Data Collection Systems to Support Performance Measurement

Tadashi Okutani
National Institute for Land and Infrastructure Management (NILIM)
Ministry of Land, Infrastructure and Transport (MLIT)

Performance indicators in Japan's road administration

Strengthening international competitiveness

- Accessibility to Airports & Ports

Ensuring safety and security

- **Traffic Accidents**
- Disaster Resistan' in Urban Area
- Relief Routes during Disasters
- Measures for Railroad Crossings

Significantly extending the lifespan of existing stock

- Bridge Reinforcement
- Pavement Maintenance & Repair

Execution of road policies

- Cost Reduction
- Contentment of Road User
- Website Access

Reinforcing regional autonomy and competitiveness

- ***Congestion Time Loss***
- *Reduction of Road Works*

Creating environments for affluent living

- *CO2 Reduction*
- "Barrier-Free" Spaces
- Burial of Power Lines

Functional reinforcement of expressway networks

- Expressway Use
- Diffusion of ETC

Others

- Linkage of Cities
- Easy-to-Understand Traffic Signs
- Reduction of Nighttime Noise

italic: expressed by number, others by ratio

Integrated Traffic Accident Database

Traffic accident statistical data (NPA)

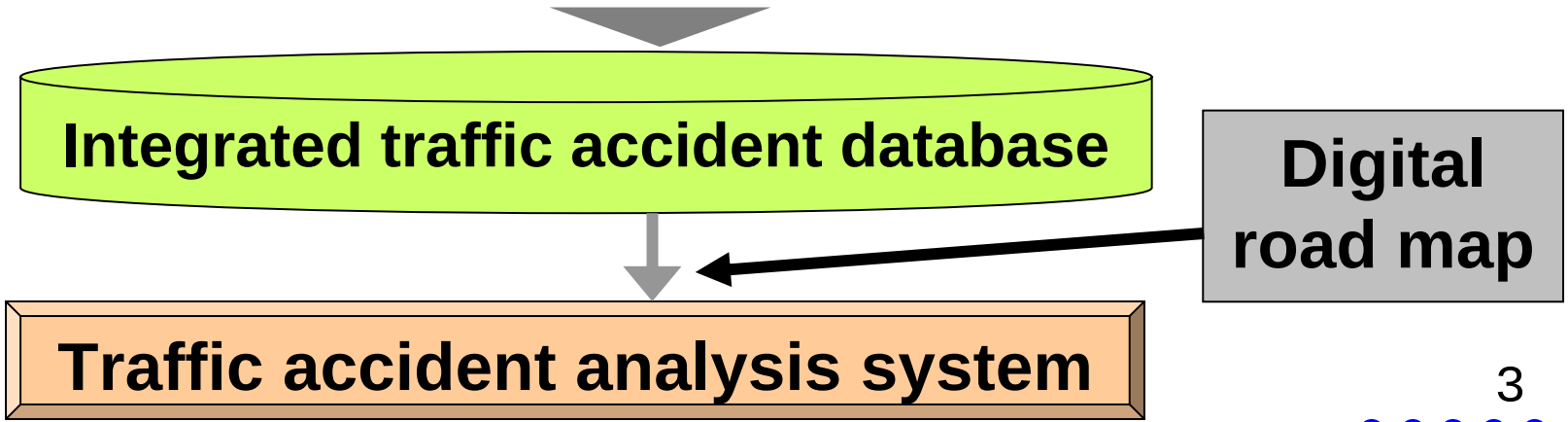
Fatalities,
Serious injuries,
Number of injuries,
Date, day/night time,
Ages, etc.

Matching data (Each road administrator)

Accident report No.
Route No.
Location(km-post)
Lane No. & offset
Section No. etc.

Road traffic census data (MLIT)

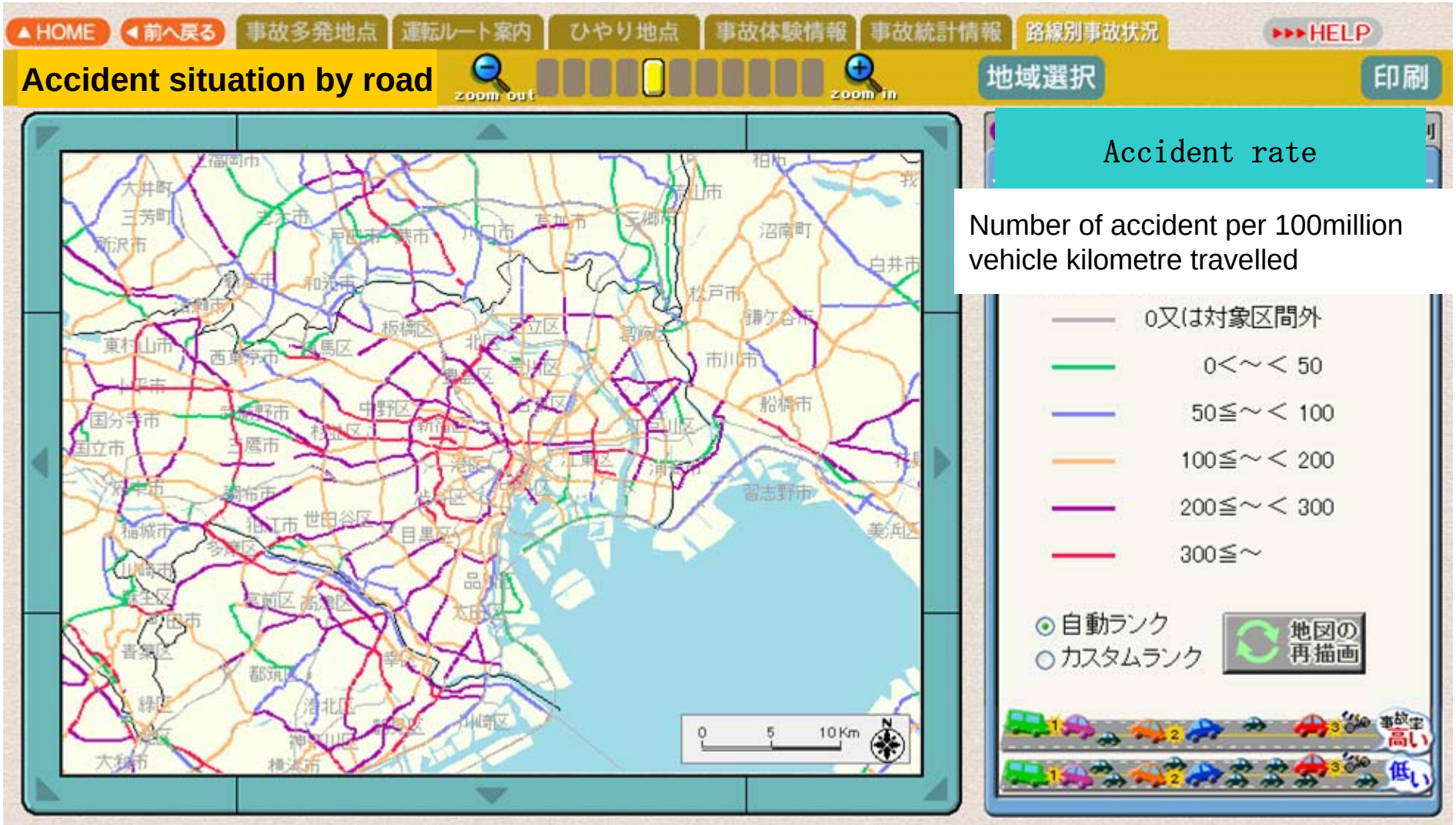
Section length,
Traffic volume,
Number of lanes,
Centre divider length
Sidewalk length, etc.



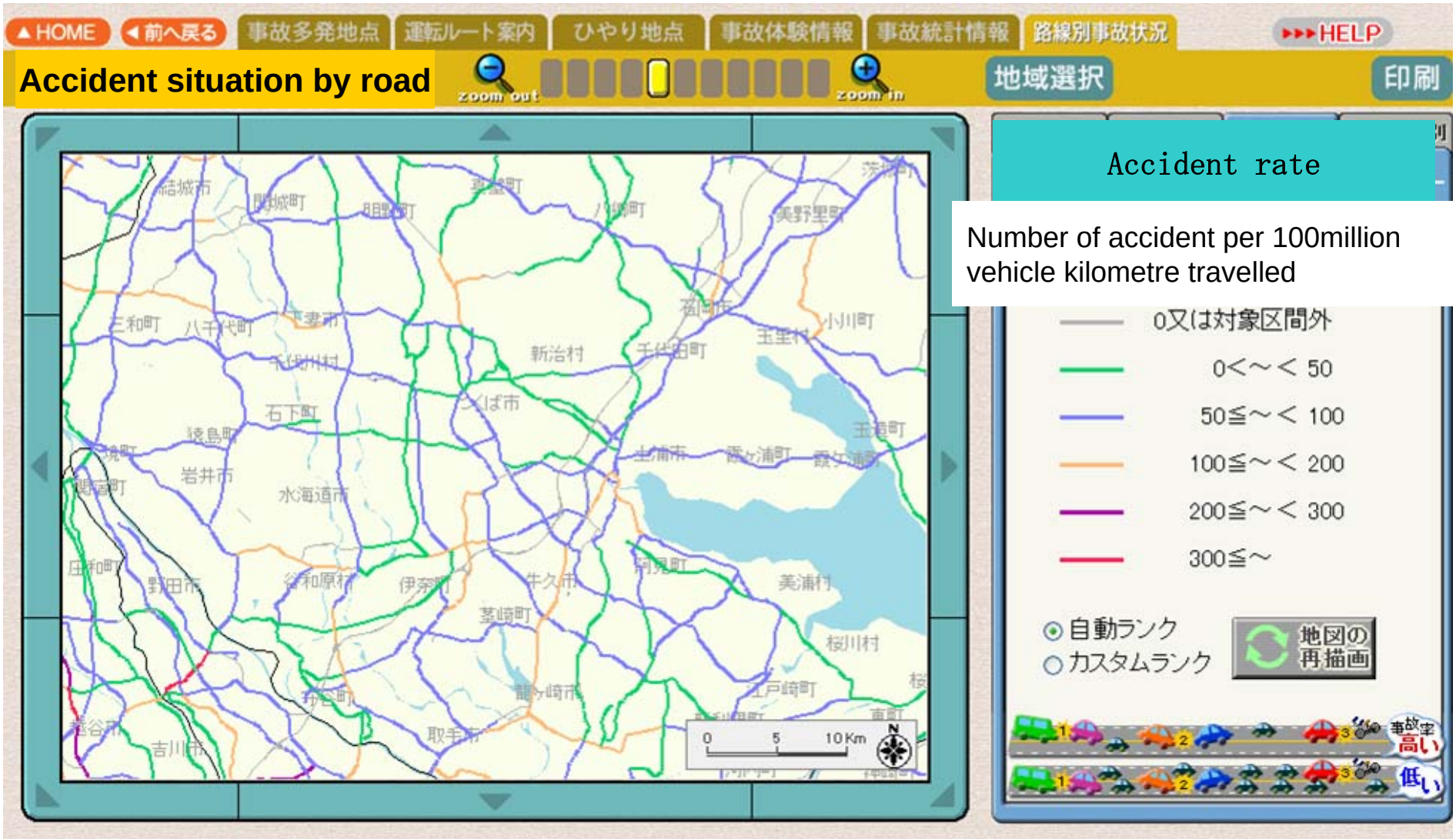
Road Safety Map: Hazardous Spots

- In 2003, **4,000 Hazardous Spots** were designated on the locations with accident rate **5 times or higher** than the average rate
- Concentrated prevention measures have cut accidents **by 30%**

Road Safety Map: Accident rate in Urban area



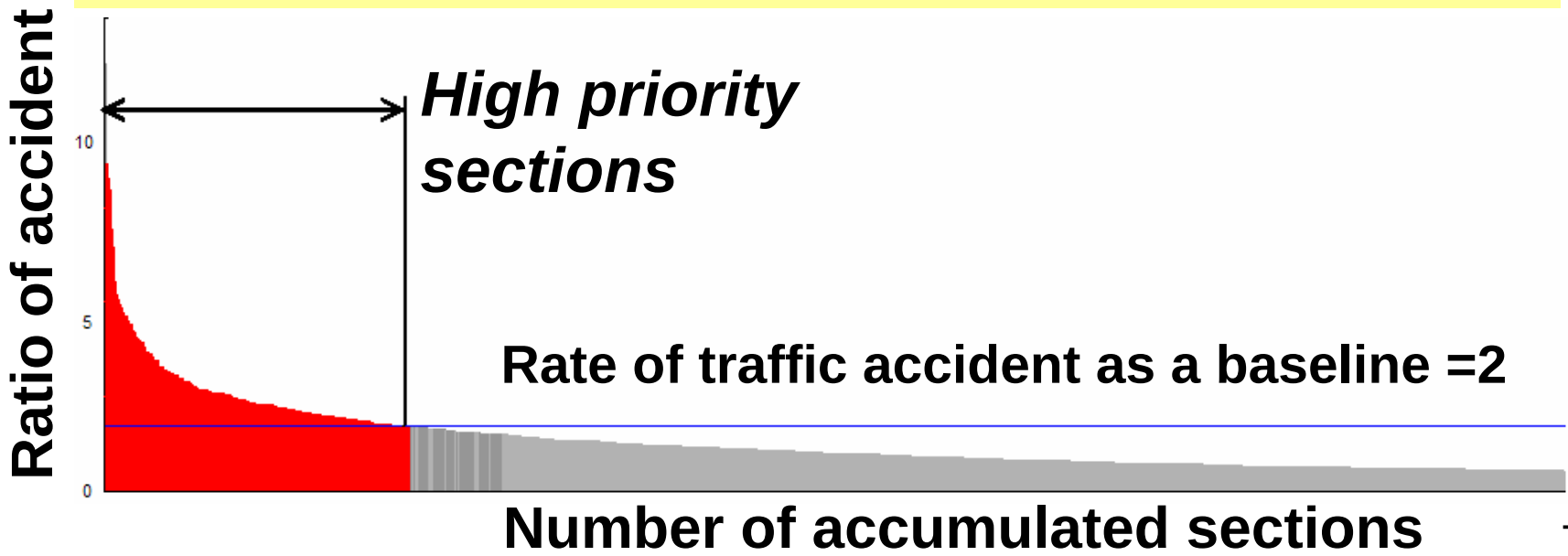
Road Safety Map: Accident rate in Suburban area



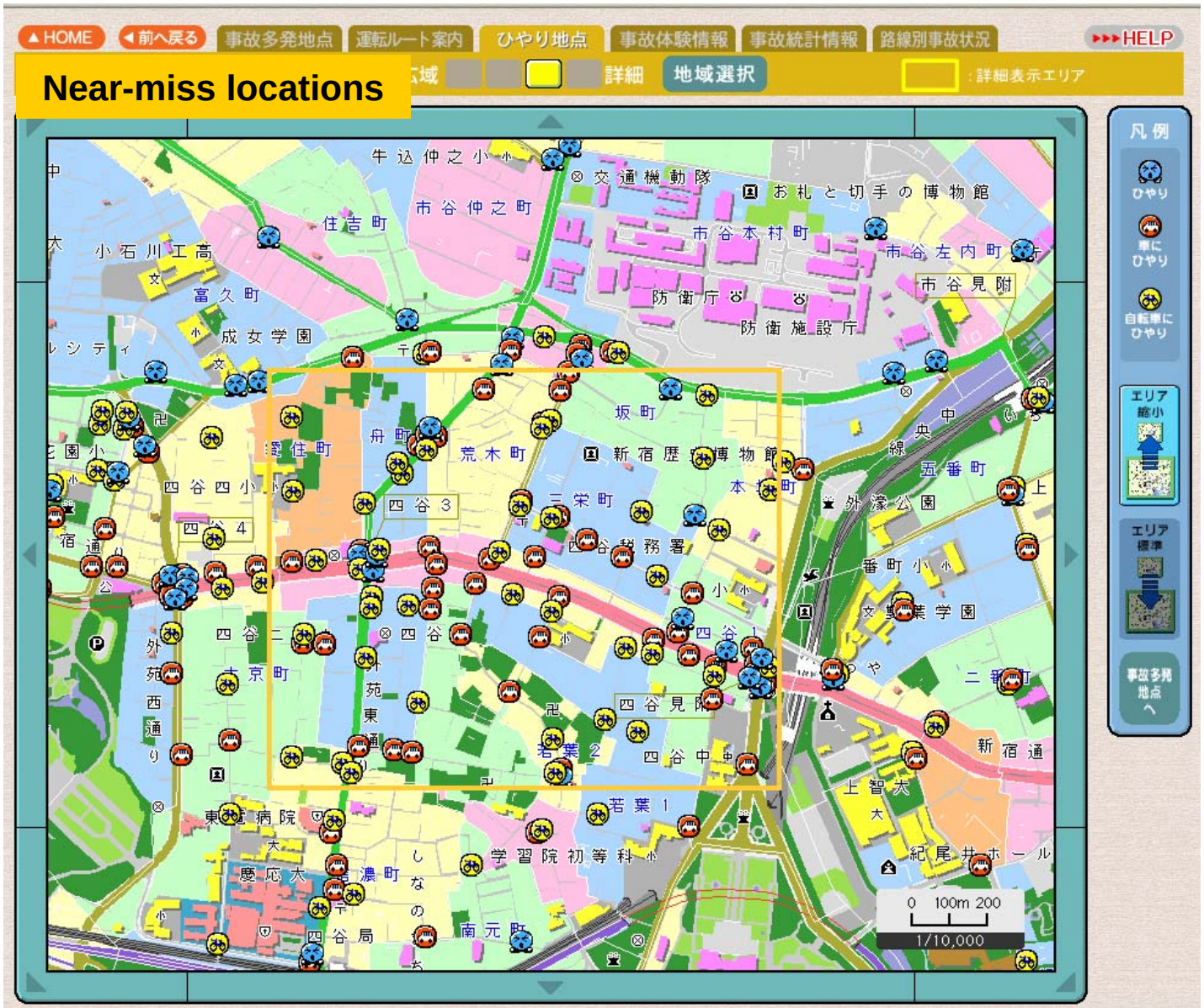
Extracting hazardous locations using Accident Rate Curve

Integrated Traffic Accident Database

- Arterial roads are divided into 890,00 sections
- Ratio of accident (a ratio against the average accident rate) is calculated for each section
-Put each section in order of ratio of accident, and make Accident Rate Curve

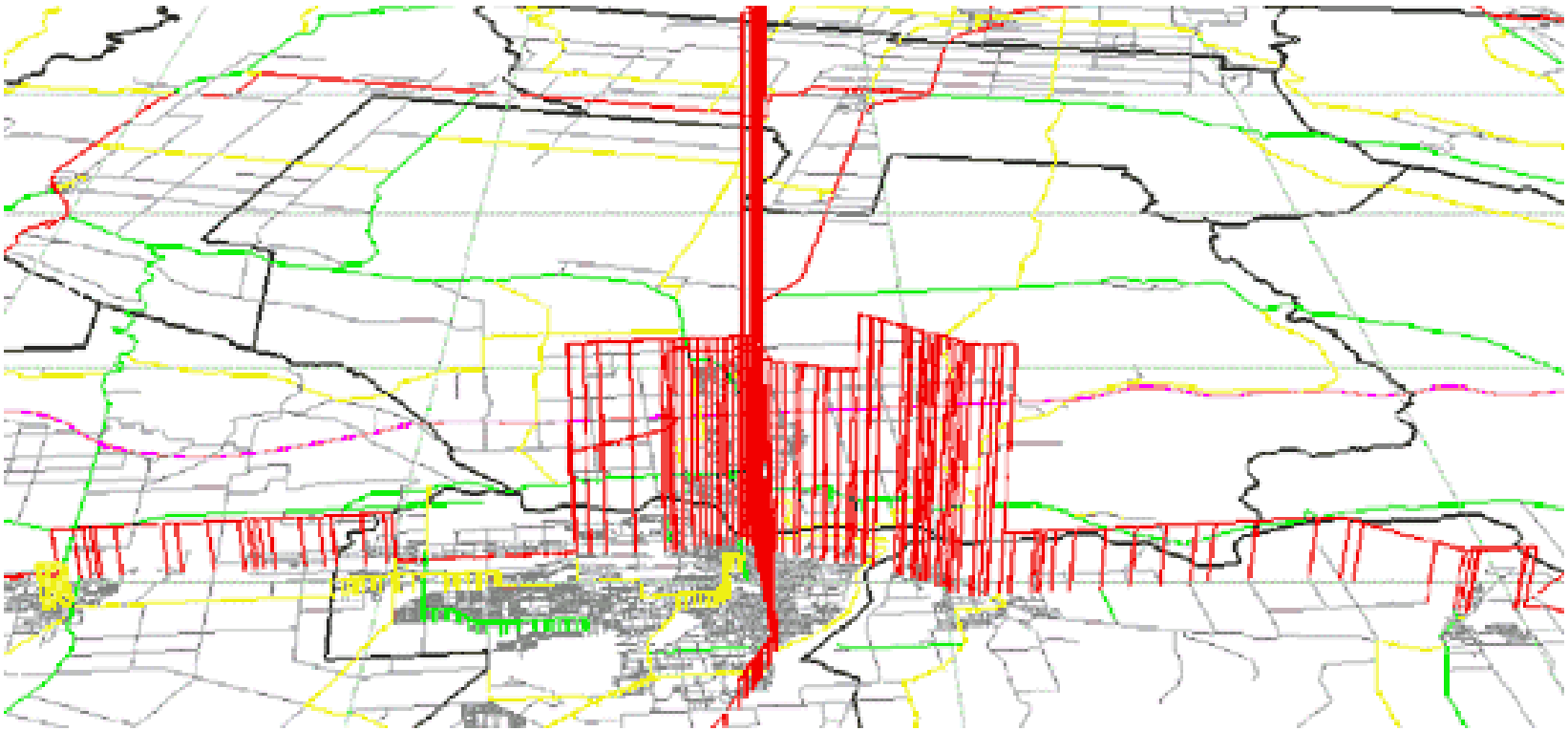


Road Safety Map: Near-miss Locations



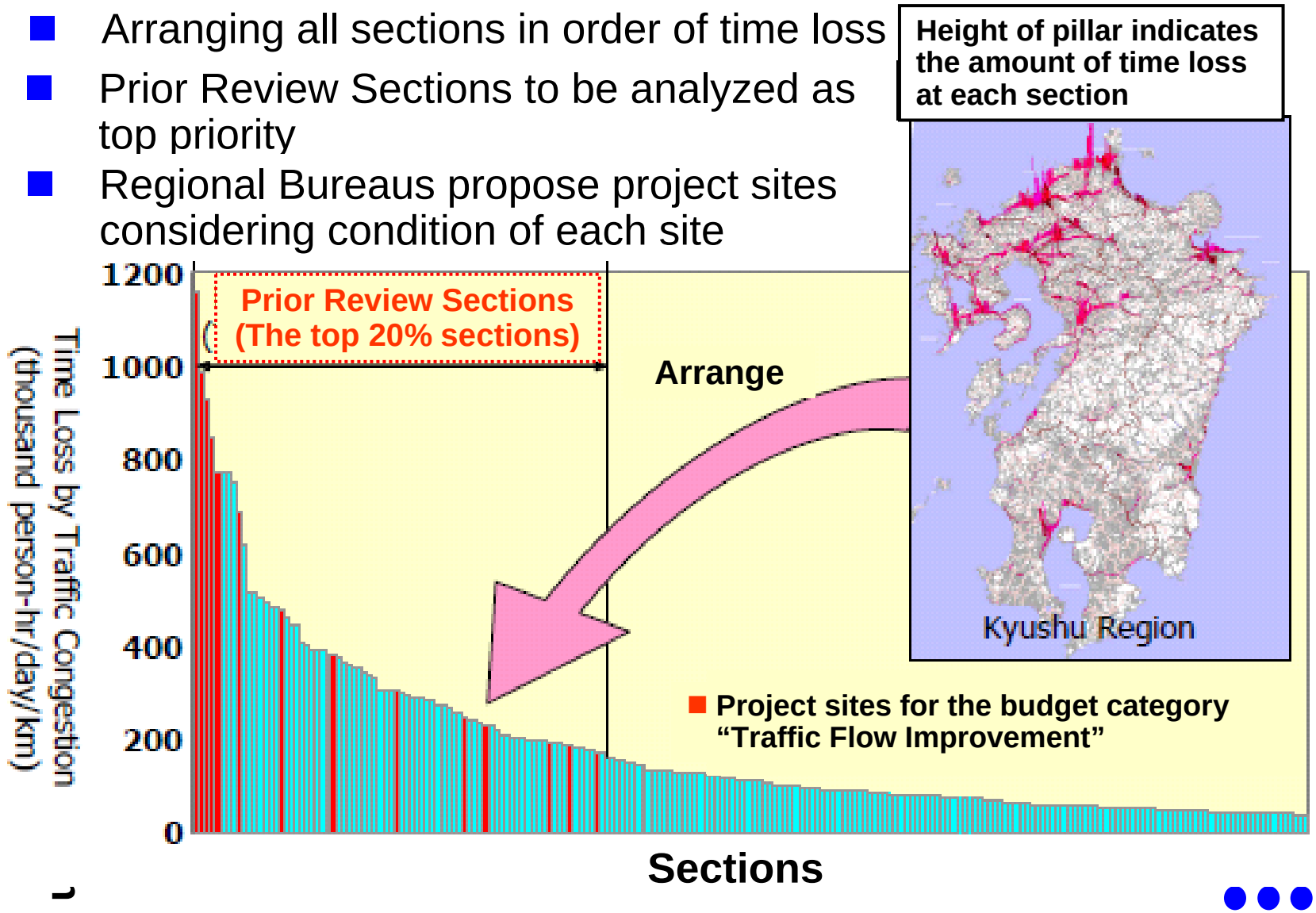
Visual image of time lost due to traffic congestion

3-D Map



Priority Indication Method (Congestion Mitigation)

- Arranging all sections in order of time loss
- Prior Review Sections to be analyzed as top priority
- Regional Bureaus propose project sites considering condition of each site

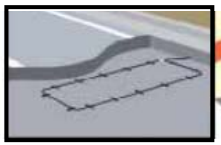


Applicable use of VICS data

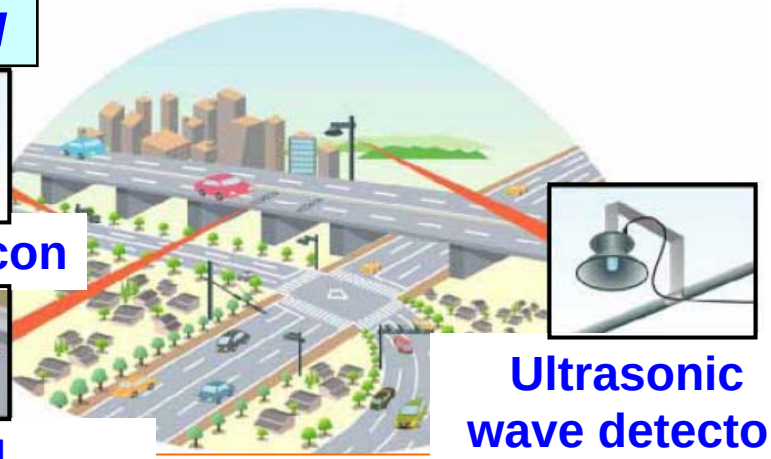
Data gathering

Roadside devices

Light beacon



Loop coil



Ultrasonic wave detector

Flow of information

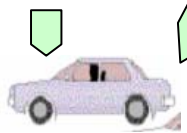
JARTIC e.t.c

VICS center

Radio wave beacon

Light beacon

FM multi-broadcast

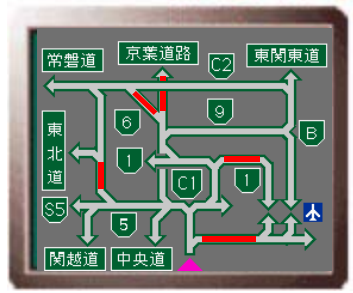


Car navigation display

Level 1: Character message

section A - B Traffic jam 2 km by traffic accident

Level 2: Simple figure



*Red line indicates traffic jam

Level 3: Map information

One lane limited

Gate closed

Works

Constr uction

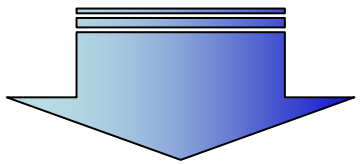
Obstacles

Parking (not full)

Accident car

Evaluation of “reliability of travel time ”

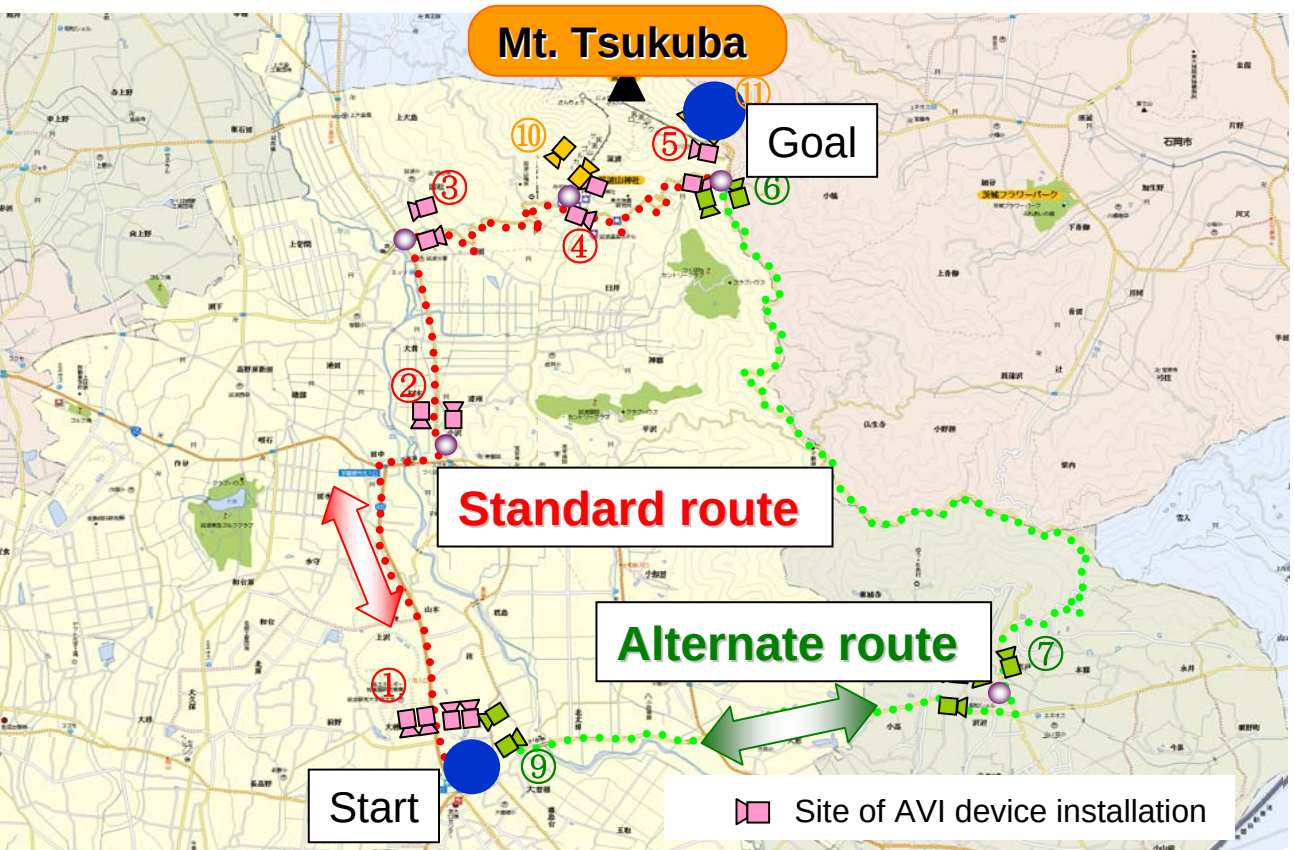
- Social diseconomy is caused also by fluctuations in travel time.
- Travel time reliability and design speed may compose traffic service level.



Reliability of travel time: “probability of arrival at destination within a set travel time” is worth establishing as an performance indicator

Survey of travel time reliability using Automatic Vehicle Identification devices

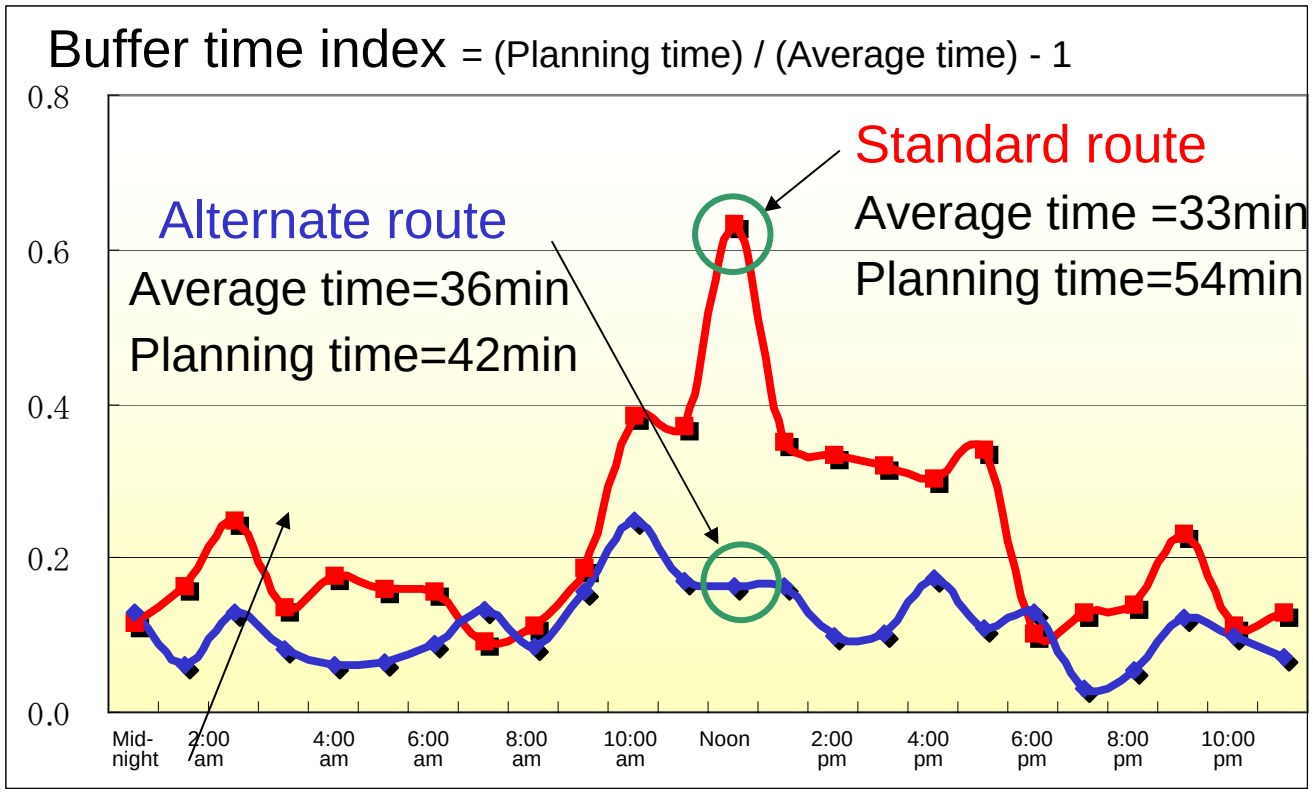
AVI devices could obtain accurate travel times of two different routes in a sightseeing area on high season.



AVI devices store license plates, time & date automatically.

Point-to-point travel time is ascertained by matching license plates.

Evaluating fluctuation of travel time in a sightseeing area

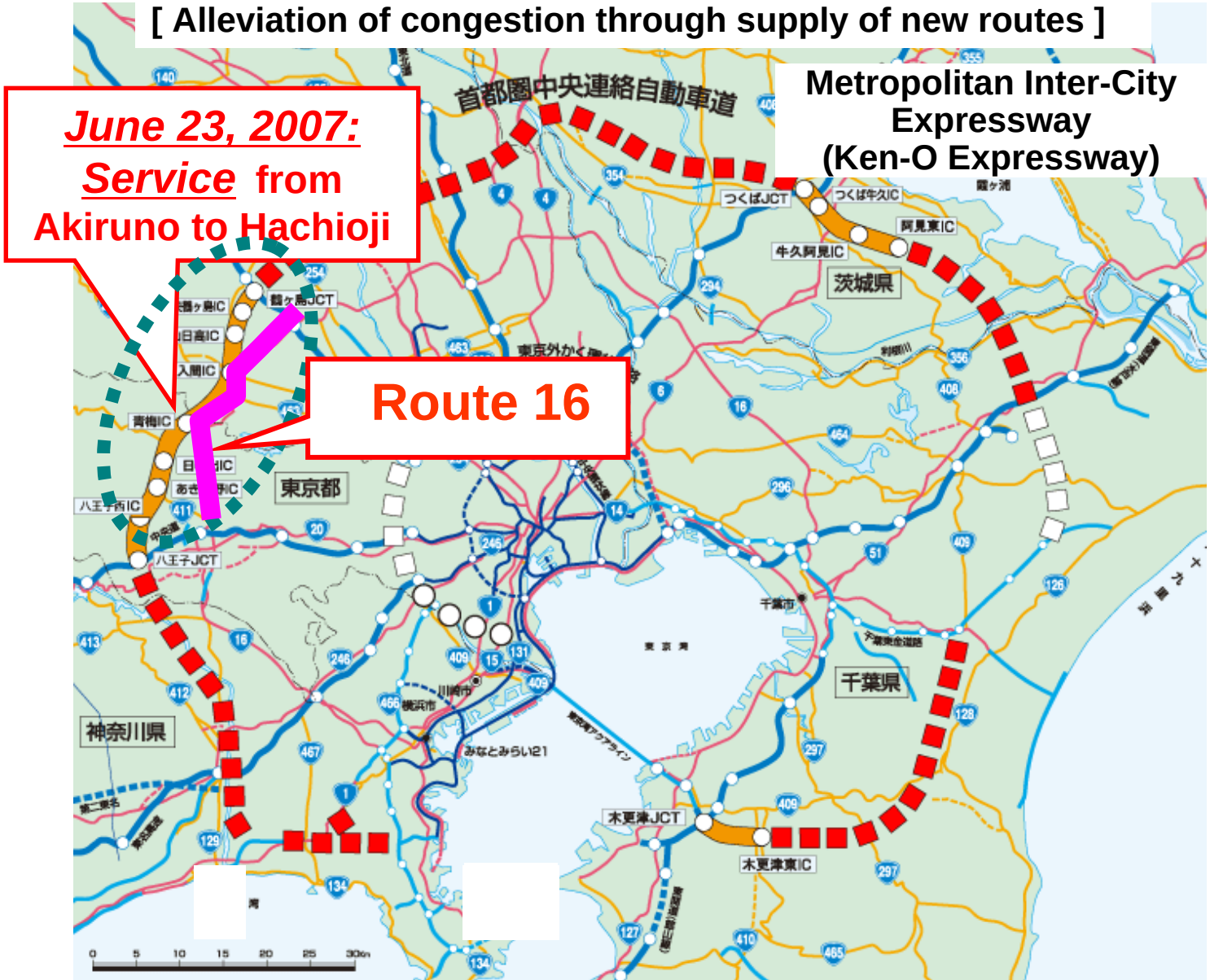


By time period Weekends/holidays: N=42

Travel time of the alternate route is longer in average, but has less fluctuation, that makes it easy to predict arrival time.

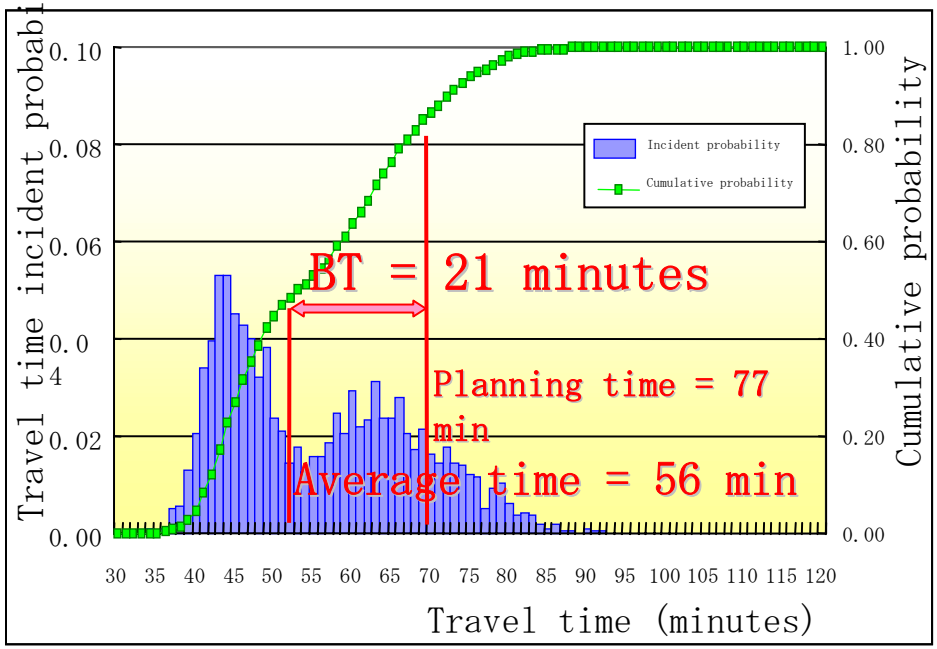
Changes of reliability before/after new service of expressway using AVI devices

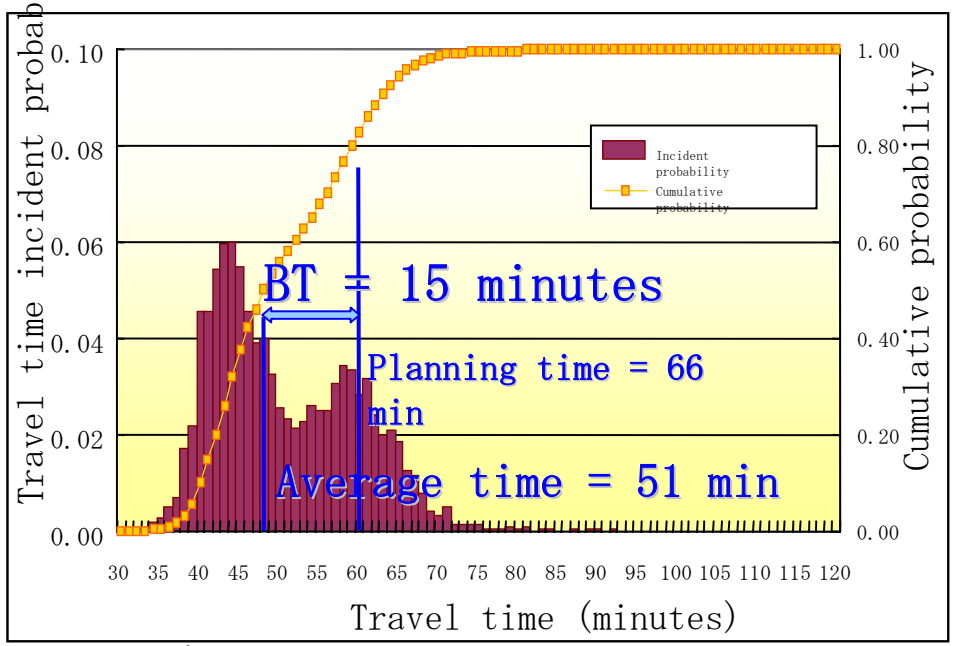
[Alleviation of congestion through supply of new routes]



Survey results

Travel time reliability on National Route 16 (Before/after opening to service of the Ken-O Expressway: downbound)

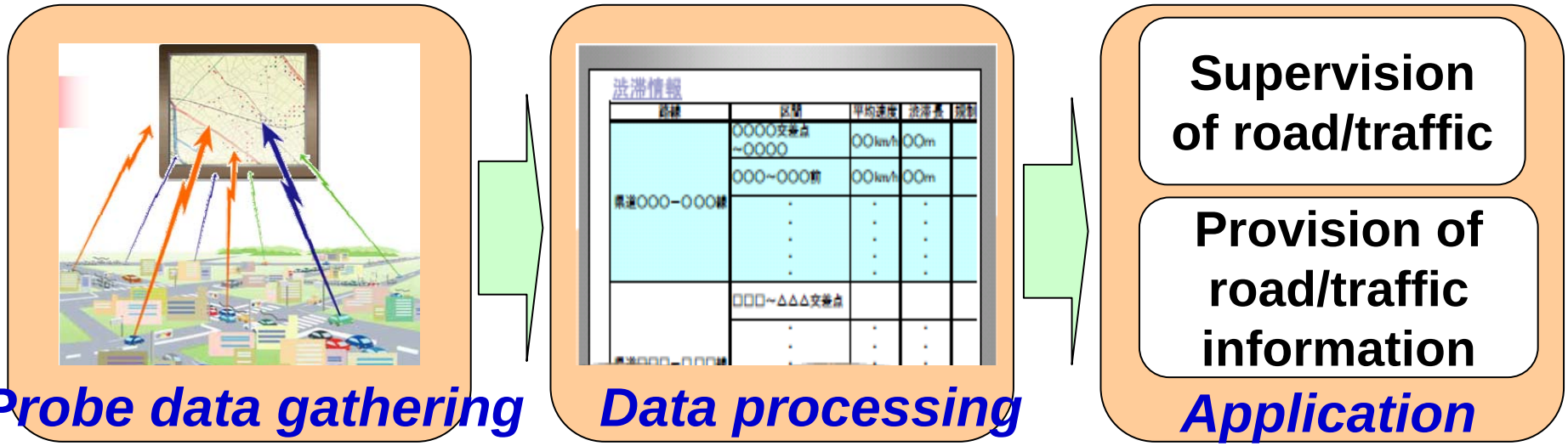




Before → After

Buffer time: 6 min. reduction
Average time: 5 min. reduction

Using probe technology

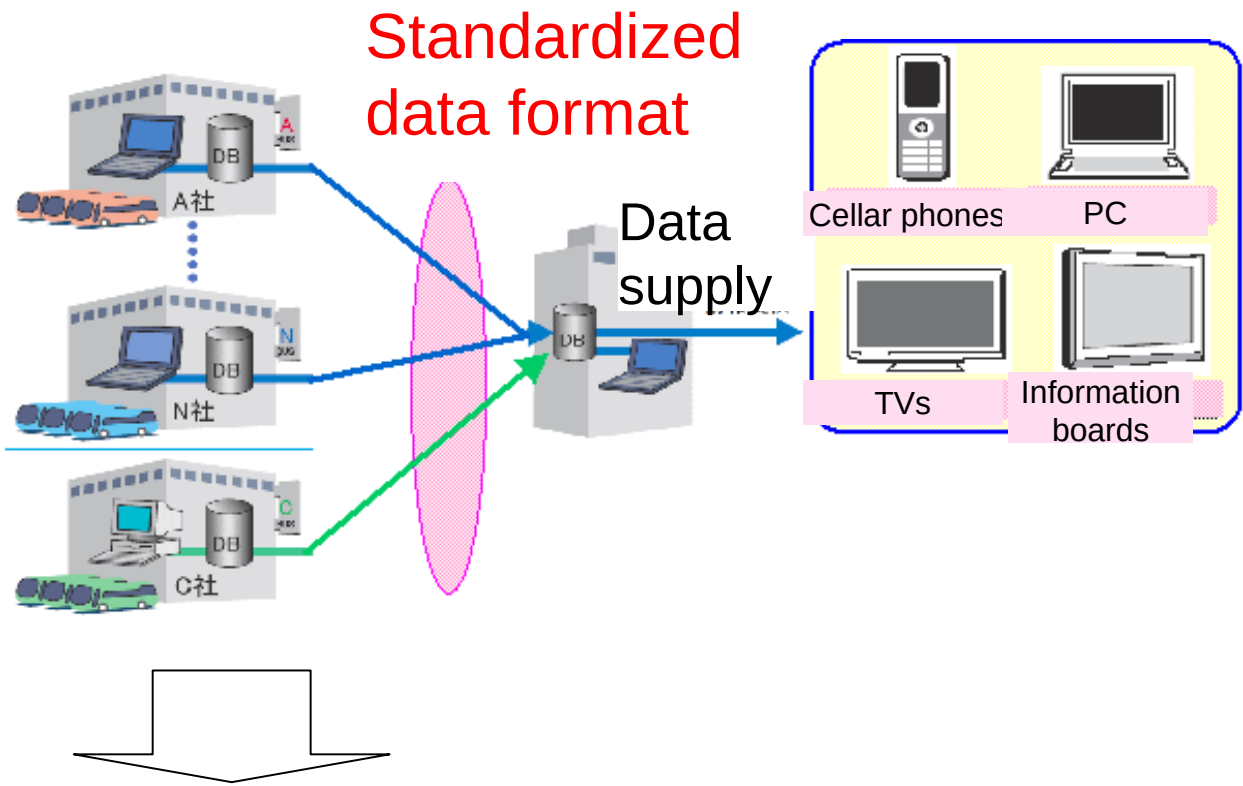


- **Probe car survey** (High cost)
- **Probe person (Survey of person trip by a cellar phone)**
- **Bus location system**
- **Taxi probe (Vehicle allocation system)**

} Low cost

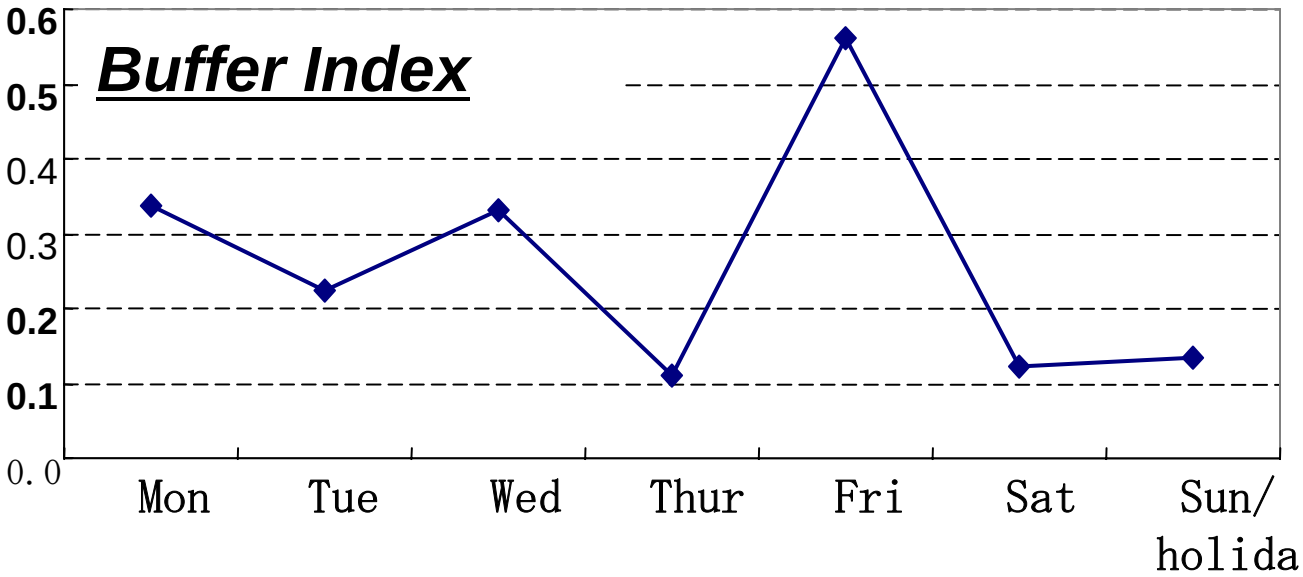
- **Drive recorder** (Safety recorder (® datatech))
- **ITS equipped vehicle**

Data from Expressway bus-location system

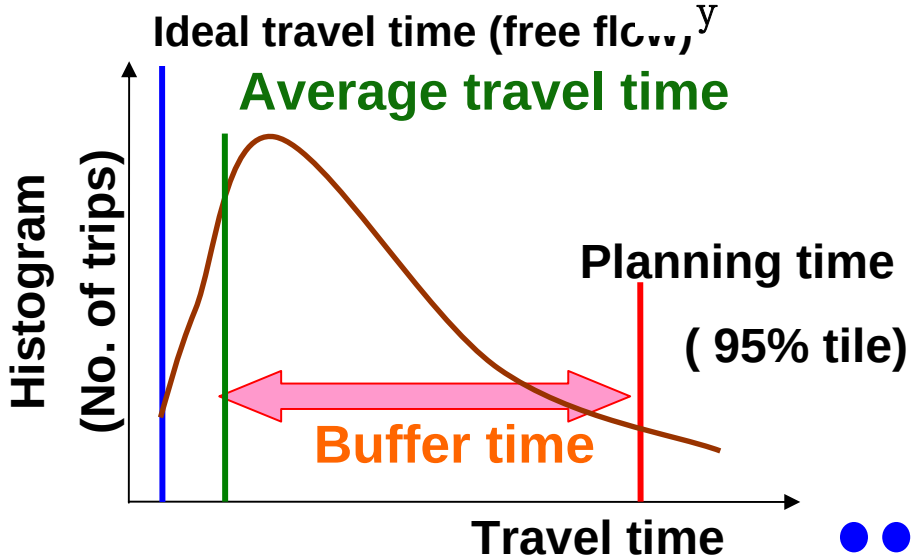


Establishment of total system to gather and combine all expressway bus-location data from each company.

Reliability of travel time using Bus-location Data



Buffer Index (BI) = $\frac{\text{Buffer time}}{\text{Average travel time}}$



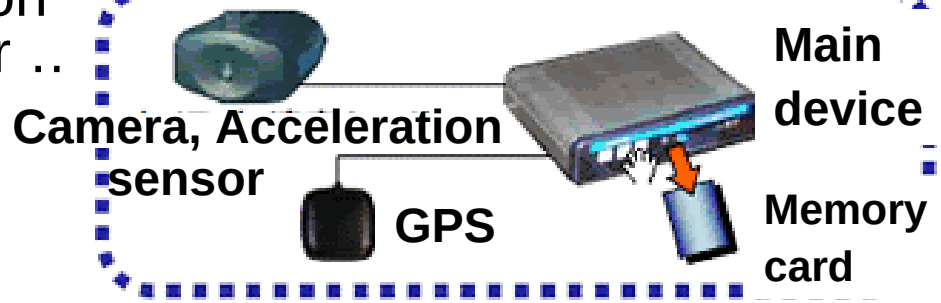
Drive recorder

Record following driving data

Forward image, acceleration, location information, speed, break, blinker ..

Recently introducing by freight transport company

Device composition



Usage/Effect

Proof of traffic accident (Record of images and acceleration)

Secure driving (Evaluating risk factor of roads)

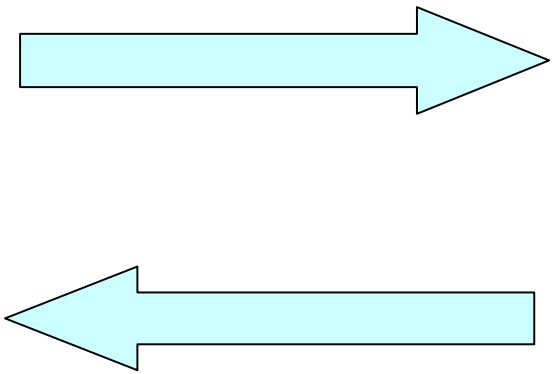
Improving driving behaviour (Reduction of CO_2 emission)

Recorded Data ⇒ **Road drivability**, **Accident-prone locations**, **Reliability of travel time** } ***Applicable for these measurements***

Collaboration with private sectors for data collection

Supply of probe data
(tracking data, acceleration data)

Distribution companies



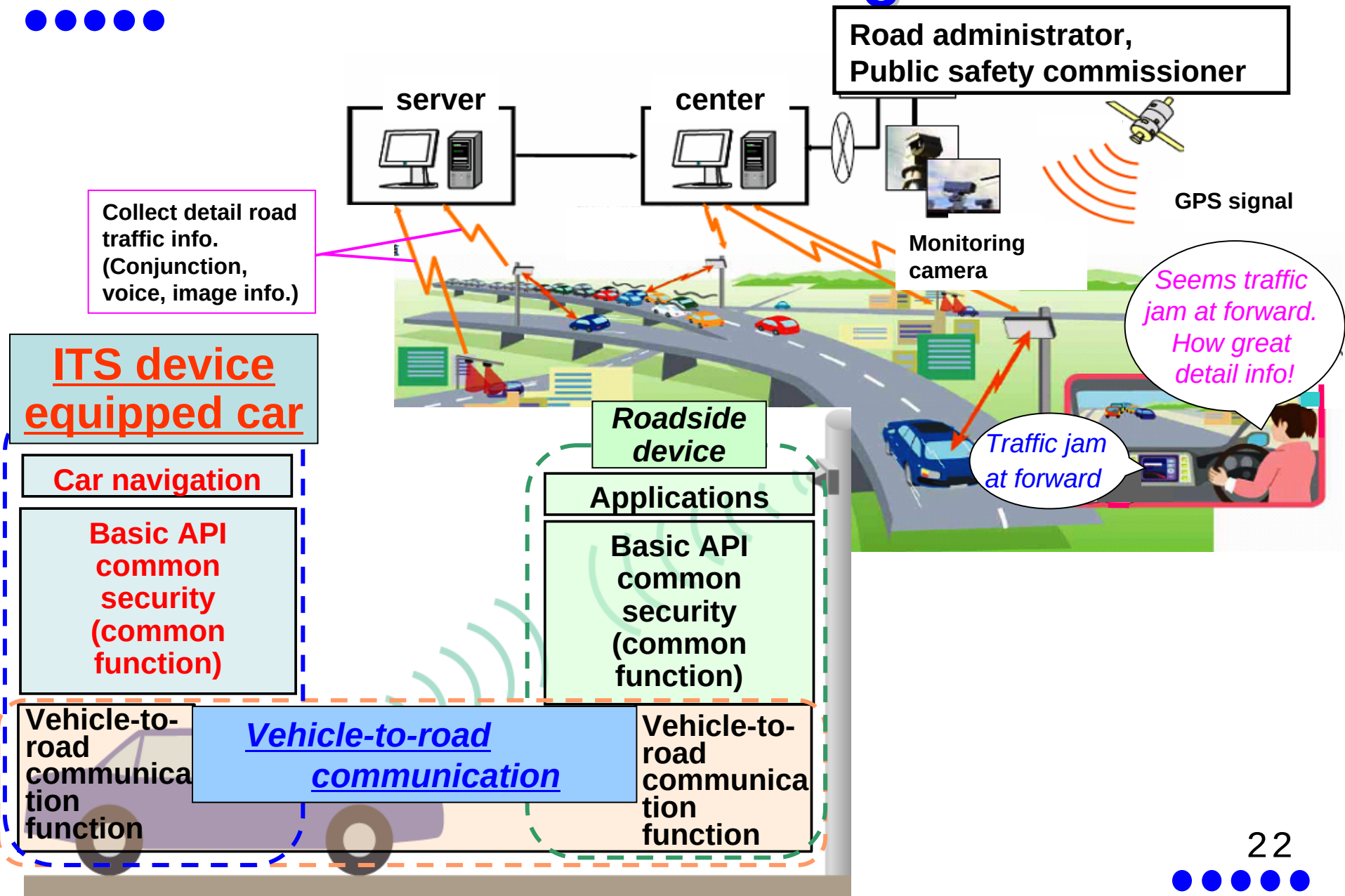
NILIM

Central server (future)

Feedback to distribution companies (proposed)

Accident-prone locations, Road drivability information, Reliability of travel time, Driving character (Evaluation of eco-friendly driving)

Road service in next generation



Road Drivability Map (Outline)

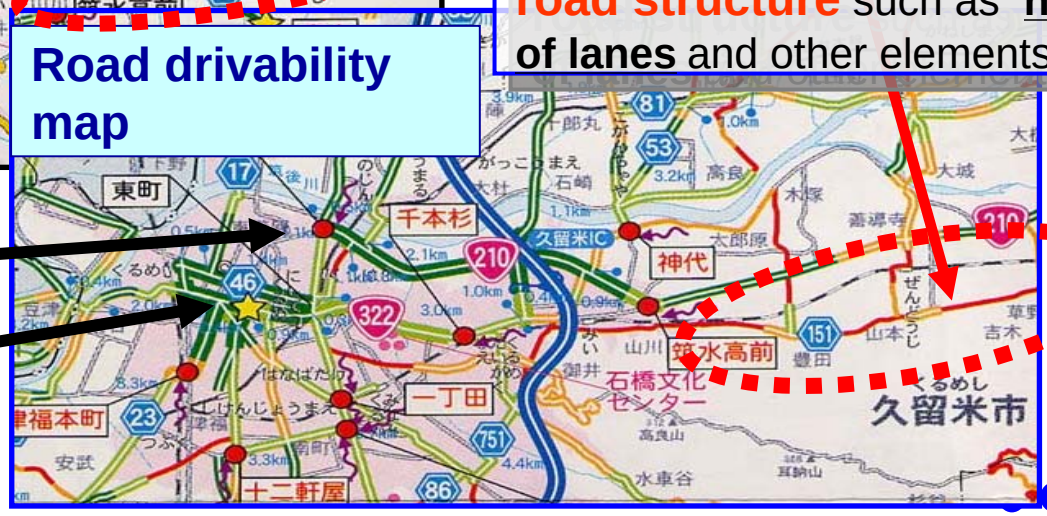
Following information that enables drivers to travel **safely** and **comfortably** is incorporated in the Road Drivability Map.

・Elements concerning with **road structures** : Number of lanes, radius of curves ・・・etc. ***graded according to six ranks (M - D)***

・Factors that affect diving speed : **Congested points ( )**

・Factors that affect safety when diving : **Hazardous Spots (Black spots) ( )**

Road drivability map



Congested spots ●

Hazardous Spots ★

…) **Various thicknesses and colors** indicate the **differences in road structure** such as **number of lanes** and other elements

categorization image (1/3)

Network studied and evaluation method

Criteria for ranking of road are:

M: Motorway (Automobiles only),

permits smooth traveling

S: (1) Roads more than one lane with soft curves/inclinations over 5km.

(2) Wide shoulders with few pedestrians or sidewalks and roadways divided by fences.

(3) Fewer than one level crossing with main road per 1km.

Road Drivability Map

categorization image (2/3)

(a suburban/mountainous area)

Criteria for ranking of road are:

A:

(1) 2 or more lanes, gentle curves/slopes.

(2) Sidewalks, wide shoulders

B:

(1) 2 or more lanes, fully gentle curves/slopes.

(2) Partly includes narrow shoulders.

C:

(1) One lane road with sharp curves.

2 or more lanes, many sharp curves and steep slopes.

(2) Includes parts with narrow shoulders.

D:

(1) One lane road with continuous sharp curves.

(2) Its shoulders are always narrow.

Road Drivability Map

categorization image (3/3)

(an urban district)

Criteria for ranking of road are:

A: (1) 2 or more lanes and gentle curves.

(2) Sidewalks usable by cyclists on both sides, and wide shoulders.

B: (1) 2 or more lanes.

(2) Sidewalks on both sides.

C: (1) 2 or more lanes.

(2) Sidewalk on 1 side or no sidewalk.

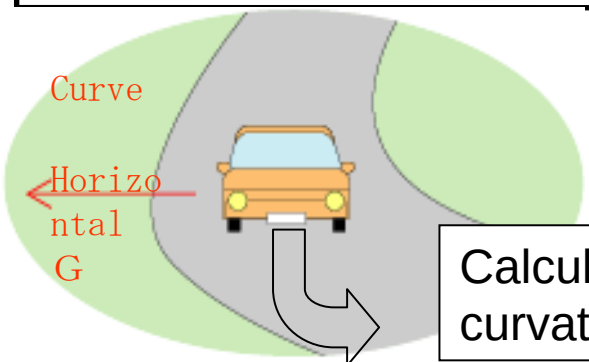
D: (1) 1 lane

(2) No sidewalk.

Measurement of road evaluation data

Required data and measurement method

Evaluation data	Method of measuring data
Design speed (radius of curvature)	Measure by probe car measurement
Number of lanes	Measures during the survey (The captured digital images give additional information to some categories.)
Sidewalk	
Shoulder	
Road mergers/divisions	
Frequency of traffic signals	
Roadside structures	Measures during survey; check from maps
Longitudinal slop	Confirm from road authorities



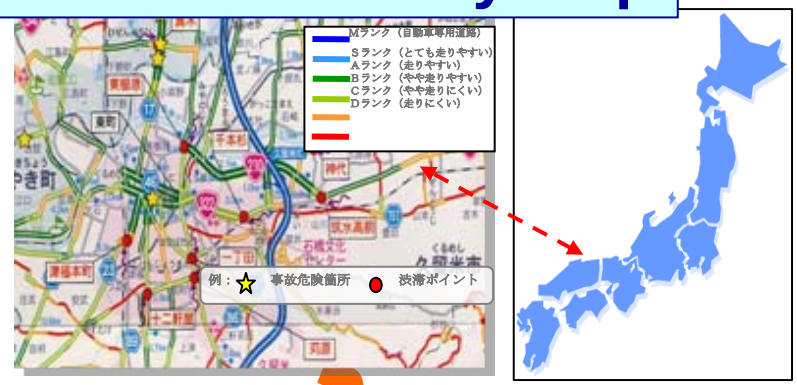
Data given by probe car

1) Travel speed
2) Horizontal gravity

Calculate the radius of curvature ⇒ Estimate the design speed

Application of Road Drivability Map to car navigation system

Road Drivability Map



（Effects）

1) Various route selections more than ordinal car navigation system.
2) Improvement of drivability (Effect of fatigue reduction)
3) Reduction of traffic accident (Improvement of senior driver's skills to the safe driving)

Car Navigation System

Information of easy-driving road supports the safe driving for senior drivers.

Summary and future issues

- Present Indicators: **safety**, c**ongestion**…
- For the indicator of "**Reliability**": Expecting **Probe data** collection systems

  -Bus-Location system

  -Public-Private sector partnerships for Probe data (Drive recorder of freight transport company)

  -ITS equipped car (in the future)
- **Drivability** Map: User friendly indicator, as road assessment via car navigation system