

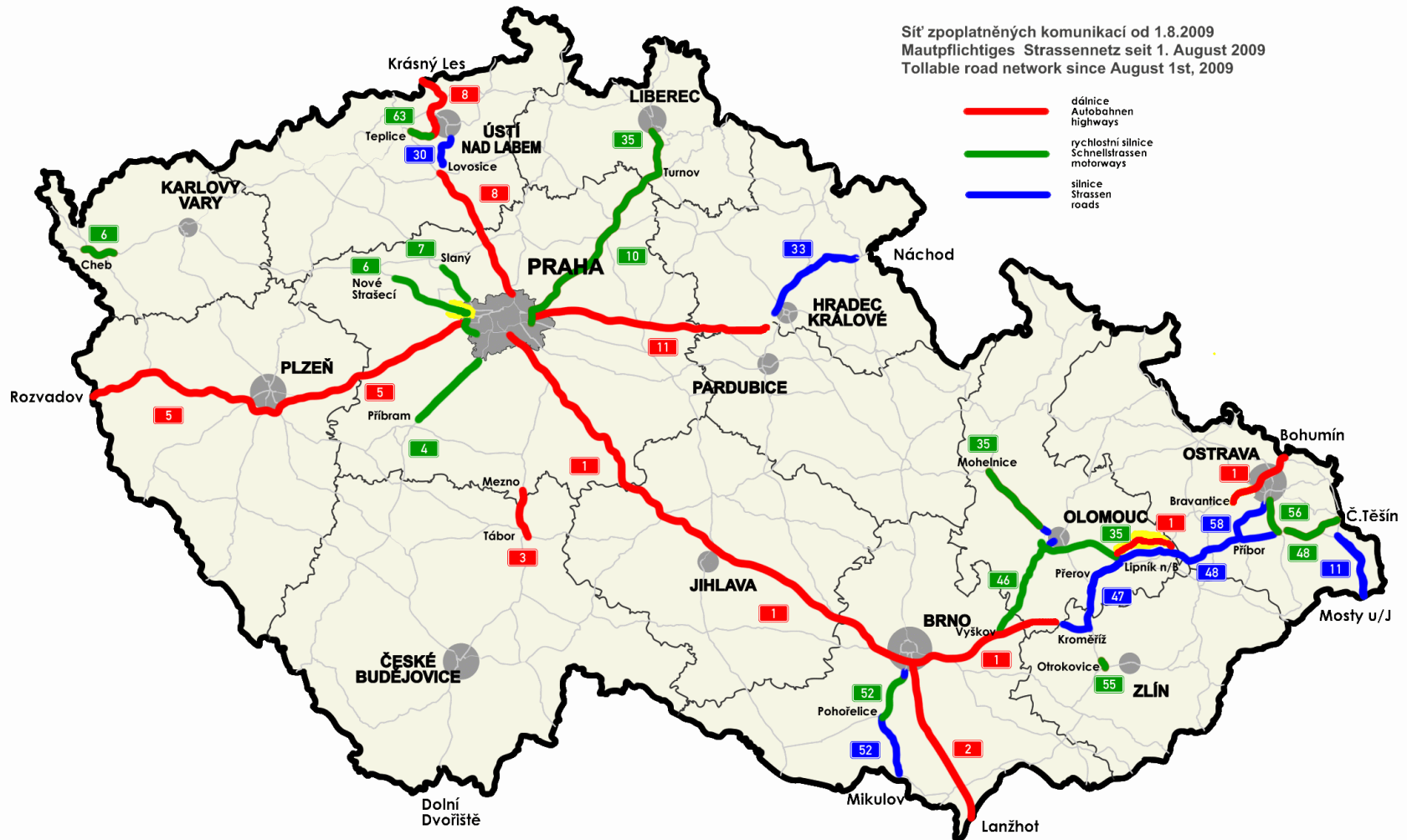
Hybrid satellite tolling solution by Kapsch

Prague - 20100628

Pavel Pazourek



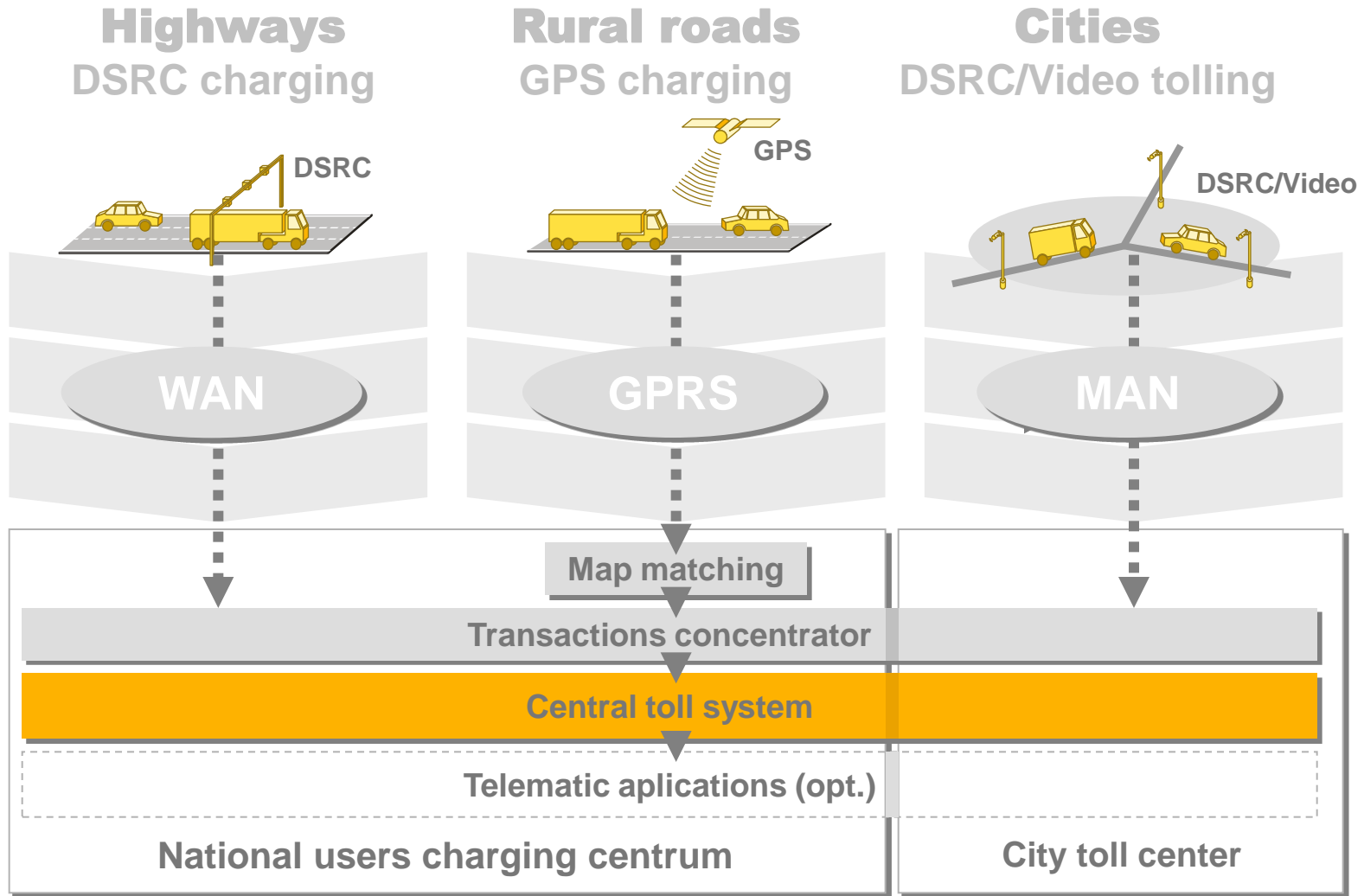
DSRC and GPS



Hybrid solution by Kapsch.

- **The pilot project of Hybrid Electronic Toll System on 1st class, 2nd class and 3rd class roads.**
- Kapsch, together with the Technical University of Prague and the Czech Ministry of Transport developed the concept of a hybrid toll system.
- This solution combines the existing microwave system on highways and motorways with satellite subsystem for rural road network.
- Kapsch implemented the pilot interface for a future satellite-based toll collection system to achieve the hybrid toll system, which combines existing Czech Electronic Toll System with satellite technology.
- The hybrid system was implemented in July 2008 and now runs a pilot project of the hybrid toll system with up to 10.000 testing cars (5.000 by Kapsch, 5.000 by 3rd party).
- **The final resolution about economical benefits of Hybrid toll system commercial operation is in jurisdiction of the Czech MoT.**

Kapsch and all roads solution.



Kapsch Area: Field of Application.

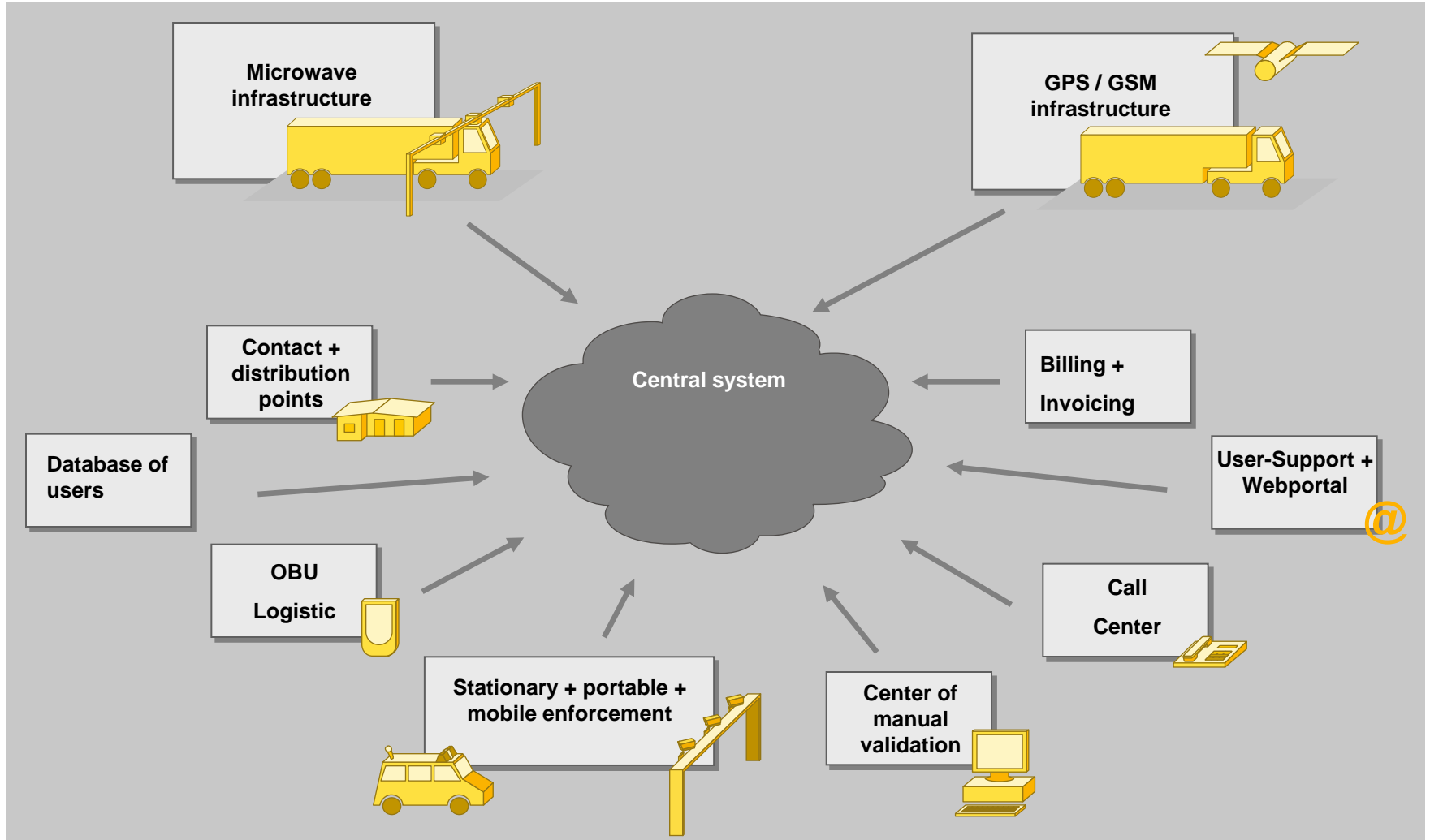
- Kapsch System Concept shows how a future national road pricing system could be implemented for all roads and all vehicles:
- DSRC for motorways and other main roads (current solution)
- GPS/GPRS for rural roads (Trial)
- DSRC/Video charging for urban areas or specific charging zones (next year)



GPS/DSRC on-board unit

- 3 system parts fully compatible: enable the system planners to choose the best technology for each specific use case

Czech Electronic Toll System is open.



Kapsch Area: Combined DSRC/GPS Tolling.

DSRC

- Low-cost onboard unit (easy installation)
- Little communications cost
- Very reliable and accurate

GPS / GPRS, GSM

- Flexible system (e.g. adding toll roads, introducing toll zones)
- Little road side equipment needed
- Basis for add-on telematics applications

Combined DSRC/GNSS Solution

Kapsch Area

- Offers DSRC system operators a migration path into the GPS world
- Combines the benefits of both technologies

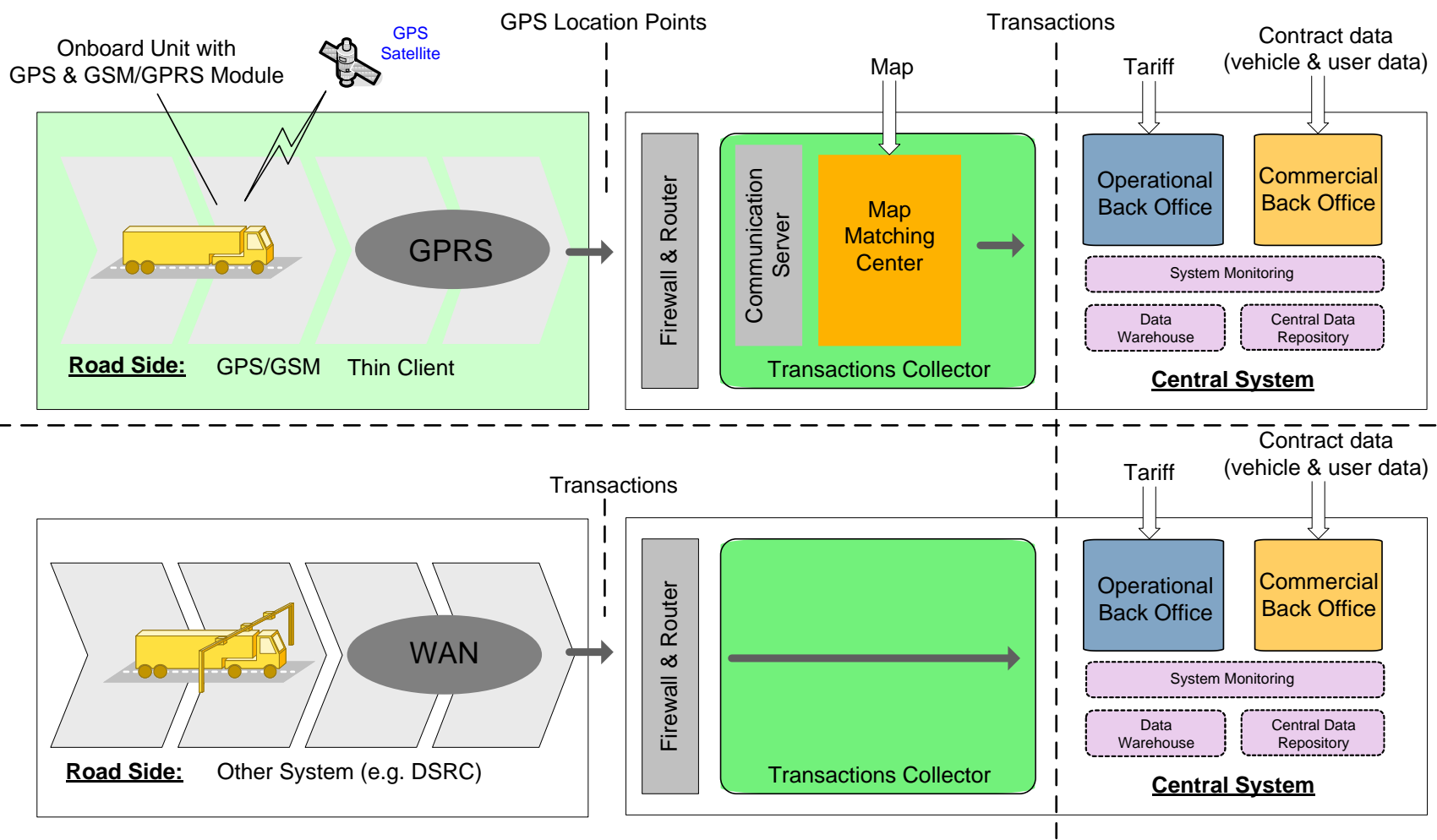
Kapsch Area / OBU.

The OBU delivers the basis for toll transactions:

- Receiving & dynamic recording of GPS positions
- Storage, encryption & packing of GPS positions
- Dynamic data transfer (configurable; dependent on application) to the central system over mobile network (VPN tunnel)
- Holding and providing vehicle specific & system specific data
- OBU behaviour is controlled over configurable parameters
- Parameters and software updates via the air interface
- Different operational modes / personalisation
- Mounting at the windscreen (like PREMID)



Czech Kapsch Area Pilot / System Overview.



How the Kapsch Area works?

Kapsch Area / Step 1

- OBU collects positions
- Filters controlling the storage of positions (speed, time, direction)
- OBU closes the package
- OBU tells the Communication Server that data is available
- Communication Server decides to take the data or not
- Data is secured and transferred from the OBU via GPRS (fallback GSM) to the Communication Server
- The Communication Server decrypts the data and decides to which Input / Output server (IOServer) the Data will be send
- The IOserver makes pre-processing of data and sets priorities (prepay, special vehicles)
- Handover to the Map-Matching

Kapsch Area / Step 2

- Map-Matcher matches the positions to segments & detects anomalies
- Filtering of impossible positions and closing of gaps
- Taking road relations into account (e.g. one way streets)
- Identification of the passed toll segments / toll zones
- Multiple map matching Engines
 - large area can be divided into several parts , which can be covered from different Map Matching Engines. For improvement of matching performance, the number of Map Matching Engines can be started in parallel for specific regions (near cities)
 - The number of running Map Matching Engines is not limited
 - The dimension of the assigned map region is not limited

Kapsch Area / Step 3

- Segment data or distance is send to Central System for rating
 - Segment based tolling & km based tolling
 - Definition of:
 - Areas
 - Streets
 - Roadclasses
 - Directions
 - Time
 - Emission Class
 - Axle class
 - Vehicle class
 -

Applications and pilot results.

Kapsch Area / Applications – Vehicle Tracking.

Kapsch Vehicle Tracking - Windows Internet Explorer
 https://area.kapsch.net/Europe/default.aspx#

Verfolgung

Zeige Daten vom 18.02.2008
 von 00:00 bis 23:55
 Aktualisieren

Letzte Position anzeigen
 GPS Positionen anzeigen
 Track anzeigen

130545747/3/10747906
 130545752/3/10747906
 130545753/3/10747906
 130545767/3/10747906
 130545777/3/10747906
 130545778/3/10747906
 130545785/3/10747906
 130545801/3/10747906
 130545804/3/10747906
 130545826/3/10747906
 130545827/3/10747906
 130545829/3/10747906
 130545832/3/10747906
 130545837/3/10747906
 137101315/3/7618561

OBU: 130545747
 Hersteller: 3
 Anbieter: 10747906
 Datum: 18.02.2008 09:23:12

Zu überwachende OBU
 130545747/3/10747906
 Track aktualisieren

Automatisch aktualisieren (30 Sekunden)

Segment- / Stationsdetails

vehicle tracking

Aktualisieren Beenden Info

Sie sind angemeldet als GPSLWEB1Demo | Logout

Fertig Internet 100%

Kapsch Area / Applications – Trip Board.

Overview

Trip

Show trip for vehicle
130545767/3/1074790

Show data on 18.02.2008
from 00:00 to 12:10

Show Trip

Segment/Station	Passage Time	Amount to pay	Amount paid
10-40002900991	18.02.2008 07:22:00	...	...
10-40000194753	18.02.2008 07:22:48	...	...
10-40000194751	18.02.2008 07:23:08	...	...
10-40000978067	18.02.2008 07:23:21	...	...
10-40000978067	18.02.2008 07:23:21	...	...
10-40000194764	18.02.2008 07:23:39	...	...
10-40000194574	18.02.2008 07:23:50	...	...
10-40000194575	18.02.2008 07:23:56	...	...

Statistics

Cost
Summary: No information available

Trip Time: 0d 0h 13m

Segment- / Stationdetails

18.02.2008 06:22:00

18.02.2008 06:35:57

110 55 0 110 Kilometer

Reload Out About

You are logged in as KAPSCHgrfnerer | Logout

Lokales Intranet 100%

Kapsch Area / Applications – Fleet Monitor.

The screenshot displays the Kapsch Flottenmonitor web application in a Windows Internet Explorer browser window. The browser's address bar shows the URL `https://area.kapsch.net/stw/default.aspx`. The application interface includes the Kapsch logo in the top right corner and a sidebar on the left with the following sections:

- Übersicht** (Overview)
- Flotten Monitor** (Fleet Monitor)
- Fahrzeuge** (Vehicles): A scrollable list of vehicle IDs: 02, 11, 12, 13, 14, 16, 18, 19, 21, 23, 24, 25, 26, 27, 29, 30, 35, 36.
- Legende** (Legend)

Below the vehicle list, there are fields for vehicle details: Name, OBU, Geschw. (Speed), Datum (Date), Richtung (Direction), Breite (Latitude), and Länge (Longitude). The main map area shows a street map of Kleinenzfurt, Austria, with numerous yellow circular markers representing vehicle locations. Each marker contains a number corresponding to the vehicle ID in the list. The map includes a scale bar (0 to 1,440 meters) and navigation controls (zoom in, zoom out, pan, and a compass). At the bottom of the application, there are buttons for 'Aktualisieren' (Refresh), 'Beenden' (End), and 'Info', along with a user status indicator: 'Sie sind angemeldet als GPSLWEB1STW | Logout'. The browser's status bar at the very bottom shows 'Fertig' (Done) and 'Internet'.

First pilot results.

Figures from the tests in Czech Republic:

- Average street segment length is 200 meters
- On Highway average street segment is 350 meters which is matched with 4-5 GPS positions.
- Average time from receiving GPS position in OBU and match to street segment is 10 minutes (including sending the data from OBU to MapMatcher)
- In best case the time from receiving GPS position in OBU and match to street segment is below 1 minute (including sending the data from OBU to MapMatcher)

Kapsch Area / Summary.

- Covers all streets (highway, rural, city)
- Cheap OBU
- Handling of frequent and non frequent users
- Handling of prepay and postpay users
- Easy adaptation of tolled segments
- Flexible rating
- Application friendly
- Adaptable Central System
- Less road side equipment

Status of the pilot project in CZ (1)

Status

- System prepared for 10.000 concurrent GNSS OBUs
- 5.000 Hybrid OBUs from Kapsch (thin client)
- 5.000 Hybrid OBUs from 3rd party (thin or thick client)
- Map covers all roads in CZ (not only tolled network)

- 1.100 Hybrid OBUs at Telefonica O2
- 3.550 Hybrid OBUs at the Czech Post
- 150 Hybrid OBUs at Kapsch

- Next 5.000 Hybrid OBUS from the 3rd party – tender in process

Status of the pilot project in CZ (2)

Preliminary results

- Update of 1.000 selected OBUs (TO2) within 24 hours
- Matching result >99,75%
- No problem with coated windshields
- Time from data entry to matching result <40 seconds (until end of August 2009)
- Personalisation with virtual and real licence plates

typical figures from one calendar week, year 2009		
Number of used OBU's	4.423	
Number of stored GPS positions	23.132.157	
Number of all matched segments	8.607.230	
Length of all matched segments	1.324.512	km
Average length of all matched segments	0,15	km
Matched performance	99,79%	

Thank You!

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