Presentation Outline

- Pressing Issues in Congestion
- Examples of Congestion Pricing Programs
- Emerging Approaches for Charging for Road Use
  - Usage-based pricing/taxation
  - The Oregon example
- Implementing HOT Lanes in the LA Region
- Discussion
Congestion Pricing

### Policy Drivers

- **Increasing Congestion – Everywhere**
  - Improve mobility
  - Reduced journey times – private and public transportation
  - Improved emergency vehicle response times

- **Increasing Funding Shortfall**
  - Raise money to reinvest in transportation infrastructure
  - Long term replacement of other taxation such as the gas tax

- **Deteriorating Environment (Green)**
  - Improve air quality
  - Reduce noise pollution
  - Improving road safety
  - Improve quality of life
  - Improve health

### Technology Enablers

- Smart cards
- Imaging
- transponders
- Gantries
- On-Board Units
- GPS
- Mobile Telecoms
- Journey mapping
## Selected City Congestion Charging Projects

<table>
<thead>
<tr>
<th>Stockholm scheme</th>
<th>London Congestion Charging</th>
<th>Singapore Pricing, Traffic Prediction</th>
<th>Edinburgh Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime responsibility for the design, implementation and operation of the scheme</td>
<td>Provision of a new enhanced central system and scheme operation for 5 yrs from Nov 09</td>
<td>Built central system infrastructure in 1998</td>
<td>Delivered full scheme design and proof of concept demonstration</td>
</tr>
<tr>
<td>Brisbane Electronic Toll Collection</td>
<td>San Francisco Congestion Pricing</td>
<td>Singapore Pricing, Traffic Prediction</td>
<td>Edinburgh Scheme</td>
</tr>
<tr>
<td>- A shared system that will allow of the centralized operation of five separate toll highways</td>
<td>- Part of team delivering feasibility study for a potential congestion charging program for the City of San Francisco</td>
<td>- Built central system infrastructure in 1998</td>
<td>- Delivered an innovative “real time” traffic prediction tool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Supporting LTA with trials for the implementation of a full Time Distance Place scheme</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Intelligent Transport Pricing is one of IBM's top ten innovation themes, focused on:</td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Accuracy/performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- interoperability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Eco system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Trialling and in market experimentation e.g. Singapore</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Solution Assets

- Reference Solution architectures for City, TDP and tolling schemes
- Component business model
- Proven solution assets:
  - Traffic Prediction
  - Rating engine
  - Telematics gateway
  - Integration hub
  - OBU devices
- Total cost of ownership model
Charging Programs Vary Based on Objectives

**Corridor**

- Charges to use a particular roadway; or special use charges, for example when single drivers travel on high occupancy lanes

**Area / Cordon**

- Charges to enter and/or drive within a designated area

**Usage-based**

- Distance or time-based charges, usually across a regional or national road network. Can cover all vehicles, or only certain types such as trucks
Evolution of Congestion Pricing Schemes

Current

Policy
- City Congestion Charging
  - Flat rate area or cordon charge
- Congestion Charging scheme with radial routes
  - Variable by time/emission class
- National Truck Charging schemes
  - Main roads/time/emission

Existing schemes
- London #1
- Stockholm
- Norway
- Singapore #1
- Germany (GPS)
- Switzerland (DSRC)
- Austria (DSRC)

Future schemes
- New York
- San Francisco
- Copenhagen
- Amsterdam
- Seoul
- Sweden
- Hungary
- Slovakia

Volumes

- < 2M accounts
- Up to 1 M transactions per day
- < 1 M passages per day
- Specific Time Periods

Uses Incremental Innovation

Future

- National/State all roads, all Vehicles
- Dynamic multimodal pricing linked to congestion levels
- Multi-modal emissions based
  - Personal carbon trading

- 40 M accounts
- 1 Billion transactions per day
- 30 M passages per day
- 24/7

Requires Radical Innovation

Step change
Usage Based Pricing/Taxation
Major Issues

- Step-change in volume
- Total Cost of Ownership
  - Device cost
  - Installation costs
  - Communication costs
- Privacy and Auditability
- Vandalism, exceptions
- Revenue collection and distribution frameworks

- Standards and interoperability
  - Seamless interstate travel
  - Apply local pricing rules (e.g. citywide congestion pricing)
- Legacy fleet issues
  - retrofit of older vehicles
Usage Based Fees
The Oregon Experiment

A per-mile charge based on miles driven within Oregon by zone

Zone 1 = in state
Zone 2 = out of state
Zone 3 = rush hour

Source: Oregon Department of Transportation
www.oregon.gov/ODOT/HWY/OIPP/rufffshtml
Oregon Mileage Based User Fee
How does it work?

Miles collected electronically by zone

Source: Oregon Department of Transportation
www.oregon.gov/ODOT/HWY/OIPP/ruffish.html
Oregon Mileage Based User Fee
Payment Mechanism

### Mileage Fee Receipts

**At the Pump**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST Fuel Tax</td>
<td>$ (4.68)</td>
</tr>
<tr>
<td>Sale Total</td>
<td>$ 45.03</td>
</tr>
<tr>
<td>VMT Fee</td>
<td>5.12</td>
</tr>
<tr>
<td>Rush Hour</td>
<td>40.0</td>
</tr>
<tr>
<td>In_Oregon</td>
<td>280.6</td>
</tr>
<tr>
<td>Non-Oregon</td>
<td>0</td>
</tr>
<tr>
<td>No Signal</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45.03</strong></td>
</tr>
</tbody>
</table>

**In the Store**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST Fuel Tax</td>
<td>(4.68)</td>
</tr>
<tr>
<td>VMT Fee</td>
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</tr>
<tr>
<td>Rush Hour</td>
<td>40</td>
</tr>
<tr>
<td>In_Oregon</td>
<td>280.6</td>
</tr>
<tr>
<td>Non-Oregon</td>
<td>0</td>
</tr>
<tr>
<td>No Signal</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45.03</strong></td>
</tr>
</tbody>
</table>

1. **ST Fuel Tax**
   This is a credit for the state gas tax of 24 cents/gallon

2. **VMT Fee**
   This is the mileage fee calculated for this vehicle. This amount is deducted from this driver's endowment account and not included in the transaction payment.

3. **Sale Total**
   This is the total amount that this driver must pay at the pump. The price of gas and all taxes minus the state gas tax.

4. **Rush Hour/In-Oregon/Non-Oregon/No Signal**
   These are the zones the miles are being counted in. The numbers here represent miles counted since this vehicle's last mileage reading.

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Source: Oregon Department of Transportation
The Privacy Challenge

Privacy vs. Audit-ability

Absolute Privacy
No records maintained
No ability to audit
No ability for customer validation

No Privacy
Detailed trip data maintained
Full ability to audit
Full ability for customer validation

Source: Oregon Department of Transportation
www.oregon.gov/ODOT/HWY/OIPP/rufff.shtml
Privacy and Auditability

OBE options

- Camera/ANPR
- DSRC gantry
- GPS
- GPS
- GPS

Device complexity

- No Device, Position determined by camera
- OBE tag Identifies vehicle
- Determine usage using GPS and maps
- Determine fee using GPS, maps and tariffs
- Take payment using GPS, maps & tariffs to determine fees.

Central System workload

- Usage
- Charge calc.
- Billing
- Payment.
- Charge calc.
- Billing
- Payment.
- Charge calc.
- Billing
- Payment.
- Off-line settlement only.

Privacy

- Low
- High

RUC Schemes

- London CC
- Stockholm European motorways
- E-ZPass in US
- Swiss Lorry
- German Lorry
- Singapore (but DSRC not GPS)

Other Schemes

- Norwich Union PAYD
- Dubai CERT
Video Analytics

- Advanced License Plate Recognition
- IBM S3: Smart Surveillance System
  - Fast content or activity based query of video data across large numbers of cameras, over long intervals of time
- Real-time automated video analysis
  - Vehicle counting
  - Vehicle classification
  - Path analysis
  - License plate recognition
  - Speed monitoring
- Improved operator effectiveness and reduced workload
- Operational cost reduction
- Higher levels of security
Implementing HOT Lanes in the LA Region

- The proposed network of HOT lanes presents a great opportunity for the LA region to build a robust, scalable platform for enabling pricing in the region for both the short and long term.

- The goal of designing, implementing and making the system operational by December 2010 is achievable. However, a number of challenges need to be overcome:
  - Charging policy design
  - Operating model
  - Public outreach
  - Political approvals
  - Civil engineering
  - Enforcement approach
  - Multi-channel payments solutions
  - System design, implementation testing and operations
HOT Lanes in the LA Region
Best Practices in System Design and Development

- Low Total Cost of Ownership
- Open Standards
  - Interoperability key part of initial design
  - Reuse
  - Reduced lifecycle costs
- Modular
  - Services Orientated Architecture
  - Cost efficient technology evolution
  - High degree of flexibility to accommodate changes in policy
- Scaleable
  - Easier expansion of service area
- Robust and Reliable
  - Continuous operations
  - Strict performance targets in terms of availability and quality
- Proven Methods
  - High confidence in delivery
  - Reduced solution costs
  - Reduced implementation risk
  - Improve reliability
Thank You

For more information, please contact:

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Backup Slides

LA County Congestion Pricing Discovery Workshop
June 27th, 2008
Typical Components of a Charging System
IBM was prime contractor for end-to-end solution, integrating 18 partners
Complex solution deployed in 13 months with a fixed launch date under significant public scrutiny

The Outcome – Exceeded all Expectations
- 25% reduction in traffic volume, removing 100,000 peak hour vehicles
- Increase of 40,000 mass transit users per day, bus schedule speed improvements
- Over $120 million net revenue per annum
- Public Opinion – increasingly positive, media, individuals and businesses

Trial period Jan 2006 – July 2006
Referendum September 2006
Decision made to make scheme permanent
Re-started August 2007
## Stockholm Congestion Tax Project - Case Study

### Clearly Measurable Results
- **25% reduction in traffic entering cordon**
- **15% reduction in CO₂ emissions**
- **$120M/yr in revenue to City of Stockholm; payback in 4 years**
- Congestion charges will fund transit improvements

Source: [www.stockholmforsoeket.se](http://www.stockholmforsoeket.se)
How Does the Stockholm System Work?

Call-center operations managed by IBM

1. Picture is taken of the vehicle’s license plate.
2. Information is matched with registered vehicle. Vehicle owner has five days to pay
3. The gateway registers the vehicle

IBM has designed, built, implemented, integrated and runs the congestion charging system

Way of payment
- Transponder/direct debit
- License Plate/direct debit
- Internet
- Contact Center
- 7-eleven/Pressbyrån
Representative Performance Metrics

- **Daily Passages**: 345,000
- **Percentage of plates sent to MCR**: 4.4%
- **System Uptime (lane-minutes)**: > 99.95%

### Identification methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Trial 2006</th>
<th>Aug 1-Sep 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBU</td>
<td>49.7%</td>
<td>1.4%</td>
</tr>
<tr>
<td>OCR</td>
<td>40.8%</td>
<td>94.2%</td>
</tr>
<tr>
<td>MCR</td>
<td>9.5%</td>
<td>4.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

### MCR results

<table>
<thead>
<tr>
<th>Category</th>
<th>Trial 2006</th>
<th>Aug 1-Sep 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identified</td>
<td>6.1%</td>
<td>2.4%</td>
</tr>
<tr>
<td>No license plate</td>
<td>0.1%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Manipulated license plate</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Bad camera tuning</td>
<td>0.4%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Bad weather</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Foreign vehicle</td>
<td>1.4%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Dirty license plate</td>
<td>0.1%</td>
<td>-</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.6%</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9.5%</td>
<td>4.4%</td>
</tr>
</tbody>
</table>

**Customer Service Highlights**

- 1,000,000 + accounts
- 850,000 photos to manage (daily)
- Automated Vehicle Registration Lookup
- Vehicle Charged Using Rating Software
  - Passage, time of day, vehicle type
  - Exemptions, discounts, & waivers
- Full Accounting & Payment Systems
- 2,200 calls/day; > 99.5% answered within 60 seconds
Technical System Availability – 99.96%
Worked well in complex and simple locations, in good weather and bad

- All service level agreements met from day one till the end of the trial period
- Error rate below 0.1% of all charges
The swing in public opinion came within 3 months.
London Congestion Charging Scheme
Features of the Current System

- A zone-based congestion charging system with operating hours of 7AM - 6PM. There is a charge to drive or to park on a public street in the charging zone.

- The charge is £8 if it is pre-paid or paid by midnight on the travel day or £10 if you pay by midnight the following day.
  - A fine of £100 is assessed if congestion charge is not paid by midnight the following day.

- Multi-channel payment options:
  - Online, retail outlets, mail, telephone, SMS text message from a mobile phone, internet kiosks.

- The charge is enforced by a network of cameras. The cameras are not a charging mechanism, but primarily an enforcement mechanism.
London Congestion Charging Scheme
Key Features of the Future Redesigned System

- 2 year design and build phase, 5 year operate phase, with options to extend
  - Switch over from current system in Nov 2009
- Roadside Infrastructure procured separately
- Transport for London expects to achieve
  - Future flexibility
  - Scalability
  - Reduce operational costs
- Key features of new system
  - Account based
  - Variable pricing
  - On Board Units (OBU)

Will be designed to allow for scaling to **30 times** current volumes (180,000 transactions per day)
IBM Integrating Tolling Operations in Brisbane, Australia

- Queensland Motorways, Ltd. is Australia’s Largest Toll Road & Bridge DBMO (Design, Build, Maintain, Operate)
- Over 69 million vehicles now travel on their road network; in 2008/09, over 76 million vehicles are anticipated
- IBM Recently Won Central IT System Contract DBMO for QML
- The single central system is being designed to operate 5 separate toll roads
- Built on IBM’s Stockholm / London / US Tolling ITS Model
Innovation in Security – Chicago Transit Authority

CTA Background
- Responsible for the second-largest public transportation system in the United States
- Fixed-route bus service
  - 1,937 miles
  - 1,900 buses
- Rapid transit train lines
  - 222 miles of track.
- Total of 1.5 million passengers daily

Business Need
- Since 2003, CTA buses and rapid transit trains have been equipped with security cameras
- However footage could only be reviewed after incidents occurred, leaving CTA unable to take a proactive stance against crime.
- To ensure the safety of its passengers, CTA needed the ability to monitor footage and collaborate with police in real time

Solution
- The IBM team designed and implemented a wireless network to feed real-time footage from over 50 buses and trains to the CTA downtown control center as well as to emergency response vehicles

Benefits
- Ability to monitor passengers inside its buses and trains
- Should an incident occur, employees can notify and send footage to nearby police
- Strengthens the security of CTA transportation
- Helps promote peace of mind for passengers
Thank You

For more information, please contact:

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