

# New Developments in ITS using Probe Data

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1990'      1996      2000      2011      2014

**V to I Applications**

- Traffic information
- Electric toll collection
- Safety driving support etc.

**Car navigation**

63 million units ship(2014.6)

**VICS**

43 million units ship(2014.6)

**ETC**

47million units ship(2014.6)

**ITS Spot**

**Various applications**

- Wide area traffic information
- Safety driving support
- ETC

*ITS Spot on-board unit*

Evolve into



**ETC2.0**

**Upgrade of existing service**

- Still images
- Weather data
- Information on local tourist spots, etc.

**New service**

- Tolls for individual routes
- Commercial vehicle management

**Vehicle Automation**



Platoon demonstration test using lane maker etc.



Truck platoon demonstration test using radar, camera etc.

Auto-pilot System Study Group (MLIT)

2013

Interim Report Released

Government-wide SIP Research Project

2014

R&D Plan Released

○ Roads and vehicles are connected to each other via high-speed and large-capacity communication.

## *Compatible Navigation System*



Sales commenced in October 2009

## *ITS Spot Roadside Unit*



Deployed on expressways nationwide in 2011

**5.8GHz DSRC**  
*High-speed and large-capacity communication*



ISO 24103  
ISO 29281

## Traffic Information

Operator  
(Road)

Operator  
(Police)

Collection

Japan Road Traffic Information Center  
(JARTIC)



Processing

Vehicle Information Communication System Center  
(VICS Center)



Certification,  
Security

Provision

ITS Technology Enhancement Association  
(ITS-TEA)

Mechanism designed to ensure  
safe system operation



Probe data stored in the ITS Spot-compatible OBU is uplinked when the vehicle passes under an ITS Spot.

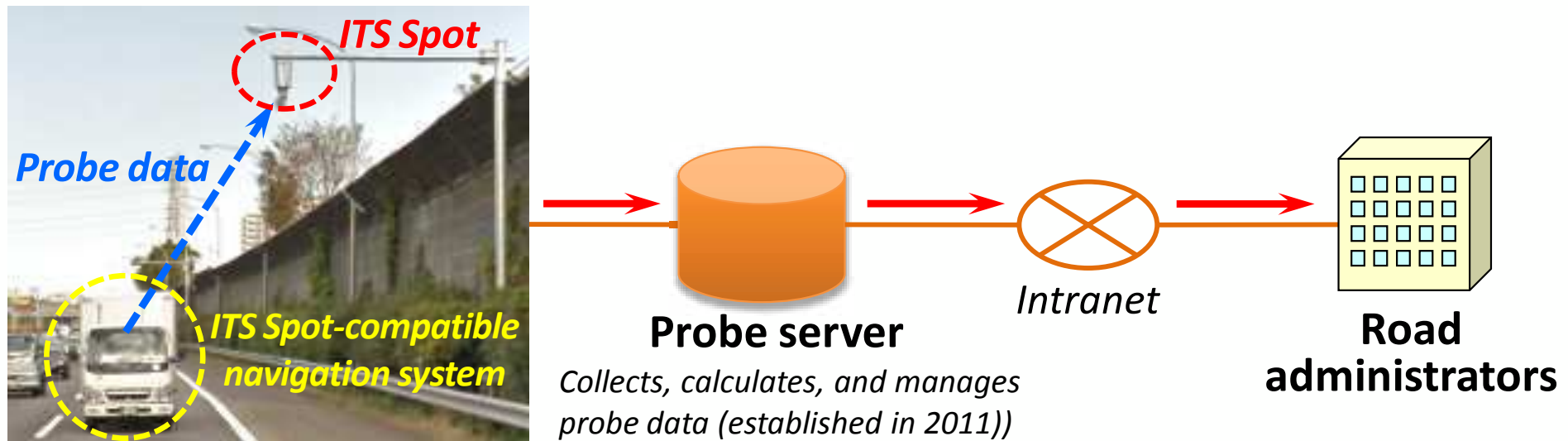
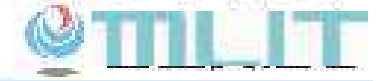


Fig. Schematic diagram of probe data collection system

## Collected probe data:

- **Travel record** : time, position (longitude, latitude), speed  
→ stored every 200m, or for every 45° change in driving direction
- **Behavior record** : time, acceleration, speed, yawing angle  
→ stored when the acceleration exceeds the threshold value

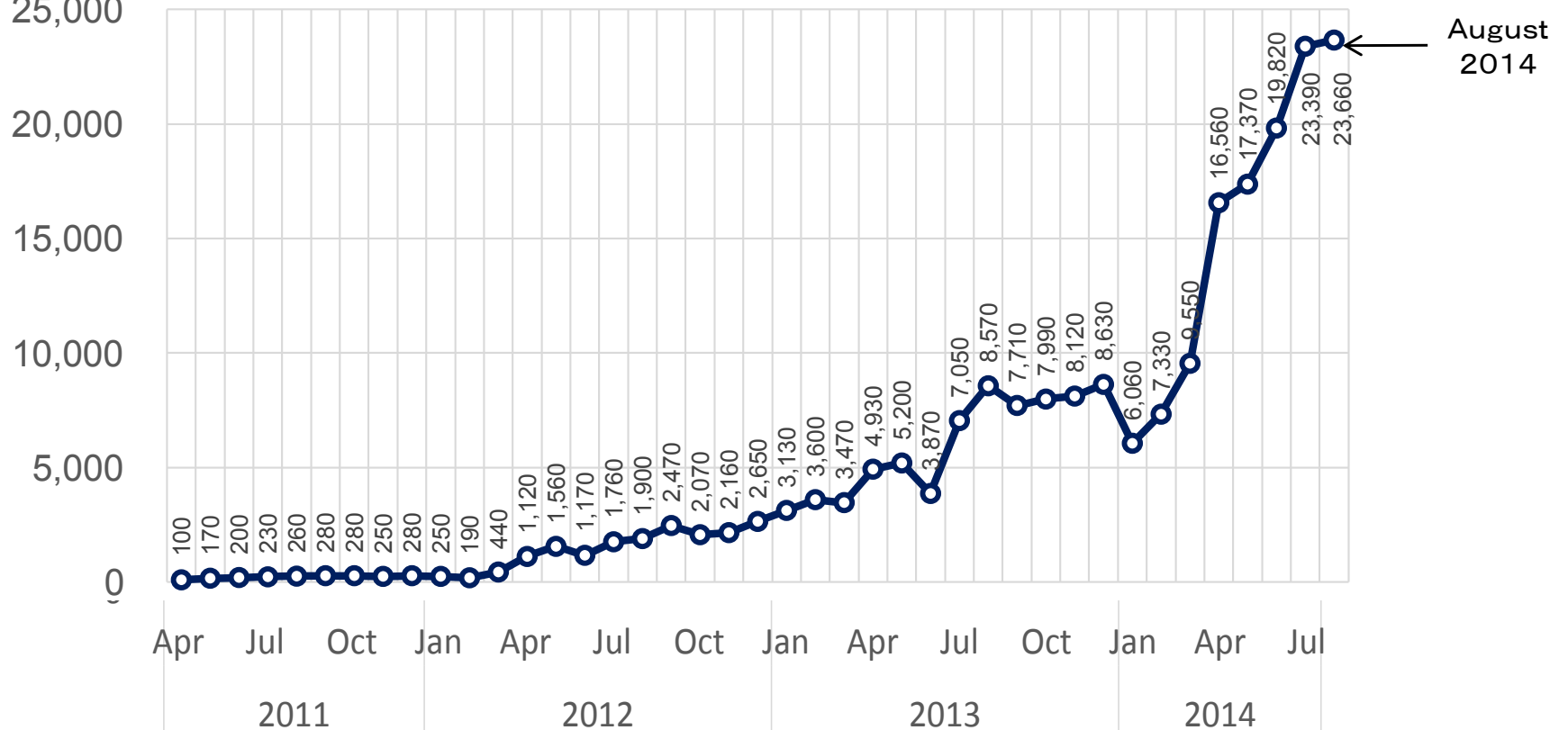
# Current State of Collected Probe Data



- As of the end of September 2014, approximately 400,000 ITS spot compatible onboard units had been set up.
- Probe data for nearly 23,660,000 vehicle kilometers traveled (VKT) are collected every month.

## Vehicle kilometers traveled

[x 1,000 VKT/month]  
25,000



## Adoption rate

Of the vehicles traveling on the Metropolitan Expressway (approximately 1,035,000 million users per day), 0.27% are probe vehicles.

- As it is possible to determine the routes traveled by large vehicles from probe data, appropriate route which large vehicles should take can be set and revised and locations where construction is needed can be determined.



- ◆ Example of analysis  
Determination of route status when a large vehicle drives between Shimizu Port and the Shimizu IC on the Tomei Expressway

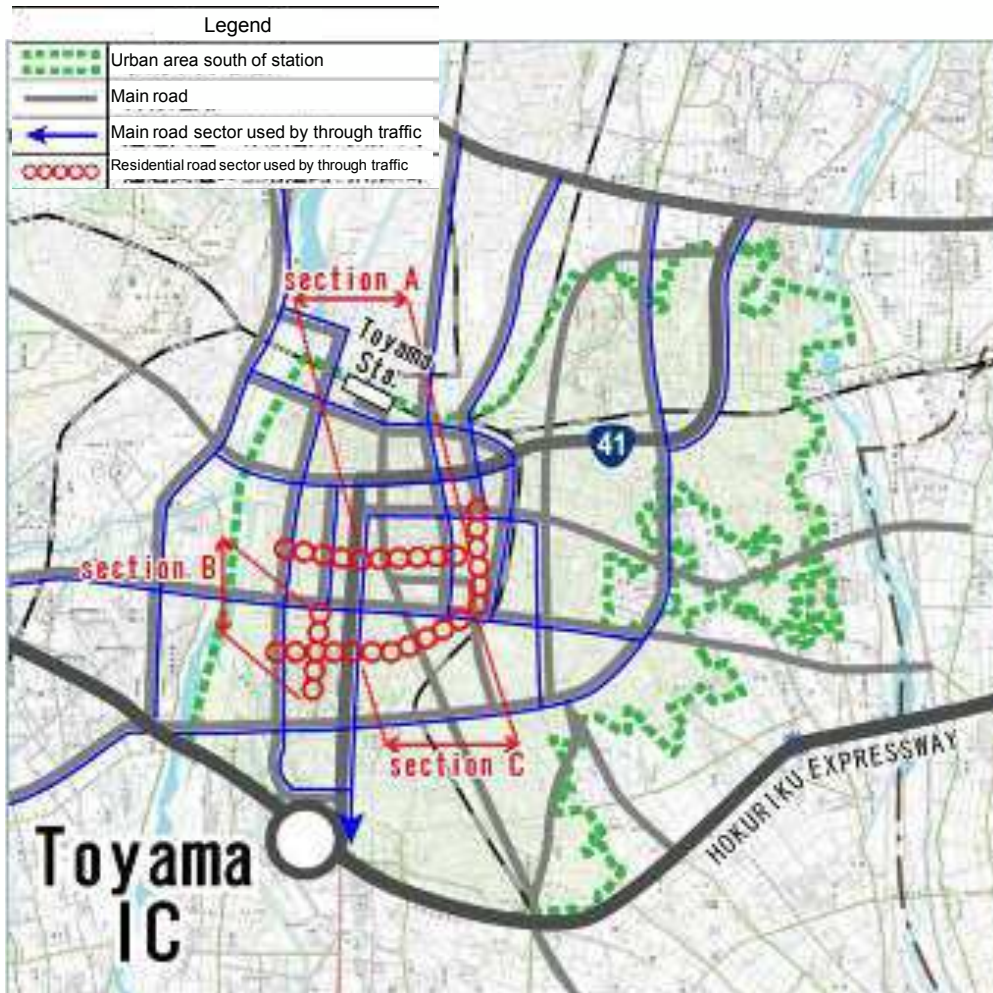
Confirmation that large vehicles using the Ejiri Wharf use prefectural roads

Confirmation that large vehicles using the Fujimi Wharf use parallel prefectural roads in addition to National Route 149



Setting and revision of the routes which large vehicles should take and determination of locations where construction is needed

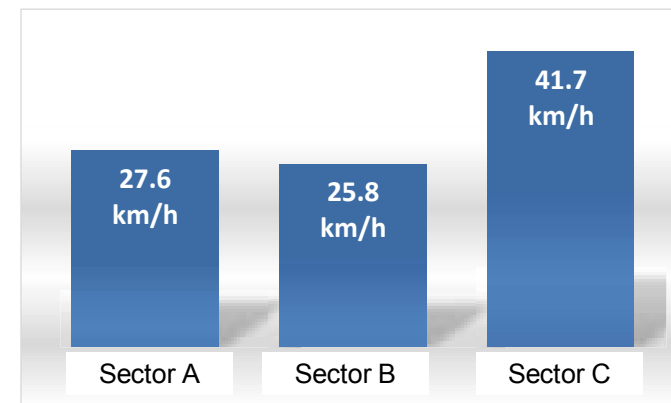
- Probe data show the routes traveled by vehicles bound for a certain IC. Accordingly, it is possible to study the speed of vehicles that are headed for the IC and are traveling along residential roads, identifying dangerous locations where vehicles travel at high speeds.



Area of analysis

#### ◆ Example of analysis

The urban area south of Toyama Station was studied to determine the inflow status of traffic entering residential roads (sectors and speed).



The study confirmed the presence of sectors on residential roads where vehicles traveled at speeds exceeding 40 km/h, giving rise to concerns about a worsening of the roadside environment.



- The locations where drivers brake suddenly can be identified from probe data. This makes it possible to identify and analyze the locations where drivers frequently braked suddenly, and to implement effective traffic safety measures.

## ◆ Example of analysis

Locations of frequent sudden braking are pinpointed.

Locations where roadside trees obscured the view were trimmed, and this reduced the incidence of sudden braking.

Probe data are analyzed to identify frequent sudden braking locations

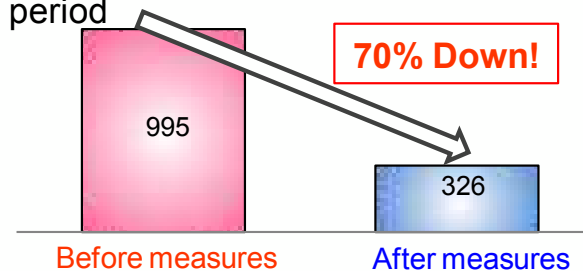


The causes are analyzed and effective safety measures are implemented.

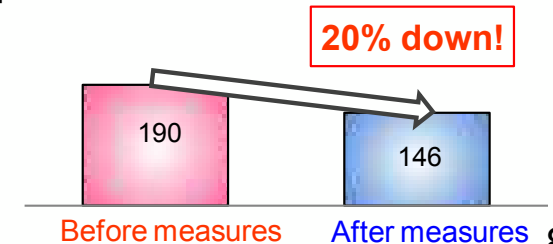


## ◆ Effect of measures

(a) Comparison of sudden braking incidents during a one-month period



(b) Comparison of accidents involving injury or death during a one-month period



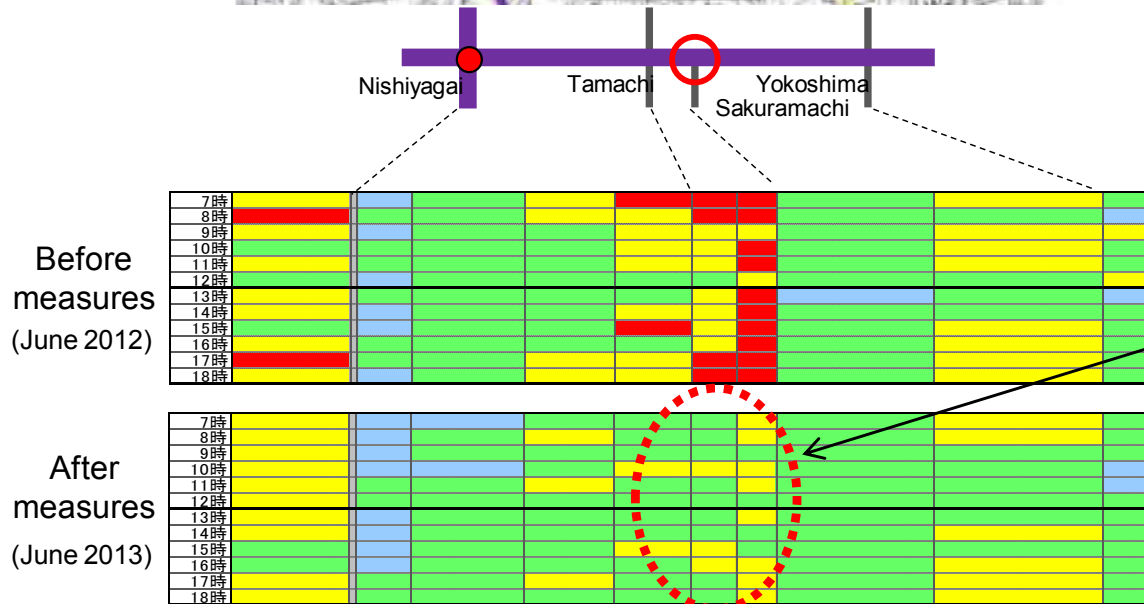
\*1 160 locations in the prefecture were identified as locations where drivers frequently braked suddenly.

\*2 The totals for the effect of measures are (a) the total for all 160 frequent sudden braking locations where measures were implemented and (b) the total for 145 of the frequent sudden braking locations where accidents involving injury or death occurred.

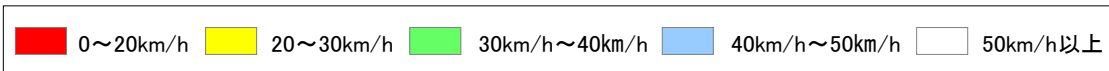
○ As the locations of traffic congestion can be determined from the probe data, it is possible to devise appropriate measures to reduce congestion, and to assess their effectiveness after they have been introduced.



◆ Example of analysis  
 The status of traffic congestion near the Sakuramachi intersection on National Route 50 was determined, and measures including the creation of a right-turn lane were devised. After the measures were implemented, the effectiveness of these measures was analyzed.



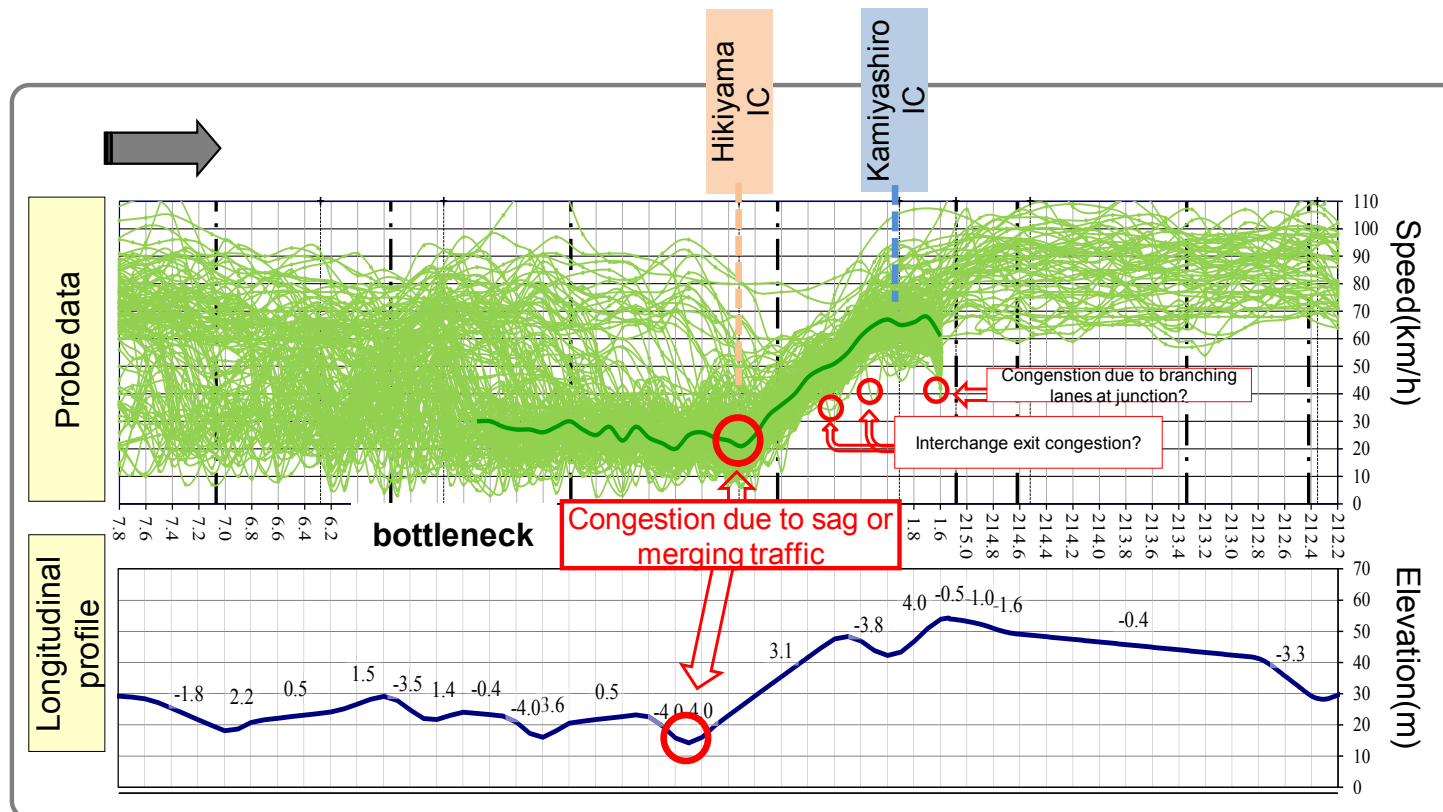
It was confirmed that chronic congestion had been eliminated



- Probe data show the speeds of vehicles at each location.
- Possible to pinpoint the location where traffic congestion occurs

### ◆ Example of analysis

Using probe data, the locations of bottlenecks where congestion occurs are identified and effective measures are devised.



### 【Traffic Counter Estimate】

Traffic congestion begins near the Kamiyashiro IC.



### 【Probe Data Analysis】

The actual bottleneck is the sag near the Hikiyama IC.

## Road transport challenge

### ◆ Congestion

40% of the total driving time are lost due to traffic congestion. (40 hours per person each year)

### ◆ Emission

The catalog mileage for Japanese vehicles is among the highest in the world, but actual driving mileage is only one-half the catalog mileage.

### ◆ Inadequate highway network

Proportion of expressway sections with 3 or fewer lanes  
Japan: 31.9% US: 5.1% UK: 01%

### ◆ Unfeasible to expand network on a large scale

#### • Fiscal constraint

Not enough resource for capacity building

#### • Spatial constraint

Limited space for road way in density – populated big cities and due to mountainous rural regions

Ring Expressway Network in big cities will soon be completed.

## Solution

Smart use of the existing expressway network with ITS

Due to traffic congestion

Standard amount of time (8 billion hours) Additional time (5 billion hours)

40 hours per person



ETC2.0 provides new services that utilize route information collected from ITS spots, in addition to information about toll collection, traffic information and driving assistance

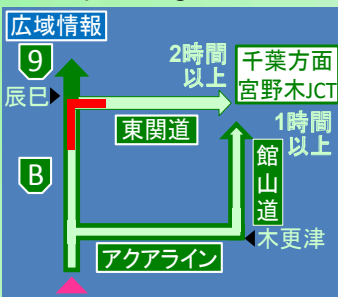
## “ETC2.0”

### Information service <sup>\*1</sup>

#### Detouring assist

Real-time region-wide traffic information and pictures of congested road are provided.

<Simple diagram>



<Picture>



#### Safe driving assist

Locations of obstacles and the last car of the back-up and danger warnings are provided.

<Simple diagram> <Picture>



Backup ahead. Careful for rear-end collision.



Careful with Snow on the road.

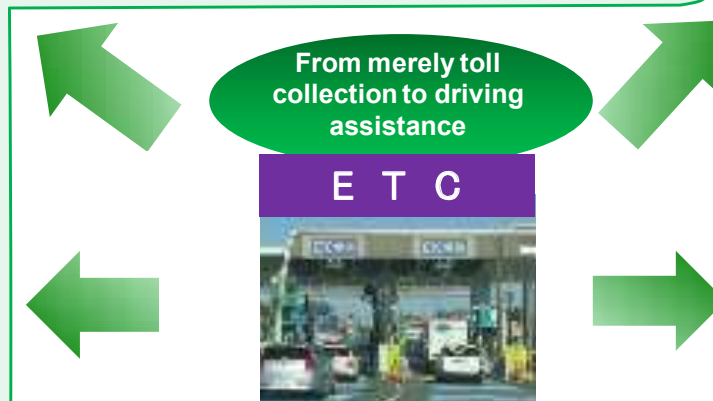
#### Assistance in the event of disaster

Upon occurrence of disaster, information on disaster occurrence and other useful information will be provided.

<Simple diagram>



Earthquake occurred. Turn on the hazards and park on the shoulder.



### Routing service (to be introduced)

New services such as

Preference treatment to detouring drivers

Ensuring overweight/oversized vehicles route and flexible approval

Commercial fleet management assistance will be introduced.

### Emerging services provided by private business

New services such as:

- Access control at parking lot\*2
- Payment at private parking lot\*2
- Payment at drive-through
- Information about tourist destinations



Note \*2: in service

Payment at parking lot

Note \*1: Existing services called ITS spot service.

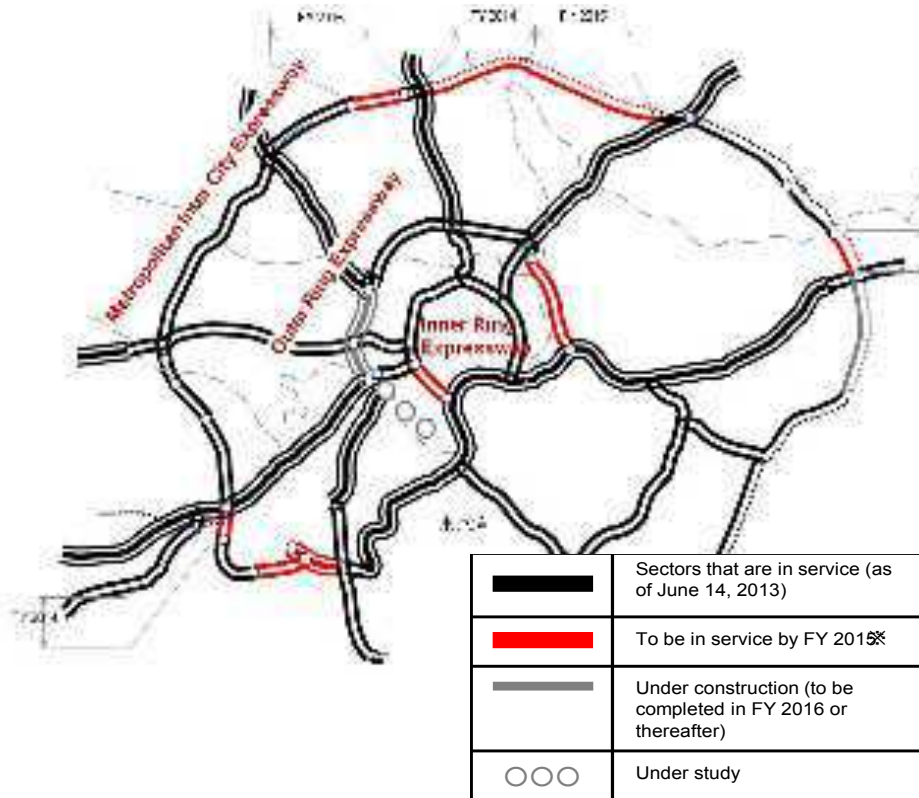
Incentives to drivers who select the best route in accordance with status of congestion is under consideration

## 【Construction of ring expressway】

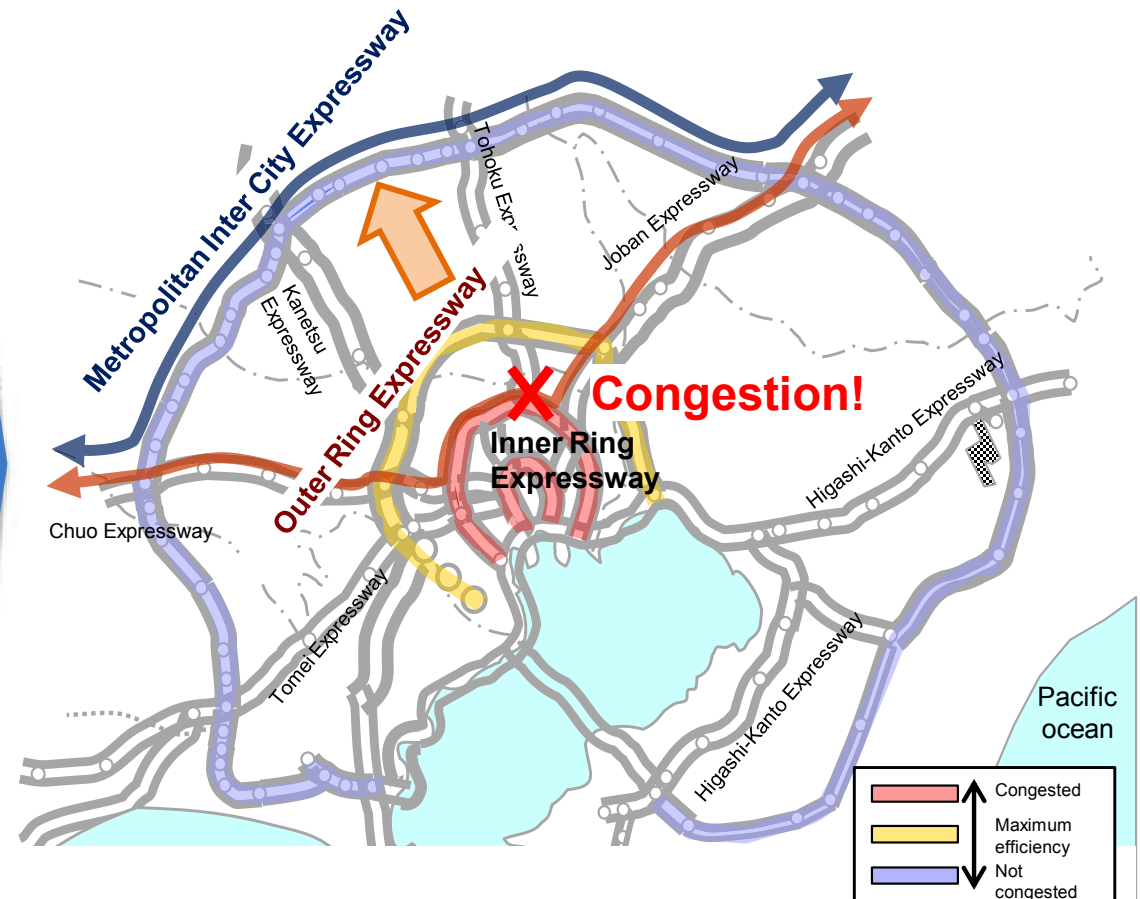
3 ring roads in central Tokyo  
64% complete



82%  
(by 2015)



## 【Smart route selection using “ETC 2.0”】



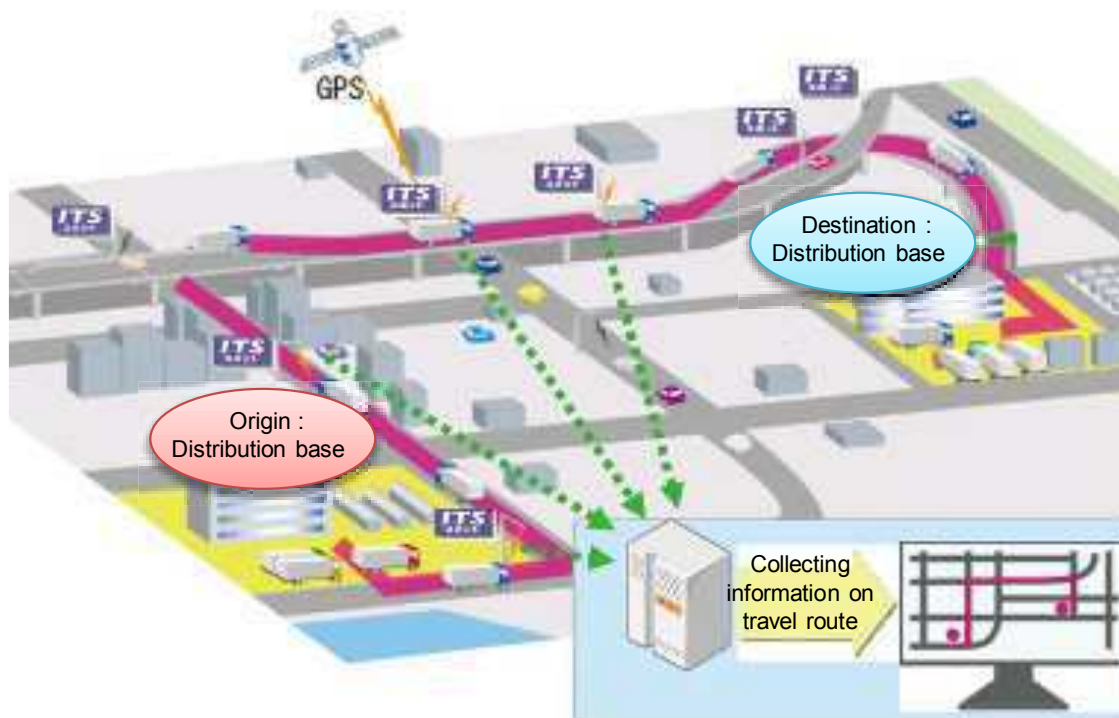
- Deterioration of road structures has become a serious problem.
- Overweight vehicles that are the cause of road deterioration need to be monitored to travel on designated routes.

【Effect of overweight vehicles on highway bridge deterioration】 【Example of effect on concrete slab of bridge】



Travel routes are identified by ETC2.0

- The current location of a particular vehicle is identified using ITS Spots.
- Through the use of the probe data, logistics companies are able to manage the movements of individual vehicles and increase the efficiency of unloading and transshipment operations at logistics centers.



Current location and route traveled by vehicle can be determined



## Benefit to logistics companies



This enables

- management of vehicle movements
- estimation of arrival time and sharing with relevant entities etc.



**Thank you  
for your kind attention!**

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