New Advances in Electronic Toll Collection (ETC) Systems

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Introduction of ETC

Roadside antenna

On-board unit

IC card

Two-way radio communications
Features of ETC in Japan

Radio frequency band: 5.8GHz band

System: Active system

Permitted bandwidth: 4.4MHz

Number of channels (Downlink): 7

Number of channels (Uplink): 7

Modulation type: ASK, QPSK (ETC: ASK)

Transmission speed: 1Mbps/ASK, 4Mbps/QPSK (ETC: 1Mbps)

Radio access type: TDMA/FDD

Maximum antenna power:
- Base stations: 300mW
- Mobile land stations: 10mw

Communications format of the ETC system:
- 5770 MHz (5.8 GHz DSRC band)
- 5850 MHz

Radio frequency distribution:
- Downlink:
  - Channels: #1, #2, #3, #4, #5, #6, #7
  - Frequencies: 5775, 5780, 5785, 5790, 5795, 5800, 5805

- Uplink:
  - Channels: #1', #2', #3', #4', #5', #6', #7'
  - Frequencies: 5815, 5820, 5825, 5830, 5835, 5840, 5845

ETC on-board unit

DSRC roadside unit

5.8 GHz band short-range communications
Features of ETC in Japan

＜Active DSRC＞

【Roadside unit】

【On-board unit】

Summary:
Both the on-board unit and the roadside unit have radio transmitters and can send radio signals to each other.

Features:
- Highly reliable communications
- High-capacity two-way communications
- Communications across multiple lanes
Situations of ETC infrastructure

Locations using ETC as of June 30, 2008 (cumulative total: Approximately 1,500 tollgates)

Locations where ETC has not yet been introduced (However, ETC cards can be used.)
### Measures to promote the proliferation of ETC

#### Issues based on user questionnaires:

- It is expensive to purchase ETC equipment.
- Installation and setup are troublesome.
- I don't want to use a credit card.
- I need a receipt.
- I'm thinking about replacing my car.

#### Measure to promote proliferation | Details

<table>
<thead>
<tr>
<th>ETC leasing program</th>
<th>Upon the introduction of ETC, users receive a fixed subsidy from the national government.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free on-board unit campaign</td>
<td>Provide free ETC on-board units by adding a subsidy to the ETC leasing program for persons such as new purchasers of ETC cards.</td>
</tr>
<tr>
<td>Free mileage points</td>
<td>Upon the introduction of ETC, expressway companies are awarding mileage points for users.</td>
</tr>
<tr>
<td>One-stop service</td>
<td>With this service, users can obtain an ETC card, purchase an on-board unit, and get it installed and set up at one location, on the same day.</td>
</tr>
<tr>
<td>Personal Card</td>
<td>ETC card depositing funds in advance and having the toll charges deducted from their bank accounts.</td>
</tr>
<tr>
<td>Providing usage history records</td>
<td>ETC usage history records are available via the Internet and from desktop printers at service areas and parking areas.</td>
</tr>
<tr>
<td>Standard installation</td>
<td>ETC standard equipments (The carmakers are increasing these figures every year.)</td>
</tr>
</tbody>
</table>
Penetration of ETC on-board units

- Approximately **20.1 million** ETC on-board units have been installed (as of October, 2008).
- The ETC utilization rate on expressways nationwide is **74.6%** (as of October, 2008).
Price distribution of ETC on-board units

<Trends in ETC on-board unit prices>

<table>
<thead>
<tr>
<th>Time (fiscal years)</th>
<th>Manufacturer's suggested retail price (yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2001</td>
<td>¥45,000</td>
</tr>
<tr>
<td>FY 2002</td>
<td>¥35,000</td>
</tr>
<tr>
<td>FY 2003</td>
<td>¥29,800</td>
</tr>
<tr>
<td>FY 2004</td>
<td>¥19,000</td>
</tr>
<tr>
<td>FY 2005</td>
<td>¥16,190</td>
</tr>
<tr>
<td>FY 2006</td>
<td>¥15,800</td>
</tr>
<tr>
<td>FY 2007</td>
<td>¥15,800</td>
</tr>
</tbody>
</table>

Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan
Effects of ETC penetration

Causes of congestion on expressways

- Toll gates: 31%
- Merging lanes: 22%
- Sags and tunnels: 40%
- Others: 7%

Reduction in carbon dioxide emissions due to ETC

With the introduction of ETC, congestion has been eliminated, reducing carbon dioxide emissions by about 170,000 tons per year.

Trends in ETC utilization rates and congestion at tollgates

Amount of congestion (km-h/day)

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount of Congestion</th>
<th>ETC Utilization Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 2002</td>
<td>4.8%</td>
<td>64.6%</td>
</tr>
<tr>
<td>Dec. 2003</td>
<td>15.6%</td>
<td>31.6%</td>
</tr>
<tr>
<td>Dec. 2004</td>
<td>29.7%</td>
<td>29.7%</td>
</tr>
<tr>
<td>Dec. 2005</td>
<td>63.0%</td>
<td>72.2%</td>
</tr>
<tr>
<td>Dec. 2006</td>
<td>10.6%</td>
<td>77.9%</td>
</tr>
<tr>
<td>Dec. 2007</td>
<td>2.1%</td>
<td>80.0%</td>
</tr>
</tbody>
</table>
Measures using ETC: Smart interchanges

Ordinary interchanges

Problems:
- The cost of labor to collect tolls is high.
- Construction costs are high, and facilities need to be concentrated to limit toll collection expenses.

Smart interchange
(directly off the main route)

- Because smart interchanges use ETC, there is no need to concentrate the toll collection facilities, and they can be compact.
- The cost of labor to collect tolls can be saved.
- New interchanges can be added efficiently, contributing to regional revitalization and more efficient distribution through the effective use of expressways.
Effects of smart interchanges: Regional economic revitalization

Example: Enshu Toyoda Smart Interchange on the Tomei Expressway

- Attract 13 factories and other businesses, one large-scale commercial facility, and one lodging facility.
- About 2,700 jobs will be created through the establishment of these businesses.

Location map of land readjustment project

Full-scale introduction: April 2007
Traffic volume: 1,000 vehicles per day (FY 2007)
Adjacent interchanges: Iwata Interchange (1.9 km)
Hamamatsu Interchange (4.7 km)
A certain quantity of stock has been established (expressway network):

The focus changes from construction to utilization of the expressway network.

**Measures using ETC: Diverse and flexible expressway toll pricing measures**

**Ordinary roads**
- Traffic congestion
- Environmental problems
- Traffic safety problems

**Expressways**
- Unused capacity
- High potential demand

**Outline of diverse and flexible expressway toll pricing measures**

- **Mileage discount** (up to about 13.8%)
- **Commuter discount** (50%)
- **Early morning and night discount** (50%)
- **Volume and frequency discount** (up to about 30%)
- **Late-night discount** (30%)

Higher effective discount rates are obtained by combining multiple discounts.
Implementing economic measures by reducing expressway tolls

"Emergency Policy Measures for Achieving Peace of Mind"

- The following toll charge discounts are provided to vehicles that use ETC radio transmission to pass through tollgates.

(1) Expanded late-night discount and night discount time span

Example: National Expressway

<table>
<thead>
<tr>
<th>Weekdays</th>
<th>Weekends and holidays</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 AM</td>
<td>6 AM</td>
</tr>
<tr>
<td>9 AM</td>
<td>9 AM</td>
</tr>
<tr>
<td>5 PM</td>
<td>5 PM</td>
</tr>
<tr>
<td>8 PM</td>
<td>8 PM</td>
</tr>
<tr>
<td>10 PM</td>
<td>12 AM</td>
</tr>
<tr>
<td>12 AM</td>
<td>4 AM</td>
</tr>
</tbody>
</table>

Starting Tuesday, Oct. 14
50% discount

Starting Tuesday, Sept. 16
30% discount

Existing 50% discount

Existing 30% discount

Existing 40% discount

Existing 50% discount

(2) Daytime discount for non-working days in the provinces

Example: National Expressway

Starting Saturday, Sept. 20
50% discount (up to standard cars, up to 100 km, excluding suburbs of large cities)

Wednesday, Oct. 14
50% discount

Wednesday, Sept. 16
30% discount

Existing 30% discount

Existing 50% discount*

Existing 40% discount*

Existing 50% discount

Toll charges are reduced at night, when a great deal of long-distance freight transport occurs, contributing to more efficient distribution.

Toll charges are reduced on weekends and holidays, when a great deal of tourist and leisure travel occurs, contributing to regional revitalization (promoting tourism).

* Planned implementation from Saturday, Oct. 18, 2008 to Jan. 31, 2009
**Multipurpose use of ETC**

- **ETC = Toll roads**
  - The vehicle identification function of ETC on-board units is now used for multiple purposes.

- **Parking garages**
  - Cars can now pass through the exit gates of parking facilities in much less time.

- **Shopping malls**
  - Parking facility entry/exit management at department stores and shopping malls.

- **Tourism toll roads**
  - Automated fee payment and automatic gate opening.

- **Ferries**
  - Boarding procedures are greatly simplified.
Smartway services with expanded ETC technologies

VICS (wide-area, detailed road traffic information)

Fee payment at parking facilities, etc.

In-car Internet access

Driving safety support services

Shinjuku-Dori Ave. near Yotsuya-Mitsuke: Congested for 0.5 km

Congestion ahead. Take care to avoid a rear-end collision.

Fee payment at parking facilities, etc.

Car navigation system

ETC on-board unit (5.8 GHz DSRC)

VICS receiver (2.4 GHz)

Diverse media

Car navigation system

ITS on-board unit (5.8 GHz DSRC)
Japan’s Electronic Toll Collection (ETC) …

• adopted the technical format that is high level of accuracy and highly reliable.

• has spread rapidly and its benefits are now well established throughout Japan.

• is now used in various situations and deployed to various applications.
Thank you !