

JuztDrive

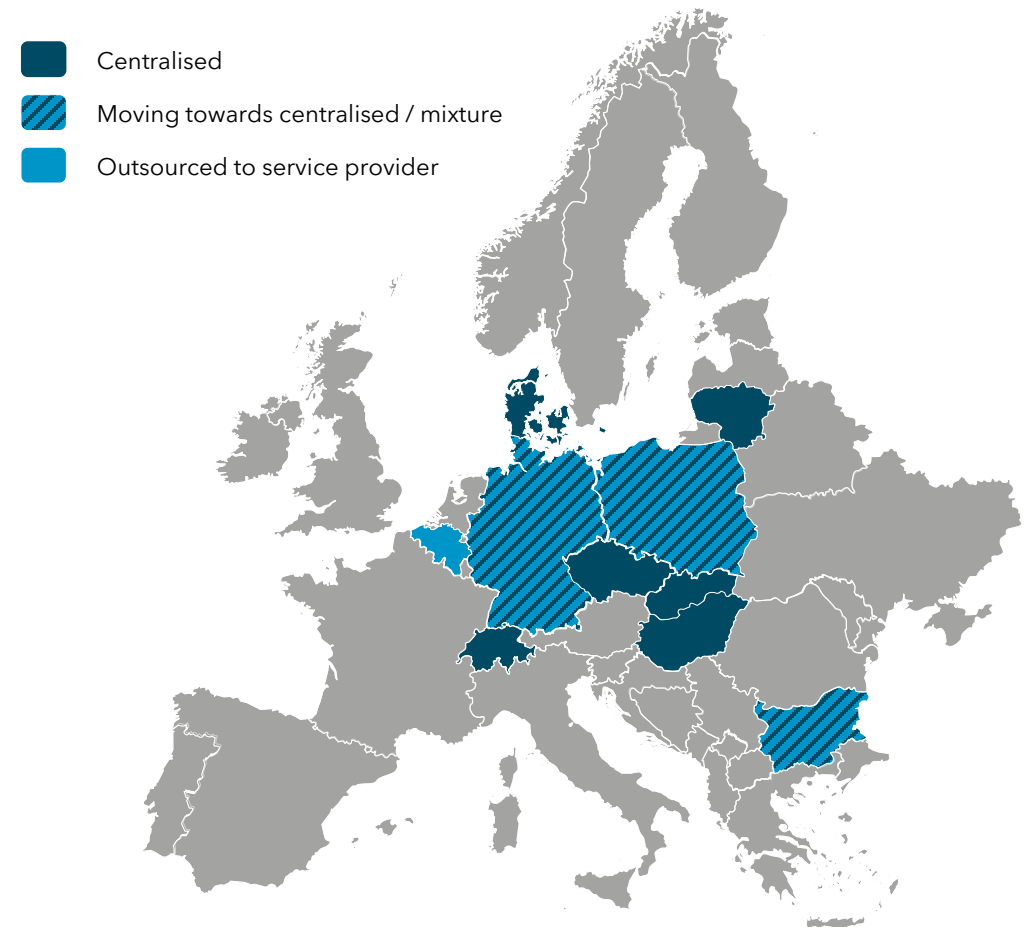
**Road user charging
proof of concept
(RUC PoC)**

14.10 Introduction to the JuztDrive RUC PoC

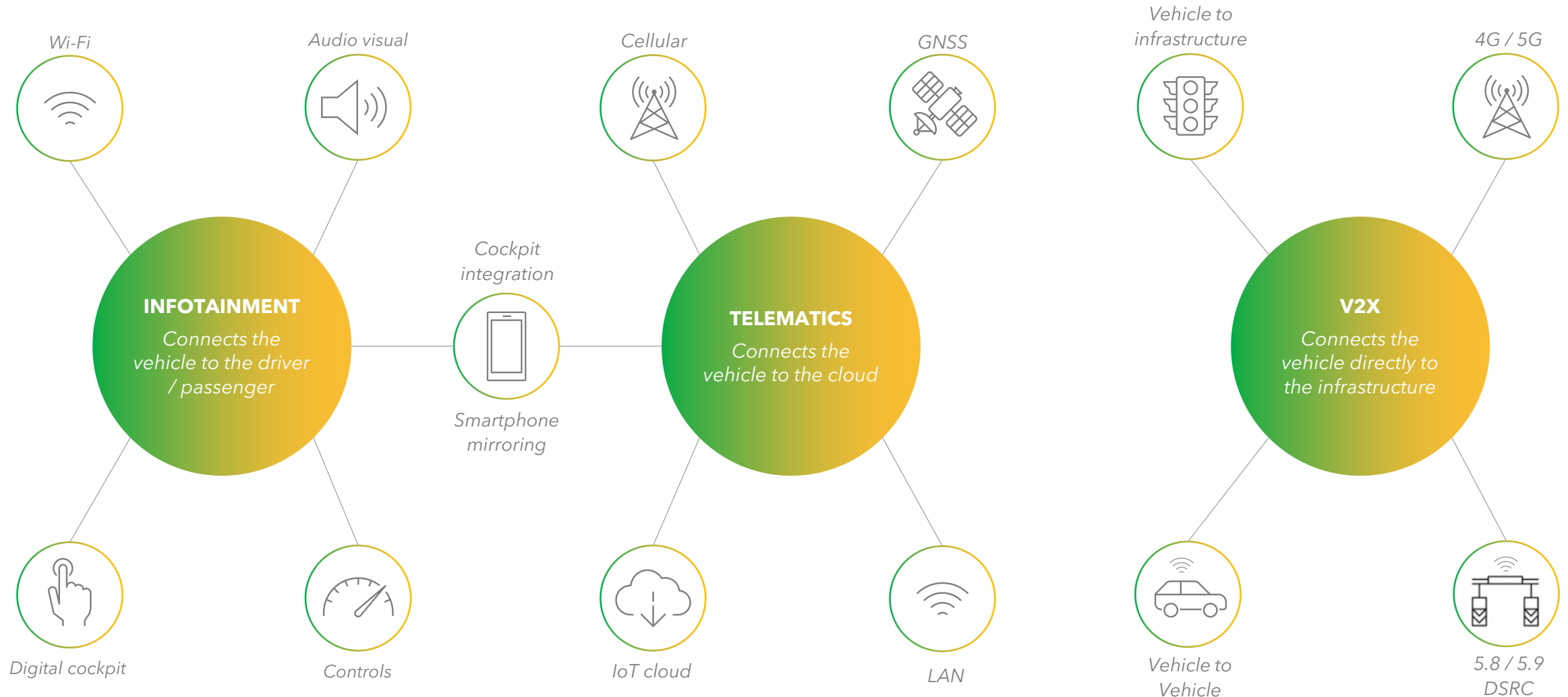
Most countries either have or are moving towards a centralised (thin client) trip rating model

- > Almost **all new GNSS domains are expected to implement a centralised model** (Denmark, Lithuania, the Netherlands etc.)
- > Germany - the most important GNSS domain - is in the process of moving away from an outsourced model and towards a centralised model
- > Czech republic is operating a centralised model and Slovakia has opened recently tender for a centralised model
- > Belgium (Viapass) will continue to outsource matching and rating until 2027, after which we expect to see the implementation of a centralised system
- > A centralised matching and rating engine ensures common outcomes and avoids the discrepancies that could arise from different providers

Centralised vs outsourced map matching / rating



Vehicle connectivity can be defined in multiple ways – however it is the telematics connectivity which can deliver RUC in future



Our approach to this PoC was defined by six clear principles

1 The solution should be as **low cost and efficient** to build, deploy and operate as possible

2 The solution should be **flexible** to meet the changing needs of the charging authority

3 The solution must deliver the **highest possible KPIs**

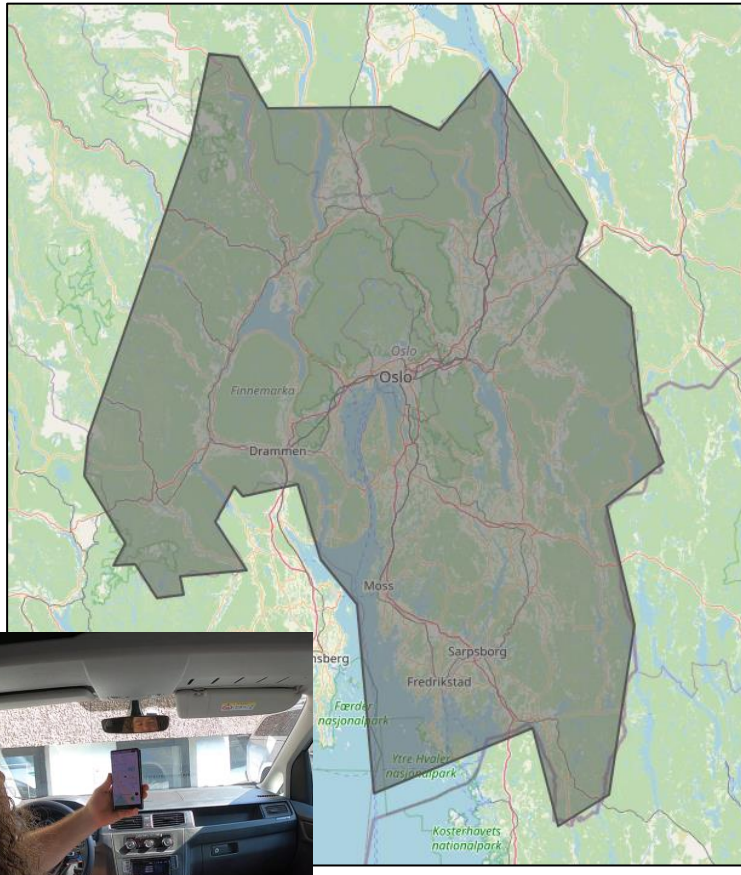
JuztDrive

4 The solution should **complement and not conflict** with existing and neighbouring solutions

5 The solution should be **acceptable, affordable and easy to access** for the end user and help to mitigate any potential resistance

6 The solution must ensure complete **transparency, integrity and security** of user data

The JuztDrive PoC began in June 2022 and has focused on vehicles in and around Oslo



- > Hardware agnostic android application for smartphones and tablets
- > Deployed and tested throughout the greater Oslo area
- > Mixture of real world and simulated vehicles over a period of 3 / 4 months
- > Variable road user charges based on driven distance according to vehicle and road classification
- > Account creation and user consent within the app
- > GNSS location and associated data provided by the device

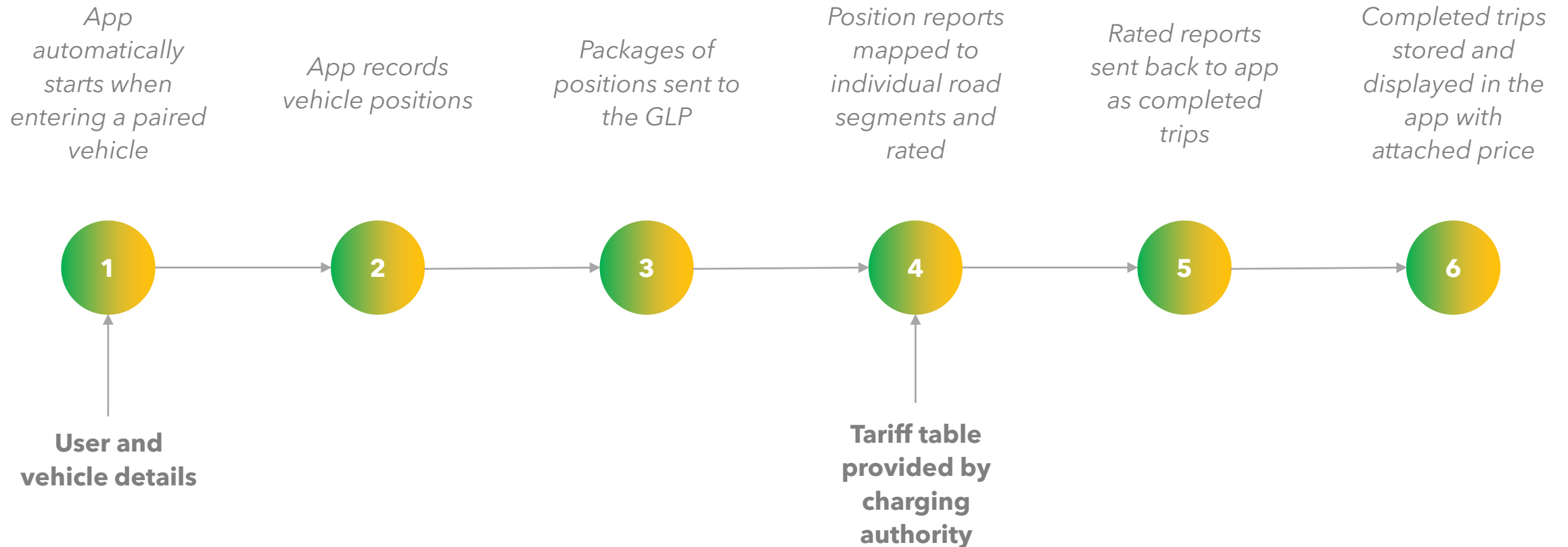
The rating table was calculated by TØI to reflect existing fuel tax rates and environmental costs

- > TØI calculated reasonable kilometre charges based on estimated external vehicle costs, such as CO2, local pollution, noise, accidents, congestion and road wear
- > These prices were calculated for four vehicle classes separately (zero-emission, hybrid, gasoline + Diesel)
- > Geographic criteria were urban vs. non-urban and road classification
- > Time criteria were weekends vs weekdays and rush-hour times (only in urban areas)
- > Special policies were applied to the E18 on general price and direction-based (city-in vs. outbound), to demonstrate system capabilities

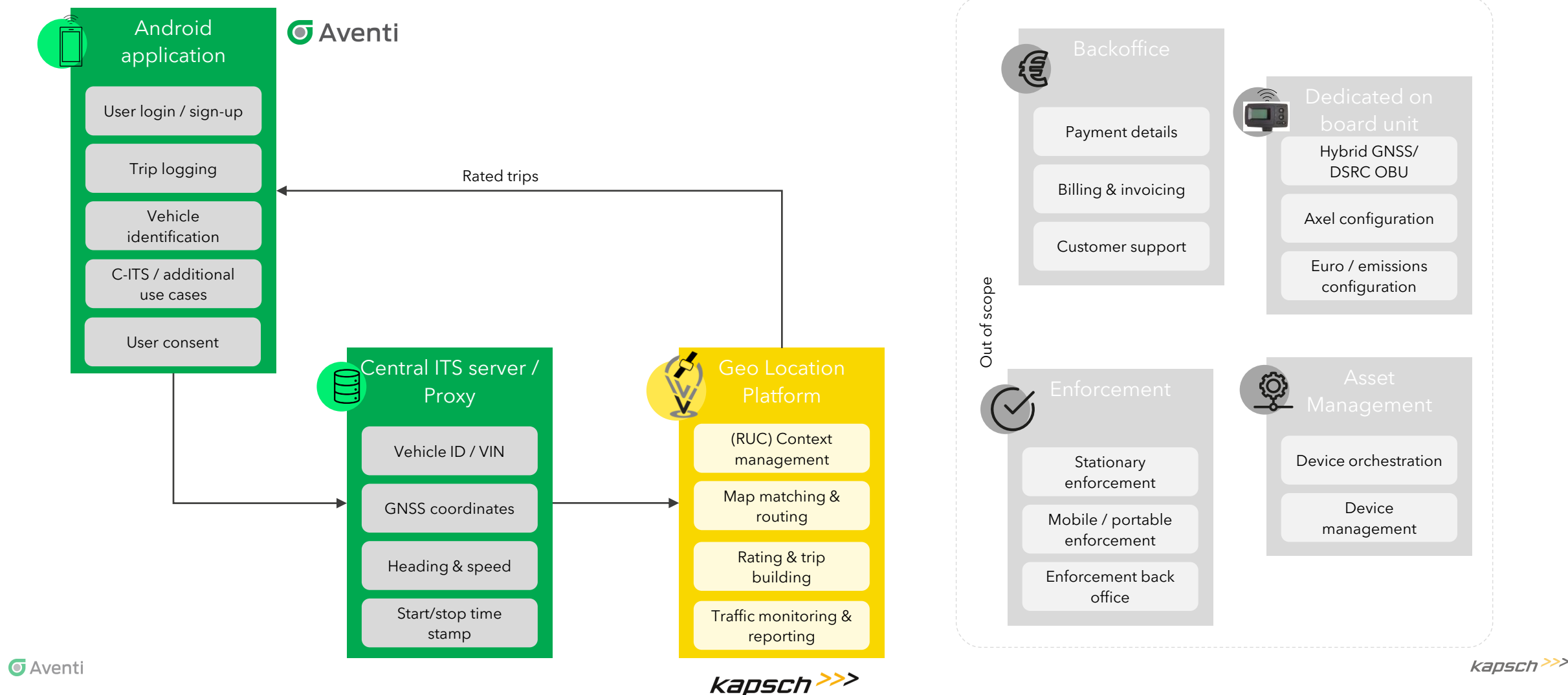
		Non-Urban	Urban		
			Non-weekday	Weekday	
				Non-rush-hour	Rush-hour
Motorway	Zero-emission	0.33	0.79	1.25	3.57
	Plug-in hybrid	0.35	0.83	1.31	3.75
	Gasoline	0.36	0.86	1.35	3.85
	Diesel	0.40	0.95	1.49	4.27
Trunk	Zero-emission	0.33	0.79	1.25	3.57
	Plug-in hybrid	0.35	0.83	1.31	3.75
	Gasoline	0.36	0.86	1.35	3.85
	Diesel	0.40	0.95	1.49	4.27
Primary	Zero-emission	0.30	0.71	1.12	3.21
	Plug-in hybrid	0.32	0.75	1.18	3.37
	Gasoline	0.32	0.77	1.21	3.47
	Diesel	0.36	0.85	1.34	3.84
Secondary	Zero-emission	0.27	0.63	1.00	2.86
	Plug-in hybrid	0.28	0.67	1.05	3.00
	Gasoline	0.29	0.68	1.08	3.08
	Diesel	0.32	0.76	1.20	3.42
Tertiary and Unclassified	Zero-emission	0.20	0.48	0.75	2.14
	Plug-in hybrid	0.21	0.50	0.79	2.25
	Gasoline	0.22	0.51	0.81	2.31
	Diesel	0.24	0.57	0.90	2.56
Residential	Zero-emission	0.17	0.40	0.62	1.79
	Plug-in hybrid	0.18	0.42	0.66	1.87
	Gasoline	0.18	0.43	0.67	1.93
	Diesel	0.20	0.47	0.75	2.13
Track	Zero-emission	0.00	0.00	0.00	0.00
	Plug-in hybrid	0.00	0.00	0.00	0.00
	Gasoline	0.00	0.00	0.00	0.00
	Diesel	0.00	0.00	0.00	0.00

Prices in NOK per km

The end-to-end process consisted of six steps

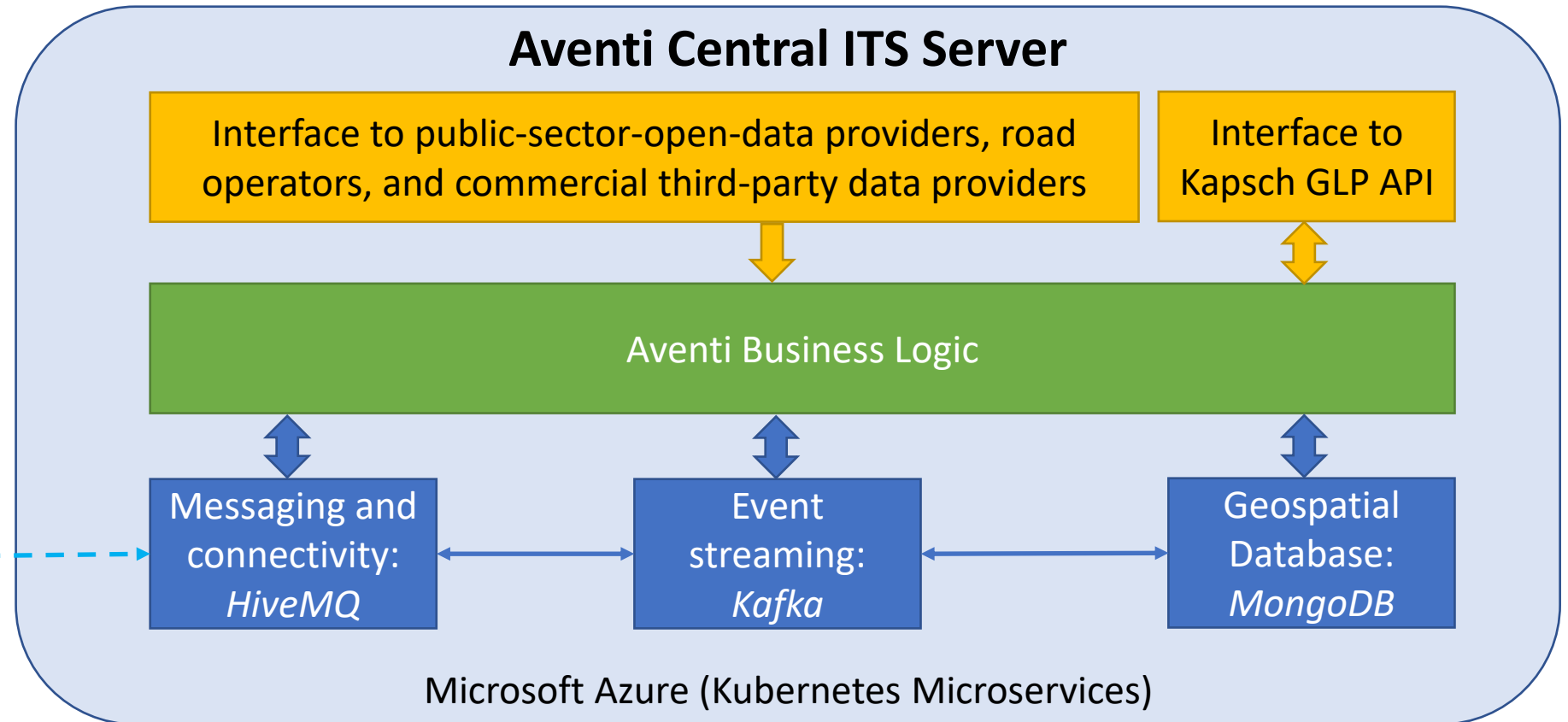
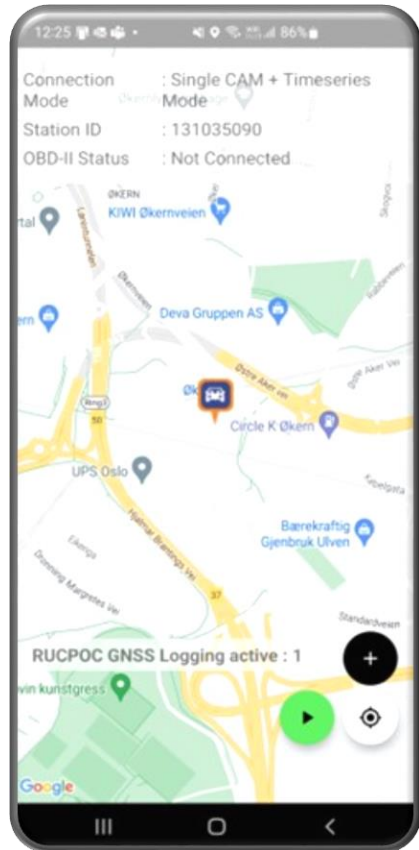


Kapsch and Aventi had a clear work split, with both delivering key competencies



14.30 The JuztDrive app and Aventi central ITS server

Android app and Central ITS Server - Overview





Here we demonstrate how people will use the RUC POC app



Verification of smartphone GNSS location against nearby cell towers



Tracking GNSS coordinates in tunnels

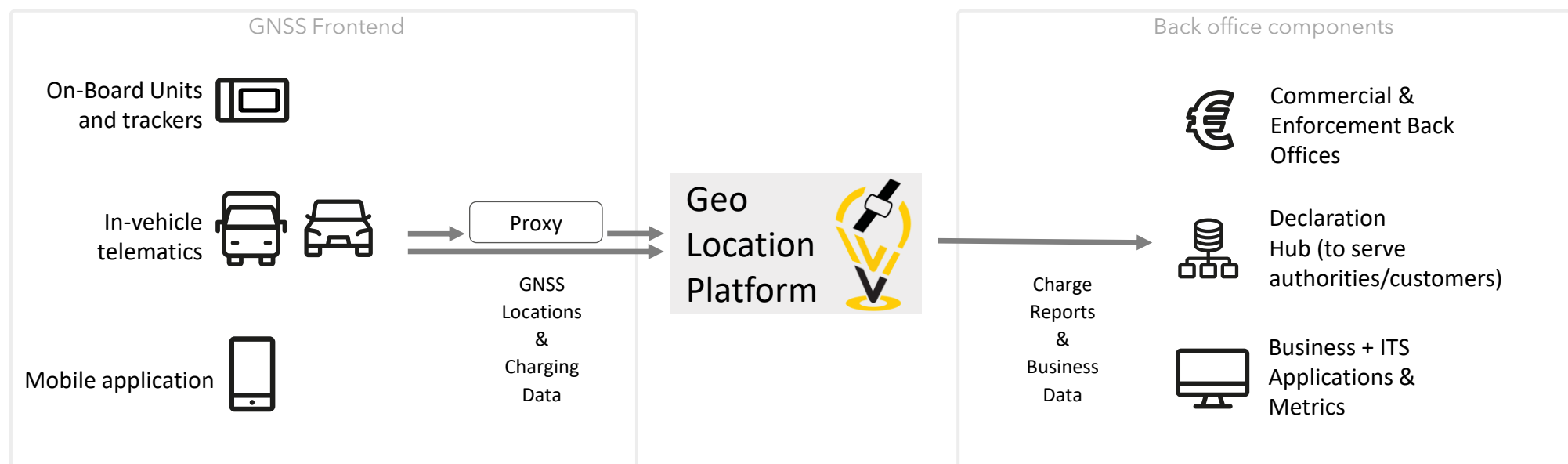


Location verification using vehicle OEM API

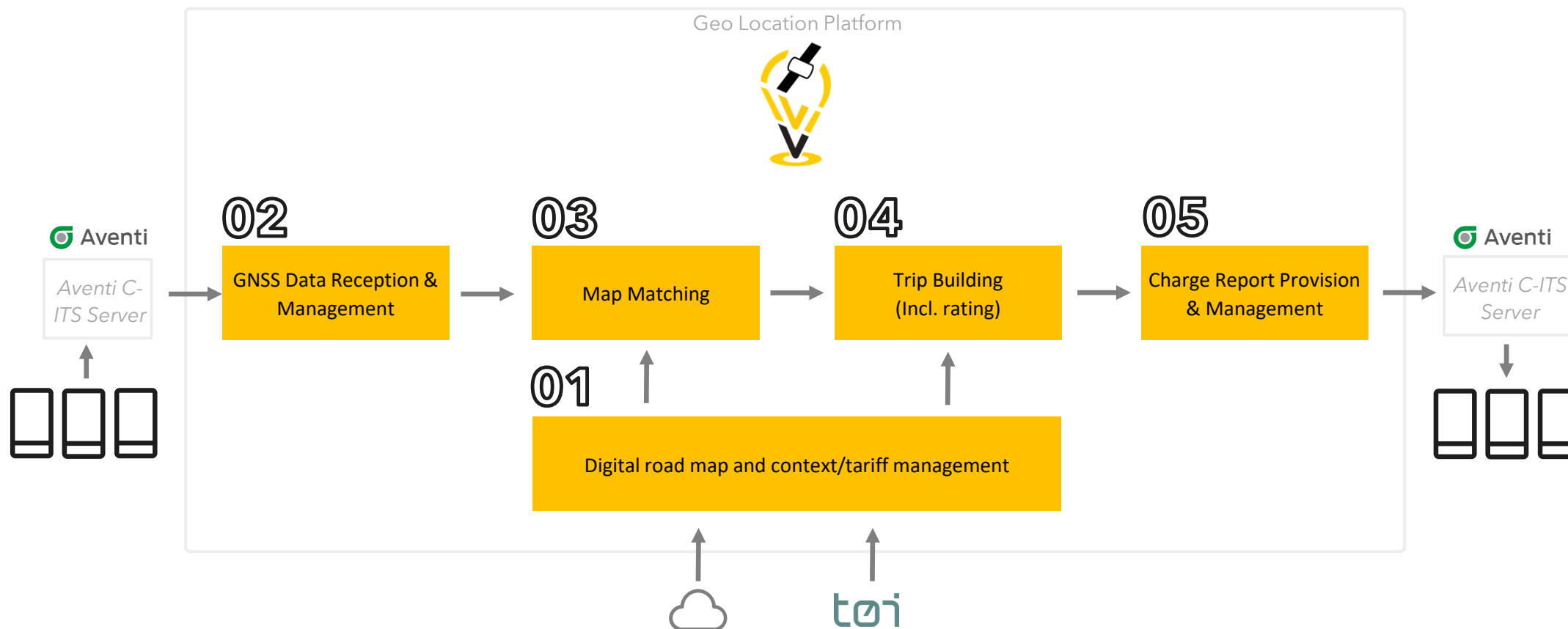


14.50 Kapsch's Geo Location Platform

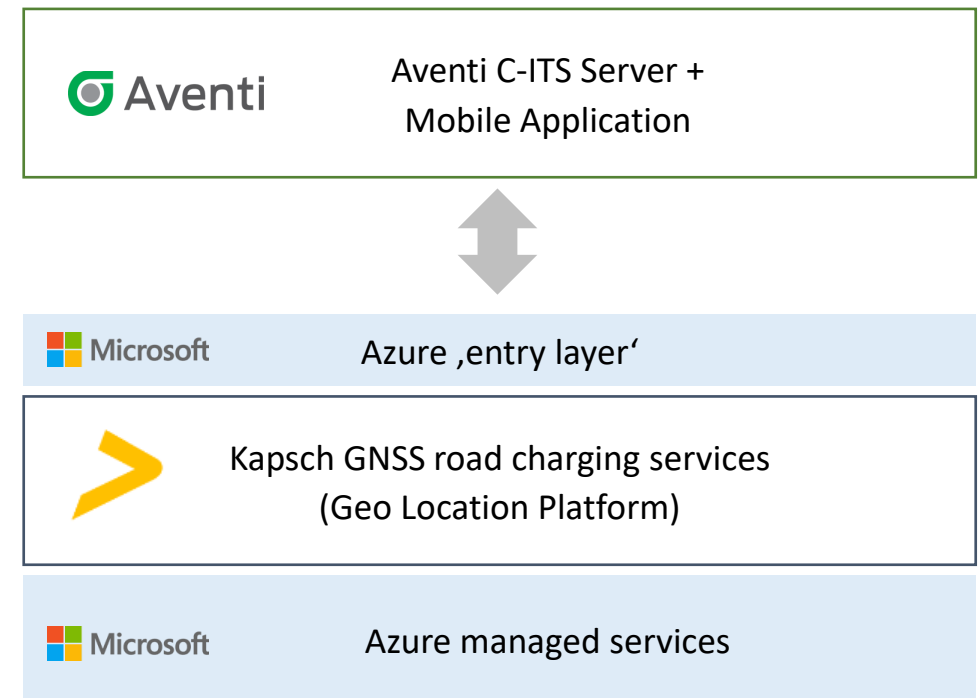
Geo Location Platform streams vehicle location from any source into business value near real-time



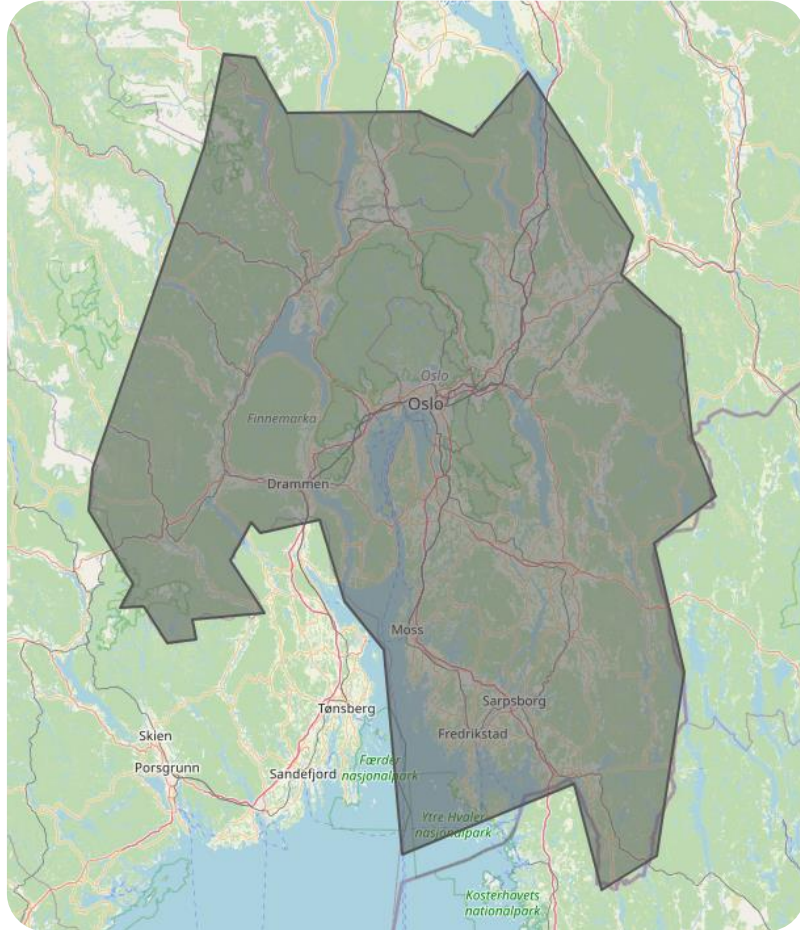
GLP's services scale independently, data utilization is reduced to the minimum possible



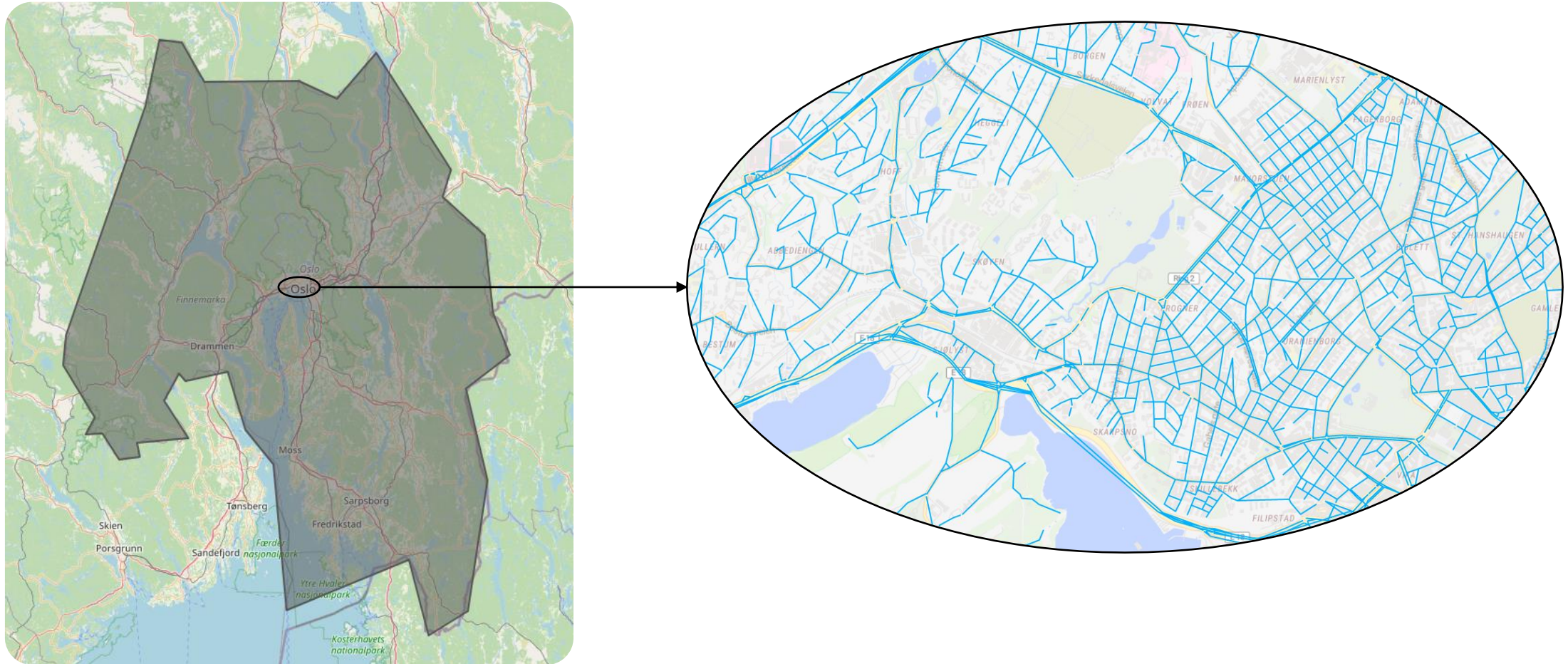
CI/CD ensures delivery pace, quality and iteration; cloud-native services ensure security, availability and scalability



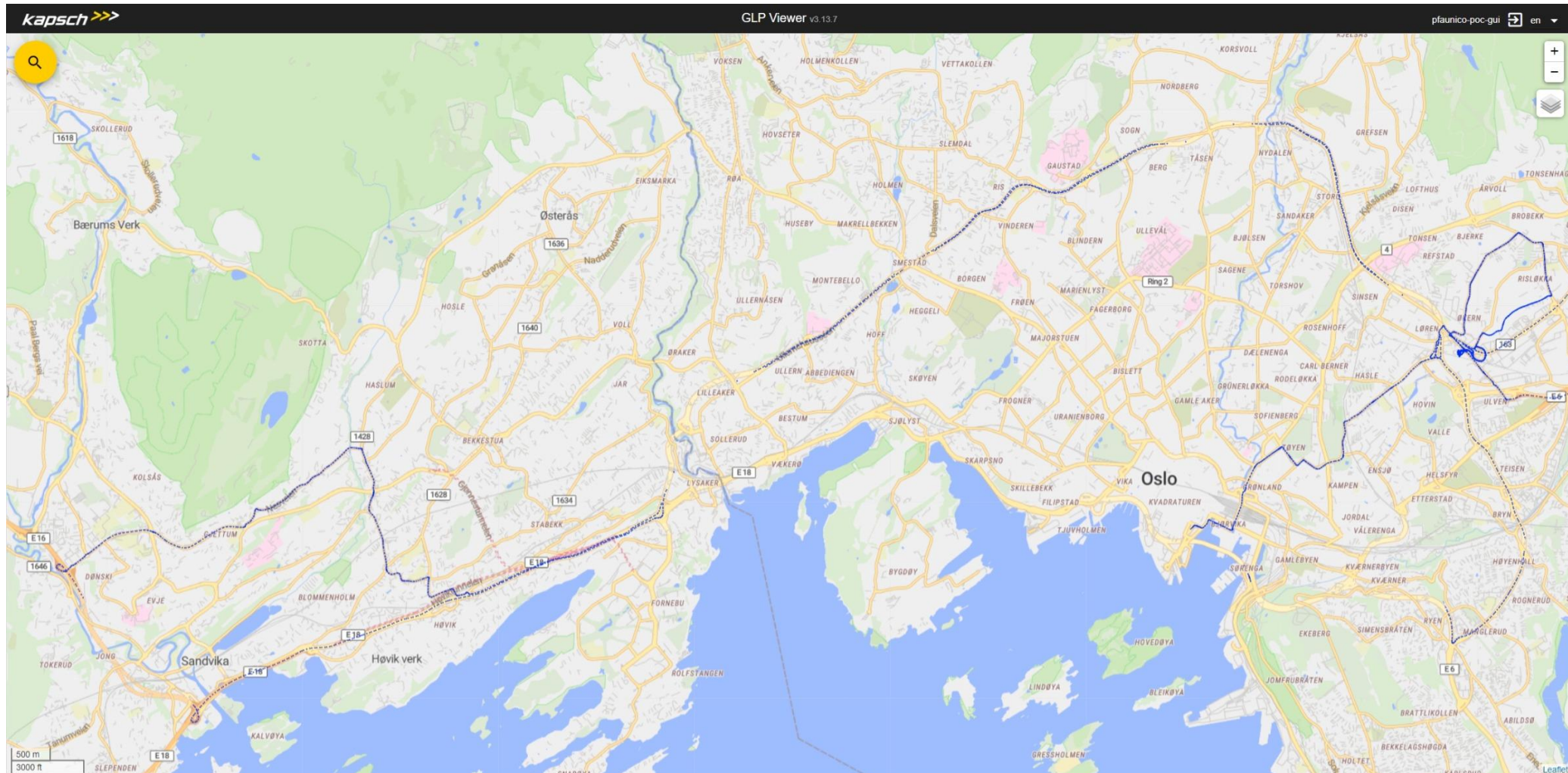
We created a charging context for greater Oslo, for both urban and non-urban environments



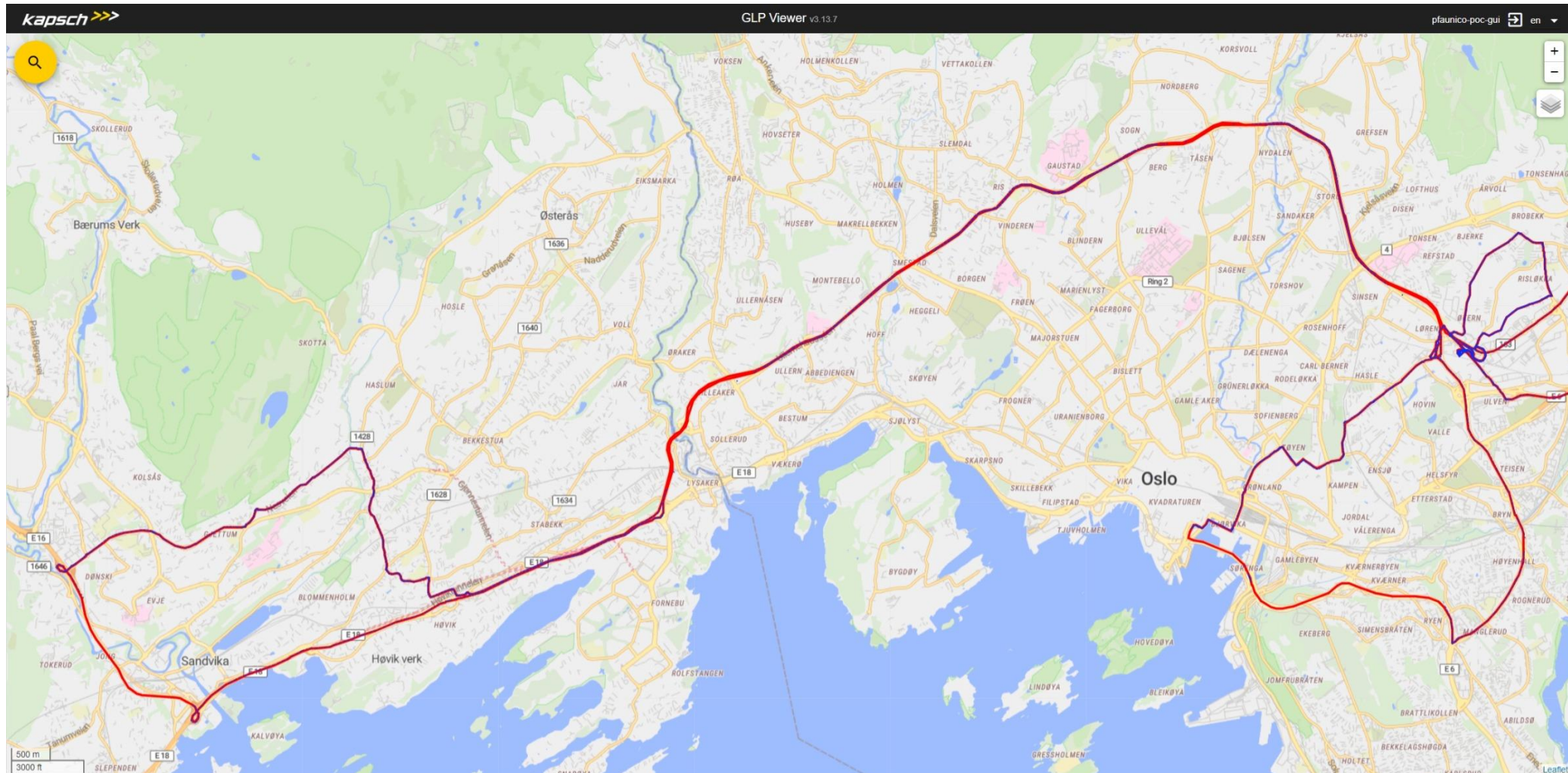
In order to accurately price each trip according to variable tariffs we created granular charge segments within the GLP



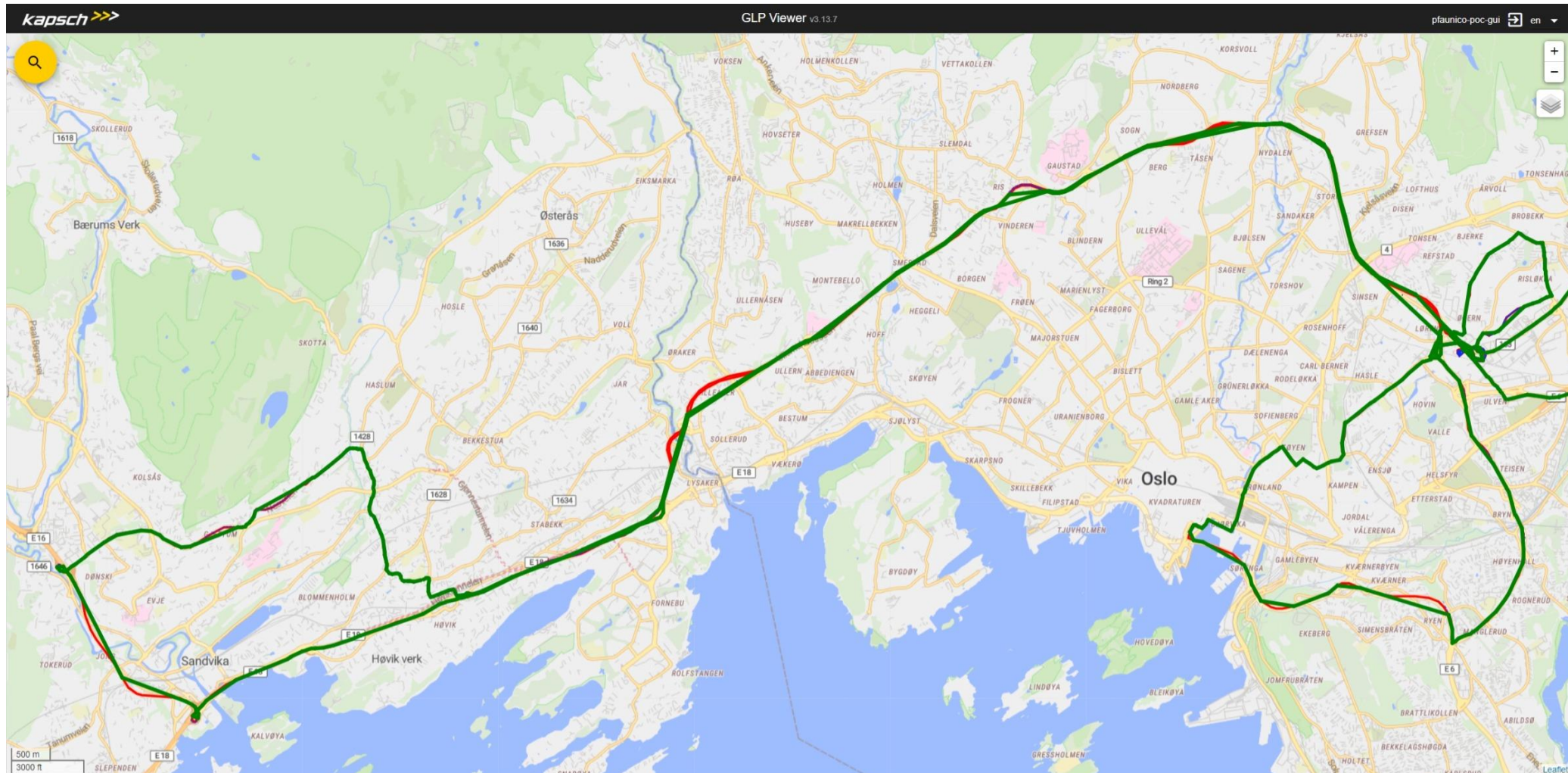
GLP's detection performance and integrity is centered around map accuracy, algorithm quality, 'one truth' and context quality assurance



GLP's detection performance and integrity is centered around map accuracy, algorithm quality, 'one truth' and context quality assurance



GLP's detection performance and integrity is centered around map accuracy, algorithm quality, 'one truth' and context quality assurance



Pre-defined test tracks were evaluated, results very positive except for overly erroneous GNSS input, which was easily improved

Fees for non-weekdays (Weekends), Sunday September 4th, 2022, 11:00-13:30

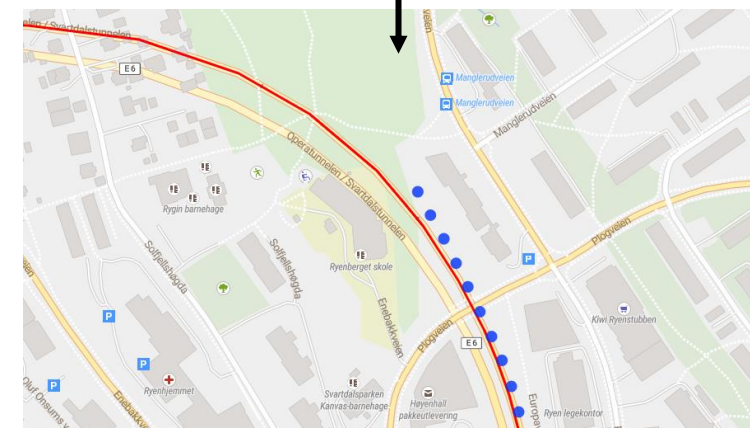
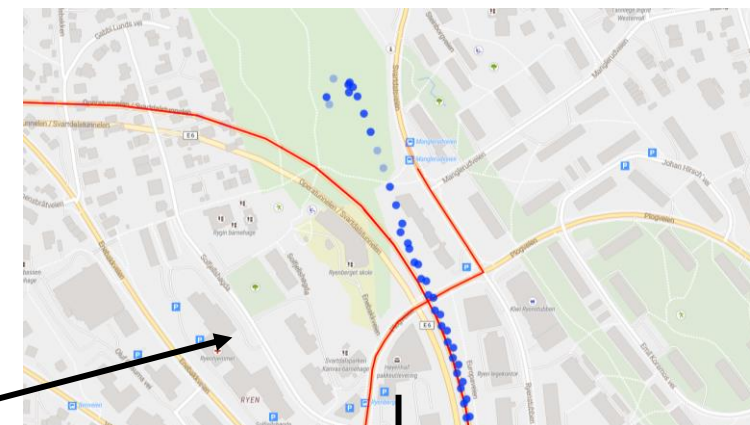
Test Route	Map link	Diesel	Gasoline	Plug in hybrid	Zero emission
Test route #1 Lørenskog	Map	Calc: 11.00 Test: 10.98	Calc: 9.87 Test: 9.81	Calc: 9.58 Test: 9.57	Calc: 9.09 Test: 9.08
Test route #2 Bjerke	Map	Calc: 1.97 Test: 1.95	Calc: 1.83 Test: 1.77	Calc: 1.78 Test: 1.77	Calc: 1.67 Test: 1.66
Test route #3 Opera Tunnel	Map	Calc: 11.09 Test: app fail	Calc: 9.97 Test: 9.90	Calc: 9.67 Test: 10.45	Calc: 9.14 Test: 9.03
Test route #4 Sandvika	Map	Calc: 95.34 Test: 95.10	Calc: 86.17 Test: 85.06	Calc: 83.27 Test: 82.73	Calc: 79.22 Test: 79.09

Fees for weekdays non-rushhour, Monday September 5th, 2022, 09:30-12:30

Test Route	Map link	Diesel	Gasoline	Plug in hybrid	Zero emission
Test route #1 Lørenskog	Map	Calc: 14.47 Test: 14.43	Calc: 13.02 Test: 12.98	Calc: 12.67 Test: 12.64	Calc: 12.00 Test: 12.05
Test route #2 Bjerke	Map	Calc: 2.88 Test: 2.87	Calc: 2.62 Test: 2.60	Calc: 2.60 Test: 2.59	Calc: 2.44 Test: 2.41
Test route #3 Opera Tunnel	Map	Calc: 15.40 Test: 18.46	Calc: 13.87 Test: 13.73	Calc: 13.47 Test: 12.81	Calc: 12.81 Test: 12.67
Test route #4 Sandvika	Map	Calc: 147.66 Test: 146.95	Calc: 133.80 Test: 133.56	Calc: 129.85 Test: 131.06	Calc: 123.82 Test: 123.47

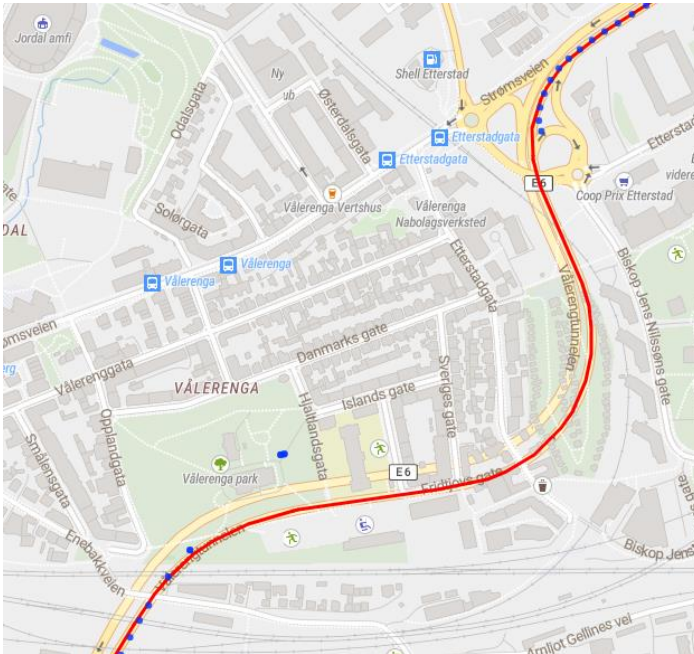
Fees for weekdays rushhour, Monday September 5th, 2022, 07:00-08:30, 15:00-17:00

Test Route	Map link	Diesel	Gasoline	Plug in hybrid	Zero emission
Test route #1 Lørenskog	Map	Calc: 32.34 Test: 32.27	Calc: 29.12 Test: 29.03	Calc: 28.39 Test: 28.34	Calc: 26.97 Test: 26.93
Test route #2 Bjerke	Map	Calc: 7.46 Test: 7.41	Calc: 6.79 Test: 6.76	Calc: 6.61 Test: 6.54	Calc: 6.27 Test: 6.23
Test route #3 Opera Tunnel	Map	Calc: 37.30 Test: 37.96	Calc: 33.57 Test: 33.15	Calc: 32.68 Test: 32.65	Calc: 31.05 Test: 31.63
Test route #4 Sandvika	Map	Calc: 417.52 Test: 417.44	Calc: 376.41 Test: 375.97	Calc: 366.63 Test: 378.98	Calc: 348.92 Test: 348.82

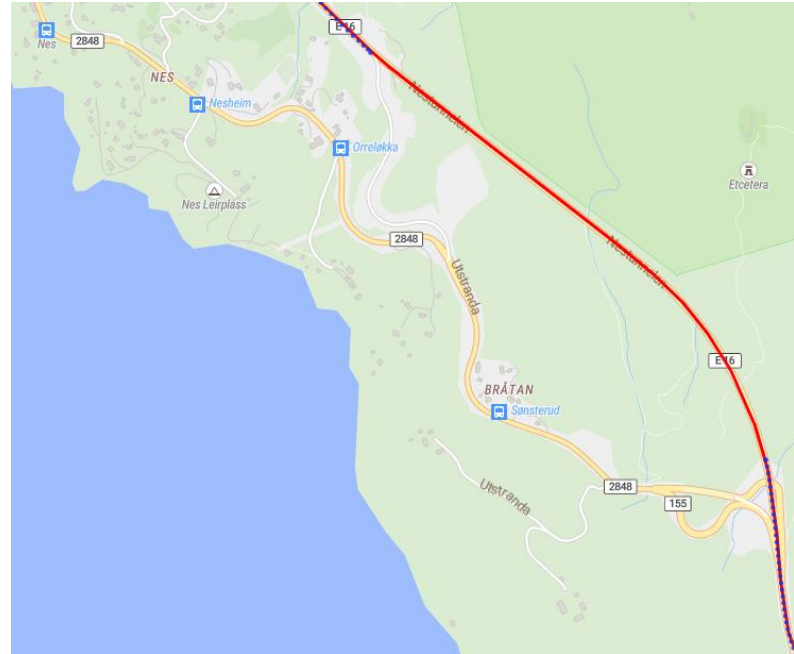


After GNSS Frontend (Mobile app/server) enhancements fee for test track calculated with 15.23NOK or ~99% accuracy.

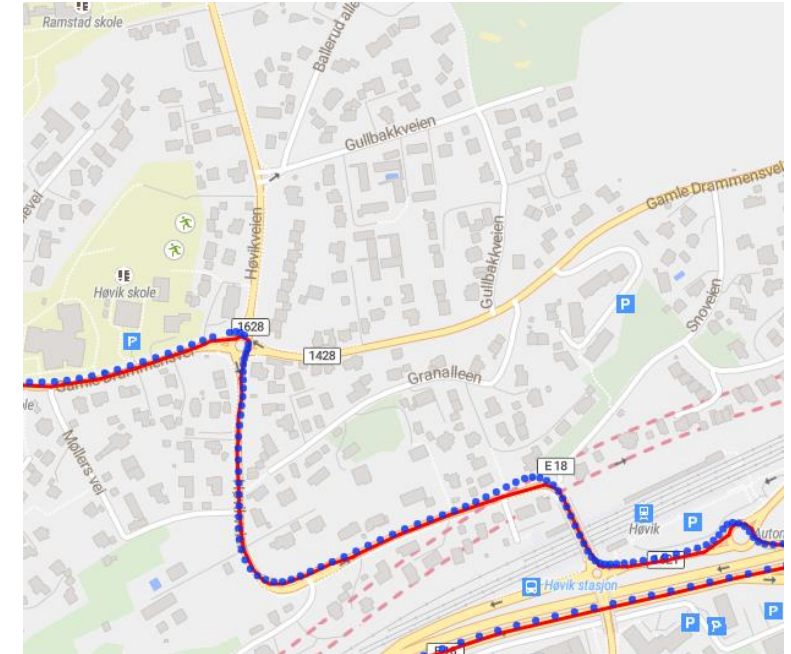
Kapsch's Geo Location Platform was able to successfully handle challenging environments and ambiguous data input



Example of tunnel entry and exit. GLP is capable of matching the correct route (red) while input GNSS points (blue) might be partly highly inaccurate due to connection loss

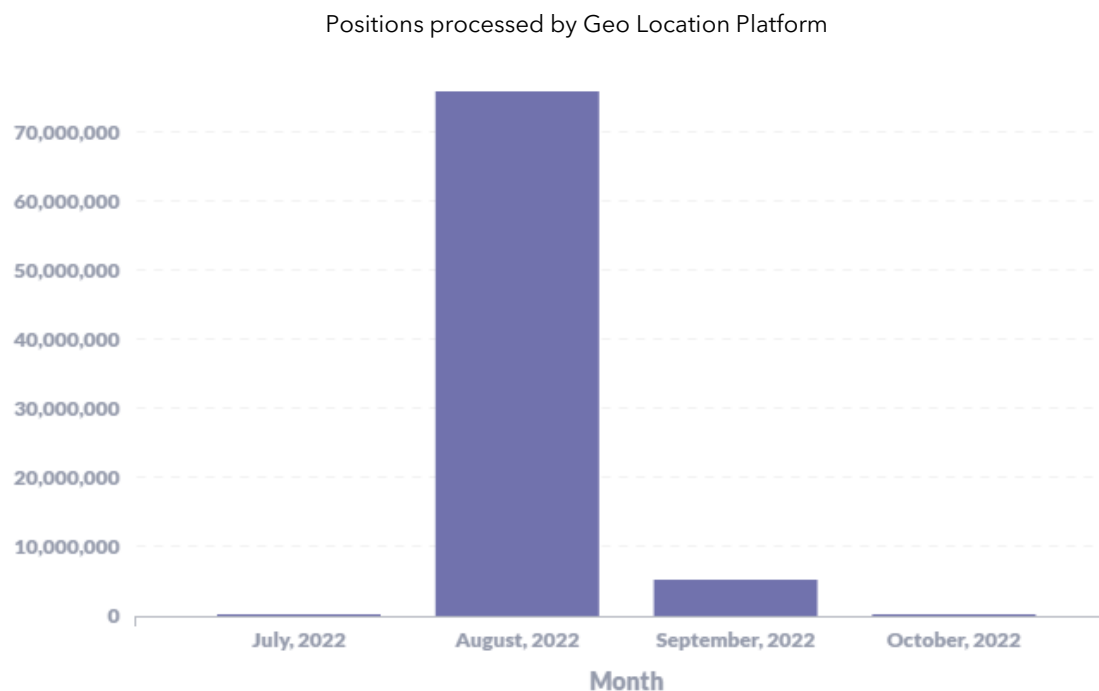


Another tunnel example in a non-urban environment. GLP is again handling these cases successfully (red track matched), even with significant GNSS gaps (blue dots)



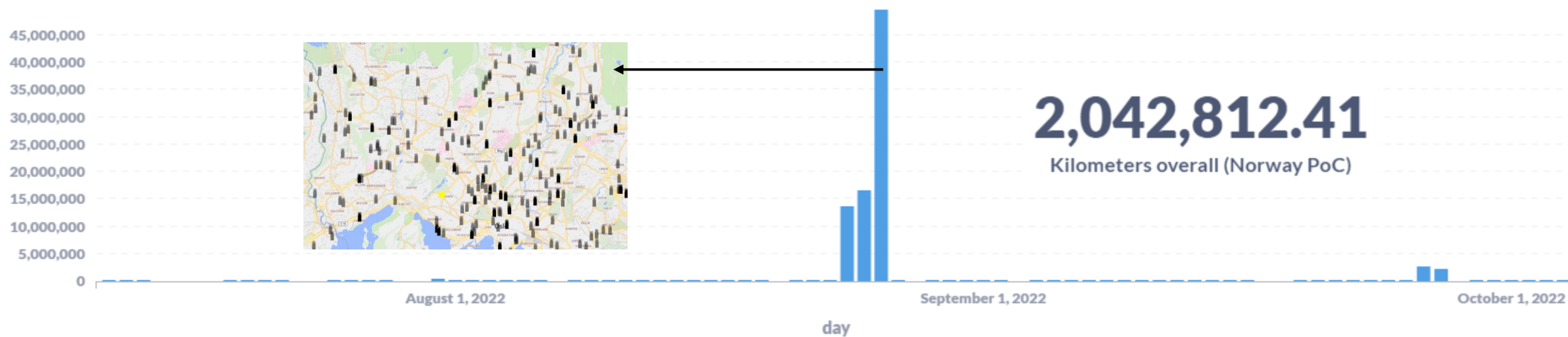
Multiple roundabouts in urban environments are handled successfully by GLP for a sample track

GLP processed over 80 million positions, provided by Aventi's C-ITS server either through both mobile application and simulation



The vast majority of processed positions were generated during three days of stress testing the system in September

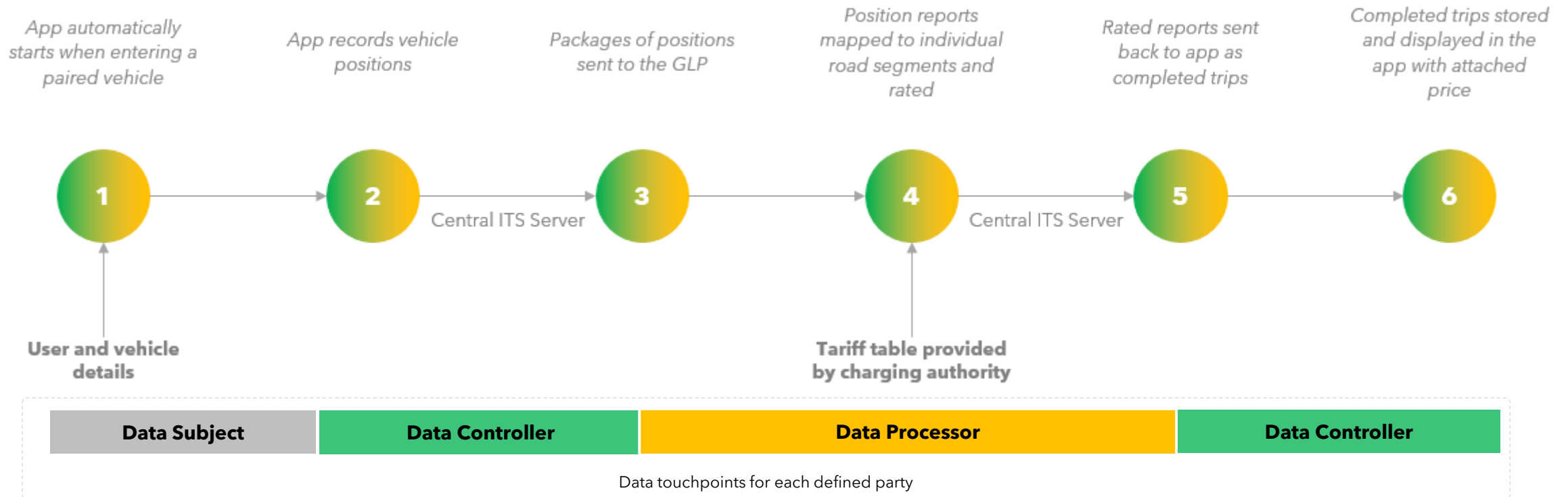
Positions processed by Geo Location Platform



15.15 Where we go from here

15.05 JuztDrive and GDPR compliance

The responsibilities of each party are clearly defined and communicated



- The **Data Subject** (the person whose data is being processed e.g. the driver) **in this case the driver**
- The **Data Controller** (the person or entity who determines the purposes and means of data processing e.g. the service provider) **in this case Aventi** as the owner of the driver
- The **Data Processor** (the person or entity processing the data, often on behalf of the data controller) **in this case Kapsch**

The JuztDrive solution is based on user consent and adheres to all applicable legislation

Importance of integrity

- > Legitimate purpose and a lawful basis (GDPR and EDPB Guidelines)
- > Prevent surveillance and misuse of data
- > Minimization of data, e.g. only collect data necessary for the purpose of the processing
- > Only collect data when the vehicle's location needs to be known
- > Clearly inform the user that geolocation is taking place
- > Option to deactivate geolocation
- > Limited storage period

Examples of ways to comply with this

- > Machine to machine interfaces and automated decisions to reduce human involvement of data
- > Not collecting excess data for other purposes
- > Avoid to store exact start and end positions of a route
- > Only store data until the tax is collected or the appeal period is passed
- > Security measures according to EDPB recommendations in place
- > Valid consent under GDPR and possibly special legislation needed
- > For statistical purposes (as traffic management analyses) the data can be fully anonymized when the tax have been collected (Optional)



**Thank you for
participating**

Key contact persons:



Terje Hundere
Daglig leder / General Manager
+ 47 90 59 99 60
terje.hundere@aventi.no

Aventi Group
Østre Aker vei 19
0581 Oslo

www.aventi.no



Mikael Hejel
Area Sales Manager
+46 76 879 55 45
mikael.hejel@kapsch.net

Kapsch TrafficCom AB
Bataljongsgatan 12, Box 1063
551 10 Jönköping

www.kapsch.net