Vehicle-Infrastructure Cooperative System and Probe Data in Japan

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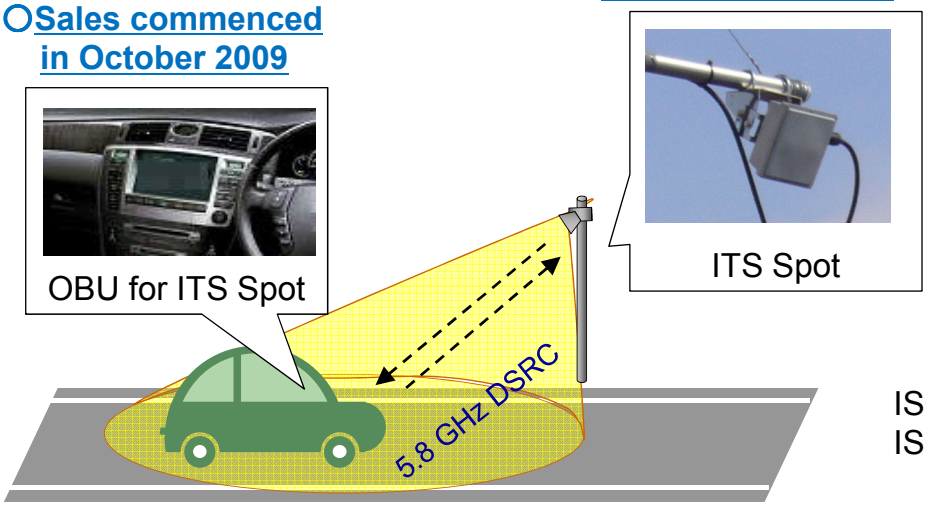
1. Start of ITS Spot service
2. Collecting probe data via ITS Spots
3. Utilizing probe data in road administration
4. Applicability to private-sector services

1. Start of ITS Spot service

- Installation of the vehicle-infrastructure cooperative system in 2011 has made possible various services in an “all-in-one” system.
- Services are provided via 5.8 GHz DSRC that links “ITS Spots” and compatible on-board units installed in vehicles.

○Deployed on expressways nationwide in 2011

○Sales commenced in October 2009

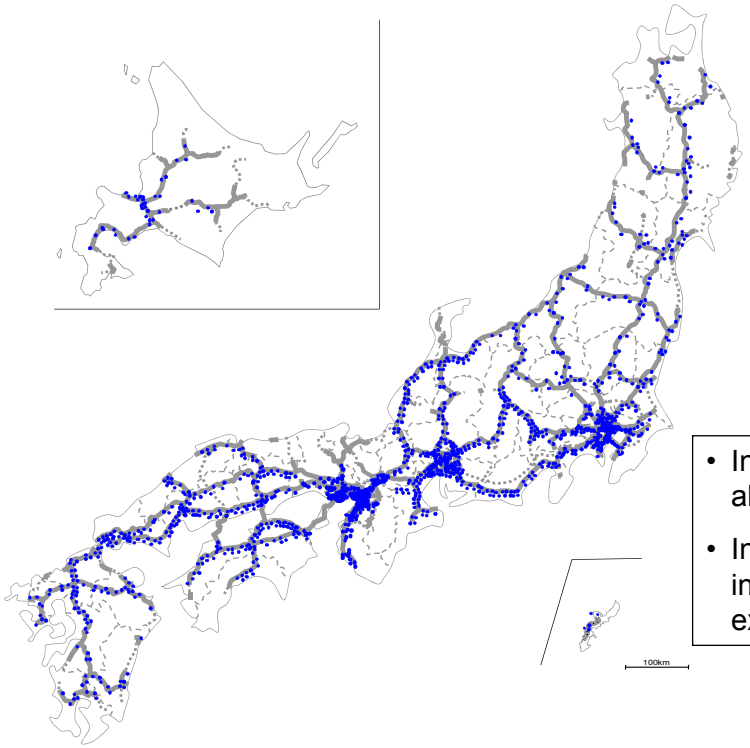


ISO 24103
ISO 29281

1. Start of ITS Spot service

Locations of ITS Spots

- Installed at approximately 1,600 locations on expressways throughout all of Japan



- Installed at 10 to 15-km intervals along inter-city expressways
- Installed at approximately 4-km intervals along inner-city expressways

1. Start of ITS Spot service

ITS Spot-compatible OBUs

- ITS Spot-compatible OBUs are marketed by 8 companies.
- It is forecasted that a total of approximately 10M units will be sold over 5 years.

Manufacturers of ITS Spot-compatible OBUs

Car manufacturer

TOYOTA

NISSAN SHIFT_the way you move

Drive@earth MITSUBISHI MOTORS

Electrical equipment manufacturer

ALPINE Mobile Media Solutions

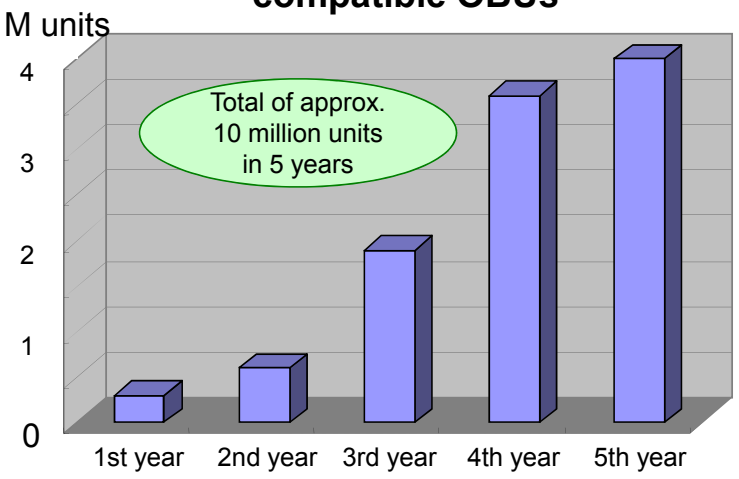
Pioneer

Panasonic ideas for life

MITSUBISHI HEAVY INDUSTRIES, LTD. Our Technologies, Your Tomorrow

MITSUBISHI Changes for the Better

Forecasted growth of ITS Spot-compatible OBUs



Source: ITS Japan

1. Start of ITS Spot service

- High-speed, high-volume communications between roads and vehicles provides road traffic information and others, and allows collection of data from vehicles.

Three basic services

Dynamic route guidance:	Receipt of wide-area congestion data allows car navigation system to select routes intelligently.
Safety driving support:	Reduction of close-call experiences by alerting drivers to possible dangers such as fallen obstacles.
ETC:	Realization of ETC services.

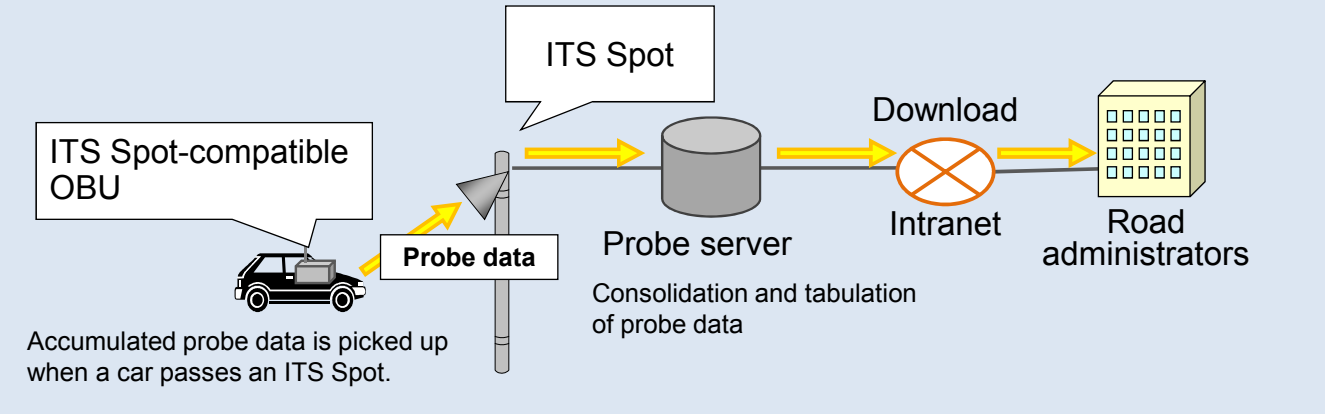
Collection of probe data: Collection of traveling data from individual vehicles

Other services (available with some manufacturer's OBUs)

Local sightseeing information and other information can be obtained via Internet connection.

*Additionally, services related to payments, tourism, distribution, etc., are planned for the future.

2. Collecting probe data via ITS Spots

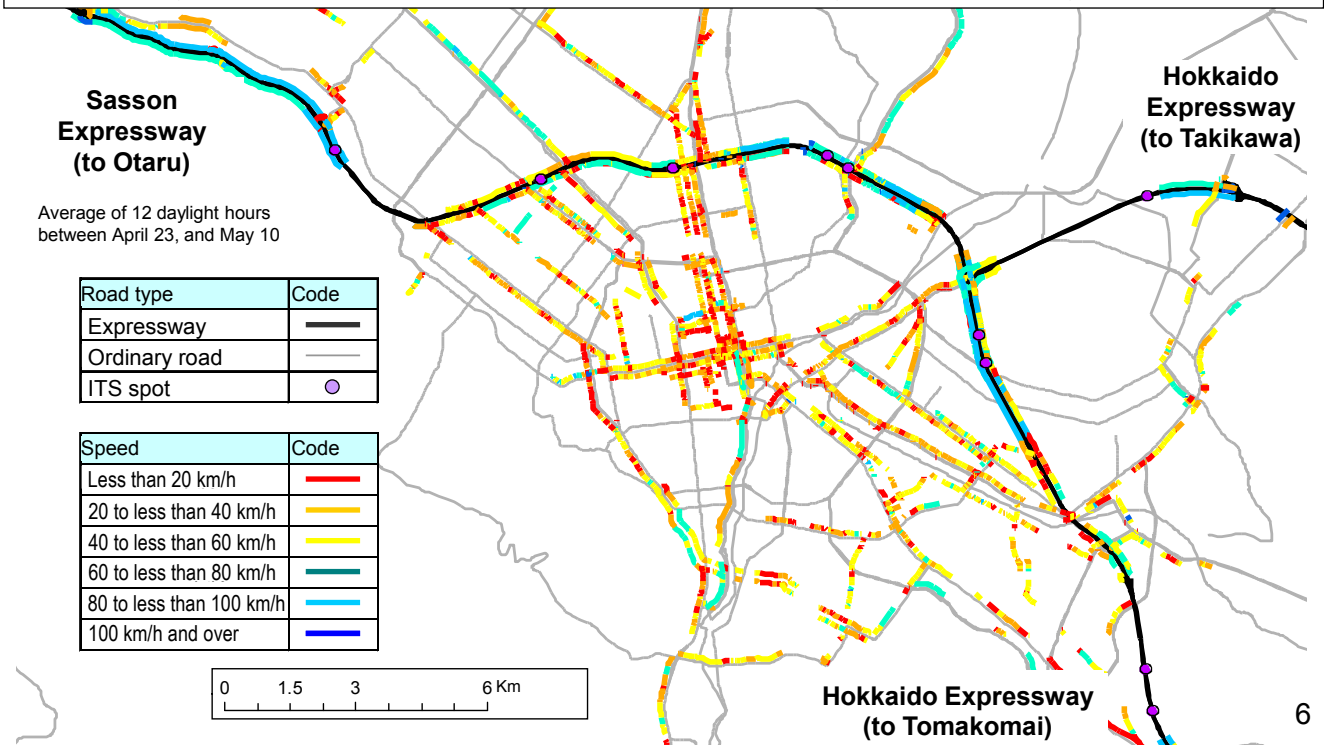


- Data collected
  - Travel data ; Time, location, speed
  - Behavioral data ;Time, acceleration in all directions, yaw angle speed
  - Timing of data recording
    - Location and speed: Every 200 meters of driving distance or when direction of travel changes by 45 degrees
    - Acceleration: When 0.25 G is surpassed
    - Yaw angle speed: When ±8.5 deg/s is surpassed
  - Data recording distance: Approx. 80 km

2. Collecting probe data via ITS Spots

Processed probe data (Sapporo City)

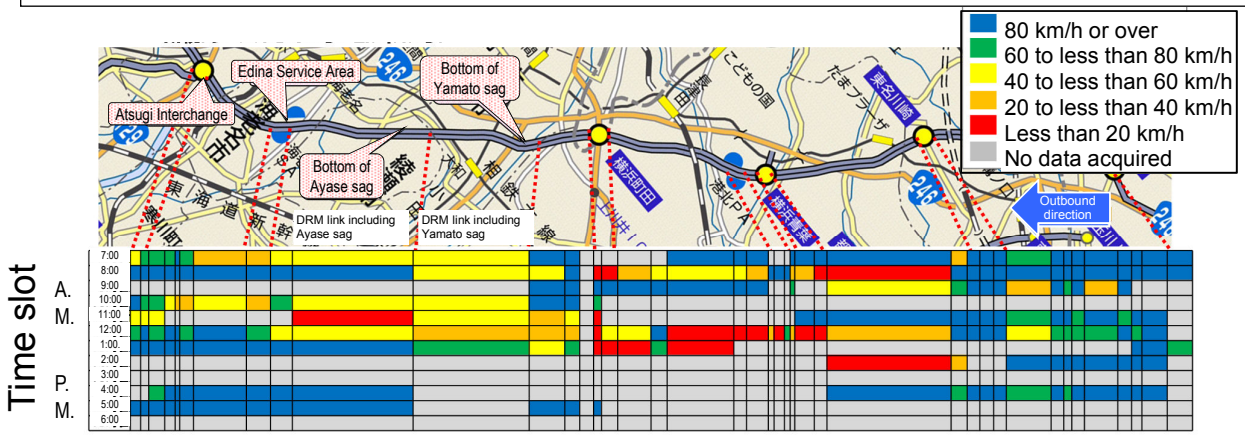
- Utilizing probe data collected via ITS Spots on expressways make it possible to survey whole-area travel speed on expressways and ordinary roads.



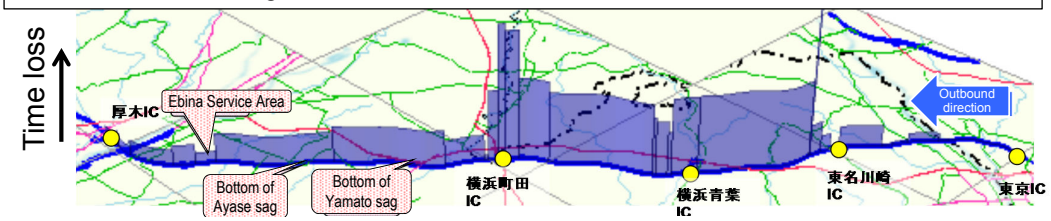
2. Collecting probe data via ITS Spots

Example of probe data analysis

Traffic conditions on the Tomei Expressway can be surveyed by section and time slot.
→ These data will be applied to administrative decisions.



Time lost to traffic congestion in each zone can be calculated



3. Utilizing probe data in road administration

Probe data application menu

- Greater sophistication and efficiency can be achieved in various areas of road administration by utilizing travel records and behavioral records.

Use area	Forms of probe data use
Survey and planning	• Implementation of whole-area and continuous travel speed surveys
Congestion countermeasures	• Quantitative survey of congestion conditions • Clarification of effect of road construction on road traffic
Traffic safety measures	• Analysis of travel conditions on community roads • Identification of potential hazardous points (accident-prone areas)
Management of large-vehicle passage	• Survey of conditions concerning passage of special-purpose vehicles and vehicles carrying hazardous materials
Road management during disasters	• Identification of passable route during disasters • Survey of passage conditions during snowfall
Provision of information	• Increased sophistication of provided road traffic data

3. Utilizing probe data in road administration

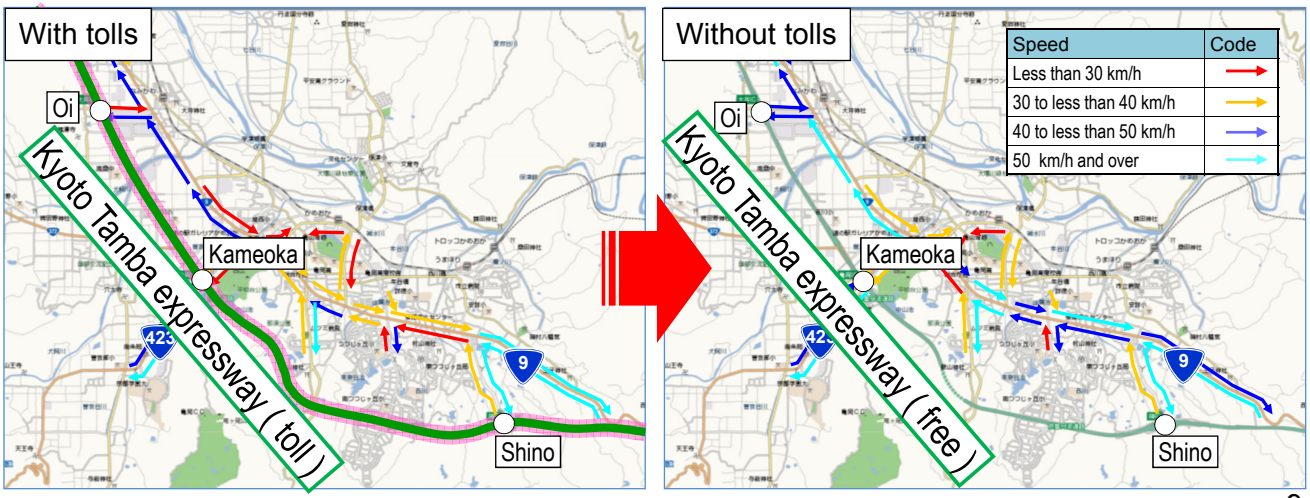
Example of application in evaluation of road policy

- Probe data can be used to ascertain road traffic over a wide area and evaluate road policy quantitatively.

Pilot project abolishing expressway tolls

Zone: 1,652-km zone
Period: June 28, 2010, to March 31, 2011

■ Change in speed during peak time periods



3. Utilizing probe data in road administration

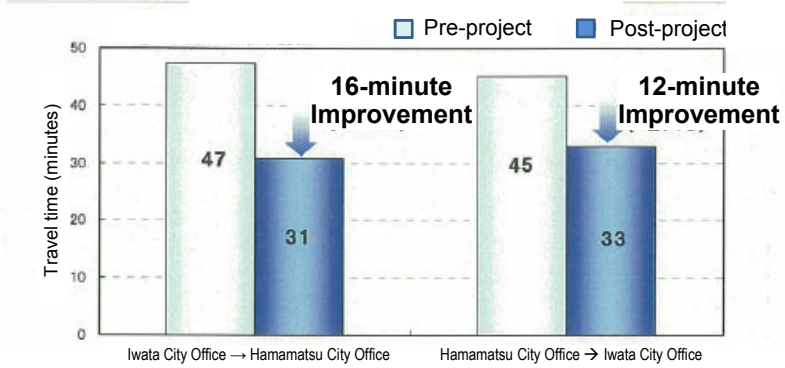
Example of application in road project evaluation

- Utilizing probe data makes it possible to quantitatively evaluate road projects, such as lane-widening work.

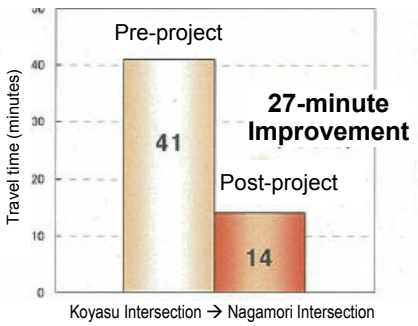
Example of the effect of road-widening project on National Highway 1

- Despite an increase in traffic volume on National Route 1 from 4,100 vehicles/hour to 5,600 vehicles/hour, travel time was reduced.
- Travel time on the parallel Iwata-Hosoe Line (prefectural road) was also reduced.
- Travel speed increased from the previous 20 km/h or less to 40 km/h or more.

Change in travel time on Nat. Route 1



Change in travel time on Iwata-Hosoe Line (prefectural road)

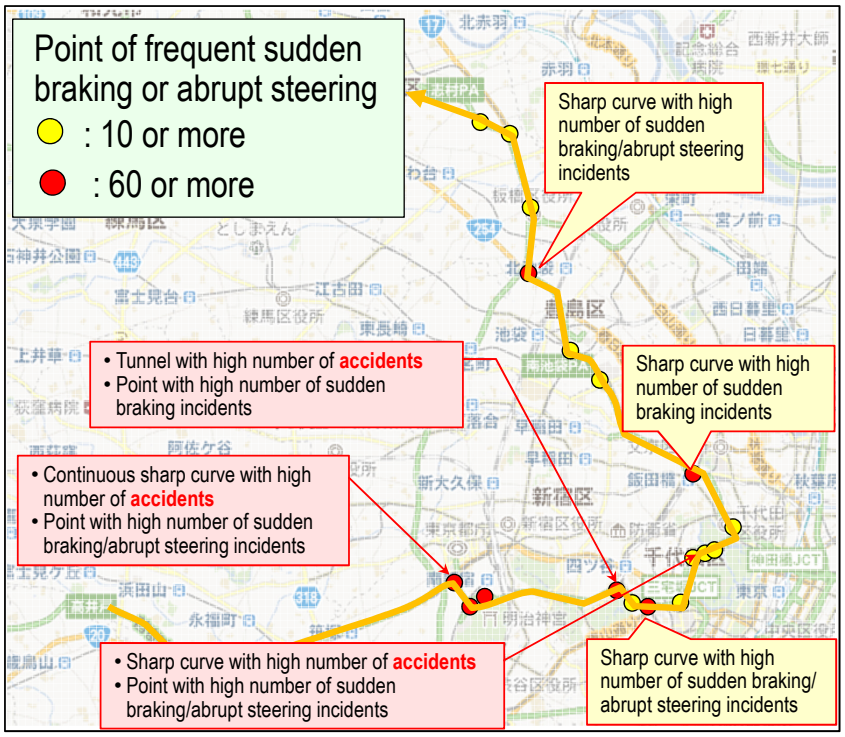


Source: Hamamatsu Office of River and National Highway (FY2008 project evaluation data)

3. Utilizing probe data in road administration

Example of identification of potential accident points

- Extracting locations of sudden braking or abrupt steering from behavioral records in probe data makes it possible to identify potential hazardous points.

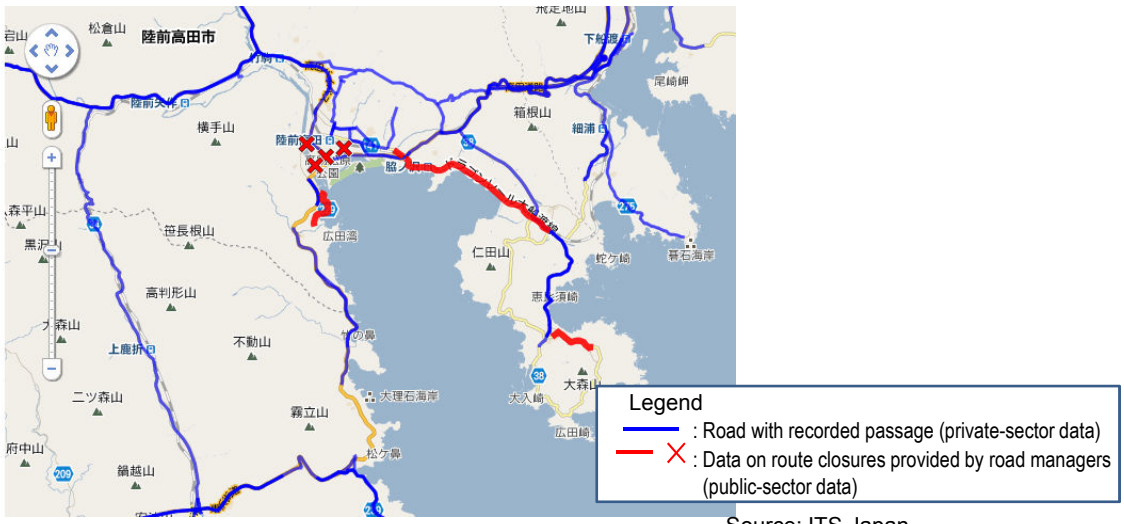


Source: AHS Research Association, NILIM (Material of the 2007 ITS Symposium)

3. Utilizing probe data in road administration

Example of application during a disaster

- Probe data collected by automobile manufacturers can be used in estimating passable routes. (Great East Japan Earthquake)
  - •Application in selection of routes for emergency transport vehicles
  - •Ascertainment of information on whether or not routes are passable within the nuclear accident evacuation area



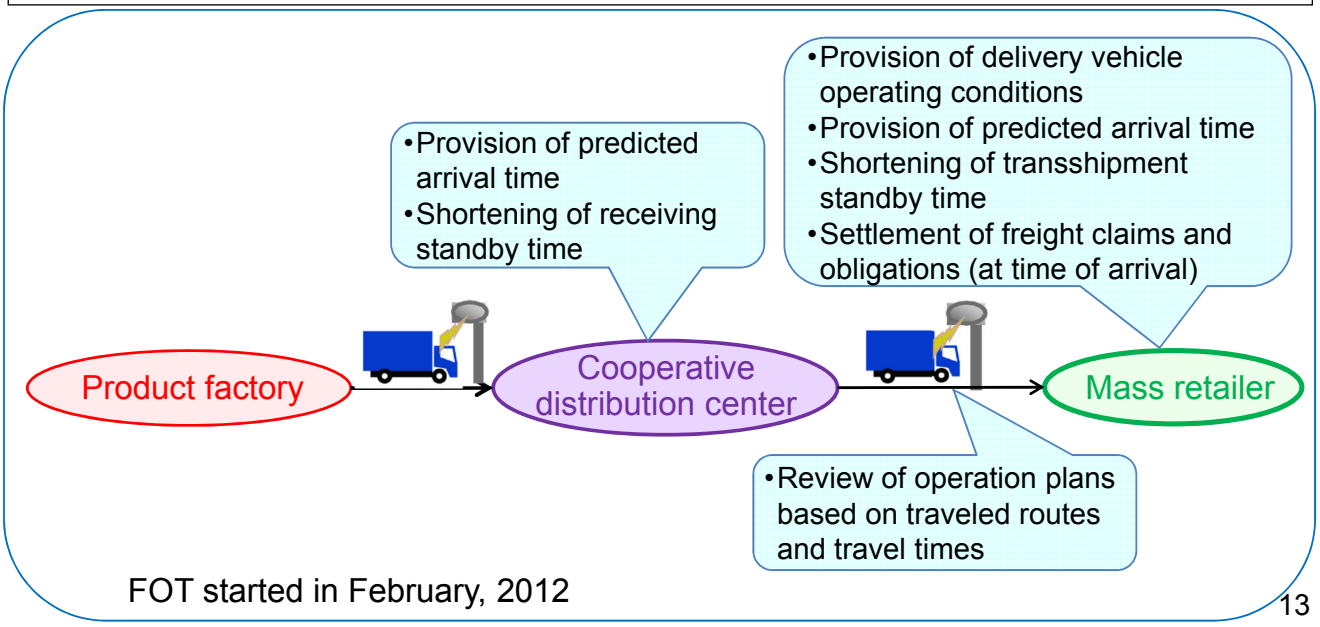
Source: ITS Japan

Data on vehicle passage and route closure

4. Applicability to private-sector services

Support for logistics business

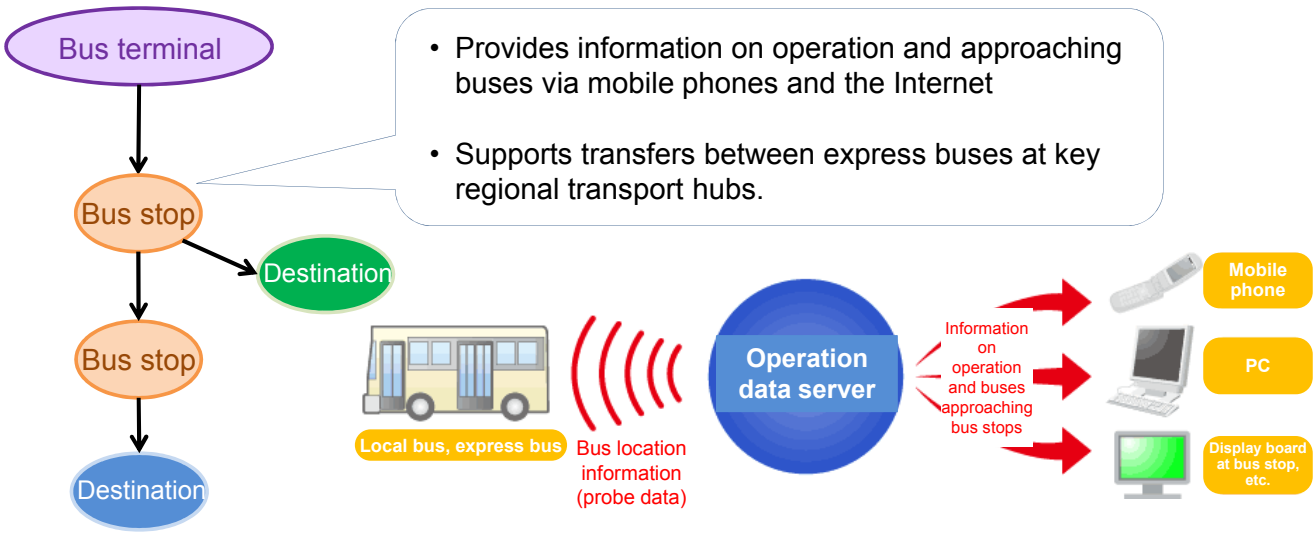
- Logistics companies can estimate product arrival times by surveying vehicle locations by probe data.
- The system supports regular reviews of operation plans and greater efficiency in receiving work by mass retailers.



4. Applicability to private-sector services

Support for scheduled express bus operation

- The system collects probe data from express buses and estimates their current locations and arrival times.
- It provides current location and estimated arrival time to expressway bus stops, thereby shortening waiting time and supporting transfers.



Thank you !

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