Operational excellents: The example of the German HGV tolling system

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In the scope of a **public-private partnership project**, Toll Collect developed the **world's first GNSS based tolling system in 2005**.

Toll charges are based on:

- distance travelled, number of axles, emission class

The System

- serves as a free-flow system without disrupting traffic flow
- uses no roadside Infrastructure for charging
- shows a very high performance

The Collect system offers three different **log-on options**:

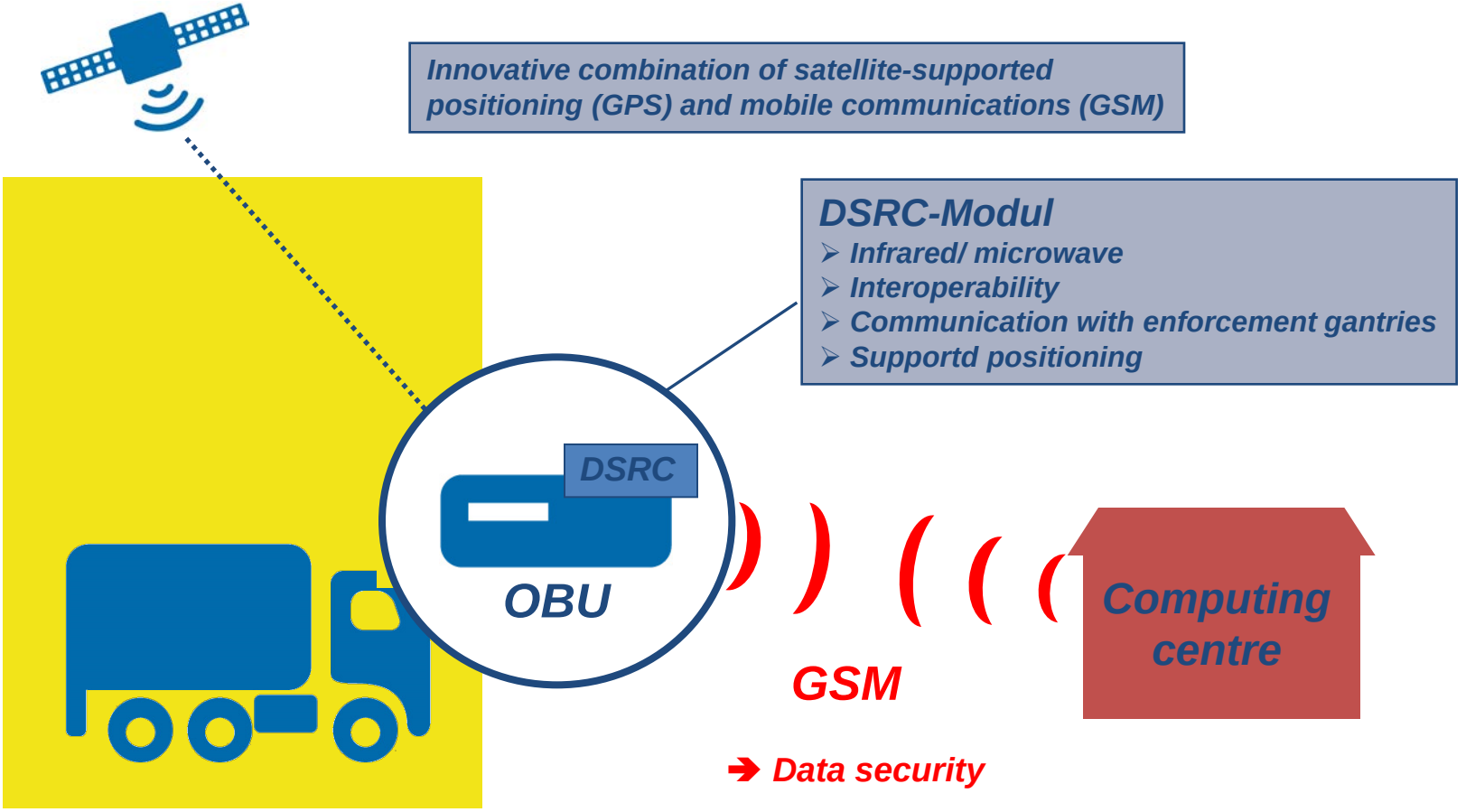
Automatic log-on with **On-Board Unit** (OBU)

- *>750.000 OBU installed (from 56 different countries)*
- *90% of toll revenues*

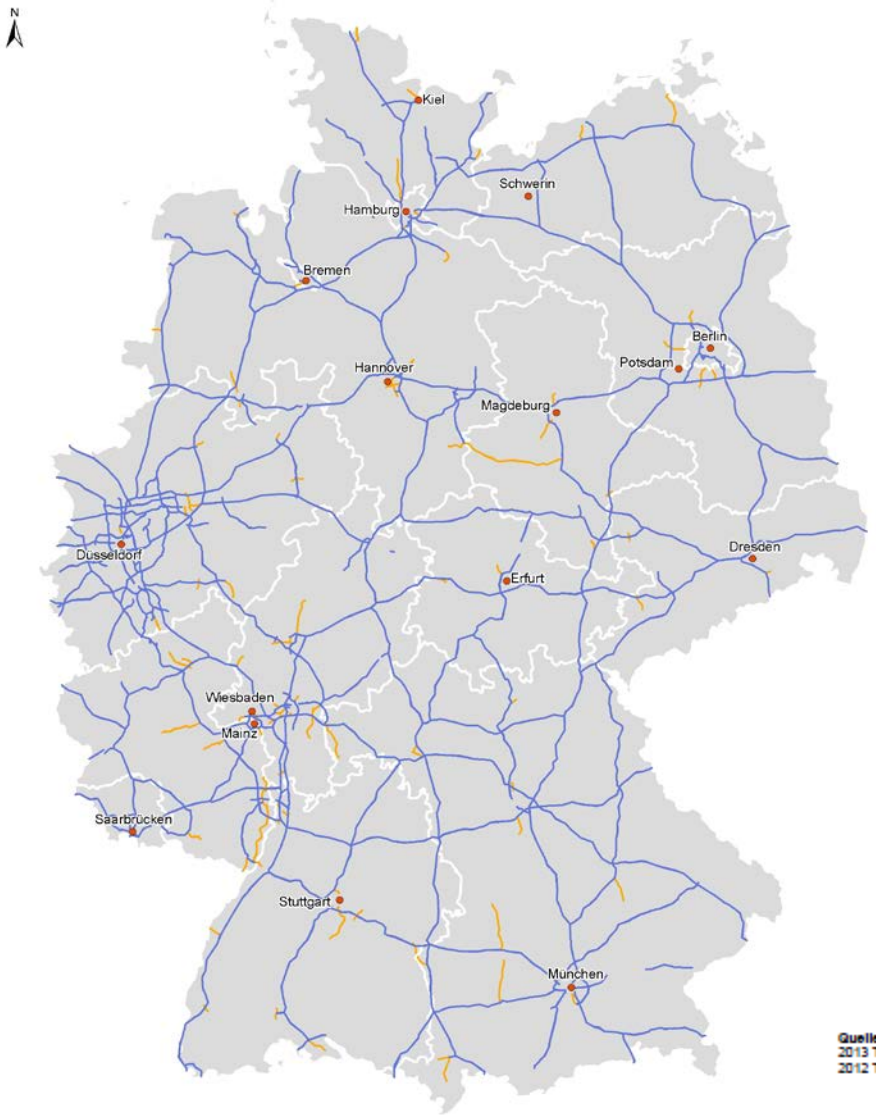
Manual log-on at a **toll station terminal**

Manual log-on via **Internet**

The German GNSS Toll System combines GPS and GSM



Tolled Road Network



Motorways

- *Start: January 2005*
- *12.800 km*
- *5.500 segments*
- *Smallest length: 160 m*

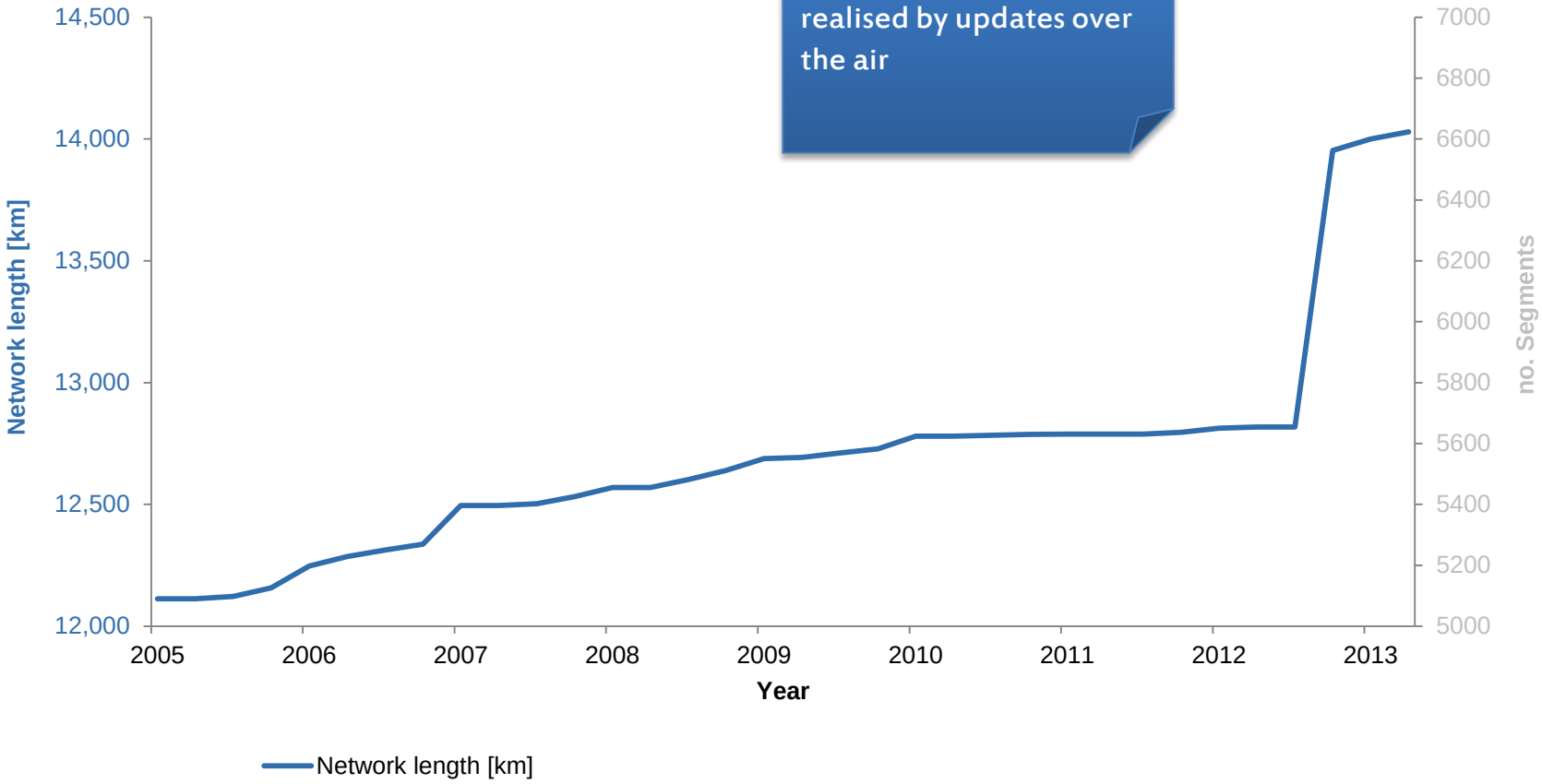
Secondary roads

- *Start: August 2012*
- *1.100 km*
- *1.100 segments*
- *Smallest length: 60 m*

Total toll revenues per year sum up to 4.5 billion € (5.9 billion US Dollar).

Tolled Road Network

Flexibility
Growing Network is realised by updates over the air

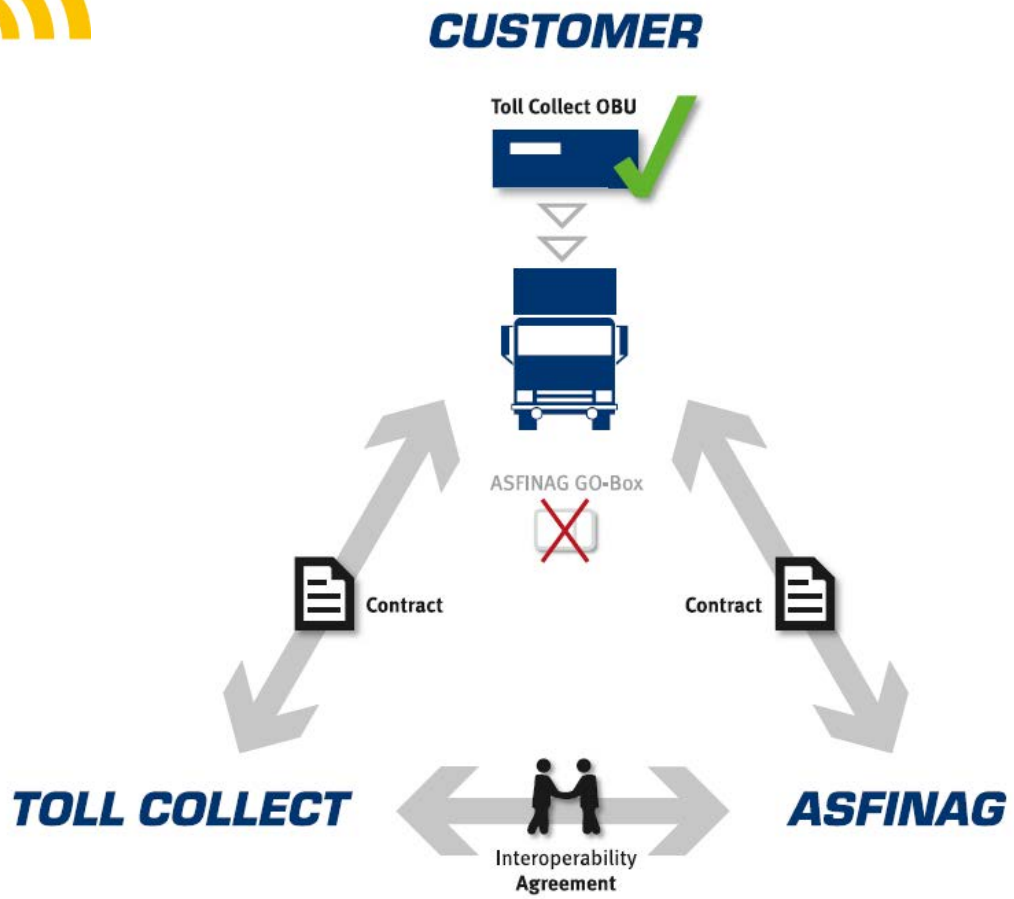


Technical sustainability: two countries – one device

TOLL2GO

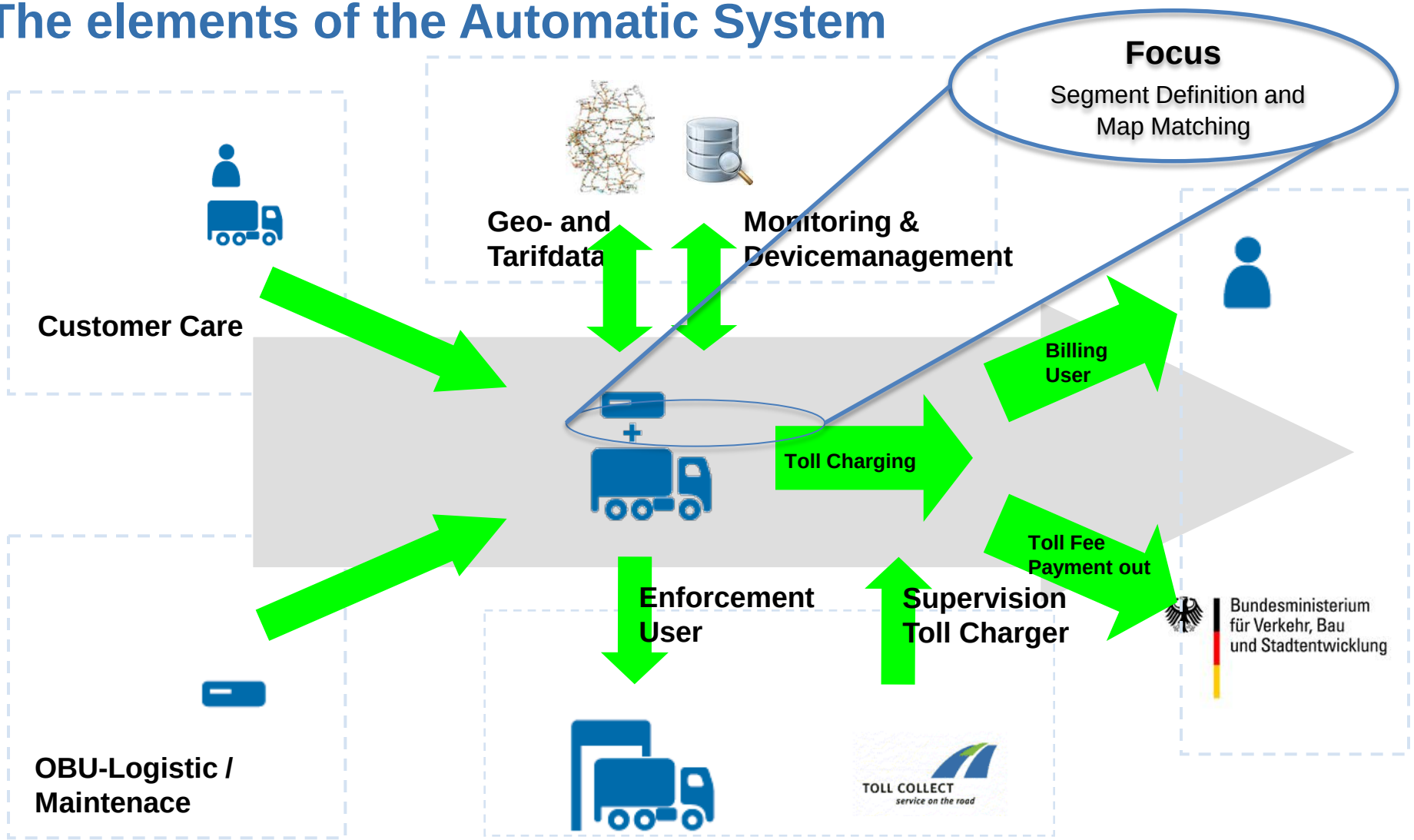
Interoperability – it works!

First joint GNSS / DSRC interoperability toll project ever:
> 66.000 in 2 years

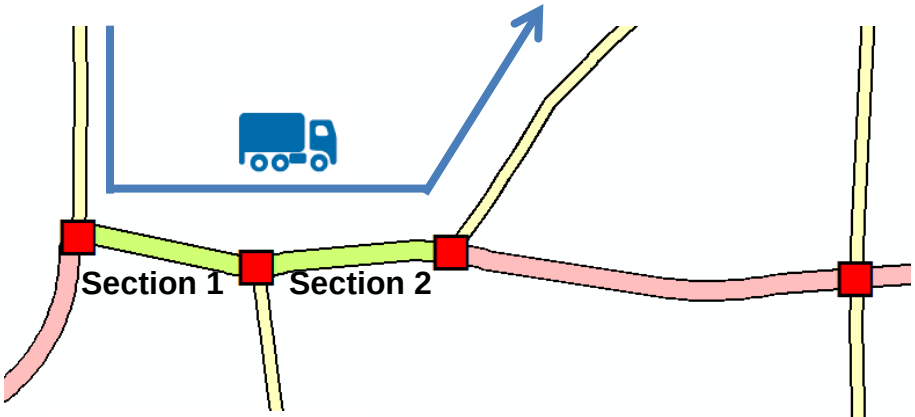


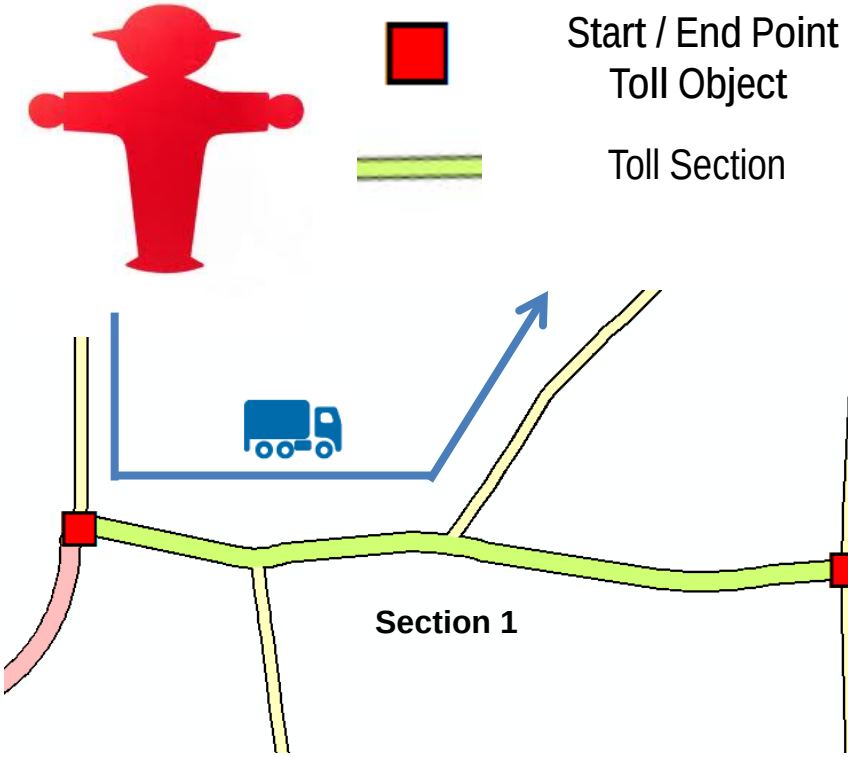
What are Toll Collect's key success factors for achieving these excellent results in system performance?

The elements of the Automatic System



Definition of section roads in Germany by law





- A section starts at a junction and always ends at the next junction
- Users pay only for the road segments they use
- Smallest segment sums up to 100 meters

The main operational challenges of Mapmatching

Continuous Changes

- Over 500 Changes per year
- Always optimizing operations

Detection of complex road characteristics

- Short sections
- Parallel roads (overcharging)

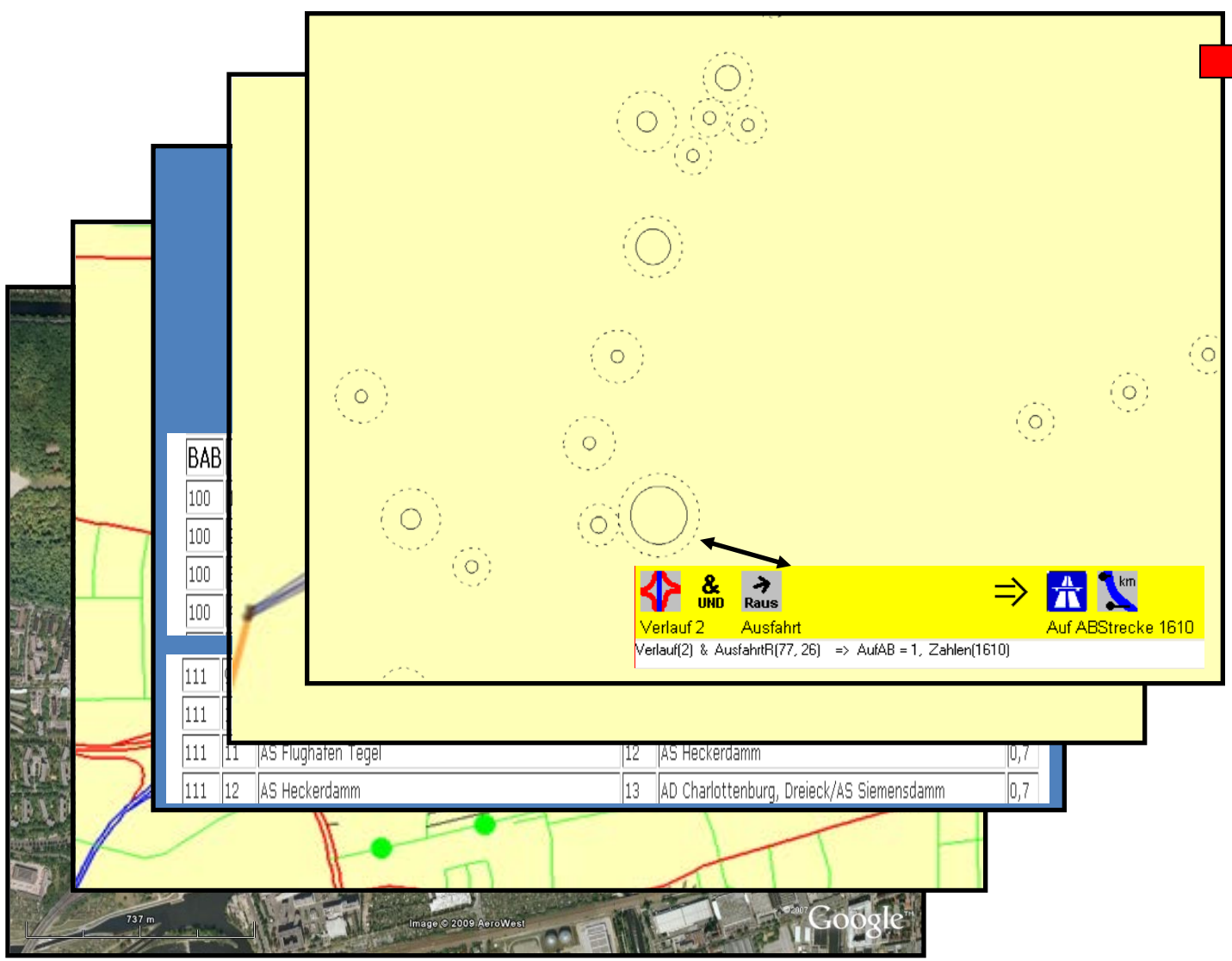
Traceability of Decision

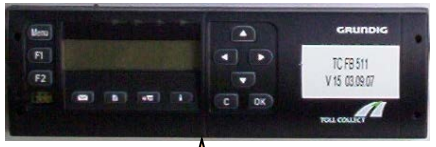
- Why does the algorithm decide to charge or not to charge?
- Minimises charging gaps

Robustness against changes

- When GPS Positions are not reliable
- Changes in Road Tracks determined by construction sites

Simplification to the essential





Remote Update

5. Auto System

4. Toll twork

3. Tarif

2. Map

1. Rea Vorld

Monitoring the End-to-End Process

- Toll Collect **permanently** monitors the whole End-to-End process of automatic toll collection based on incoming data

- The monitoring contains two core areas:
  - The map monitoring detect changes in road tracks
  - The OBU monitoring ensures functional correctness of the plattform

- The monitoring and improvement measures are **highly automated**
  - additional costs for these efforts are significantly smaller than the resulting benefits

Achieving operational excellence

Overall Detection Quota **99,9%**

Thank you !