

Automatic speed adaption to handle bottlenecks in the road network

Halvor S. Grønaas, Bouvet
Lars Klyve, Bouvet



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About Bouvet

- Norwegian consultancy:
 - 13 office locations in Norway and Sweden
 - 1500 employees
 - Listed on the Norwegian Stock Exchange
- Design, development and implementation of IT solutions and digital communications

Bottlenecks in the road network

Bottlenecks on County road 866

Cargo route Skjervøy to mainland



Handling bottlenecks through speed adaption

Bottlenecks on County road 866



Cargo route Skjervøy to mainland



Avoid meetings : Speed adaption



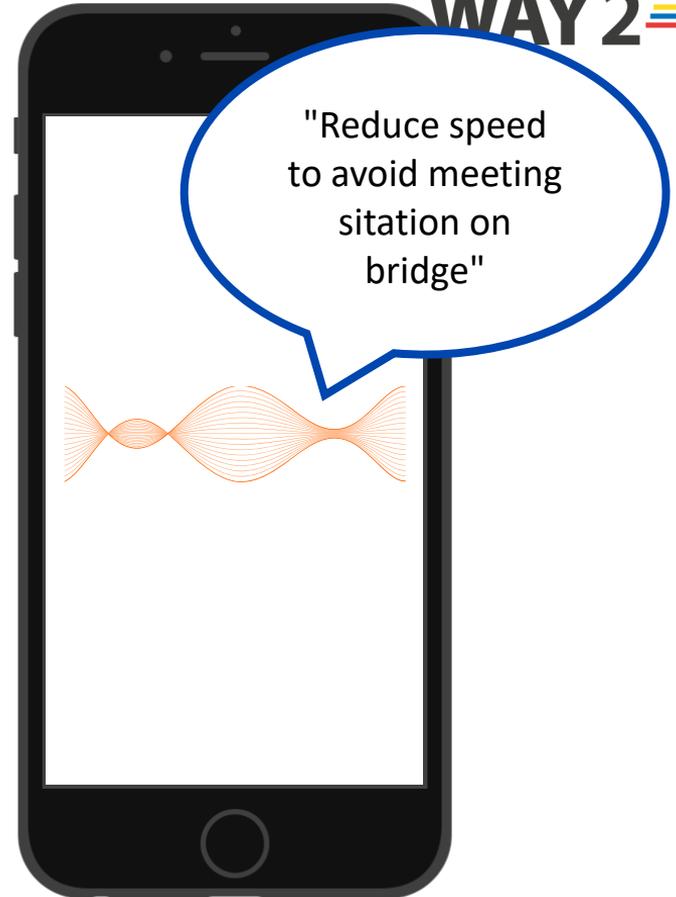
System

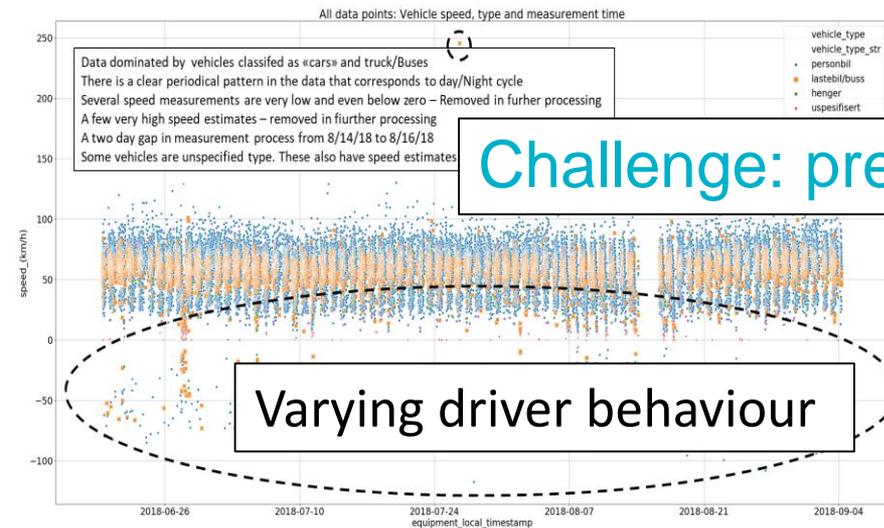
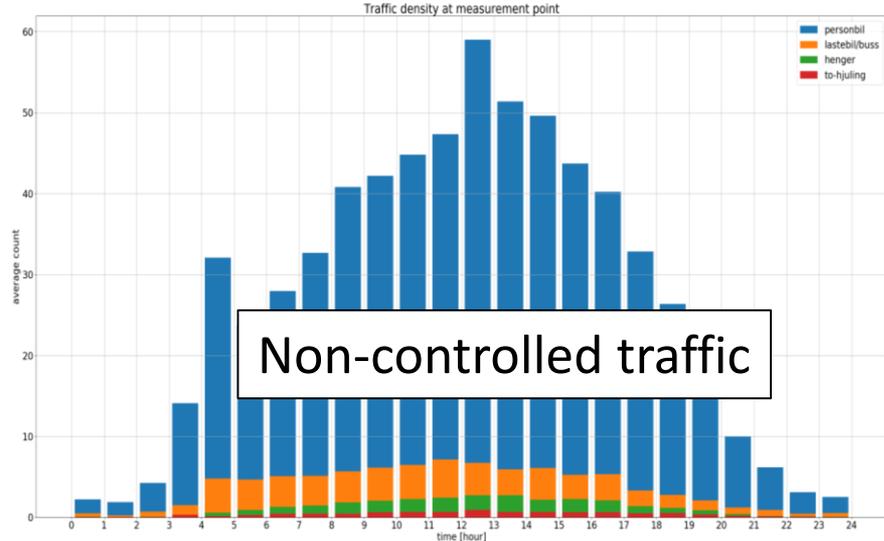
Mobile app

- Transmits GPS data to cloud backend
- Receives speed advice
- Communicates speed advice through GUI and speech synthesis

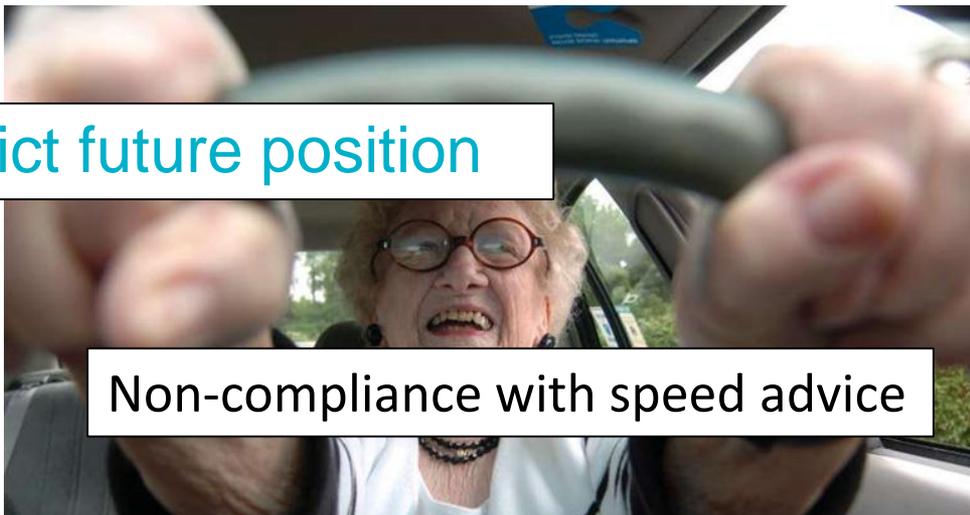
Cloud backend

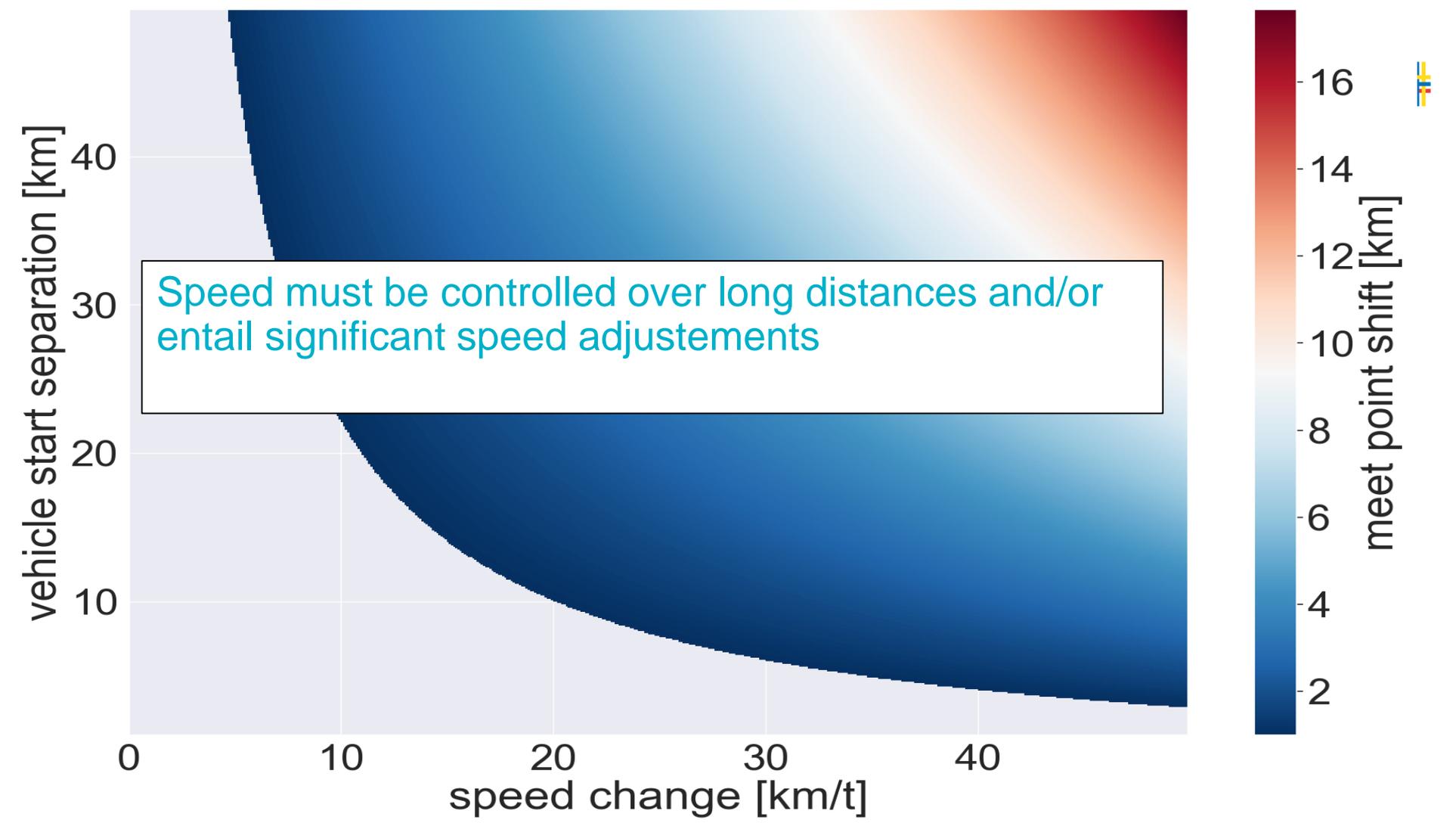
- Receives navigation data from all vehicles
- Predict meeting situations
- Calculate speed advice
- Pass speed advice to mobile apps
- Persists data



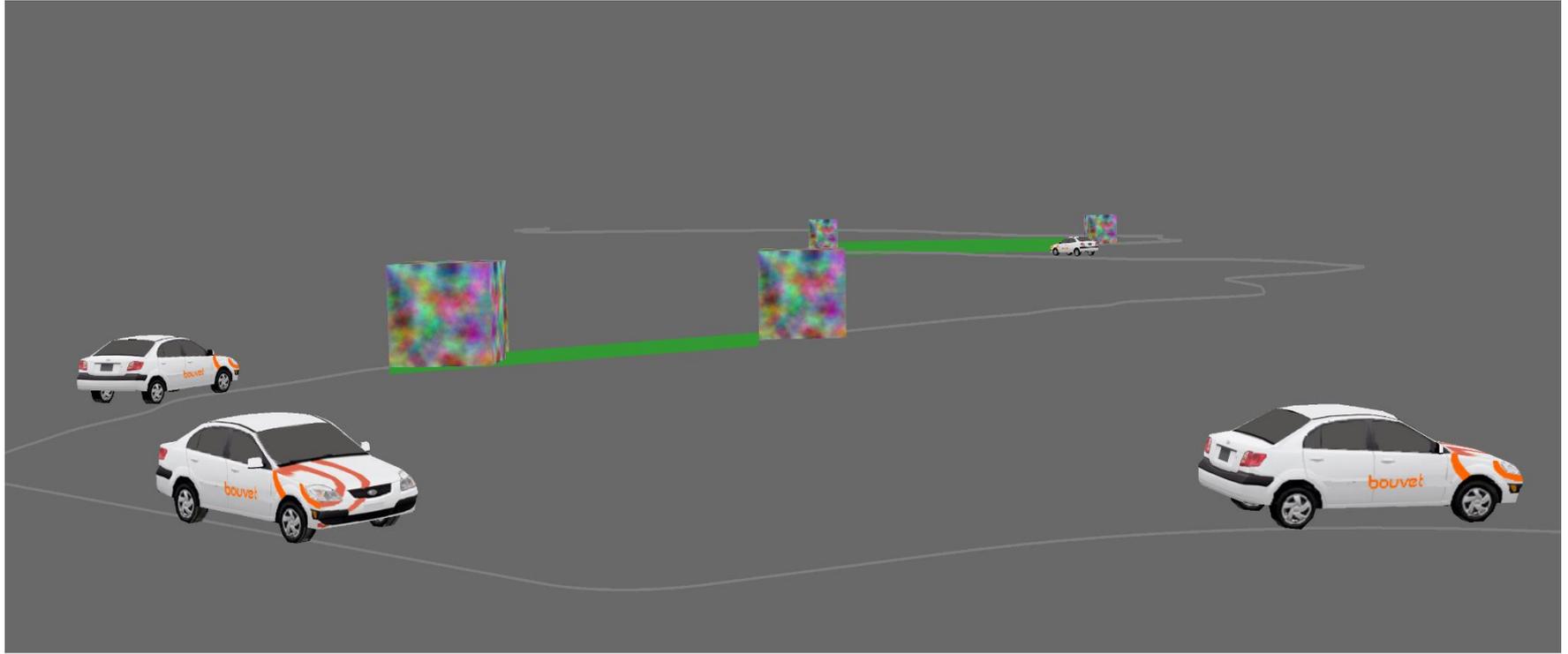


Challenge: predict future position



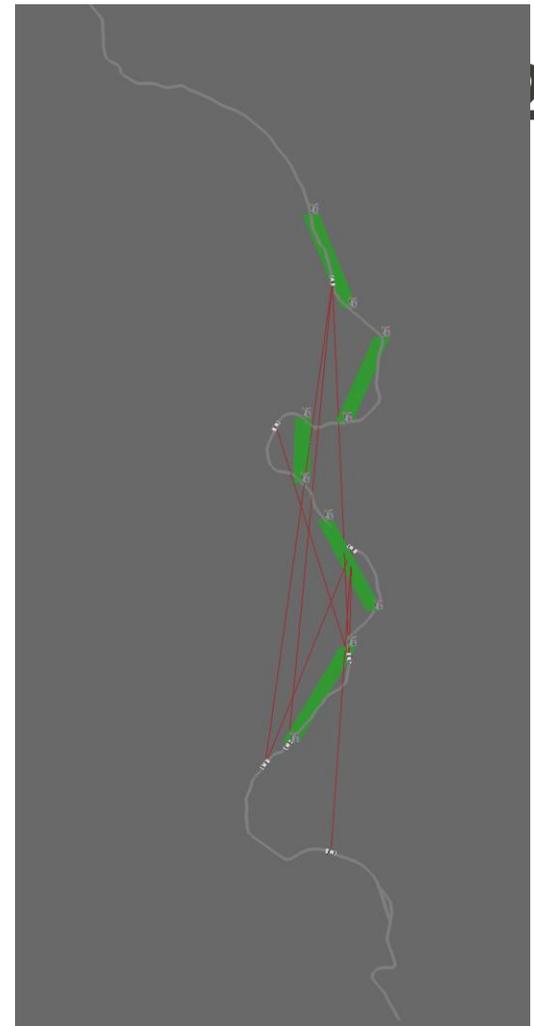


Speed adaption engine

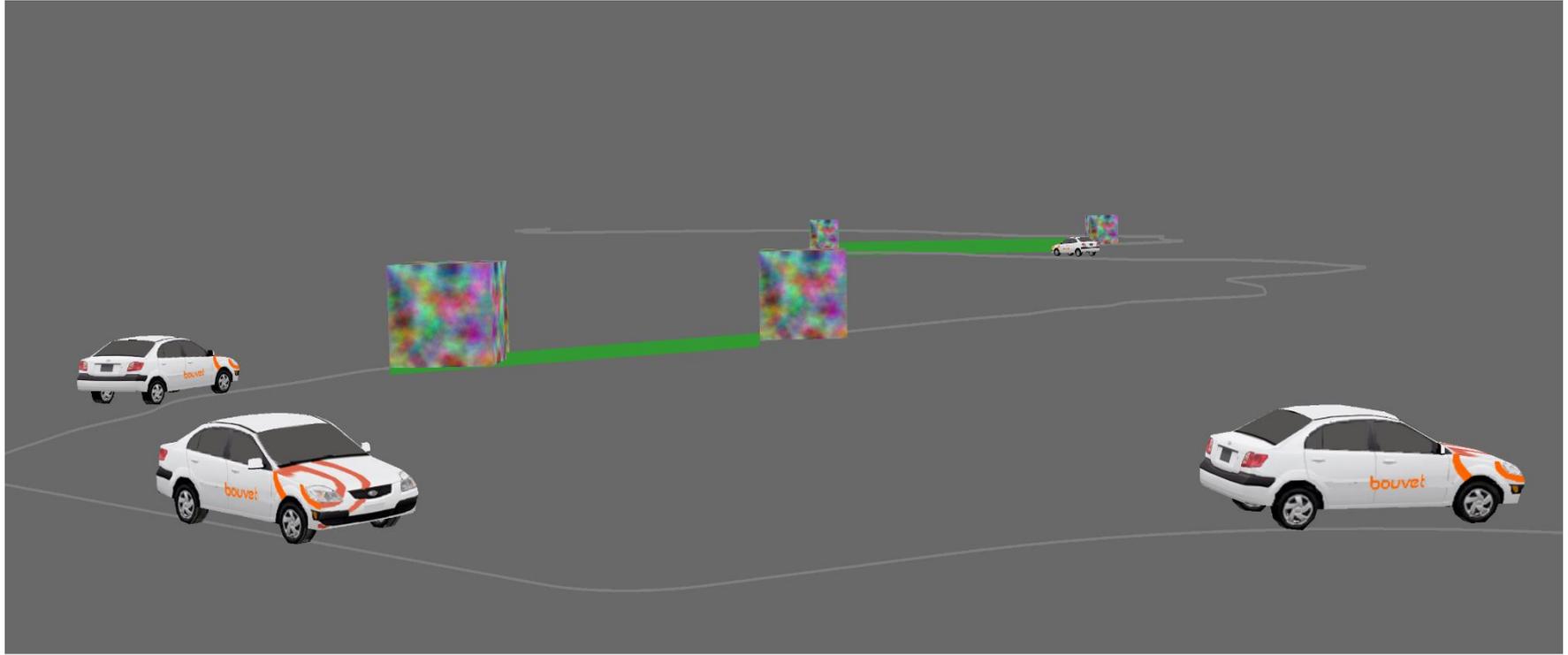


Simulation og visualization

- Simulation framework to generate synthetic data for algorithm development
- Based on traffic flows extracted from induction coils in area
- Together with visualization this enabled rapid prototyping and testing of new ideas
- Hardware acceleration to speed up computations and improve visualization



Demo



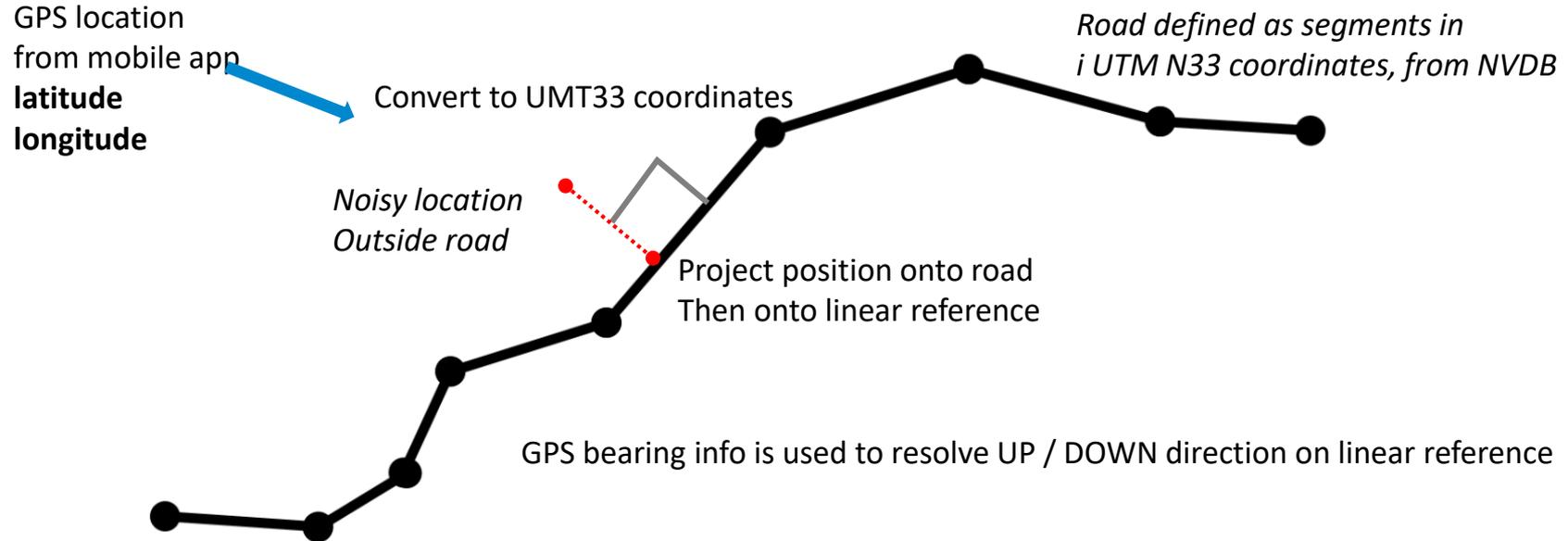
From simulator to the real world!



- Extract road models from NVDB API
- Operation on road data
- Handling GPS signals
- Real cars driven by humans



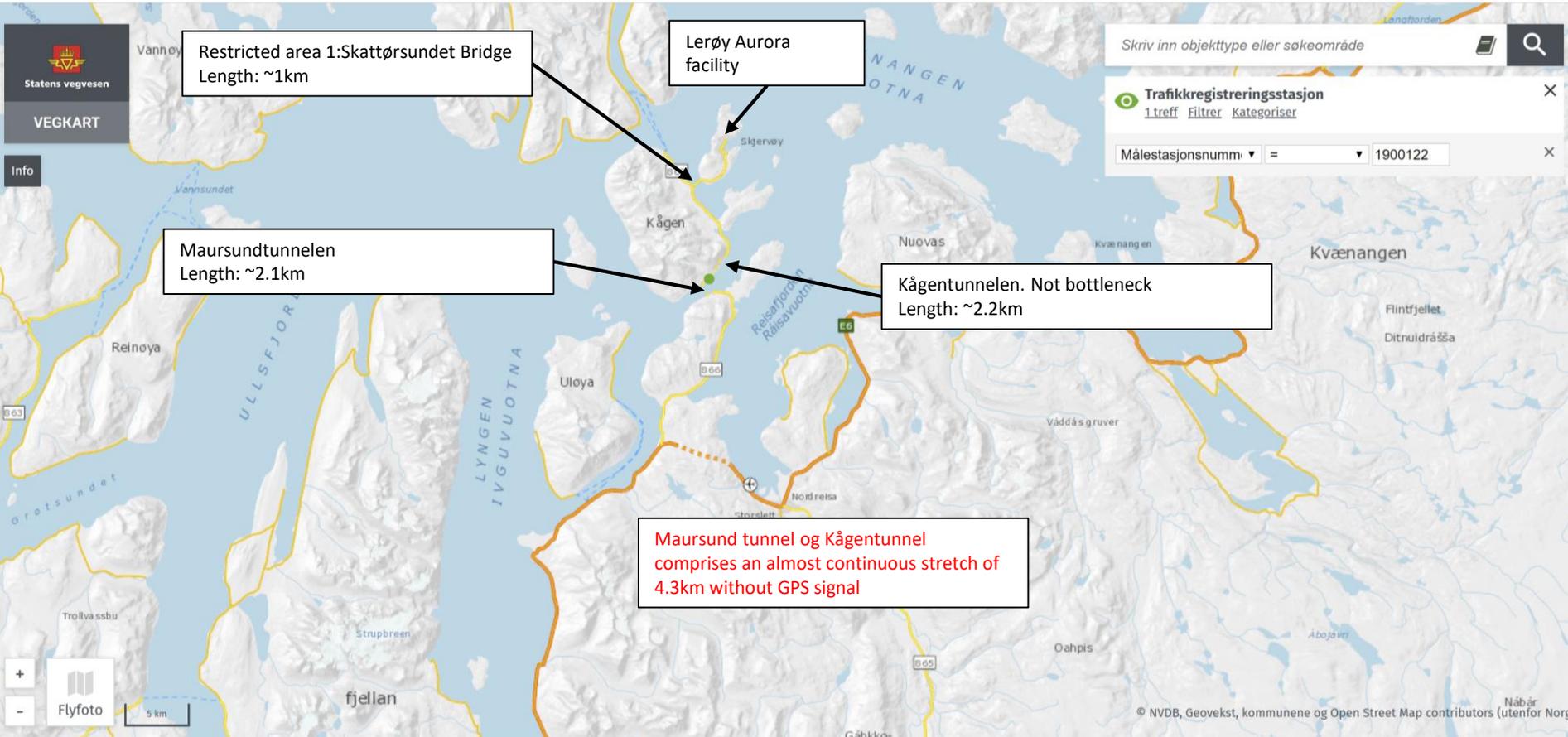
Example: GPS location to linear reference



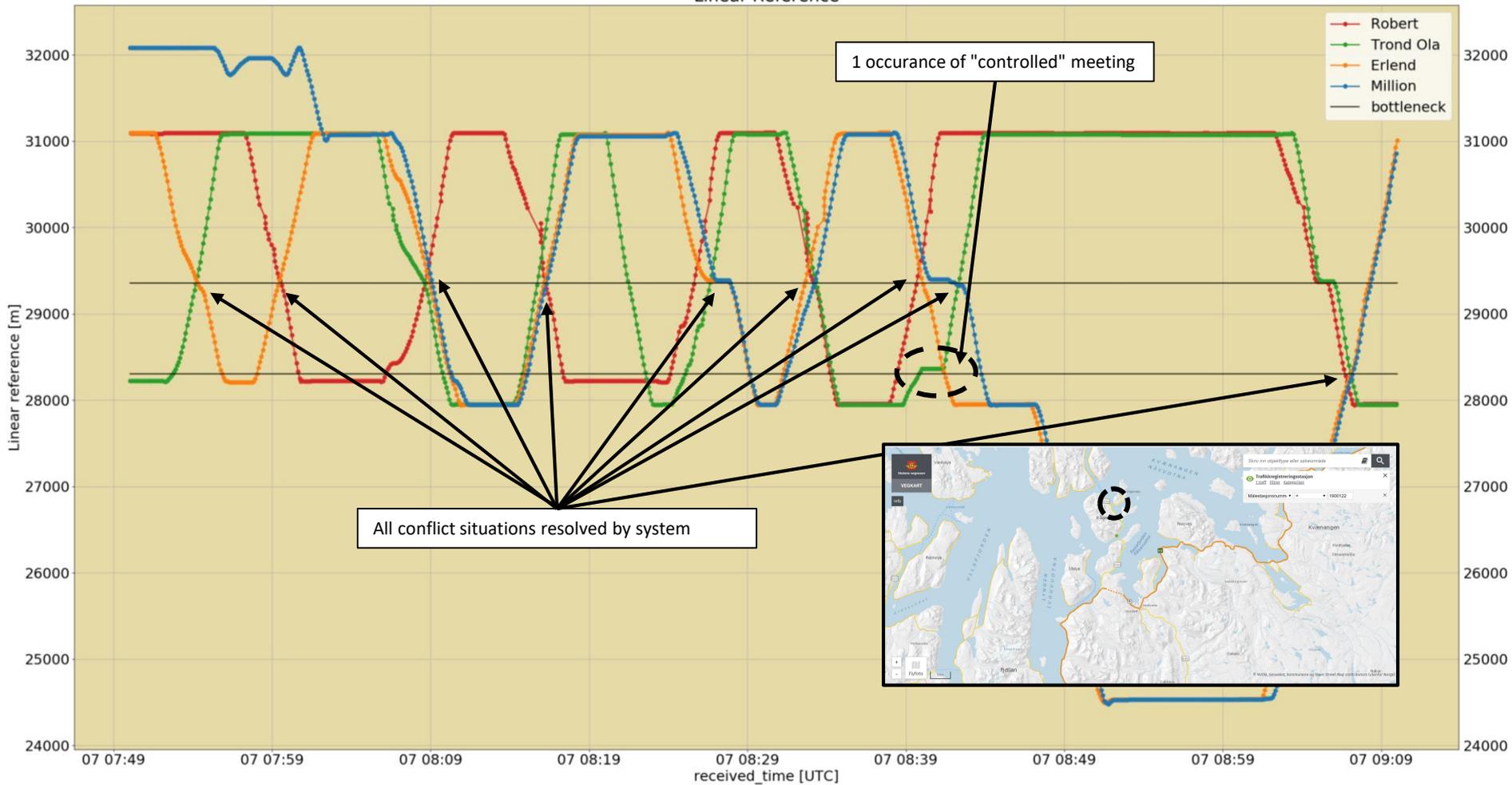
Skjervøy test 6-7 mars 2019



Test site



Linear Reference



Skjervøy tests: Key points

- 16 tests completed
 - 9 on bridge over Skattør sound
 - 7 through Maursund tunnel
- **31 potential meeting situations**
 - **29 resolved through speed adaption**
 - **2 meeting situations**
- Utfordringer
 - Latency
 - Target speeds sometimes impractially low
 - Noisy speed advice



Thanks for your attention!



Speed adaption algorithm

A_i, A_o, B_i, B_o : Tid for hhv. A og B å komme inn og ut
 $A_{d,i}, B_{d,i}$: Distanse for A og B sin posisjon til sine innganger
 A_s, B_s : Hastigheter for A og B

For bn in bottlenecks:

For A, in cars_going_upwards:

For B in cars_going_downwards:

$A_i, A_o, B_i, B_o, A_{d,i}, B_{d,i} = \text{calculate_times_and_distances}$

If $A_i \leq B_o \wedge B_i \leq A_o$:

If $A_o > B_o$

$$A_s = \min \left(A_s, \frac{A_{d,i}}{B_o} \right)$$

else

$$B_s = \min \left(B_s, \frac{B_{d,i}}{A_o} \right)$$

Looper igjennom alle bil-par som har motsatt kjøreretning

Forutse ankomsttid til start og slutt punkt i Flaskehalsen, og mål avstander

$$t_{pred} = \frac{d}{s_{avg, pred}}$$

Sjekker om de vil befinne seg i samme Flaskehals på samme tidspunkt

Gir en hastighets anbefaling til bilen som ville ha kommet sist ut.



