Charging technology and cost effectiveness

GPS, GSM, DSRC, .... What to choose?

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Contents

- Which charging system is best?
- Which technology is optimal?
- How to arrive at a cost effective solution?
Recent heavy vehicle charging systems

since 1.1.01

since 1.1.04

since 1.1.05

Rapp Trans
Objectives

<table>
<thead>
<tr>
<th>Austria</th>
<th>Germany</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Finance extension and operation of motorway network</td>
<td>• Finance extension and operation of motorway network</td>
<td>• Charge the real costs, internalisation of external costs</td>
</tr>
<tr>
<td></td>
<td>• Charge the real costs, “the user pays” principle</td>
<td>• Finance new railway infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Promote the efficient use of HGV</td>
<td>• Limit HGV traffic growth</td>
</tr>
</tbody>
</table>
# Charging Principles

<table>
<thead>
<tr>
<th></th>
<th>Austria</th>
<th>Germany</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charged network</strong></td>
<td>Motorways &amp; some expressways</td>
<td>Motorways</td>
<td>all roads</td>
</tr>
<tr>
<td><strong>Charged vehicles</strong></td>
<td>HV &gt;3.5 tons</td>
<td>HGV &gt;12 tons</td>
<td>HGV &gt;3.5 tons</td>
</tr>
<tr>
<td><strong>Charge parameters</strong></td>
<td>• distance • axles</td>
<td>• distance • axles • emission class</td>
<td>• (all) distance • weight • emission class</td>
</tr>
<tr>
<td><strong>Legal nature</strong></td>
<td>Fee, subject to VAT</td>
<td>Tax, no VAT</td>
<td>Tax, no VAT</td>
</tr>
<tr>
<td><strong>Charging technology</strong></td>
<td>DSRC (mandatory OBU)</td>
<td>GPS/GSM or journey booking</td>
<td>Tacho/GPS/DSRC or manual recording</td>
</tr>
</tbody>
</table>
# Costs and revenues

<table>
<thead>
<tr>
<th></th>
<th>Austria</th>
<th>Germany</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment costs</strong></td>
<td>€ 370m</td>
<td>n.a.</td>
<td>€ 200m</td>
</tr>
<tr>
<td><strong>Operating costs</strong></td>
<td>€ 35m/a</td>
<td>€ 620m/a</td>
<td>€ 35m/a</td>
</tr>
<tr>
<td><strong>Personnel</strong></td>
<td>ASFINAG 150 Ops. 120 Enf.</td>
<td>750 Toll Collect 540 BAG (Enf.)</td>
<td>120 Swiss Customs</td>
</tr>
<tr>
<td><strong>Fee income</strong></td>
<td>€ 770m/a</td>
<td>€ 3 000m/a</td>
<td>€ 800m/a</td>
</tr>
<tr>
<td><strong>Costs in % of revenue (incl. capital costs)</strong></td>
<td>10 - 12 %</td>
<td>20-22 % (excl. enforcement)</td>
<td>6-8 %</td>
</tr>
</tbody>
</table>
Which system is optimal?

Criteria to assess a system

- **Will it be accepted?**
  - by the public, by interest groups
  - most systems fail in the political process

- **Does it meet the policy requirements?**
  - a question of charging concept

- **Is it cost effective?**
  - a question of total lifetime costs
Optimal system: Will be accepted

Policy must answer to an acceptable need

- **Clear prime objective**
  - financing
  - charging of real costs
  - demand management

- **Transparent use of revenue**
  - Earmarking increases acceptance

- “No new taxes”
  - New and better fee replaces other fees
Choosing the right charging concept  
(not the right technology)

• **Financing**  
  ■ Vignette (time)  
  ■ Toll (distance)

• **Charging of real costs**  
  ■ Infrastructure tolls  
  ■ Charging all distance

• **Demand management**  
  ■ Access charges  
  ■ Charging all distance
Optimal system: **Is cost effective**

Factors influencing cost effectiveness

**Policy**
- Tariff
- Network size

**Charging concept**
- Treatment of occasional users
- Enforcement concept
- Project delays
Influencing cost effectiveness: Tariff

High tariffs make for good cost effectiveness

Operational costs in % of revenue

<table>
<thead>
<tr>
<th>Country</th>
<th>6-8%</th>
<th>10-12%</th>
<th>20-22%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Germany</td>
<td></td>
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</tr>
</tbody>
</table>

Charge for a 40t lorry

- Switzerland: CH 2005
- Austria: CH 2005
- Germany: CH 2005

Operational costs in % of revenue:

- Switzerland: 6-8%
- Austria: 10-12%
- Germany: 20-22%

Influencing cost effectiveness: Tariff

High tariffs make for good cost effectiveness
Influencing cost effectiveness:

Treatment of occasional users

• Vienna convention
  ■ Non-equipped users must be admitted to the network
    UN Convention on Road Traffic (8 Nov 1968), Art. 3 §3

• European law
  ■ Equal treatment of all users (equipped and non-equipped)
  ■ No barriers to trade

Occasional user scheme

... is decisive for charge sophistication
  ■ severely limits tariff flexibility

... is a cost driver
  ■ requires manual access points on a 24/7 basis
Influencing cost effectiveness: Enforcement concept

- Nobody throws a coin into the basket if there is no barrier
- Charging technologies usually automate the throwing, not the barrier

In order of decreasing efficiency:
- Tamper proof on-board equipment
- Automated fixed enforcement stations
- Mobile patrols stopping offenders
- Patrols making random spot-checks
Influencing cost effectiveness: Project delays

- Lost revenue with a delayed system start is orders of magnitude higher than the investment

- Reasons for delay
  - technical problems: rare
  - back office operations: often
  - procurement challenged at court: always

- De-risking by
  - proper system design (occ. users & enforcement)
  - clear and specific requirements

- Procurement must be open regarding technology, but VERY specific regarding functional requirements
Charging concepts in a nutshell

- **Access charges**
  - Charge for duration of stay in zone
  - Charge for crossing border of zone

- **Tolls for special infrastructure**
  - Tolls on bridges, passes, tunnels, ferries
  - Tolls on motorway networks

- **Tolls on complex networks**
  - Motorways plus high-level roads
  - Defined map or fully signed

- **Charges on all distance**
  - All distance in an area (country)
  - No defined map
Charging technologies in a nutshell

- **Automatic number plate reading**
  - Camera to identify vehicle and location
  - Not for payment

- **Short range communication**
  - DSRC to identify charging location
  - DSRC for charging transaction

- **Positioning + wide-area communication**
  - GPS to identify charging location
  - Wide-area comms for charging transaction

- **Tachograph**
  - For measuring chargeable distance
  - Not for payment
Technologies for Access Charges

- **Paper permit (sticker, vignette)**
  - Parking tickets, motorway vignettes, etc.
  - Occasional users
    - requires dense network of points of sales
  - Enforcement
    - spot checking
  - Risk of delays
    - user acceptance is critical since finance aspect is obvious

- **Automatic number plate reading, ANPR**
  - London congestion charge, project for Swiss Vignette
  - Occasional users
    - many access points: kiosks, internet, call centre, ...
  - Enforcement
    - automated fixed stations
  - Risk of delays
    - user acceptance is critical
Technologies for Access Charges (2)

• **Short range communications, DSRC**
  Italian cities (limited access zones), Stockholm
  - **Occasional users**
    requires occasional user scheme (e.g. ANPR-based)
  - **Enforcement**
    mix of fixed and mobile enforcement
  - **Risk of delays**
    user acceptance is critical

• **Positioning + wide-area communication, GPS/GSM**
  (no example)
  - **Occasional users**
    requires occasional user scheme (e.g. ANPR-based)
  - **Enforcement**
    costly
  - **Risk of delays**
    technically potentially little problems; enforcement?
Technologies for Tolls

• **Short range communications, DSRC**
  European motorway toll concessions
    ▪ Occasional users
      manual lane or mandatory OBU
    ▪ **Enforcement**
      problematic in free flow
    ▪ **Risk of delays**
      time critical road-side installation

• **Positioning + wide-area communication, GPS/GSM**
  German LKW-Maut
    ▪ Occasional users
      manual booking scheme
    ▪ **Enforcement**
      high proportion of mobile patrols
    ▪ **Risk of delays**
      complex but manageable
Costs of DSRC and GPS/GSM compared

- **DSRC** is strong with **large number of users** (passenger cars) or **small network** (bridge, small country)
- **GPS/GSM** is strong with **low number of users** (e.g. lorries > 12t) or **large network** (large national motorway network)
  - costs of occasional user scheme neglected
  - additional revenue through value added services neglected
Technologies for Complex Network

- Significant problems with detour traffic
- Theoretical countermeasure: charge on motorways plus selective parts of the lower level roads
- Network is defined by a map (as part of the law)
- Widely seen as a migration scenario for GPS/GSM systems

- **Positioning + wide-area communication, GPS/GSM** envisaged to counteract toll avoidance

  - **Occasional users**
    - inconceivable manual booking scheme

  - **Enforcement**
    - needs to cover a huge network

  - **Risk of delays**
    - incomprehensible to occasional users; barrier to trade
Technologies for All Distance

- The 2nd solution to the avoidance problem
- Ideal measure to charge for external costs
- Leads to a better use of the road network
- No defined network, no map! → Measure distance

- Positioning + wide-area communication, GPS/GSM was planned in Holland as a national scheme

Severity: Occasional users
- No solution. (Tachograph does not show same distance)

Enforcement
- with mandatory OBU is good enforcement possible

Risk of delays
- Complex system
Technologies for All Distance (2)

- **Tachograph + wide-area communication**
  Swiss LSVA

  - **Occasional users**
    Tachograph on all heavy vehicles. For passenger cars??

  - **Enforcement**
    concept of strong OBU

  - **Risk of delays**
    complex but manageable
Summary: System concepts meeting policy requirements

<table>
<thead>
<tr>
<th>Policy</th>
<th>Technologies</th>
<th>Occasional User Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Charges</td>
<td>Paper/ANPR</td>
<td>Paper/ANPR</td>
</tr>
<tr>
<td>Tolls</td>
<td>DSRC</td>
<td>Manual DSRC</td>
</tr>
<tr>
<td>Complex Network</td>
<td>DSRC</td>
<td></td>
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<tr>
<td>All Distance</td>
<td>GPS/GSM</td>
<td>Tachograph</td>
</tr>
<tr>
<td>km</td>
<td>GPS/GSM</td>
<td>Tachograph</td>
</tr>
</tbody>
</table>

Note: The Complex Network is marked as not meeting policy requirements.
Which system is optimal

A good system ...

1. ... gets accepted → good policy work
2. ... meets the policy → right charge concept
3. ... is cost effective → right system concept

All this has little to do with technology

Why then is technology always discussed first?
GPS, GSM, DSRC, ...
What to choose?

• No need to bother
  - technology is not a value in itself
  - industry will offer competitive solutions
  technology should be decided by the market

• Important to decide on
  - charging concept
  - treatment of occasional users
  - enforcement concept
  function should be decided before going to market

Problems are not solved by “throwing them over the fence”
There is no single concept that fits everybody