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Smart Traffic 06

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We make the INVESTMENTS of our CUSTOMERS BETTER
through people, technology, processes and financial strength

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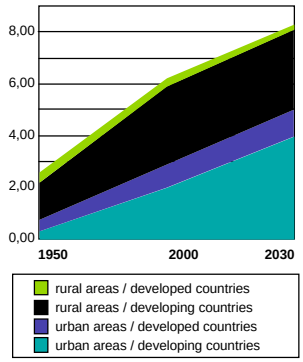
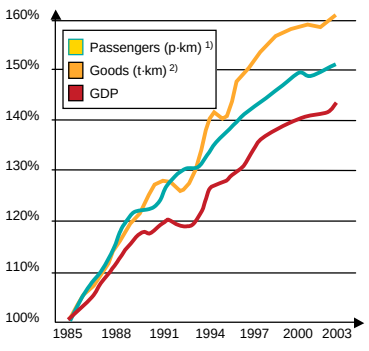
Mobility

World population growth and distribution (billions of people)



Transport growth worldwide 1985-2003 (1985 = 100%)



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Madness

Congestion

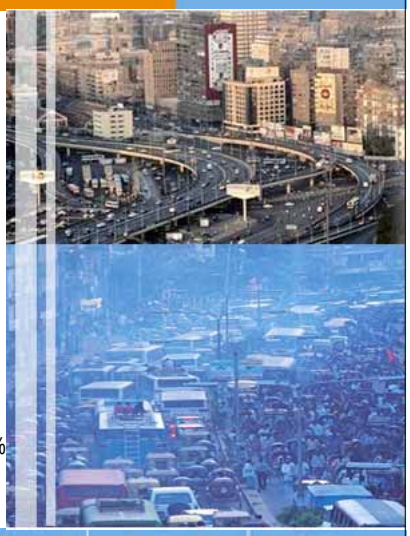
Cars increased by factor of 5 since 1950
10% of Europe's motorway congested
15 % of income per capita

Destruction

Every 90 minutes a person is killed
Over 3000 people killed and 130,000 injured
USD 518 billion cost

Pollution

11 billion litres of fuel
External costs of road freight increased by 43%
10 hectares covered each day



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Mobility

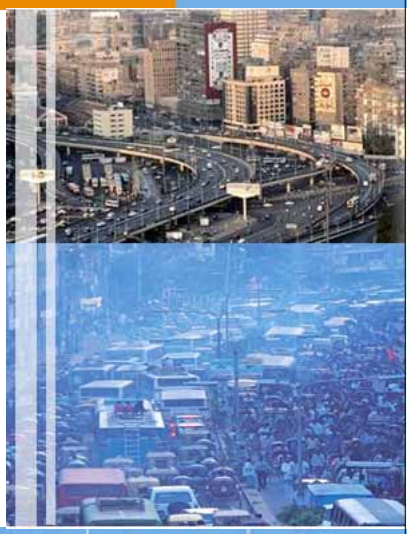
Basic human need
Precondition for development

Safety

Decreasing traffic fatalities and accidents
Improving trust

The environment

Improving living conditions
Compliance to environmental standards
Improving attractiveness



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Intelligent Transport Systems promise …

More Efficient Infrastructure

Ensure efficient transport by introducing intermodal Telematics systems and services

Increase traffic flow by managing the high volume of traffic

Safer transport

Decrease traffic fatalities and accidents
Improve citizens' trust in local authorities by providing more security and compliance

Less pollution

Reduce traffic related pollution specially CO2 emissions through decongestion & harmonisation of traffic flow

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Intelligent Transport Systems deliver

More Efficient Infrastructure

Managed ramps, free flow tolling

Incident detection and management

Adaptive Traffic Control

More Informed Consumers

Travel time information

Incident & congestion information

Alternatives

Improved Behavior

True alternatives

Carrot & Stick

Compliance

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Siemens Intelligent Transport Systems deliver

Traffic Management
Public Transport
Tolling
Advanced Driver Solutions
Parking
Emergency Fleets

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Public Transport

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Making public transport more attractive

Challenges

Passengers
- Punctuality, frequency & reliability
- Convenience e.g. integrated payment
- Attractiveness e.g. car vs. bus
- Safety & security

Transit authority
- Flexibility of network
- Demand for public transport
- Policy issues e.g. bus vs. metro
- Seamless integration throughout modes

Operators
- Optimization of operations
- Passenger preferences
- Costs of operations
- Avoid fraud & vandalisms

Solutions

Quality of Service
- Schedule Adherence & Connection Control
- Electronic Fare Collection & Ticketing
- Dynamic Passenger Information
- In-vehicle video surveillance

Quality of Operations
- Real-time Fleet Management, Monitoring, Utilization & Forecast
- Traffic Light Priority & Preemption
- Depot Management

Make public transport more attractive

Benefits

Political
- Increase modal shift from individual traffic to public transport
- Increase public transport flow

Financial
- Reduction of operational costs
- Increase of productivity & efficiency
- Increase transparency of fare revenue streams

Passengers
- Better service predictability
- More passenger confidence in public transportation
- Increase customer satisfaction & loyalty

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Telematics solutions

	Transit Authority	Operators	Passengers
			
Goals & Expec-tations	▪Urban transport policy ▪Integrated modal services ▪Performance monitoring ▪Service indicators ▪Contracting of operators	▪Profitability of operations ▪Customer care & image ▪Service availability ▪Service reliability ▪Service regularity	▪Punctuality ▪Frequency ▪Convenience ▪Information any time ▪Safety & security
Range of Methods & Solutions	▪Definition of Services ▪Definition of fares & ticketing ▪Network Management ▪Quality & Indicators Management ▪Information & Promotion	▪Real-time Fleet Management for performance monitoring, utiliza-tion measurement & forecasting ▪E-Fare Collection & Ticketing ▪Traffic Light Priority & Pre-emption ▪Depot Management	▪Dynamic Passenger Information ▪Integrated Payment Systems ▪Schedule Adherence ▪Connection Control ▪In-vehicle Surveillance

Collective transport policy vs. revenue generation ***Demand for quality***

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Integrated solutions to support policy

Planning

1 Policy, network structure, services, fares & indicators

Route Network (dynamic & static data)

5 Real-time forecast at stops

4 Real-time fleet monitoring and forecasts

Control Center

6 Real-time information away from stops

Passengers

3 Two-way mobile radio data link

7 Travel information centers

2 Intelligent On-board Equipment

Traffic Light Priority (TLP)

Vehicles

Source: Team Siemens One

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Accurate information increases customer loyalty

Pre-Trip		Near-Trip	On-Trip
At the workplace or at home	On the way to the stop	At the stop	In the bus or light rail
			
Web-based info. makes modal integration more convenient	Mobile devices for schedules & other mobile based services	Display boards for more customer confidence	Multimedia & Advertisement in addition to connection info
			

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Traffic Light Priority (TLP) helps increase quality of service

- **Increase in punctuality and regularity** *by eliminating waiting times at lights*
- **Reduction of journey times by more than 20%** *using integrated or stand-alone priority systems*
- **Avoidance of noise and exhaust emissions** *by eliminating standing times and engine start-up at junctions*
- **Coexistence with additional transit priority measures** *such as priority signal indicators or dedicated lanes*

•**Example:** Wilshire Whittier Corridor (26 Miles) & Ventura Corridor (16 Miles) - Los Angeles – USA -Between 22-27 % bus journey time reduction

Source: Los Angeles Department of Transport, 2003

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In-Vehicle video surveillance systems

do we need it ?

- **Increased passenger / driver safety**
  making passengers/customers feel securer
- **Protection of the equipment**
  by reducing the costs for damages by reason of vandalism
- **Offender identification**
  using in-bus recording for details to the course of events
- **Prevention / determent**
  as determent for potential offenders

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Conclusions

Political	▪Raise public transport modal share by increasing quality of service through implementation of real-time integrated systems ▪Increase public transport flow thanks priority treatment of buses and light rails
Financial	▪Reduce operational costs through more effective fleet management and performance monitoring ▪Efficient usage of infrastructure (less investment) due to effective vehicle assignment and higher vehicle availability
Passengers	▪Increase satisfaction and loyalty through better information and connection protection ▪Get additional passengers through shorter travel times and improved schedule adherence

Source: Team Siemens One

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Public Transport Example - London

- 500 (up to 1600) traffic lights
- 13,000 On Bus signs
- 8000 Onboard computers
- Equipment for 90 garages
- 145 control centre stations

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Parking

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Public and Private Parking Operators - Very different requirements

Challenges

Users
- Availability
- Parking search time
- Payment flexibility
- Security

Public Operators
- Parking Search Traffic
- Residents' Parking
- Enforcement
- Fund Raising
- Shift to Public Transport

Private Operators
- Revenue Generation
- Attract Users (Security, Convenience, Parking Guidance)
- Efficient Operations (Utilisation, Central Management)

Solutions

▶On-Street Parking:
- Parking Guidance
- Payment
- Enforcement

▶Off-Street Parking:
- Lot Parking (Park&Ride, incl. Payment)
- Car Park Guidance
- Car Park Management (incl. Payment)

Optimal fit to customer requirements

Benefits

Users
- Shortest route to vacant parking spot
- Simplification of parking process (guidance, cashless payment options)
- Fair and reliable service (usage based payment)

Public Operators
- Optimization of Traffic
- Operational and administrative relief through Integrated Enforcement
- Innovative Image
- Better Modal Split

Private Operators
- Revenue increase (capacity utilization, tariff structure flexibility)
- Increased Attractiveness
- Better operational cost position through standardisation

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Demand Management OR Revenue Generation

	Parking Guidance	On Street Parking	Off Street Parking
			 
Goals	▪Reduce parking search traffic ▪Real-time Monitoring and Guidance based on availability ▪Enable Interfaces to Traffic Management ▪Enable Interfaces to Public Transport	▪Allow basic access functions for residents ▪Create barriers for visitors by pricing and max. parking period ▪Optimize Parking Process (incl. Enforcement) to maximize throughput	▪Maximize capacity and throughput for revenue generation ▪Optimize processes to reduce costs (incl. multiple parking garages) ▪Ensure Security ▪Allow Inter-modal access ▪Differentiate User Groups (handicapped parking, women, motorbikes, SUV, trucks etc.)
Customers	▪Authorities and City Planners	▪Authorities and City Planners	▪Private parking space operators (Airports, Hotels, Offices etc.) ▪Public Transport companies

Demand Management | ***Revenue Generation***

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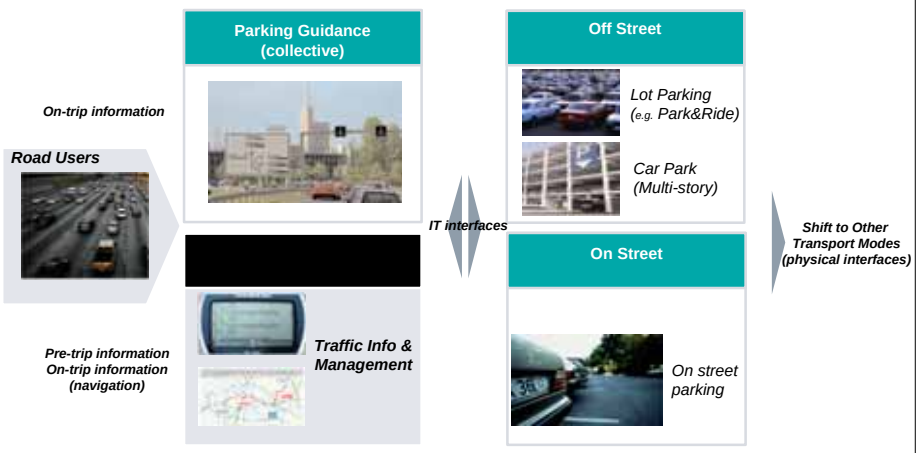
Parking Management in cities is an integral part of inter-modal Traffic Management



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Parking Management Solutions

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Parking Guidance Systems are a MUST to reduce parking search traffic

Parking Guidance System

Application areas

- Inner-City guidance
- Guidance to Park & Ride
- Airports
- Event areas (Stadium, Concert Hall, Convention Center)

Benefit

- Reduction of parking search traffic (up to 30%)
- Reduction of emissions
- "Proof of Attractiveness" (pre-trip data, statistics)
- Happy users (fast access, cost savings)

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Mobile Parking: A win-win story

Registration to the system (initial process, only once)

Registration Info
- Car plate number
- Car owner name
- Mobile Tel. Number

Payment Info
Via Account, Credit Card, or Telephone Bill

Registration data

Internet based
Via mobile phone, PC, or in provider's sales offices, free of charge

m-parking System
Payment
Provider

Parking (each time you park a car)

- Plate number
- Parking time reserved or start / end information

Parking data
SMS (pre defined)

Confirmation
SMS

m-parking System
Registration, Charging

Reminder (before parking time expires)

Reminder

end time of parking ticket

m-parking System

Pre Payment (before pre payment account is empty)

Charging

Amount to be charged

Confirmation

m-parking System
Payment

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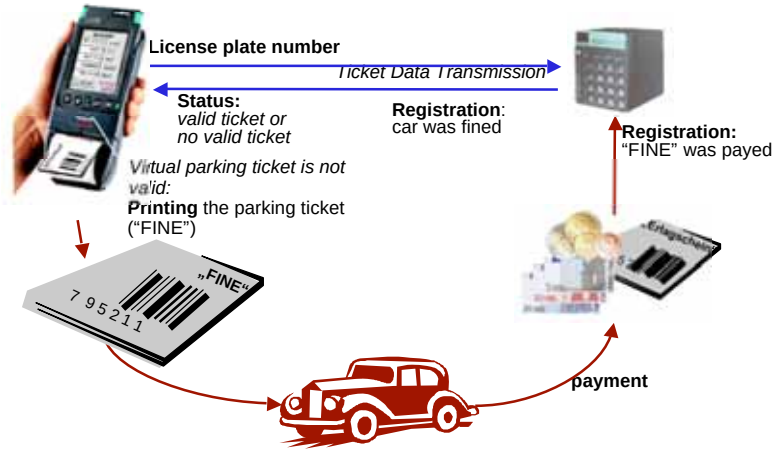
m-Parking Enforcement process is optimized



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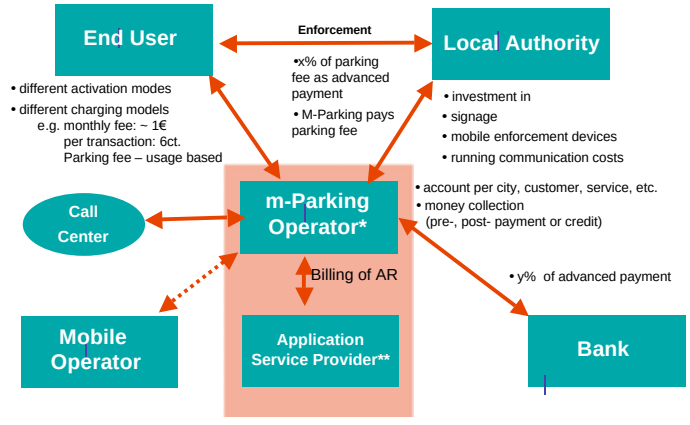
The m-Parking Business Model always has to be adapted to city specific requirements

•Example: m-Parking payment process in Vienna



* either local authority or private company;
Set up as „non profit / minimum cost" operation, revenue – cost = Adjusted Revenues (AR),

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Conclusions

Users

- Users strongly want to avoid time consuming parking search traffic
- Integrated Parking Info is used for mode choice and trip planning
- Users are accepting m-parking solutions provided that fallback systems exist
- Security and Services are an issue where parking facilities can differentiate

Public Authorities

- Parking Management is seen as an integral part of Integrated Traffic Management
- Parking Solutions' benefits are not fully exploited without interfaces to other transport / telematics services
- Enforcement is critical to realize political targets (modal split shift etc.)
- Parking Facilities are seen as image factor for residents and tourists

Private Operators

- Attractiveness of facilities increases with security, convenience and additional services and coheres with revenue
- Cooperation with Public Authorities to generate real-time Parking Information and Guidance is concerned essential

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Demand Management

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Demand Management — Tolling

Challenges

Political
- Objectives (fund raising, tax, traffic management)
- Introduction strategy (class of vehicles, road network, upgrade, compensation for drivers)
- Tariff structure (flexible)

System Concept
- Technology (Charging Data-, Enforcement-, Central Services)
- Costs (Capex, Opex)
- Interoperability

Implementation
- Business Processes
- Proof of Concept (Field Trial)
- Reliable partner (proven track record, synergies through turnkey solution)

Solutions

- **Interurban Tolling**
- ►Single Lane Tolling
- ►Open Road Tolling
- **City Tolling**

Optimal fit to customer requirements

Benefits

Political
- Environment (shift to public transport, less congestion)
- Mobility (increased traffic flow, flexible management of congestion)

Financial
- Fair cost sharing (user pays for maintenance)
- Re-financing of new infrastructure
- Additional funding (reinvest in public transport)
- Efficient usage of infrastructure (less investment)

Driver
- Higher quality of service at moderate additional cost

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Framework defines the appropriate technology

	Single Lane Tolling	Open Road Tolling	City Tolling
			
Technologies	high ↕ low (Velocity of transaction) ▪DSRC 1) (microwave / IR 3)) ▪Video (Real-time/HQ) ▪RFID ▪Manual (incl. Smartcards)	high ↕ low (Flexibility) ▪ GNSS 2) / GSM ▪ DSRC1 (microwave / IR 3))	high ↕ low (Velocity of transaction) ▪GNSS 2) / GSM ▪DSRC 1) (microwave / IR 3)) ▪Video (Real-time/HQ) ▪RFID ▪Manual (incl. Smartcards)
Features	▪ Established products ▪ Improved throughput	▪ Barrier-free ▪ Highest throughput	▪ Mainly Cordons today ▪ Implicit Security Aspects
Range of Solutions	▪ Motorways, ▪ Tunnels, Bridges	▪ Country-wide networks ▪ Motorways	▪ Cities ▪ Conurbations

Revenue Generation — ***Demand Mangement***

1) DSRC = Dedicated Short Range Communication 2) GNSS = Global Navigation Satellite System 3) IR = Infrared

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Complexity, Flexibility of System Architecture varies with selected technology

Complexity: High ⬆ Normal ➡ Low ⬇
Complexity is defined by # of process steps needed

Flexibility: High ⬆ Normal ➡ Low ⬇
Flexibility is defined by # of features

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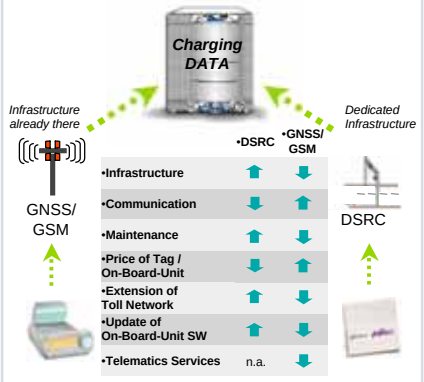
Cost and Interoperability influence decision on Infrastructure and Satellite based Tolling Systems

Cost



High ⬆ Low ⬇

Interoperability

Present situation

- **EU:** High diversity of ETC solutions, European Toll Service: EU directive in preparation
- **Asia:** High diversity of manual and ETC solutions, Interoperability addressed by "Two Piece Tag"

▶ Patchwork of non-interoperable systems (mostly DSRC)

Requirements for Interoperability

- Charging Data Services
- Hybrid Concepts (DSRC, GNSS, SmartCard)
- Low cost OBU
- Standardization
- Central Services
- Clearing (e.g. for pre-payment)
- Enforcement
- Transnational agreements

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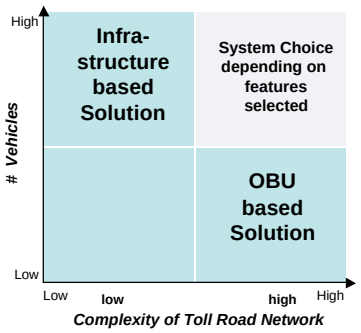
Which solution

Features	•DSRC	•GNSS/GSM
•Political Intention		
•Fund raising	•yes	•yes
•Congestion charging	•cordons, lanes	•comprehensive
•Tax replacement	•no	•yes
•Flexibility		
•Adaptation of toll networ	•Infrastructure	•Software
•Remote SW upgrades	•no	•yes
•Remote Tariff adaptatior	•no	•yes
•Telematics Services		
•Fleet Application [1)]	•no	•yes
•Navigation	•no	•yes
•Traffic Information	•spot	•continuous

Assessment related to cost



1) E.g. vehicle, goods monitoring, theft protection, infotainment

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Electronic Toll Collection - Comparison of the Two Most Common Technologies

GNSS

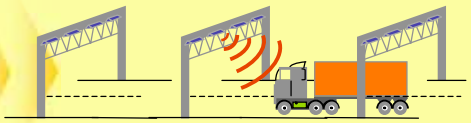




GPS Satellites → GNSS OBUs ↔ (GSM / GPRS) ↔ CD* Back Office

DSRC

DSRC OBUs ↔ (IR / µ-wave) DSRC Toll Gantries ↔ (IP) DSRC Back Office



*CD = Charging Data

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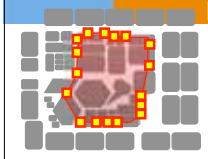
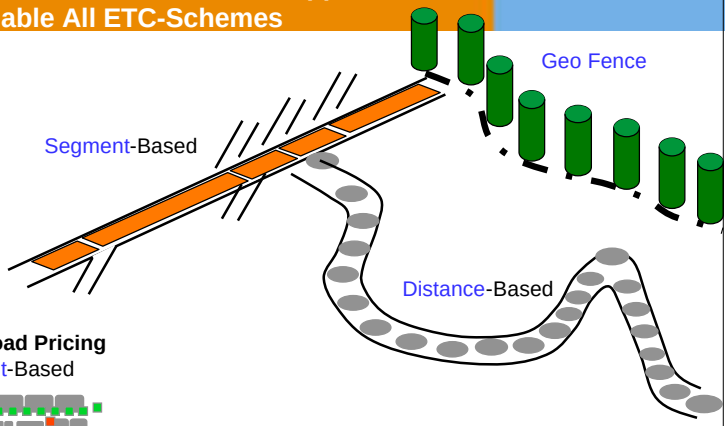
Electronic Toll Solutions Application – Enable All ETC-Schemes

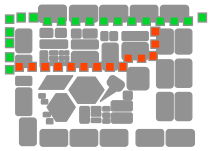


Congestion Charging
Area-Based
Geo-Fence/Toll-Points

Urban Area



Flexible Road Pricing
Segment-Based



Nation-wide ORT Scheme

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Toll Collection System “Brenner” (Austria) — Example

Solution

- Set-up of a turn key supply of all relevant components

Task

Providing a system for pre- and post-payment accepting all established means of payment to accommodate convenient payment for one time users

Customer: Alpenstraßen AG
Contract: 1993 + (many extensions)
Implementation: 12 months
Software extended for nationwide usage in 2001

Result

- State-of-the-Art Toll System including OCR with high user benefits

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Toll Collection System “Oslo Toll Ring”

Example

Task

Design, program, interface and commissioning of a manual and fully electronic tolling system

Customer: A/S Fjellinjen

Contract: 1995+(complete update 2000)

Solution

- Design and build of the toll ring facilities
- Conceptualize a multi user UNIX-based back office
- Systems integration of a manual and fully electronic tolling system based on microwave tags (AutoPass)
- Maintenance of road-side infrastructure as well as of the back office

Result

- Highly profitable, accurate and reliable system
- Working 24 hours a day, 7 days week

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Pilot Project „Puget Sound“ (Seattle, USA)

Example

Task

Pilot project. Set-up of an electronic toll collection (ETC) system without additional infrastructure

Customer: Puget Sound Regional Council, Seattle, USA

Contract award: 2004 (extension 2006)

Implementation: 6 months

Solution

- Set-up of a GPS/GSM based toll system without additional infrastructure
- Identification of toll routes via GPS
- Transfer of data to a Back office (location, time, distance)
- Web-site for customer and participants
- Dual mode vehicle miles travelled calculation

Result

- A **reliable** system with accuracy **>98%** of correctly detecting the links was established **without** additional **road-side infrastructure**
- **GNSS** satellite-based toll solutions have been proven to be a **mature technology** using **Off-the-shelf** equipment and solution know-how

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Seattle – Guiding Commuters – Fighting Gridlock

Example

Time of Day	Toll Rates per Mile*			
	Monday thru Friday		Saturday & Sunday	
	Freeways & Highways	Streets & Arterials	Freeways & Highways	Streets & Arterials
Midnight	No Charge		No Charge	
1:00 AM				
2:00 AM				
3:00 AM				
4:00 AM				
5:00 AM				
6:00 AM	$0.40	$0.20	$0.10	$0.05
7:00 AM				
8:00 AM				
9:00 AM	$0.15	$0.075	$0.20	$0.10
10:00 AM				
11:00 AM				
Noon				
1:00 PM				
2:00 PM				
3:00 PM				
4:00 PM	$0.50	$0.25		
5:00 PM				
6:00 PM				
7:00 PM	$0.10	$0.05	$0.10	$0.05
8:00 PM				
9:00 PM				
10:00 PM	No Charge		No Charge	
11:00 PM				

*Downtown Seattle zone is toll-free

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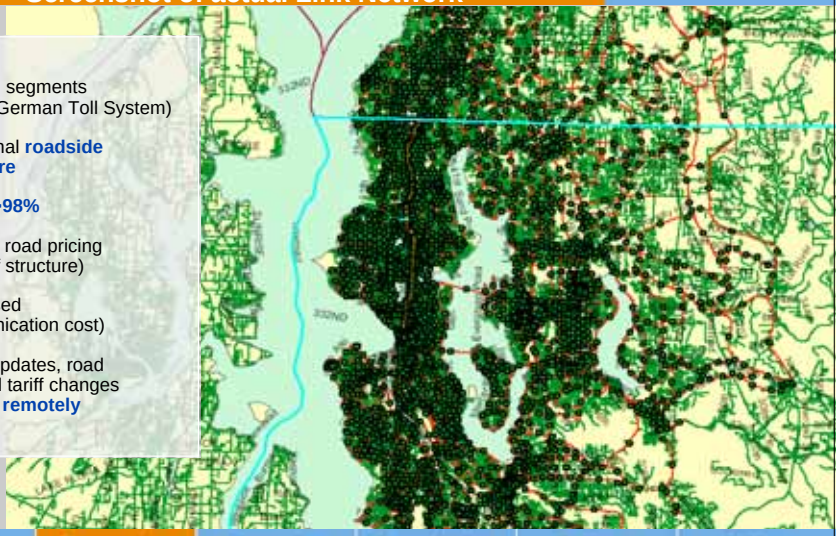
The Puget Sound Toll-Pilot Project - Screenshot of actual Link Network

Example



- **8.000** road segments (>30% than German Toll System)
- **no** additional **roadside infrastructure**
- accuracy **>98%**
- **intelligent** road pricing (flexible tariff structure)
- **GPRS**-based (low communication cost)
- Software updates, road segment and tariff changes can be done **remotely**

o Toll links

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London – Western Extension Zone

Example

Solution

127 ANPR sites, 700 cameras, 160 cabinets

- Use of high accuracy ANPR SPIKE+ cameras
- 2 in 1 solution (1 camera enclosure for detection + overview)
- detect, process, send or discard vehicle data on site
- send compressed data via Broadband 128-bit encrypted
- no infrastructure such as fibre-optic cables necessary
- integration into the existing scheme Back-Office system

Task

Detect all vehicles entering the zone with the highest accuracy possible, process collected data to back office at low bandwidth with the minimum roadside-infrastructure.

Customer: Transport for London
Contract award: October 2005
Implementation: February 2007

Result

A state of the art ANPR system that offers:

- immediate on-site processing of pictures taken
- transfer of low volumes of encrypted data
- an advanced and cost sensitive solution

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London Congestion Charging

Example

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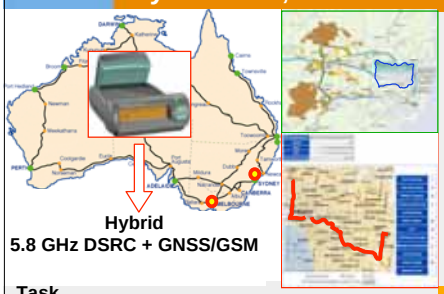
Hybrid OBU, Thin + Fat Client Concept



Hybrid
5.8 GHz DSRC + GNSS/GSM

Solution
Enhanced software application

- using DSRC 5.8 microwave parallel to
- GNSS GSM/GPRS tolling application
- Solution supervised by Quality Monitoring Station
- Alarm records created when failures detected
- Thin Client and decentralised scheme tested

Task

Trial a centralised/decentralised GNSS tolling system
in Australia. Test smooth migration possibilities from DSRC towards GNSS. Show feasibility of GPS tolling in a greater geographic scope in urban and inter-urban environment.

Customer: Transurban Ltd.
Duration: November 05 - February 06

Result

- 99.74% overall recognition rate
- DSRC Gantry detection (City Link Melbourne)
- Performance of Thin Client equal with decentralised scheme
- Geo-coding done off-site; server located in Vienna

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London GNSS-based Trial –

Solution

- Usage of new algorithms
- 10,000 toll sections
- Length <5 metres
- Sections have been processed in the back office
- Handle satellite signal loss as well as fading

Task

Check the accuracy of GPS-based tolling algorithms in difficult urban environment (City Centre of London).
Demonstrate the whole process chain (evaluation of location; recognition of toll-segments; implement a tariff-scheme).

Customer: Transport for London
Duration: 2/2006 – 5/2006

Result

- Siemens received the best result out of the 14 participating parties
- Payment according to location and time manageable centrally in the back office

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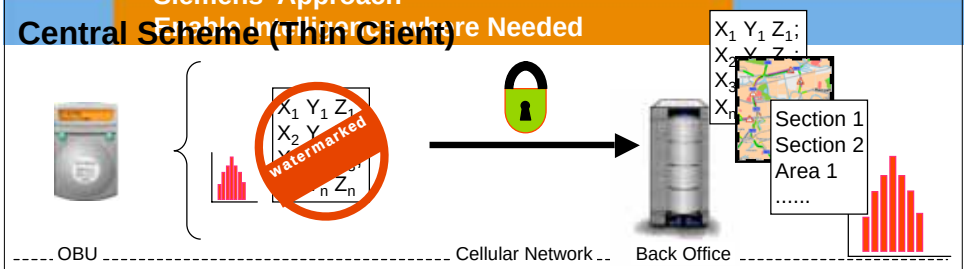
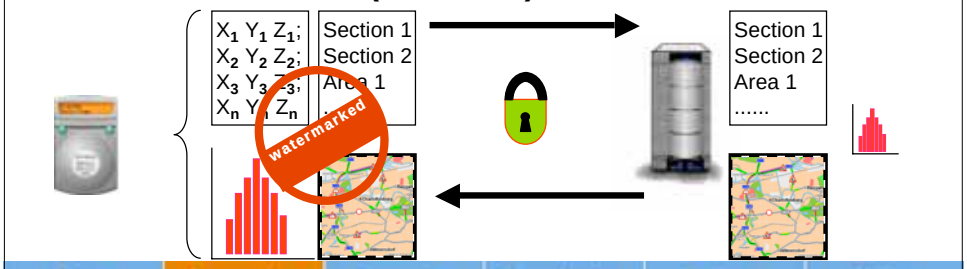
Siemens' Approach –
Flexible Intelligence Where Needed

Central Scheme (Thin Client)



Decentralised Scheme (Fat Client)



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City Tolling London & Stockholm:
Impact of demand management on the magic triangle

London
- 290' € invest
- 99' € revenues FY 04/05

Mobility

	London	Stockholm
Congestion	-30%	appr. -30%
Traffic Volume	-15%	- 100.000 cars
Modal shift	+18%	+ 40.000 pass.

Stockholm
- 336' € invest
- 82' € revenues p.a. (estimate)

Environment

London	Stockholm
- 20% fuel - 19% CO2 - 12% oxids	14% less emissions in inner city 2,5% in total county

Safety / Security

London	Stockholm
- 20% accidents	~ - 10% accidents

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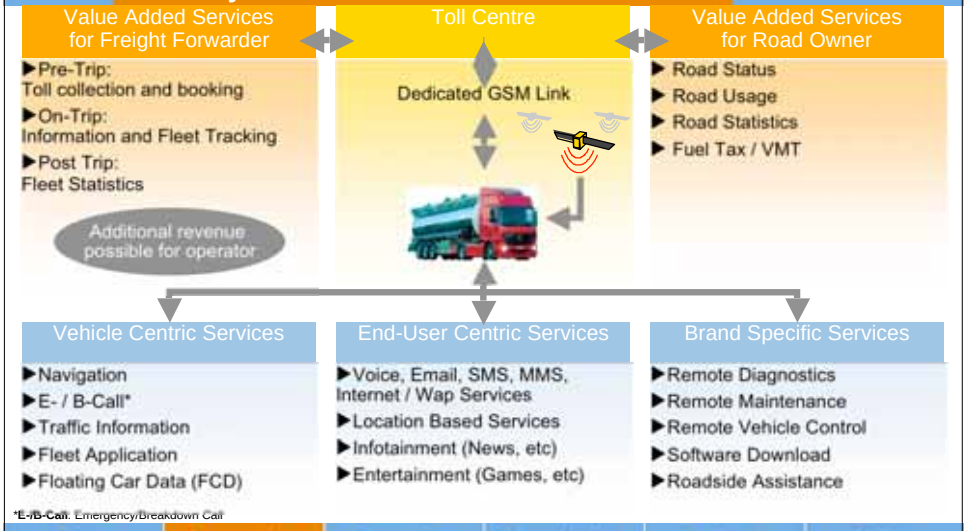
Satellite-Based Systems Support a Variety of Advanced Telematics Services



*E-/B-Call: Emergency/Breakdown Call

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Web Tooling Interface - Utmost Flexibility in Back Office

For the toll operator / trusted 3rd party:

- Create/delete user accounts
- Vehicle data registration
  - vehicle class
  - environmental class
  - trailers
  - # of axles
- Insert/change location-time-category-based tariff tables
- System Monitoring
- Data mining for trusted partners
- Privacy issue: connection to trusted 3rd party

For the participant:

- Trip view
- Sections log
- Billing information

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Roadmap for On-Board Equipment

Power | Transportation | Automation | Communications | Healthcare | Buildings

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Roadmap for On-Board Equipment

Windscreen OBU
3rd generation
self installation

Alternative Approaches
Mobile Phone

Tolling Module

Miniaturisation

New Concepts
Integration into Communication Centre (TCC) / Radio / DTCO / Navigation / Head up display

2007 **2008** **2010** **201X**

Autonomic OBU
experience from speed boat
"single gauges" requirements

New Concepts
Integration into existing components
Speedometer / Tachometer

Power | Transportation | Automation | Communications | Healthcare | Buildings

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Conclusions

Politics	▪Congestion Charging: private traffic creates revenue for public transit ▪Tolling is well accepted to raise funds for new traffic infrastructure investment ▪Mileage Payment is perceived to be a fair if compensated e.g. by tax replacement ▪Introduction Strategy, Business Processes to be included in political framework definition
Industry	▪Technology is available ▪Satellite Based Solutions serve best complex networks with operational flexibility ▪Infrastructure Based Solutions provide lowest cost of ownership for non-complex requirements
User	▪User Acceptance for tolling coheres with user benefits ▪Road Users change behavior according to road usage cost