Vehicle-Infrastructure Cooperative System and Probe Data in Japan
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

5. Public-private partnership on probe data
1. Start of ITS Spot service

- Vehicle-infrastructure cooperative system installed in 2011.
- Services provided via 5.8 GHz DSRC.

- Sales commenced in October 2009
- Deployed on expressways nationwide in 2011

ISO 24103
ISO 29281
1. Start of ITS Spot service

Locations of ITS Spots

- 1,600 ITS Spots installed 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

- 16 manufactures marketed the compatible OBUs.
- 10M OBUs to be sold over 5 years.

Automobile manufacturers

Manufacturers of navigation systems and on-board units

Source: ITS Japan
1. Start of ITS Spot service

- Three basic services and probe data collection started.

**Three basic services**

- Dynamic route guidance: Wide-area congestion data for selecting routes intelligently.
- Safety driving support: Alerting drivers to possible dangers.
- ETC: Electronic toll collection

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

**Other services** (available with some manufacturer’s OBUs)

- Local sightseeing information via Internet.

*Additionally, services related to payments, tourism, distribution, etc., are planned for the future.*
2. Collecting probe data via ITS Spots

Accumulated Probe data

Probe Server

Consolidation and tabulation

Intranet

Road administrators

**Data collected**

- **Travel data**: Time, location, speed
- **Behavioral data**: Time, acceleration in all directions, yaw angle speed

**Timing of data recording**

<table>
<thead>
<tr>
<th>Location and speed</th>
<th>Every 200 meters of driving distance or when direction of travel changes by 45 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration</td>
<td>When 0.25 G is surpassed</td>
</tr>
<tr>
<td>Yaw angle speed</td>
<td>When $\pm 8.5$ deg/s is surpassed</td>
</tr>
<tr>
<td>Data recording distance</td>
<td>Approx. 80 km</td>
</tr>
</tbody>
</table>
2. Collecting probe data via ITS Spots

Protection of Privacy

1. Arrangement of the data to be transmitted
   - Drivers and vehicles can not be identified.
   - Probe data around the point where the engine stops will not be transmitted.
   - Driver can choose not to transmit probe data.

2. Declaration of data usage
   - Purpose of data usage is limited.
     ・ *Improvement of road management*,
     Manufacturer's product development, research, etc.
   - Described in the instruction manual of OBUs and on the MLIT website.
2. Collecting probe data via ITS Spots

Processed probe data (Sapporo City)

Gathering of travel speed data (average 12 hours/day) in Central Sapporo (Sep - Nov 2011 (3 months))

Legend Speed ([km/h])
- 0 to 20
- 20 to 40
- 40 to 60
- 60 to 80
- 80 to 100
- 100 or more

Legend (Others)
- Expressway
- Ordinary roads
- Railway (JR)

*The bold line is the speed of expressway.*
### 3. Utilizing probe data in road administration

#### Probe data application menu

- Greater sophistication and efficiency to be achieved by travel records and behavioral records.

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

Example of application in evaluation of road policy

- Probe data used for evaluating 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

- Probe data indicates sudden braking points.
- Taking counter measures at such points can prevent traffic accident in advance.

Sudden braking point: Treat the roadside plants

Sudden braking point: Painted road marking

Quotation from Honda Motor Co., Ltd.
Sudden braking reduced by 70%
3. Utilizing probe data in road administration

Example of application during a disaster

• Probe data used for estimating passable routes. (Great East Japan Earthquake)

• Selecting routes for emergency transport vehicles and relief supplies.

Data on traveled route and route closure
4. Applicability to private-sector services

**Support for distribution business**

- Probe data of each logistic vehicle is collected at ITS Spots free of communications charges, and provided to the logistic center real-time.
- Physical distributors use the probe data for controlling vehicular operation and guiding each driver for safe driving.

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The Study Group of Consumer Electronics Logistics (Organizer: MITSUI-SOKO-LOGISTICS Co., Ltd.)

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Joint research on Probe data

Purpose
Take advantage of the probe data collected through ITS Spots in conjunction with industry.
(1) Technology development for the use of Probe data
(2) Validation of the effects of introducing service
(3) Creating a technical standards and institutional framework

Period
September 2012 ~ March 2015

Proposal submitted  7 companies.

Now, in preparation for a joint research agreement.

Results to be expected
Clarification of the use of effective service.
Improved easiness of utilization.  →  Practical Service!
5. Public-private partnership on probe data

- Private sector is also collecting probe data and creating various services.
- Quality and quantity of such data is usually undisclosed.

<table>
<thead>
<tr>
<th></th>
<th>Car companies</th>
<th>Cellular application</th>
<th>Taxi companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection method</td>
<td>Cellular phone</td>
<td>Cellular phone</td>
<td>Business-use radio</td>
</tr>
<tr>
<td>Data items collected</td>
<td>Time stamp</td>
<td>Time stamp</td>
<td>Time stamp</td>
</tr>
<tr>
<td></td>
<td>Latitude /</td>
<td>Latitude / Longitude</td>
<td>Latitude / Longitude</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>Speed</td>
<td>(Partly undisclosed)</td>
</tr>
<tr>
<td>Number of target</td>
<td>Partly</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Undisclosed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity of data</td>
<td>Undisclosed</td>
<td>Undisclosed</td>
<td>Undisclosed</td>
</tr>
<tr>
<td>Accuracy of data</td>
<td>Undisclosed</td>
<td>Undisclosed</td>
<td>Undisclosed</td>
</tr>
</tbody>
</table>
5. Public-private partnership on probe data

Next Steps

- **Probe data collected through ITS Spot**
  - Realization of private services through joint research.
  - Establishment of rules to use probe data.
    - *Format to be provided, Personal information protection, etc.*

- **Probe data collected by private sector**
  - Necessary to compare the quality of probe data.
    - *Accuracy, Amount of data, Availability of real-time data, etc.*
    → *this is an area of competition.*
  - Further study for new application aiming efficient road administration.
    - *Analysis of traffic behavior including a variety of transportation modes, Optimal transportation planning.*
    - *Analysis of time loss due to congestion by road work, Adjusting the timing of road work, etc.*