From ETC to IoT & Smart City

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Far Eastern Electronic Toll Collection Co., Ltd.
Mobile IoT and Smart City
Mobile IoT and Smart City

- Digitalization
- Personalization
- Mobility

- Medicine
- Housing
- Traffic
- Education
- Entertainment
- Eating
- Smart City
Mobile IoT and Smart City

- Mobile Cell Phone
- Cable / Digit TV
- Internet
- eTag

- Television shopping / TV Program
- Mobile Shopping / Video / Information

- Office
- Vehicle

- On line Shopping / Games / Video / Information
- Toll / Parking / Traffic Management

Infrastructure
Penetration
Integration

Application
Taiwan ETC Overview
## Taiwan ETC Overview

<table>
<thead>
<tr>
<th>Area</th>
<th>36,192 Km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>23 M</td>
</tr>
<tr>
<td>Registered Vehicle</td>
<td>7.1 M</td>
</tr>
<tr>
<td>Total Highway Distance</td>
<td>1,000 Km</td>
</tr>
<tr>
<td>Tolling Method</td>
<td>Distance-based</td>
</tr>
<tr>
<td>Tolling Infrastructure</td>
<td>327 free flow gantries</td>
</tr>
<tr>
<td>BOT Contract</td>
<td>The Taiwan Area National Freeway Bureau awarded 20 years of BOT concession to FETC from 2004</td>
</tr>
</tbody>
</table>
Taiwan ETC Overview
Public–private partnership

- Public: Taiwan Area National Freeway Bureau (TANFB)
  - Policy, Toll Rate

- Private: Far Eastern Electronic Toll Collection Co, Ltd (FETC)
  - Design, Build, Operate
  - Duration: 2004-2025
Taiwan ETC Overview

- Manual toll
- Phase I: Y2006 SLFF ETC
- Phase II: Y2014 MLFF ETC

Manual → Phase I
- Manual toll & ETC toll
- Extend ETC Lane by usage

Phase I → Phase II
- Construct 319 new gantries
- Full ETC without manual toll
Taiwan ETC Overview

- IR DSRC OBU system started in Feb 2006
  - IR OBU was paid by vehicle owner ($40 USD)
  - Only accumulated 1.2M of vehicles until 2012

- Passive RFID system introduced in May 2012
  - eTag (RFID) for free
  - IR OBU and eTag co-exist operation
  - Reach 5M of vehicles by only spending 16 months
  - 100% eTag and full distance-based MLFF started from Jan, 2014

ETC Card + IR OBU

Virtual Account = License Plate + ID of Car Owner

Each eTag links to a Virtual Account
Taiwan ETC Overview

Japan DSRC: 13 years

Taiwan RFID: 1.5 years
<table>
<thead>
<tr>
<th>THE FIRST COUNTRY</th>
<th>have implemented ETC on the entire national freeway system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>THE FIRST COUNTRY</td>
<td>transformed from manual flat-fate toll plazas to distanced-based ETC.</td>
</tr>
<tr>
<td>THE LONGEST ETC</td>
<td>The total ETC length reaches 926 kilometers.</td>
</tr>
</tbody>
</table>
## Taiwan ETC Overview

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ETC Customer</strong></td>
<td>6.4 M</td>
</tr>
<tr>
<td><strong>ETC Daily Transactions</strong></td>
<td></td>
</tr>
<tr>
<td>Daily Average: 15 M</td>
<td></td>
</tr>
<tr>
<td>Historical Daily High: 22.7 M</td>
<td></td>
</tr>
<tr>
<td><strong>eTag Usage Rate</strong></td>
<td>94%</td>
</tr>
<tr>
<td><strong>ETC Usage Rate</strong></td>
<td>100%</td>
</tr>
</tbody>
</table>
## Audited by the third party and supervised by the government

<table>
<thead>
<tr>
<th>Audit period (2014/02/01-2014/04/30)</th>
<th>Audit result</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Audit Transactions</td>
<td>4,805,610</td>
<td></td>
</tr>
<tr>
<td>Tolling Accuracy Rate</td>
<td>99.9999%</td>
<td>only 7 cases</td>
</tr>
<tr>
<td>Vehicle Detection Accuracy Rate</td>
<td>99.9800%</td>
<td>KPI: 99%</td>
</tr>
</tbody>
</table>
Taiwan ETC Overview
Sustainable ITS Business Model

Service Channel

Bank Account

ETC Operator

Government (TANFB)

3rd Party Auditor

Account & Tag Mgmt.

Commission%

Cash$

Deduction

Service Fee%

Toll Statements

IV&V

Quality Monitor & Enforcement

(activation, top up, payment, inquiry)

pay$
2015 Toll Excellence Award Winners
Customer Service & Marketing Outreach

Taiwan Area National Freeway Bureau - Program for Transition from Manual Flat-rate Pay-Per-Use Toll Collection to Electronic Distance-based Toll Collection on Taiwan’s Freeways.

The Taiwan Area National Freeway Bureau introduced its electronic, distance-based toll collection system to increase fairness and equity across the highway network, boost operational efficiency, streamline traffic flow through variable pricing, and deliver superior accuracy. The agency introduced manual and electronic tolling in February 2006, followed by an eTag system in May 2012, and now averages 14 million transactions per day with a tolling accuracy rate of 99.97% and detection accuracy of 99.9%, the world’s highest. The new system consists of 319 single gantries that feature a modular design for rapid deployment. It took only 10 months to install all the gantries, with no on-the-job accidents or loss in quality.
Taiwan's electronic toll collection (ETC) system developed by Taipei-based Far Eastern Electronic Toll Collection Co. (FETC) has won the 2015 Intelligent Transport System (ITS) World Congress Industry Award. The FETC is sending a representative to receive the award at the ITS World Congress to be held Oct. 5-9 in Bordeaux, France. Combining services offered by the convenience stores around Taiwan and the smart phone app for adding value and responding to inquiries in an efficient manner, the FETC has made the ETC system a main pillar for the development of the intelligent transport system in the nation.
Taiwan ETC, the first prize of 2015 eASIA Awards among eBusiness in private sector

eASIA Award has announced by Asia Pacific Council for Trade Facilitation and Electronic Business (AFACT) every two years. For the 2015 contest held on 25th Dec in Tehran, FETC wins the first prize of eBusiness in Private Sector among strong competitors from Iran and Japan. Taiwan ETC system is well recognized by its sustainable business model and high level KPIs. Kenny Chen, the CIO of FETC, was the representative to present to the Evaluation Committee in Tehran. Total solutions, business planning, and service flow are critical to build up a successful ETC system, according to Chen. Technical issues and devices aren’t key issues since information is fast-distributed nowadays, especially in those developed countries. What matters and need to be considered first is actually the overall strategic planning for user-friendly service.
eTag Mobile IoT Application
Mobile IoT and Smart City

eTag Service Architecture

Applications Layer

- ETC
- ERP
- eParking
- ITS
- Smart City

Service Platform

Analysis of Sensor Cloud Message and Big Data

Network Platform

- Collection
- Monitor
- LPRI
- VMS
- Rating
- Billing
- Analysis
- AAA

Mediation Platform

Sensor Layer
eTag Mobile IoT Application

- Smart Parking
- Smart City
- Mobile IoT
- Big Data
- eTag
- Smart Safety
- Smart Traffic
- Smart Security
- Smart Payment
Dear customer,
Welcome to Neihu parking lot at 08:06 05/10/2015.
The parking fee is $5/hr.
Your account balance is $395.
Dear customer, today's transaction is $10 for 2 hours until 10:06 05/10/2015. Your account balance is $385. Have a nice day, thank you!
eTag Mobile IoT Application
Smart Safety
Dear Sir/Madame,

Typhoon is coming. The flood gate will be closed at 04:00 pm, please move your car out of the area before 03:00 pm. Thank you for your cooperation!

Page 24
Dear Sir/Madame,

your vehicle had been towed to Neihu tow pound because of parking violation. Please retrieve your vehicle. Thank you!
eTag Mobile IoT Application

Smart Traffic
eTag Mobile IoT Application
Smart Traffic

a. Network interface
b. Camera
c. Microprocessor
eTag Mobile IoT Application
Smart Traffic
eTag Mobile IoT Application
Smart Payment (ERP)

Antenna + eTag detection

eTag Payment Platform
Road to the Future
Overseas Business Collaboration Progress
## Overseas Business Collaboration Progress

<table>
<thead>
<tr>
<th>Country</th>
<th>Interest in Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Malaysia</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Indonesia</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td></td>
<td>• Urban road traffic congestion toll collection</td>
</tr>
<tr>
<td>Philippines</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>India</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td></td>
<td>• Smart City application</td>
</tr>
<tr>
<td>Kuwait</td>
<td>• eParking</td>
</tr>
<tr>
<td>Italy</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Turkey</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td></td>
<td>• ETC system and operation of Marmaray Tunnel</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Thailand</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Iran</td>
<td>• Freeways ETC system and operation</td>
</tr>
<tr>
<td>Belarus</td>
<td>• Freeways ETC system and operation</td>
</tr>
</tbody>
</table>
Implementation of eTag, 4G, Cloud Computing, Big Data, IoT to **Smart City**

Embedded eTag to a **new business model**

Engaged eTag and smart city toward **productivity 4.0**

eTag based ETC is a **sustainable PPP model**
Thank you

www.fetc.net.tw/en/
## ETC 1.0 (Speed 0km)

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Toll Detection</th>
<th>Country/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>stop and go to pay tolls</td>
<td>Malaysia ETC, Taipei MRT (easycard)</td>
</tr>
</tbody>
</table>
# ETC 2.0 (Speed 20km)

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Toll Detection</th>
<th>Country/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>slow down to pay tolls</td>
<td>Japan, Korea, Hong Kong, China/ETC</td>
</tr>
</tbody>
</table>
ETC 3.0 (Speed 70km)

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Toll Detection</th>
<th>Country/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>single lane free flow</td>
<td>Taiwan per-entry-based ETC</td>
</tr>
</tbody>
</table>
# ETC 4.0 (Speed ≥110km)

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Toll Detection</th>
<th>Country/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>multi-lane free flow</td>
<td>Taiwan distance-based ETC</td>
</tr>
</tbody>
</table>
Basic Rule

- eTag register ID = License Plate → Normal Case
- eTag register ID ≠ License Plate → Issue Case
Toll Transaction Handling Process

Daily 14M Transactions, 0.8% need human intervention

14M

ABC-1234 = ABC-1234 ≠ ???-???? ≠ ABC-1234

12M

1M

1M

2M

94% Success (1.9M photos)

6% Fail (120K photos)

Billing Collection Settlement

Manual Identification

Exceptional Transactions

*LPR: License Plate Recognition System
Taiwan ETC Overview
Operation Service Model
Taiwan ETC Overview

Instant APP Service

- Real time balance within 0.5 hour
- Tolling fee calculation
- Detail list for the paths taken
- 2.3 Million mobile device downloads
Taiwan ETC Overview
ETC Social Benefit (2013/12/30~)

Paper Ticket Reduced

Equivalent to 2,075 Taipei 101s (508m)
Taiwan ETC Overview
ETC Social Benefit (2013/12/30~)

Paper Ticket Reduced equivalent to 2,075 Taipei 101s (508m)

Carbon Emissions 430 thousand metric tons of CO₂ equivalent to the CO₂ captured by trees in 55 New York’s Central Park
430 thousand metric tons of CO₂ equivalent to the CO₂ captured by trees in 55 New York’s Central Park

equivalent to 2,075 Taipei 101s (508m)

180 million liters of fuel equivalent to 74 Olympic swimming pools
Taiwan ETC Overview
ETC Social Benefit

Taiwan ETC

1.5 million car journeys per day x 15mins
=22.5 million minutes (42.8 years)

Taiwan HSR

150 thousand car journeys per day x 120mins
=18 million minutes (34.2 years)
Taiwan ETC Overview
ETC Social Benefit

42.8 years × USD 22 thousand × 365 days + USD 72 million = USD 418 million per year
Mobile IoT and Smart City

eTag sensor network (mobile IoT)

ETC Front-end

Deduction Sensor (RFID)

Detection Sensor (Laser)

Light Sensor

Camera

Digital Video Recording Sensor (DVR)

Detection Sensor

Deduction Sensor

Camera / Light Sensor

DVR Sensor

Detection Module

Deduction Module

Enforcement Module

DVR Module
Taiwan ETC Overview
ETC Service Innovation

- MLFF single-gantry solution
Taiwan ETC Overview
ETC Service Innovation

- MLFF single-gantry solution

- In-house development by operator

...... hundreds more vendors
MLFF single-gantry solution

In-house development by operator

Open Standard System (ISO 18000-6C)
Taiwan ETC Overview

ETC Service Innovation

- MLFF single-gantry solution
- In-house development by operator
- Open Standard System (ISO 18000-6C)
- Flexible toll charging capabilities
### Taiwan ETC Overview

#### ETC Service Innovation

<table>
<thead>
<tr>
<th>Flexible toll charging capabilities</th>
</tr>
</thead>
</table>

#### Rules of Charging

<table>
<thead>
<tr>
<th>Structure</th>
<th>Variable 1</th>
<th>Variable 2</th>
<th>Variable 3</th>
<th>Variable 4</th>
<th>Variable 5</th>
<th>Variable 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category</td>
<td>Time</td>
<td>Section</td>
<td>Segment</td>
<td>Daily Charge</td>
<td>Account Balance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Applicant identity</th>
</tr>
</thead>
<tbody>
<tr>
<td>compact car</td>
<td>eTag deposit account</td>
</tr>
<tr>
<td>truck</td>
<td>Non-eTag deposit account</td>
</tr>
<tr>
<td>trailer</td>
<td>Non-eTag user</td>
</tr>
<tr>
<td>Motorcycle (more than 500c.c)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Time</th>
<th>Section</th>
<th>Segment</th>
<th>Daily Charge</th>
<th>Account Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peak</td>
<td>Traffic direction</td>
<td>Daily discount mileage (&lt;20km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off-peak</td>
<td>Gantries</td>
<td>Standard rate (20-200km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No charge</td>
<td></td>
<td>Long distance driving discount (&gt;200km)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Account Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>sufficient</td>
</tr>
<tr>
<td>insufficient</td>
</tr>
</tbody>
</table>
Taiwan ETC Overview
ETC Service Innovation

- MLFF single-gantry solution
- In-house development by operator
- Open Standard System (ISO 18000-6C)
- Flexible toll charging capabilities
- 24x7 continuous stable operation
Taiwan ETC Overview
ETC Service Innovation

Front-end System Monitoring

Dashboard

Back-end System Monitoring

Call Engineer
eTag Mobile IoT Application
Smart Payment (ERP)