5G Loginnov – Lessons Learned

Ralf Willenbrock | Ameron Hotel | 23.02.2023

Agenda

01 **Introduction to 5G Loginnov Living Labs**

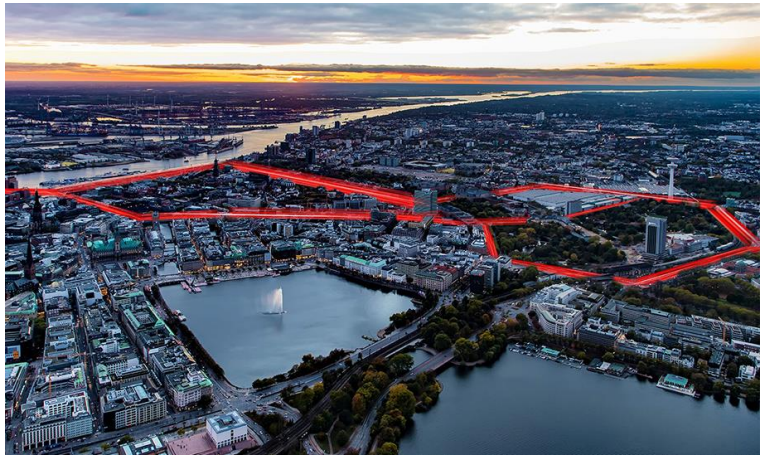
02 **Testfield Autonomous Driving & LL Hamburg**

03 **Ecosystem & Benefits**

04 **Results**
Reduction of standstill
Measurable reduction of carbon emissions

05 **Roadmap to 6G**

Introduction to 5G Loginnov Living Labs



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)

UC3: Optimal selection of yard trucks

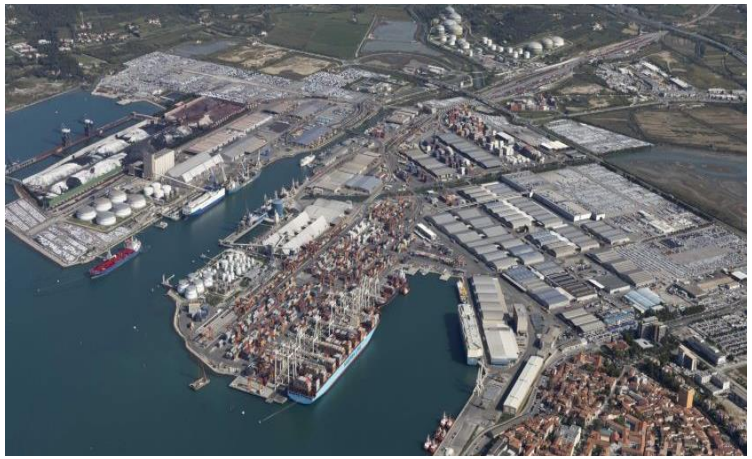
- Installation of a 5G access point on yard trucks
- 5G latency, precise localization services, etc.

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

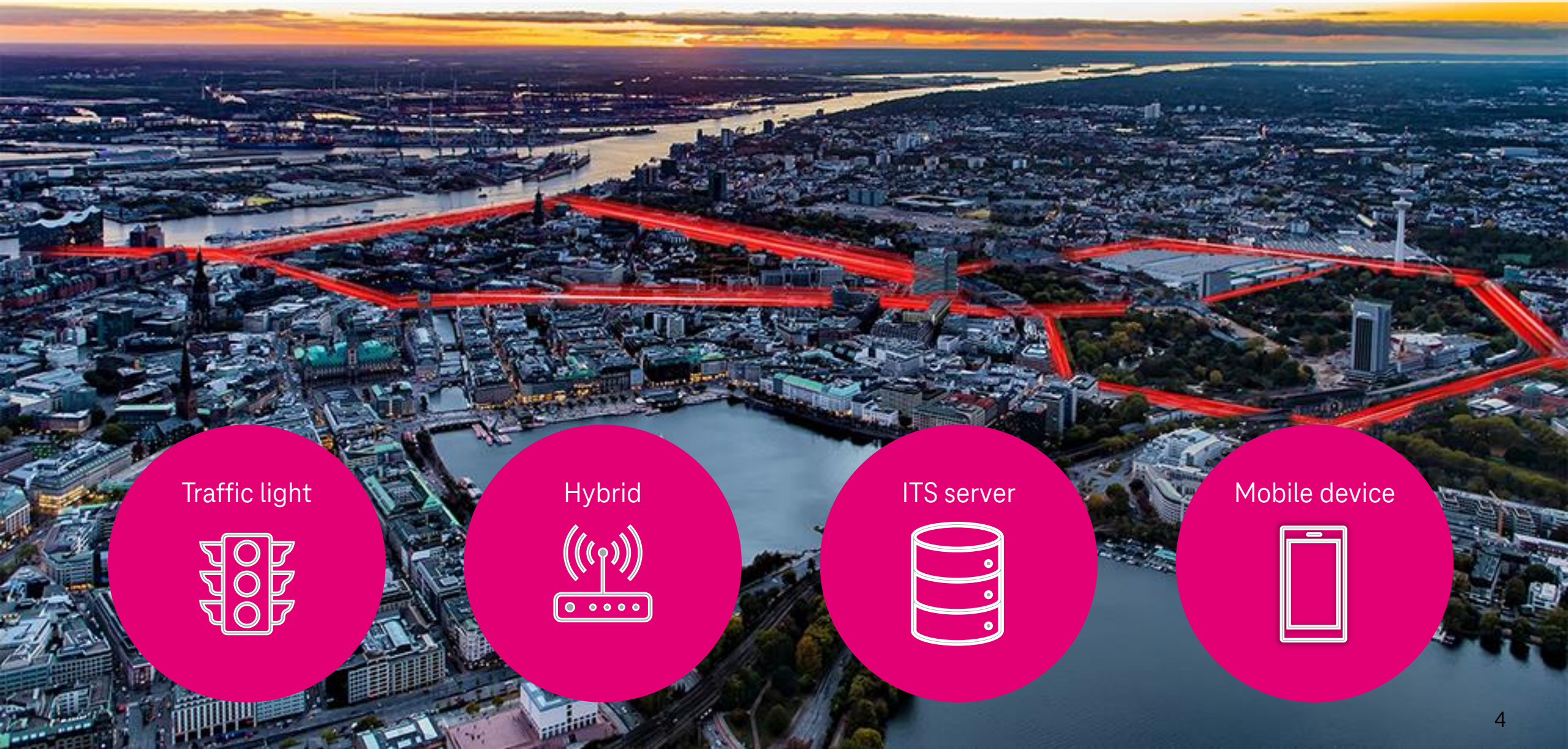


UC1: port control, logistics and remote automation

UC2: business critical and mission critical communications

Co-financed by the European Union
Connecting Europe Facility

Testfield autonomous and connected driving (TAVF)



5G Loginnov – Partners & SMEs involved

T-Systems

Continental

TAVF

tec4U Ingenieurgesellschaft mbH

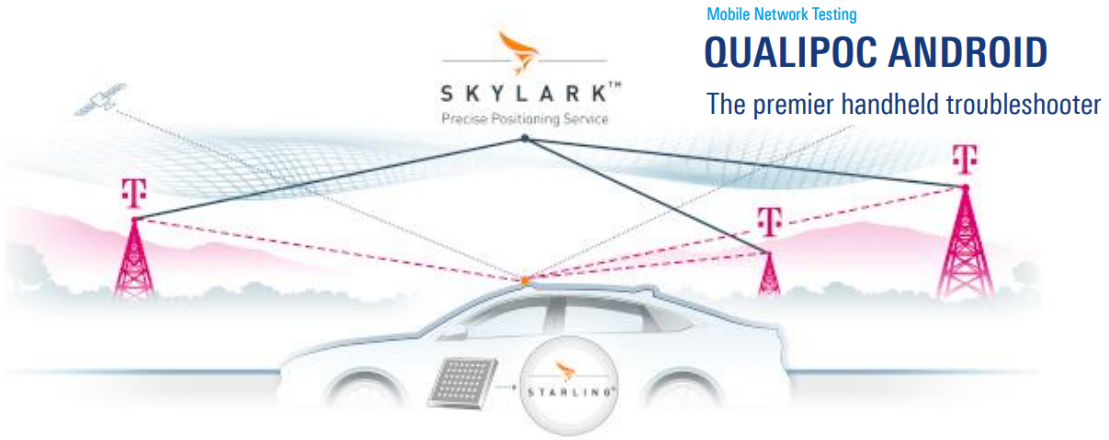
HAW HAMBURG

UZE MOBILITY

roads.ai digital roads for digital drivers

e-Shuttle

5G – Why? Precise Positioning, Big Data and More



In 2021, within the EU Project „5G-Loginnov“ (www.5g-loginnov.eu), a field trial in Hamburg took place where 80 platooning trips were recorded along the Test field for Autonomous and Connected Driving (TAVF)

In 2022, another 150 platooning trips were registered with the Time-to-Green information, given via GPS equipped smartphones to the drivers of the platoon

For carbon monitoring, the T-Systems ISO-23795-1 APP was used comparing the emissions with and without Time-to-Green to measure and quantify the potential savings and the positive environmental impact using 5G cellular V2X (Connected Automated Mobility – CCAM)

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LCMM – T-Systems solution to measure consumption & emission

Just take a smartphone and Newtonian physics …

$$= \eta b_e \frac{\int_o^T (F_{acc} + F_{brake} + F_{roll} + F_{air} + F_G) v(1s) dt}{\int_o^{T'} v(1s) dt}$$

$$(2) \Phi \left[\frac{Liter}{100km}\right] = \Phi(v > 0) + \Phi(v = 0)$$

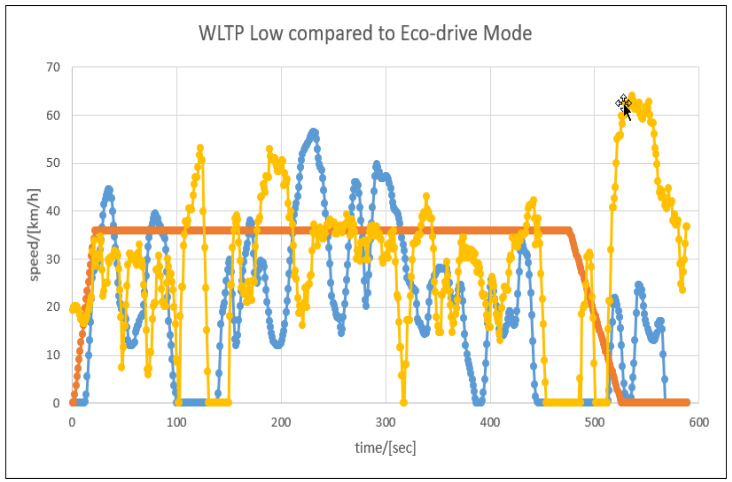
$$(1.a) F_{acc} = m * \frac{dv}{dt}, dv > 0$$

$$(1.b) F_{brake} = \beta m * \frac{dv}{dt}, dv < 0$$

$$(1.c) F_{air} = \frac{\rho}{2} * A * c_w v^2$$

$$(1.d) F_{roll} = mg\mu$$

$$(1.e) F_G = mg * sin(\alpha)$$



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

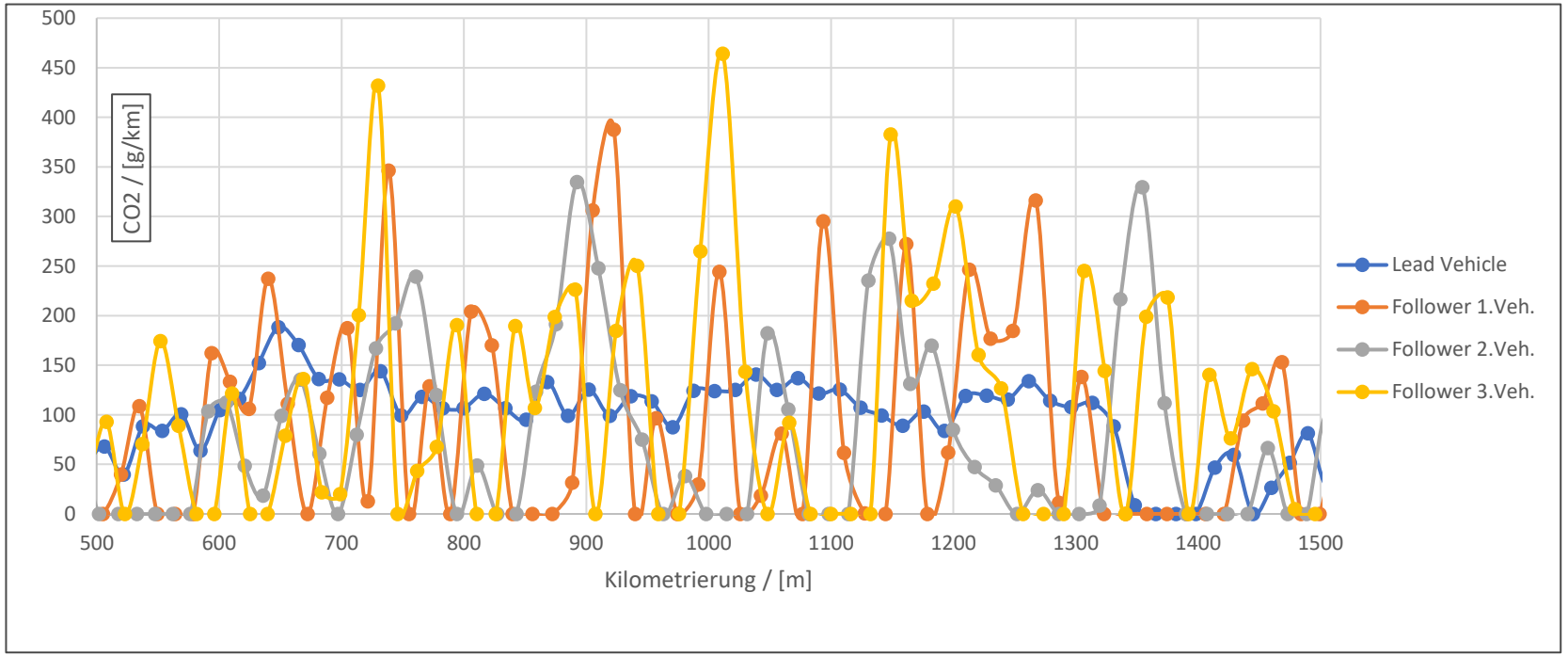
	Avg. Speed/[km/h]	Dist./[km]	EPI / [Centilitre/tkm]	STS/[sec]
WLTP	18,9	3,09	3,15	150
REAL	28,5	4,66	125%	46%
36kph	29,9	4,89	34%	43%

ISO 23795-1:2022

Intelligent transport systems — Extracting trip data using nomadic and mobile devices for estimating C02 emissions — Part 1: Fuel consumption determination for fleet management

5G-Loginnov test trips and evaluation (2021)

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	Lowest degree of automation	300–400	30	25	90		
Information exchange between a group of UEs supporting V2X application.	Low degree of automation	6500	50	20			350
	Highest degree of automation	50–1200	30	10	99.99		80



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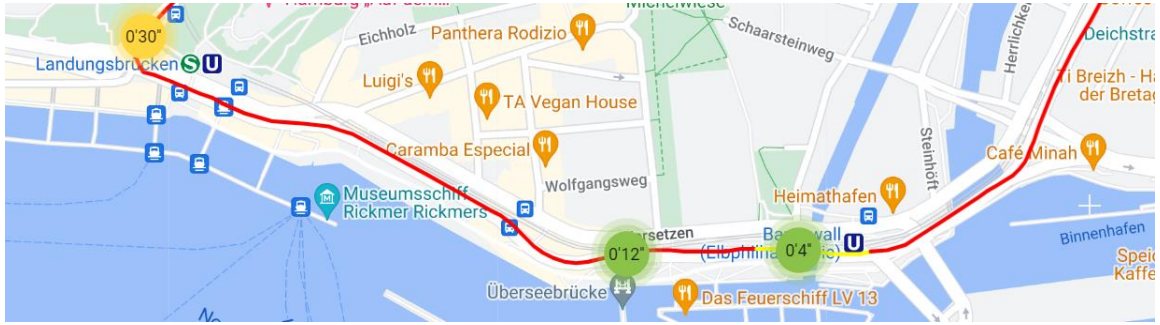
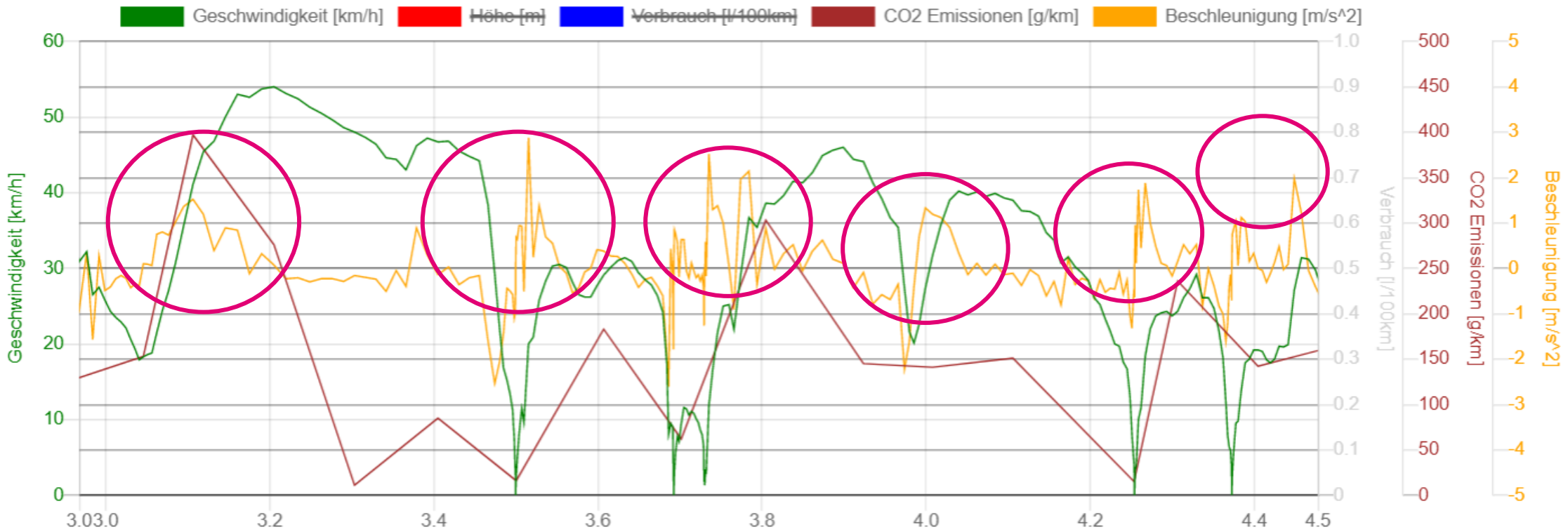
Test trip Sept. 15th 2022, Segment Landungsbrücken, WLTP %ACC 164%



Karte | Geschwindigkeitsprofil | Höhenprofil | Emissionsprofil | Wegprofil | Info



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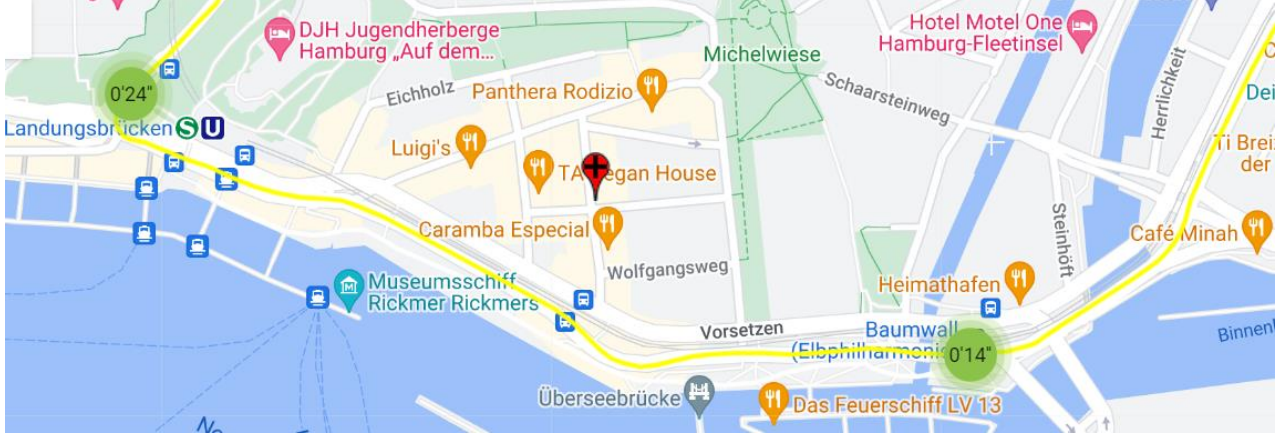
Test trip Sept. 13rd 2022,
Segment Landungsbrücken,
WLTP %ACC 107%



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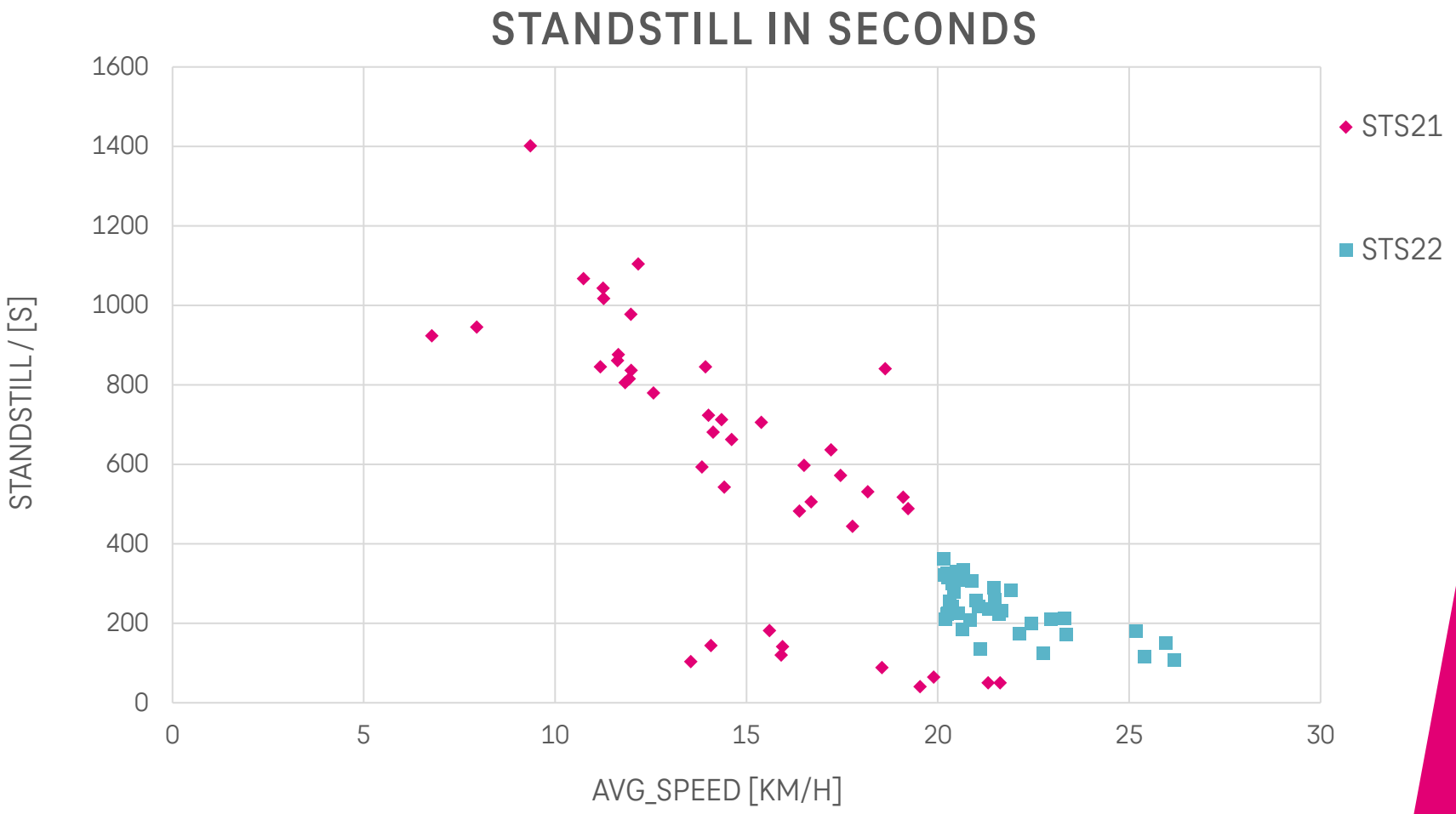
Reduction of standstill



Results

No GLOSA - Tests 2021

- 15 km/h
- 613s

GLOSA - Tests 2022

- 22 km/h
- 214s

- No GLOSA has 3-times the standstill

Measurable reduction of carbon emission

For saving 1 ton of CO2

You would have to plant 80 trees…

…or equip 80 taxis in Hamburg with 5G GLOSA

Ecosystem & Beyond 5G Benefits

Vulnerable road users, Public Transportation

Low Latency Collision Alerts (multi-modal)

Intersection Object Detection (NaaS, CCAM)

Traffic managers, Authorities

Cloud based Online Traffic Information (Bn p.m.)

Impact assessment for corridor management

Industry, Logistics, Fleets

Green Navigation via real Space-Time relevant trip data

Iso conform energy monitoring, reliable fuel and CO2 reporting, Carbon Certificates

Mobility service provider

B2B Marketplaces for data and advertisement

Seamless and multimodal mobility services

CO2 certificates to promote low carbon modes

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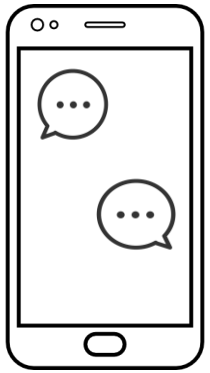
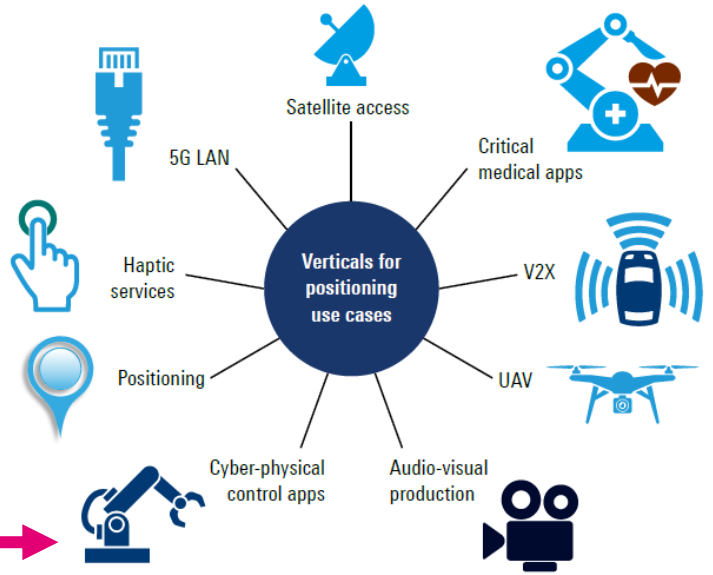
Roadmap towards 6G

Note: No new network (“5G is last G”)





1G	2G	3G	4G	5G	6G
1980 -	1990	2000 -	2010	2020 -	2030

Establishing cell phones for everyone → Always connected with a variety of applications → **One integrated network**

5G is the starting point of Industrial IOT

3GPP specifies the evolution path beyond R15

- China launched first 6G satellite 2020
- High Frequency Test, Vacuum Conditions
- Network sensing due to >60 GHz bands
- 6G => 100 times 5G => 4G
- Enables Seamless Container Tracking
- GNSS Tracking: Long-Life Battery Supply
- No Reverse Tracking Device Management

Let’s create our future!
Connect with us:

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← ICS ← 13 ← 13.020 ← 13.020.40

ISO 23795-1:2022

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#GREEN MAGENTA