Grant Agreement No.: 814956
Research and Innovation Action
Call Topic: ICT-22-2018 EU-China 5G Collaboration

5G HarmoniseD Research and TrIals for serVice Evolution between EU and China

D6.4: Final Report on Standardisation

Version: v1.0

Deliverable type	R (Document, report)
Dissemination level	PU (Public)
Due date	30/06/2021
Submission date	21/07/2021
Lead editor	Anna Brékine (MI)
Authors	Anna Brékine (MI), Sébastien Ziegler (MI), Adrian Quesada Rodriguez (MI), Kinga Kepessy (MI), Cédric Crettaz (MI), Ion Turcanu, Jaime Ferragut (JRC), Latif Ladid (UL), Sławomir Kukliński (Orange), Lechosław Tomaszewski (Orange)
Reviewer	Latif Ladid (UL)
Work package, Task	WP6, T6.3
Keywords	Standardisation

Abstract

The following deliverable presents the Final Report on Standardisation of the 5G-DRIVE project. It documents the activities and key standardisation achievements throughout the duration of the project. First, the deliverable describes the methodology applied in this report, and follows up on the KPIs in the field of standardisation, as defined in the Plan for Standardisation (D6.2). Next, D6.4 reports on the standardisation outcomes at the end of the project. Subsequently, the document presents key takeaways and recommendations identified by the 5G-DRIVE standardisation partners.

Document revision history

Version	Date	Description of change	List of contributors
0.1	2.02.2021	Table of Contents	Anna Brékine
0.2	13.03.2021	Initial inputs	Anna Brékine
0.3	25.05.2021	Inputs from JRC	Jaime Ferragut
0.4	27.05.2021	Inputs from UL	Latif Ladid
0.5	4.06.2021	Inputs from VTT	Matti Kutila
0.6	10.06.2021	Integration of inputs regarding Europrivacy	Adrian Quesada Rodriguez
0.7	20.06.2021	Inputs from Orange	Lechoslaw Tomaszewski, Slawomir Kuklinski
0.8	25.06.2021	Final inputs	Anna Brékine
0.9	29.06.2021	Internal review	Latif Ladid
0.10	29.06.2021	Final version	Anna Brékine, Sébastien Ziegler
1.0	05.07.2021	Final editing	Uwe Herzog, Anja Köhler

[1] http://creativecommons.org/licenses/by-nc-nd/3.0/deed.en_US

Executive Summary

Standardisation is a crucial tool to bring forward technological advances and facilitate their wider deployment. The aim of this document is to report on the standardisation efforts undertaken within the scope of the H2020 project 5G-DRIVE which focuses on testing and approving the interoperability of 5G networks between the EU and China. The focus is put on standardisation activities of the individual consortium members before diving deeper into work conducted during the third of the project and discussing its outcomes.

The Final report on standardisation (D6.4) serves as a complement to the previous Plan for Standardisation (D6.2). Structure-wise, the Final report on standardisation deliverable is first presented in a summarising manner while drawing upon the objectives of the related task and deliverable. The methodology section explains how the discussed information was compiled and follows up on the relevant KPIs and targets. The results section represents the most crucial and therefore the most extensive part of the report. It first draws upon the standardisation plan developed under D6.2 which groups the priority standardisation activities related to the project. Then the partners' (i.e., JRC, VTT, the University of Luxembourg, Orange and Mandat International) contributions and outcomes within specific working groups at ETSI, ISO and ITU respectively are discussed, namely:

(1) Technical contributions to ETSI TC ERM TG37 for the improvement of ETSI EN 302 571, as well as dissemination of experimental results from the ITS-G5/LTE-V2X coexistence tests in T4.3 with ETSI and Directorate-Generals of the European Commission (mainly, DG CNECT and DG MOVE).

(2) 'IPv6-based Vehicular Networking (V2X)' standardisation within the ETSI IPv6.

(3) V2I connectivity and sharing point-clouds in collaborative sensing framework via the Pan-European C-ROADS initiative which is promoting ITS related standardisation topics to ISO TC204.

(4) Contributions to ITU-T SG13 in the field of network slicing: Y.DL-AINW-fra draft recommendation: 'Framework for data linkage between AI-based network slice management and orchestration and network slice customers in networks beyond IMT-2020' and Y.IMT2020-EIL draft recommendation: 'Evaluating intelligence capability for network slice management and orchestration in IMT-2020'.

Additional standardisation activities external to the scope of the standardisation plan aiming at further transferring 5G-DRIVE research outputs to the global SDOs while also reinforcing the dialogue with key bodies on how to strengthen the participation of European research in global standardisation are also touched upon. These supplementary efforts were made by Mandat International within the ITU with the Contribution 690 on 'IoT and V2X Communication' at ITU-T Study Group 20, Question 3, the joint contribution (MI, EURESCOM, UL) to ITU-T FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture', the accomplishments in regards to Europrivacy certification and through relevant activities to the standardisation partners, such as:

(1) the Workshop on 'European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives' at the ITU,

(2) the Symposium on the Future Networked Car 2020 (FNC-2020) at ITU/UNECE,

(3) the ITU-T Focus Group on Vehicular Multimedia (FG-VM) and,

(4) 2021 Joint EuCNC & 6G Summit.

The key takeaways and recommendations regarding V2X standardisation were gathered through a survey filled out by all consortium partners. The general findings mainly refer to identified gaps in terms of standardisation, topics that should be encouraged for future EC research and future standardisation plans beyond the project. 5G-DRIVE-specific learnings and recommendations concern key challenges and barriers encountered, the standardisation activities as such and advice for future projects focusing on the same domain.

Table of contents

List of Figures

List of Tables

Abbreviations

3GPP	The 3rd Generation Partnership Project
5G-AA	5G Automotive Association
5G-PPP	5G Infrastructure Public Private Partnership
AI	Artificial Intelligence
ARIB	Association of Radio Industries and Businesses
ATIS	Automatic Terminal Information Service
BSS	Basic Service Set
CAM	Cooperative Awareness Message
CCSA	China Communication Standards Association
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CEPT	European Conference of Postal and Telecommunications
DVB	Digital Video Broadcast
EC	European Commission
ECC	European Communications Committee
eMBB	enhanced Mobile Broadband
EMC	Electromagnetic Compatibility
ERM	EMC and Radio Spectrum Matters
ETSI	European Telecommunications Standards Institute
FCD	Floating Data collection
FG	Focus Group
GLOSA	Green Light Optimised Speed Advisory
HD	High Definition
HOA	Higher Order Ambisonics
HSPA	High-Speed Packet Access
ICRW	Intersection Collision Risk Warning
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IoT	Internet of Things
IPv6	Internet Protocol version 6
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
ISO	International Organisation for Standardisation

LTE	Long Term Evolution
MANET	Mobile Ad-hoc: Network
M2M	Machine to Machine
MCM	Manoeuvre Coordination Message
MEC	Multi-access Edge Computing
mMTC	Massive Machine-Type Communications
MRP	Market Representation Partner
NFV	Network Function Virtualisation
NGN	Next-Generation networks
OCB	Outside the Context of a BSS
KPI	Key Performance Indicator
SG	Study Group
TSG	Technical Study Group
TTA	Telecommunications Technology Association
URLLC	Ultra-Reliable, Low-Latency Communications
V2I	Vehicle-to-Infrastructure
V2X	Vehicle-to-Everything
V2V	Vehicle-to-Vehicle
VRU	Vulnerable Road User
WAVE	Wireless Access in Vehicular Environments
WG	Working Group

1 5G-DRIVE in a Nutshell

The objective of the Horizon 2020 project 5G-DRIVE: 5G HarmoniseD Research and TrIals for serVice Evolution between the EU and China (2018-2021) was to test and approve the interoperability of 5G networks functioning at 3.5 GHz bands for enhanced Mobile Broadband (eMBB) and 3.5 & 5.9 GHz bands for V2X scenarios between the EU and China.

Both the European Commission and China approved funding joint projects on 5G trials to focus on the most encouraging 5G deployment scenarios, i.e. enhanced Mobile Broadband (eMBB) and Vehicle-to-Everything (V2X) communications.

The ambition of 5G-DRIVE was to achieve this goal by collaborating with its Chinese twinning equivalent. For this, 5G-DRIVE engaged in connecting current 5G developments in Europe and China through collective trials and research activities, notably to enable the technology convergence, spectrum harmonisation and business innovation before 5G networks are commercially deployed on a large scale. The main activities of 5G-DRIVE focused on developing essential 5G technologies and pre-commercial testbeds for eMBB and V2X services jointly with the twinning project based in China. The necessary trials for both testing and validating key 5G functionalities and services as well as the network planning took place both in Europe and China.

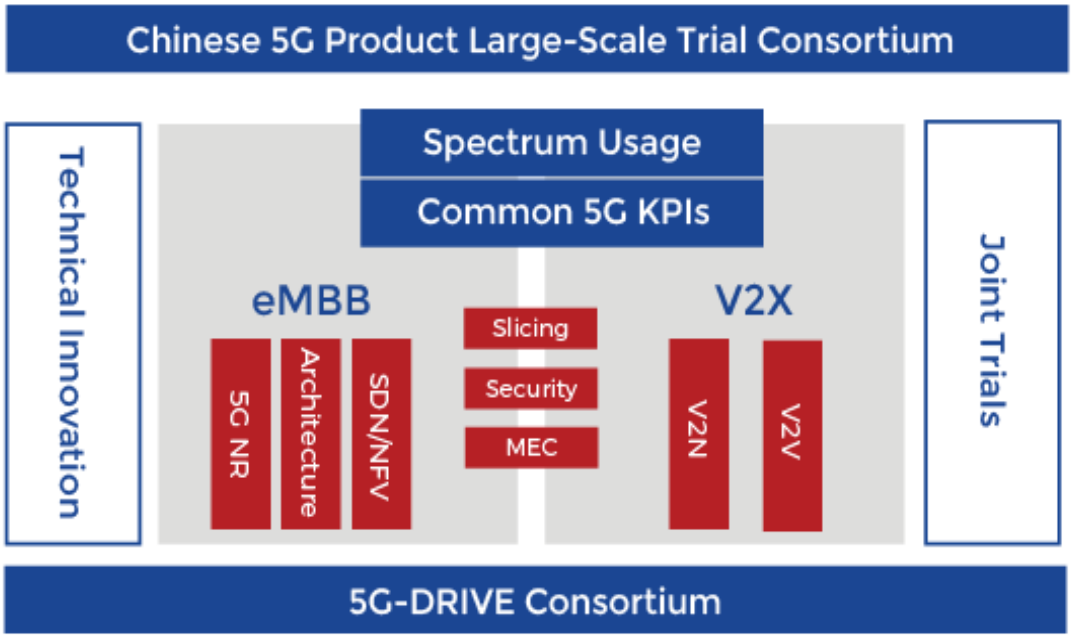


Figure 1: 5G-DRIVE – an overview

1.1 Objectives of Task 6.3 on standardisation

As stated in the Description of Actions:

'5G-DRIVE will publish the project recommendations and results to the ITU-T (SG13 and SG20) to ETSI and 3GPP PCG board and to the 3 main 3GPP Working Groups (Core, SA and RAN) as a 5G validation concept with large-scale trials. The task will identify relevant technologies to be standardised and will coordinate and facilitate the effort of the relevant research partners from both regions in order to adopt and promote joint contributions that are expected to have a higher impact on the process. UL has already created a working Group on 5G and vehicular networking within the ETSI IPv6 ISG defining the impact of IPv6 on 5G as well as on vehicular networking. It will submit the project results to the ETSI ITS and to the IETF IPwave as they have just started to standardise vehicular networking. MI will publish the results of the vehicular networking to the ITU-T SG20. MI will propose draft Recommendations with UL defining a reference model of IPv6 addressing plan for Internet of Things. 5G-DRIVE will submit its results to the Chinese IMT2020 Promotion Group responsible for 5G

harmonising and aligning China with Europe in view of worldwide 5G interoperability as well as vehicular networking. MI will coordinate the standardisation contributions towards ITU with focus on SG13, SG20. Role of partners: MI will coordinate the standardisation effort towards the ITU with a focus on SG13 and SG20, in order to foster the adoption of 5G-DRIVE outputs in the 5G and Machine to Machine (M2M) related standards. Orange is already active in ETSI NFV, ITU-T SG 13 and IETF in the areas of Network Function Virtualisation (NFV), Software Defined Networking (SDN), orchestration, network management and slicing and plans to contribute to these standardisation bodies. UL, as Board member of 3GPP PCG, will organise the submission of the 5G and LTE V2X trials results to the 3GPP board as the validation of the use cases. UL co-chairs the ETSI IPv6 ISG and will set up a Group Report on 5G & LTE V2X.'

Given that some of the partner organisations are not members of SDOs, the autonomous initiation of standardisation activities was not possible for them. Consequently, MI was engaged in the regular organisation of standardisation conferences to inform partners about standardisation opportunities and facilitate capacity building. Regardless of their experience in the standardisation domain or their affiliation to SDOs, every partner was invited and strongly motivated to attend these meetings. Whenever possible, all consortium members were encouraged to engage in common standardisation initiatives.

Disclaimer: It is important to point out that the work plan of the Chinese Twin project did not include activities related to standardisation. Indeed, standardisation in China is typically under the complete responsibility of Chinese SDOs. Therefore, the European side entirely undertook standardisation activities related to the 5G-DRIVE project. Previous experience with EU-China projects such as the EU-CHINA 5G-IoT project has shown that the most efficient way to tackle the harmonisation and alignment of the two approaches is through 3GPP and the ITU. Given that the Chinese SDOs, namely CCSA (China Communications Standards Association), IMT-2020 ((5G) Promotion Group), TIAA (Telematics Industry Alliance) and C-ITS (China ITS Industry Alliance), are all part of both the 3GPP and the ITU, it was presumed that the work carried out by 5G-DRIVE automatically influences 5G standards.

1.2 Objectives of Deliverable 6.4

According to the project's description of the action regarding D6.4, '*This report documents the project's standardisation activities and their outcomes related to the whole project duration'.*

Before projects can be brought to standardisation, they need to focus on elaborating technological innovations. For this reason, the main aim of this task and deliverable was to determine the potential for standardisation and to suggest a precise standardisation plan to the consortium. The activities planned by each consortium member were considered to identify the opportunities for standardisation which can support partners to align their research with these opportunities.

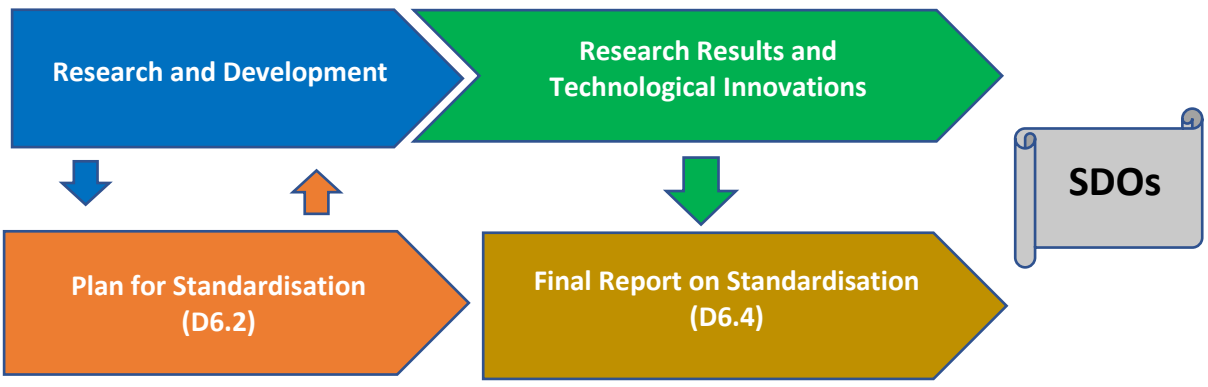


Figure 2: Standardisation process interdependencies and sequence

2 Contextual Information Regarding Standardisation

Before diving deeper into methodology applied and the standardisation results achieved for this deliverable, it is considered pertinent to first follow up on the contextual information regarding standardisation provided in D6.2.

Standardisation as such is defined as the procedure of developing technical standards based on the consensus of different stakeholders such as firms, users, interest groups, standards developing organisations (SDOs) and governments. The benefit of standardisation efforts is related to the fact that safety, interoperability and compatibility of goods or services can be guaranteed.

In the scope of the 5G-DRIVE project, standardisation activities aim at the following:

- boosting interoperability of services for vehicular transmissions and other networks;
- relaying relevant inputs from the project into existing or new international standards;
- highlighting and showcase achievements and the results of the project;
- creating relevant use-cases and promote their dissemination within SDOs.

In general, three types of standard-setting entities can be identified: (1) individual, private companies, (2) formal standard-developing organisations and fora and (3) consortia. The nature of the body committed to developing standards often has repercussions on its status, including its extent of openness.

The standards developed by a single company are generally referred to as “proprietary specifications”. The developer, in that case the company, fully controls the specifications and the future evolution of the standard, notably by implementing restrictions on the participation of other stakeholders or by setting specific rules to enable the participation of other parties, while maintaining the right to the final decision. In addition, the company will have the option of either encouraging and facilitating the adoption of the developed specification by others or, alternatively, to withhold the standard exclusively for its own use.

In parallel, a great number of national authorities have founded and/or formally acknowledged certain national or international standards bodies, generally known as formal SDOs. National SDOs are typically membership-driven bodies that gather standardisation experts – often from competing companies as well as governments, academia and civil society – to generate standards responding to priorities determined by the public- or private-sector members. One of the best-known SDOs are the International Telecommunication Union (ITU) and the European Telecommunications Standards Institute (ETSI).

Last but not least, fora, consortia and other informal industry associations are often founded based on the belief that collaborating within a narrow group of like-minded organisations can faster achieve an outcome satisfying all participants. An example is the Internet Engineering Task Force (IETF).

2.1 Guiding principles of standardisation

The following section will briefly summarise and explain the similarities and differences between the various existing standardisation outputs relevant within the scope of the 5G-DRIVE project, previously discussed in D6.2.

3GPP Technical Specification

The main activity of 3GPP is to design Technical Specifications which are then transposed by relevant Standardisation Bodies into appropriate deliverables (e.g., standards). Regarding the term "3GPP specification", all GSM (including GPRS and EDGE), WCDMA (including HSPA), LTE (including LTE-Advanced and LTE-Advanced Pro) and 5G specifications are included.

It has to be noted that the 5G Automotive Association (5GAA) has recently been approved as a Market Representative Partner (MRP) by 3GPP similar to the IPv6 Forum (led by UL since 1999). 5GAA will serve as the prime source of defining the requirements of the Vehicular Networking for 3GPP.

ISO International Standard

ISO acts as the global standardisation organisation and issues common frameworks for various technical domains. Regarding ITS infrastructure, the Technical Committee 278 has published more than 300 related standards. In addition, about 100 standard drafts are currently in the preparation phase. CEN and ISO are closely collaborating, whereas ETSI, as a telecom-driven SDO, puts its focus more on technical interfaces instead of ITS systems and modules.

ITU-R Resolutions and Recommendations

The goal of the ITU- is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, while conducting studies and approving recommendations on radiocommunication topics. Furthermore, ITU-R aims at guaranteeing interference-free operations of radiocommunication systems, notably by implementing Radio Regulations and Regional Agreements and efficiently and timely updating relevant instruments through procedures related to the World and Regional Radiocommunication Conferences.

ITU-T Recommendation

Due to the special approach to standards development chosen by ITU-T, based on consensus and led by contributions, all countries and companies, independent of their size, are accorded equal rights to shape recommendations. The main outputs of the ITU-T take the form of Recommendations (ITU-T Recs), which are standards defining how telecommunication networks operate, and interwork. The status of these recommendations is non-mandatory until they are adopted within national laws. In practice, the level of compliance is high due to international applicability and the high quality ensured by ITU-T's secretariat, as well as the members from the world's ICT companies and global administrations.

CEPT Report

The European Conference of Postal and Telecommunications Administrations is a voluntary association of European countries joining policymakers and regulators from 48 Member States. By collaborating on harmonising telecommunication, radio spectrum and postal regulations, the goal of CEPT is to improve efficiency and coordination for the benefit of European society.

ECC Decision

ECC Decisions are measures targeting significant harmonisation matters. They should be an outcome of any relevant decision-making processes related to matters significant to harmonisation efforts in the electronic communications regulatory field within the context of the long-term ECC strategy and policy.

As per the principle of technology neutrality defined in the EU Radio Spectrum Regulation, ECC Decisions should not be subject of discrimination in the sense of favouring the use of a particular type of technology over another. However, this principle does not preclude taking proportionate steps to promote specific services where this is justified.

Harmonised European Standard (ETSI/CEN/CENELEC)

A Harmonised Standard is a European standard developed by a recognised European Standards Organisation – i.e., CEN, CENELEC, or ETSI. It is developed following a formal request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that their products, services, or processes comply with the relevant EU legislation. To this end, product conformance to harmonised standards is an entry-access condition to the EU Single Market.

2.2 European priorities in relation with 5G and V2X

European Commission

According to the European Commission, 5G is a key asset for global competitiveness, not only by empowering socioeconomic transformations but also by bringing forward productivity, sustainability, well-being and innovation opportunities.

As seen above, standardisation is a crucial tool to foster new technologies. A reference document for ICT standardisation, namely the 2020 European Rolling Plan for Standardisation, has thus been developed, which gathers 165 identified actions regarding four thematic areas: (1) key enablers and security, (2) societal challenges, (3) innovation for the single market and (4) sustainable growth. The 5G technology is listed as the first relevant topic for key enablers and security.

Other 5G standardisation priorities

According to the Second Opinion on 5G networks by the Radio Spectrum Policy Group (RSPG), the European priorities in terms of 5G are the provision of wide-area coverage and high-reliability low-latency communications. Objectives include (1) granting high-speed internet access to sparsely-populated areas, (2) boosting the efficiency of industrial/production/service processes by introducing robust massive machine-type communications (mMTC) and (3) enabling the mass deployment of Smart Mobility Solutions/ Intelligent Transport Systems.

Other V2X standardisation priorities

Factors like growing deterioration of traffic conditions, population concentration in urban areas, the need to reduce the impact of transport on climate and the environment and, last but not least, EU Member states targeting Vision Zero for accidents, injuries and fatalities, will significantly shape road transportation in the next decade. In recent years, with the rise of IT technologies, self-driving has become increasingly attractive, significantly transforming the road infrastructure. This revolution will decisively benefit from V2X technology developments. To guarantee a high level of automated driving, it is required to constantly collect information about the driving environment while updating vehicle High Definition (HD) maps with data gathered by sensors located outside the vehicles, such as cameras, road sensors or data provided directly from other vehicles.

V2X communication and wireless performance are critical for the next generation of vehicles to provide a wide and reliable offer of mobility service. The self-driving vehicle deployment path is considered having the most stringent requirements on V2X.

The EU's top priority is to ensure that the Connected and Automated Driving deployment path is fully sustained by 5G technologies.

3 Overall methodology of the 5G-DRIVE final standardisation report

The following section presents the methodology behind the D6.4. D6.4 has the objective of documenting the 5G-DRIVE project's standardisation activities and their outcomes until M34. In order to present these points in a comprehensive manner, the report will, after having offered a general overview of the project, touch upon its standardisation results. This section will principally draw upon standardisation activities of the individual consortium members in line with the identified Plan for Standardisation, while also discussing some additional activities. The report will then present some key takeaways and recommendations and concluding the paper. A visual overview on the structure of the deliverable is offered in the figure below.

Figure 3: Visualisation of the structure of the deliverable

3.1 Target outcomes and KPIs

As indicated in the grant agreement, one of the deliverable objectives included the '*definition of target outcomes and key performance indicators. MI, Orange and UL will design it according to the priority of the consortium members'.* Following consultation with all consortium members during the face-to-face meeting in Brussels in April 2019, it was agreed that the project would follow the three following Key Performance Indicators (KPIs):

KPI	Target
Number of contributions to SDOs per year	3
Number of joint contributions per year	2
Percentage of joint contributions per year	50%

Table 1: KPIs and targets

By the end of the 5G-DRIVE project, the KPIs have been completed successfully, with a total of 16 contributions made on behalf of 5G-DRIVE and all of the KPIs being achieved towards the end of the project. The summary of the results is presented in the conclusion of the report.

4 From Standardisation Assets Identification to Standardisation Plan

The following section first explains the methodological process that led to the identification of standardisation results in the Plan for Standardisation (D6.2) and reminds of the standardisation assets identified in the standardisation plan in the first part of the project.

4.1 Initial identification of 5G-DRIVE standardisation results

In the early stages of the project, a formal survey has been set up to identify and capture potential 5G-DRIVE research results relevant for standardisation. The survey methodology was based on the 'three Ws questions' below:

1. What is likely to be submitted to standardisation?
2. Where (which SDO/Working group) this will be best suited and where to put the priority effort?
3. Who can lead and support the standardisation effort on each track?

The survey included closed and open questions about future standardisation and exploitation plans of each partner and was sent to all 5G-DRIVE partners to complete. All the partners have submitted the results to the survey. The part A of the questionnaire was entitled 'Partner perspective' and discussed exploitable results from 5G-DRIVE, their value proposition, intellectual property strategy and possible partnerships. The part B 'Partner's standardisation activities' required the partners to indicate any standardisation activities that they are involved in, express their views on the standardisation processes that 5G-DRIVE should focus on, propose key elements that the project should push to standardisation, and provide specific standardisation information regarding their organisation. Finally, part C 'Exploitable result description' further addressed each partner's exploitable results in the framework of 5G-DRIVE. More details about the survey can be found in D6.2 Plan for Standardisation.

4.2 Awareness and capacity building

Due to the fact that not all partners are members of SDOs, they were not autonomously initiating activities in the field of standardisation. In order to raise awareness on standardisation opportunities and facilitate the capacity building, regular standardisation conference calls were organised by MI. All the consortium partners were invited and strongly encouraged to attend the meetings, regardless of their standardisation experience or affiliation to SDOs. Whenever possible, all consortium partners were also solicited to support or participate in joint standardisation initiatives.

4.3 Standardisation items identified in the Plan for Standardisation

It is clear that standardisation necessitated continued efforts and contributions over time. Therefore, to assure that the standardisation strategy is successful, determining which priority venues the project needed to focus on and which efforts necessitated contributions to be impactful, was utterly important. The Standardisation Plan identified four key research results relevant for standardisation. Based on the results, the respective affiliation and the partners' ability to contribute to SDOs as well as the specific relevance of each SDO, the table presents the priority standardisation activities as identified by the Plan for Standardisation.

Research result to be standardised	Lead expertise / contributor	Priority SDO and Working Group		Lead SDO facilitator
Experimental results from the ITS-G5/LTE-V2X coexistence tests	JRC	ETSI	ETSI TC ERM TG37	JRC
IPv6-based V2X communications standardisation	UL	ETSI	IP6 ISG	UL
V2I connectivity and sharing point-clouds in collaborative sensing framework	VTT	ISO	ISO/TC 22, WG9	VTT
Network Slicing	Orange	ITU	SG13/Q21	Orange
			SG20	MI

Table 2: Synthetic plan for standardisation

5 5G-DRIVE Standardisation Results

5G-DRIVE followed the aforementioned standardisation plan and successfully brought to standardisation the items and topics previously identified in the earlier section. Most activities were carried out both within ETSI, ITU and ISO.

At the ETSI level, the Joint Research Centre (JRC) has contributed to the revision of EN 302 571 by submitting seven technical contributions to ETSI TC ERM TG37, namely:

- **ERMTG37(19)034003r1:** Proposed modifications to EN 302 571 for testing of multi-antenna devices
- **ERMTG37(19)000106:** Proposed modifications to EN 302 571 to add a definition of smart antenna systems
- **ERMTG37(19)000122:** On the evaluation of the ITS-G5 and LTE-V2X duty cycle
- **ERMTG37(19)00141:** Updated duty cycle requirement
- **ERMTG37(19)00137:** Updated testing procedure for duty cycle measurement
- **ERMTG37(20)000021r1:** On the definition of smart antenna systems in draft EN 302 571 V2.1.10
- **ERMTG37(21)040013:** Reversion of two editorial changes to analytical expressions of P(e.i.r.p.) in EN 302 571 V2.1.14

Furthermore, the University of Luxembourg (UL) actively participated and contributed to the standardisation efforts within ETSI ISG IP6, producing an **ETSI Group Report (GR) 'ETSI GR IP6 030 V1.1.1 (2020-10), 'IPv6-based Vehicular Networking (V2X)'** that summarizes the ongoing worldwide V2X standardisation initiatives that target the introduction of IPv6 for V2X communications and related applications and services. The document has been published and is available on the ETSI portal.[2]

On its side, VTT made contributions to the following standards:

- **Data exchange requirements ISO/DIS 13111-2 and YTL/CEN/TC 278: Intelligent Transport Systems (ITS)[3]:**
    1. The use of personal ITS stations to support the provision of ITS services for travellers
    2. General requirements for data exchange between ITS stations
- **Sensors and data-fusion ISO/FDIS 23150 and YTL/CEN/TC 278: Road vehicles[4]**
    1. Data transmission between sensors and data-fusion unit for automated driving functions
    2. Logical interface

[2] ETSI. ETSI GR IP6 030 V1.1.1 (2020-10), 'IPv6-based Vehicular Networking (V2X)', https://www.etsi.org/deliver/etsi_gr/IP6/001_099/030/01.01.01_60/gr_IP6030v010101p.pdf

[3] ISO. 'ISO/DIS 13111-2'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/88/78863.html.

[4] ISO. 'ISO 23150:2021'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/47/74741.html.

In respect to the ITU, ORANGE submitted two contributions to ITU-T Study Group 13, Question 21 'Networks beyond IMT-2020: Network softwarisation':

- **Y.DL-AINW-fra draft recommendation:** 'Framework for data linkage between AI-based network slice management and orchestration and network slice customers in networks beyond IMT-2020'
- **Y.IMT2020-EIL draft recommendation**: 'Evaluating intelligence capability for network slice management and orchestration in IMT-2020'

Additional standardisation efforts outside of what has been identified in the standardisation plan took place within the ITU and EuroPrivacy and were principally carried out by Mandat International (MI). Namely, the following contributions were made:

- Contribution 690 on **IoT and V2X Communication** in the Study Group 20, Question 3 'IoT and SC&C architectures, protocols and QoS/QoE'
- Joint contribution to the ITU FG-VM Technical Report (FGVM-O-040) on **'Vehicular Multimedia Architecture' within ITU FG-VM** (by MI in collaboration with EURESCOM)
- A set of complementary criteria were developed by MI, with the support of UL for the **Europrivacy GDPR certification scheme** which will enable the scheme to address key personal data protection requirements of relevance to connected vehicles. This action seeks to provide a relevant, legally recognized solution for voluntary certification of compliance, available for both EU and non-EU companies.

Finally, 5G-DRIVE partners contributed to the standardisation task through relevant events and fora where they promoted the project's standardisation efforts and findings, namely:

- 'Workshop on European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives',
- Symposium on the Future Networked Car 2020 (FNC-2020),
- Focus Group on Vehicular Multimedia (FG-VM),
- 2021 Joint EuCNC & 6G Summit.

5.1 Contributions to Harmonised European Standard ETSI EN 302 571

The European Telecommunications Standards Institute (ETSI) is an independent European standards-developing organisation that provides a platform for the development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services across all sectors of industry and society. ETSI supports European regulations and legislation through the development of Harmonised European Standards. Furthermore, ETSI partners with 3GPP on the development of 3GPP mobile communications, including 5G.

The technical Group 37 in the ETSI Technical Committee on Electromagnetic and Radio Spectrum Matters (TC ERM TG37) is the ETSI standardisation group responsible for developing and maintaining the Harmonised European Standard EN 302 571. Compliance with this Harmonised Standard provides the presumption of conformity with the essential requirements of article 3.2 of Directive 2014/53/EU (the Radio Equipment Directive (RED)) for Radiocommunications equipment of Intelligent Transport Systems (ITS) operating in the 5855 MHz to 5925 MHz frequency band.

Since May 2017, ETSI TC ERM TG37 has been working on a revision of EN 302 571 with the aim of:

- Addressing the comments received from the European Commission RED Desk officer on:

(i) receiving parameters/sensitivity,

(ii) uncertainty measurements,

(iii) limits of transmitter frequency stability,

(iv) AGC in transmit power and

(v) limits of spurious emissions;

- Improving the overall quality of the standard with a particular focus on replacing technology-specific clauses with technology-agnostic testing requirements and procedures.

In the context of 5G-DRIVE, the Joint Research Centre (JRC) has contributed to the revision of **ETSI EN 302 571** by submitting seven technical contributions to ETSI TC ERM TG37[5], namely:

- **ERMTG37(19)034003r1:** Proposed modifications to EN 302 571 for testing of multi-antenna devices
- **ERMTG37(19)000106:** Proposed modifications to EN 302 571 to add a definition of smart antenna systems
- **ERMTG37(19)000122:** On the evaluation of the ITS-G5 and LTE-V2X duty cycle
- **ERMTG37(19)00141:** Updated duty cycle requirement
- **ERMTG37(19)00137:** Updated testing procedure for duty cycle measurement
- **ERMTG37(20)000021r1:** On the definition of smart antenna systems in draft EN 302 571 V2.1.10
- **ERMTG37(21)040013:** Reversion of two editorial changes to analytical expressions of P(e.i.r.p.) in EN 302 571 V2.1.14

All of the above contributions have been accepted by ETSI TC ERM TG37. Currently subject to EC revision and final ETSI approval, they will be included in the next revision of EN 302 571, scheduled for public release in September 2022.

However, the specific contents of technical contributions made to ETSI TC ERM TG37 cannot be made public before the official release of the next version of EN 302 571. The following subsections, thus, provide a brief summary of the JRC contributions to ETSI TC ERM TG37 regarding three areas:

(i) multi-antenna systems,

(ii) technology-agnostic requirements and testing procedures, and

(iii) editorial improvements.

5.1.1 Contributions on multi-antenna systems for Intelligent Transport Systems

Contributions **ERMTG37(19)034003r1**, **ERMTG37(19)000106** and **ERMTG37(20)000021r1** focus on the issue of testing multi-antenna systems for ITS. The latest public release of EN 302 571 does not contain specific testing procedures for multi-antenna systems, thus leaving room for interpretation to the organisation responsible for implementing the standard (e.g., device manufacturers, test houses, etc.). To avoid any potential misunderstandings, specific testing procedures for multi-antenna devices were added to EN 302 571. A normative definition of 'smart antenna systems' (based on other Harmonised European Standards referenced in the Official Journal of the EU) was

[5] ETSI. 'ETSI Portal > TB'. Accessed 8 June 2021. https://portal.etsi.org/tb.aspx?tbid=620&SubTB=620#/. ETSI members can access these contributions by searching for the contribution reference in the ETSI TC ERM TG37 portal (e.g., "ERMTG37(19)000122").

also included to determine to which type of devices the new testing procedures would apply.

5.1.2 Contributions on technology-agnostic requirements and testing procedures

Contributions **ERMTG37(19)000122**, **ERMTG37(19)00141** and **ERMTG37(19)00137** aim at replacing technology-specific provisions on ITS-G5's Decentralised Congestion Control mechanism with technology-agnostic testing requirements and procedures for duty cycle evaluation applicable to both ITS-G5 and LTE-V2X. The rationale for these contributions was to make EN 302 571 more technology-agnostic without compromising the original objectives of the technical requirements and testing procedure of the ITS-G5's Decentralised Congestion Control. This was achieved by setting limits to the duty cycle of ITS-G5 and LTE-V2X as a function of the maximum and current occupied bandwidth. It has to be noted that ITS-G5 and LTE-V2X use the radio spectrum differently; however, the same congestion control limits apply equally to both technologies.

5.1.3 Contributions on editorial improvements

Finally, contribution **ERMTG37(21)040013** addressed an editorial issue with the analytical expression of the Effective Isotropic Radiated Power (EIRP) in various testing procedures in EN 301 571.

5.2 ETSI ISG IPv6 V2X standardisation

The faster a cohesive strategy for 5G and IPv6 is developed and applied into among others in standardisation and research, the sooner the benefits and risks of using IPv6 in 5G will be validated. Overall, this will enable the fast deployment and success of 5G.

Mobile operators are currently being stimulated to deploy IPv6 in their 4G mobile networks due to:

- the performance improvements seen in IPv6 deployments;
- support of multi-layered secure networking and,
- the deployment of IPv6 by a large content provider. This trend is expected to be continued for 5G mobile networks. However, it is expected that IPv4 and IPv6 will co-exist also in 5G deployments due to the fact that only a few applications or services are currently available only in IPv6. This means that even in the presence of IPv6 deployments, IPv4 provisioning needs to be considered. It is important to be noted that one of the operators in the USA announced that in new 5G deployments, only the IPv6-only solution will be applied.

In this context, the University of Luxemburg (UL), as its chair rapporteur, has established the ETSI Industry Specification Group on IPv6 integration (ISG IP6). Duties for this work item include defining best practices, gathering support and creating awareness of the impact of Internet Protocol version 6 (IPv6). In particular, ETSI ISG IP6 addresses the transition from IPv4 to IPv6, bringing together stakeholders worldwide to work on pre-standardisation in a neutral environment, defining requirements and use cases, outlining best practices, gathering support and creating awareness of the impact of IPv6.

IPv6 is one of the key technologies required in 5G deployments supporting billions of new devices that form the Internet of Things (IoT). IPv6 also facilitates IP-enabled applications to be applied and used in vehicular communications. Specifically, in the context of 5G-enabled cooperative mobility and vehicular communications, IPv6 provides several advantages, such as:

- The large space of addressing due to the exhaustion of IPv4 address space, which impacts the growth of internet continuity;
- The improvement of end-to-end connectivity, mobility, and security services;
- The addition of node auto-configuration mechanisms to facilitate the configuration of connected equipment and others. In addition, the emergence of Automotive Ethernet for in-

vehicle communications, combined with the possibility of remote access and monitoring of specific in-vehicle sensors and functionalities, naturally brings in the need for IP communications.

In the case of 5G-enabled vehicular communications, relevant connectivity-based services could be enabled by IPv6, such as remote diagnostics, advanced and remote driving, extended sensors, Cooperative-Advanced Driving Assistance Systems (C-ADAS), cloud-assisted platooning, and others.

The UL leads since 2014 the ETSI ISG IP6 and actively participated and contributed to its standardisation efforts, producing an ETSI Group Report (GR) that summarises the ongoing worldwide V2X standardisation initiatives that target the introduction of IPv6 for V2X communications and related applications and services. The document has been published and is available on the ETSI portal: ***ETSI GR IP6 030 V1.1.1 (2020-10), 'IPv6-based Vehicular Networking (V2X)'***[6].

In particular, the report focuses on the following elements:

- Identifying and describing the best IPv4-to-IPv6 transition strategies in Vehicular Network (IPv4 only, Coexistence of IPv4 and IPv6, IPv6 only, Enhanced IPv6 only + NAT64, Enhanced IPv6 only + 464XLAT)
- Summarising the ongoing worldwide V2X standardisation activities that aim at introducing IPv6 for vehicular communications, focusing on:
    - Applying IPv6 to extra-vehicular communications
    - Modelling IPv6 links and subnets over wireless LAN
    - Applying IPv6 Neighbour Discovery to wireless links
    - Connecting to the infrastructure with IPv6 over Wi-Fi and OCB
    - Enabling network mobility
    - IPv6 security and IPsec
- Gathering and consolidating relevant information regarding the worldwide V2X standardisation initiatives carried out within different standardisation institutions, such as 3GPP, ISO, ETSI, IETF and 5G-AA. These efforts also included inviting relevant partners to provide their contributions, integrating the received inputs into the main document, periodically submitting consolidated drafts, requiring revisions and reviewing the document accordingly. A special focus has been given to:
    - The use of IPv6-over-OCB for V2V with prefix exchanges between three cars;
    - Transmission of CAM messages over OCB with empty Geo Networking and BTP header;
    - ITS Station architecture specified in ISO and ETSI;
    - IPv6 over Geo Networking;
    - Commercial Probe Vehicle Data (or Floating car data, FCD) services using IPv6.
- Reporting best cases on IPv6 transition strategies for vehicular communications, describing several concrete use cases where the introduction of IPv6 could bring benefits.

[6] ETSI. 'IPv6-based Vehicular Networking (V2X).' Accessed 25 May 2021. *https://www.etsi.org/deliver/etsi_gr/IP6/001_099/030/01.01.01_60/gr_IP6030v010101p.pdf*

In the last months of the project, UL has established and currently chairs a new ISG on IPv6 enhanced innovation (ISG IPE) that aims at providing and demonstrating use cases and proofs of concepts to support innovation on IPv6 networking topics and validate standards-based approaches. This ISG seeks to enhance the capture and dissemination of real-life IPv6 deployments, trials and relevant industry projects. The purpose is to allow the rapid convergence of the IPv6 standard and to share best practices to enable the smooth transition from legacy solutions. Within this ETSI ISG IPE, UL supported by the European Commission (Dr. Jorge Pereira) as counsellor, is working on a GR on 'IPv6-based 5G for Connected and Automated Mobility' that will tackle the lack of clearly defined requirements and reference architectures that are needed to enable the deployment of IPv6 for 5G-enabled CAM.

5.3 V2I connectivity and sharing point-clouds in collaborative sensing framework

The International Organisation for Standardisation (ISO) is an independent, non-governmental international organisation involving 164 national standards bodies. The SDO facilitates knowledge sharing and seeks to present voluntary, consensus-based, and competitive international standards supporting innovation and responding to global challenges. ISO's work is carried out by technical committees. In the scope of 5G-DRIVE, we can distinguish three technical committees of relevance: Information technology, Road vehicles and Intelligent transport systems. The table below provides an overview of the existing working groups and sub committees of high relevance to the project.

In this context, VTT has principally contributed to the development of ISO standards related to vehicle automation and, in particular regarding connectivity functions that serve to improve situation assessment and awareness.

In addition, VTT, in collaboration with the Finnish Traffic Safety Authority (Traficom) and the Transport Infrastructure Agency, has actively been involved in the C-ROADS project. The 5G/LTE-V2X related pilots and results are used as a reference for proposing an adaptation of digital infrastructure. Concerning the 5G-DRIVE initiative, the main activities focused on message exchange within European 5G and C-V2X networks to increase passenger cars' automation level. Such an example is the 5G-DRIVE components used in intersection collision avoidance and using MCM (Manoeuvre Coordination Message). In Finland, the 'Yhteinen Toimialaliitto' (Joint Confederation of Finnish Industries) is the principal standardisation facilitator for ISO, and monthly inquires the current state of relevant standard drafts. Throughout the course of the project, reviews for the following standards have been performed:

- **Data exchange requirements ISO/DIS 13111-2 and YTL/CEN/TC 278: Intelligent Transport Systems (ITS)[7]:**
    3. The use of personal ITS stations to support the provision of ITS services for travellers
    4. General requirements for data exchange between ITS stations

- **Sensors and data-fusion ISO/FDIS 23150 and YTL/CEN/TC 278: Road vehicles[8]**
    3. Data transmission between sensors and data-fusion unit for automated driving functions
    4. Logical interface

[7] ISO. 'ISO/DIS 13111-2'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/88/78863.html.

[8] ISO. 'ISO 23150:2021'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/47/74741.html.

5G-DRIVE V2X focuses on the following two applications:

1. *GLOSA – Traffic Light Signalling (ETSI TS 103 301 Intelligent Transport Systems (ITS); Facilities layer protocols and communication requirements for infrastructure services and CEN ISO/TS 19091:2017 Intelligent transport systems -- Cooperative ITS -- Using V2I and I2V communications for applications related to signalised intersections)*
2. *Intersection collision avoidance (ETSI TS 101 539-2 Intelligent Transport Systems (ITS); V2X Applications; Part 2: Intersection Collision Risk Warning (ICRW) application requirements specification)*

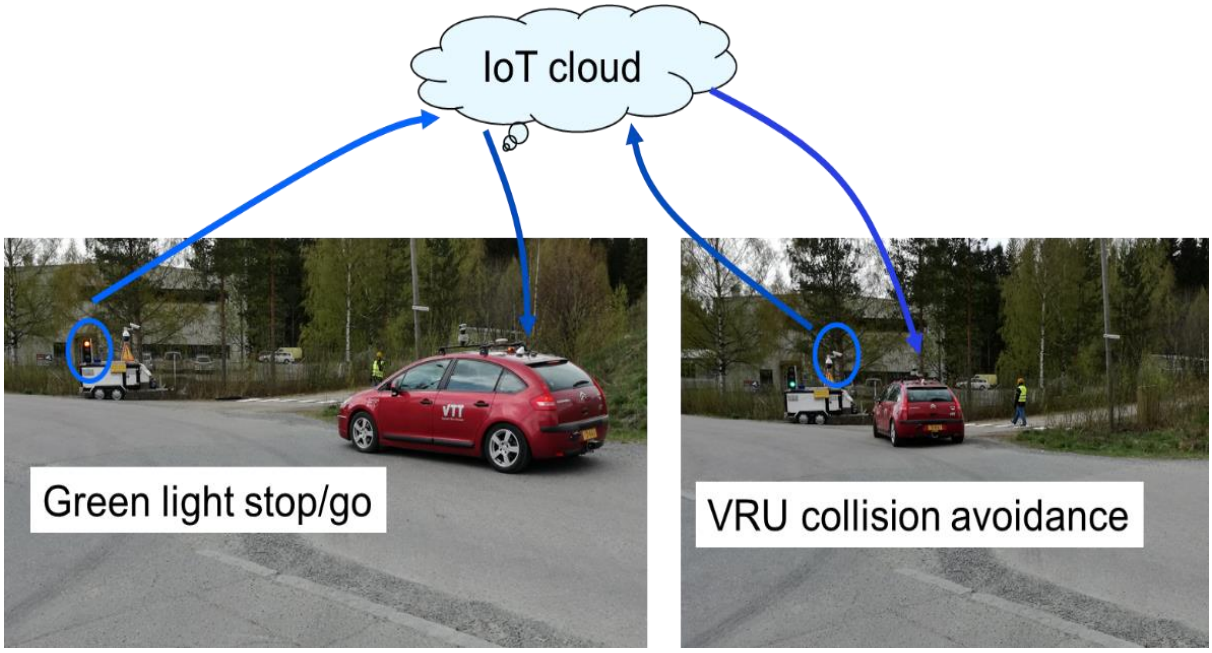


Figure 4: 5G-DRIVE trial experiment (EU-China) for having GLOSA and VRU collision avoidance trials and optimising the messages between IoT devices

Both of the use cases have been designed and standardised more for ITS-G5 environment where payload and message format do not allow more versatile messages without increasing the latency times of message transmission. The C-V2X, eMBB and slicing features could potentially be improved with optimising message content.

These applications are mainly covered by:

- ETSI TS 103 301 'Intelligent Transport Systems (ITS), which facilitates layer protocols and communication requirements for infrastructure services,
- CEN ISO/TS 19091:2017 'Intelligent transport systems - Cooperative ITS - Using V2I and I2V communications for applications related to signalised intersections' and,
- ETSI TS 101 539-2 'Intelligent Transport Systems (ITS); V2X Applications; Part 2: Intersection Collision Risk Warning (ICRW) application requirements specification'.

In addition, VTT has also been contributing to safety standards regarding automated vehicles within Traficom. The latter is part of the UNECE working group related to the Validation Method for Automated Driving, the goal of which is to standardise the methods that ensure the safety of automated vehicles on roads.

5.4 Network slicing

Network slicing is a fundamental enabling technology for 5G mobile networks. Those networks will be settled on an open pool of interconnected infrastructural resources delivered by various owners, resellers, integrators and brokers. A major reshaping of the market and business models is expected to happen as a result, implying changes in the management and orchestration architecture. Hence, efficient means for management and orchestration are a must for dealing with such big profusion, complexity and variety of co-existing networks, as well as actors. The mutual interdependence of business environment and management architecture will drive the necessary changes of management and orchestration (MANO) frameworks architecture that is designed for a single operator only. The problem of a new business architecture also deals with an efficient management interface exposed to slice tenants.

Network slices will be typically deployed in multiple domains (technological, orchestration and also ownership ones). Even if some MANO Operators will try to provide the services at all layers (E2E slice orchestration, network sub-slice orchestration, infrastructure management and infrastructure operation), the common market of interconnected infrastructure will consist of multiple resources' owners, who are just interested in exposing and selling their resources without any further responsibility. These resources may be exposed to different Infrastructure Brokers who will offer the resources at different prices and rules. Existing resources of multiple infrastructure providers can be aggregated, enriched and, in case of 'overlapping' resources, the resource selection can be based on the price/performance ratio. The slice deployment brokering mechanism lies on the iterative evaluation which part (if not all) of slice template can be implemented and what will be the price of such implementation.

Future telecommunications networks, based on network slicing, will cause an explosion in the number of separate instances of 5G networks, especially as a result of the implementation of private, campus networks with local coverage. Their tenants will be interested in the efficient and uninterrupted operation of these networks, without the need for personal involvement in their management and maintenance. This responsibility will therefore be delegated to other players who, while providing the management service, will need efficient real-time management tools for multiple networks with various characteristics, used by tenants with different requirements. That is why the ITU-T area of interest currently covers the application of artificial intelligence (AI) and machine learning (ML) algorithms to network management processes, thus the working documents devoted to network slicing standardisation are currently dedicated to the related topics.

In November 2020, Orange submitted two contributions to ITU-T Study Group 13, Question 21 'Networks beyond IMT-2020: Network softwarisation':

- **The contribution to Y.DL-AINW-fra draft recommendation: 'Framework for data linkage between AI-based network slice management and orchestration and network slice customers in networks beyond IMT-2020'**[9] describing in more details the role of the External Management entity and specifies the expected functionalities of slice management interfaces: intent-based management and policy rules to be converted by AI mechanisms to atomic management operations, exposure of current and predicted KPIs, enabling of high-level slice capacity planning, and access to slice management data and capabilities, including creation and configuration of a network function within a slice.
- **The contribution to Y.IMT2020-EIL draft recommendation: 'Evaluating intelligence**

[9] ITU. '[619-WP1] Initial Draft New Recommendation ITU-T Y.DL-AINW-Fra: "Framework for Data Linkage between AI-Based Network Slice Management and Orchestration and Network Slice Customers in Networks beyond IMT-2020"'. Accessed 15 June 2021. https://www.itu.int/md/T17-SG13-200720-TD-WP1-0619.

capability for network slice management and orchestration in IMT-2020'[10]. This contribution lists of AI-driven Network Slice Management and Orchestration operations that should be a subject of evaluation by the framework defined within this recommendation: resource allocation (including RAN), fault and security management, optimisation of slice management and orchestration (e.g. reduction of the number of operations), slice isolation-oriented resource allocation, multi-objective optimisation of slice deployment and performance.

Orange plans to contribute to new versions of the mentioned documents until they are consented. The nearest contributions will be submitted for the SG13 Rapporteurs Group Meeting that will be held in July 2021.

5.5 Additional standardisation activities

In addition to the standardisation activities originally mentioned in the standardisation plan, a number of parallel outcomes have also been produced throughout the duration of the project. MI and 5G-DRIVE partners active in the standardisation field have further pursed their efforts to transfer 5G-DRIVE research outputs to the global SDOs while also reinforcing the dialogue with the key bodies on how to strengthen the participation of European research in the field of IoT and V2X to global standardisation.

5.5.1 ITU contributions and activities

As task leader, MI has contributed to the T6.3 by drafting and submitting the Contribution 690 on IoT and V2X Communication to Question 3 ('IoT and SC&C architectures, protocols and QoS/QoE') of Study Group 20 (smart cities and communities) at the ITU-T, as well as coordinating and submitting a second contribution to ITU FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture', in collaboration with EURESCOM and UL.

Contribution 690 on 'IoT and V2X Communication' at ITU-T Study Group 20, Question 3

MI presented and successfully submitted the Contribution 690 on '**IoT and V2X Communication'** [11]at the Study Group 20, Question 3 'IoT and SC&C architectures, protocols and QoS/QoE' meeting in Geneva (from 25 November-6 December 2019). The contribution sought to share information on V2X European Research and the work undertaken in the scope of 5G-DRIVE that could be relevant for the SG20 and the Focus Group on Vehicular Multimedia. Considering the fundamental nature of IoT connectivity and communication in the V2X domain, it was recommended for SG20 to closely follow up the research developments in this domain and consider addressing the standardisation needs in this area. It was also suggested for SG20 to consider studying this important area and its impact in cities. The contribution was welcomed by the Chair and triggered interest from participants. The main achievement of this activity is that the content of the contribution was taken into account to define the structure of the ITU-T Study Group 20 in 2020.

ITU-T FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture'

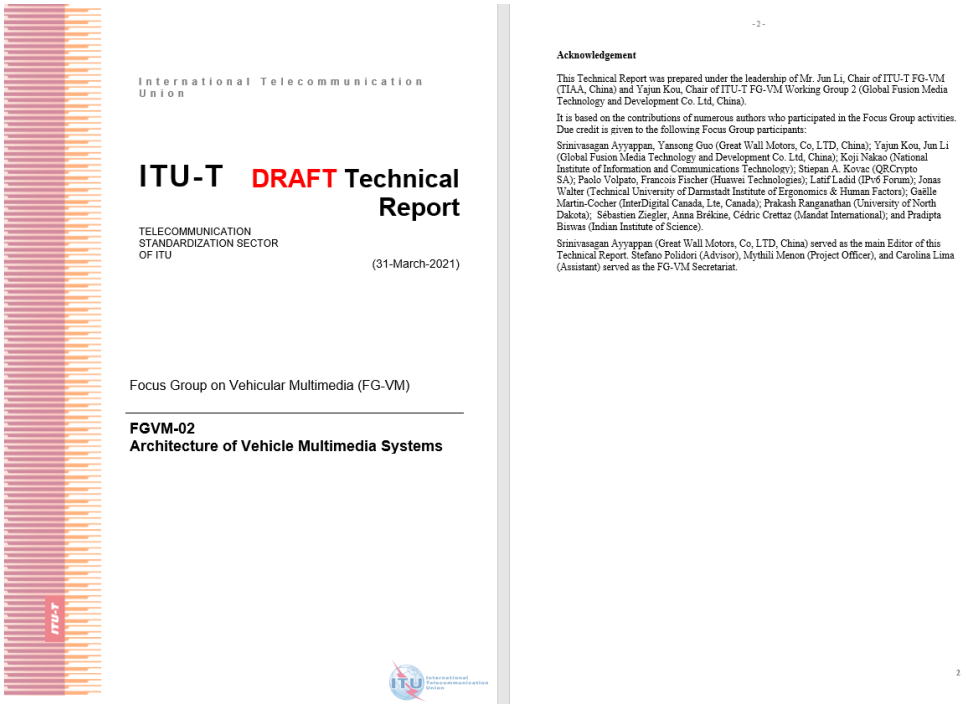
Moreover, MI engaged in direct coordination with the ITU regarding participation opportunities within the freshly established ITU-T Focus Group on Vehicular Multimedia (FG-VM). The study of this Focus Group concentrates on identifying and evaluating gaps within the vehicular multimedia

[10] ITU. '[687-WP1] Draft New Recommendation Y.IMT-2020-EIL: "Evaluating Intelligence Capability for Network Slice Management and Orchestration in IMT-2020"'. Accessed 15 June 2021. https://www.itu.int/md/T17-SG13-201217-TD-WP1-0687/fr.

[11] ITU. '[690] Contribution on IoT and V2X Communication'. Accessed 18 June 2021. https://www.itu.int/md/T17-SG20-C-0690/en.

standardisation landscape. The aim is also to draft technical reports and specifications regarding, among others, vehicular multimedia use cases, requirements, applications, interfaces, protocols, architectures and security. As a joint work of both MI, UL and EURESCOM, a second contribution to the ITU FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture' was submitted in June 2020 and presented at the FG-VM plenary meeting. The contribution described at high level the mandatory requirements in terms of security and data protection for Vehicle Multimedia System (VMS). In particular, the handling of Personally Identifiable Information (PII) must strictly follow the General Data Protection Regulation (GDPR). For instance, the end-to-end encryption must be applied between each component of the architecture specified in the ITU-T FG-VM technical report. Other GDPR requirements like the avoidance of PII linkage or the transfer of data outside the European Union were also mentioned. This contribution was favourably received and is further examined through a freshly formed sub-group level which will include it in a relevant document in collaboration with other experts. The FG-VM/WG2 held an e-meeting on 31 March 2021, which followed the Joint FG-VM/WG2 & Q27/16 e-meeting, held on 4-5 March 2021. At that FG-VM/WG2 e-meeting, the 2nd Technical Report on 'Architecture of Vehicle Multimedia Systems'[12] was updated and the latest baseline text was proposed for approval by FG-VM and will be sent for standardisation to Study Group 16.

The group's latest publication, a technical report on the 'Architecture of Vehicle Multimedia Systems', was published and approved on April 13th 2021[13]. These collaboration opportunities have been discussed with the 5G-DRIVE members through MI who also directly reached out and stood in contact with the ITU-T.



International Telecommunication Union

ITU-T DRAFT Technical Report

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

(31-March-2021)

Focus Group on Vehicular Multimedia (FG-VM)

FGVM-02
Architecture of Vehicle Multimedia Systems

-2-

Acknowledgement

This Technical Report was prepared under the leadership of Mr. Jun Li, Chair of ITU-T FG-VM (TIAA, China) and Yajun Kou, Chair of ITU-T FG-VM Working Group 2 (Global Fusion Media Technology and Development Co. Ltd, China).

It is based on the contributions of numerous authors who participated in the Focus Group activities. Due credit is given to the following Focus Group participants:

Srinivasagan Ayyappan, Yansong Guo (Great Wall Motors, Co, LTD, China); Yajun Kou, Jun Li (Global Fusion Media Technology and Development Co. Ltd, China); Koji Nakao (National Institute of Information and Communications Technology); Stiepan A. Kovac (QRCrypto SA); Paolo Volpato, Francois Fischer (Huawei Technologies); Latif Ladid (IPv6 Forum); Jonas Walter (Technical University of Darmstadt Institute of Ergonomics & Human Factors); Gaëlle Martin-Cocher (InterDigital Canada, Lte, Canada); Prakash Ranganathan (University of North Dakota); Sébastien Ziegler, Anna Brékine, Cédric Crettaz (Mandat International); and Pradipta Biswas (Indian Institute of Science).

Srinivasagan Ayyappan (Great Wall Motors, Co, LTD, China) served as the main Editor of this Technical Report. Stefano Polidori (Advisor), Mythili Menon (Project Officer), and Carolina Lima (Assistant) served as the FG-VM Secretariat.

2

Figure 5: ITU-T FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture'

[12] ITU. 'Output documents'. Accessed 28 May 2021. https://extranet.itu.int/sites/itu-t/focusgroups/vm/input/FGVM-I-221R1.zip

[13] ITU. 'Focus Group on Vehicular Multimedia (FG-VM)'. Accessed 28 May 2021. https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx

Workshop on European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives

Additionally, MI has focused the standardisation efforts on building dialogue with relevant SDOs on and disseminating the work of 5G DRIVE to standardisation exports. In this context, MI has organised the 'Workshop on European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives' at the Geneva ITU offices on March 3rd 2020, with the participation of UL to present the 5G-DRIVE project and part-take in the discussion on exploring possible paths to foster collaboration between IoT research and global IoT standardisation.

The audience included lead researchers from Horizon2020 research projects involved in standardisation, high-level representatives from global SDOs (ITU, IEC and ISO), President/Vice-Presidents of IoT related fora (TM Forum, IPv6 Forum, and IoT Forum), as well as public authorities (European Commission, Switzerland). The purpose of the discussion was to identify practical measures that can enhance the contribution of the research community to global standardisation.

The event also discussed the solid potential standardisation has in Horizon Europe to support innovation and competitiveness and to enable access to markets and interoperability while giving consumers confidence in innovations. Therefore, to foster collaboration between IoT research and global IoT standardisation, three main recommendations were proposed:

1. Facilitate and enhance the participation of the research community in standardisation activities;
2. Adapt the research programme;
3. Explore innovative approaches.

Figure 6: Workshop on European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives held at the ITU in Geneva (Source: NGIoT)[14]

Symposium on the Future Networked Car 2020 (FNC-2020)

MI has facilitated and collaborated with the ITU on the Symposium on the Future Networked Car 2020 (FNC-2020) with the participation of UL to present and discuss 5G DRIVE project to SDOs and automated car experts.

[14] NGIoT. 'NGIoT – mobilising an IoT ecosystem for Horizon Europe'. Accessed 28 May 2021. https://www.ngiot.eu/ngiot-mobilising-an-iot-ecosystem-for-horizon-europe/

The ITU/UNECE annual Symposium on the Future Networked Car (FNC-2020) held on Thursday 5 March 2020 brought together the automotive and information and communication technology (ICT) industries, along with government leaders, to explore advances in connected, automated vehicles and associated implications for technology, business and regulation.

Figure 7: Symposium on the Future Networked Car 2020 (FNC-2020)[15]

In the scope of the event, UL presented 5G-DRIVE and the research conducted in the scope of IPv6-based Vehicular Networking (V2X). The participation was a great success and the contributions on IPv6 for V2X received endorsement by ITU-T. Following the meeting, the IPv6 has been deemed 'crucial for security', as stated in the ITUNews Magazine.[16]

Chairmanship at Focus Group on Vehicular Multimedia (FG-VM)

As mentioned above, the ITU-T FG-VM has been established to identify the need for new vehicular multimedia standards based on space and terrestrial networks integration[17]. UL has joined this focus group in 2020 as co-chair of WG3 on the Implementation Aspects of Vehicular Multimedia[18]. The work consisted in defining the essential aspects of implementing Vehicular Multimedia functionalities in vehicles. The document in the link below is planned to be finished by end of 2021 and is intended to relate the implementation aspects with pre-defined configurations and their corresponding requirements, related to Vehicular Multimedia capabilities, like services (Parking Find and Pay, intelligent Navigation, MaaS, On Demand mobility...), applications (Music, Radio, Video, Telephony, Messaging, Smart home…) or technological features (voice recognition, haptics, vehicle comfort control, connectivity…).The implementation aspects include different categories of requirements like interoperability and openness, cyber-security, driving safety, aftermarket and next generation connectivity technologies from 5G and beyond.

[15] ITU. ITU Pictures. Future Networked Car Symposium (FNC-2020). 5 March 2020. Photo. https://www.flickr.com/photos/itupictures/49622327881/.

[16] ITU. ITUNews Magazine, Technology driving safer transport, No.1, 2020.

[17] ITU. 'Focus Group on Vehicular Multimedia (FG-VM)'. Accessed 18 June 2021. https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx.

[18] ITU. 'FG-VM-WG3-TR-Implementation_aspects-V06.Docx'. Accessed 25 May 2021. https://extranet.itu.int/sites/itu-t/focusgroups/vm/_layouts/15/WopiFrame2.aspx?sourcedoc=%7B76c48d5e-91ab-49e7-8f1e-0e676fd966c8%7D&action=default&slrid=b648c39f-eea2-60f3-3969-f2d5fcea3158.

5.5.2 Europrivacy

As previously specified, multiple standards and legal frameworks directly affect the development and deployment of 5G vehicular networks. This multitude of reference sources and the great number of legal requirements involved generate obstacles to the interoperability and massification of V2X communications. Indeed, various jurisdictional requirements may present technical and organisational barriers for foreign solutions to enter a market.

Certification has been a historically relevant approach to enable the globalisation and interoperability of technologies. By ensuring conformity criteria and incorporating these into business practices, market players can ensure the easy adaptation of their products and services regardless of the final location of the deployment. However, personal data protection regulations complicate this situation, as they include both technical and organisational requirements and even incorporate security obligations and best practices which have traditionally been outside of the scope of most national legal frameworks.

As noted in D5.3, both the European approach to Personal Data Protection, as embodied in the GDPR, and the Chinese approach to privacy regulation present many such challenges to the deployment of innovative technologies in a globalised environment. From data localisation requirements to limitations of trans-border data flows, the identification of a path forwards for the harmonisation of both legal regimes will be key to the massification of V2X and future 5G networks as envisioned in the 5G-DRIVE project.

A potential solution can be found in the form of voluntary certification mechanisms, which are increasingly relevant in both European and Chinese contexts (as showcased in D5.3 Section 2.2) and which have increasingly focused on homogenising previously unaddressed areas such as personal data protection.

The GDPR mentions the term 'certification' over 70 times (although it does not define it), noting that it is aimed towards '*demonstrating the existence of appropriate safeguards provided by controllers or processors that are not subject to this Regulation pursuant to Article 3 within the framework of personal data transfers to third countries* (…)'(GDPR, 2016).

Trustable certification solutions bridge the legal divides within existing jurisdictions while some even take into account other solutions, such as domain-specific requirements or standards (e.g., ISO or ITU-T). Therefore, they are key to the massification of 5G connected vehicles of 5G-DRIVE. The GDPR introduces certification mechanisms under Article 42 and 43 as a solution for data controllers to demonstrate their compliance. The voluntary certification system of the GDPR allows national supervisory authorities or accredited certification bodies to issue certifications based on demonstrated compliance independently from other existing certifications. It is important to note, however, that a certification does not reduce the responsibility of a data controller or a data processor to comply with the GDPR (Publications Office of the European Union, 2019). It is the task of the EDPB to define common criteria applicable across the EU that may lead to a definition of the European Data Protection Seal. Since the GDPR came into force, the EDPB published a Guideline for identifying certification criteria in accordance with Article 42 and 43 that was approved in 2019. The Guideline defines the role of Supervisory Authorities and Certification Bodies, as well as details the development and approval procedure for certification criteria, including the criteria for the European Data Protection Seal (European Data Protection Board, 2019).

Finding a certification scheme that is able to assess the compliance of diverse data processing activities effectively can be challenging. In this sense, we can argue that there are two main types of GDPR certification schemes, but not without disadvantages. Universal certification schemes are cost-efficient; especially if we consider their accessibility to small to medium-sized enterprises (SMEs) which is one of the main objectives stated in the GDPR (Publications Office of the European Union, 2019). Nevertheless, the main disadvantage of these schemes is that they are inherently limited in nature and do not allow the assessment of specific risks related to technology, for example. On the other hand, specialised certification schemes are able to certify specific categories of data

processing, but this advantage makes them near-inaccessible and expensive to most businesses. Neither of the certification scheme solutions mentioned above is applicable to the complexity of data processing in connected vehicles, especially in the context of the 5G-DRIVE project where we aim for building a bridge between the European and Chinese frameworks. Cost is an important factor in both certification solutions, as a GDPR certificate is valid only for three years and must be renewed based on the continuous demonstration of compliance. Therefore, consideration must be given to 'hybrid' certification mechanisms that combine the advantages of universal certification schemes and their comprehensive lists of criteria together with complementary national-, domain- and technology-specific criteria, making hybrid certifications the most effective in terms of not only compliance but cost considerations. Currently, the only GDPR certification under the review of EDPB to be endorsed as a European Data Protection Seal is Europrivacy™/®.

Europrivacy is a certification scheme developed through the Horizon 2020 European research programme with financial support from the European Commission and Switzerland. Europrivacy was developed through a sequence of European research projects, including EAR-IT (2012-2014 on privacy risk assessment methodology), Privacy Flag (2015-2018 on certification scheme design), and ANASTACIA (2017-2019 on authenticated certificates). It was also extended and used in the context of Synchronicity, the European Large-Scale Pilot on Internet of Things for Smart Cities, to assess the compliance of smart city deployments with the GDPR.

It was co-created by several European research partners committed to promote personal data protection and to support the implementation of the GDPR. Europrivacy is managed by the European Centre for Certification and Privacy (ECCP) in Luxembourg under the guidance of an international board of experts in data protection. ECCP has been granted the status of research centre by the authorities of Luxembourg and will keep a continuous and close cooperation with the European research programme to maintain a high level of reliability of its certification scheme by leveraging on the European research community and a network of seasoned experts in data protection from all over Europe and beyond.

Europrivacy has been designed to directly encompass the whole range of requirements found in the GDPR and can easily be extended to include complementary national and domain-specific obligations, which makes it particularly relevant in the context of 5G-DRIVE. It has been designed to be comprehensive and capable of assessing a large scope of data processing activities by complementing its core list of checks and controls with complementary ones according to the Target of Evaluation. While its focus is on data processing activities (following the required approach by EDPB), its dual compliance with ISO/IEC 17065 and 17021-1 (where applicable) enables Europrivacy to assess data processing in the context of services, products, and information management systems.

Europrivacy has closely followed the EDPB recommendations regarding certification criteria generation: '*the basis for certification criteria must be derived from the GDPR principles and rules and help to provide assurance that they are fulfilled. The development of certification criteria should focus on verifiability, significance, and suitability of certification criteria to demonstrate compliance with the Regulation. The certification criteria should be formulated in such a way that they are clear and comprehensible and that they allow practical application*[19]'.

For all these reasons, the Europrivacy Certification Scheme complies with all the necessary criteria (e.g., in terms of applicability and scope) identified by the 5G-DRIVE project and may very well be implemented successfully across jurisdictional borders to ensure vehicle and service providers overcome the identified difficulties associated with diverging protection standards granted by national and regional legal frameworks.

This being considered, 5G-DRIVE sought to propose a specific extension of the Europrivacy criteria for

[19] See Page 15 - Guidelines 1/2018 on certification and identifying certification criteria in accordance with Articles 42 and 43 of the Regulation - version adopted after public consultation https://edpb.europa.eu/sites/edpb/files/files/file1/edpb_guidelines_201801_v3.0_certificationcriteria_annex2_en.pdf

connected vehicles through direct collaboration between MI, as lead of both the privacy and standardisation tasks for the project, UL, as lead of the work on security performed in T5.4, and the ECCP. As noted in D5.3, the process followed for the generation of this extension comprised two main stages:

1. The identification of relevant documents containing specific information and legal requirements for the connected vehicle industry with the focus on data protection and data privacy (the most relevant outcomes of this assessment has been conveyed in D5.3 Section 2). This first stage involved the compilation of recommendations, guidelines, reports, and legal articles published by international institutions and organisations of the European Union, such as the European Commission, European Data Protection Board, and the European Union Agency for Cybersecurity. Secondly, the assessment examined the work (recommendations, guidelines, and other publications) of national data protection supervisory authorities of all Member States of the European Union, on how to address the initial inconsistencies and legal challenges of the connected vehicle industry. Finally, the assessment also studied the findings and proposals of national associations of the automotive industry, particularly those who have submitted codes of conduct and best practices on relevant topics for their consideration and approval by national supervisory authorities.
2. Once this preparatory phase was concluded, an in-depth analysis was carried out to determine the obligations and specifications mentioned by the documents. This process took place in several iterations, where requirements were extracted, compiled, and synthetized to properly convey the necessary information. It concluded with the adaptation of the draft criteria to match the Europrivacy guidelines on criteria generation with the final goal of easing their adoption by the International Board of Experts.

The final list of criteria can be found in D5.3 section 3.5.1.2, and it includes key issues as:

- Personal data protection safeguards by default
- Identification of data categories
- Data management / data subject right compliance
- Data retention compliance
- Data breach information
- Update and review of privacy measures
- Data processing information or documentation
- Vehicle usage data communication
- Regular processing of geolocation data
- Special processing of geolocation data in case of theft
- Tracking via in-vehicle WiFi technology
- In-car applications and processing
- Behavioural monitoring
- Utilisation requirements of eCall system
- Securing vehicle’s communications
- Other security measures
- Biometric data restrictions
- Data processing revealing criminal offences or other infractions
- Protection of communications and traffic data

As previously noted, has MI ensured the quality and technical validity of the proposed through

numerous bilateral meetings with the Europrivacy International Board of Experts and with the relevant technical experts of the 5gDrive project partners. Furthermore, effective take-up has been sought through direct cooperation with the Data Protection Supervisory Authority of Luxembourg, which graciously reviewed the criteria's alignment with the EDPB requirements. Following a successful completion of 7 editorial rounds and multiple bilateral validation calls, the International Board of Expert agreed to incorporate the proposed criteria into the Europrivacy Complementary Checks and Controls on Wednesday 26/5/2021. The final list of criteria (including the output of the 5G-DRIVE project will be submitted for final EDBP validation in the following months. If positive, the successful completion of this process will demonstrate the relevance of 5G-DRIVE standardisation and personal data protection outputs through its collaboration in the development of a relevant and legally recognized certification solution available to both European and global entities.

5.5.3 2021 Joint EuCNC & 6G Summit

The 2021 Joint EuCNC & 6G Summit brought together two successful conferences in the telecommunications domain:

- EuCNC (European Conference on Networks and Communications), backed by the European Commission, running its 30th edition of a series, and the
- 6G Summit, which was created by the Finnish 6G Flagship programme as one of the very first in this domain, taking place in its 3rd edition.

Sponsored by the IEEE Communications Society and by the European Association for Signal Processing, the summit focused on all elements of telecommunications, stretching from 5G deployment and mobile IoT to 6G exploration and future communications systems and networks, encompassing experimentation and testbeds as well as applications and services. Uniting cutting-edge research and world-renown industries and businesses, more than 1,300 representatives from over 40 countries all over the globe joined the last years' editions. In the 2021 edition, even more than 2,000 experts participated in the virtually held event to present and discuss the most recent developments and achievements. In addition, exhibitors had the chance to demonstrate the newest domain-specific technology developed notably within the scope of research projects from EU R&I programmes.

In the context of the 2021 Joint EuCNC & 6G Summit, the JRC presented an overview of the standardisation activities carried out in ETSI TC ERM TG37. The presentation focused on the general improvements to the Harmonised European Standard EN 302 571 for radiocommunications equipment of Intelligent Transport Systems operating in the 5.9 GHz frequency band. UL presented the summary of the results and impact of the ETSI IP6 ISG work done on IPv6 for V2X.

6 Takeaways and Recommendations

To conclude the standardisation activities in the project and to gather final takeaways regarding the standardisation experience, MI elaborated a questionnaire structured around two sets of questions. The first part was aimed at all the 5G-DRIVE partners and sought to give all the partners the opportunity to express their ideas and share the findings obtained throughout the duration of the project. The second part was targeted at the 5G-DRIVE partners who were involved in standardisation. It intended to extract key takeaways and recommendations for future activities in V2X standardisation.

The following section is based on the inputs received from the partners and summarises the key findings obtained through the questionnaire.

6.1 General standardisation takeaways

The first part of the questionnaire was structured around the four following questions:

1. What are the main gaps in terms of V2X standardisation?
2. What are the main gaps in terms of cellular network standardisation (5G, 6G) for V2X?
3. Is there any standardisation topic you would encourage the European Commission to include in its upcoming research calls?
4. What are your plans for standardising your results after the end of the project?

6.1.1 Main gaps in terms of V2X standardisation

The respondents agree that although V2X standardisation is progressing well, there are gaps in the standardisation effort due to different international trends for promoting the respective technological solutions, in different areas of the world. Indeed, due to the high number of different standards (technologies, bands, message formats, application specific, etc.), some are partly overlapping and therefore, sometimes even conflicting. It is a matter of critical importance for the market actors from the various regions to cooperate so that to ensure harmonisation of technologies. Joint research and trials, like those promoted between the EU and China within the 5G-DRIVE's scope should be beneficial. As of existing V2X technical solutions, there are differences in terms of message types used and available technical capabilities. For example, while China uses Basic Safety Message (BSM) for status information and event notifications, Europe has split these into Cooperative Awareness Message (CAM) and Decentralised Environmental Notification Message (DENM). Under potential common trials by the participating partners, it would be important to evaluate similar use cases and identify potential interoperability problems (as in the 5G-DRIVE case), thus identifying areas for developing future standardisation activities able to be adopted by the market sector.

Other difficulties may be due to differences in the spectrum used and/or to related frameworks for access to and use of spectrum.

Additionally, at the time of writing, there are no standard mechanisms to ensure neither spectrum sharing nor co-channel coexistence of Cooperative Intelligent Transport Systems (C-ITS) technologies (such as ITS-G5 and LTE-V2X) in the 5.9 GHz radio frequency band.

6.1.2 Main gaps in terms of cellular network standardisation (5G, 6G) for V2X

The 5G network was prophesied as a 'conditio sine qua non' enabler for new services, but paradoxically the full standardisation of fundamental mechanisms for these services (network slicing, RAN slicing, minimisation of drive tests for RAN measurements collection, 5G ProSe/Sidelink, URLLC, location services and precise positioning, enhanced V2X services, small data, etc.) was given a lower

priority on the standardisation roadmap and was deferred to later releases (Release 17, to be completed in mid-2022, or even Release 18, yet to be defined), so the 5G network is still unable to support these services. The strategy of 3GPP failed to promote killer applications of 5G and resulted in the delivery of a 'boosted LTE' instead of the 5G network of the initial visions. European operators, under the pressure of a competitive race, were therefore forced to implement 5G NSA (implementation options 3/3a/3x), i.e. NR with upgraded LTE core.

Special concerns should be dedicated to the issue of ETSI MEC, both from the point of view of its integration with the 3GPP 5G System (only in scope of the 3GPP Release 17) and its internal readiness (complete specification in standards). MEC seems to be a natural candidate for hosting the V2X applications, but it is not ready for the carrier-grade implementation. For instance, the APIs exposed by MEC Platform to MEC Applications promise a lot of features (RNIS, Location API), which in fact cannot be delivered due to the lack of standards of integration with the underlying 3GPP mobile network.

The 3GPP 5G System management architecture is designed as complementary to the ETSI NFV MANO framework, which seems to be structurally maladjusted to the challenges of management and orchestration of future thousands of sliced networks operated in parallel, especially in terms of scalability, management isolation, implementation of AI mechanisms, intent-based management for tenants' independence, etc. In the future, the ETSI NFV MANO will need to be rethought and redesigned, thus impacting the 3GPP vision of management.

Additionally, it is assumed that future mobile networks will use various frameworks at the same time (3GPP 5GS slicing-compliant architecture with various extensions like SON or LCS, NFV, MEC, O-RAN, ONAP etc.). There are functional overlaps between frameworks, so their loose integration may lead to competition between overlapping mechanisms and thus to the overall system instability. The overall integration architecture should be commonly rethought and redesigned.

Also differences in national or regional policies, as depicted in the respective regulatory frameworks, may affect the fast deployment of 5G and 6G in the future. 5G is currently under development while 6G will be further developed in the years to come; this implicates that potential issues may arise in the years to come, if there is no care for technology convergence and spectrum harmonisation before large scale commercial deployments of 5G networks take place, supported by well-defined standardisation rules.

6.1.3 Standardisation topics to be encouraged in the European Commission's upcoming research calls

As a general remark, 5G-DRIVE partners highlighted that it would be both efficient and useful if participation access to standardisation bodies - or standardisation fora - should be allowed not only for registered members but also to legal entities/participants to EU-funded projects, potentially under a specific framework. This would be an opportunity for having direct access to dedicated working groups and/or committees for further disseminating and promoting results coming directly from the ongoing projects. This could be helpful at least for defining a common terminology aligned to the actual research effort as well as for establishing a harmonised research methodology.

Apart from this, partners noted the following topics to be encouraged in the European Commission's upcoming research calls:

- It would be interesting and important if, in the scope of future EU Horizon Europe calls and where it could be relevant and feasible, frameworks for joint trials were supported to enhance intended standardisation actions.
- Interoperability between existing releases is an important issue. Of importance can be initiatives for checking interoperability between subsequent releases (especially Release 15, Release 16 and Release 17), also in view of the 6G gradual development.
- Spectrum sharing and co-channel coexistence of next-generation C-ITS technologies, such as

NR-V2X (technology evolution of LTE-V2X) and 802.11bd (technology evolution of 802.11p).

Futureproof communication network management architectures; scalable and decentralised frameworks.
Cross-technology mechanisms that would allow vehicles to connect to the network as a service, through multiple wireless communication technologies.

6.1.4 Future standardisation plans beyond the project

5G-DRIVE partners have announced the following related standardisation plans beyond the duration of the project:

- **OTE:** 5G-DRIVE results will be assessed by the company in the wider scope for the intended corporate exploitation activities. OTE is a member of the Deutsche Telekom (DT) Group of Companies and, for conformity reasons, all standardisation activities affecting the members of the Group of Companies, are coordinated and performed by DT. In any case, if project results are relevant to any future commercial activity among the DT Group defined or forthcoming priorities, these will be assessed by under the respective Group Functional Unit responsible for standardisation and will be processed accordingly.
- **VTT**: VTT plans to use the ETSI message standards and MAP-messages to support automated driving in intersection area. Furthermore, VTT will use the ISO standard for testing connected vehicles. VTT will change its testing tool (IPR) to cover testing requirements.
- **SMNET:** The company does not have direct access to standardisation organisations or related fora. Once 5G-DRIVE is accomplished, project results will be assessed in the scope of any future potential involvement of the company to the development of related solutions, potentially in cooperation with other market actors (such as OTE). However, the company monitors all related standards that may affect the offered technical solutions and, progress performed by the project will be useful, in any case.
- **Dynniq:** A GLOSA application was developed using LTE-V2X PC5 for V2X communication. Due to limited time, individual speed advice from the GLOSA application is calculated and shown directly inside the vehicle. Future studies should standardise the speed advice (sent via MCM messages) from infrastructure to each individual vehicle.
- **JRC:** The JRC has submitted 7 contributions to ETSI aimed at updating Harmonised European Standard ETSI EN 302 571 (radiocommunications equipment of Intelligent Transport Systems operating in the 5.9 GHz band).
- **ORANGE:** Several ideas have been submitted as contributions to ITU-T and will be discussed during the rapporteur session in July 2021. Further follow up will be possible and is planned.
- **UL:** UL chairs the ETSI IPE ISG and has introduced as rapporteur a new Work Item called 5G for CAM in May 2021 to further the work done on the previous WI on IPv6 based V2X.
- **MI:** Will continue supporting relevant standardisation actions pertaining to privacy and personal data protection. Upcoming work on the topic will focus on bilateral discussions with non-EU data protection authorities, aiming to reach consensus on applicability of the proposed certification scheme extension in their diverse jurisdictions, identifying potential for certification interoperability and enhancement of international collaboration. Furthermore, it will continue to support the work performed at the ITU, engaging the international standardisation community on topics pertaining to smart mobility solutions, raising research results for standardisation actions, and easing integration with relevant global events for the ecosystem, such as the IoT Week, the Privacy Symposium, and Digital Around the World.

6.2 Lessons learned from the 5G-DRIVE standardisation taskforce

The second part of the questionnaire, only intended for the 5G-DRIVE partners involved in standardisation activities during the project, contained the following questions:

1. What are the key challenges and barriers that you have encountered during your standardisation activities?
2. What are your main takeaways and lessons learned from your standardisation activities?
3. What would be the three main pieces of advice you would give to other researchers and projects willing to standardize in the 5G and connected vehicles domain?

6.2.1 Key challenges and barriers encountered during the 5G-DRIVE standardisation activities

5G-DRIVE partners involved in standardisation activities have identified the following four elements that represent challenges and barriers for them:

- **'Tied hands':** Representatives of industrial players (both telco vendors and operators) participating in project consortia do not force any solutions or ideas in the projects in advance. However, the official delegates of these companies to SDOs may be bound by the corporate strategy of technology standardisation, therefore the proposals for new solutions developed by research consortia may not be accepted despite lobbying by the project team members working for these companies. As a result, these ideas will not be presented as the company's official position. For this reason, SMEs, academic units and independent research institutions participating in projects should formally request direct affiliation with SDOs in order to clear the path of impact of European research projects on standardisation.
- **Different timelines:** Another challenge is related to the presence of different timelines regarding research projects and SDOs. Projects are limited in time and the first part of a project is usually focused on researching and developing technologies. As a consequence, most contributions to standardisation are ready to be shared only in the second half of projects and sometimes at the end of it. Inherently, a standardisation process requires time to build a consensus on a proposed standard. As a result, there is a misalignment in terms of time. The most relevant results to be standardized require the strongest support after the project has ended. This misalignment makes it hard for a project to contribute to effectively standardisation activities. Moreover, it takes time to build trust and a solid reputation in the standardisation community and often projects don't dispose of sufficient time to do so.
- **Fragmentation:** In addition, it has to be noted that the standardisation of V2X is fragmented across several SDOs. The IETF is focusing on the IP layer whereas 3GPP is looking at Layer 1 and 2. Also, 3GPP has adopted IPv6 only for V2X but no work is foreseen for it, given that they are waiting for the IETF to work on it. This fragmentation can, thus, cause some important hurdles to bring standardisation forward.
- **R&D life cycle:** Last but not least, standards generally focus on technical innovations that have already taken place in the past whereas R&D is actively creating the future although this later remains unpredictable. Indeed, there is a certain temporal gap between R&D and standardisation as a specific technology or product first needs to be developed before it can become subject of standardisation. In addition, given that R&D programmes are becoming increasingly longer, this gap is only amplified which creates further challenges for standardisation.

6.2.2 Main takeaways from 5G-DRIVE partners' standardisation activities

To overcome some abovementioned barriers, the partners suggested some means to increase the impact of future research project on standardisation:

- Encouraging direct affiliation of academic and independent research beneficiaries involved in research projects at SDOs to submit their contributions to standardisation.
- Some SDOs, such as the ITU, include public authorities in their members. The European Union and its member states could support contributions coming from European research projects.
- Developing collaboration and mutual support with other experts from the research community can enhance the chances of success in the standardisation process. Similarly, getting contributions to standardisation endorsed by several partners of the consortium can also increase the impact of the contribution.

In addition, the consortium partners indicated three other, independent, takeaways in the survey, reflecting the wide-ranging learnings among members of the consortium:

- The car industry started to get involved in 3GPP mainly through 5G-AA. However, 5G-AA lacks knowledge about the network layer. UL, thus, proposed to the 5G-AA CTO to work with them and offered to support them at the ETSI IPE ISG. However, no follow-up has been achieved with them since they declared that they do not have the corresponding expertise.
- Technical Groups in SDOs generally welcome good technical contributions. However, regarding sensitive topics such as coexistence of road ITS technologies, many different dimensions need to be taken into account, technical but also policy-related and political.
- Last but not least, there are many important aspects that need to be considered when engaging in standardisation. Network technicians are considering 3GPP, application developers target ETSI or ISO, while telecom specialists are engaged with the ITU. Discussions are slightly different in each group, and a certain adaptation is necessary.

6.2.3 Advice to other researchers and projects willing to standardise in the 5G and connected vehicles domain

In the survey, the 5G-DRIVE partners identified the following pieces of advice to researchers and projects willing to standardize in the 5G and connected vehicles domain:

- At the project level, it is recommended building the integrated map of SDOs roadmaps to identify the organisations (and right Technical Groups) at which the project scope and SDO standardisation topic plans are compliant during the project's lifetime at the beginning of the project;
- In addition, to foster crucial synergies and collaboration between the consortium partners, it is recommended to encourage joint contributions and leverage the partners' direct memberships and contacts at the global SDOs.
- In line with what has been mentioned regarding the temporal gap between standardisation and the R&D life cycle, it is recommended to plan standardisation activities in the second half of the project, when the project ideas are already developed and ready for promotion.
- Based on this, the intensity of the project effort should increase over time - contrary to the normally expected linear consumption of resources over the entire duration of the project. This increase is motivated both by the natural intensification of work as the research progress is made as well as by the increasing dissemination and standardisation of the incrementally achieved results.

7 Conclusion

The D6.4 'Final Report on Standardisation' sought to report on the standardisation activities carried out in the scope of the 5G-DRIVE project and complement the D6.2 'Plan for Standardisation'. The table below provides an overview of the standardisation efforts and outcomes undertaken throughout the project, with the cells in grey referring to activities previously identified in the standardisation plan and cells in red pointing out additional efforts. Based on the table, we can note a total of 16 contributions to SDOs, with two of them being joint efforts with 5G-DRIVE partners. It can be concluded that the standardisation KPIs, as identified at the beginning of the project have been successfully accomplished by the end of the project, with a clear increase in standardisation outputs in the second half of the project. This is due to the project reaching greater maturity and a more advanced level of technical development in years 2-3, with concrete results to be brought to standardisation.

Standardisation results (as per Plan for Standardisation)	Research result	Title	Contributor	SDO and Working Group	
	Experimental results from the ITS-G5/LTE-V2X coexistence tests	**ERMTG37(19)034003r1:** Proposed modifications to EN 302 571 for testing of multi-antenna devices	JRC	ETSI	ETSI TC ERM TG37
		ERMTG37(19)000106: Proposed modifications to EN 302 571 to add a definition of smart antenna systems			
		ERMTG37(19)000122: On the evaluation of the ITS-G5 and LTE-V2X duty cycle			
		ERMTG37(19)00141: Updated duty cycle requirement			
		ERMTG37(19)00137: Updated testing procedure for duty cycle measurement			
		ERMTG37(20)000021r1: On the definition of smart antenna systems in draft EN 302 571 V2.1.10			
		ERMTG37(21)040013: Reversion of two editorial changes to analytical expressions of P(e.i.r.p.) in EN 302 571 V2.1.14			
	IPv6-based V2X communications standardisation	**ETSI GR IP6 030 V1.1.1 (2020-10), 'IPv6-based Vehicular Networking (V2X)'**	UL	ETSI	IP6 ISG

	V2I connectivity and sharing point-clouds in collaborative sensing framework	**Data exchange requirements ISO/DIS 13111-2 and YTL/CEN/TC 278: Intelligent Transport Systems (ITS)**	VTT	ISO	ISO/TC 22, WG9
		Sensors and data-fusion ISO/FDIS 23150 and YTL/CEN/TC 278: Road vehicles			
	Network Slicing	**Contribution to ITU-T Y.IMT2020-EIL**	Orange	ITU	SG13/Q21
		Contribution to ITU-T Y.DL-AINW-fra			
		Contribution to ITU-T Y.SLOA-arch (submitted and pending)			
Additional efforts	IoT and V2X Communication	**'Contribution on IoT and V2X Communication'**	MI	ITU	SG20/Q3
	Vehicular Multimedia Architecture	**ITU FG-VM Technical Report (FGVM-O-040) on 'Vehicular Multimedia Architecture'**	MI, EURESCOM, UL		FG-VM
	Europrivacy	**Proposed GDPR Certification criteria extension for connected vehicles**	MI, UL	ECCP	International Board of Experts

Table 3: Summary of Standardisation Efforts and Outcomes

Furthermore, 5G-DRIVE partners contributed to the standardisation task through relevant events and fora where they promoted the project's standardisation efforts and findings, namely:

- 'Workshop on European Research Support and Contribution to Global Standardisation, Internet of Things Perspectives' at the ITU,
- Symposium on the Future Networked Car 2020 (FNC-2020) at ITU/UNECE,
- ITU-T Focus Group on Vehicular Multimedia (FG-VM),
- 2021 Joint EuCNC & 6G Summit.

The deliverable was complemented with the partners' reflections on the main challenges and takeaways they encountered throughout the standardisation process in 5G-DRIVE. They mainly referred to the discrepancies in terms of timelines, internal structure and voice between SDOs and research programs.

References

Creative Commons. http://creativecommons.org/licenses/by-nc-nd/3.0/deed.en_US

ETSI. 'ETSI Portal > TB'. Accessed 8 June 2021. https://portal.etsi.org/tb.aspx?tbid=620&SubTB=620#/. ETSI members can access these contributions by searching for the contribution reference in the ETSI TC ERM TG37 portal (e.g., "ERMTG37(19)000122").

ETSI. 'IPv6-based Vehicular Networking (V2X).' Accessed 25 May 2021. *https://www.etsi.org/deliver/etsi_gr/IP6/001_099/030/01.01.01_60/gr_IP6030v010101p.pdf*

ETSI. ETSI GR IP6 030 V1.1.1 (2020-10), "IPv6-based Vehicular Networking (V2X)", https://www.etsi.org/deliver/etsi_gr/IP6/001_099/030/01.01.01_60/gr_IP6030v010101p.pdf

ETSI. Intelligent Transport Systems (ITS); Communications Architecture, September 2010. ETSI EN 302 665 V1.1.1 (2010-09)

ISO. ISO 21217:2010 Intelligent transport systems – Communications access for land mobiles (CALM) – Architecture, April 2010

ISO. 'ISO/DIS 13111-2'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/88/78863.html .

ISO. 'ISO 23150:2021'. ISO. Accessed 10 June 2021. https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/07/47/74741.html .

ITU. '[619-WP1] Initial Draft New Recommendation ITU-T Y.DL-AINW-Fra: "Framework for Data Linkage between AI-Based Network Slice Management and Orchestration and Network Slice Customers in Networks beyond IMT-2020"'. Accessed 15 June 2021. https://www.itu.int/md/T17-SG13-200720-TD-WP1-0619.

ITU. '[687-WP1] Draft New Recommendation Y.IMT-2020-EIL: "Evaluating Intelligence Capability for Network Slice Management and Orchestration in IMT-2020"'. Accessed 15 June 2021. https://www.itu.int/md/T17-SG13-201217-TD-WP1-0687/fr.

ITU. '[690] Contribution on IoT and V2X Communication'. Accessed 18 June 2021. https://www.itu.int/md/T17-SG20-C-0690/en.

ITU. 'FG-VM-WG3-TR-Implementation_aspects-V06.Docx'. Accessed 25 May 2021. https://extranet.itu.int/sites/itu-t/focusgroups/vm/_layouts/15/WopiFrame2.aspx?sourcedoc=%7B76c48d5e-91ab-49e7-8f1e-0e676fd966c8%7D&action=default&slrid=b648c39f-eea2-60f3-3969-f2d5fcea3158.

ITU. 'Focus Group on Vehicular Multimedia (FG-VM)'. Accessed 18 June 2021. https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx.

ITU. 'Focus Group on Vehicular Multimedia (FG-VM)'. Accessed 28 May 2021. https://www.itu.int/en/ITU-T/focusgroups/vm/Pages/default.aspx

ITU. 'Output documents'. Accessed 28 May 2021. https://extranet.itu.int/sites/itu-t/focusgroups/vm/input/FGVM-I-221R1.zip

ITU. ITU Pictures. Future Networked Car Symposium (FNC-2020). 5 March 2020. Photo. https://www.flickr.com/photos/itupictures/49622327881/.

ITU. ITUNews Magazine, Technology driving safer transport, No.1, 2020.

NGIoT. 'NGIoT – mobilising an IoT ecosystem for Horizon Europe'. Accessed 28 May 2021. https://www.ngiot.eu/ngiot-mobilising-an-iot-ecosystem-for-horizon-europe/