

The Siemens logo is displayed in a bold, teal, sans-serif font. It is positioned in the upper right corner of the slide, set against a white rectangular background that partially overlaps the aerial city image.

Congress Copenhagen

Tolling Technologies

Showcase Slovakia: Example of best practice

**Christoph Wondracek,
Global Projects & Sales - Electronic Tolling**

Infrastructure & Cities Sector, Division Mobility and Logistics

- 1. Technologies in General**
- 2. Nation Wide Tolling**
- 3. Tolling Slovakia**
- 4. First Results**

1. Technologies in General

2. Nation Wide Tolling

3. Tolling Slovakia

4. First Results

Tolling Technologies and Approaches

Main Types of Tolling Systems

Toll Plazas



Typical Environment

- ▶ Motorways
- ▶ Tunnels and bridges

Characteristics

- ▶ Closed road networks
- ▶ Delays at cash points

Technologies

- ▶ Manual
- ▶ Video
- ▶ Microwave and infrared

Open Road Tolling



Typical Environment

- ▶ Motorways + all roads
- ▶ Nationwide schemes

Characteristics

- ▶ Open, barrier-free roads
- ▶ High traffic throughput

Technologies

- ▶ Microwave
- ▶ Satellite with GSM
- ▶ Satellite with SmartCard

Congestion Charging



Typical Environment

- ▶ Cities
- ▶ Urban Areas

Characteristics

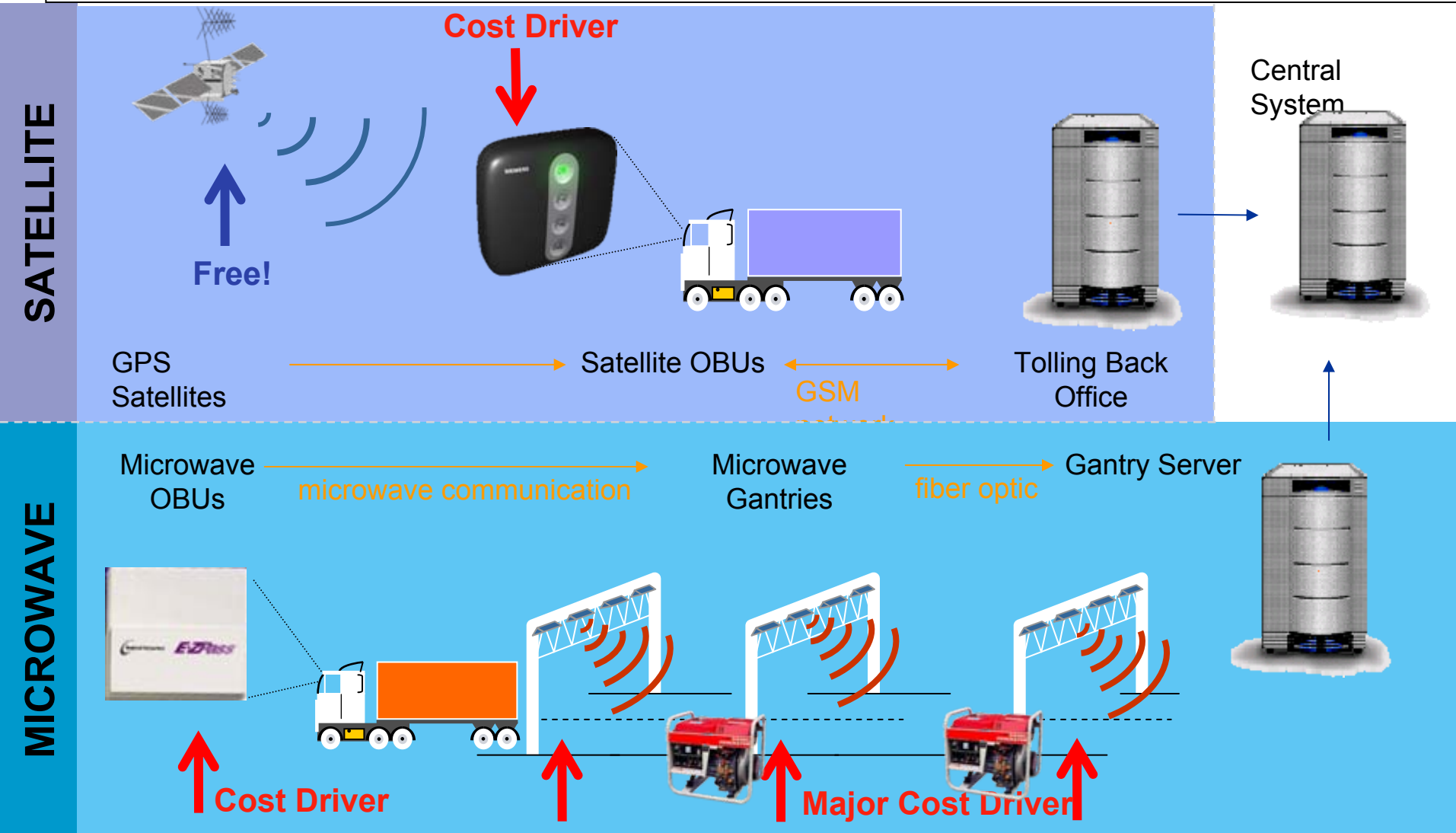
- ▶ Reduce City Congestion
- ▶ Promote Public Transport

Technologies

- ▶ Video
- ▶ Microwave
- ▶ Satellite with GSM

Tolling Technologies and Approaches

Comparison of the Two Most Common Technologies



1. Technologies in General

2. Nation Wide Tolling

3. Tolling Slovakia

4. First Results

European Interoperability

High Diversity in Europe Makes Interoperability a Major Issue in the Future!

Microwave-based systems are not yet compatible.

Austrian, German, Czech OBUs don't work abroad.

The EU Directive 2004-52/EC*

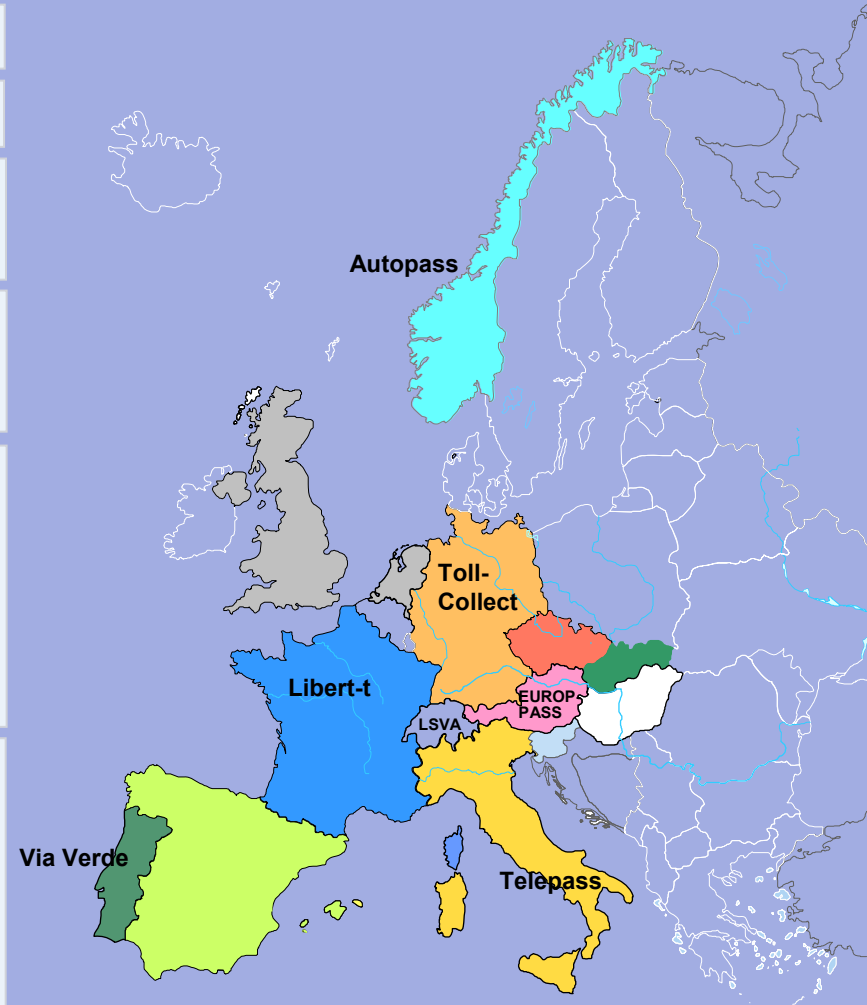
Recommendation for Satellite-Based Tolling

- (6) The electronic toll systems **should be interoperable** and based on open and public standards, available on a non-discriminatory basis to all system suppliers.
- (8) In particular, owing to their great flexibility and versatility, application of the **new satellite positioning (GNSS)** and **mobile communications (GSM/GPRS)** technologies to electronic toll systems **may serve to meet the requirements** of the new road-charging policies planned at Community and Member State level.

Article 2

Technological Solutions

- 3. It is **recommended that new electronic toll systems** brought into service after the adoption of this Directive **use the satellite positioning and mobile communications technologies**

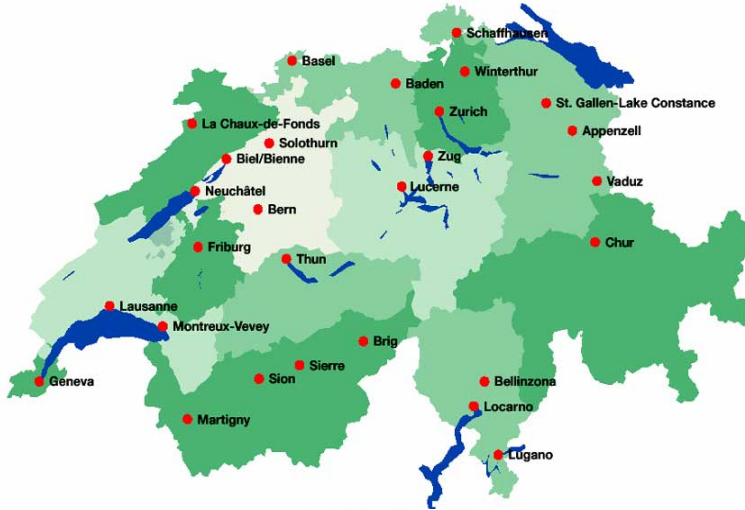


SWITZERLAND

2001

SIEMENS

First Nationwide Toll System for Trucks (on *all* roads)



Distance-Based Tolling

(LSVA = “Leistungsabhängige Schwerverkehrsabgabe”)

- ▶ Law for “LSVA” passed in 1998 for tolling on all roads
- ▶ System start: January 1st, 2001
- ▶ For Trucks > 3.5 tons; ~ 60,000 On Board Units (OBUs)
- ▶ avg. price / km: 65 Eurocents or 1.6 cents / ton / km

Commercial Issues

- ▶ Contract award (1999): Fela/Ascom; CAPEX ~ € 200 million
- ▶ Operation costs ~ 5% of revenues (€ 35 million / year)
- ▶ ~ 750 MEUR revenues generated per year
- ▶ LSVA makes for 20% of the overall transport costs

Satellite and Microwave Technologies Used

- ▶ Distance measured by odometer (tachograph) connection
- ▶ GPS verifies the distances, recorded on a “smart-card”
- ▶ Microwave used for enforcement and at the borders



➔ **New OBU generation will be launched 2009 by Siemens**

GERMANY

2005

SIEMENS

First Nationwide Toll System for Trucks with GNSS/GSM



Open Road Tolling on Motorways and Highways

- ▶ System start: on January 1st, 2005 (16 months delayed)
- ▶ For Trucks > 12 tons; 1.3 Million users (> 550,000 OBUs)
- ▶ avg. price/km: 12.4 Eurocents or 0.3 cents / ton / km
- ▶ ~ 12,000 km Road Network; ~ 5,000 Toll Segments
- ▶ ~ 90% of revenue via OBUs; 3,500 roadside terminals ~ 8%

Commercial Issues

- ▶ Contract award (2002): TollCollect; CAPEX “way over €1b”
- ▶ Operation costs ~20% (€ 600 million / year)
- ▶ approximately € 3 Billion revenues generated per year
- ▶ Penalty for delays still open, government wants € 4.5 billion

Satellite / GSM Technology

- ▶ **Tolled road network is easily expandable**
- ▶ Satellite Technology has proven to be very reliable
- ▶ Delays due to underestimated system integration efforts
- ▶ Dual system (manual booking) is too complex & costly

➔ **Siemens supplies > 350,000 OBUs to TollCollect**

First Nationwide Toll System for Trucks on Motorways

ASFiNAG Streckennetz

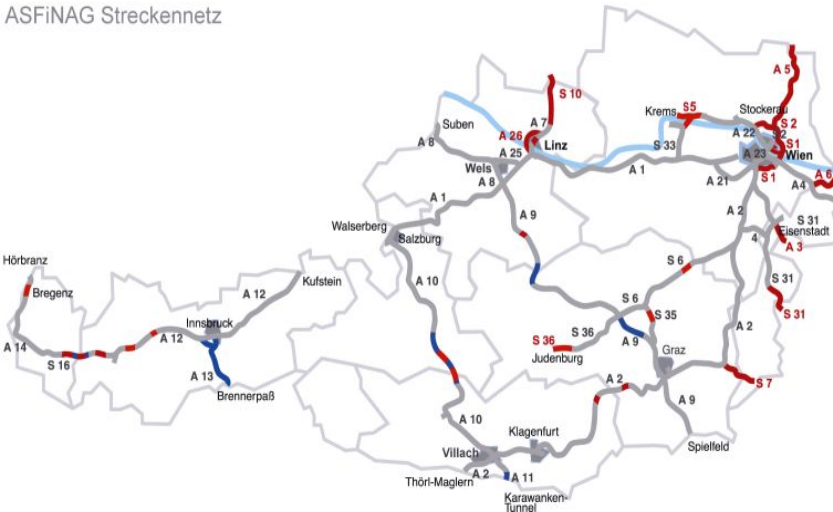


Photo courtesy of Autostrade S.p.A.

Open Road Tolling on Motorways and Highways

- ▶ System start on January 1st, 2004
- ▶ For Trucks & Buses > 3.5 tons (~ 500.000 active OBUs)
- ▶ avg. price/km: 22 Eurocents or 0.6 cents / ton / km
- ▶ ~ 2.000 km Tolloed Network; ~ 800 Toll Segments
- ▶ ~ 45% of tolling revenue generated by foreigner users

Commercial Issues

- ▶ Contract award (2002): Autostrade; valued at € 747 million
- ▶ Operation costs ~10%
- ▶ ~ € 800 million revenues generated per year
- ▶ ASFiNAG purchased "Europass" for € 208 million in 2005

Microwave Technology

- ▶ Local Austrian supplier purchased companies in Germany and Sweden with the technology, making some adaptations
- ▶ Major effort in building 800 gantries (building permits needed for digging data and power lines to all the gantries)
- ▶ Project started on time, 18 months after contract award

Preparation of “Taxes” for all Trucks on all Roads



Lorry Road User Charging Programme (“LRUC”)

- ▶ Distance-Based Tolling for Trucks > 3.5 tons
- ▶ Road usage fees based on truck category, **type of road**, and **time of day** (i.e. higher fees during rush hour)
- ▶ Not a tolling scheme, but a tax-refund scheme forcing foreign trucks to pay (since they didn't pay U.K. fuel taxes)
- ▶ Was planned for introduction 2007-2008, then cancelled since the combination with fuel taxation was too costly
- ▶ Only satellite-based solutions were considered

Tender Process

- ▶ 3 Tenders for Charging Data, Enforcement, Central System
- ▶ Anticipated revenues about € 5 billion per year
- ▶ Anticipated costs € 3 - 4 Billion (with 10 years operation)

Lessons Learned

- ▶ Consultants not only made a small fortune, but had an excellent chance to educate themselves in tolling
- ▶ No company or consortium made an offer for all three lots, since the integration risks were considered too high

CZECH REPUBLIC 2007

Nationwide Toll System for Trucks on Motorways



Open Road Tolling on Motorways (& First-Class Roads)

- ▶ System start on January 1st, 2007
 - ▶ For Trucks > 12 tons (although tender issued for > 3.5 tons)
 - ▶ Phase 1: 970 km Motorway Network, 350 Toll Segments
 - ▶ Phase 2: 1,100 km of first-class roads, 500 Toll Segments
- PHASE 2 NEVER IMPLEMENTED – New Tender Planned

Commercial Issues

- ▶ System cost 22 Billion CZK (~ € 930 million)
- ▶ 5.5 Billion CZK revenues for 2007 (ČTK 04-11-2007)
- ▶ 10 years operation (but only for highways, not other roads)
- ▶ Operation costs: $22/5,5 = 2.2$ Billion, ~ 40%

Minister Admits That Technology Is Not Suitable

- ▶ In June 2007, shortly after the system was launched, the Minister of Transport held a press conference, presenting the problems of the system and announcing a new tender

2005-2012 THE NETHERLANDS

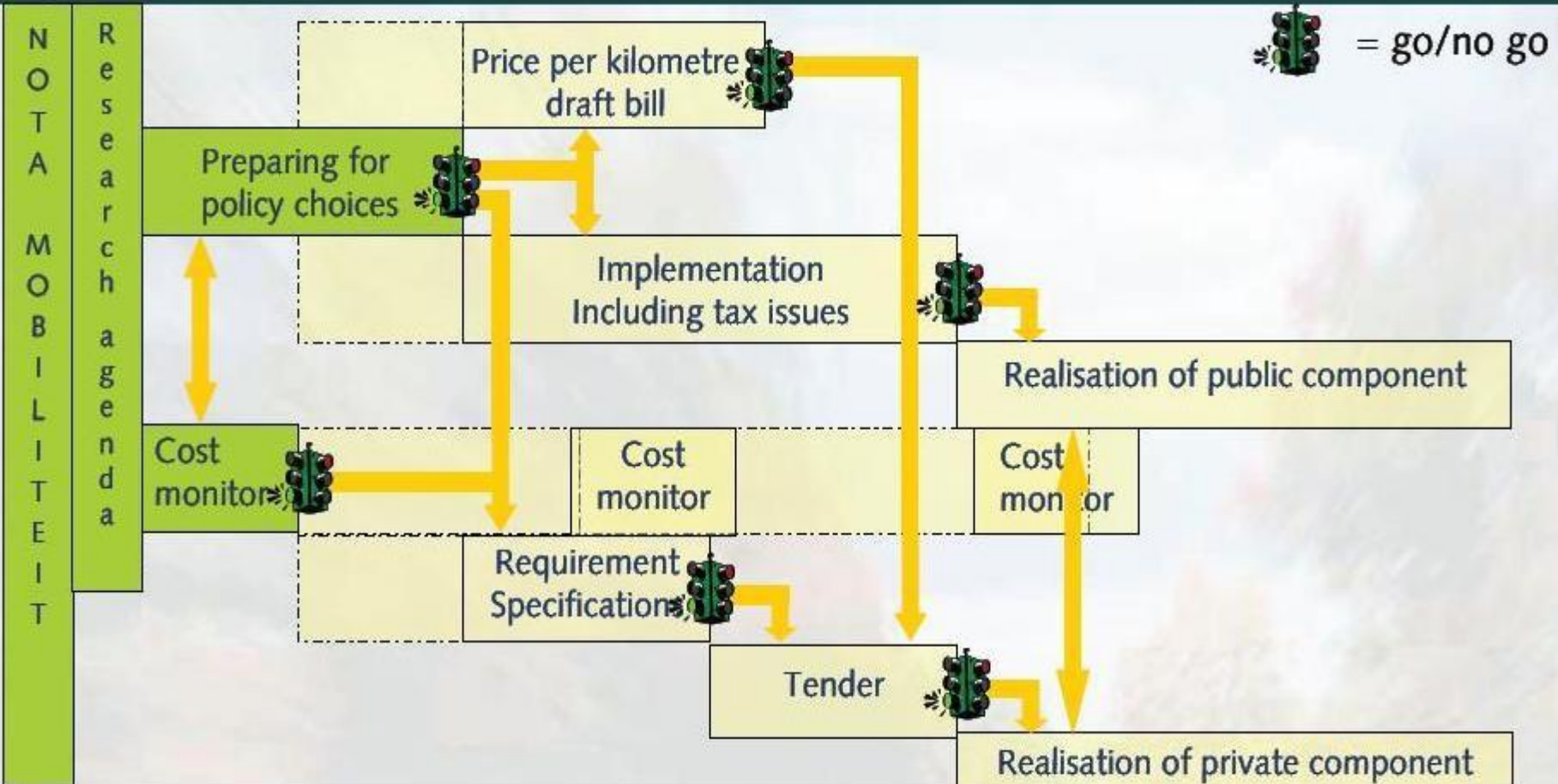
First Nationwide Scheme for all Vehicles on all Roads



“Anders Betalen voor Mobiliteit”



Km-price



SINGAPORE 2006 +

Siemens Awarded Satellite Trial Project

SIEMENS



Objectives of the Singapore Electronic Road Pricing (ERP) Trial

- ▶ Proof that GPS is the state of the art technology for tolling
- ▶ GPS is a reliable technology to be the basis of an advanced tolling technology for different districts in urban areas
- ▶ Demonstrate the reliability of the Siemens GPS solution and the Back Office System and prove that the Siemens technology is ready for implementation on a large scale

The Situation in Singapore Today

- ▶ High Sales tax on cars and trucks, annual road and vehicle taxes
- ▶ After 10 years, a vehicle owner must pay additional taxes

Target for Singapore

- ▶ Change the current fixed taxes on all vehicles to a kilometer-based (usage-based) scheme
- ▶ Deploy the latest technologies (GPS and UMTS), Integrate tolling into a Traffic Management System
- ▶ Use existing cash cards for tolling, parking etc.
Select the most reliable and advanced company for the project

LONDON

Congestion Charge Introduced 2003 – A Success Story

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Highly Innovative (and Controversial) City Charge

- ▶ Introduced 17 February 2003, extended 19 February 2007
- ▶ Daily fee set at £5, raised to £8 on 4 July 2005
- ▶ Payment online, per phone, SMS, or at special outlets
- ▶ Fines start at £50, after 2 weeks £100, after 1 month £150
- ▶ Special discounts for those living within the zone

Results

- ▶ Traffic delays reduced by 30%
- ▶ Reduction of traffic by 15% (60,000 less vehicles)
- ▶ Average speed in zone increased from 13 km/h to 18 km/h
- ▶ 50-60% of car drivers moved to public transportation

Commercial Issues

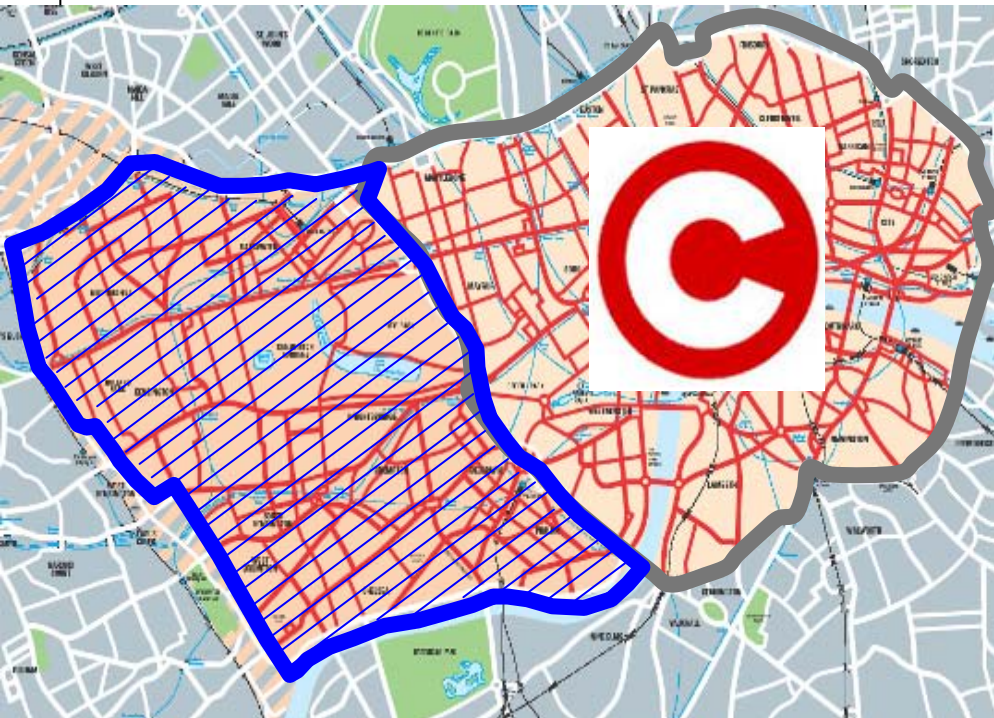
- ▶ annual operating costs £64 million
- ▶ £160 million revenues (£138 million for charges, £22 million for penalties) which are re-invested into the transportation system
- ▶ Transport for London: “congestion charging was contributing the equivalent of £50 million of net transport benefits to London’s economy per year”



LONDON 2007

The Success Continues With the Western Extension

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Siemens Launches "WEZ" In February 2007

- ▶ 850 high-accuracy license plate recognition cameras
- ▶ 1 million plates per day (evidential records encrypted)
- ▶ Innovative system architecture to reduce data traffic
- ▶ No CCTV connections required as in original scheme

Sweden STOCKHOLM & GOTHENBORG City Center Congestion Charge Launched in 2007

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Trial Operation

- ▶ Trial period from January 3rd to July 31, 2006
- ▶ 450,000 vehicles equipped with microwave tags
- ▶ 18 bi-directional payment portals (“cordon-based”)

Results

- ▶ Reduction of traffic by 20-25%
- ▶ Queue times down 30-50%
- ▶ Public voted in favor of keeping in permanently

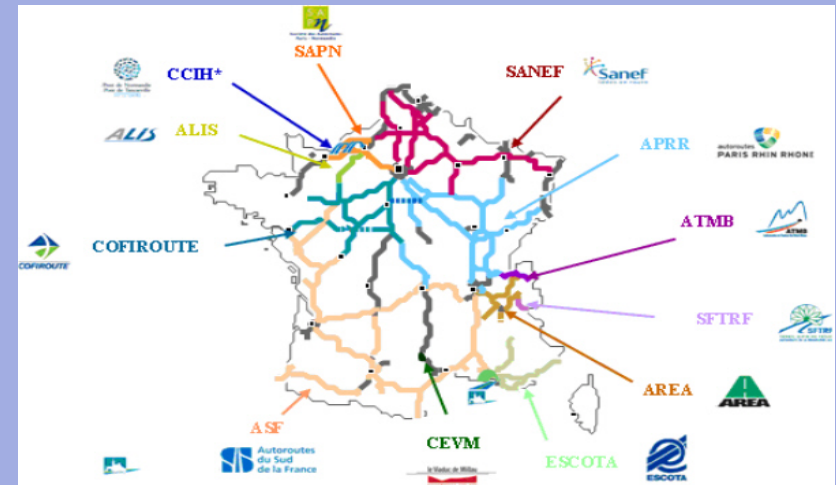
Consequences

- ▶ ANPR worked well, even in snow and bad weather
- ▶ The scheme was re-launched in August 2007
- ▶ ~ € 150 million revenues expected per year
- ▶ **Microwave tags and infrastructure taken down!**



2011 FRANCE Eurotoll Ecotaxe

- ▶ The Ministry of Ecology, Energy, Sustainable Development and the Sea delegates the implementation of the National HGV Tax (Heavy Goods Vehicle) to a private company within the framework of a partnership contract (PPP Model)
- ▶ The project is called “Ecotaxe” and is a distance based tax for vehicles over 3,5t on 10.000-15.000km of national roads.
- ▶ Approved toll service provider (SHT) under contract with Ecomouv (toll charger) are enabled to buy and use their own Front-end system (OBU & Proxy)
- ▶ The contract between state and the private company will cover finance, design, set up, maintenance and operation of the toll system. The contract is awarded to the consortium “Autostrade” and was signed by 20th of October 2011



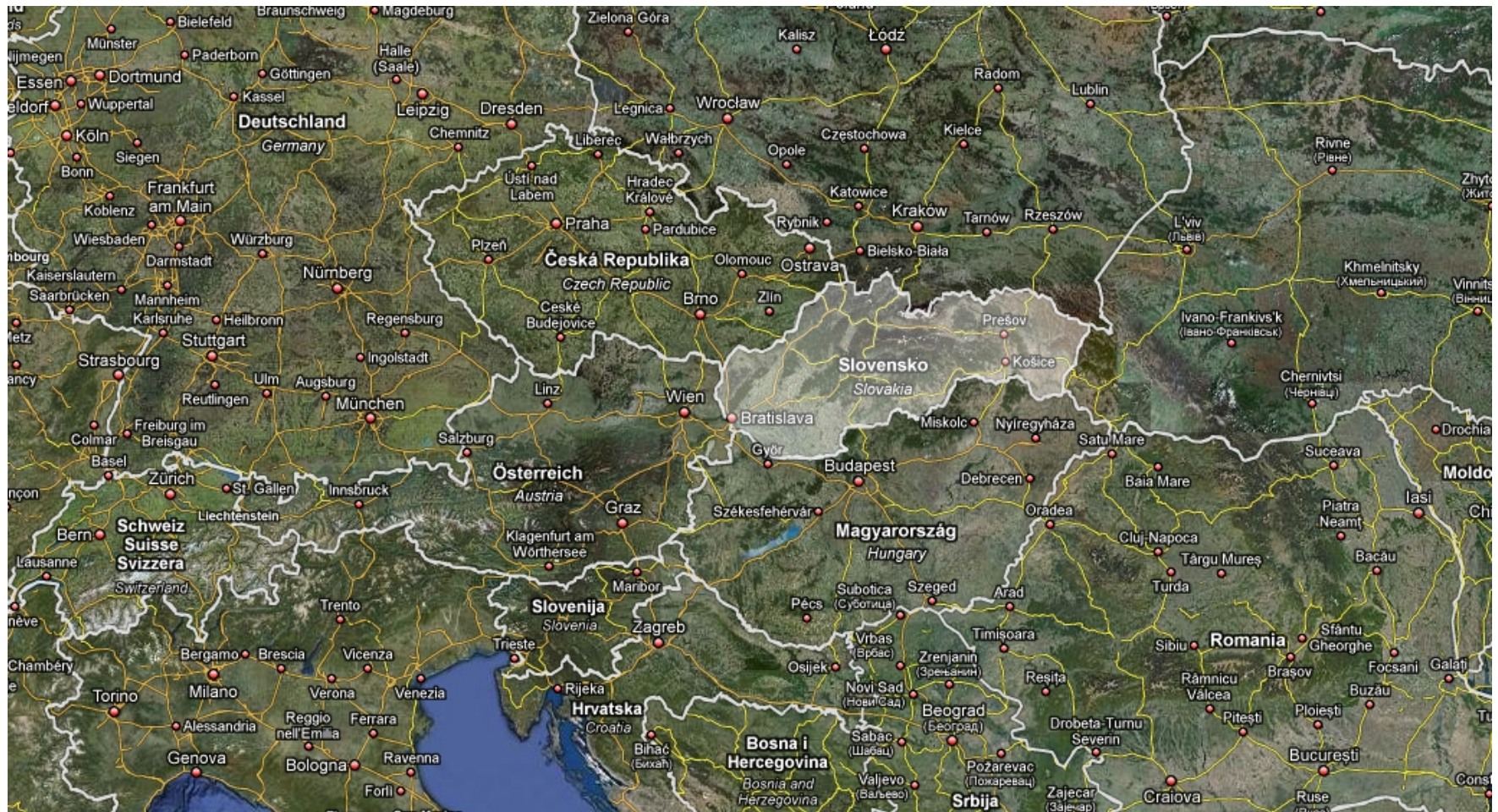
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Slovakia: Where to find?



Reasons for a toll system in Slovakia

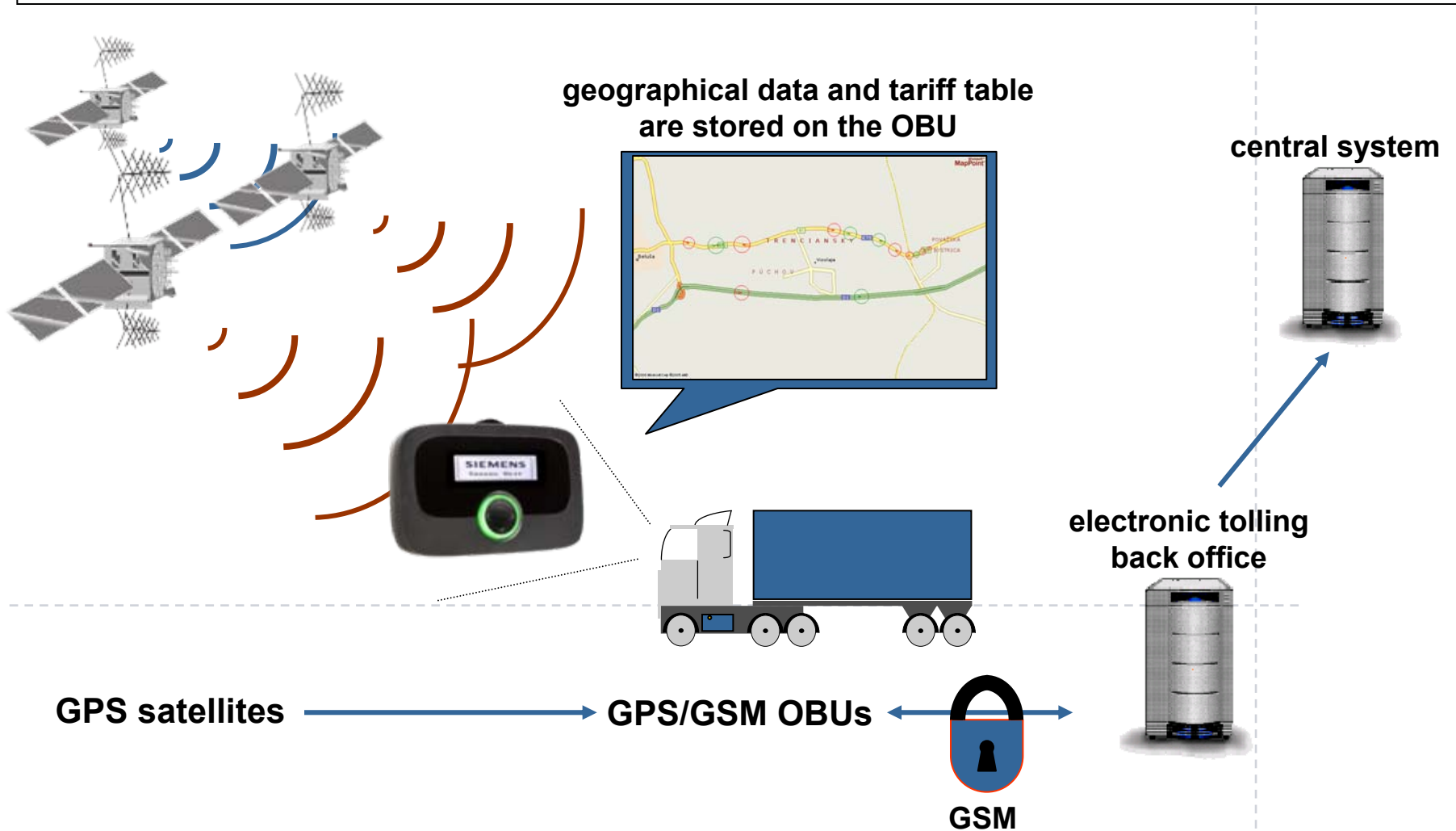
- New highways and 1st class roads were needed
- Slovakia is quite mountainous – construction very expensive
- Transiting trucks: No fuel tax, road tax or registration tax
- High Maintenance cost due to
 - Hot summers
 - Cold winters
 - High temperature differences between day- and night time.

Government decision: Additional Financing needed!

Why Choose a GPS Based Tolling System

- No need for tolling infrastructure
- No power supply lines for gantries needed
- Independent from national power grid
- No fiber optical network needed
- Low Maintenance cost on roadside infrastructure just for enforcement
- Theft prevention of the roadside infrastructure is kept to a minimum
- Easy upgrade and update of road segments and charge points
- Flexibility:
Pricing models depending on road type, vehicle categories, peak hours, off-peak hours, working day vs. weekend can be set up easily
- Investing into the future:
GPS will be the leading technology for tolling

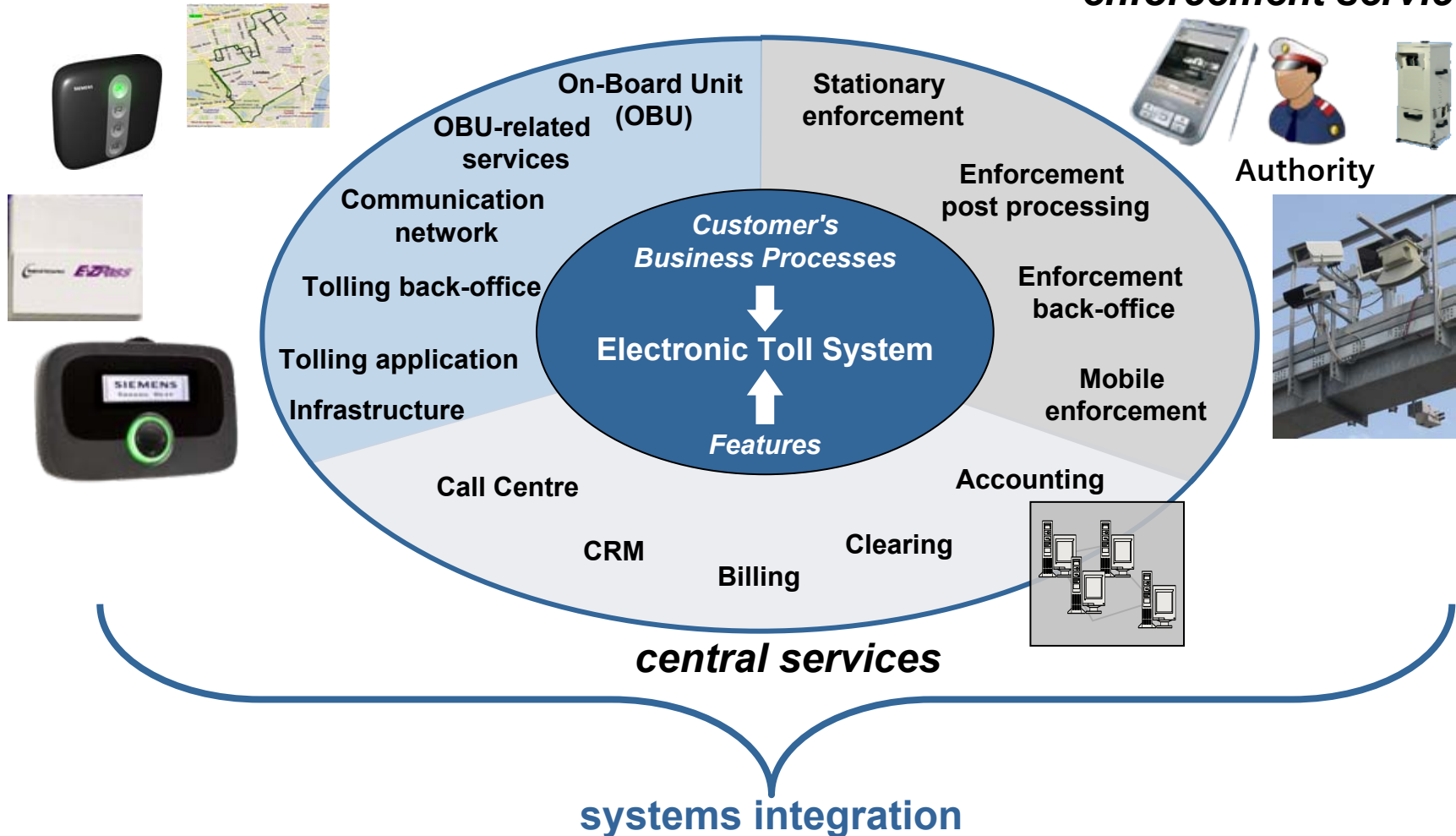
Sitraffic Sensus Unit – schematic operation



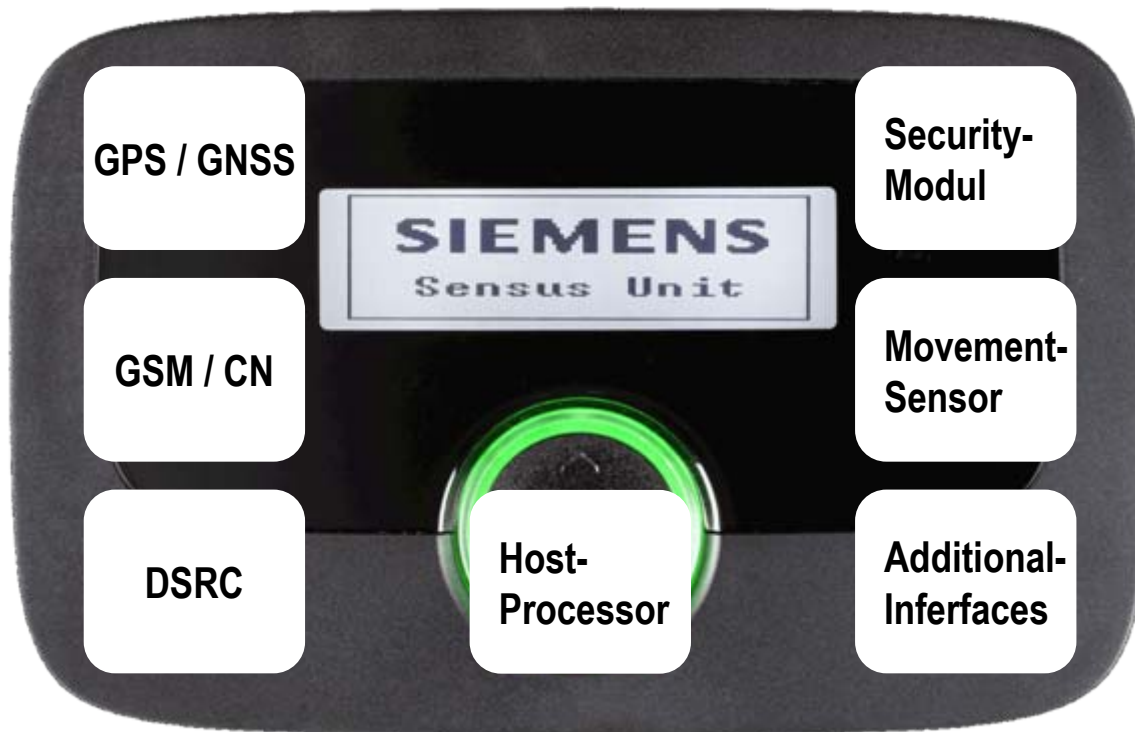
Basic tolling solution components

electronic toll recognition

enforcement services

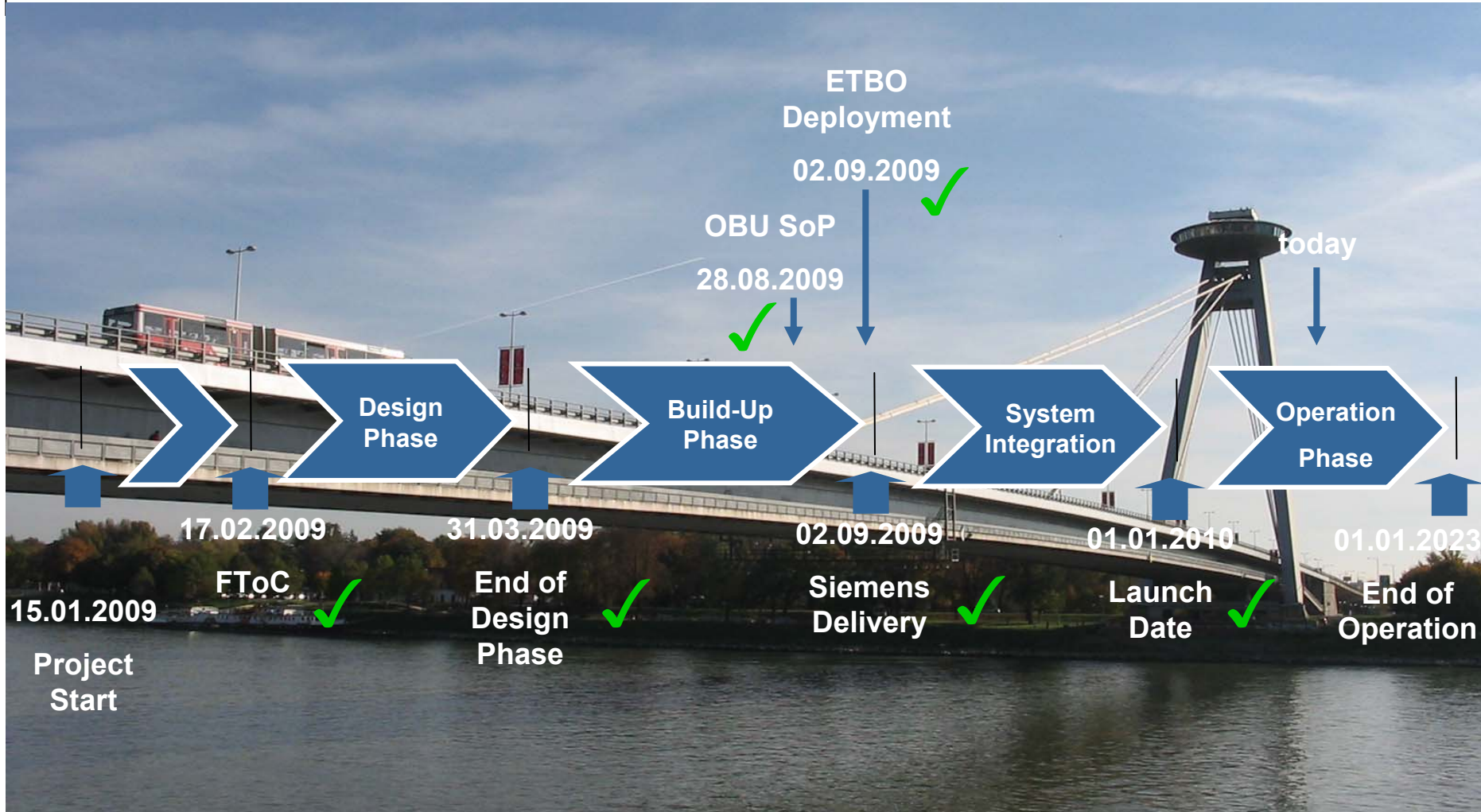


OBU Components of the Next Generation



- High sensitivity GPS / GNSS Module for position
- GSM / CN module for GPRS data communication
- DSRC Module compliant with TC 278
- Security-Module for encryption and signing of the data communication
- Movement-Sensor for anti tempering and self installation and last but not least
- Host processor for data processing in general.
- Additional interfaces as external antennas
- Graphics Display

Realization: Project Milestones



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Project: Electronic Tolling Slovakia

Nationwide Electronic GPS/GPRS Tolling Solution for Slovakia

- Siemens is **technology supplier** for the toll operator company **Skytoll**
- Skytoll planned, financed, delivered and operates the Truck Tolling Solution in Slovakia for 13 years starting in 2010
- Vehicles over 3,5t will be tolled on a road-network of **2370 km** (**570km** motorways and **1800 km** first class roads)
- **2.300** virtual charge stations on total road network, operating at **~7.000 lanes!**
- Siemens delivers **Electronic Tolling Software Application** and **250.000 On-Board Units** including all maintenance



Income from Tolling enables customer to build/maintain infrastructure

Project: Electronic Tolling Slovakia

- Toll-able vehicles: Trucks >3.5t, busses 9+ persons incl. driver
- 35.000 different trucks driving a day
- 378 Mill. toll transactions per year
- Tariff scheme: Depending on road type, vehicle category, number of axles and environmental class.
- GPRS update of all On Board Units performed successfully (DSRC Firmware, GSM Module, road network update – geo data)
- Project delivered in time, budget and quality (within 12 month)
On Board Unit Mandatory

Operations

90 POS (13 on boarder posts, gas stations and customer care centers)

POS handles all customer and OBU related issues

- Payment options: Pre pay and post pay are defined at the POS.
- Prepay:
 - Self installation and fixed installation possible
 - Minimum top up for pre pay: € 50
 - Warning level of pre pay account: €12
 - Surcharge scheme for late top up of pre pay account.
- Post payment:
 - Fixed installation obligatory at ~€110 for the installation
 - Bank guarantee depending on average mileage of the vehicle necessary.
 - Invoicing periode weekly, two weeks or monthly.

Enforcement

Violation cases are the following:

- Use of the tolled road network without payment of toll
- No OBU installed in the vehicle or tampered
- Wrong vehicle category set (trailer is connected and not set at the OBU)
- Non payment if caught by the enforcement patrol
- No registration form for an OBU and/or certificate confirming the current vehicle category.
- Fines vary between €160 - €1.300 Administrative Fees between €120 - €700

Figures for 2011

- 1.1 mio enforcement checks by mobile enforcement
- 44 mio enforcement check by fixed enforcement
- 2.700 cases detected.

Figures

Financials 2001

- Toll collection until 06/2011 = €75mio
- Financial June 2011 = €13.6mio
- Increase of 11% year on

Customer Care:

- 32.900 calls + 380.000 visitors of the web portal
- 424 cases were finally registered out of that
- 26 justified cases remained
- All cases settled within 5 days only.

Thank you for your attention!

SIEMENS

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**Traffic Solutions -
green light for mobility**