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Free Flow Tolling Systems based on GNSS:
Advantages, Experiences, Success Factors

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Traffic Gridlock?



Traffic Management

Infrastructure
Adaptions

Road Pricing

Who needs EFC systems?

Private Road Operators

- to get as much as possible income for the refinancing of their invest
 - to get as much as possible traffic at the highways (upper limit of tariffs)
 - provide services to increase acceptance


Public Authorities (Finance Ministries)

- to get more income as with flat rated vehicle taxes
- to generate income also from foreign vehicles

Public Authorities (Transport Ministries)

- to influence the driver behavior and
- to manage traffic flow

Which conclusions can be derived from that?

- ✓ Private investors **do not have access to any flat rated tax** neither from trucks nor from passenger cars
 - ✓ Private investors own just **small parts** of the total available road network
 - ✓ Due to that fact, private investors must **include passenger cars** in their list of vehicle classes liable to charge
 - ✓ Public authorities will focus more on **commercial traffic** and may limit the chargeable vehicle classes to heavy trucks
-  **Private investors** will have a high number of chargeable customers on a small network of roads while **public operators** will have a lower number of vehicles on a complex network of roads

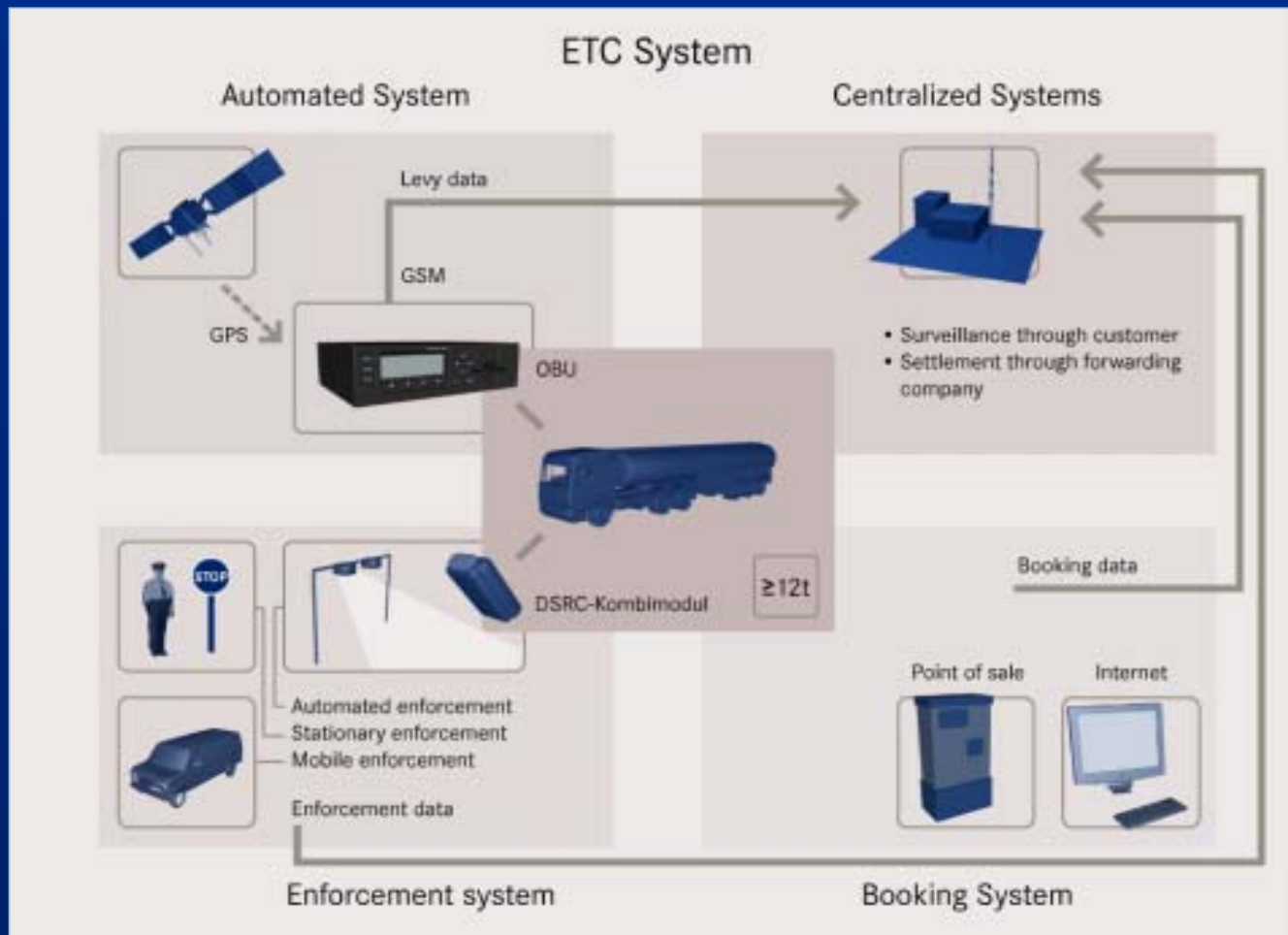
This conclusions results in some basic requirements for an EFC architecture

- Private investors need a **cost effective** vehicle unit and do not need much flexibility for traffic management, security services or chargeable network extension
- Public authorities need a **long term overall optimized concept** easily allowing **extensions** of road classes, the traffic management functions, using more complex tariffs and extensions of chargeable vehicle classes as well as large scale implementation of security services
- ↪ *private investors require features which **beacon** based EFC systems may provide*
- ↪ *public authorities will find that **autonomous** EFC systems will better serve their requirements especially in the long run*

Which new features will be provided by autonomous EFC systems?

- ✓ complete set of tariff models including **area pricing**
- ✓ **100% anonymity** in all payment means if required
- ✓ **fast** reaction time **to extend** the toll road network if vehicle using sensitive parallel roads to evade the payment
- ✓ **fast change** of the toll network if policy or traffic management goals require that
- ✓ **no** or very limited **road side equipment**
- ✓ **reduced costs** for the vehicle units if sensors, communication means (including short range communication) and computing power existing in the vehicles are **re-used** for EFC

Example: German Truck Tolling System



Example: Implementation of an autonomous EFC system

- Tariff model supports fair revenues as well as effective traffic management to reduce congestion
 - in the county: distance based area pricing
 - in urban areas: higher rate area pricing and highest in peak hours
 - on highways and national roads in rural areas: highest rate
 - on highways in urban areas: high at peak hours but lower than the area rate
 - Fast updating of the list of chargeable roads if users behavior does not support traffic management goals
- Easy installation of standard OBUs containing all sensors, communications as well as secure charging means
- Occasional users may buy retrofit OBUs at a kiosk and install them themselves
- No installation at any road
- Enforcement managed by spot checking using vehicles or temporary road side installations

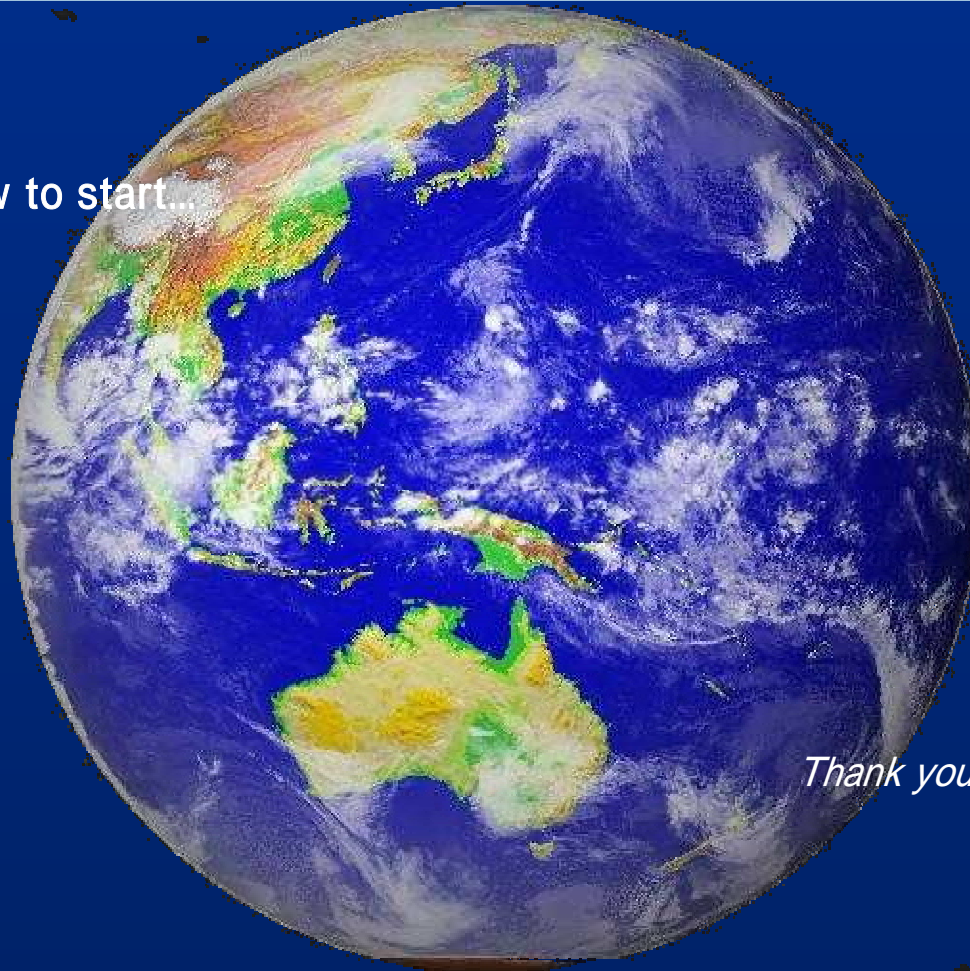
Few of many examples

Examples of advanced Features for an ETC System

- Tariff model includes:
 - several overlapping areas with increasing fees closer to the center of cities
 - fee depends also on the time of day and the day of week
 - fee depends also on class of roads with reverse differentiation in rural and urban areas
 - fee depends on vehicle classes
- Amount to pay is aggregated in the vehicle to keep full privacy
- Real time traffic information is gathered in the vehicles and reported to others using the enforcement inter-vehicle-communication system
- Inter vehicle hazard warning is implemented in large scale
- Hazardous goods transport may be strongly monitored
- Several sensible locations or transported goods may be managed using slot allocation
- Vehicle unit is pre-installed by the vehicle manufacturer and combined with the navigation system. Tariff structure is visible on the navigation map display

Which problem is left?

The decision how to start...



Thank you for your attention