Tests on ETC roadside equipment for Smart Interchanges for connection at Service/Parking Areas

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The planned extension of Japanese expressways is 64% completed, yet, the usage ratio is low compared to those of U.S. or Europe.

A policy promoting usable expressway is urged:
- Addition of more interchanges should be addressed
- Flexible and diverse toll charge policy is required
- Prioritized construction of the missing road links
1. Current Status of Expressway operation (2)

ETC commenced in March, 2001
Aims: alleviate congestion, preserve roadside environment, save operation costs

As of September, 2005

Setup units 9 million, accounting for 50.8% of settlements

Pervasive ETC and use (as of Oct 25, 2005) source: ORSE

Various discount services
- ETC for commute early/late hours discount (since Nov. 2004)
- ETC mileage discount service (since April, 2005)
- large/frequent transaction discount system (since April, 2005)
- others
Impact of ETC pervasiveness on tie-ups (Metropolitan Expressways: 18 main lane tollgates)
2. Smart Interchange

- Cost reduction benefits
  - construction costs reduced by approx 30%
    (trumpet-shape vs diamond shape)
  - operation costs reduced by approx 50%

- placement impacts
- direct effectiveness of additions
  results in 200 million JPY/year/location

Smart Interchange
- Interchange dedicated only to ETC vehicles
- costs savings realized for
construction/maintenance/operation
3. The Social Experiment of Smart Interchange (1)

**Target:** identify specification of system/device, device placement location and issues of operations

Conceptual image: Smart Interchange of link type at service/parking area
### 3. The Social Experiment of Smart Interchange (2)

#### Comparison between ETC roadside system for the social experiment and existing ETC roadside system

<table>
<thead>
<tr>
<th>Operation</th>
<th>Device</th>
<th>ETC roadside system for the social experiment</th>
<th>Current ETC roadside system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted to particular vehicle</td>
<td>wireless roadside device</td>
<td>When restricting a tractor, single antenna at entrance method</td>
<td>Double-antenna method is employed</td>
</tr>
<tr>
<td>Dedicated for the vehicle with ETC OBE</td>
<td>ETC lane sign board</td>
<td>Fixed sign board</td>
<td>Movable sign board</td>
</tr>
<tr>
<td>For a vehicle halt</td>
<td>Vehicle start control</td>
<td>General purpose products (for a low price) are applicable (open/close operations in 3 seconds)</td>
<td>Dedicated device (open/close operation in 500ms)</td>
</tr>
<tr>
<td></td>
<td>Vehicle detector</td>
<td>A single device is used without sensing axle load or reverse operations</td>
<td>4 sensors</td>
</tr>
<tr>
<td>A short term operation during Social Experiment</td>
<td>Tollgate server</td>
<td>Security processing section is composed of the current devices</td>
<td>Duplicated security procession</td>
</tr>
</tbody>
</table>

**Diagram:**
- **Existing ETC roadside system**
- **ETC roadside system for Smart Interchange of Service/Parking area connection type as a social experiment**
3. The Social Experiment of Smart Interchange (3)

The Social Experiment of Smart Interchange

- Roadside wireless device (antenna)
- Vehicle detector
- Communication start control (sensor)
- Vehicle start control
- Data processing device
- Toll gate server
- Lane monitoring camera
- Roadside display unit
- Egress lane
- Ingress lane
- Communication start control (start button, inter-phone)

Service/parking area connection type (Arai Parking area)
4. System Operation

Outcome Review (1)

Required time to pass through gate section

Outcome of system operations

Processing volume
Approx. 800 vehicle/hr
(existing ETC)
Approx. 400 vehicle/h
(Smart Interchange)
Approx. 230 vehicle/hr (manual)

On a vehicle halt requirement in ETC service operation

Making a halt is required
Unfamiliarity
Taking some time to pass
Hard to understand an operational
others

Approx. 25%
**4. System Operation**  
**Evaluation Review (2)**

**User’s performance evaluation on device operations**

- Understandable: 64%
- Not understandable: 36%

**User’s remarks on Social Experiment of Smart Interchange**

- Problem: 7%
- No problem: 93%

**Understandability of road surface sign**  
(available answer: 1,334)

- Understandable: 85%
- Not understandable: 15%

**Identification of button operation to start communications**  
(available answer: 121)

- Cannot say either: 0%
- Not understandable: 15%
- Understandable: 85%

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4. System Operation  
Evaluation Review (2)
### Remarks of the users for a practical system use

<table>
<thead>
<tr>
<th>Issue pointed out</th>
<th>cause</th>
<th>countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low operation speed of Vehicle start control bar</td>
<td>A general purpose product is used</td>
<td>• Review of a gate passing time, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Device specifications are taken into consideration</td>
</tr>
<tr>
<td>Due to adverse weather (snowfall), poor visibility on</td>
<td>Low operation capacity of roadside display unit and low visibility</td>
<td>snow melt capacity (snow melt heater) is prepared to cope with the site conditions</td>
</tr>
<tr>
<td>signs of ingress/egress or a halt line</td>
<td>of a halt line due to snow stuck</td>
<td></td>
</tr>
<tr>
<td>Operation time is not clear</td>
<td>User’s unfamiliarity with operation time</td>
<td>• An additional display capacity and display unit ahead of the system is reviewed</td>
</tr>
</tbody>
</table>

4. System Operation

Outcome Review (3)
5. Smart Interchange Operation in the Future

Issues:

- Enhancing safety
  - Secure a vehicle halt
- Smoother traffic flow guidance
  - Reliable vehicle guidance, plus reverse operation when a vehicle makes a wrong lane
- Total costs reduction
  - Review for reduction of monitoring efforts/costs

With review on operation conditions and device specifications, prepare for full-scale operation at further sites