IBM Corporation

Stockholm Congestion Charging Scheme and Other Related Projects

Presentation to:
The National Surface Policy and Revenue Study Commission
US Department of Transportation

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Agenda

- Congestion Charging Overview
- Stockholm Congestion Charging Scheme
  - Background
  - Solution design and implementation
  - Results
- Other Technologies and Initiatives
  - Vehicle and usage tracking
  - Video analytics
- Discussion

Road users can be charged to address various policy objectives. Technology is a key enabler.

Policy Drivers

- Increasing Congestion
  - Improve mobility
  - Reduced and reliable journey times
    - Private, commercial and public transportation
  - Improved emergency vehicle response times
- Deteriorating Environment
  - Air quality
  - Noise pollution
  - Improving road safety
- Emerging Government Priorities
  - User funded transportation improvements
  - Long term replacement of other taxation

Technology Enablers

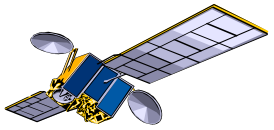
Smart cards

Imaging

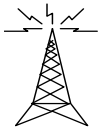
transponders

Gantries

On-Board Units



GPS



Mobile Telecoms

Journey mapping

Different Monitoring Methods for Tracking Vehicles

Hand Held Devices in Vehicle

- Uses mobile link, but not linked to vehicle
- Uses devices such as Symbol, Intermec
- Primary apps. Include route management, change mgmt., documentation and LBS

BEKINS Since 1891

FLEET BOARD

Embedded device "not" connected to vehicle bus*

- Has GPS unit and processor installed in vehicle with comm. Link for tracking
- Can use Celestica eDevice, Arcom or other processors
- From location data sent back, apps.
- Can determine location, speed, time of travel, etc…

UNITED ARAB EMIRATES UNIVERSITY

NORWICH UNION

Embedded device connected to vehicle bus*

- Can have same device as the example to left, or more sophisticated
- Attaching to vehicle bus connects to vehicle data, e.g. speed, fuel, door locks, engine data
- Necessary for prognostics and diagnostics

INTERNATIONAL

TACOM

Transponder or short range intermittent sync device

- To be used for Stockholm city and city of Edinburgh
- Transponders in vehicle can be read when passing gantry
- State of Oregon wants to sync road mileage at gas stations for taxing

STOCKHOLMS STAD

No device in vehicle

- As used for congestion charging for city of London
- Vehicles can be monitored by cameras and other sensing devices

Transport for London
Congestion charging
Central ZONE
Mon - Fri 7 am - 6.30 pm

STOCKHOLMS STAD

*The vehicle "bus" is how one connects to all the in-vehicle electronics and processors embedded at manufacture

High Level Congestion Charging Solution - Conceptual Overview

Administration segment

Administration, Management, Monitoring and Maintenance

Infrastructure segment

Payments
Account mngmnt, billing, credit card & bank interfaces

Enforcement System
Violator mngmnt, dunning, reporting

CRM System
Customer data, preferences, front office, back office

Web Servers
Call center interface customer self service & payments

Network segment

Data Transmission
High speed dedicated fibre optic network

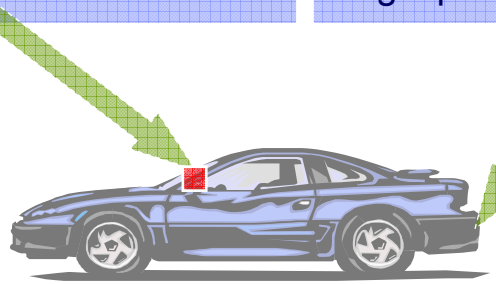
Customer segment

Toll Points
Overhead gantry, DSRC sensors, vehicle location

Enforcement
imaging, OCR, evidence validation legal proceedings

Call Center
Customer support, sales, distribution, dispute resolution

Distribution
and registration of OBUs, first line support, payments



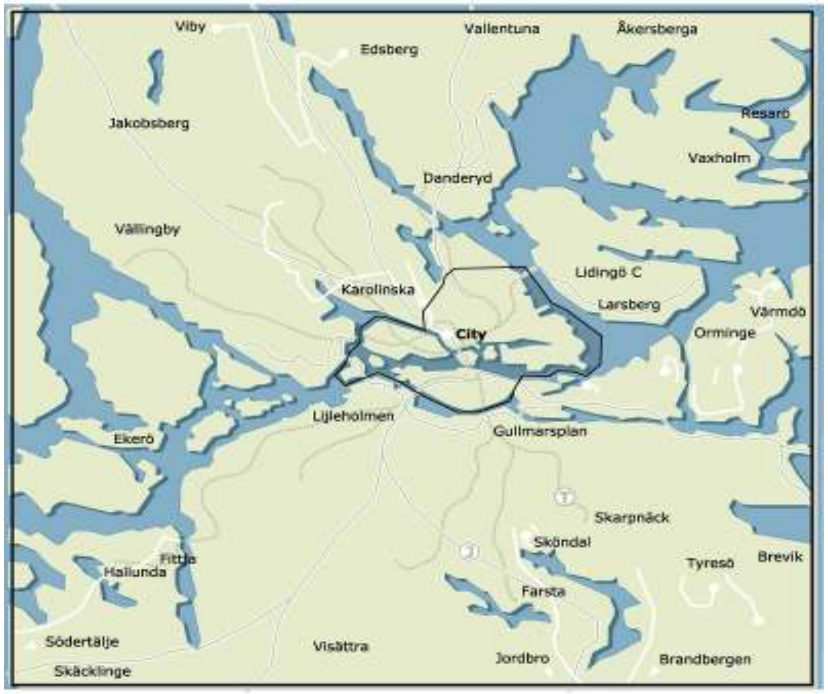
High Level Congestion Charging Solution – Design Principles

- Open Standards
  - Interoperability
  - Reuse
  - Reduced lifecycle costs
- Modular
  - Cost efficient technology evolution
- Scaleable
  - Capacity on demand
  - Easier expansion of service area
- Robust and Reliable
  - Continuous operations
- Proven Methods
  - Reduced solution costs
  - Reduced implementation risk
  - Improve reliability

Relevant IBM Experiences: Congestion Charging

Build and Operate Stockholm City Scheme	Singapore Electronic Road Pricing	Edinburgh City Scheme	UK National Lorry Road User Charging Procurement
	▪Built central system in 1998 when Singapore moved from paper to electronic	▪Delivered scheme design and proof of concept	▪ Short listed in all 3 of the contract lots before program cancellation
London Congestion Charging	**San Francisco Congestion Charging**	**Related ITS Projects**	**Thought Leadership / Solution Assets**
▪Delivered advice on scheme design and program set up	▪ Currently part of team conducting a feasibility study	▪Design & development of on-board units for road safety applications in Dubai ▪Norwich Union pay-as-you-drive Insurance	▪Reference solution architectures ▪Partnerships with specialty suppliers ▪Project management models ▪ Re-usable solution components

Facts about Stockholm



Inhabitants

- 1,9 million in the county of Stockholm
- 760 000 in the city of Stockholm
- 275 000 in the Stockholm inner city

Travel & transportation

- 560 000 vehicles cross the inner city cordon per working day
- 73% of all personal trips across the inner city cordon during rush hour is by public transport
- 2.5% car ownership increase per year
- Lack of capacity in between the northern and the southern halves of the region (road and rail)

External impacts

- Congestion in Stockholm estimates cost 600 to 800 million Euro per year
- 361 severely injured & 18 traffic deaths
- 10-100 cases of cancer caused by atmospheric pollution
- 50 000 inhabitants exposed to over 65 dBA

The Stockholm trial project are built on three complementary components to support the main objective: “reduce congestion”

Improved Public transport

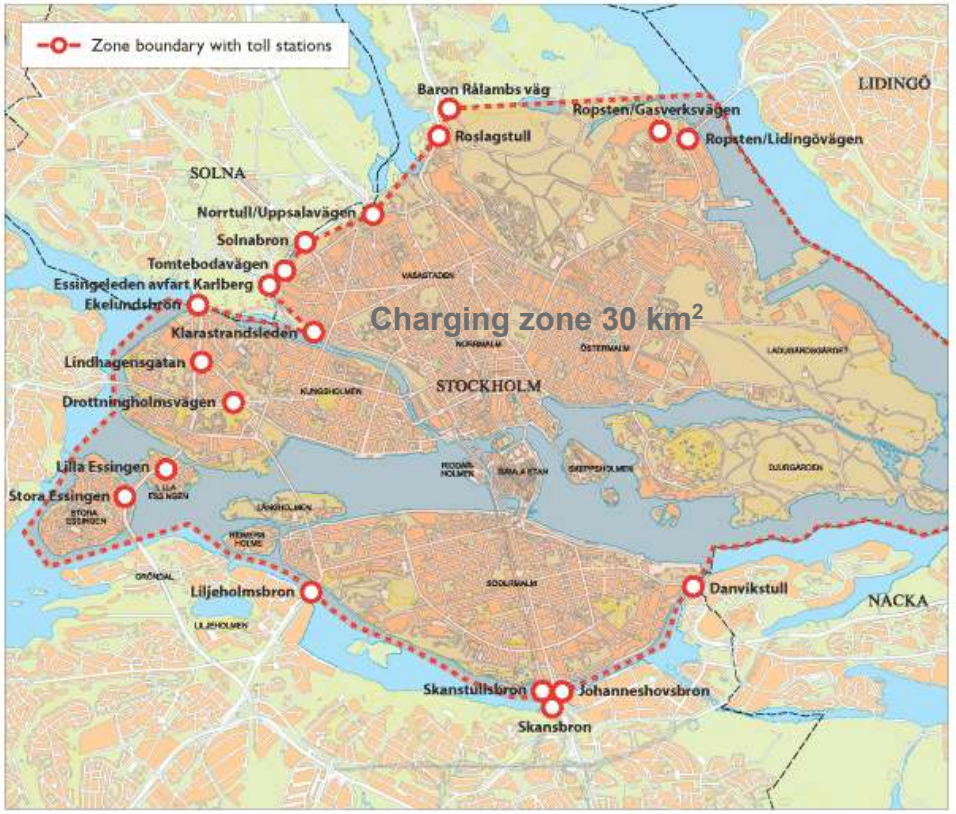
New Park & Ride

Congestion Charges

The city of Stockholm	Procurement, General information, Evaluation program, Park-and-ride
Swedish Road Administration	Congestion Charges system owner, information how to pay tax
IBM	Technical system design & built, system operator
SL	Public Transport operator

Stockholm Road Charging Scheme: Overview

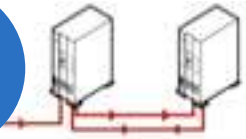
- Congestion Charges trial period
  - Trial period January 2006 - July 2006
  - Referendum September 2006
  - Decision about making the system permanent or not
- Objectives – Improved mobility and environment
  - Reduce congestion (reduce traffic volume by 10 -15 % during rush hour)
  - To improve accessibility for buses and cars in the inner city.
  - Improve the environment
- The congestion charge is a national tax
  - The revenue will be returned to the Stockholm region for investments in the public transport system and infrastructure connected with the trial



How Does it Work?

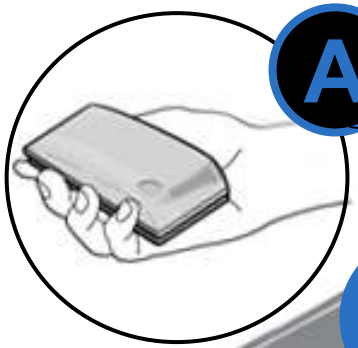
Call-center operations managed by IBM

2



Information is matched with registered vehicle. Fee is added to the owner's account

The gateway registers the vehicle



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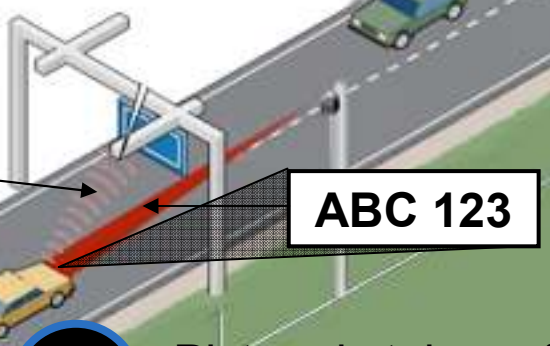


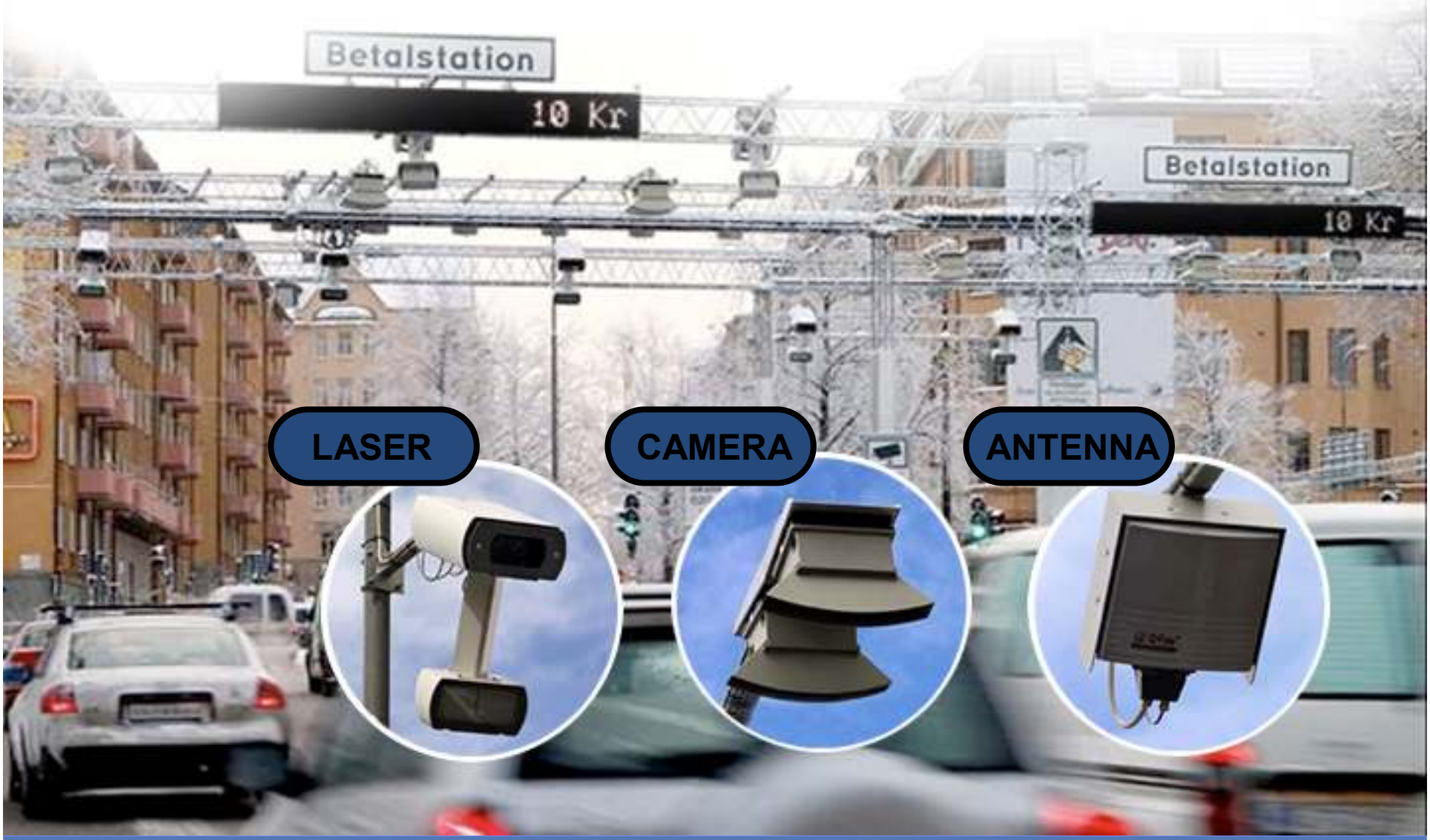
Picture is taken of the vehicle's license plate.

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

3

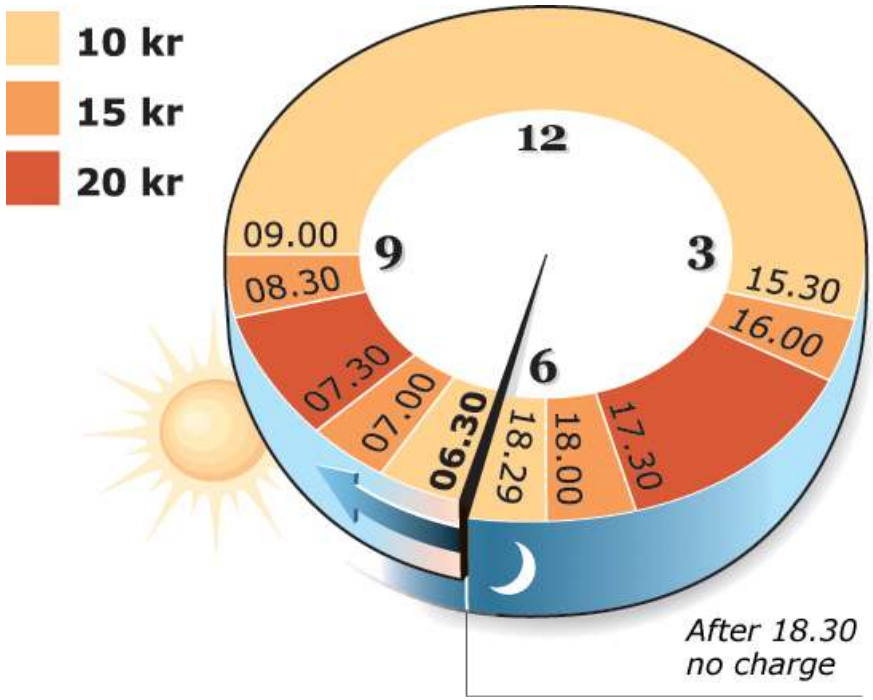
Way of payment
- Transponder/direct debit
- Bank/Giro
- 7-eleven/ Pressbyrån

No barriers, no stops, no roadside payments



Pricing approach for redistributing the traffic volume over time

- Charge in both directions across the cordon
- Peak – “low price” structure
- Maximum charge per day 60 kr (6 Euro)
- No charge during
  - Evenings, Saturdays, Sundays, holidays
- Exemptions
  - Emergency vehicles
  - Vehicles with disability permits
  - Foreign cars
  - Buses over 14 tons
  - Taxis
  - Motorcycles
  - Environmental vehicles (e.g. electricity, ethanol and biogas).



Extensive Media Coverage

Before the launch date

Solution, transponders and project costs

Extensive Media Coverage

System launch day

Focused on the expected chaos

Extensive Media Coverage

One day after

Immediate positive press focused on the huge impact

Extensive Media Coverage

Some weeks after

System performance exceeds all expectation

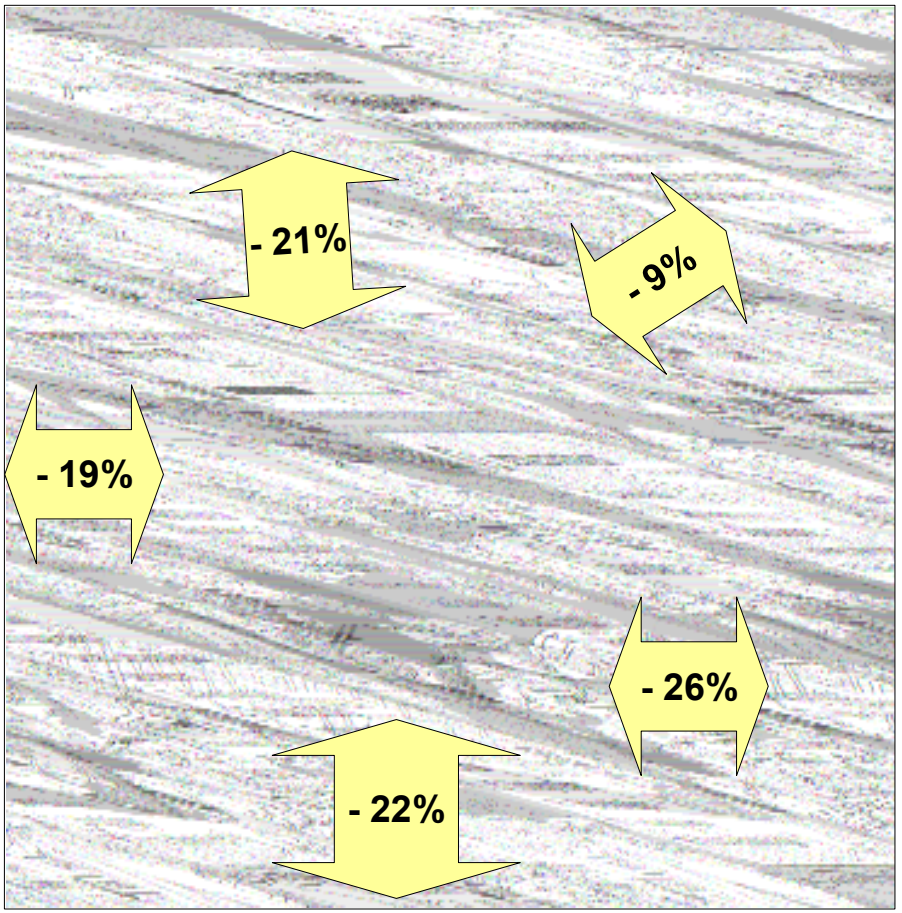
Stockholm Congestion Charging System – A Huge Success

The Outcome – Exceeded all Expectations

- 25% reduction in traffic volume, removing 100,000 peak hour vehicles. Stable and sustained
- Increase of 40,000 mass transit users per day. Bus schedules speeded up
- 30 – 50% reduction in queue times
- Decreased Emissions – 14% in city, 2.5% in county
- Public Opinion – increasingly positive, media, individuals and businesses

Challenges

- Short delivery time of a complex solution in combination with a fixed launch date under significant public scrutiny
- Integration of a large number of external partners



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

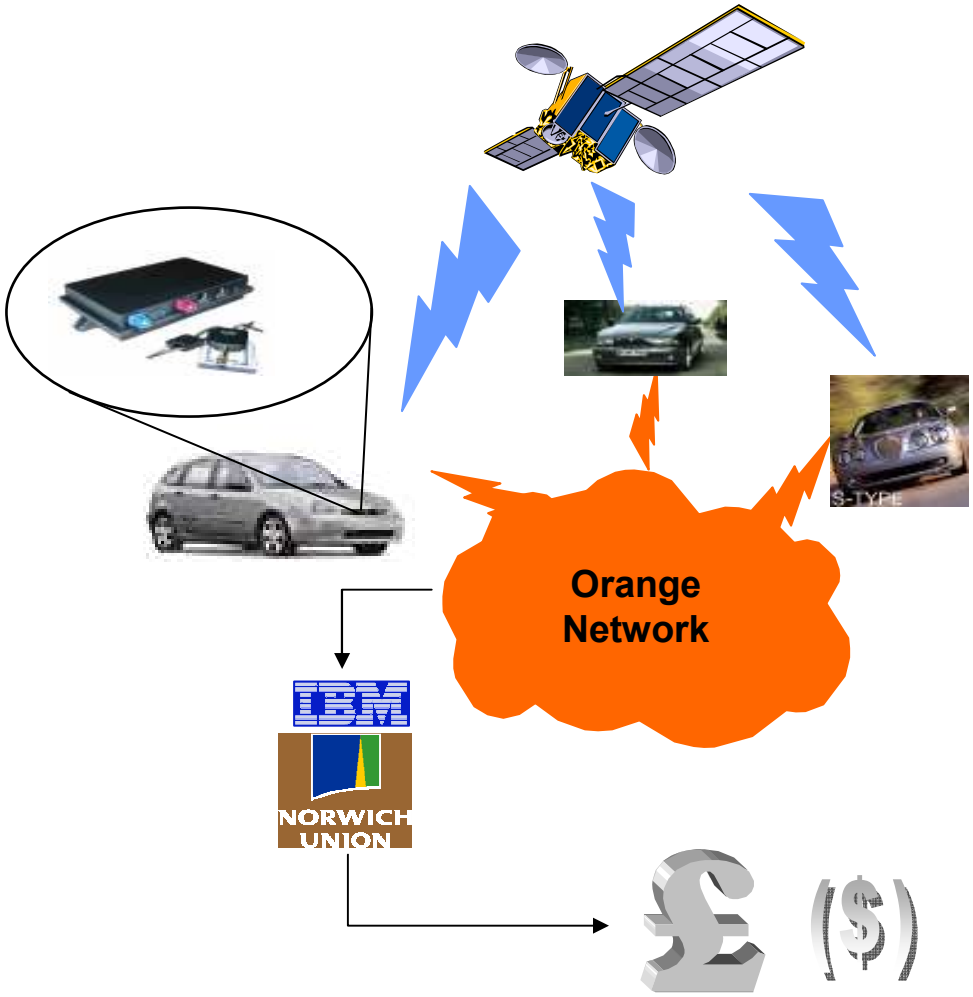
Stockholm Congestion Scheme – After the Trial

- Congestion charging scheme trial period ended July 31st 2006
- Traffic volumes up by an average of 20% on August 1st
- A “non-binding” public referendum was held on September 17th
  - City resident voted “Yes” to continue the scheme
  - Other neighboring jurisdictions voted “No”
  - Prior government had indicated that they will base their decision to continue or stop the scheme based on the vote of city resident (which was a “yes”)
  - However, the government was voted out and a new government has taken over, both at the city and at the central government level
  - The new government is leaning towards continuing the scheme, with some policy changes that allow for using toll revenue for a broader set of transportation infrastructure improvements
- Significant interest from around the world in the scheme design, implementation and operation
  - Onsite visits from several U.S. organizations, both public and private
    - San Francisco
    - New York
    - Seattle
    - Minnesota

Other Relevant Technologies/Initiatives

- Vehicle Usage and Tracking
  - Norwich Union
  - Secure Trade Lanes
  - CERT, Dubai
- Video Analytics

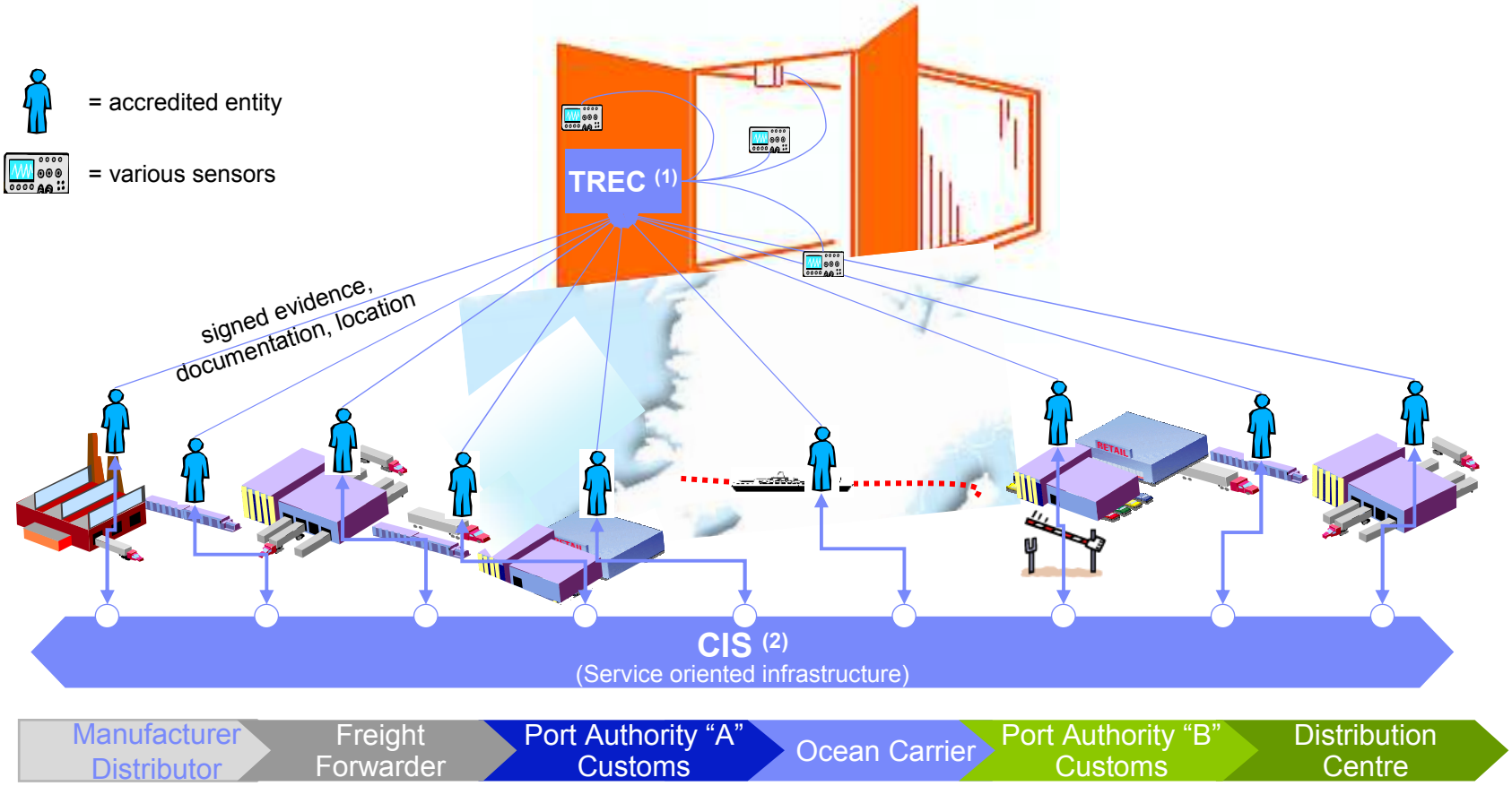
"Pay As You Drive" ™ Car Insurance



- UK's largest motor insurer
- Business Pilot
- To record journeys of 7,000 private vehicles
- Over 18-24 month period
- Records
  - Position, Speed &Direction
  - Every second of every journey
- Enrich with map information
- Process by customer systems
- To determine 'Factor X'
  - Dynamic 'on-demand' premium
- Requirements confirmed by Use Cases

Secure Trade Lanes

This unique IBM solution is based on the integration of different state of the art technologies into an end-to-end vision, implemented in a modular, non-proprietary and pragmatic way



(1) TREC= Tamper-Resistant Embedded Controller
(2) CIS = Container Information Services

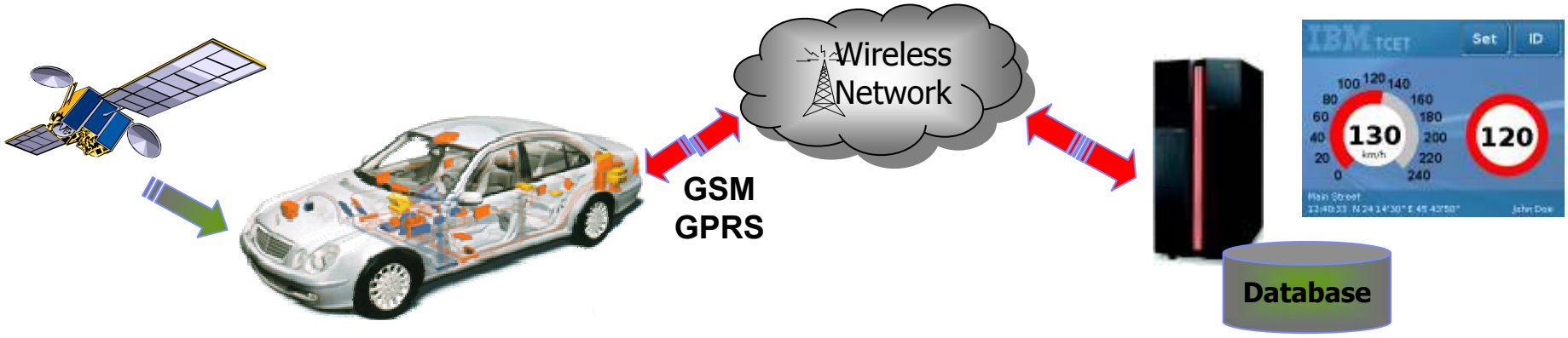
Secure Trade Lanes: Intelligent monitoring based on changeable business rules

- Multiple sensors
  - Door status
  - Motion detector
  - Light sensor
  - Vibration detector
  - Humidity
  - Temperature
  - etc
- Monolithic sensor module
  - Integrated with TREC
  - Tamper-resistant
- Distributed sensor-area network
  - Secure communication
- Intelligent monitoring & alerting
  - TREC processes sensor readings yielding integral container status
- Authentic track of container status
  - Tamper-proof storage
  - Authenticated access control
  - Periodic logging of sensor readings

Door	Motion	Light	Vibration	Level
↙	↙	↙	↙	ALARM
↙	↙	↙	-	ALARM
↙	↙	-	↙	ALARM
↙	↙	-	-	ALARM
↙	-	↙	↙	ALARM
↙	-	↙	-	ALARM
↙	-	-	↙	ALARM
↙	-	-	-	ALARM
-	↙	↙	↙	ALARM
-	↙	↙	-	INSPECT
-	↙	-	↙	INSPECT
-	↙	-	-	SUSPECT
-	-	↙	↙	INSPECT
-	-	↙	-	INSPECT
-	-	-	↙	SUSPECT
-	-	-	-	PASS

Dubai, United Arab Emirates (UAE)

- For the Centre of Excellence for Applied Research and Training in UAE, IBM developed and implemented systems to improve road safety and enable Road User Charging
  - IBM developed complex on-board units (OBUs) and associated systems to monitor the speed of vehicles and communicate data to a central location
- All-in-One function OBU include:
  - GPS positioning and navigation
  - Mobile phone and organizer
  - “Pay-as you-drive” applications



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
- Improved operator effectiveness and reduced workload
- Operational cost reduction
- Higher levels of security

IBM Telematics References

In-vehicle Device	Wireless Carriers	Service Providers	Enterprise Appls	Content

Contacts

Thank You

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