5G-enabled technologies on Smart Cities and Mobility: new opportunities and business challenges

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Vertical

IEEE World Forum on Internet of Things

5G LOGINNOV – Facts & Figures

5GLOGINNOV

Start 10 oct 2020, duration 36 months

7,9 million €

Consortium with 15 members from 7 countries (BE, FR, IT, RO, GR, SL, DE)

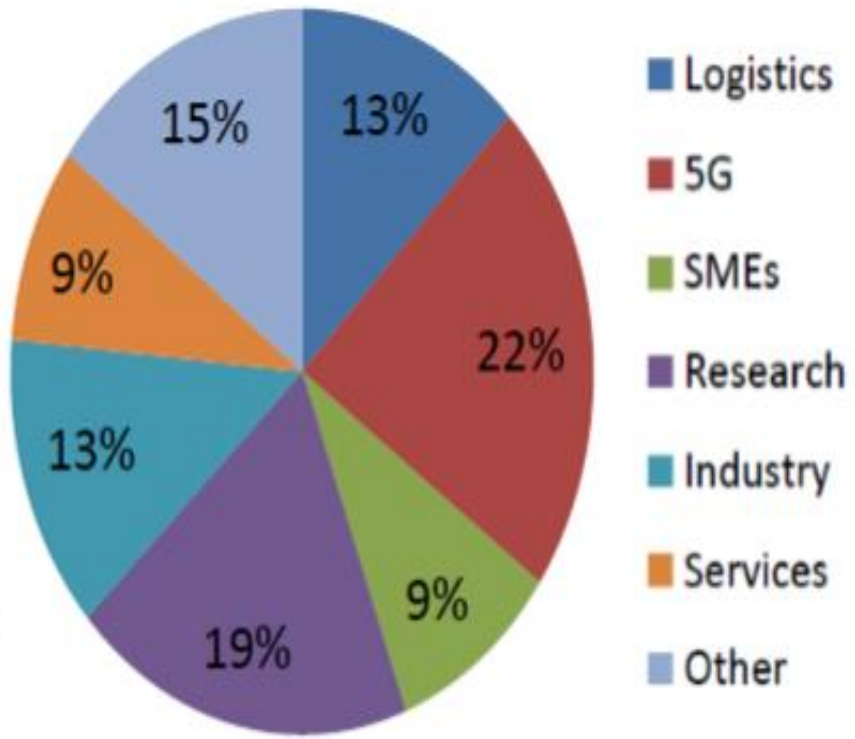
Members represent stakeholders from Logistics, Automotive and Telecom Industry working closely with Infrastructure operators and Research Institutes.

SMEs and Start-Ups will be integrated for future 5G market uptake across Europe

Project members

- ERTICO
- AKKA
- CIRCLE
- Continental
- ICCS
- ICOOR
- ININ
- Luka Koper
- PCT
- SWARCO
- tec4U
- Telekom Slovenije
- T-Systems
- VICOM
- VODAFONE

Per type of partner:



Project partners

ERTICO ITS EUROPE

swarco

ICCS ΕΠΙΣΕΥ

ΟΛΠ PIRAEUS PORT AUTHORITY S.A.

Vodafone Innovus

AKKA PASSION FOR TECHNOLOGIES

Circle Touch your ideas

ICOOR

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TelekomSlovenije

Continental The Future in Motion

vicomtech MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

internet INSTITUTE

tec4U Ingenieurgesellschaft mbH

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Opportunities and business challenges:
Smart Cities and Mobility

- 5G-LOGINNOV aims to support the **new generation of 5G-CAD terminals**, **new type of IoT-5G connectivity devices** through **technical solutions, business models and priority scenarios** by deploying new **CAD in real-life city areas (Hamburg, Athens, Luka-Koper=intelligent hubs & network optimisation-**multi/ synchromodal transport**)**.
- 5G-LOGINNOV's central innovation is to build a first-class European industrial supply side for **5G core technologies and new IoT-5G devices** (e.g. slicing, eMBB, uRLLC, mMTC, MEC, 5G-NR) with global market footprints.
- .
- The project has a strong interest in the emergence of new market players, such as SMEs and start-ups, taking advantage of the growing adoption of distributed cloud computing technologies in 5G networks and making possible open innovation at service level in the logistics and Industry 4.0 sectors.
- 5G-LOGINNNOV contributes to the emergence of global standards and **globally harmonised frequency bands for 5G** in the context of related developments at the level of global bodies like **3GPP, ITU and 5G standards (Rel. 16/17**).
- Being part of the third 5G PPP phase implies supporting the development of a "lead" market involving cooperation models with key vertical sectors contributing to the wider policy objectives of industry digitisation in the Digital Single Market.

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PROJECT FRAMEWORK-Hamburg Living Lab (I)

Use cases enabled

- Autonomous Driving (HWCH)
- Platooning

Short-range communication

- ITS-G5 802.11p
- C-V2X PC5

Long-range cellular communication

- LTE (4G)
- Multi-access Edge Computing (MEC)

Backend systems

- Traffic information systems

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PROJECT FRAMEWORK-Hamburg Living Lab (II)

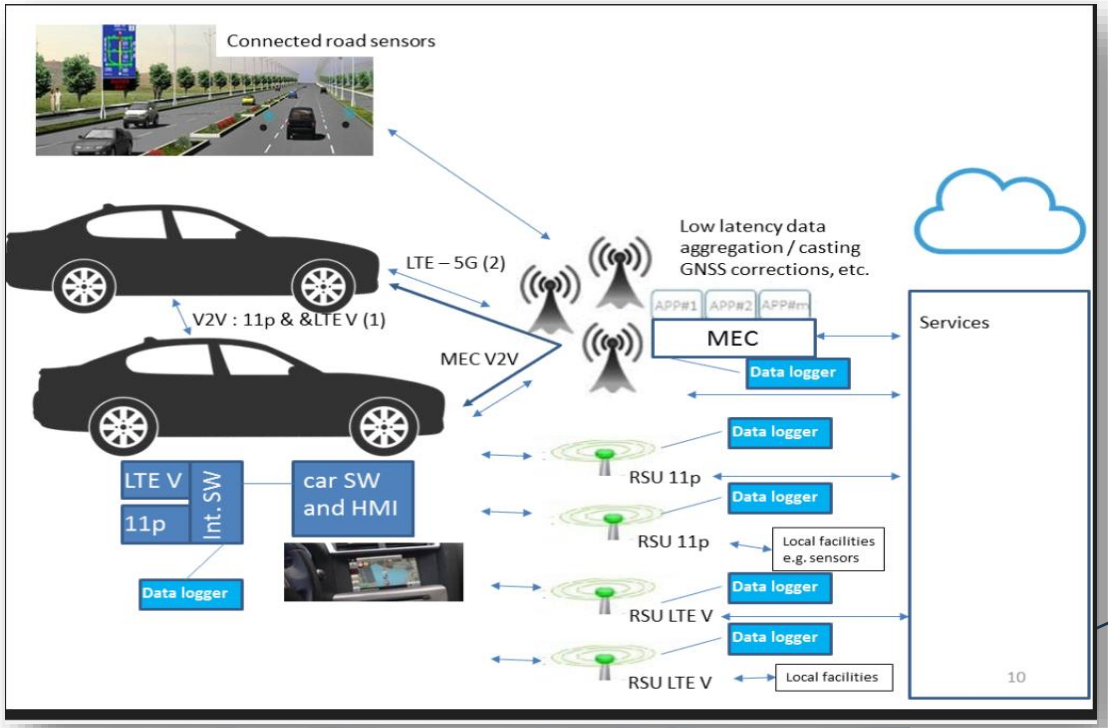
- Mobile Edge Computing, low latency communication (uRLLC) and advanced IoT, including massive Machine Type Communication (mMTC)
- Hamburg Port Authority (HPA) already traffic lights operated in the ferry port and cruise terminal area to guarantee a seamless traffic flow within the heart of Hamburg's tourist zone near "Landungsbrücken"

- **Connectivity in Hamburg.** Deutsche Telekom operates the public 5G network which covers the designated testfield for connected and automated driving (TAVF).

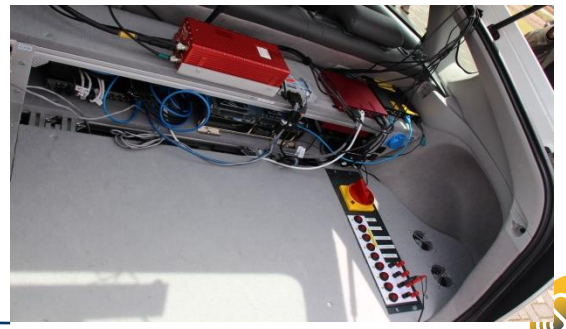
- **6G-enabled Teleoperated Driving and Multi-Modal Platooning:** uRLLC + eMBB + and mMTC+. The ISAC systemin the E-Band (71-73.4GHz) together with Multi-access Edge Computing (MEC) to support the GLOSA+ in city ATP(Automated Truck Platooning) use case.

- **Multi-sensorial collision alerts and VRU Assistance beyond 5G:** optimizes the control of traffic signaling systems and detects vulnerable road users thanks to multi-sensorial traffic data, including anonymous video data. The deployment of sensing capabilities from the infrastructure uses an Integrated Sensing and Communication (ISAC) system in the E-Band (71-73.4GHz) to enhance the perception of vehicles

USE CASE: Autonomous driving



- Hybrid communication architecture/
  - *Hybrid IEEE 802.11p & LTE-Uu communication architecture*
  - *Evaluate IEEE 802.11p and LTE-V mode 4*
- Newest communication technologies
- Coexistence
- Connected automated driving services
- Practical, real-life and complex environments)



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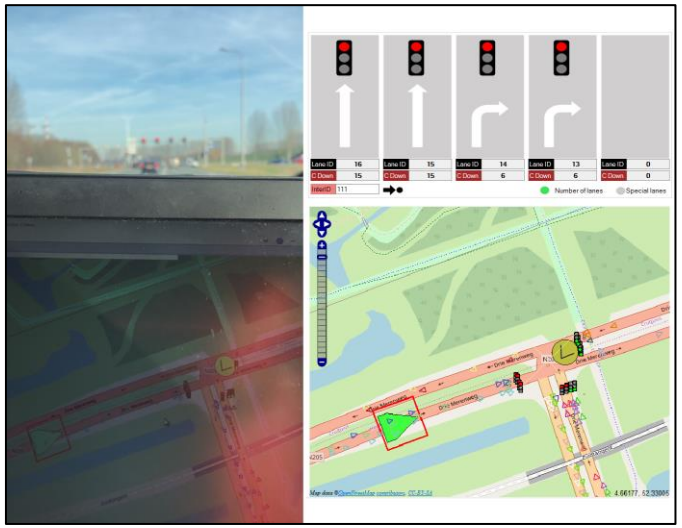
Green Light Optimal Speed Advisory

GLOSA:

- Intelligent Traffic Light transmitting MAP and SPAT messages.
- The Host Vehicle receives and decodes the messages from the TL.
- The driver is informed through the HMI about the TL phases and the timing to the phase changes.
- Lane level positioning is reached.

Display on Vector CANoE Car2X



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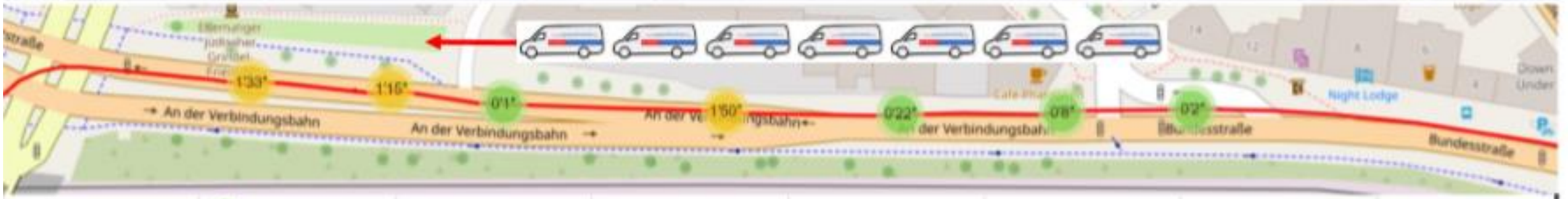
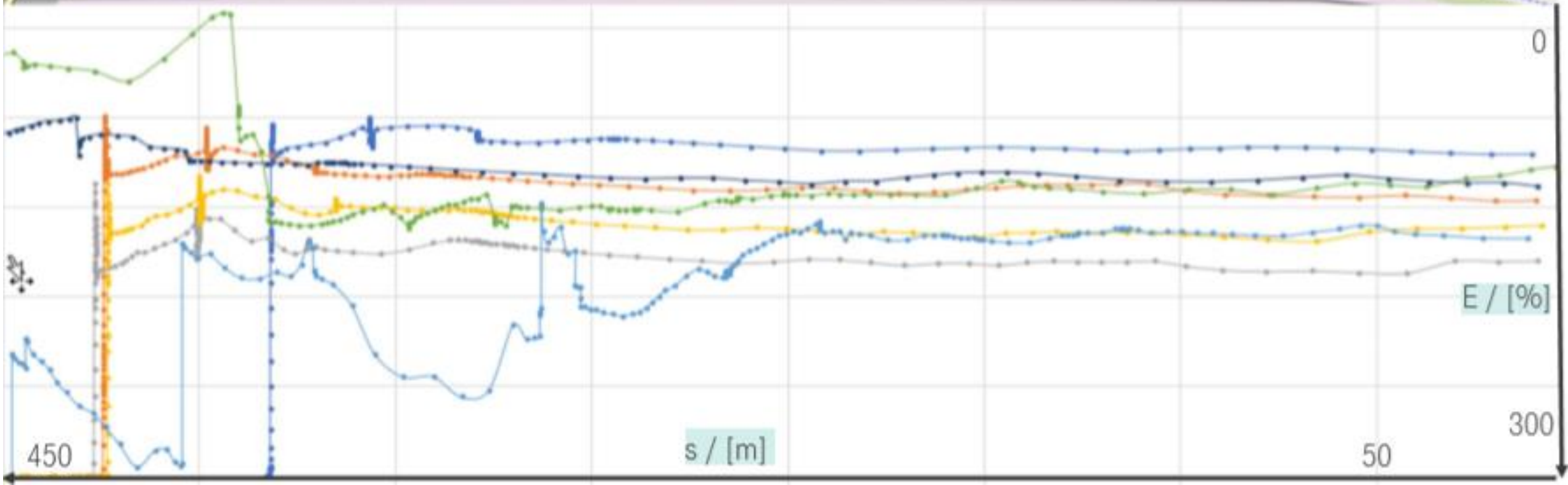
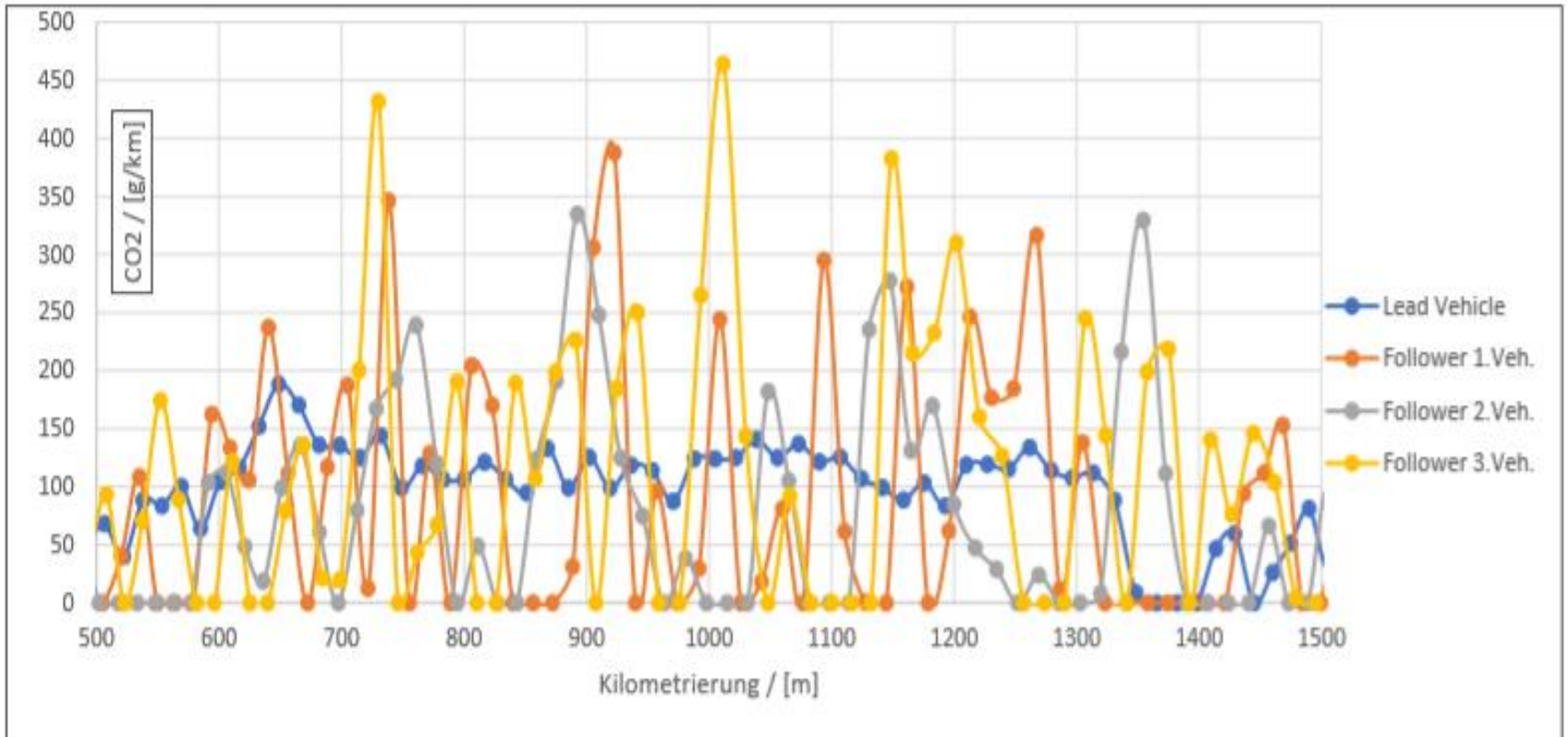
USE CASE: Platooning



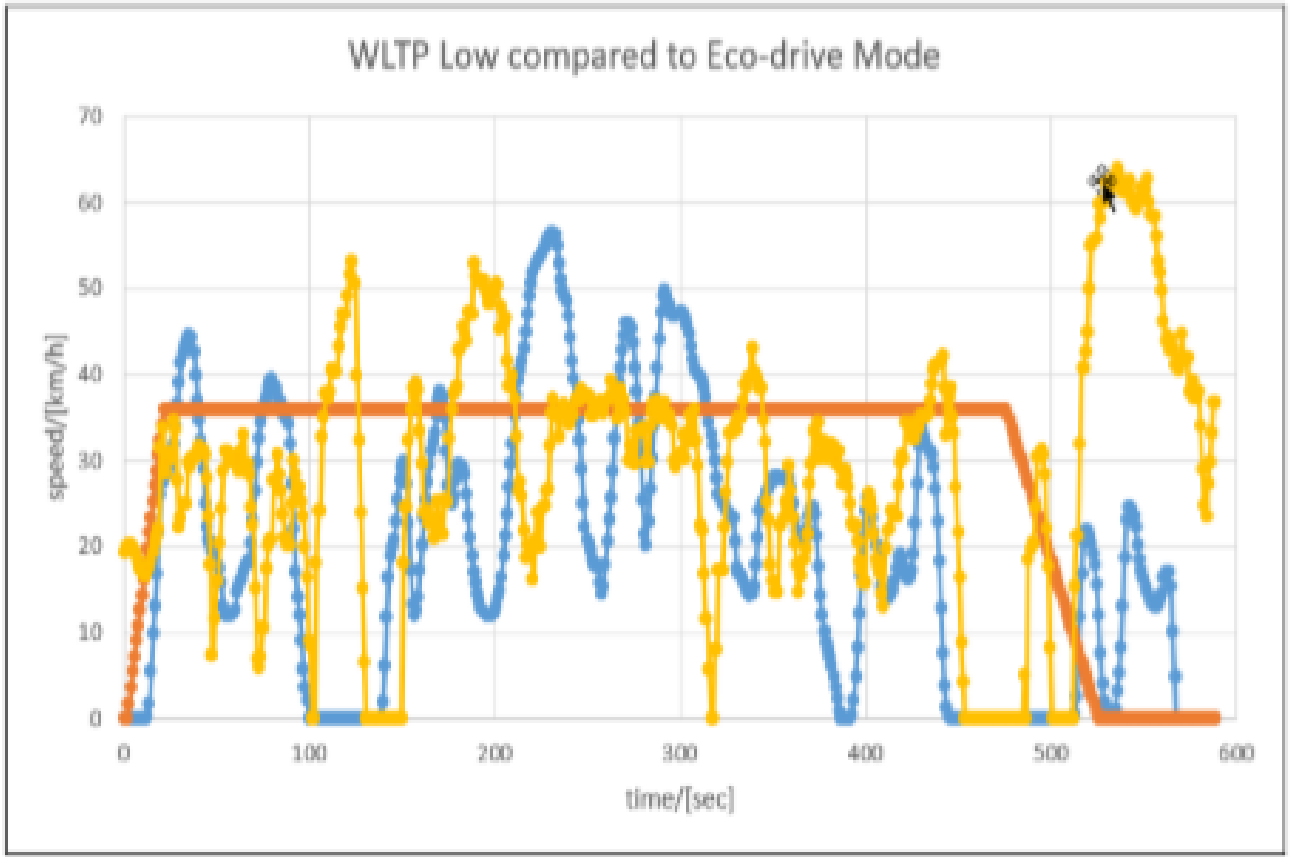


First platooning tests using ISO/DIS-23795 Carbon Monitoring

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



LCMM – Impact Assessment



tec4U
Ingenieurgesellschaft mbH

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%

DLR Deutsches Zentrum für Luft- und Raumfahrt

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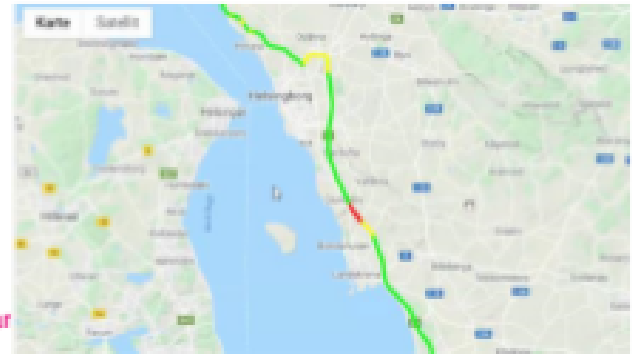


Hamburg Living Lab-preliminary results (I)

KPI	Vehicle Mode	Results
Increase average truck speed	Single	> 5 %
Reduction of average acceleration activities		> 5 %
Reduction of stillstand time		> 5 %
Increase average truck speed	Platoon	Plus > 4 %
Reduction of average acceleration activities		Plus > 4 %
Reduction of stillstand time		Plus > 4 %
Reduction of fuel consumption	Single	12 %
Reduction of CO_2 emission		12 %
Reduction of fuel consumption	Platoon	Plus 10 %
Reduction of CO_2 emission		Plus 10 %
Increase energy performance index 'EPI - cl per ton and km'	Overall	10 – 20 %
Increase acceleration performance index 'API - KWh per ton and km'		10 – 20 %
Extended cellular bandwidth on urban roads by 5G network		Max. 800 Mbit/s
Positioning quality on urban road networks with 5G by 10 cm		< 1 m
signal latency in the 5G environment		avg. 20 ms
Average rate of packed errors during 5G data transmission		5 - 15 %

Preliminary results (II)

GLOSA

C-ITS Traffic lights benefits on AD & Connected vehicles

- C-ITS Traffic lights help extending AD Operational Design Domains.
- AD & Connected vehicles are 5.7% faster than regular vehicles at crossing C-ITS traffic lights.
- Human driven vehicles stay at zero speed 2.08 times the amount that AD & Connected vehicles do.

C-ITS Traffic lights compliance analysis

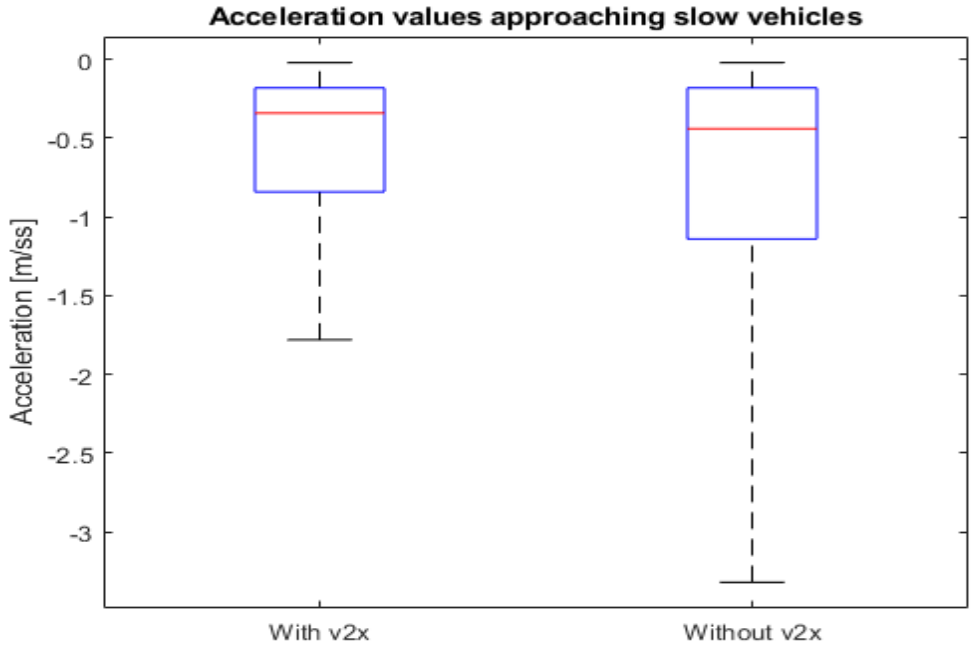
- MAP messages broadcast from the infrastructure are adequate for AD & Connected vehicles.
- Broadcast frequency of SPAT messages is rarely larger than 1Hz. Since these traffic lights are highly adaptive, update frequencies shall be 10 Hz (100 ms updates).
- Cases of SPAT messages content (min, max, likely time) not filled-in. At least the timings related to the current phase need always to be available for speed optimization.

Preliminary results (III)

V2V IMPROVED DRIVING SAFETY AND COMFORT

The tests performed on AD vehicles equipped with V2V, and non equipped highlight the importance of vehicle to vehicle communication in smoothening the decelerations in case of very slow moving vehicles.

- with V2X ~ -1.7 m/ss
- without V2X ~ -3.5 m/ss .



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Need for 6G candidate technologies-future works(I

AI-Enabled Networks: it's expected to integrate also artificial intelligence (AI) and machine learning (ML) into network operations, enabling more efficient and intelligent network management

Massive MIMO: it's also expected to use massive MIMO (Multiple Input Multiple Output) technology, which uses a large number of antennas to transmit and receive data simultaneously.

Dynamic Spectrum Access: in the near future it's expected to support dynamic spectrum access, which enables flexible and efficient use of available spectrum resources.

Network Slicing: it's expected to support network slicing, which allows multiple virtual networks to be created within a single physical network infrastructure.

Edge Computing: it's expected to support edge computing, which involves processing data and running applications at the network edge, closer to where the data is generated.

Need for 6G candidate technologies-future works(I

Integrated Satellite-Terrestrial Networks: it's important to support seamless integration between satellite and terrestrial networks, which could enable global coverage and connectivity for a wide range of applications, including autonomous vehicles, remote sensing, and disaster response.

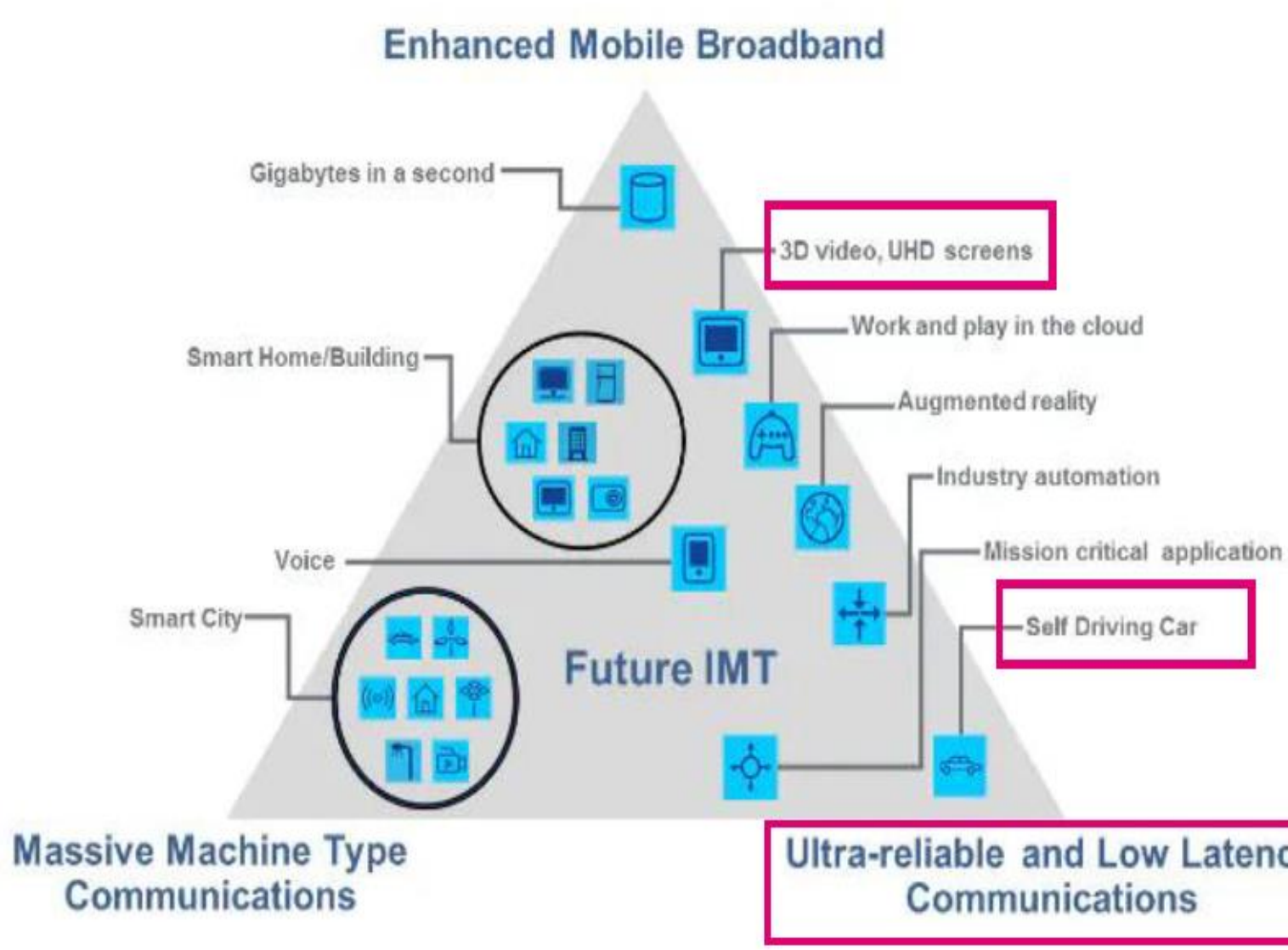
Massive IoT connectivity: if would like to connect seamless millions of IoT devices, enabling a range of applications in smart ports, autonomous vehicles, autonomous drones, vehicle robots and precision positioning.

Augmented reality (AR) and virtual reality (VR): B5G/6G could enable high-speed and low-latency communication, which could enhance the experience of AR and VR applications for seals & containers.

Energy-Efficient Communication: it's needed in order to support much higher data rates and more connected devices than 5G, which could lead to increased energy consumption and carbon emissions.

Environmental monitoring: B5G/6G networks could be used to monitor the environment in real-time, providing insights into climate change, air quality, and other environmental factors using vehicles as IoT sensors on the road network

5G ASPECTS COVERED IN 5G-LOGINNOV



5G enabled Precise Positioning, MEC

Real-time tracking & enhanced visibility

Automated Truck Platooning: <25ms cellular V2X /V2V

5G-LOGINNOV→Future of Smart Cities and Mobility

- ***TRUST*:** Trust is the basis of the 5G-LOGINNOV. To use the data, the data consumer must fully accept the data owner's usage policy.
- ***NEW BUSINESS ECOSYSTEM*:** new innovative solutions for smart cities, Identify real market opportunities especially in target niches for SMEs
- ***STANDARDIZED INTEROPERABILITY*:** is implemented in different variants and can be acquired from different vendors.
- ***VALUE ADDING APPS*:** includes also services for data processing, data format alignment, and data exchange protocols.
- ***DATA MARKETS*:** 5G-LOGINNOV enables the creation of novel, data-driven services that make use of data apps, cross-sectorial nature of the 5G core technologies and innovative services.
- ***PI*:** 5G-LOGINNOV enables the creation of new ICT infrastructure to support operations in future PI smart cities networks

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5G LOGINNOV Upcoming Events

- **5G-LOGINNOV final event-Luka Koper, 07 Nov 2023**

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Thank you for your attention!

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