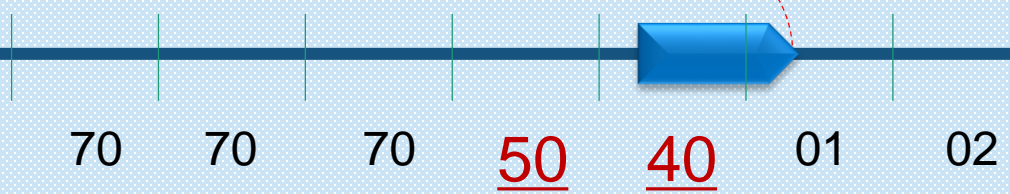
After improvement

Monzen
-nakacho

Improved dwell conditions with addition of intermediate codes

Permissible dwell time: **75** seconds (+5 seconds)

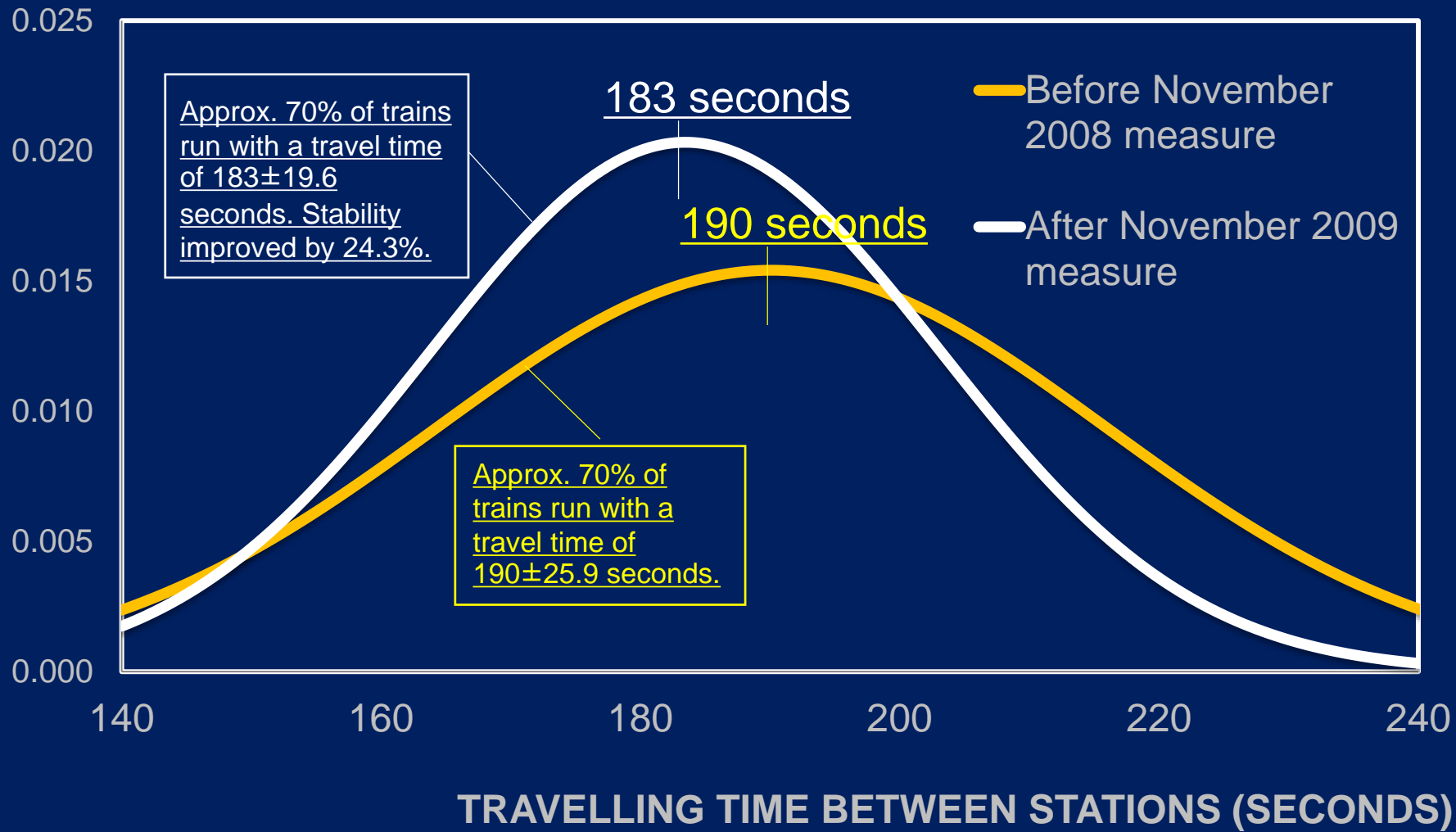
Kayabacho



16 Improvement of signal equipment between Monzen-nakacho and Kayabacho

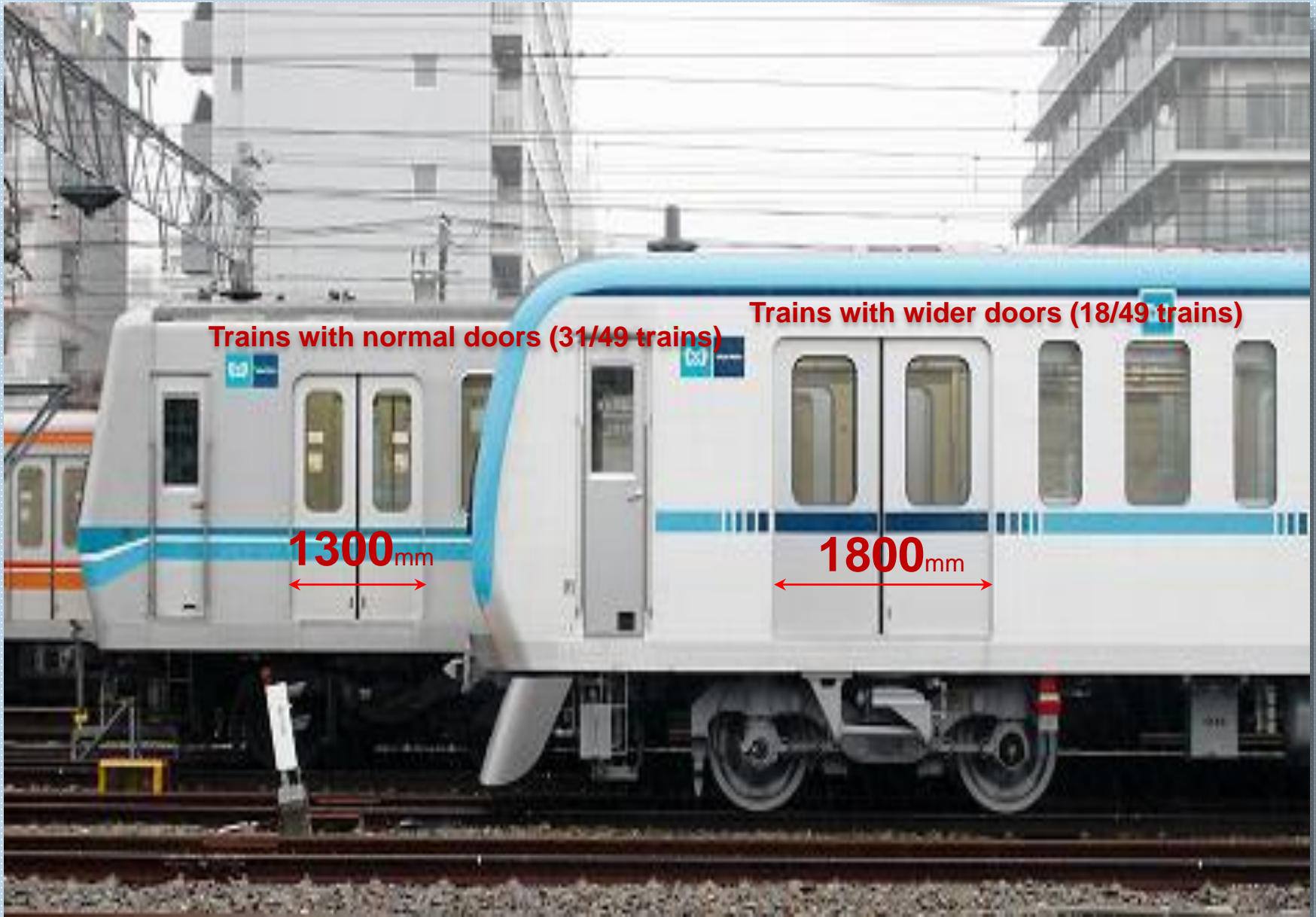
The improved signal equipment reduced travel time by 7 seconds and increased stability by 24.3%.

Effect of improved signal equipment (between Monzen-nakacho and Kayabacho)



17 Wider doors

Of 49 trains on the Tozai Line, 18 were upgraded to those with wider doors, and they are mainly used during the morning rush hours for the congested direction.



18 Effect of wider doors (Passengers getting on and off)

Trains with wider doors are used mainly during congested morning rush hours. The time for passengers getting on and off was reduced by between 1 and 7 seconds, depending on the station.

Trains with normal doors (31/49 trains)

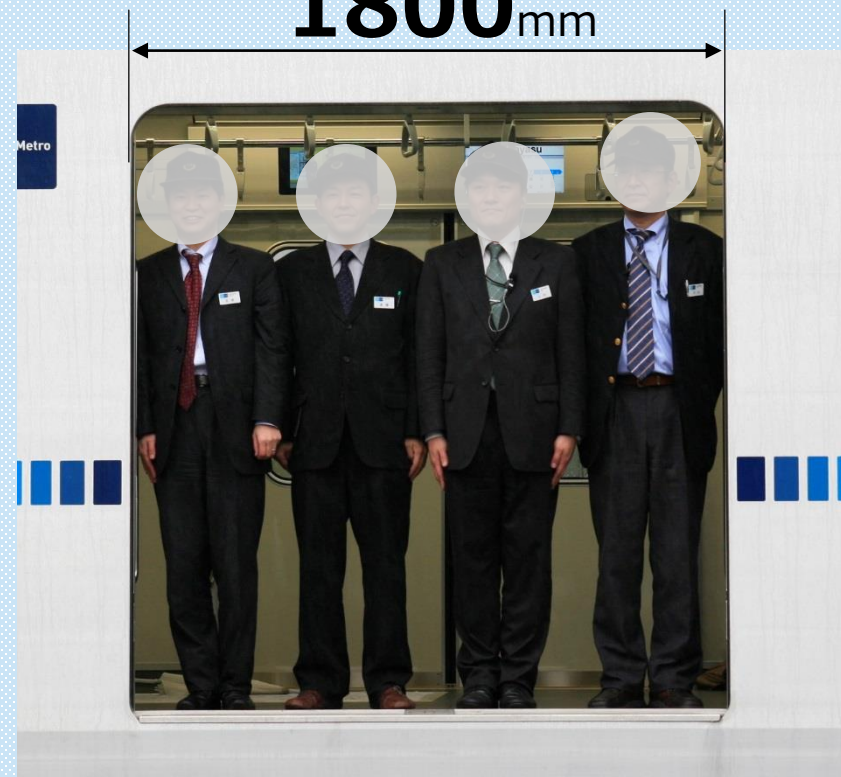
1300mm



Width of open door: 3 persons

Trains with wider doors (18/49 trains)

1800mm

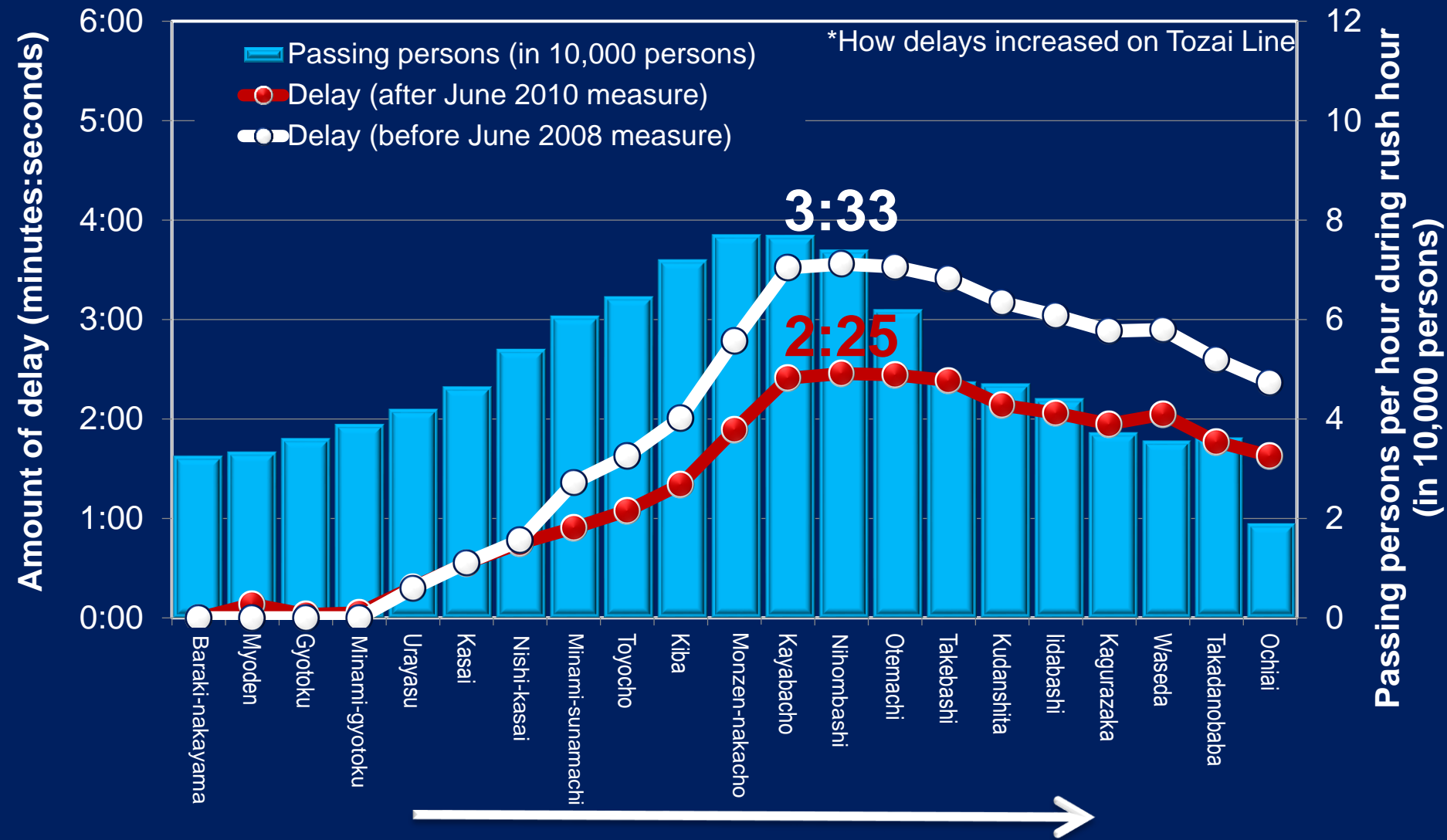


Width of open door: 4 persons

19 Comparison of delays during morning rush hour on the Tozai Line

The measure had the effect of reducing delays by 1 minute and 8 seconds. The delay was cut by approx. 32%.

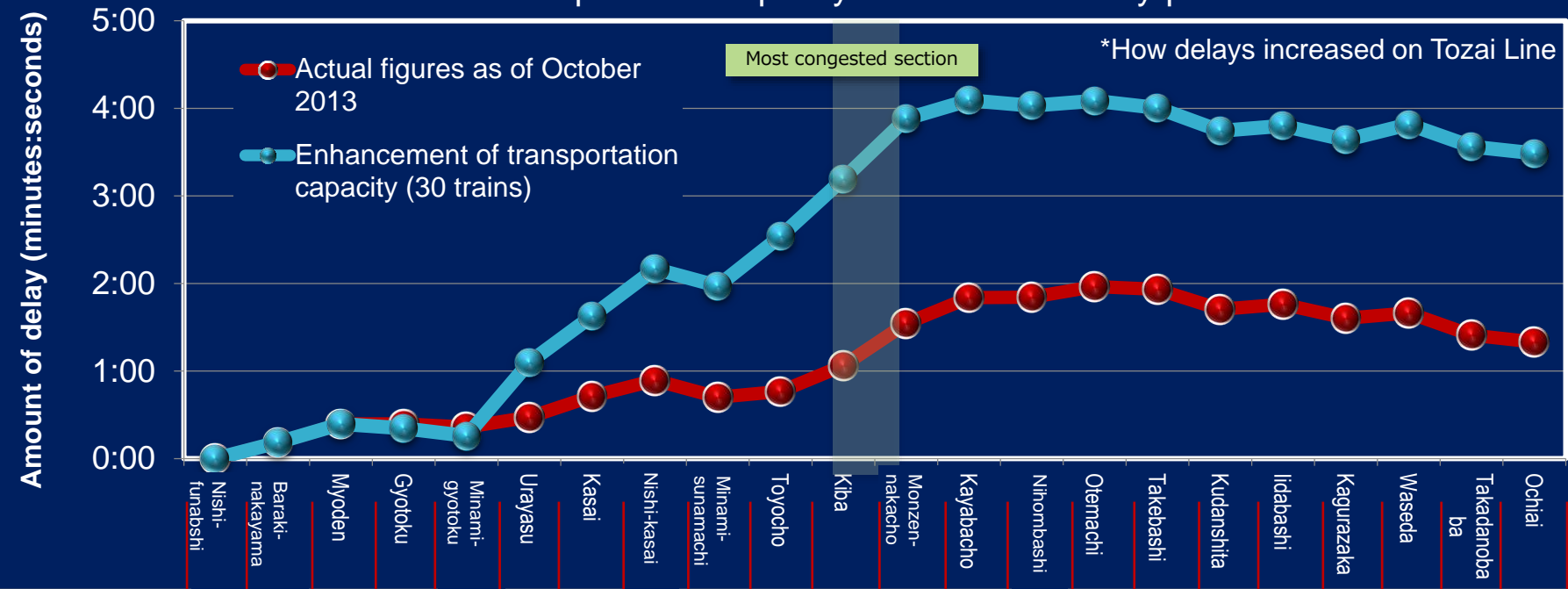
Morning rush hour monthly average (1 hr.) (without trouble)



20 Expected delay with enhanced transportation capacity and future measures to prevent delays

If the transportation capacity is increased seconds from 27 trains to 30 trains, the headway between trains will be shortened by 15, which will reduce the operation leeway and cause more delays. Prevent delays from increasing by also implementing measures to prevent delays.

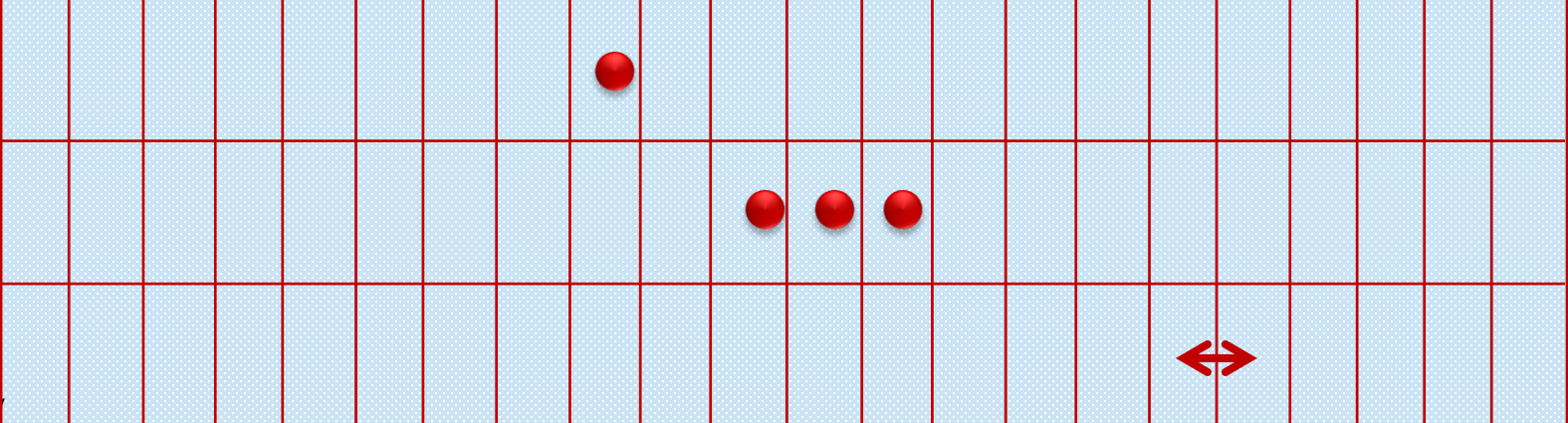
Tozai Line: Transportation capacity increase and delay-prevention measures



Introduction of 2 platforms for 3 tracks
Enhancement of capacity to absorb delays

Improvement of platforms
Improvement of passenger flow

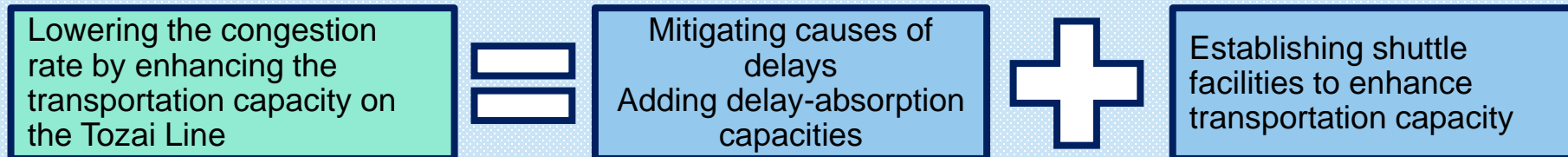
Additional shuttle operation tracks installed
Enhancement of transportation capacity



21 Further transportation improvements in the future

- 1 If the number of trains is increased to enhance the transportation capacity, more delays will become an issue; therefore it is necessary to mitigate causes of delays and add delay-absorption capacities.
 - Mitigating delay factors (reducing dwell time at stations): improving platforms of Minami-sunamachi, **Kiba**, Monzen-nakacho, **Kayabacho**
 - Adding delay-absorption capacity: adoption of 2 platforms and 3 tracks for **Minami-sunamachi Station**
- 2 In order to lower the congestion rate on the Tozai Line (200%), it is essential to enhance its transportation capacity, but the shuttle capacity is at its limit.
 - Enhancing shuttle capacity by improving **Kudanshita's shuttle track** (added 3 trains)

Goal to aim for on the Tozai Line



Operational targets on the Tozai Line

Congestion rate: Decreased from **200%** to **180%**

Amount of delay: Decreased from approx. **3** minutes to **2** minutes or lower (in the most congested sections)

22 Minami-sunamachi Station on the Tozai Line Construction to create 2 platforms and 3 tracks

Added delay-absorption functions by improving on 1 platform for 2 tracks and making it 2 platforms for 3 tracks.

Before improvement

One route

To Nakano

To Nishi-funabashi



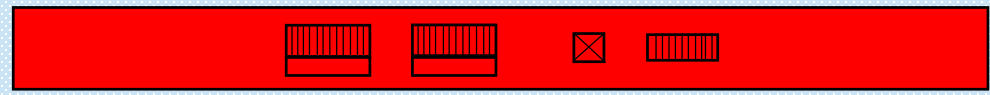
After improvement



Two routes

To Nakano

To Nishi-funabashi

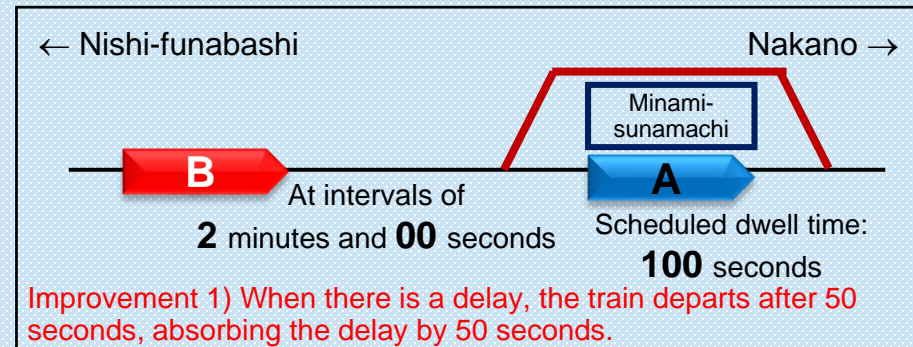
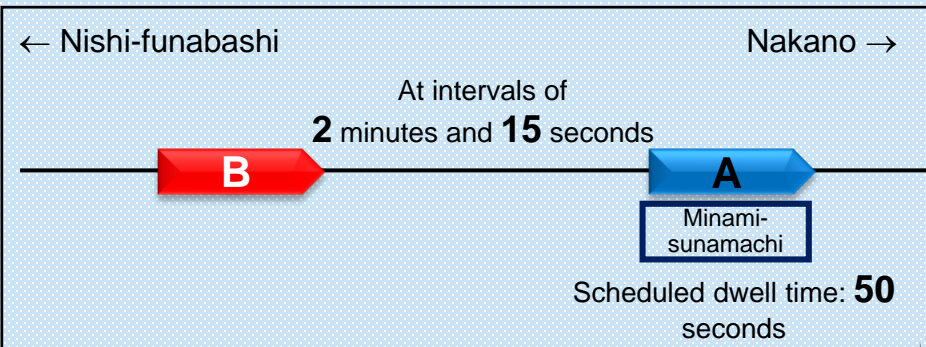


23 Adding stable delay-absorption functions by conversion to 2 platforms for 3 tracks for 3 tracks

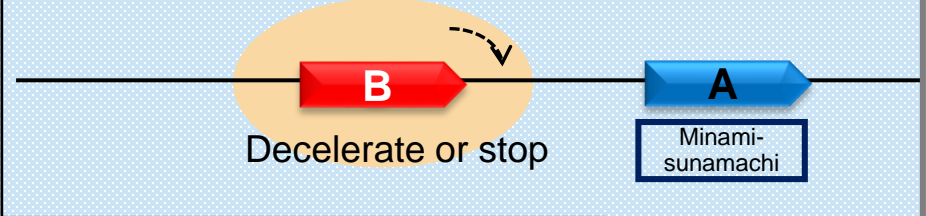
With the conversion to 2 platforms for 3 tracks in Minami-sunamachi Station, the scheduled dwell time can be set at 100 seconds even if the number of trains is increased to 30 from 27. While adding stable delay-absorption functions, the conditions for succeeding trains to enter the station will be also improved significantly.

Current state: Number of trains operated: 27
Scheduled dwell time: 50 seconds

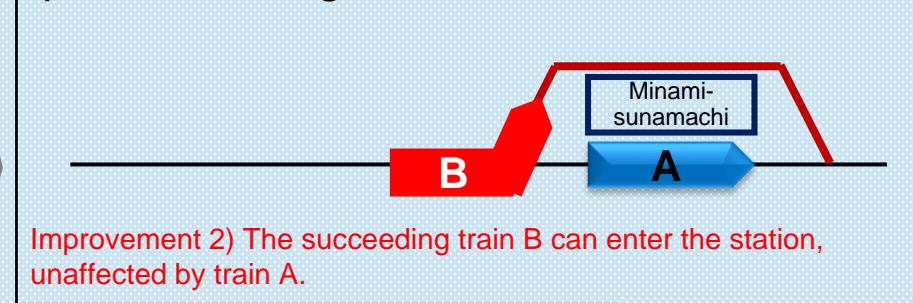
After improvement: Number of trains operated: 30
Scheduled dwell time: 100 seconds



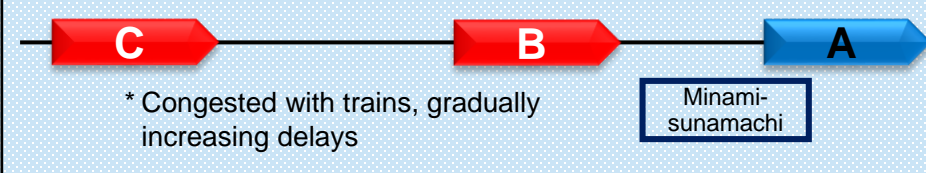
1) When exceeding the dwell time
 The succeeding train B decelerates and stops, creating a delay.



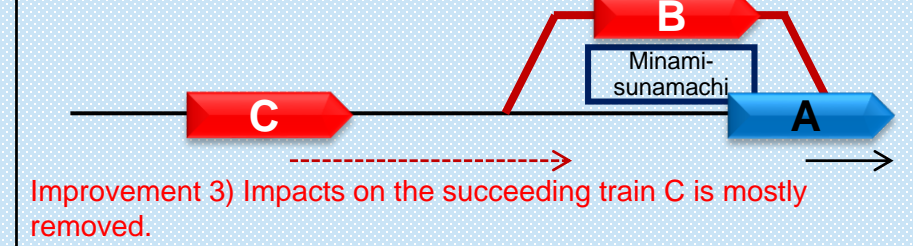
1) When exceeding the dwell time



2) Impact on succeeding trains
 The succeeding train C also decelerates and stops, increasing the delay.



2) Impact on succeeding trains

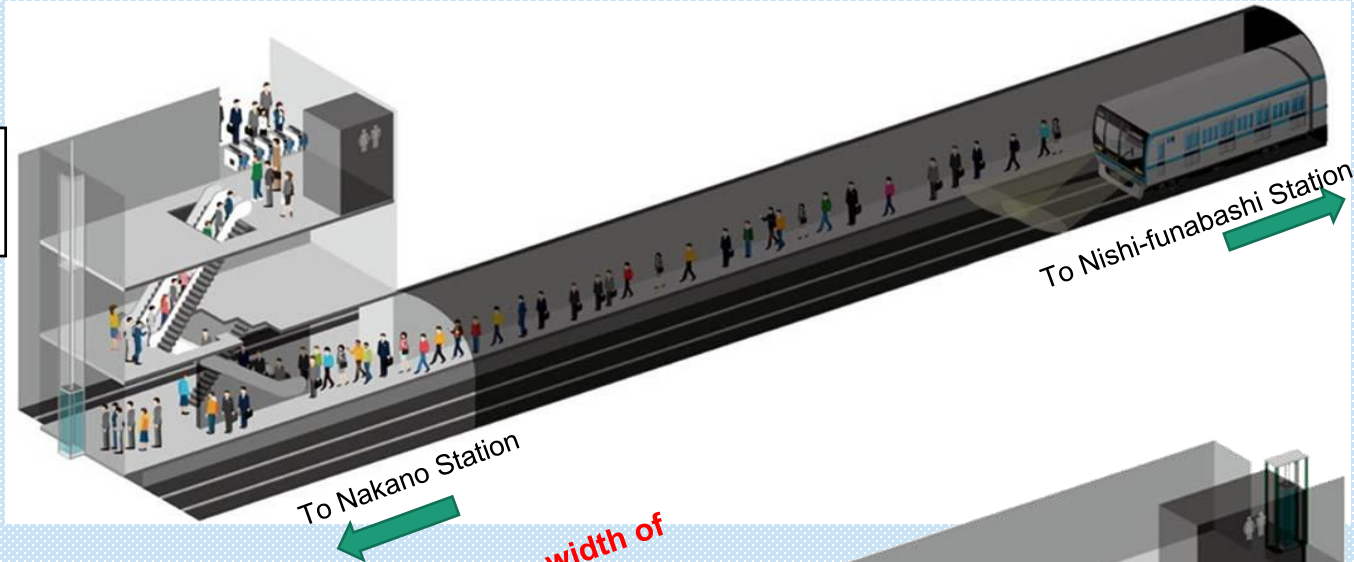


24 Kiba Station on the Tozai Line

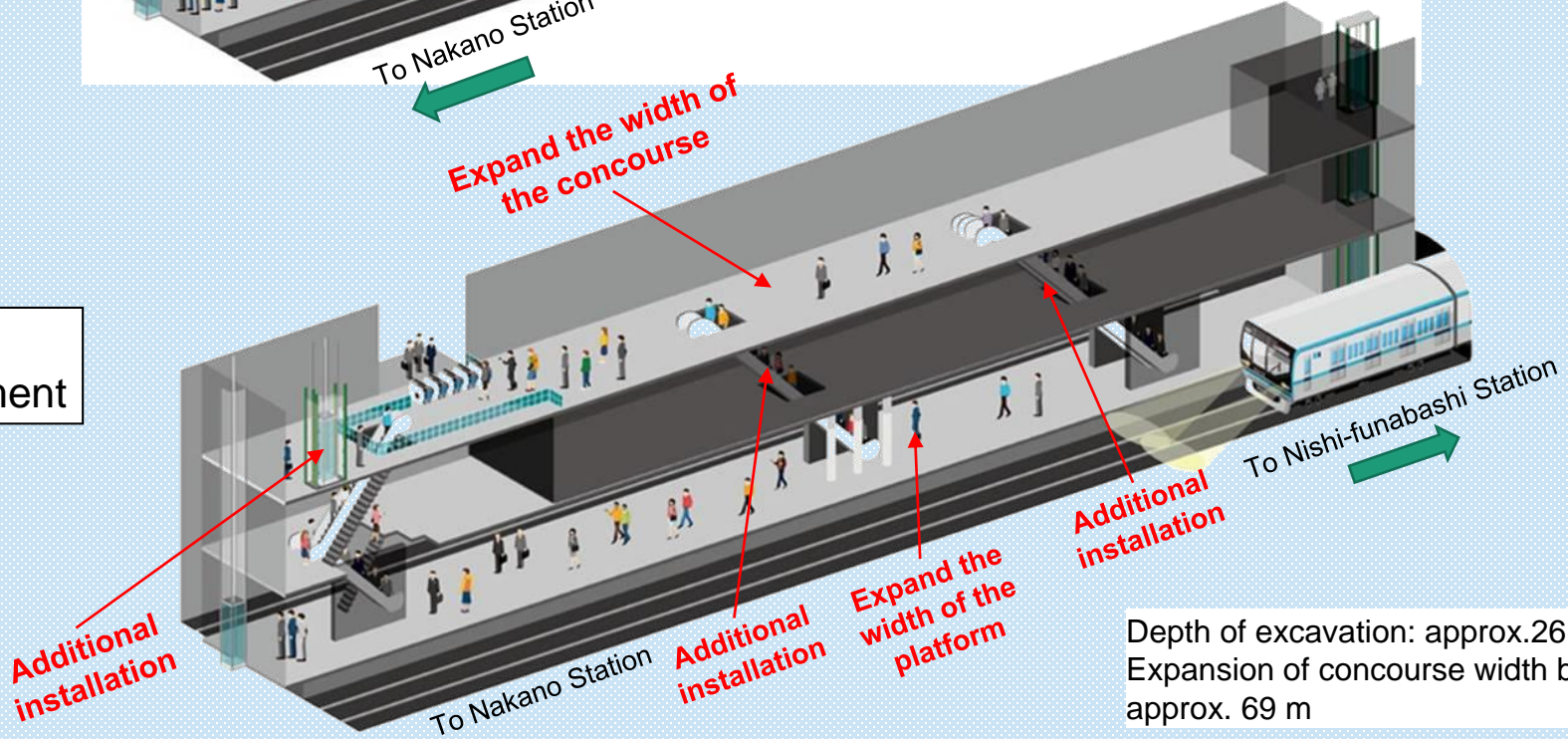
Construction work to improve flow of passengers getting off trains

Improve passenger flow and reduce dwell times by expanding the width of the platform and installing 2 additional escalators.

Before improvement



After improvement



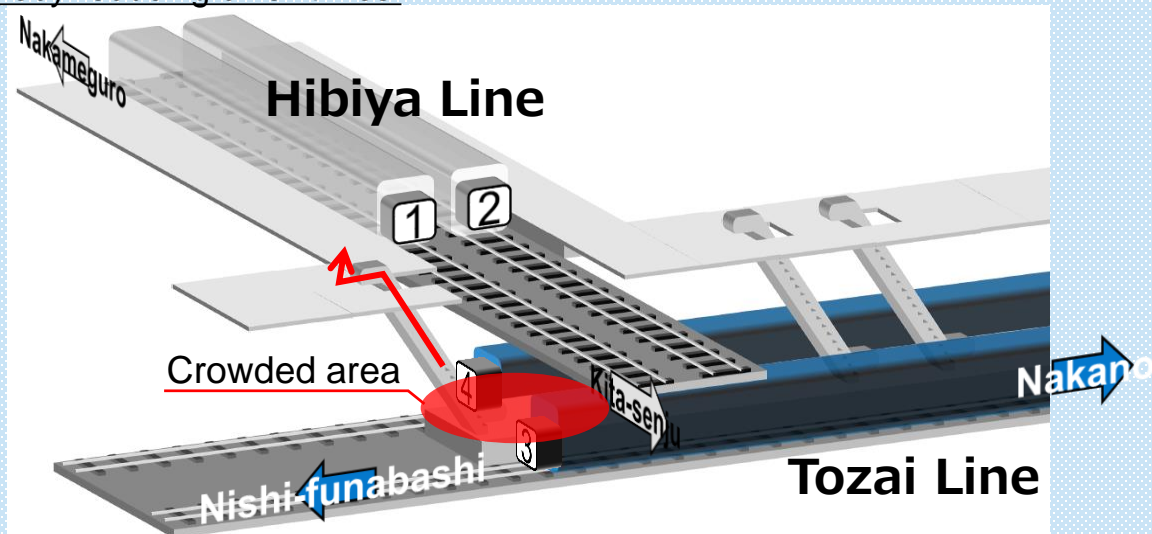
Depth of excavation: approx. 26 m
Expansion of concourse width by: approx. 69 m

25 Kayabacho Station on the Tozai Line

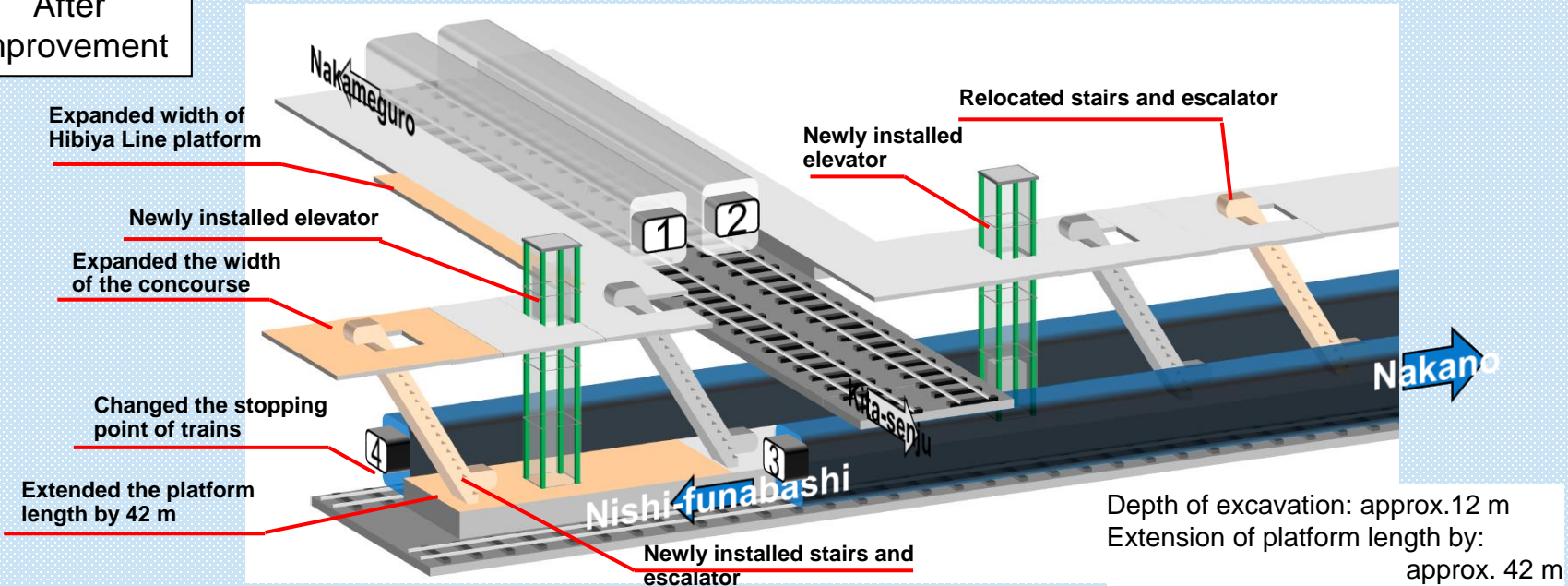
Construction work to improve flow of transferring passengers

Improve passenger flow by taking such measures as extending the platform, installing additional escalators and changing stopping points of trains, thereby reducing dwell times.

Before improvement

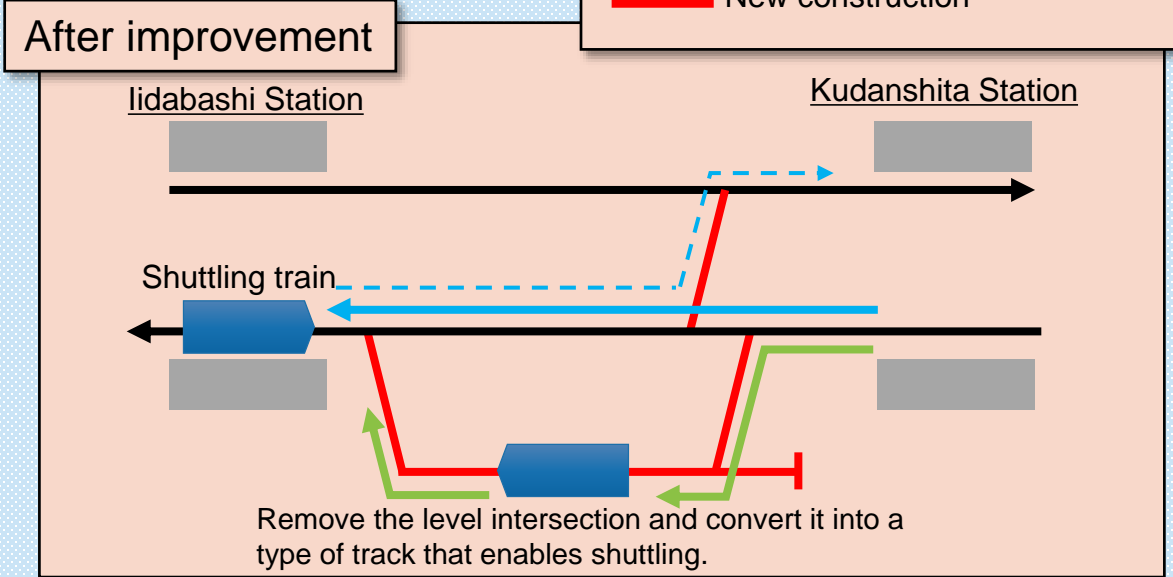
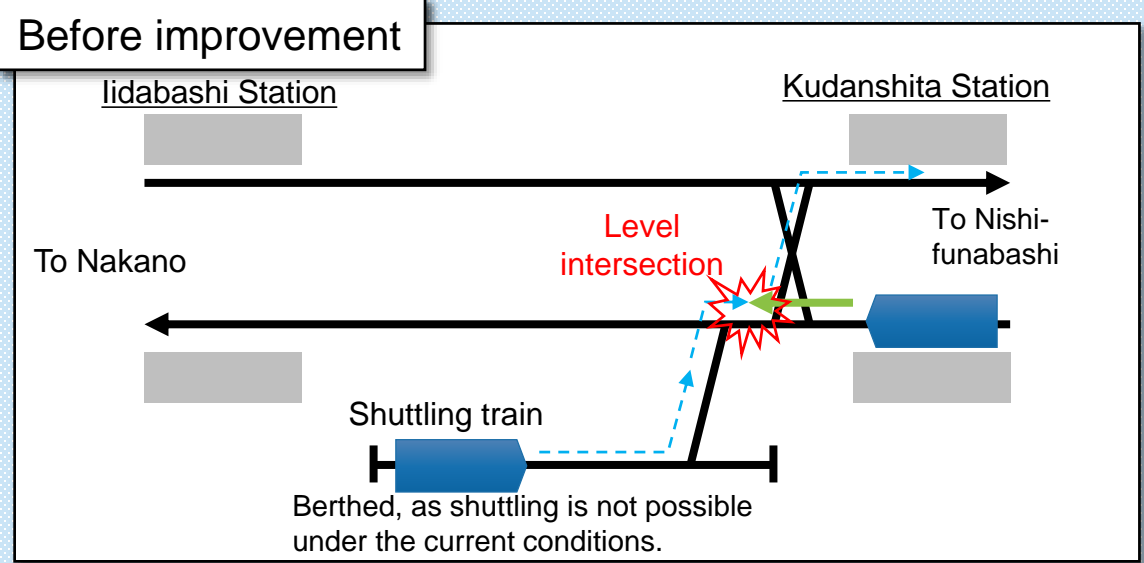


After improvement



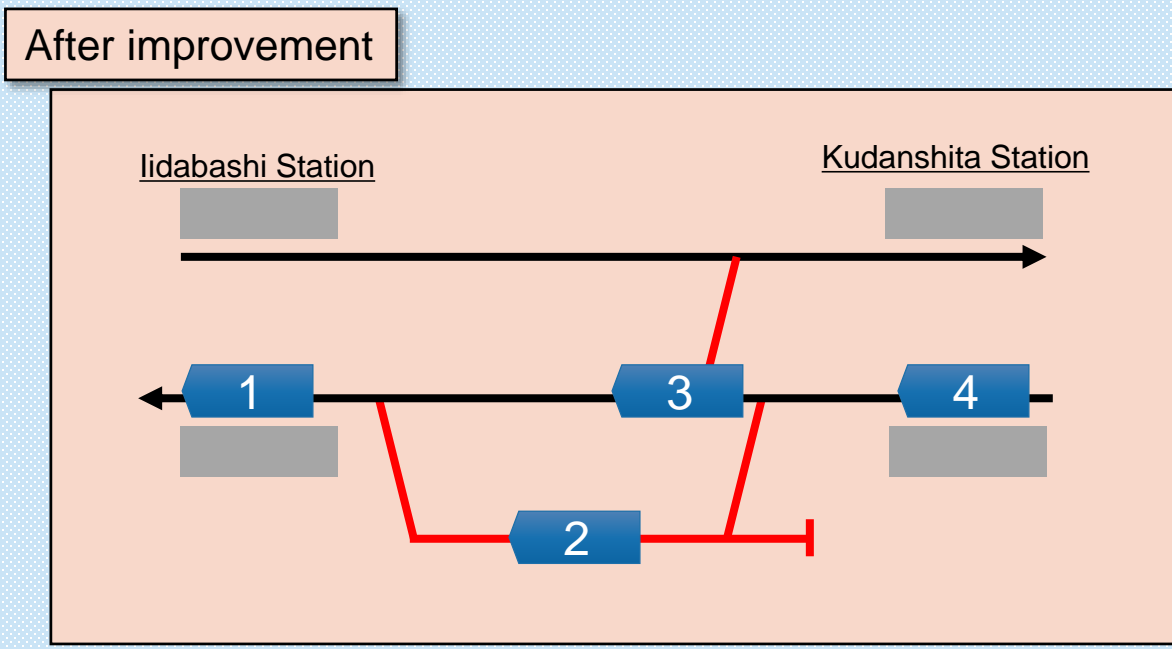
26-① Measures to further stabilise transportation on the Tozai Line and expected effects

The shuttle capacity of the terminal Nakano Station is at its limit. Therefore, aim to operate 3 additional trains and achieve a congestion rate of 180% by adding shuttle functions to the section between intermediate stations.



26-② Measures to further stabilise transportation on the Tozai Line and expected effects

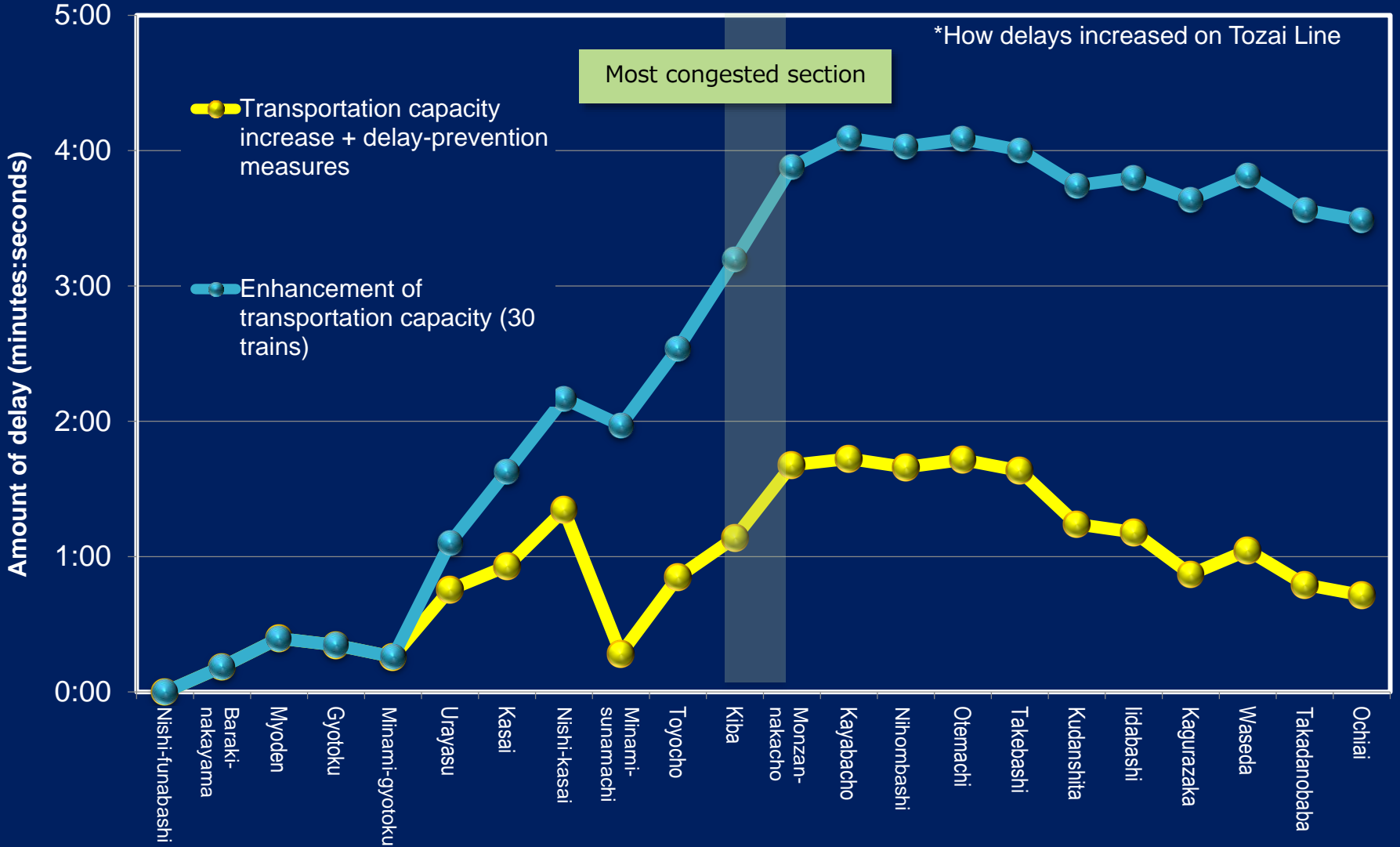
The two routes are put to good use when the shuttling function is not set, making delay-absorption possible.



27 Measures to further stabilise transportation on the Tozai Line and expected effects

By implementing the measures described earlier to prevent delays, they will be kept at the current level even if the transportation capacity is increased.

Transportation capacity increase and delay-prevention measures



II. Measures for preventing transportation disruptions

1. Occurrence of transportation disruptions

2. Installation of platform doors

- Installed on 4 lines and part of 1 line (out of 9 lines)

Preparing for installation in 3 Lines

3. Measures to stabilise transportation at stations with platform doors (video)

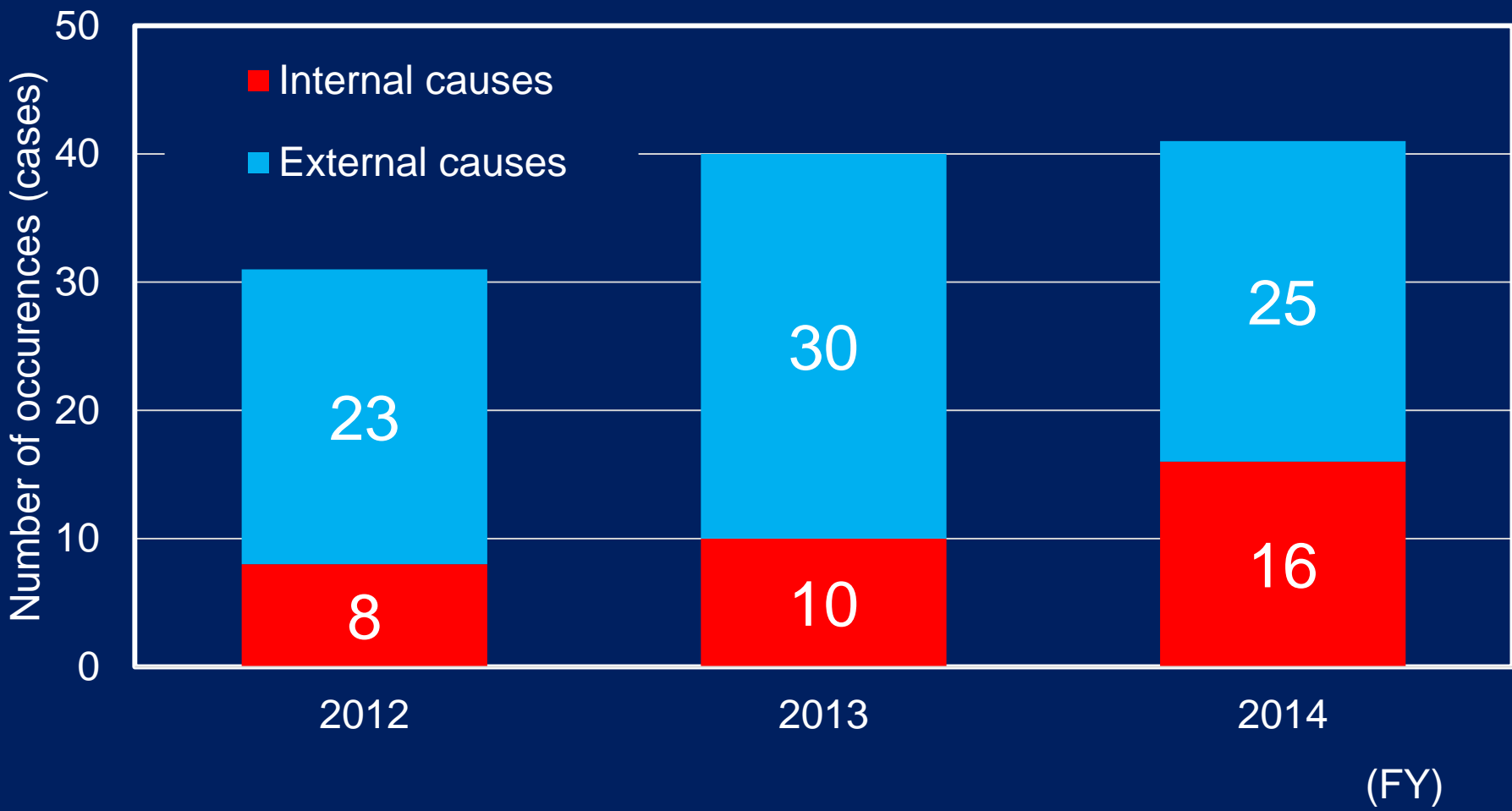
- At congested platforms, platform doors can be the cause of delays.

Prevent delays by adopting special ways of handling the situation that are suitable for the conditions of each station.

29 Occurrence of transportation disruptions (all lines)

The number of train disruptions is about 40 per year. We are working to promptly resume services whenever a disruption occurs by such means as improving the function of the Integrated Control Center. We aim to reduce disruptions caused by external factors, such as accidents involving a human life or injuries, by introducing platform doors. The number of disruptions caused by equipment failure or other internal factors is increasing, and this is one of the issues to be addressed.

Transportation disruption
(30 minutes or longer operation suspension + accidents involving a human life or injuries)



30 Measures to prevent transportation disruptions: Installation of platform doors

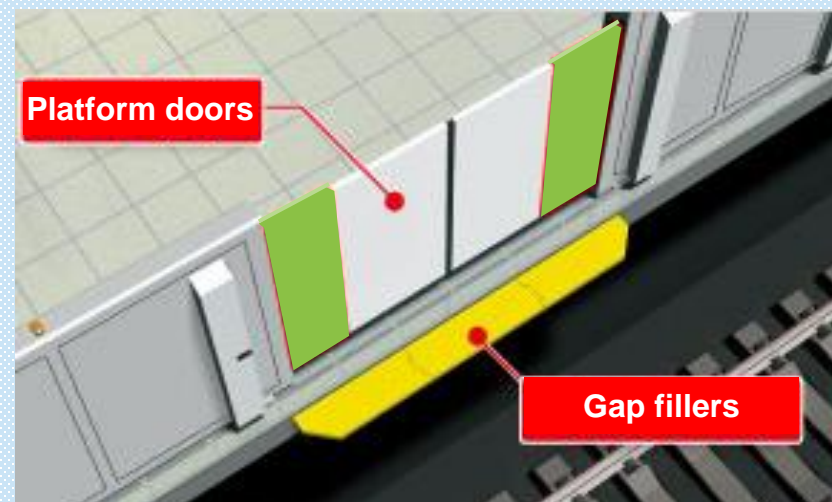
Full-height type



Half-height type



- ◆ Lines in which platform doors already installed (5 Lines)
Marunouchi Line, Yurakucho Line, Fukutoshin Line, Namboku Line, Chiyoda Branch Line
- ◆ Lines preparing for installation (3 Lines)
Ginza Line, Hibiya Line, Chiyoda Line
- ◆ Lines that are considering installation (2 Lines)
Tozai Line, Hanzomon Line
- ◆ Gap fillers
Install gap fillers for exits and entrances with a gap of 135 mm or more between the platform and the train where there is a curve in the platform.



31 Effects of platform doors and delay-prevention measures at stations with platform doors

◆ The number of platform accidents was reduced to almost zero with the installation of platform doors. Aim to install them on all lines.

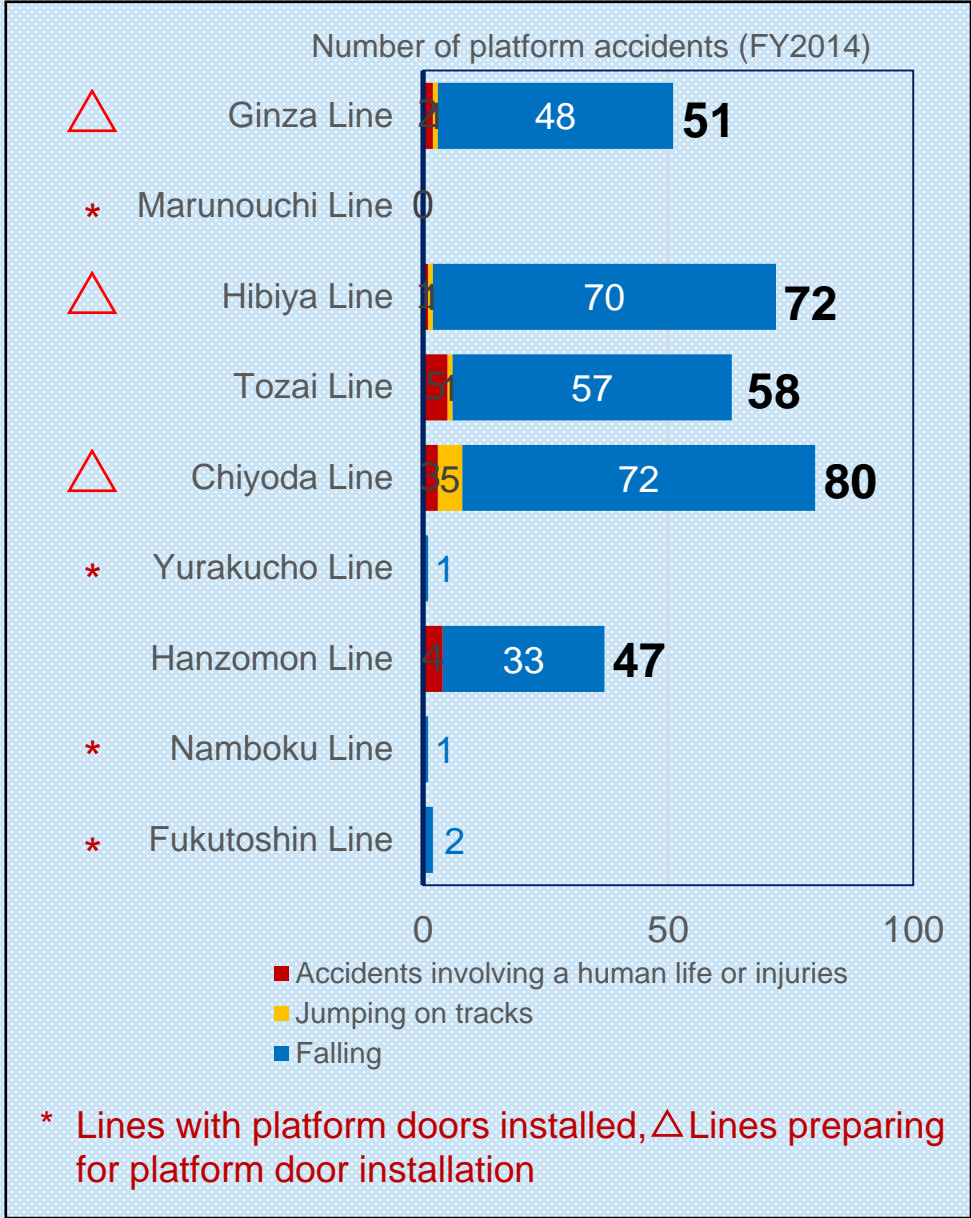
◆ Key measures taken to prevent delays for lines where platform doors are installed.

(1) Shinjuku Station
Prevent delays by switching off the device that links the platform doors to the train doors and handling them separately.

Video

(2) Ikebukuro Station
Prevent delays by securing enough space for passenger flow using rope control.

Video



III. Enhancement of Integrated Control Center functions

1. Initiatives for train operations with equal intervals
 - Suspend the departure of trains for 1 minute or longer and in 30-second units thereafter, giving frequent instructions on operation intervals as necessary. Prevent delays from increasing by preventing the occurrence of highly congested trains.
2. Enhancement of functions for shuttle operation at intermediate stations
 - Minimize the time and sections of train suspension by conducting shuttle operations in the event of any transportation disruption.
3. Enhancement of Integrated Control Center functions

33 Initiatives for train operations with equal intervals Installation of operation instruction equipment

Entry screen operated by controllers



Operation indicator viewed by train crew and station staff



Count down in 5-second units

Problem: Intervals between trains get disorganised due to disruption, and this causes specific trains to become highly congested, quickly increasing delays.



Measure: The Integrated Control Center gives instructions to trains to coordinate operations and maintains equal intervals between trains.

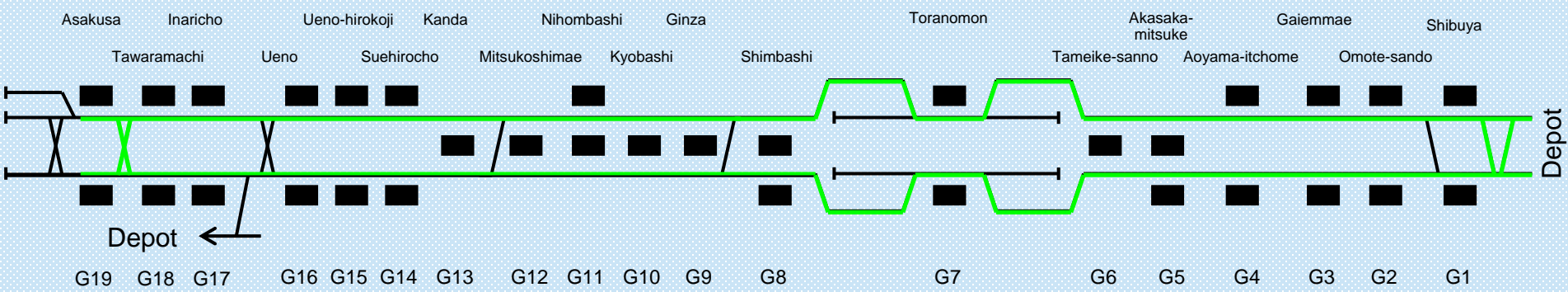


34 Measures to minimize time and sections of train suspension

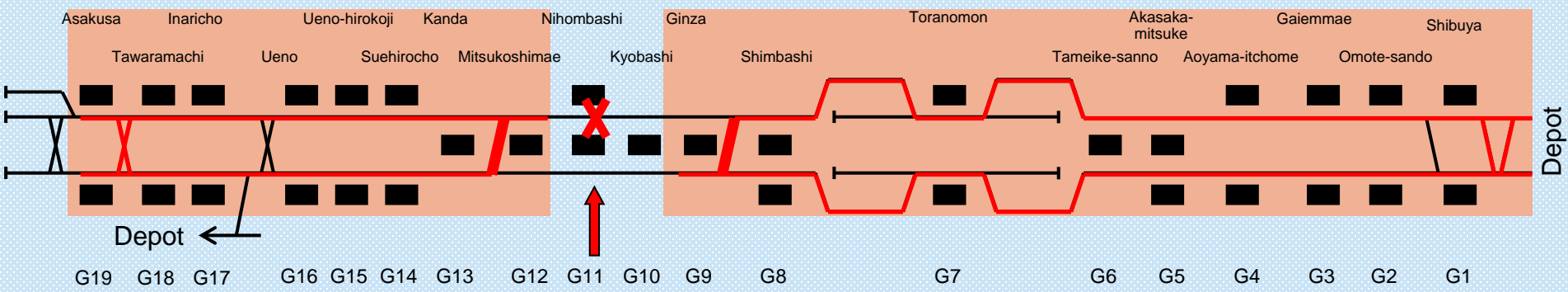
Shuttling operation

Implement shuttling operations in the event of any significant transportation disruption such as an accident involving a human life or injuries, maintaining operations in limited sections as much as possible.

Normal times



Emergency times



35 Enhancement of Integrated Control Center functions

1. Seismic base isolation building to withstand intensity 7 earthquake

2. Emergency power supply for longer hours
Redundant systems with gas power and oil power generators, which are earthquake-proof and can continuously supply power

3. Redundant communication facility

4. Measures against floods
Precision machines and computers are installed on the upper floors

5. Improved functions of ATC and PTC
Upgrading the ATC code controls such as at times of strong winds
Upgrading the check function at times of a signal abnormality

6. Enhanced information-collection functions at times of disaster
Quicker collection of information on any equipment abnormality of station service equipment, EV and other facilities that occurs in the event of a blackout or other similar events



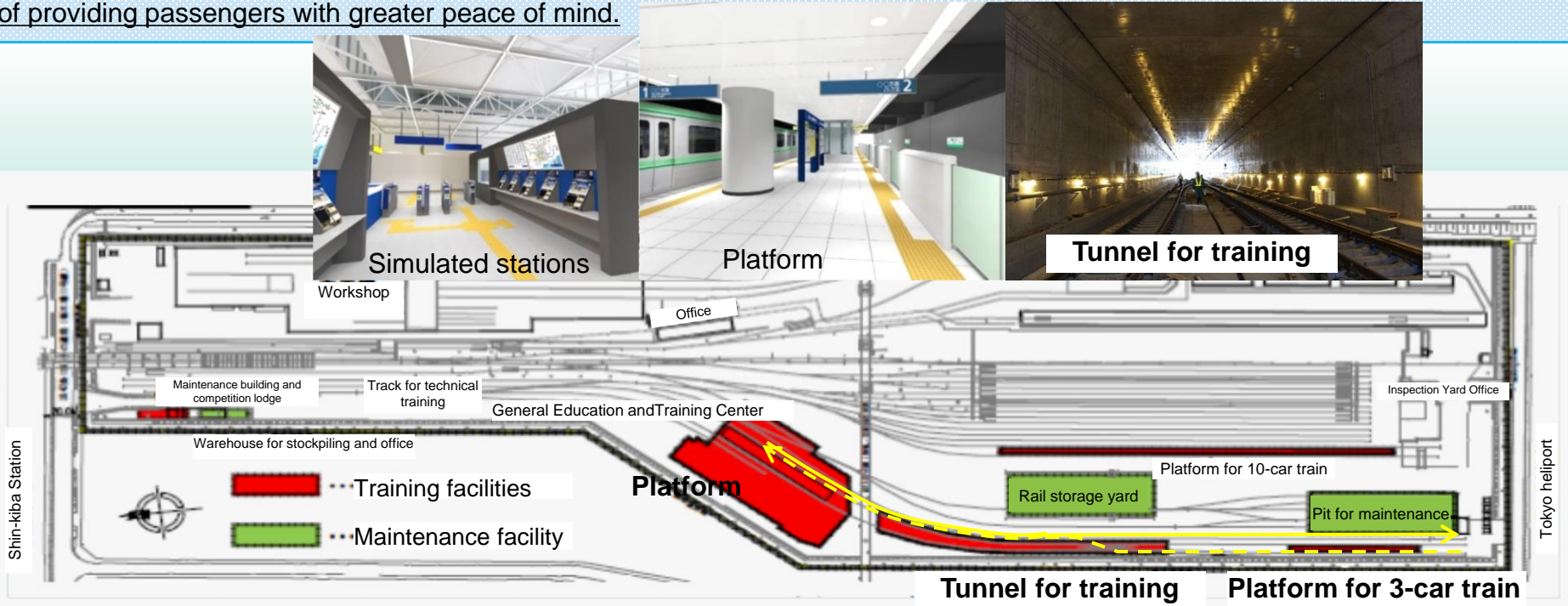
Southeast-side exterior (main entrance side)

IV. Enhancement of human resource development

1. Enhancing ability to handle transportation disruptions
2. Establishment of General Education and Training Center

37 Enhancing ability to handle transportation disruptions

Establish Tokyo Metro General Education and Training Center equipped with enhanced training facilities such as improved simulation functions. Have the center develop human resources who have a broad perspective and advanced skills and are capable of providing passengers with greater peace of mind.



Examples of training on transportation disruptions

- ◆ Training objective
To enhance the ability to handle transportation disruptions
- ◆ Target persons
Controllers, train crew, station staff
- ◆ Training overview
 - (1) Conduct joint training using a control facility, train (3-car train) and station facilities at training lines established in the training center
 - (2) Enhance coordination by implementing training in line units
- ◆ Evaluation
 - (1) Evaluate the training at the operation center and give appropriate feedback

Simulated stations for conducting practical training programs



Emergency drill



Training for repairing catenary



Rail-replacement training

38 Establishment of General Education and Training Center

1. Overview of the training center

- (1) Construct 2 stations (320m between the stations, including a 180m tunnel)
- (2) Construct double-track railway for the 2 stations (capable of being used by actual trains)
- (3) Establish station facilities and track facilities similar to actual lines in operation
- (4) Monitor training at the operation center (effectively give feedback on the training results)

2. Hold joint training for relevant divisions

Assuming an event, the relevant divisions actually in charge conduct joint training by using actual trains

3. Establishment of a large lecture hall

Temporary shelter and place to rest at times of a disaster
Construct a lecture hall with a capacity of 500 people (for holding internal presentations and lectures)

4. Establishment of Safety Consciousness Development Center

Exhibition regarding past accidents



North-side exterior



Safety Consciousness Development Center