



5G Harmonised Research and Trials for service Evolution between EU and China

C-V2X Trial Activities in 5G-DRIVE

Tao Chen

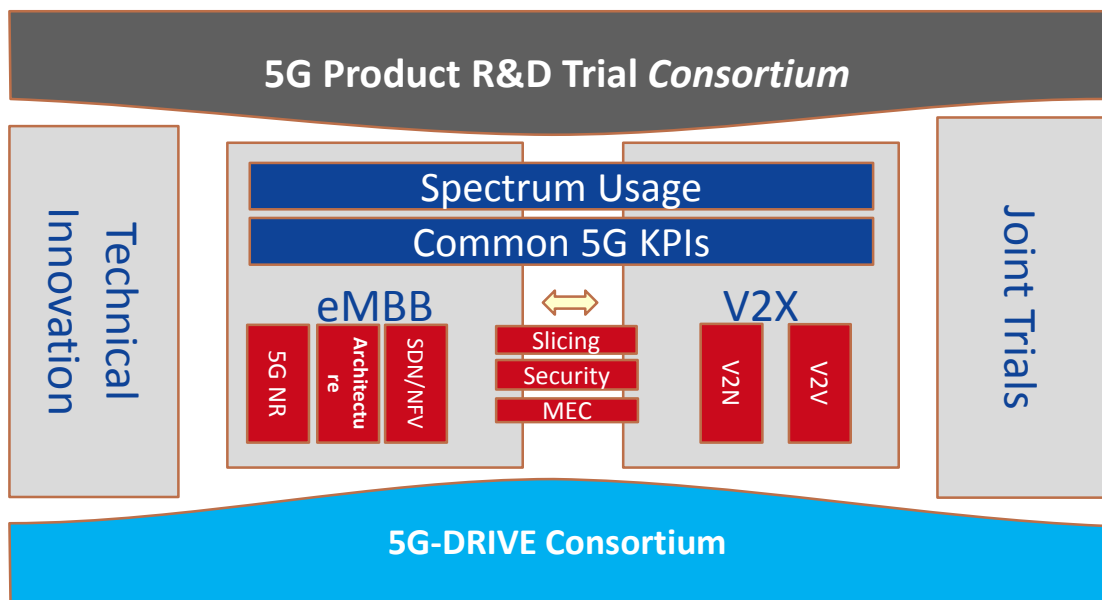
VTT Technical Research Centre of Finland

Workshop on 5G in the Era of Connected Cars, EuCNC
Valencia, 18 June, 2019

5G-DRIVE in Nutshell



- ▶ 5G DRIVE aims is to bridge current 5G developments in **Europe** and **China** through joint trials and research activities in order to facilitate technology convergence, spectrum harmonisation and business.
- ▶ **30-month** (September 2018 – February 2021) Research and Innovation Action project, funded under the Horizon 2020 Framework programme.
- ▶ **17** partners from **10** European countries (Germany, Finland, Belgium, Italy, Switzerland, Poland, Greece, Portugal, United Kingdom and Luxembourg).



C-V2X Trials in 5G-DRIVE



Demonstrate **IoV services** using Vehicle-to-Network (V2N) and Vehicle-to-Vehicle (V2V) communications operating at 3.5GHz and 5.9GHz, respectively

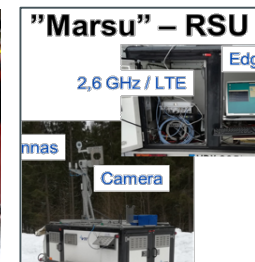
Objectives

- ❑ Jointly trial and demonstrate the 5G-based IoV scenarios
- ❑ Trial data flows between vehicles, MEC and IoT platform
- ❑ Test the URLLC capability of the 5G network in specific V2X scenarios
- ❑ Evaluate the resilience of V2V and V2N against cyber/RF attacks

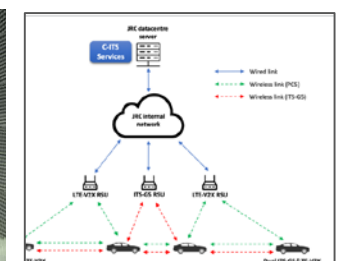
Progress

- ❑ Both Espoo and Ispra trial site have defined the V2X trial plan.
- ❑ 3.5GHz and 5.9GHz are ready in the Espoo site, 5.9GHz is ready in Ispra site.
- ❑ The first V2I and V2N trial are planned in May 2019.

Espoo trial site, Finland

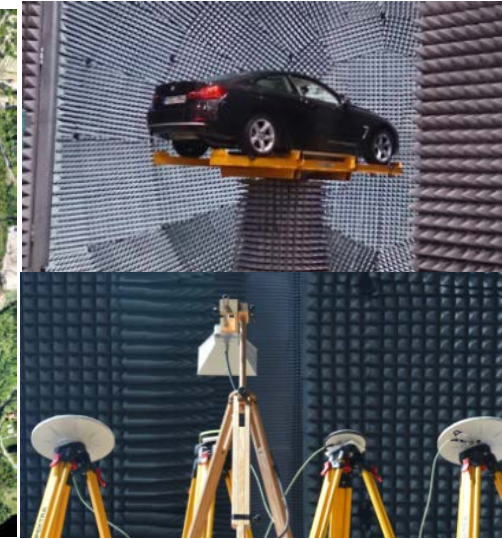


JRC Ispra trial site, Italy



JRC Ispra trial site

- ▶ 36 km road of real-life driving conditions
- ▶ 9 vehicle emissions laboratories
- ▶ High resolution localisation and mapping
- ▶ LTE/5G networks and V2X equipment
- ▶ MEC infrastructure
- ▶ PKI for security and trust in road transportation



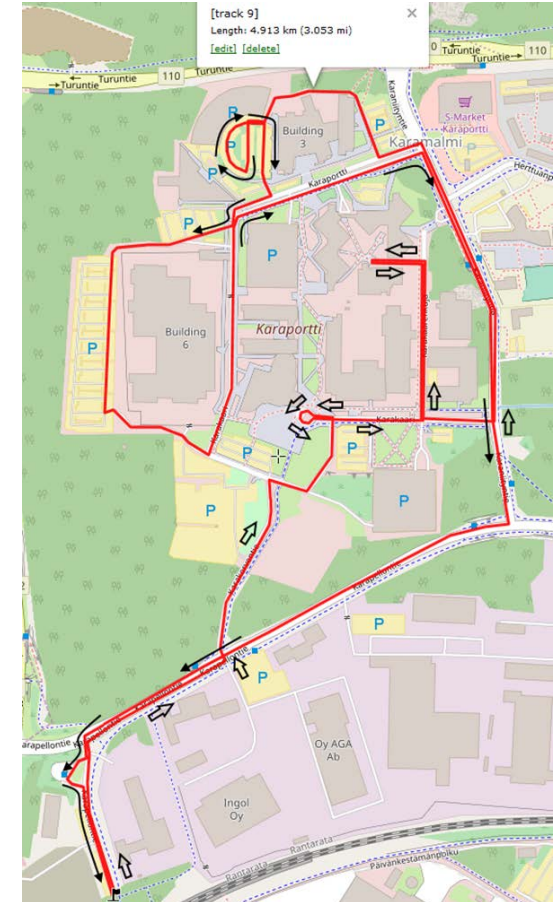
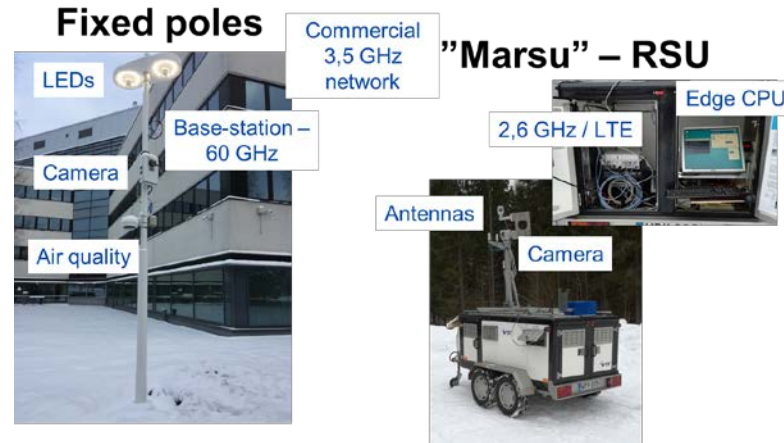
Espoo trial site

- ▶ 5G network infrastructure for V2X
- ▶ MEC for vehicle data sensing
- ▶ Road-side unit and infrastructure for V2I and V2N
- ▶ Demo vehicle (Marilyn) available for autonomous driving test

V2X Tests at Espoo



- ▶ Various communication technologies
- ▶ MEC available on-site
 - Connected to RSU
 - Connected to IoT



Espoo V2X trial
planned route

V2X Tests at Ispra



► Three levels of V2X testing at JRC Ispra:

❑ **Laboratory:**

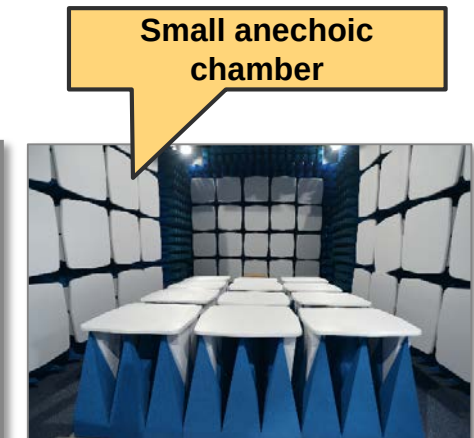
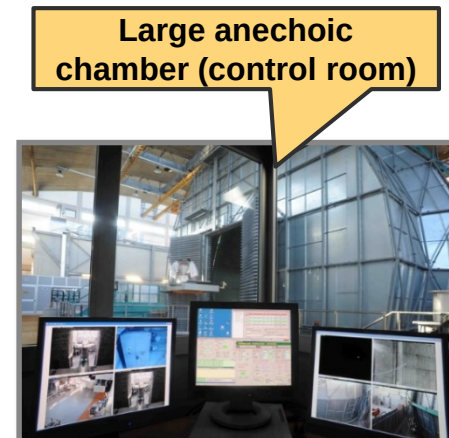
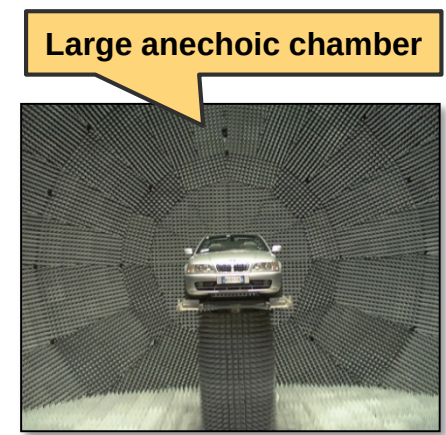
- Conducted/wired mode (no over-the-air transmissions)
- **Goal:** evaluate ITS-G5 and LTE-V2X devices against the ETSI Harmonised Standard for the 5.9 GHz band (ETSI EN 302 571)

❑ **Anechoic chambers (large and small):**

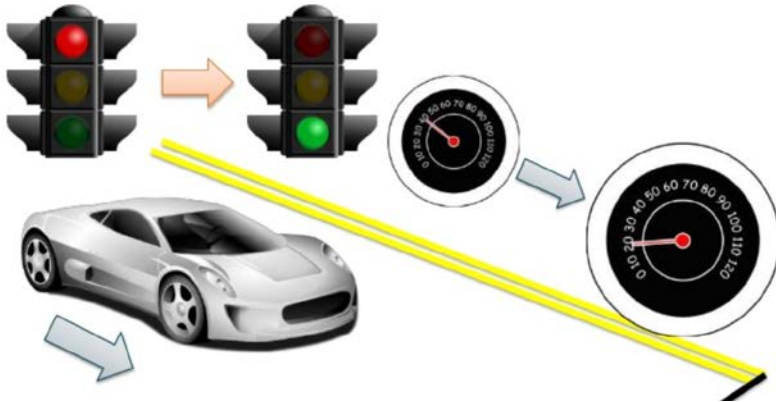
- Radiated mode (only over-the-air transmissions)
- **Goal:** measure harmful interference between ITS-G5 and LTE-V2X devices in the 5.9 GHz band (co-channel and split band scenarios)

❑ **Outdoors (field) tests:**

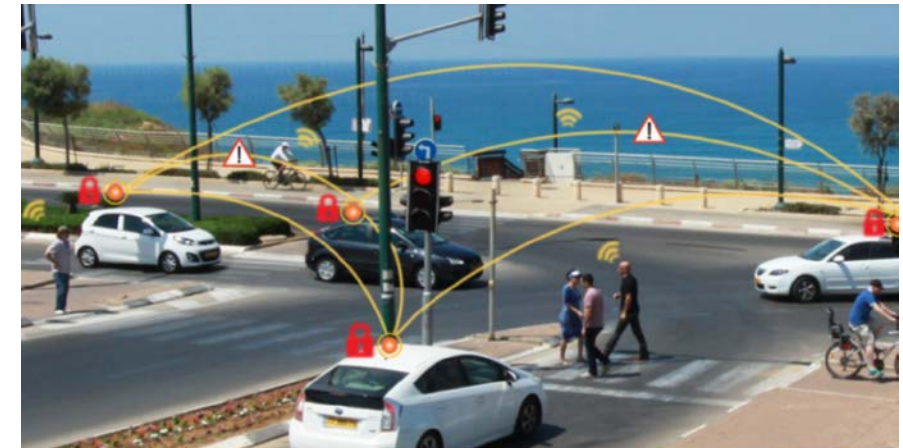
- Radiated mode (only over-the-air transmissions)
- Deploy ITS-G5 and LTE-V2X devices across the JRC Ispra campus
- **Goal:** compare and contrast both technologies from a user experience point of view, measure KPIs for GLOSA use case



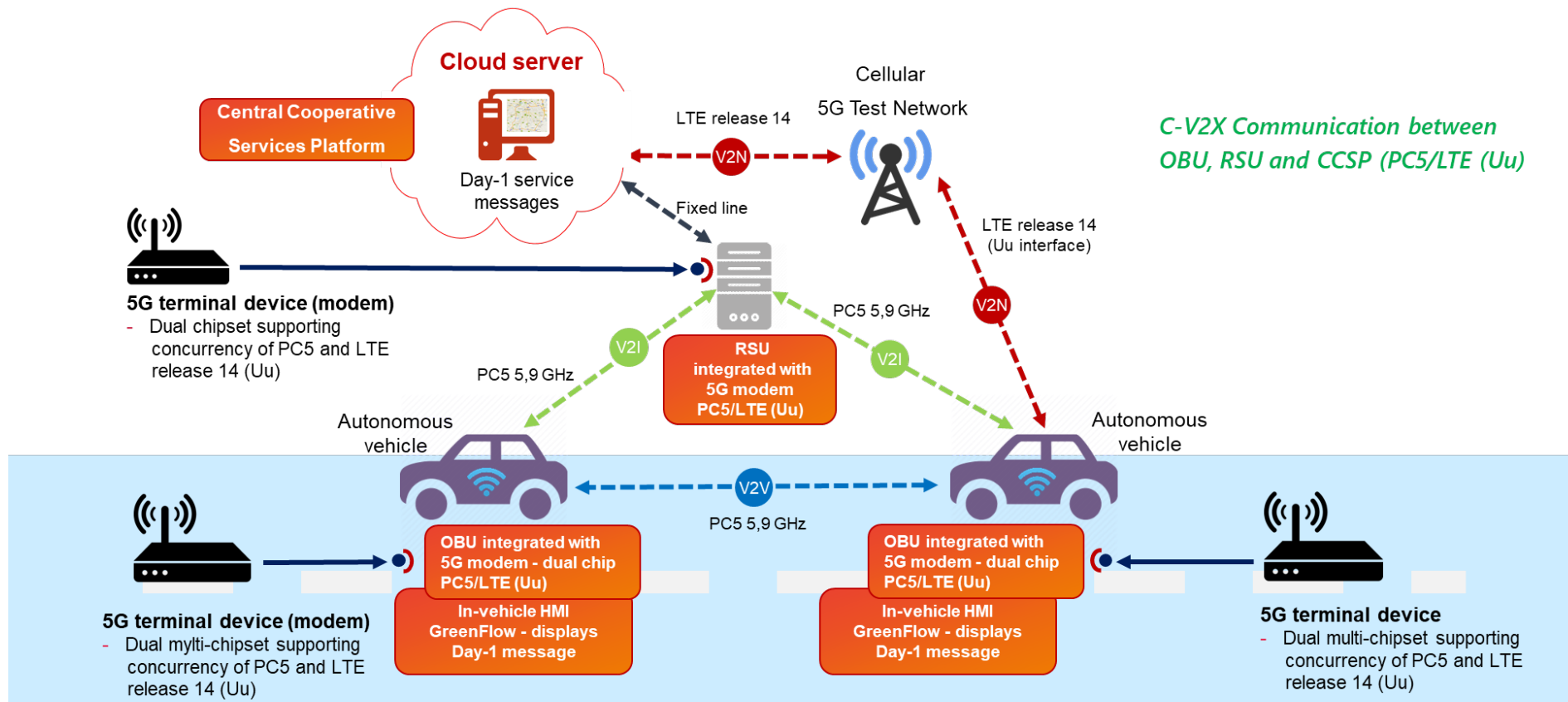
- ▶ Green Light Optimal Speed Advisory (GLOSA)
 - Aim at informing end users about the speed that needs to be sustained (within legal limits) to reach an upcoming traffic light in green status



- ▶ Intelligent intersection
 - Aim at provide safety on intersections, focusing on infrastructure detection of situations that are difficult to perceive by vehicles themselves



Implementation Proposal



VTT - 5G test site Espoo, Finland

- C-V2X OBUs and RSUs with European and Chinese standards
- Potential vendors: Qualcomm / Huawei (one potential Qualcomm X55)
- Hybrid communication: LTE + ITS G5 → 5G

Project initiators



公安部交科所

无锡交警支队

中国信通院

天安智联

Participants (23)



长安汽车
CHANGAN

上汽集团
SAIC MOTOR

PSA

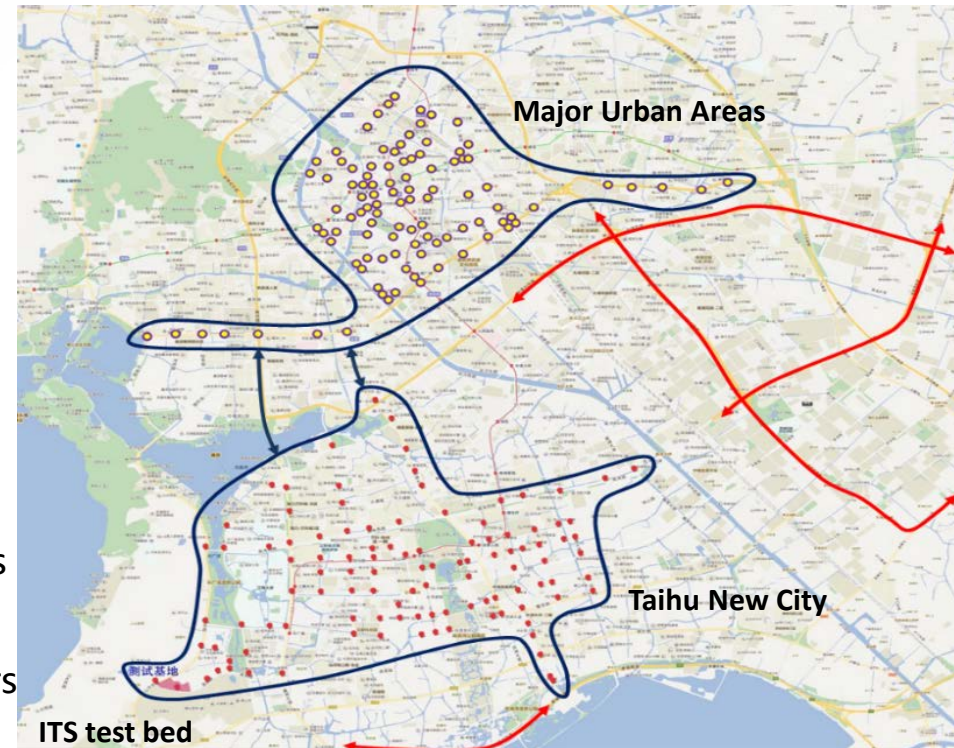


Demonstration area

Major Urban Areas, Taihu New City , 240 intersections , 170+ square kilometers

Number of target users

Annual target 10,000 to 100,000 users, including rearview mirror users, APP users corporate cooperative users etc.



V2I use cases

Traffic light info. display、green lights optimal speed advisory、traffic jam warning、emergency vehicle warning etc.



GLOSA



Emergency Vehicle Warning

V2N use cases

Traffic management optimization、illegal driving actions report etc.



vehicle dynamic information report



Illegal driving actions report

V2V use cases

Intersection collision warning、emergency break warning、lane change warning etc.



Intersection collision warning



Emergency break warning

V2P use cases

Vulnerable road user collision warning



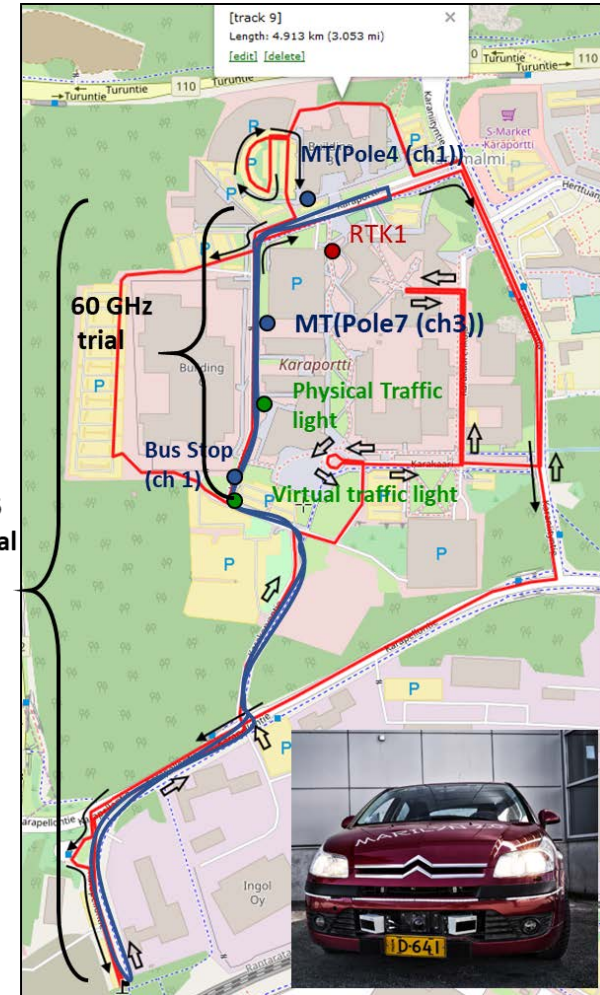
Vulnerable Road User Collision Warning

V2X planned test items in 5G-DRIVE



Trial Scenarios	Objective
Uplink bandwidth capacity / eMMB	Exchange raw sensor data between vehicles and digital local infrastructure (MEC) connected via LTE/5G. Focus especially uplink capacity
Inter-operability between different mobile network band frequencies	Switching between different frequency bands (2,6; 3,5; 60 GHz)
Mobile-edge computing	Data transmission and receiving from local edge-computing sites.
Message formats	C-ITS vs. Chinese message formats. Compare service quality levels. Take into account e.g. SENSORIS work group proposals
Latency times / URLLC	V2V, V2I latency times with using low payload ping-messages
E2E Uu-based V2X service validation and performance evaluation	To experimentally validate the functionality and performance of an E2E V2X service over e.g. the 3.5GHz Uu interface
E2E PC5-based V2X service validation and performance evaluation	To experimentally validate the functionality and performance of an E2E V2V service over the 5.9GHz PC5 interface

1st 5G-DRIVE V2X trial



Trial at Espoo on May 15, 2019

Thank you for your attention!



www.5g-drive.eu | @5gDrive

Contact us:

Uwe Herzog | herzog@eurescom.eu (Coordinator)

Tao Chen | tao.chen@vtt.fi (Technical manager)



The research conducted by 5G-DRIVE receives funding from the European Commission H2020 programme under Grant Agreement N° 814956. The European Commission has no responsibility for the content of this presentation.