Electronic Toll Collection

Approaches, technologies, experiences

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Objectives of Road Pricing

Road Pricing and Toll Collecting…

- shall increase market driven processes in transportation to balance demand and supply
- offer – when used with flexible fees – opportunities to
  - control the **spatial distribution** of traffic volumes within the network
  - influence the **timely distribution** of traffic volumes
  - support the **shift of demand** to other transportation modes
- may contribute to financing and maintaining the transportation infrastructure
- offers a market for added-value services via the installed ITS-technologies

Principles of Tolling

Principle 1:
The fees are approach- or entrance-oriented
Payments are needed when the vehicles enter the priced section or network part; fees are independent of intensity of usage

Examples:
Vignette (CH, since 1985), 'Pickerl' (A, since 1997)

Principle 2:
The fees are usage-oriented
i.e. depend on time and/or length of usage of priced road-network

Technologies
Applications

Technologies

Currently, the following technologies are in use / discussion:

- Toll Collection:
  - manual collecting
  - DSRC = Dedicated Short Range Communication
  - Video, ANPR (automatic number plate recognition), LPR (License Plate Recognition)
  - Tag / Transponder / RFiD – Recognition (electronic license-plate)
  - GNSS (Global Navigation Satellite System)
  - W-LAN / W-MAX
- Vehicle Classification:
  - Inductive loops
  - Laser scanner
  - Weigh-in-Motion
  - Video
  - Tags / RFiD

Applications and Experiences (some examples)

DSRC – Applications

- Hong Kong: (First DSRC application)
- Singapore: Electronic Road Pricing
- Stockholm: Congestion Charging

GNSS – Applications

- Truck Toll Germany (TollCollect)

DSRC - Dedicated Short Range Communication

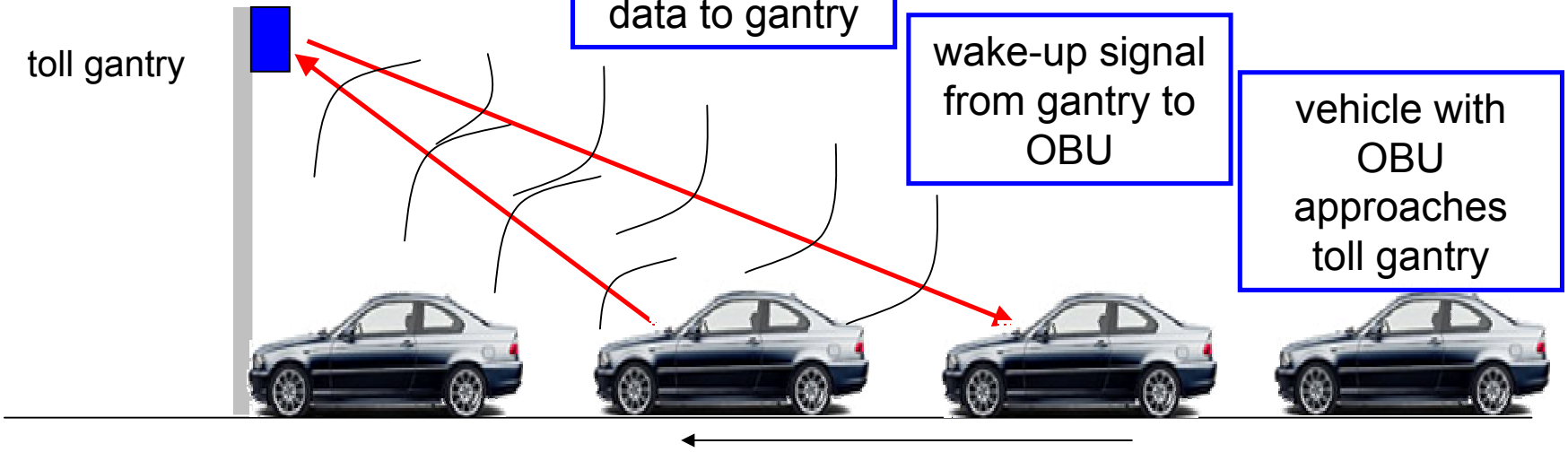
Communication between vehicle OBU (on-board unit) and infrastructure (gantry with DSRC-beacon) via microwave (5,8 GHz) or infrared.

gantry transmits the OBU-data to central system, together with timestamp

OBU sends data to gantry

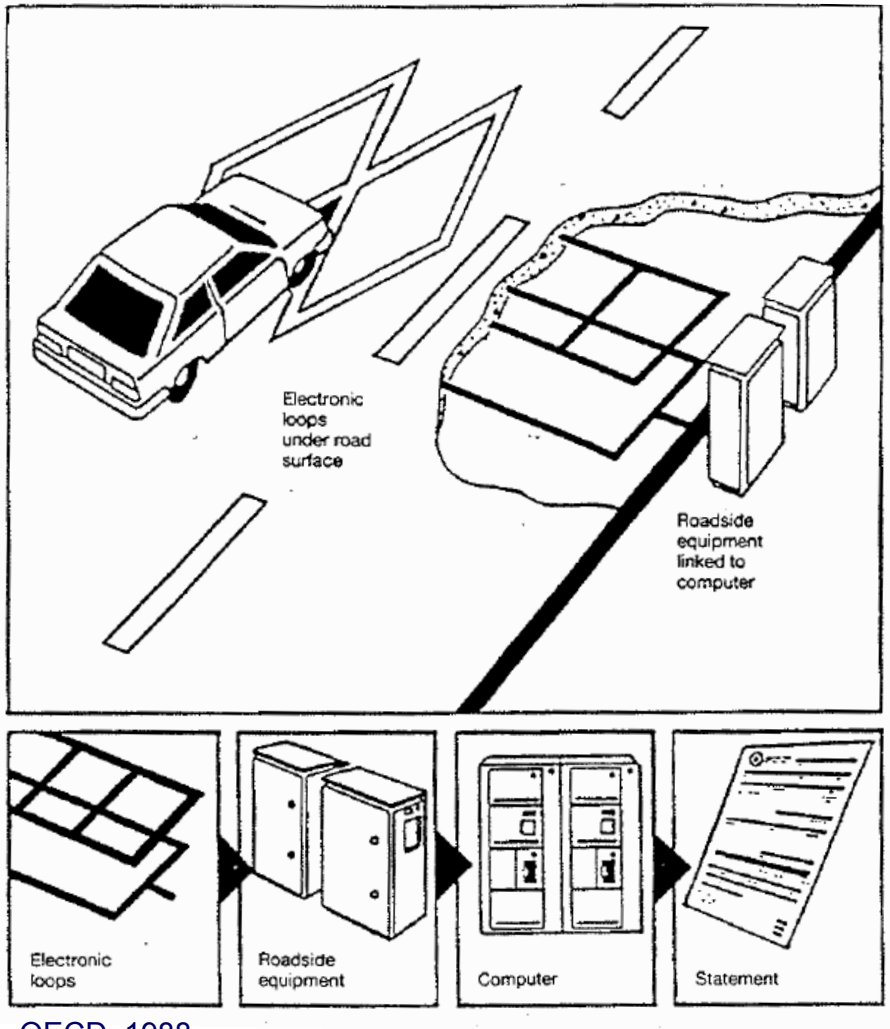
wake-up signal from gantry to OBU

vehicle with OBU approaches toll gantry



First application in Hong Kong

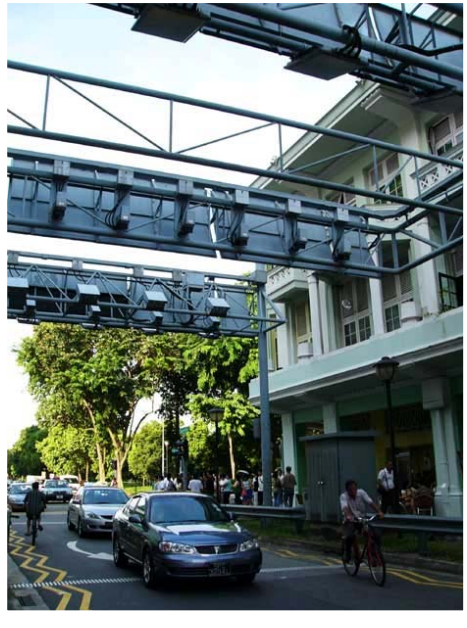
- 21-month trial 1983-1986: first application ever of Electronic Road Pricing
  - more than 2500 vehicles (mostly government-owned) with electronic identifier at the vehicle's bottom
  - technically the experiment was successful
  - permanent operation was not possible due to strong public resistance



OECD, 1988

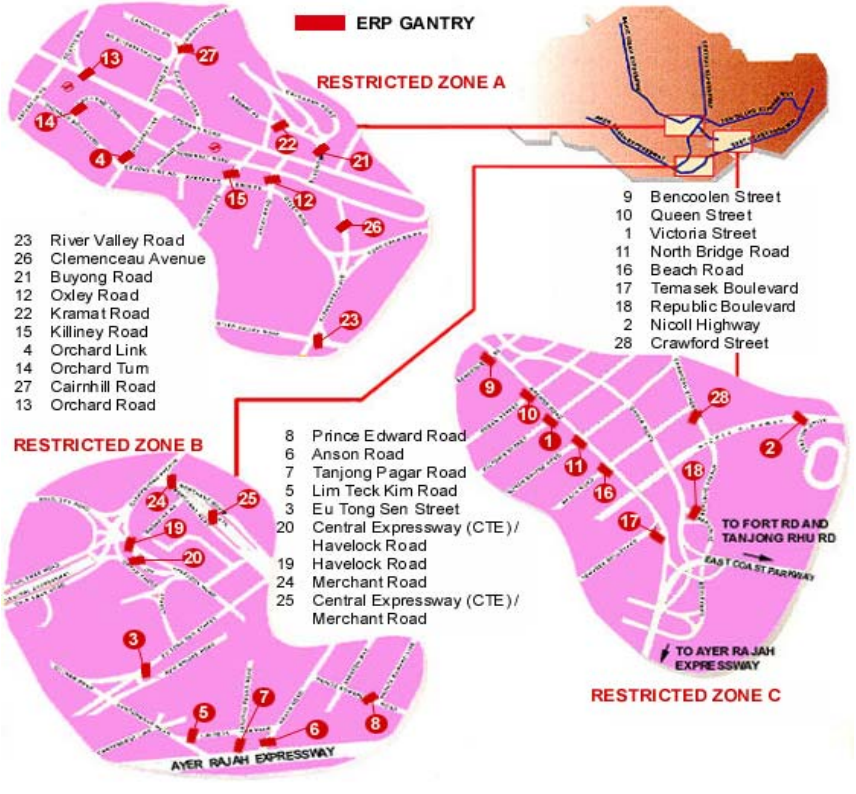
Singapore: Electronic Road Pricing

- since 1975 Singapore Area Licensing Scheme
- in the beginning only morning peak
- since 1989 extended to the evening peak
- since 1998 DSRC
- fees are time-dependant
  (long-term view, also traffic-dependant)



Singapore: Electronic Road Pricing

- Today: some expressways, trunk roads and 3 priced zones in central area of the city



Passenger Cars (Weekdays)

EXPRESSWAYS

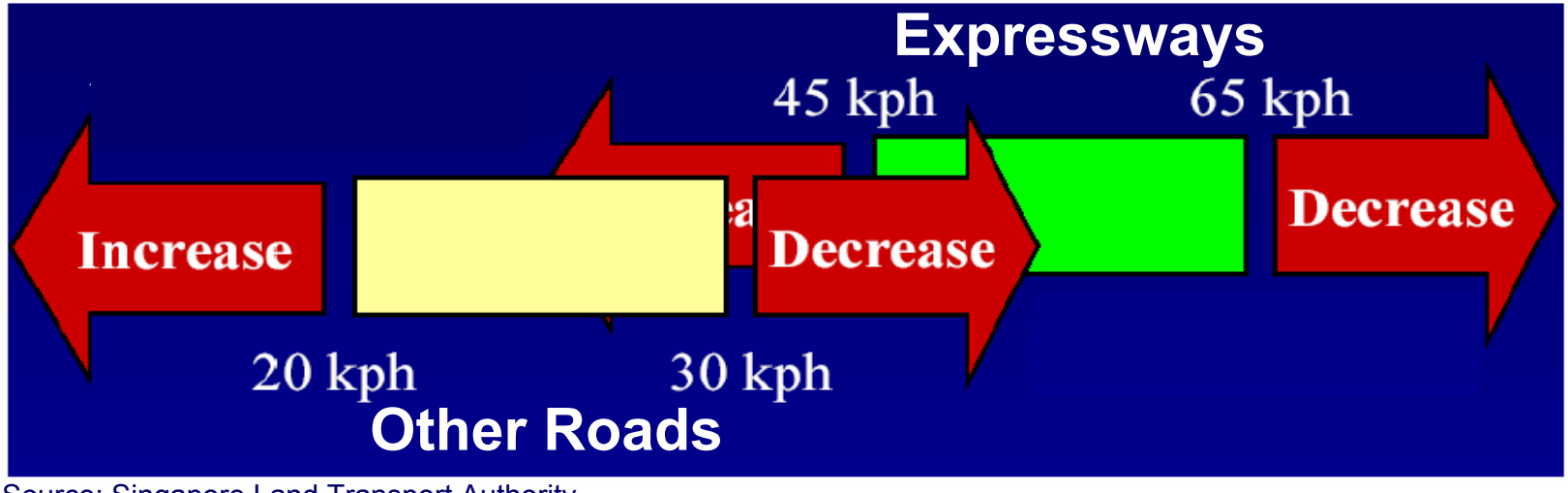
Monday to Friday : 07:30 - 20:00 (24 Hrs)

	AYE between Portsdown Road and Alexandra Road (36)	CTE after Braddell Road, Serangoon Road and Balestier slip Road (31,33,34)	CTE between Ang Mo Kio Ave 1 and Braddell Road (35)	ECP after Tanjong Rhu Flyover (30)
07:30 - 07:35	$0.00	$0.80	$0.80	$0.50
07:35 - 08:00	$0.00	$1.50	$1.50	$0.50
08:00 - 08:05	$0.50	$1.50	$1.50	$1.30
08:05 - 08:30	$0.50	$1.50	$1.50	$2.00
08:30 - 08:35	$1.00	$2.30	$1.00	$1.50
08:35 - 08:55	$1.50	$3.00	$1.00	$1.50
08:55 - 09:00	$0.80	$2.00	$1.00	$1.00
09:00 - 09:25	$0.00	$1.00	$0.50	$0.50
09:25 - 09:30	$0.00	$0.50	$0.50	$0.50
09:30 - 10:00	$0.00	$0.00	$0.00	$0.00
10:00 - 12:00	$0.00	$0.00	$0.00	$0.00
12:00 - 12:30	$0.00	$0.00	$0.00	$0.00
12:30 - 14:30	$0.00	$0.00	$0.00	$0.00
14:30 - 17:30	$0.00	$0.00	$0.00	$0.00
17:30 - 17:35	$0.00	$0.00	$0.00	$0.00
17:35 - 18:00	$0.00	$0.00	$0.00	$0.00
18:00 - 18:25	$0.00	$0.00	$0.00	$0.00
18:25 - 18:30	$0.00	$0.00	$0.00	$0.00
18:30 - 18:55	$0.00	$0.00	$0.00	$0.00
18:55 - 19:00	$0.00	$0.00	$0.00	$0.00
19:00 - 19:30	$0.00	$0.00	$0.00	$0.00
19:30 - 20:00	$0.00	$0.00	$0.00	$0.00

Source: www.onemotoring.com

Singapore: Electronic Road Pricing (ERP)

- (quarterly) adjustment of fees

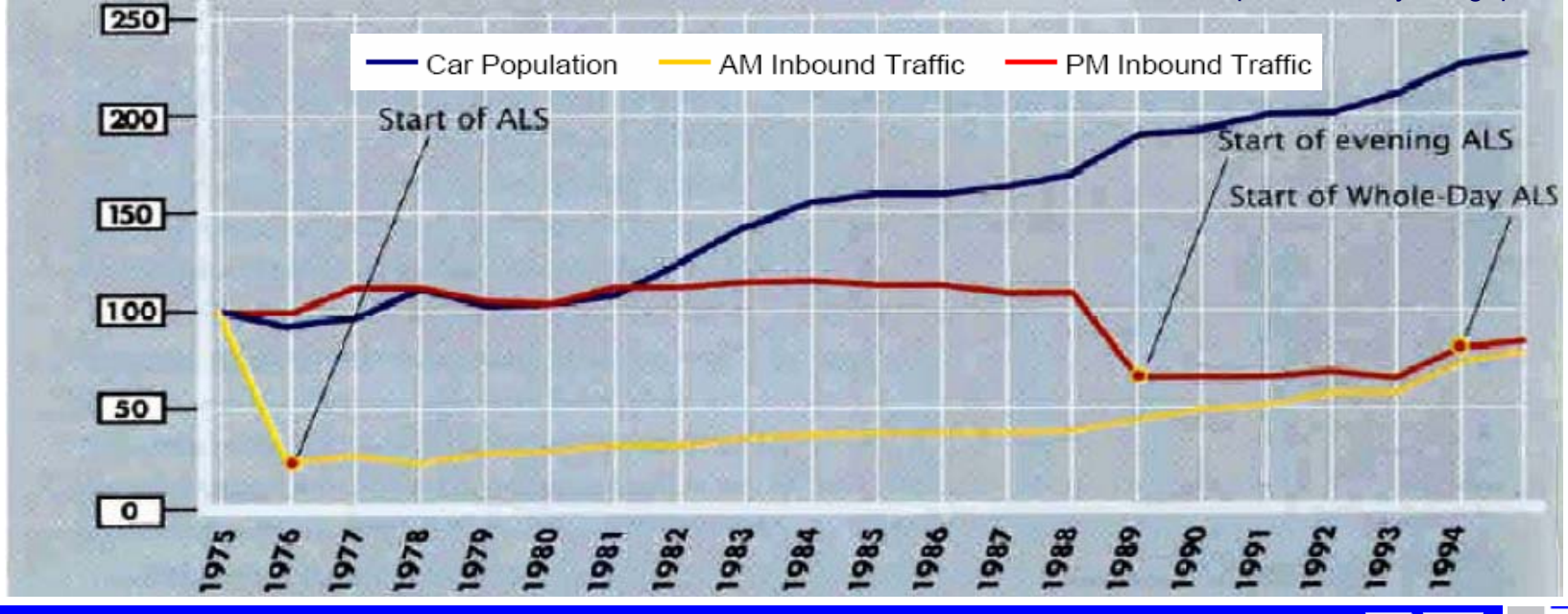


Source: Singapore Land Transport Authority

Singapore: Electronic Road Pricing (ERP)

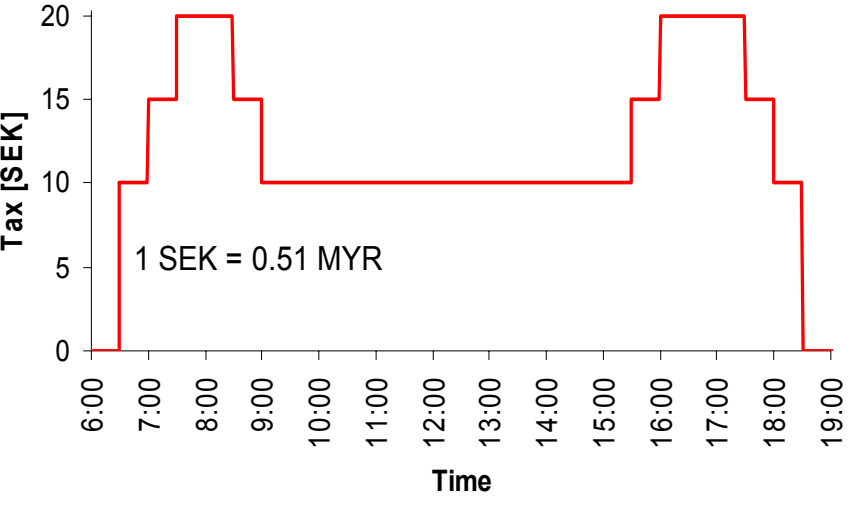
- Effects:
  - Reduction of volumes during tolling-period
  - Average speed increased by 22%
  - Less vehicles with just 1 person
  - Shift of volumes away from peak-hours

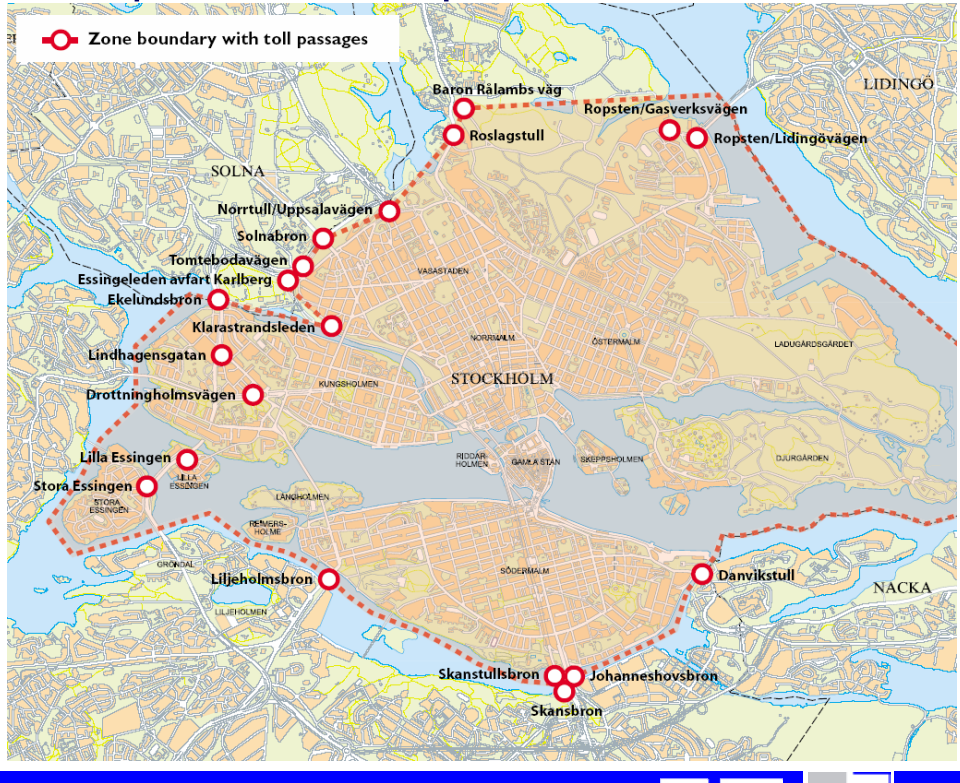
Source: Land Transport Authority, Singapore



Stockholm Congestion Charging

- 22 August 2005: extended public transport
- 3 January 2006 - 31 July 2006: trial implementation of congestion charging
- Summer 2006: impact evaluation
- 17 September 2006: referendum on the permanent implementation



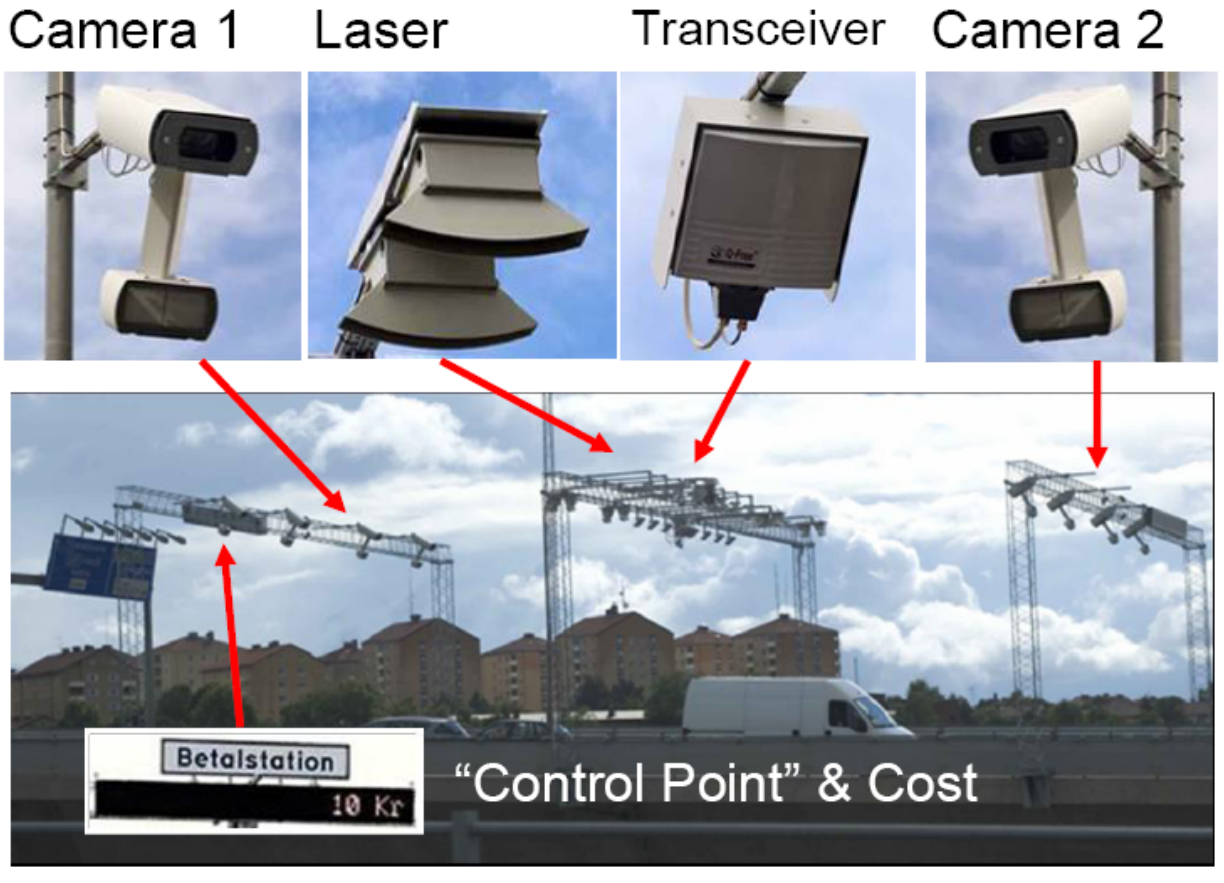


Stockholm Congestion Charging

Technology:

DSRC and

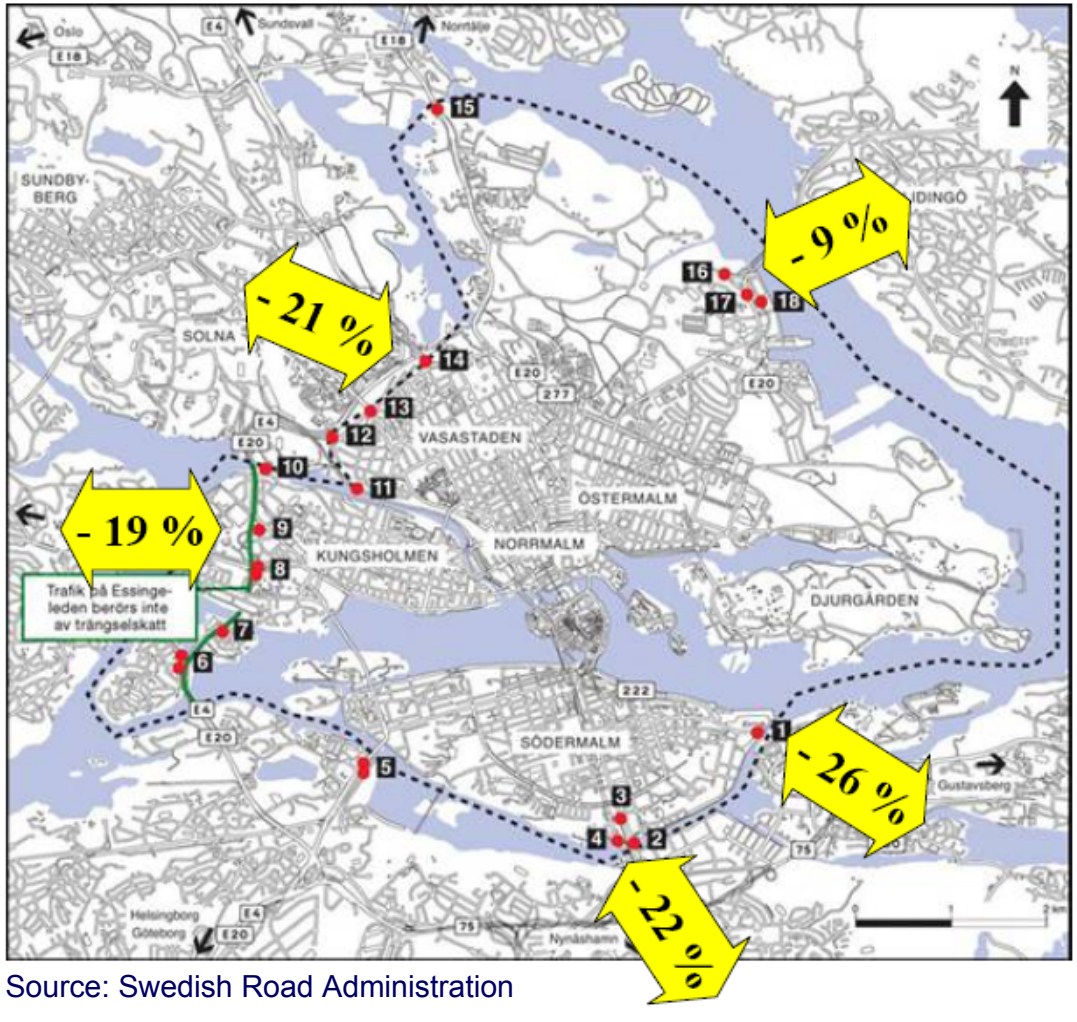
Car Number Plate Recognition



Source: Swedish Road Administration

Stockholm Congestion Charging

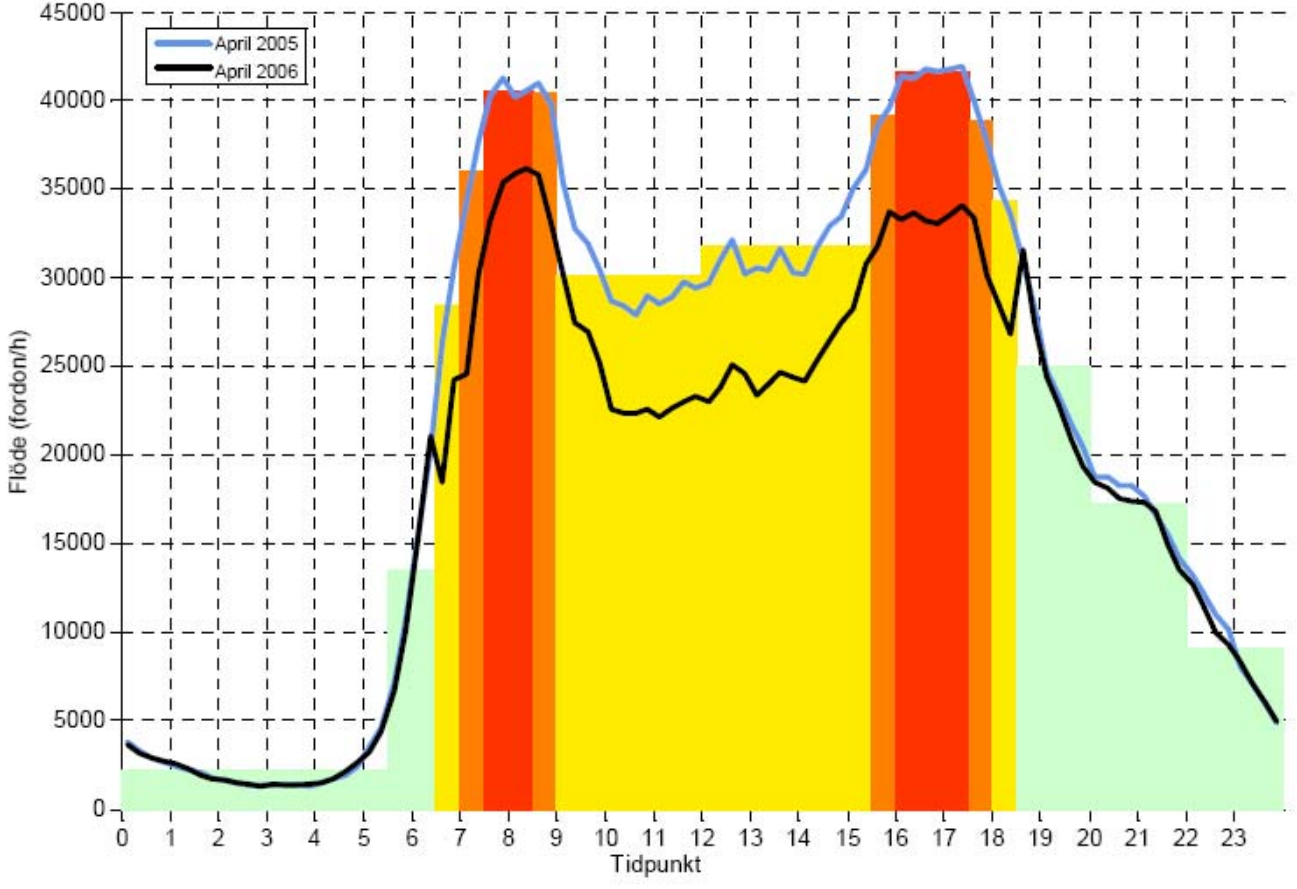
- Traffic reduction April 2006 compared to April 2005



Source: Swedish Road Administration

Stockholm Congestion Charging

- Traffic reduction spring 2005 compared with spring 2006



Source: Stockholmsforsoket: Facts and results from the Stockholm Trials; First version – June 2006 P. 26

Stockholm Congestion Charging

- **Are objectives being met?**
  - Objective: 10 -15 % less traffic to/ from inner city
    - Result: 20-25%
  - Objective: Increased accessibility
    - Result: Queue times down 30-50%, except Essingeleden
  - Objective: Decreased emissions
    - Result: 14% less in inner city; 2,5% in total county
  - Objective: Inhabitants should perceive an improved urban environment
    - Result: Unclear–difficult to define and measure

GNSS: Truck Toll Germany (TollCollect)

Toll road network

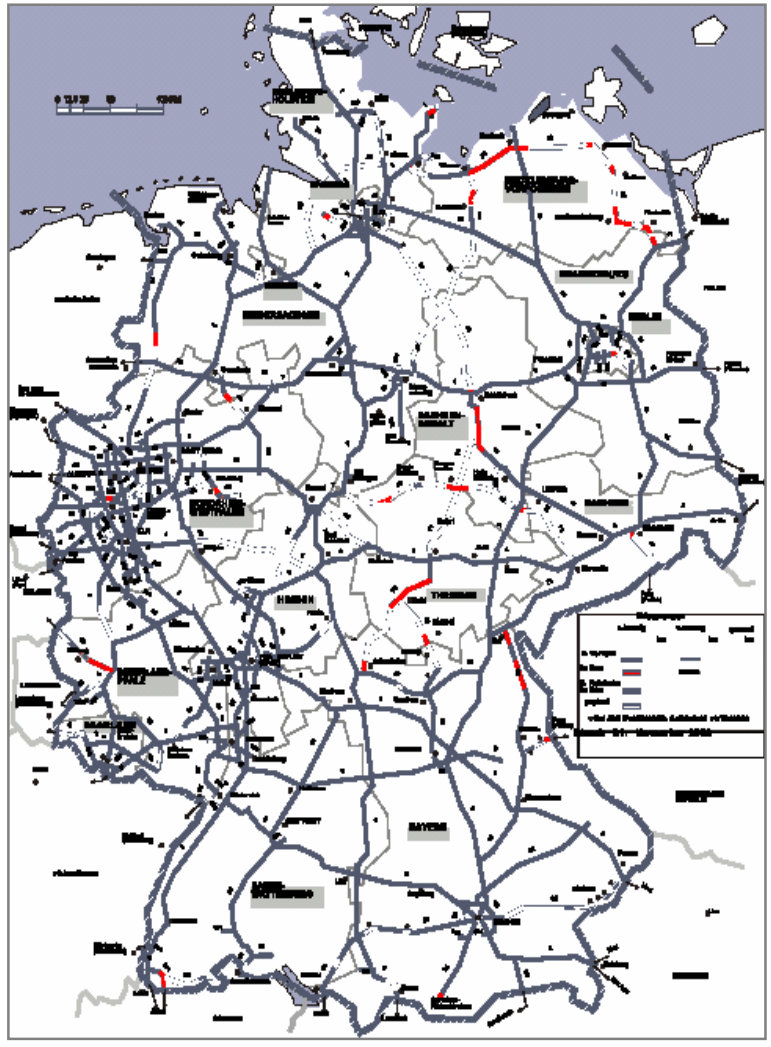
- approx. 12,000 km on federal motorways
- approx. 2,500 junctions
- approx. 250 motorway interchanges

Trucks required to pay the road toll

- 1.2 - 1.4 million trucks ≥ 12t
- Including approx. 400,000 - 500,000 registered outside of Germany

Toll road usage

- 22.7 billion vehicle kilometres per year
- 35% accounted for by vehicles registered outside of Germany



GNSS: Truck Toll Germany (TollCollect)

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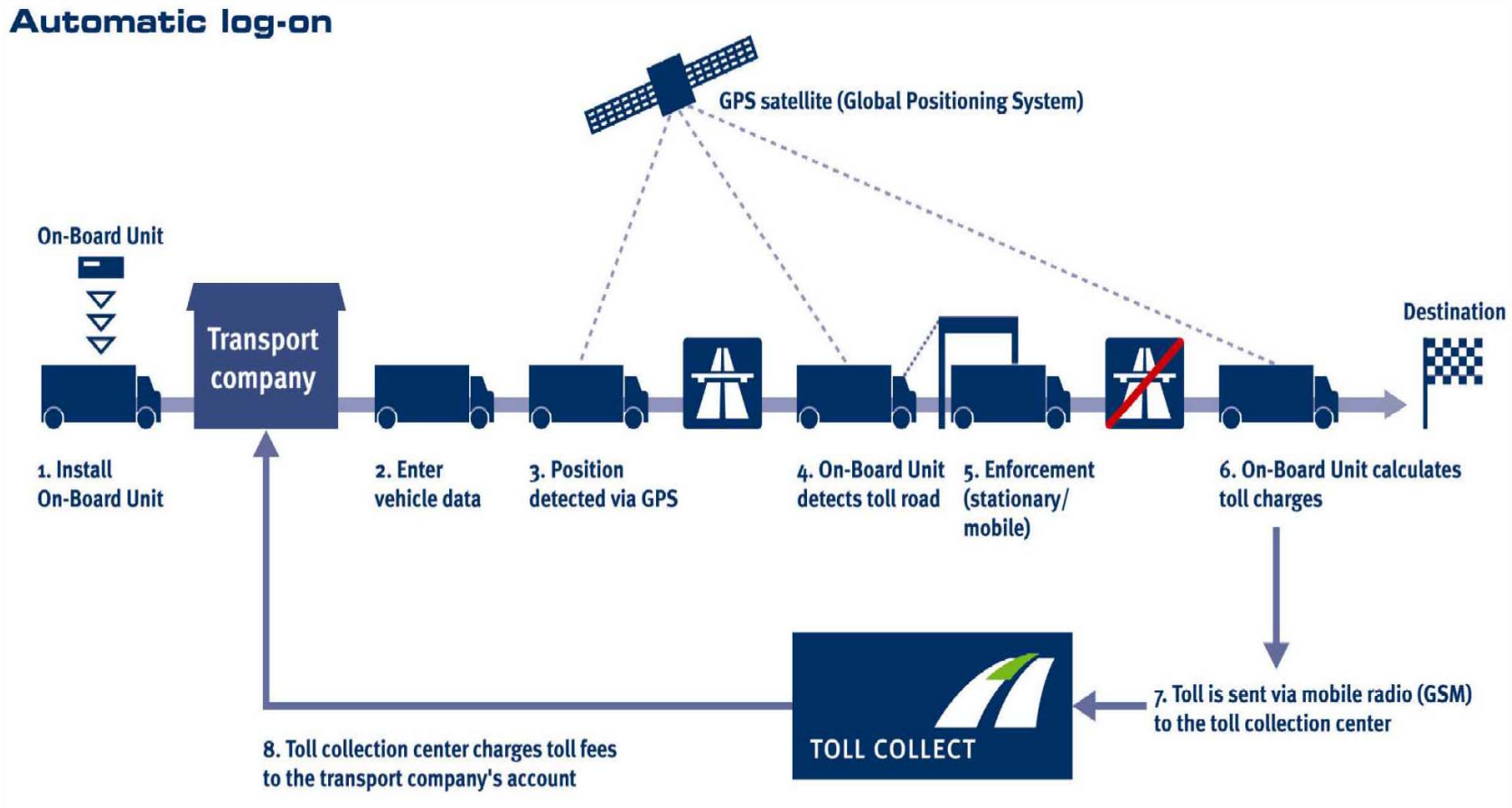
Technology:



GNSS: Truck Toll Germany (TollCollect)

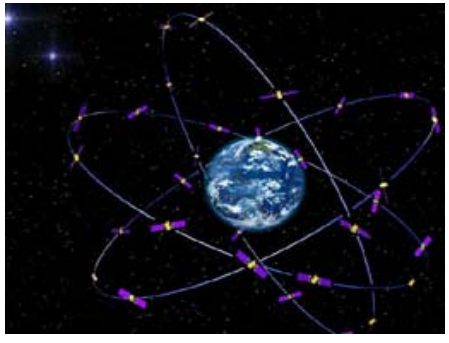
Automatic System - Technology

- System based on **GPS** (Global Positioning System), **GSM** (mobile communications), and other components
- Booking via On-Board Unit in vehicle (OBU)
- On-Board Unit with DSRC module:
  - Communication with enforcement system (infrared)
  - Technical prerequisite for interoperability with other toll collection systems (microwave)
- (Gantries: only for enforcement)

GNSS: Truck Toll Germany (TollCollect)

Objectives:

- Transport infrastructure funding
- ‘User pays’ principle
- Efficient use of transport system
- Emission reduction
- Fairer competition between road transport and the railways



GNSS: Truck Toll Germany (TollCollect)

First Results:

- Toll revenue 2005: € 2.86 billion (gross)
- Empty runs: 15% reduction
- 7 % increase of containers carried by rail

Source: Federal Ministry of Transport, Building and Urban Affairs June 2006

Chances

- Change in travel patterns
- Public transport improvements
- Traffic flow improvements
- Congestion Reduction
- Better environment
- Revenue Generation
- Increased Safety

Equity Aspects

- Some People can not change travel patterns
- Lower-income people can be more affected

→ Impacts depend on how revenues are used

→ Earmarking of Revenues!

Conclusions

- From a technological viewpoint, road pricing has proven its value in different system concepts; consolidation of technology has begun in detail.
- The positive effects of pricing clearly show up, the negative effects are much less than expected.
- If the conception of the pricing-application is well balanced and openly communicated, barriers and opposition in public as well as special lobbies are diminishing over time.
- ETC-applications with directly traffic-related fees are not yet in regular operation on a wider scale.
- A holistic view on the pricing solution is needed with respect to traffic effects, financial charge and use of fee-incomes.

Conclusions

➔ (Electronic) Toll Collection may become an increasing important instrument within the big bundle of measures for regional demand and traffic management.

Thank you for your attention.

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