Thomas Jaeger,

Head of Technology Technical Service Management,
SVP, Service Division

Product Testing

DEKRA

5GAA Workshop: C-V2X Interoperability and Deployment

The importance of Certification for 5G Automotive

Thomas Jaeger
Senior Vice President DEKRA SE
31st March 2022

DEKRA

Global partner for a safe, secure and sustainable world

Content

- Requirements and Complexitites
- Certification is the glue
- Certification Impact
- Regulatory Requirements Testing
- Interest Group and Standardization Requirements and Testing
- Private 3rd Party and Supplier to market Requirements and Testing

Requirements and Complexities

Regulatory Requirements and Testing

Application Layer

Interest Group and Standardization Requirements and Testing

Higher Layers

Private 3rd party and supplier-to-market requirements and Testing

Lower Layers

Certification is the glue

Regulatory Requirements and Testing

Interest Group and Standardization Requirements and Testi

Private 3rd party and supplier-to-market requirements and Testing

- Conformance
- Interoperability
- Performance
- Security
- Efficiency
- Sustainability

Application Layer

Higher Layers

Lower Layers

Certification Impact

- Conformance
- Interoperability
- Performance
- Security
- Efficiency
- Sustainability

Platform for Success of Technology

Generates Trust & Acceptance

Ensure availability and readiness for use in B2B, B2C, ….

Vehicle direct communication mode

Technology	Regulatory Region	Type	Scope	Test standard (subject to change)
CV2X	USA	RSU	RF	FCC Part 90M (tbd)
		OBU	RF	FCC Part 95L (tbd)
		RSU / OBU	EMC	FCC Part 15B
	EU	RSU / OBU	RF	EN 302 571
			EMC	EN 301 489-1/-52
	China	RSU	RF	工信部无[2018]203号
			EMC	YD/T2583.18-2019
		OBU	RF	工信部无[2018]203号
			EMC	YD/T2583.18-2019
DSRC	USA	RSU	RF	FCC Part 90M
		OBU	RF	FCC Part 95L
		RSU / OBU	EMC	FCC Part 15B
	EU	RSU / OBU	RF	EN 302 571
			EMC	EN 301 489-1/-3/-17
	China	RSU	RF	Not applicable
			EMC	Not applicable
		OBU	RF	Not applicable
			EMC	Not applicable

… and others

DEKRA provides regulatory testing and certification services for (PC5) vehicle direct communication (V2V, V2P, V2I) requirements

PC5 Lower Layer Testing

The Global Certification Forum (GCF) is operating a C-V2C certification program in cooperation with 5GAA based on the current GCF Work Items 281 and 282.

Test Specifications:

3GPP 36.521-1
3GPP 36.521-3
3GPP 36.523-1

Test Purposes:

3GPP C-V2X Device Testing for Radio Frequency Conformance

3GPP C-V2X Device Testing for Protocol Conformance

DEKRA provides GCF testing and certification services related to cellular V2X listed as C-V2X RTO

PC5 Lower Layer Testing

Omniair in North America is operating a C-V2C certification program addressing PC5 lower layers testing based on 3GPP and SAE specifications. It overlaps with the GCF/5GAA program.

Test Specifications:

761-OA-TSS&TP-3652X (Based on 3GPP 36521-1 & -3)
762-OA-TSS&TP-J31611 (Based on SAE J3161/1)

Test Purposes:

3GPP C-V2X Device Testing for Radio Frequency Conformance

On-Board System Testing for LTE-V2X V2V Safety Communications (SAE)

DEKRA was the first lab providing Omniair DSRC & LTE- V2X OBU and RSU certification services as an authorized OATL

RF Testing

C-V2X Higher Layer Testing

The C-V2C certification program of Omniair in North America also covers higher layer testing based on US related standards. It derived from the requirements that have been used for DSRC.

Test Specifications:

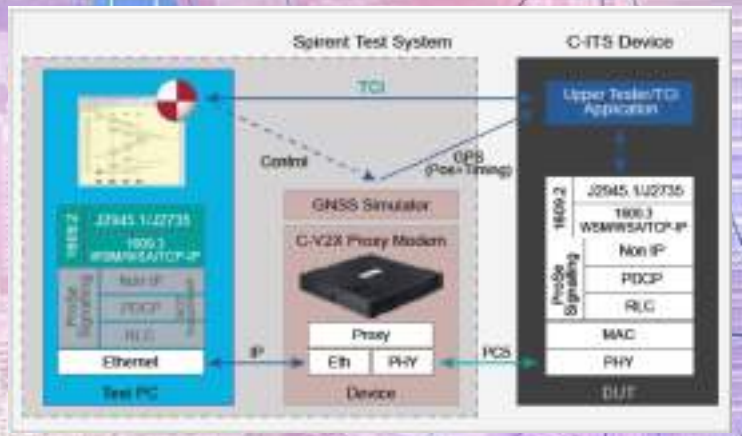
763-OA-TSS&TP-16092
765-OA-TSS&TP-16093
767-OA-TSS&TP-J29451
770-OA-TSS&TP-RSU41

Test Purposes:

Security Services (IEEE 1609.2)
Networking Services (IEEE 1609.3)
On-board System Requirements for V2V Safety Com.(SAE J2945/1)
RSU functional testing

DEKRA has been hosting many plugfests successfully to promote successful interoperability of higher layer protocols

Higher Layer Testing



C-V2X Higher(Lower) Layer Testing

ETSI ITS is developing standards for testing higher/lower layers. It derived from the requirements that have been used for ITS-G5

Test Specifications:
ETSI TS 103 794
(includes references to 3GPP)
ETSI TS 102 868
ETSI TS 102 869
ETSI TS 102 859
ETSI TS 102 870
ETSI TS 103 096
ETSI TS 103 191
...

Test Purposes:

LTE-V2X Access layer for ITS (RF, Tolling protection, congestion control,…)
Conformance for Cooperative Awareness Basic Service (CA)
Conformance for Decentralized Environmental Notification Basic Service (DEN)
Conformance for Transmission of IP packets over GeoNetworking (GN6) Conformance for GeoNetworkingBasic Transport Protocol (BTP)
Conformance for GeoNetworking (GN)
Conformance for ITS security
Conformance for Facilities layer protocols and communication requirements for infrastructure services (MAPEM/SPATEM, IVIM, SREM/SSEM)
…

ETSI test cases are available for conformance assessment and DEKRA tests devices accordingly

Application Testing (PC5 – Lab based)

Application Testing in Laboratory Environments build the initial bridge to full scale verification and validation in vehicles on roads.

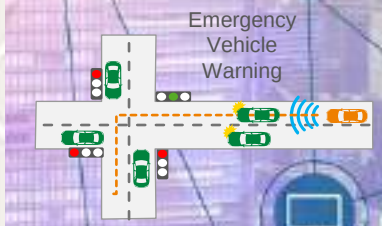
Test Specifications:

Test specifications are deriving from core requirements defined in various (standards) groups such as SAE, C-SAE but also based on 5GAA use cases (Omniair intends to implement one based on SAE J2945/1)

Test Purposes:

Validate V2V & V2I applications such as
FCW (Forward Collition Warning), **EEBL** (Electronic Emergency Brake Light, already Omniair conform), **IMA** (Intersection Moving Assistant), **LTA** (Left Turn Assist), **CLW** (Control Loss Warning), **BSW** (Blind Spot Warning), …

DEKRA has been involved in the development of core requirements and has implemented several hundred related test cases

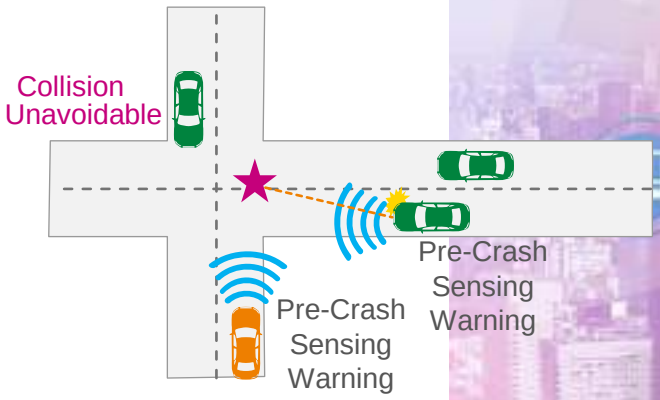


PC5 – Application Testing Examples

What is tested?

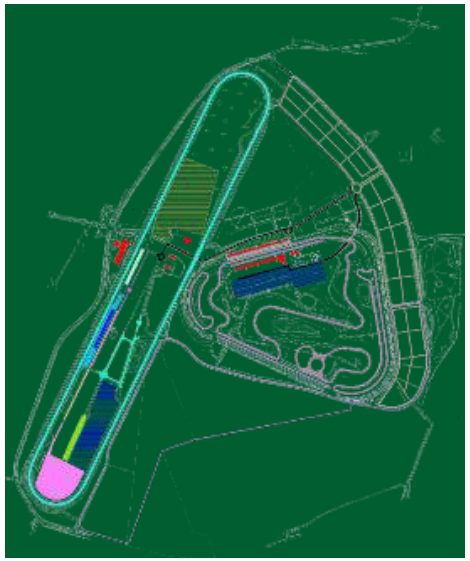
- Generation of appropriate signaling messages
- Reception of signaling messages and generation of the corresponding warnings to the driver

- Forward Collision Warning (FCW)
- Emergency Electronic Brake Lights (EEBL)
- Intersection Movement Assist (IMA)
- Vehicle Turning Right in Front of a Transit Vehicle (VTRFTV)
- Blind Spot Warning (BSW)
- Lane Change Warning/Assist (LCA)
- Work Zone Warnings (WZW)
- Spot Weather Impact Warning (SWIW)
- Speed & Curve Compliance
- Green Light Optimal Speed Advisory (GLOSA) / Time To Green (TTG)
- Red Light Violation Warning
- …



Application Testing (PC5 on Test Tracks)

Validation of Simulation and Lab Testing happens on dedicated test tracks







DEKRA supports all testing activities on operated test tracks by providing several hundreds of V2x application tests (Omniair, 5GAA, SAE, C-SAE, ETSI, …)

THANK YOU

Robert Banks,

Technology Development Manager,

Vodafone

WHAT IF …

WE COULD MAKE EUROPEAN ROADS SAFER FOR EVERYONE?

….

Bob Banks

Group R&D

vodafone business

Vodafone launches platform to improve road safety in Europe

STEP | Introduction

Vodafone is committed to make European Roads safer for all

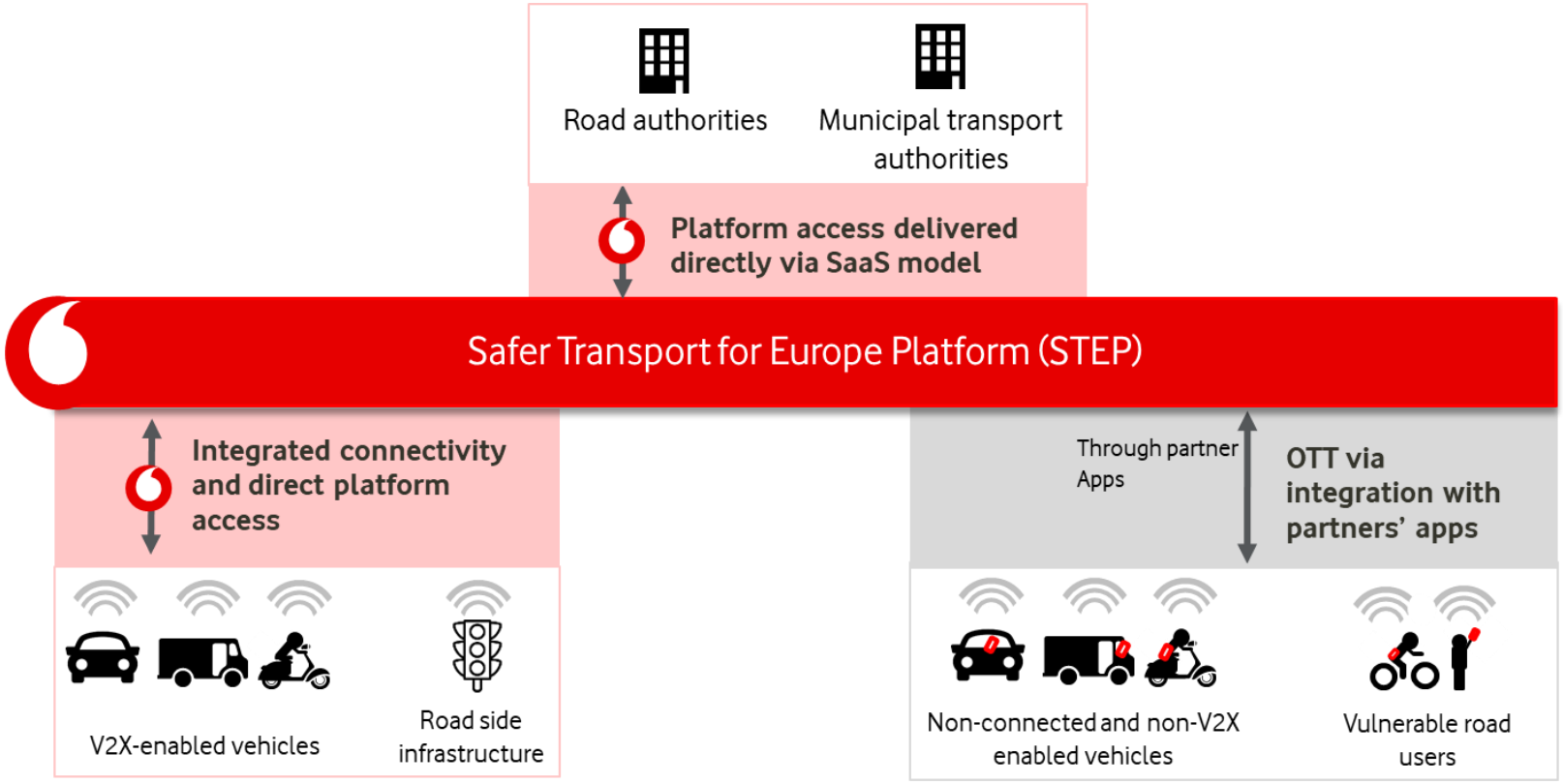
Platform to distribute, broker and validate **V2X messages in real-time leveraging 5G and Edge Cloud**

Hazard Warnings

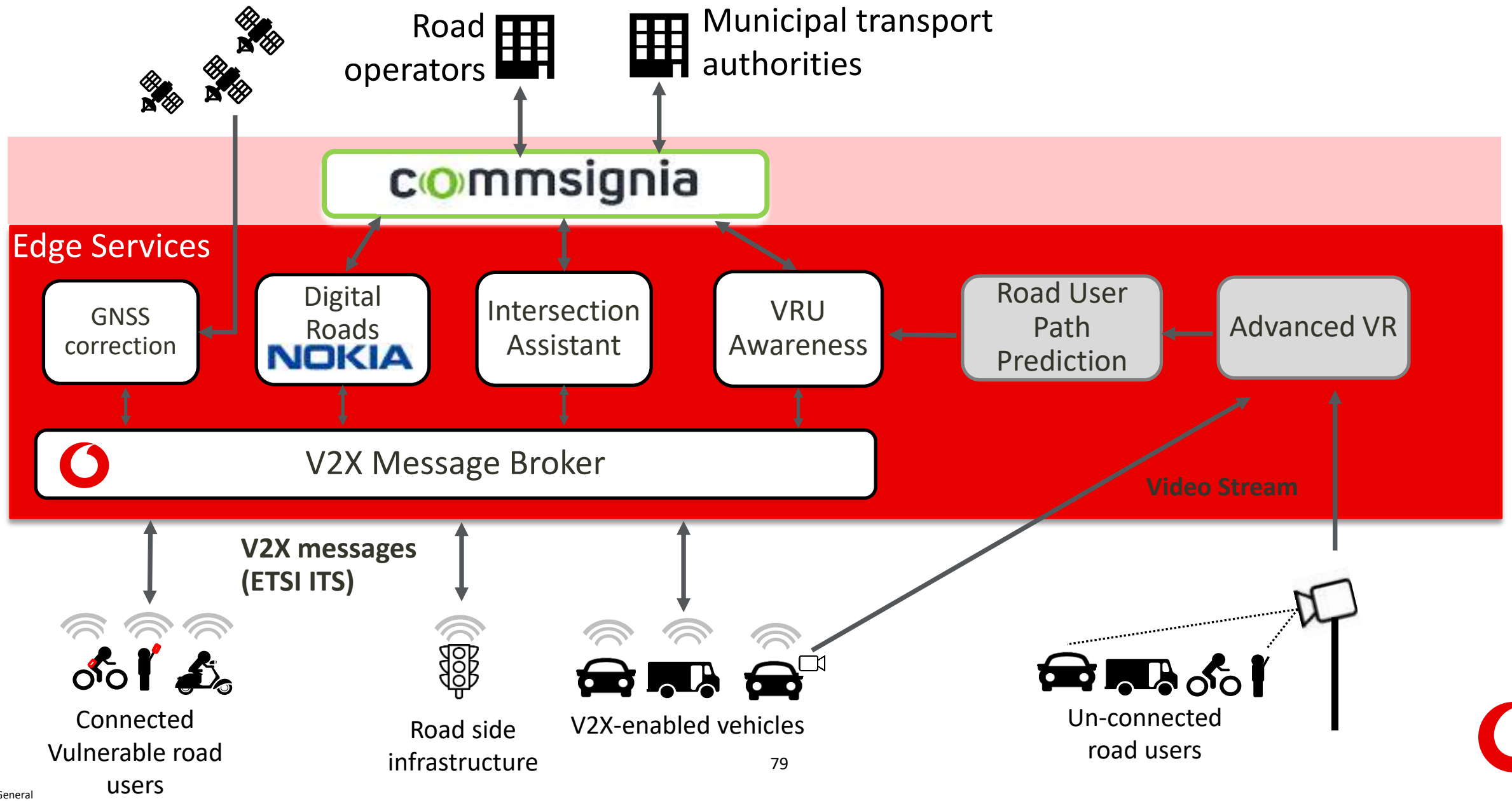
VRU Assistance

Infrastr. to Vehicle

STEP aims to scale – Starting in the V2X / Connected Mobility space and using it for all types of real-time data broker applications



V2X Platform at the Edge



Why network edge? Scalability and reliability

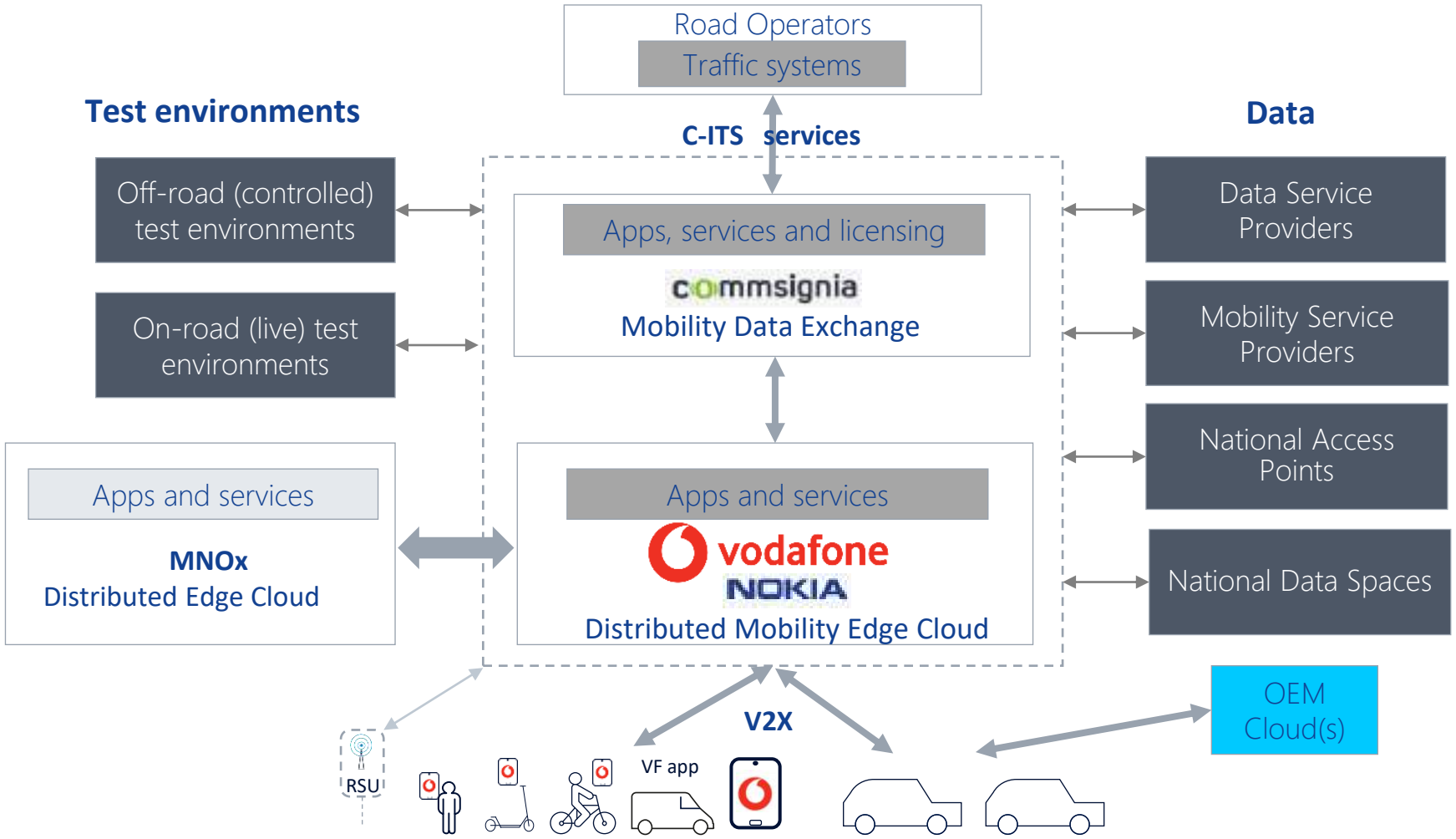
Scalability

- V2X type C-ITS messages (CAM, DENM) are sent from the vehicle to the STEP platform
- As the number of participating vehicles/devices increases, the amount and associated transport cost of data will increase – costs can be minimised if the data path is minimised
- STEP functions (MQTT and data processing) are deployed at the mobile edge and so all data originating from vehicles is terminated at the edge, thus reducing the data transport costs
- Without the network edge, much of the value of collecting data from vehicles will be spent on data transport

Reliability and service assurance

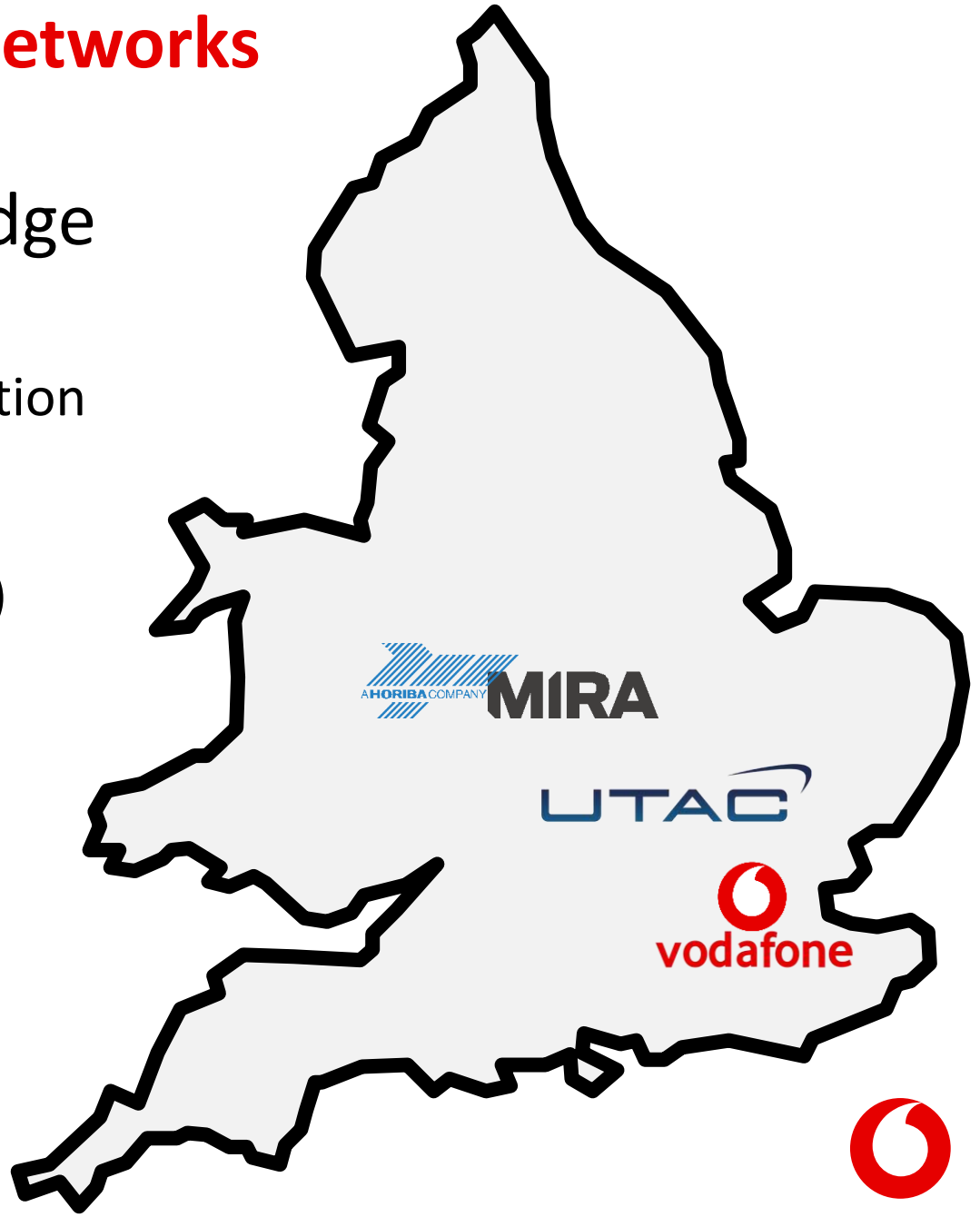
- The Mobile Edge enables the whole of the service (servers, client, connections) to be kept within the mobile network and so the potential for moving towards a QoS-enabled, targeted QoS approach is enabled
- Services outside the mobile network are generally provided by Best Effort means
- QoS enabled service have predictable, low latencies during network congestion and so timely delivery of C-ITS data is always reliable

Connecting vehicles, VRUs and infrastructure seamlessly



V2X services optimised for mobile networks

- STEP hosted at Vodafone's Mobile Edge in London (AWS Wavelength)
  - A dedicated test track (private road) configuration for UTAC and Horiba-Mira
  - STEP will also be used to support public road-based services (testing & customer/consumer)
- Local hosting enables
  - Lowest e2e latencies
  - Data remains in country
- STEP will be deployed across Vodafone's major European markets during 2022



V2X services optimised for mobile networks

- V2X through UTAC and HORIBA-MIRA mobile private networks, live commercial networks for public roads
- Data partitioning
  - Private road data only viewable by individual test track customers
  - Businesses can only see their own data on public roads
- V2X service evolution – OEM/Fleet applications can be hosted on STEP
  - ADAS integration
  - Sensor fusion
  - Vehicle autonomy support

Next steps

Phase 1

- Use UTAC and Horiba MIRA as a practical (hands-on) education facility for eco-system stakeholders – spread the word on what can be achieved today
- Discussions with OEMs/Tier1s about connectivity via in-vehicle unit and presentation via head-unit / infotainment system and additional use cases
- Discussions with Road Operators about additional use cases and connection to their road network data
- Discussions with other 3rd party app developers about integration of V2X SDK

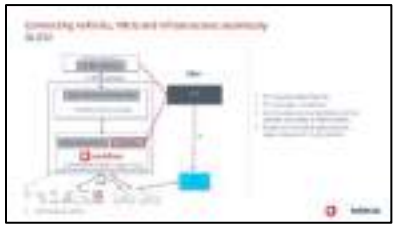
Phase 2

- Testing of vehicles connected via TCU – head-unit
- Testing of interface to road operator data
- Testing of additional use cases
- Testing of 3rd party apps

Outlook: Edge-based use cases

Candidate proposals

GLOSA



VRU

- VRU (car → VRU & VRU → car)
- VRU incl. fusion with road side sensors (cameras)

CAM
data analysis

- Road Obstruction
- Stopped/broken-down Vehicle
- Real-time lane restriction
- Aggregated CAM (coop. awareness mesg.) data to be offered road operators (rev. share)

DENM
aggregation & distribution

- EEBL as an info service
- Local weather-related events

Any App
(hosting)

Prepare the future for

Data fusion to support cooperative automated driving

Afternoon demo

- Back seat of vehicle real-time experience of STEP around the outdoor test area
  - 2 different handset OS (Android and iOS)
  - Integration into Android Auto and Apple Car Play
  - 3 different MNOs (VF DE, VF UK, 1 other)
  - 2 different applications (VF Driving Academy, Eloy Drive) + engineering app
  - Deploying Road Operator messages (IVIM and DENM)

Please come and join us


Q&A

MODERATED DISCUSSION

Bringing C-V2X on the Roads: the Role of Interoperability for Deployment

CLOSING REMARKS

Maxime Flament, 5GAA

Saurav Arora, Plugtests™ Event

Vodafone: Application and MNO Interop of Vodafone STEP

- Demonstrate the interoperability between the Vodafone Safer Transport for Europe Platform (STEP) and three different Android OS and Apple OS applications, as well as between the different mobile networks from Deutsche Telekom and Vodafone:
  - APP1 developed in house (Vodafone Demo, used for technical internal testing and showcase)
  - APP2 developed in house in conjunction with a 3rd party (Vodafone Driving Academy)
  - APP3 developed by a 3rd party (Eloy Drive)
- All the applications embed the Vodafone STEP SDK.

CTAG: Interoperability between OBU and RSU

- CTAG will demonstrate the generation of the events for their RSU and the reception in the OBU.
  - The events will be shown in a tablet that runs an Android App
- The following use cases will be performed:
  - UC1 Road Works Warning
  - UC3 Time to Green / Traffic Sign Violation
  - UC5 In-Vehicle Signage
  - UC8 Traffic jams
  - UC9 Hazard on the road

Allbesmart: C-ITS Platform

- Allbesmart will demonstrate their C-ITS platform integrated in a Cohda Wireless MK6 RSU
  - They will be able to issue events with minimal configuration and check on the health status of the RSU, and a Cohda Wireless MK6 OBU integrated with Allbesmart's onboard application
  - An onboard application running in a tablet allows to visualise the messages
- The following use cases will be performed:
  - UC1 Road Works Warning
  - UC8 Traffic jams
  - UC9 Hazard on the road

Networking lunch

12:30 – 13:30

Live demos

13:30 – 15:00