

# 5G enabled logistics using GLOSA for Vehicle Platooning

TP25, Hamburg, 12<sup>th</sup> Oct.  
I.T.S. World Congress 2021  
Ralf Willenbrock, T-Systems

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# CONTENTS

1. 5G - Connected Logistics
2. Hamburg I.T.S. (TAVF)
3. LCMM - CO2 Monitoring
4. Field Trial 2022
5. Public Transport (SHOW)

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# 1

## 1. 5G - Loginnov

Connected Logistics and  
Mobile Communication

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<https://5g-ppp.eu/5g-loginnov/>

# 5G LOGINNOV

## Connected and Automated Logistics

5G improves logistics and environmental challenges of European ports by connecting 5G devices, data analytics and next generation traffic management

- Development and deployment of innovative ports and logistics hubs operation system integrated in 5G networks
- Optimise ports & logistics hubs operation reducing OPEX
- Reducing ports & logistics emissions (CO<sub>2</sub>, NO<sub>x</sub>)
- Regulate freight traffic on 5G logistics corridors according to the EU GREEN DEAL program

# Trends of Next Releases R16, R17 and beyond

- ▶ NR
- ▶ SBA
- ▶ NG-RAN and NGC
- ▶ Network slicing
- ▶ Edge computing

- ▶ IAB
- ▶ NR-U
- ▶ eV2X
- ▶ URLLC and IIoT
- ▶ SEAL

- ▶ NTN
- ▶ Frequency bands
- ▶ NR light

- ▶ High-fidelity holograms
- ▶ Multisensory communications
- ▶ THz communications
- ▶ Pervasive AI



~2030



2018  
(5G Phase 1)

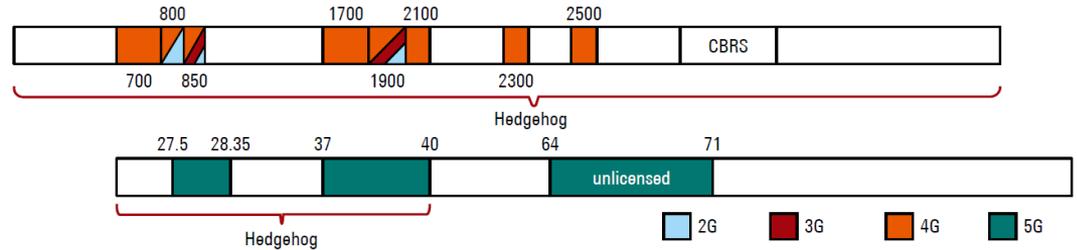


June 2020  
(5G Phase 2)



December 2021

Covering all the Gs



## Industrial IOT and Vertical SBA (e.g.)

- (uRLCC) Edge Computing & Collision Alerts
- (eMBB) Over-The-Air SW Updates
- (eMBB) Infotainment CMM systems
- (MEC) CCAM and vehicle platooning
- (MEC) Floating Truck Emission Data
- (mMTC) Sustainable Traffic Management

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# 5G LOGINNOV –

## Use cases in living labs



**Hamburg**

**UC8/9: 5G-LOGINNOV Floating Truck and Emission Data (FTED)**

**UC10: 5G-LOGINNOV 5G GLOSA and Automated Truck Platooning (GTP) under 5G-LOGINNOV Green initiative**

**UC11: 5G-LOGINNOV dynamic control loop** for environment sensitive traffic management actions (DCET)



**Athens (Piraeus)**

**UC3: Optimal selection of yard trucks**

- Installation of a 5G access point on yard trucks
- 5G latency, precise localization services, etc.

**UC4: surveillance cameras / video analytics**

- Installation of connected 4K surveillance cameras
- AI/ML solution for container seal presence, human presence detection, social distancing etc.

**UC7: Predictive Maintenance**

- 5G access point installed on yard vehicles
- AP will collect and forward in real time with low latency telemetry data over the 5G network



**Koper (Luka)**

**UC1: port control, logistics and remote automation**

**UC2: business critical and mission critical communications**

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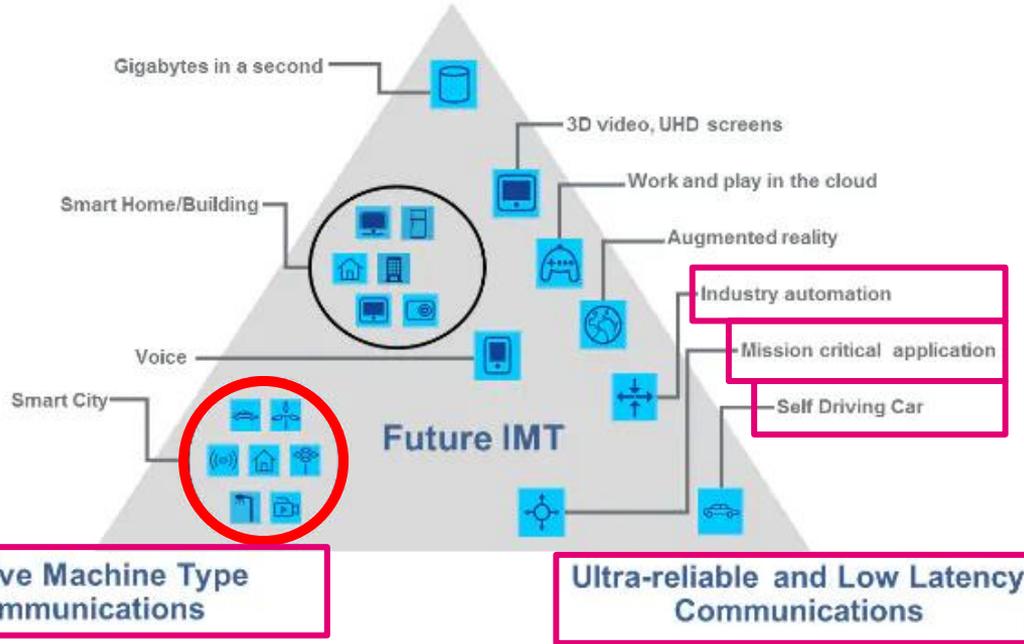
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# 5G ASPECTS COVERED IN 5G-LOGINNOV

## Enhanced Mobile Broadband



5G enabled Precise Positioning, MEC

Real-time tracking & enhanced visibility

Requirements for Vehicles platooning:  
<25ms cellular V2X /V2V

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# 2

## Hamburg I.T.S. (TAVF)

### Hamburg I.T.S. Policy

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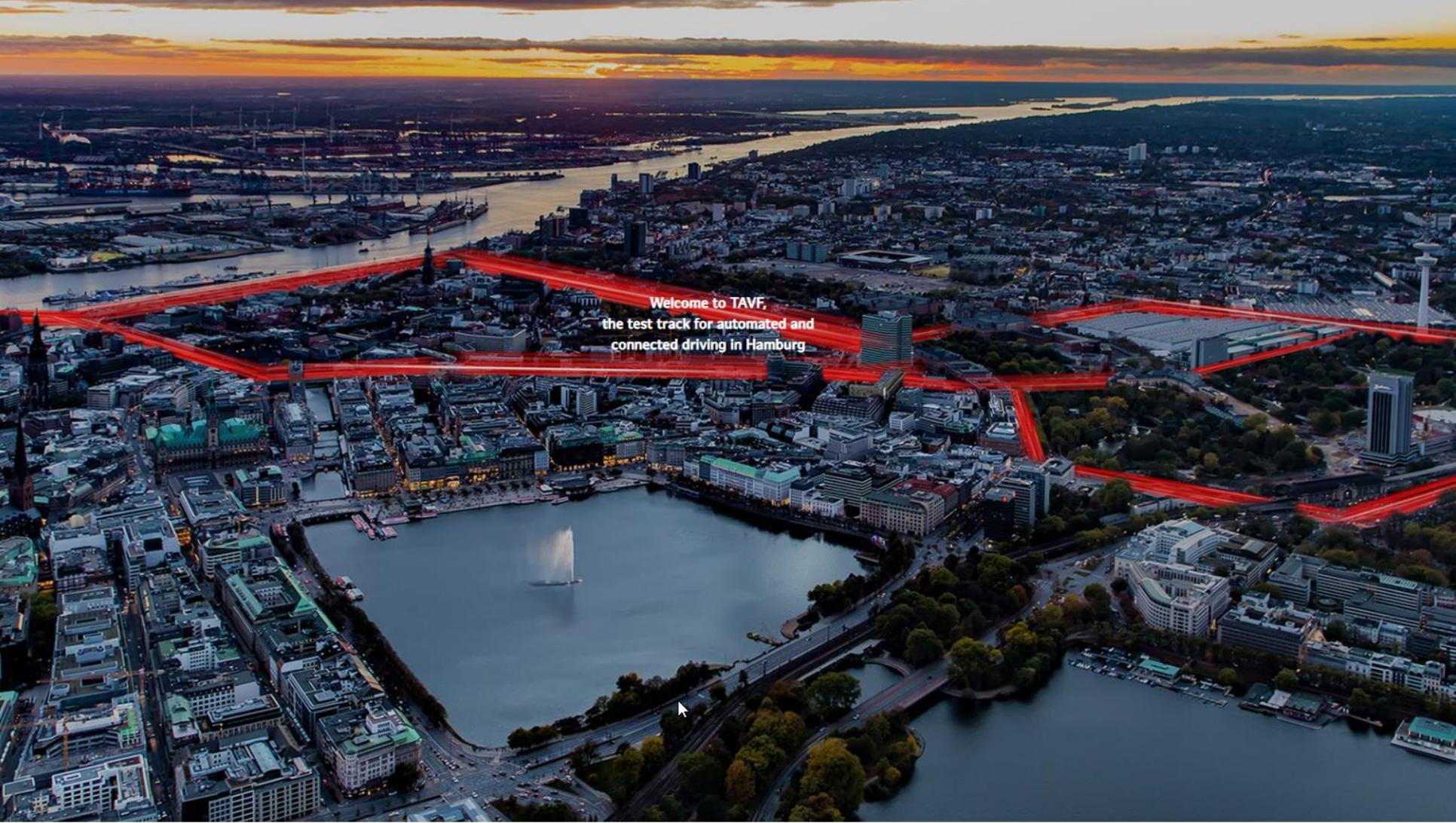


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Welcome to TAVF,  
the test track for automated and  
connected driving in Hamburg



RSU

TMC  
HH

MECs: Hamburg  
**ITS SERVER**  
(→ MOBILE EDGE INFRASTRUCTURE OF DEUTSCHE TELEKOM)

I2N (Uu)  
I2N  
SPAT / MAP (uplink only)

CAM  
Position  
Heading  
Speed



App(s)

- RSU:** Roadside Unit
- I2N:** Infrastructure to Network
- CAM:** Cooperative Awareness Message
- DENM:** Decentralized Environmental Notification Message
- SPAT:** Signal Phase and Time
- MAP:** Topology Information of the intersection (ISO TS 19091 / SAE J2735)

**GLOSA:** Green Light Optimal Speed Advisory  
(a) informational service = user has to react, user reaction time 500ms  
(b) automated driving = latency critical

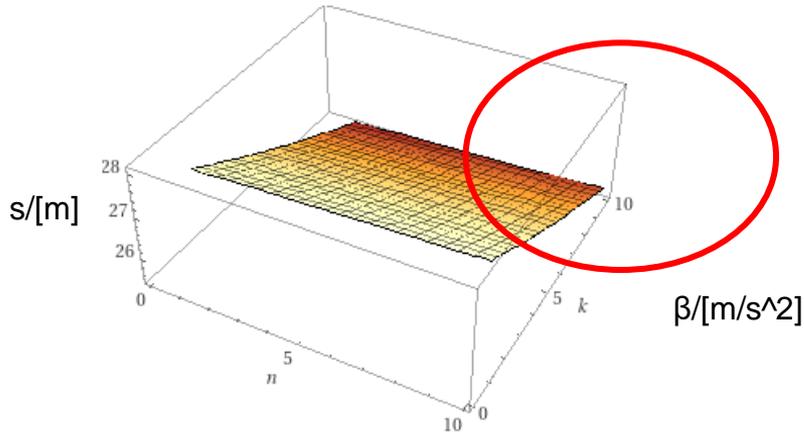
**Collision Warning**  
(a) collision warning service = user has to react, user reaction time = latency critical  
(b) Cellular V2X, V2V < 25 ms

- Bicycles / eBikes
- Motorbikes
- Pedestrians
- Trucks (ATP)

# Anhalteweg 36 km/h Notbremsung (uRLLC >25ms)

$$s = 0.025 \cdot n + 1 \text{ sec} \cdot v + \frac{v^2}{2(\beta + 0.1 \cdot k)}, v \text{ in } \left[ \frac{\text{m}}{\text{s}} \right], \beta = 5.5 \left[ \frac{\text{m}}{\text{s}^2} \right], k, n = 1..10 \text{ integer}$$

[https://www.researchgate.net/publication/228714327\\_Numerical\\_analysis\\_of\\_real-world\\_cyclist\\_crashes\\_impact\\_speed\\_collision\\_mechanism\\_and\\_movement\\_trajectories](https://www.researchgate.net/publication/228714327_Numerical_analysis_of_real-world_cyclist_crashes_impact_speed_collision_mechanism_and_movement_trajectories)



$t/[25\text{ms}]$

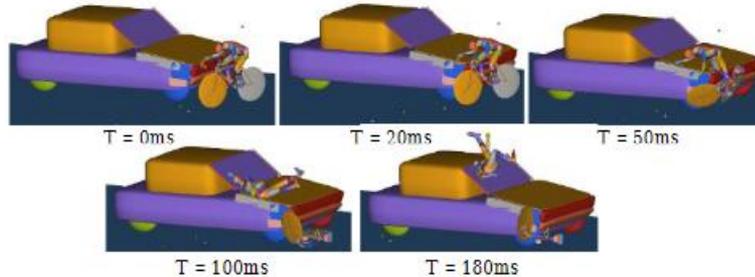
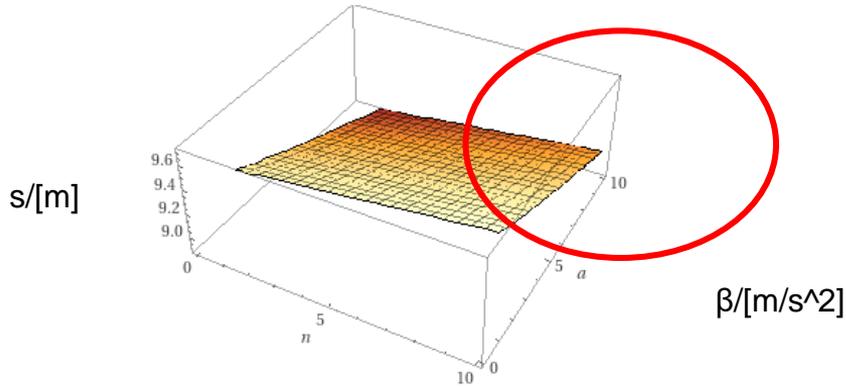


Figure 5: MADYMO simulation of a cyclist hit by a passenger car

# Anhalteweg 18 km/h Notbremsung (uRLLC >25ms)

$$s = 0.025 \cdot n + 1 \text{ sec} \cdot v + \frac{v^2}{2(\beta + 0.1 \cdot k)}, v \text{ in } \left[ \frac{\text{m}}{\text{s}} \right], \beta = 5.5 \left[ \frac{\text{m}}{\text{s}^2} \right], k, n = 1..10 \text{ integer}$$

[https://www.researchgate.net/publication/228714327\\_Numerical\\_analysis\\_of\\_real-world\\_cyclist\\_crashes\\_impact\\_speed\\_collision\\_mechanism\\_and\\_movement\\_trajectories](https://www.researchgate.net/publication/228714327_Numerical_analysis_of_real-world_cyclist_crashes_impact_speed_collision_mechanism_and_movement_trajectories)



$t$  [25ms]

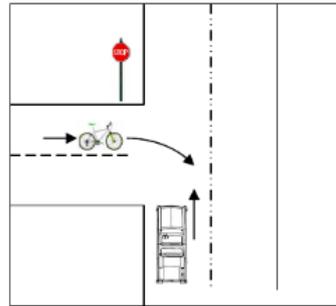
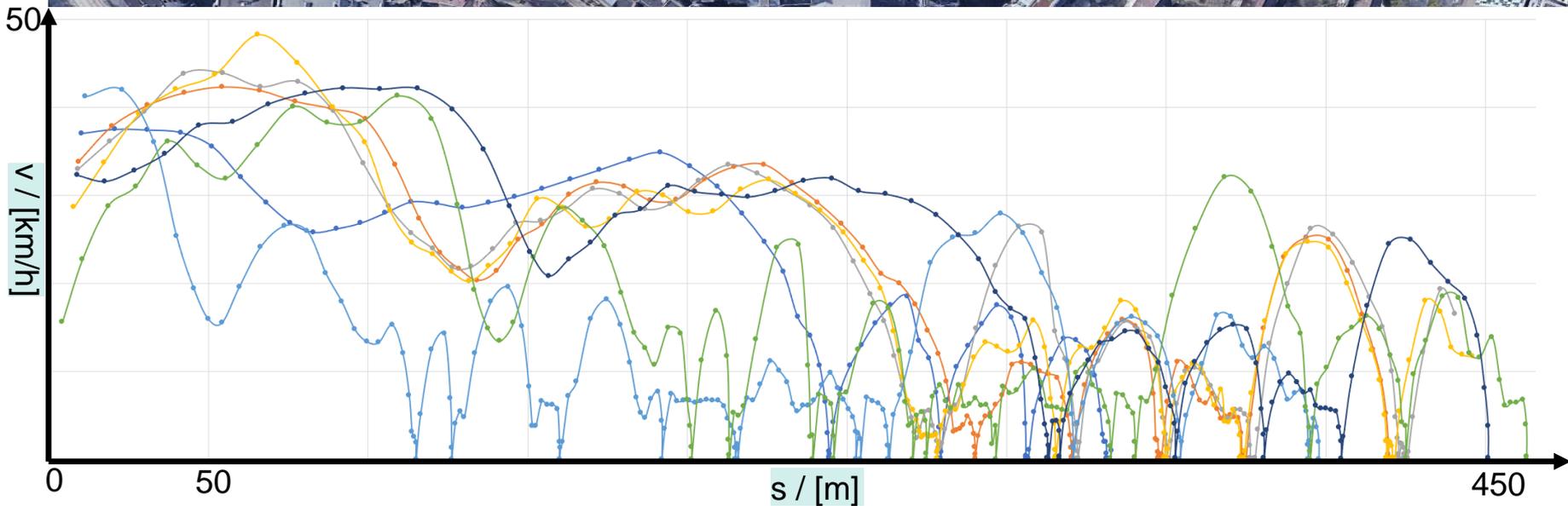


Figure 2: Schematic diagram of crash 2, not to scale.

# Vehicle platooning in real traffic conditions



# 3

## LCMM - Nomadic Devices

About Low Tech and High  
Tec Telematics

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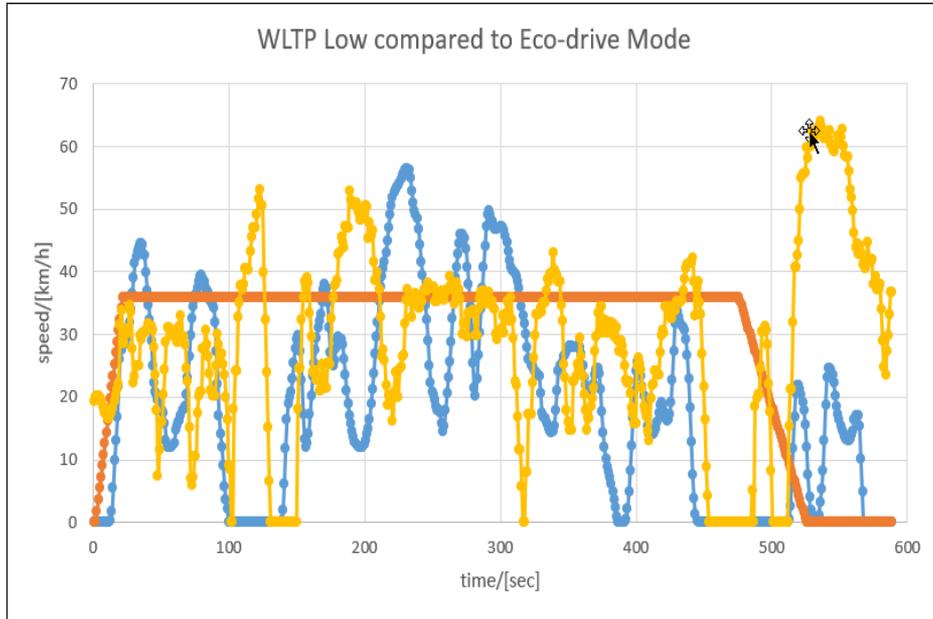
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# LCMM – An ISO-23795 Implementation



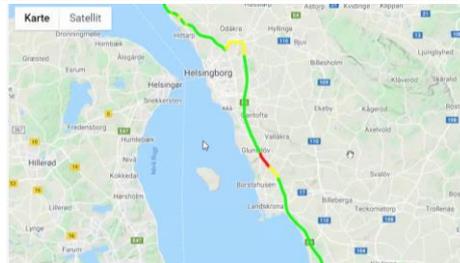
EPI for different speed cycles and profiles: Golf 7

|       | Avg. Speed/[km/h] | Dist./[km] | EPI / [Centilitre/tkm] | STS/[sec] |
|-------|-------------------|------------|------------------------|-----------|
| WLTP  | 18,9              | 3,09       | 4,17                   | 150       |
| REAL  | 28,5              | 4,66       | 4,79                   | 69        |
| 36kph | 29,9              | 4,89       | 2,19                   | 65        |

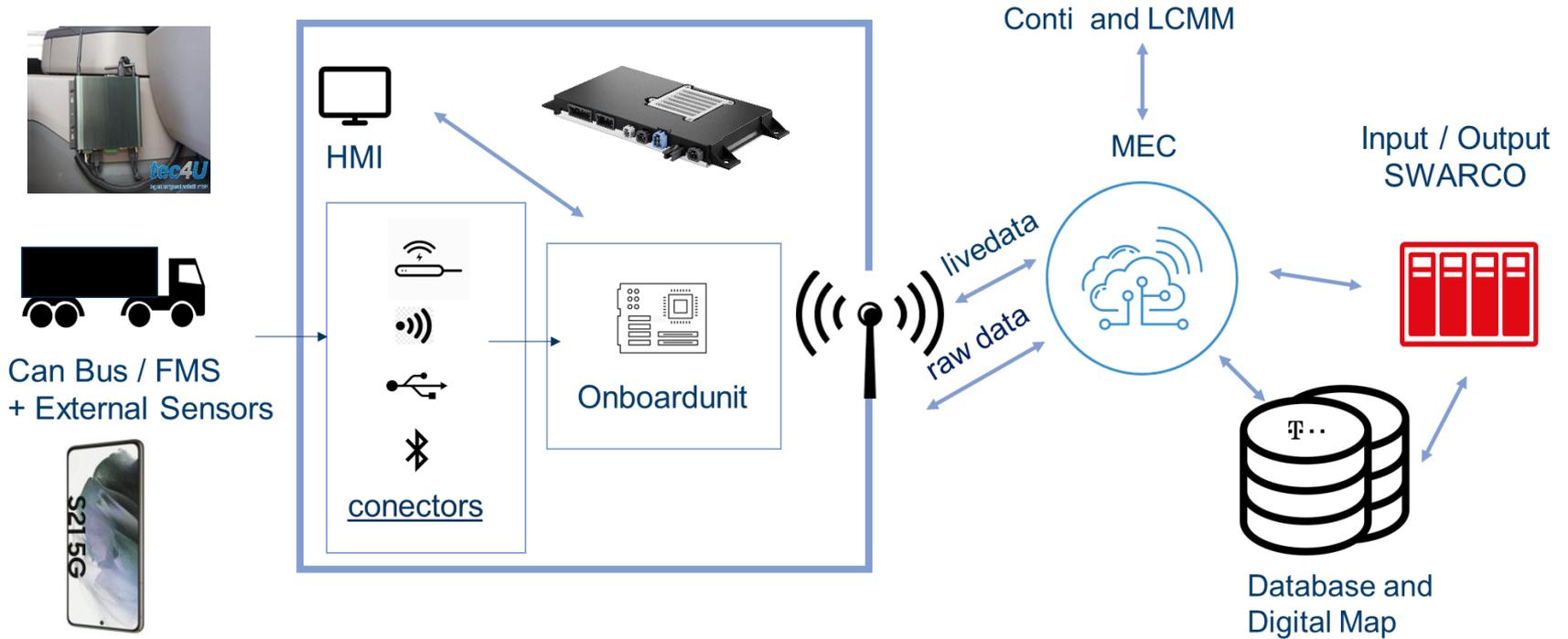
|       | Avg. Speed/[km/h] | Dist./[km] | EPI / [Centilitre/tkm] | STS/[sec] |
|-------|-------------------|------------|------------------------|-----------|
| WLTP  | 18,9              | 3,09       | 4,17                   | 150       |
| REAL  | 28,5              | 4,66       | 115%                   | 46%       |
| 36kph | 29,9              | 4,89       | 52%                    | 43%       |

EPI for different speed cycles and profiles: half-loaded truck

|       | Avg. Speed/[km/h] | Dist./[km] | EPI / [Centilitre/tkm] | STS/[sec] |
|-------|-------------------|------------|------------------------|-----------|
| WLTP  | 18,9              | 3,09       | 3,15                   | 150       |
| REAL  | 28,5              | 4,66       | 125%                   | 46%       |
| 36kph | 29,9              | 4,89       | 34%                    | 43%       |



# Telematics Big Data Fusion and Network Slicing



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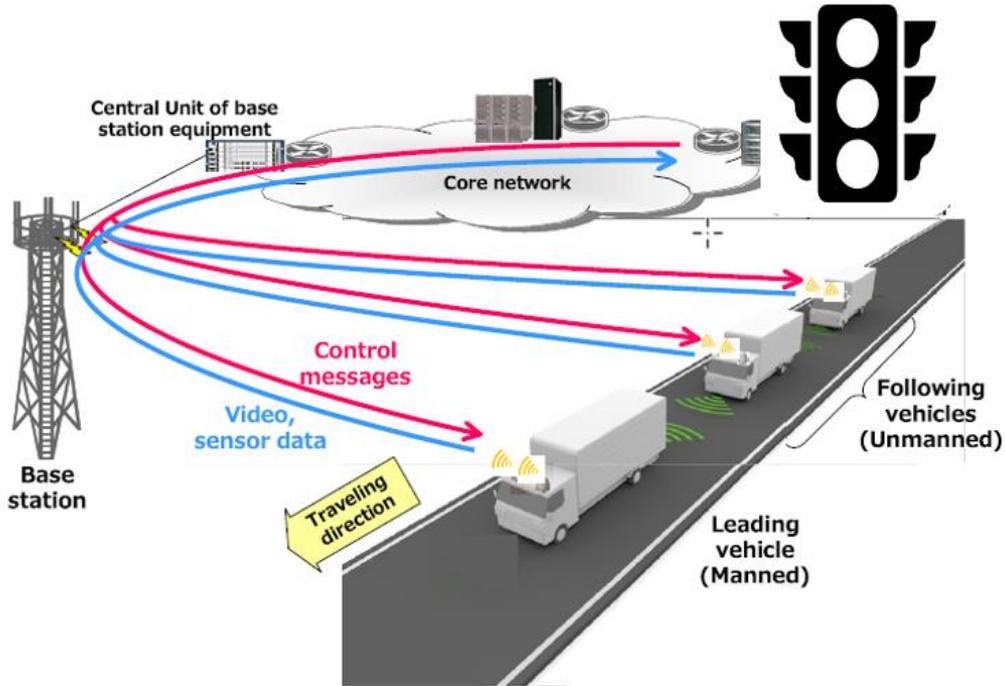


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# Use Cases planned for Living Lab Hamburg



UC8/9

UC10

UC11

FTED by LCMM, ISO/DIS-23795-1, TLF

4G/LTE

5G-Smartphones

enTruck

Conti-IoT

4G/LTE

ATP-GLOSA by 5G V2X and V2V

5G only

MEC

Precise Positioning

uRLLC

5G only

On-board Video

eMMB

5G only

Public 5G System / MEC Server

5G only

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# 4

## 5G-Loginnov Field Trial 2022

KPIs, Evaluation and  
Field Tests

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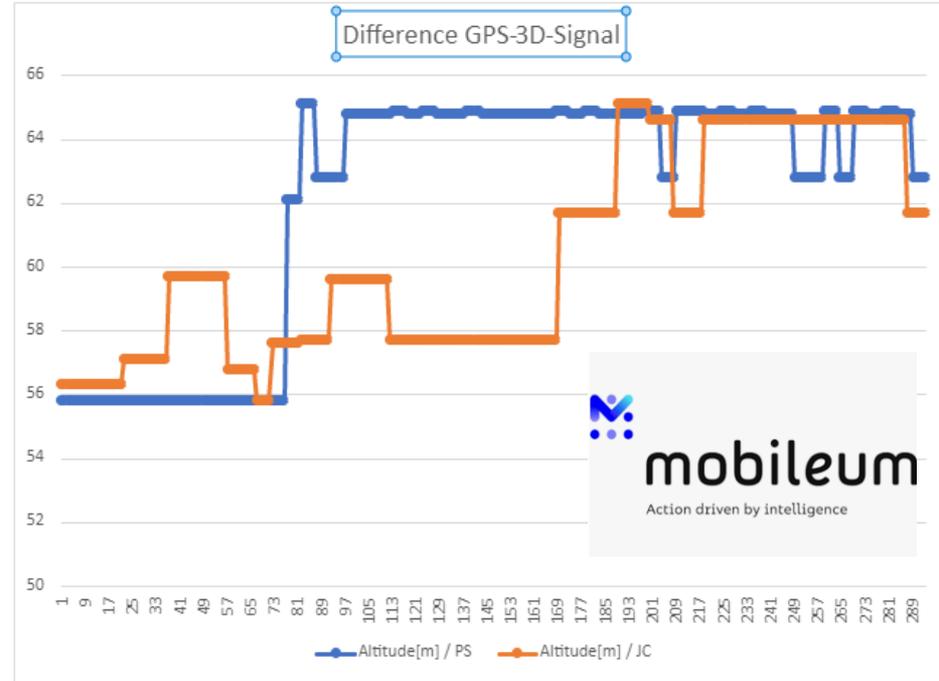
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# Precise Positioning and 5G Network



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Ort: Leinfelden-Echterdingen  
 geogr. Breite: 48.6932  
 geogr. Länge: 9.1314  
 Format:   
 Zoom: 15.00  
 Höhenlinien: anzeigen 1000 500 250 100 80 60 40 1 5 10 20 50 100 250 500 1000  
 beschriften:

Anleitung:

Ausgabe:



Karte

Profil Überhöhung: 2.5-fach

Höhe m. ü. NN: 500  
400  
A B C D  
500 m

Leinfelden  
 Echterdingen  
 Leinfelden-Echterdingen

Leinfelden-Echterdingen  
 Leinfelden  
 Echterdingen  
 Eselsmühle  
 Mäulesmühle



Landesmedienzentrum  
 Baden-Württemberg

- Stadtmedienzentrum Karlsruhe
- Stadtmedienzentrum Stuttgart
- Newsletter
- Intranet
- Stellangebote
- Kontakt
- Impressum
- Datenschutz

8dfe-08797106e81c

Geschwindigkeitsprofil

Höhenprofil

Emissionsprofil

Wegprofil

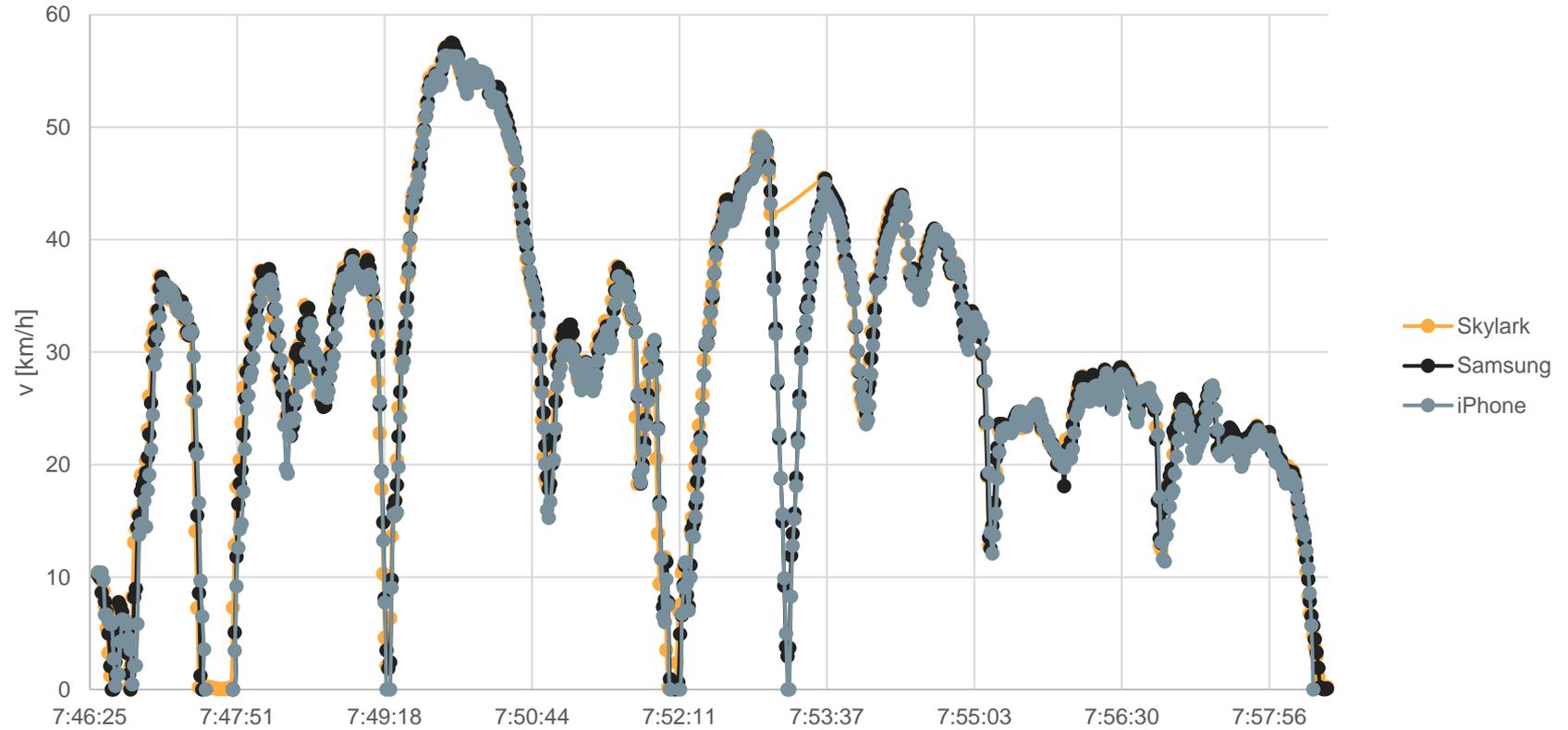
Info



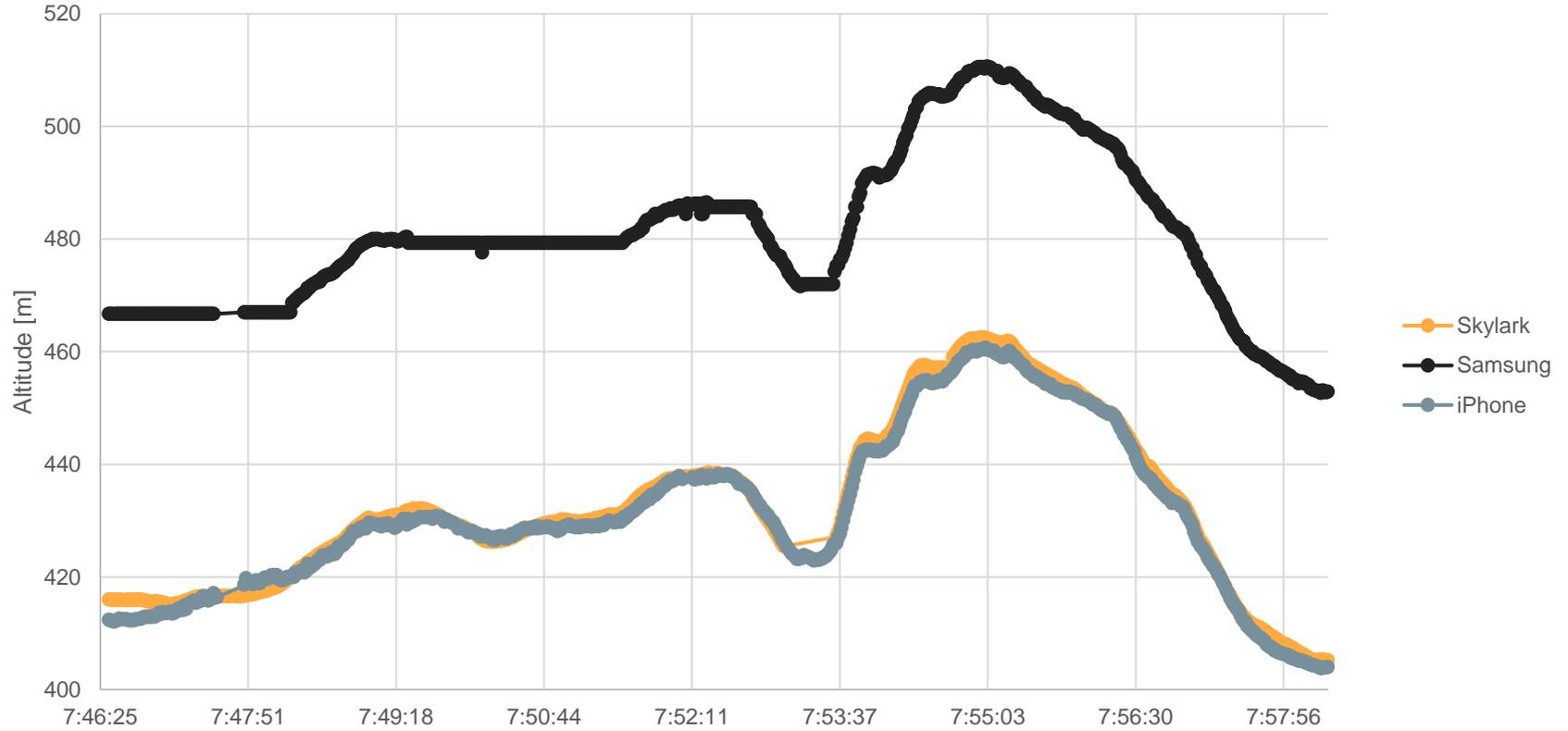
KML herunterladen

CSV herunterladen

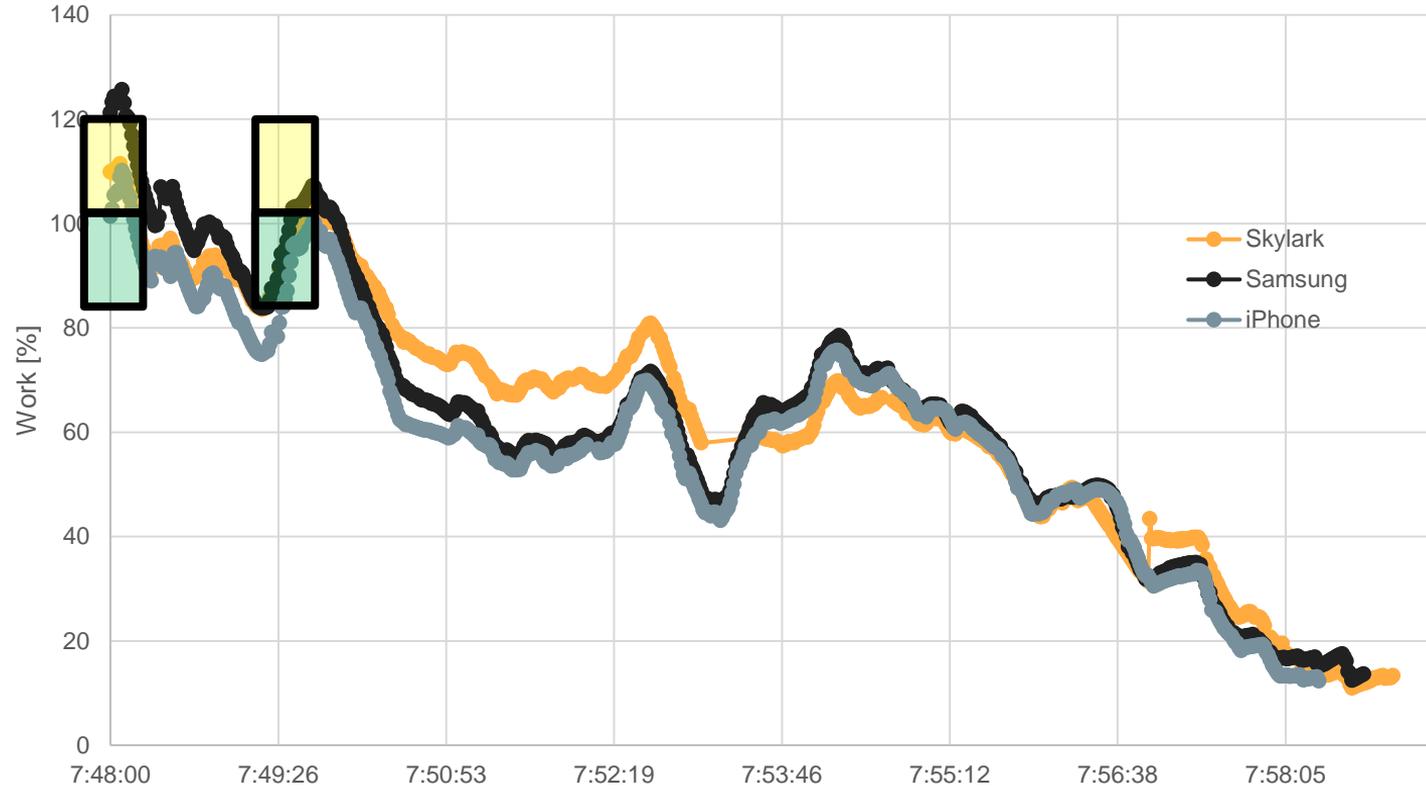
Geschwindigkeit [km/h] vs. Time



Höhe / [m] vs. Time



Energie [%] vs. Time



X

|                |                  |
|----------------|------------------|
| Date           | 2025-07-12       |
| Speed          | 07:48:10         |
| PercentageWork | 50.04 kmh        |
| Route          | 161.20 - Von.161 |

Wohndekor Inn Müller 2025

3605-27-13  
07.08.13  
Speed: 34.99 km/h  
Perzentagen: 38 %  
Route: 146.316 - 300.760

Mikrometeorologie

Wahrdecker Inh. Müller, 2013

# 5

## Public Transport V2X and Remote Control

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# SHOW

## Facts & Figures



01/2020 – 01/2024  
(48 months)



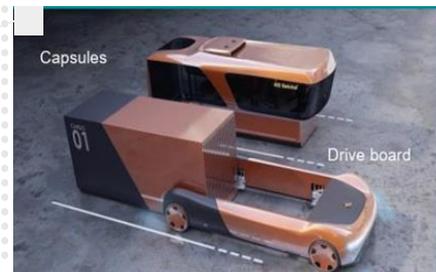
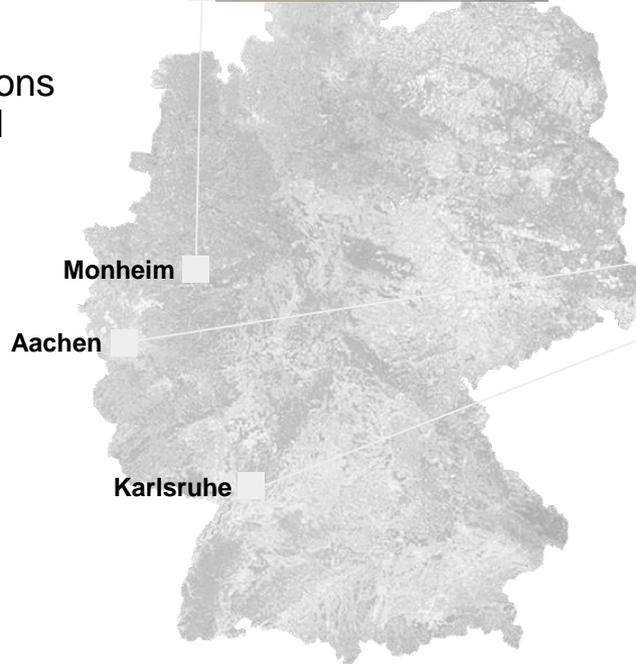
Twinning actions  
with 11 global  
organisations



69 partners  
from 13 EU-  
countries



30 million €



### T-Systems contribution

#### Technical project lead for the Mega Site Germany

- V2X integration
- 5G implementation
- Demonstration of modular vehicle for mixed passenger-cargo transport services (Karlsruhe)

#### Consulting for Business Models and Exploitation

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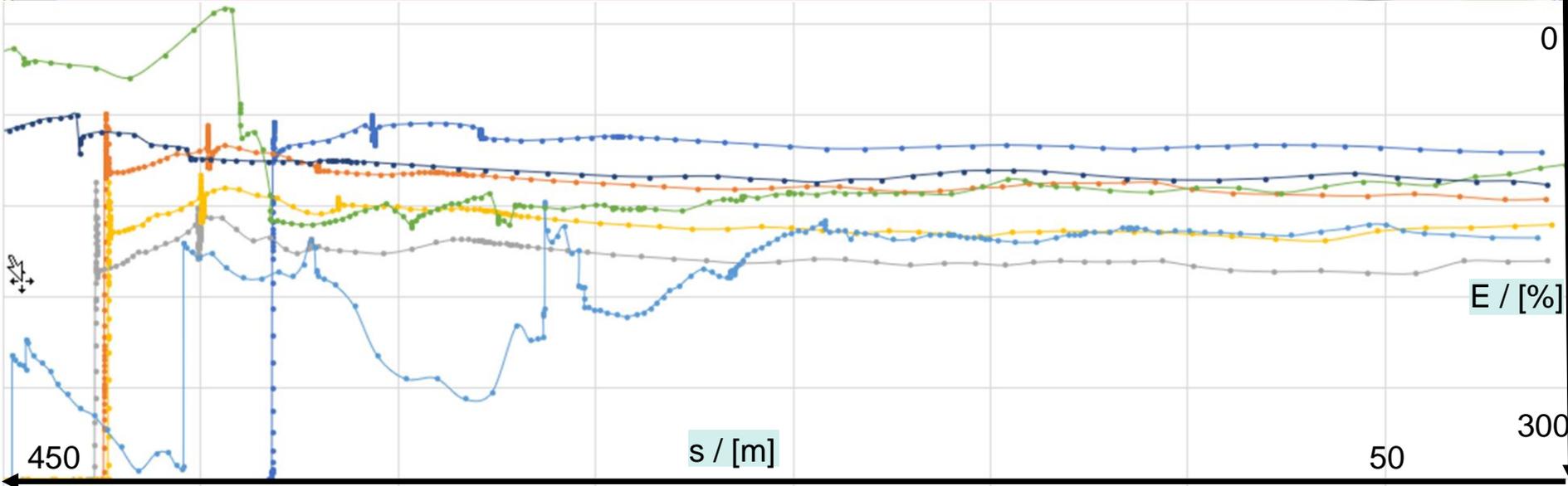
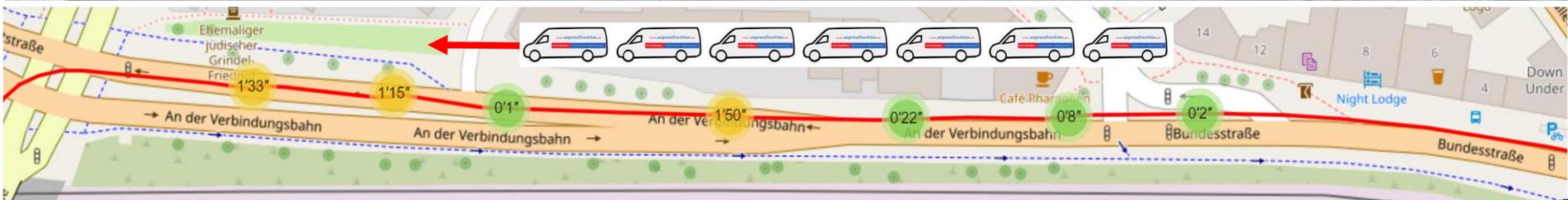


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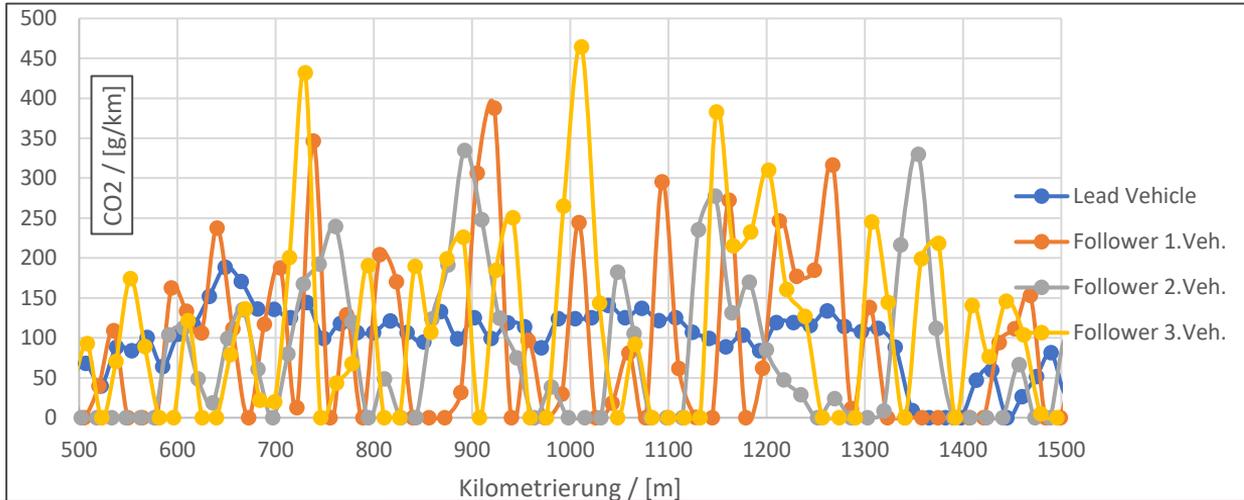


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# First platooning tests using ISO/DIS-23795

| Communication scenario  |                              | Payload (Bytes) | Tx rate (messages per second) | E2E latency (ms) | Reliability (%) | Data rate (Mbps) | Min range (m) |
|---|------------------------------|-----------------|-------------------------------|------------------|-----------------|------------------|---------------|
| Scenario  | Degree                       |                 |                               |                  |                 |                  |               |
| Cooperative driving for vehicle platooning<br>Information exchange between a group of UEs supporting V2X application. | Lowest degree of automation  | 300–400         | 30                            | 25               | 90              |                  |               |
|   | Low degree of automation     | 6500            | 50                            | 20               |                 | 350              |               |
|   | Highest degree of automation | 50–1200         | 30                            | 10               | 99.99           |                  | 80            |



**Green4TransPORT: Das Projekt**

**Vorteile**

- Verkehrsfloss verbessern: Weniger Stop + Go
- Kraftstoffverbrauch + Schadstoffausstoß reduzieren
- Wenn gewünscht: Nennung als Projekt-Testpartner (G4T ist ein Ankerprojekt des ITS Weltkongress 2021)

**Zielsetzung**

- Proof of Concept: Pilotprojekt zur Erprobung der V2X Anwendungen
- Evaluation: Einfluss auf Verkehrsfloss und Schadstoffausstoß

**Funktionalität für Testteilnehmer**

- Verlängerung der Ampel-Grünphase erhalten

**Die Teststrecke**

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# GET IN TOUCH

T-Systems

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**T-Systems International GmbH**

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Mobile: +49 160 5365453

Exhibition Partner:  
T-Systems Hall B5, booth number  
B5.140

To see 5G technology live,  
please book in the I.T.S.  
APP:

**5G-Loginnov Demo-Tours**

Tue. 12.Oct. 10am – 4pm

Wed. 13.Oct. 10am – 4pm

Thu. 14.Oct. 10am – 4pm

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