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D6.2: Plan for Standardisation

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Abstract

The following document presents the Plan for Standardization of the 5G-DRIVE project. It serves as a document to steer and control standardization action and to support the members of the 5G-DRIVE consortium in their foreseen standardization activities. First, the deliverable outlines the 5G and V2X priorities in Europe and China. Next, it describes the methodology behind the Plan, as well as the target KPIs in the field of standardization, designed according to the priority of the consortium members. D6.2 provides an overview of the four foreseen standardization assets identified by the 5G-DRIVE partners at the current stage (M10) of the project. Subsequently, the document reports on the existing opportunities at target SDOs, where the partners can contribute to, within the scope of the research.

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Executive Summary

This document presents the plan for standardization of the 5G-DRIVE project. It serves as a document to steer and control standardization action and to support the members of the 5G-DRIVE consortium in their foreseen standardization activities, particularly by identifying the windows of opportunity. First, the deliverable outlines the 5G and V2X priorities in Europe and China. Next, it describes the methodology behind the plan, as well as the target key performance indicators in the field of standardization, designed according to the priority of the consortium members. The plan for standardization provides an overview of the four foreseen standardization assets identified by the 5G-DRIVE partners at the current stage (June 2019) of the project. Subsequently, the document reports on the existing opportunities at target Standards Developing Organizations, particularly ITU, IEEE, IETF, ETSI, ISO and 3GPP, where the partners can contribute to within the scope of the research.

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Abbreviations

3GPP	The 3rd Generation Partnership Project
5G-AA	5G Automotive Association
5G-PPP	5G Infrastructure Public Private Partnership
AI	Artificial Intelligence
BSS	Basic Service Set
CAM	Cooperative Awareness Message
CEPT	European Conference of Postal and Telecommunications
DVB	Digital Video Broadcast
EC	European Commission
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 Optimized Speed Advisory
HD	High Definition
HOA	Higher Order Ambisonics
ICRW	Intersection Collision Risk Warning
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IoT	Internet of Things
IPv6	Internet Protocol version 6
ITS	Intelligent Transportation Systems
ITU	International Telecommunication Union
ISO	International Organization for Standardization
LTE	Long Term Evolution
M2M	Machine to Machine
MEC	Multi Access Edge Computing
mMTC	massive Machine Type Communications
NFV	Network Function Virtualisation
NGN	Next generation networks
OCB	Outside the Context of a BSS
PKI	Performance Key Indicator

RAN	Radio Access Network
RSPG	Radio Spectrum Policy Group
SDN	Software Defined Networking
SDO	Standards Developing Organization
SG	Study Group
URLLC	Ultra-Reliable Low Latency Communications
V2X	Vehicle-to-everything
VRU	Vulnerable Road User
WAVE	wireless access in vehicular environments
WG	Working Group

1 5G-DRIVE in a nutshell

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

The EC and China have agreed to fund joint projects on 5G trials to address two of the most promising 5G deployment scenarios, namely enhanced Mobile Broadband (eMBB) and Vehicle-to-Everything (V2X) communications. 5G-DRIVE, in collaboration with its Chinese twinning counterpart, has the ambition to fulfill this goal. 5G-DRIVE will bridge current 5G developments in Europe and China through joint trials and research activities to facilitate technology convergence, spectrum harmonization and business innovation before the large-scale commercial deployment of 5G networks occurs. 5G-DRIVE will develop key 5G technologies and pre-commercial testbeds for eMBB and V2X services in collaboration with the Chinese twinning project. Trials for testing and validating key 5G functionalities, services and network planning will be carried out in Europe and China.

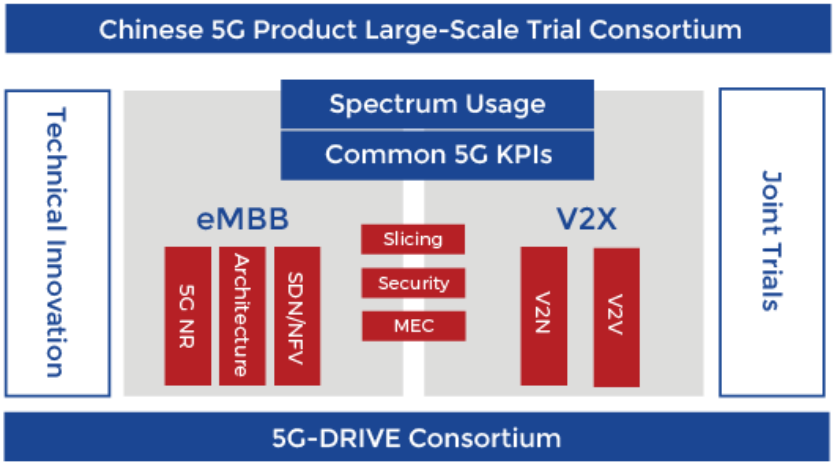

Figure 1: 5G DRIVE - an overview

1.1 Objectives of Task 6.3 on Standardization

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 create 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.

It is important to note that the Chinese Twin project does not have or not allowed to work on standardization activities as the Chinese SDOs are solely responsible for standardisation which is why the standardization activities will be carried out exclusively through the European side with input from the Chinese research partners. From previous experience with EU-China projects such as EU-CHINA 5G-IoT project, the best way of harmonising and aligning Europe and China is through 3GPP and the ITU since the Chinese SDOs (CCSA - China Communications Standards Association, IMT-2020 (5G) Promotion Group, TIAA (Telematics Industry Alliance, C-ITS (China ITS Industry Alliance) are members of both 3GPP and the ITU and therefore the work done by 5G-DRIVE will impact China automatically.

1.2 Objectives of Deliverable 6.2

According to the project's description of action: "*This plan is the basis for steering and controlling the standardisation activities, including the definition of target outcomes and key performance indicators. MI, Orange and UL will design it according to the priority of the consortium members*".

This document contains the overall Standardization Strategy for 5G-DRIVE. This preliminary standardization work-plan can be streamlined and improved based on future discussions and inputs from other relevant partners. During the course of the project, the standardization strategy may be adapted to widen the scope of contributions for the overall standardization process (see Figure 2).

Given the early stage of the project, it is important to point out that the Plan for Standardization is prepared with the intention of giving an initial overview of the status of the standardization activities in the consortium as well as guiding the 5G-DRIVE partners in their future standardization activities. Thus, the deliverable highlights the steps already initiated by the partners, and also presents the areas of opportunity in the field of standardization, where interested partners may contribute to.

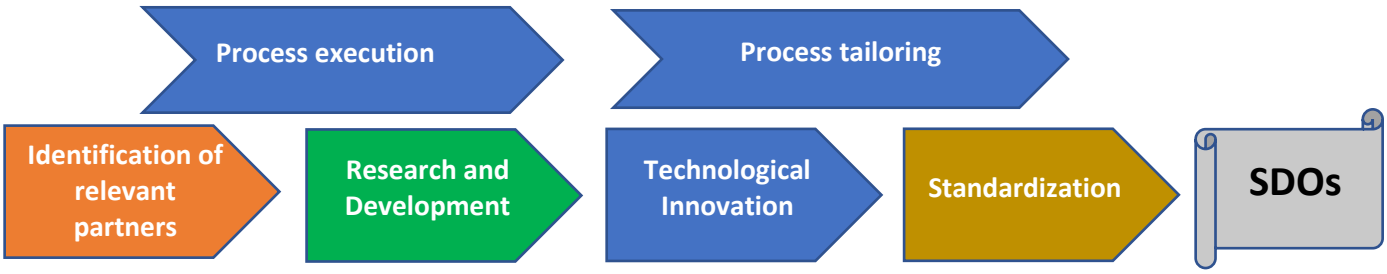

Figure 2: Standardization process sequence

The partners interested in contributing to the standardization activities within this project are to be listed in Table 1.

Partners involved in standardization	Focal point	Focal point
Mandat International	ITU	Sébastien Ziegler
Orange	ITU	Sławomir Kukliński

VTT	ETSI	Mika Lasanen
JRC	ETSI, CEPT, European Commission	Pravir Chawdhry
University of Luxembourg	ETSI	Latif Ladid, Ridha Soua

Table 1: Identified Partners for Standardization Partners

2 Standardization essentials

2.1 Standardization objectives

Standardization is the process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards developing organisations (SDOs) and governments.

Standardization allows guaranteeing the safety, interoperability and compatibility of the goods or services.

The main objectives of 5G-DRIVE standardization activities are as follows:

- to boost interoperability of services for vehicular transmissions and other networks;
- to relay relevant inputs from the project into existing or new international standards;
- to highlight and showcase achievements and the results of the project;
- to create relevant use-cases and promote their dissemination within SDOs.

2.2 Standards classification

Standards can be classified into three categories of standard-setting entities: single companies, formal standards-developing organizations and forums and consortia. The nature of the entity relevant to a standard often has repercussions for its status, including its extent of openness. The Table 2 below depicts the standards-setting entities and the respective standards they produce.

Standards-setting entity	Produces	Examples
Single companies	'Proprietary specifications'.	Standards that evolve from a specific company or vendor.
Formal standards-developing organizations (SDOs)	'Open standards'[13] (which can become 'de jure standards' if their implementation is mandated by law).	ITU, ISO, IEC, ETSI, various national standards bodies, etc.
Forums and consortia (quasi-formal SDOs)	Typically, open standards, but may produce closed standards, depending on the organization in question.	IETF, Broadband Forum, W3C, Bluetooth consortium, OASIS, etc.

Table 2: Categories of standards-setting entities and their respective standards2

Standards produced by a single company are also referred to as 'proprietary specifications'. Companies maintain full control over the specifications and their future evolution, particularly by restricting the participation of other stakeholders or defining rules to enable participation of other parties, but still maintaining the final word. The company that established a specification will choose whether it wants to encourage and facilitate others' adopting it or, alternatively, 'keep the standard to itself'.

In parallel, a great number of national authorities have founded and/or formally acknowledged

[2] ITU-T, "Understanding patents, competition & standardization in an interconnected world," ITU, Geneva, 2014.

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 and from governments, academia and civil society – to produce standards in response to priorities determined by public- or private-sector members. Some regional or global SDOs allow direct participation from private-sector entities by granting them membership, while others facilitate indirect private-sector participation via national SDOs. One of the best-known standards-developing organizations are the International Telecommunication Union (ITU) and the European Telecommunications Standards Institute (ETSI).

Finally, Forums, consortia and other informal industry associations are often established in the belief that informal collaboration between a narrow group of like-minded organizations can faster achieve an outcome satisfying all participants. As such, these organizations position themselves somewhere between single companies that develop standards and formal SDOs. An example is the Internet Engineering Task Force (IETF).[3]

2.3 EU-China harmonization of 5G and V2X Standards

2.3.1 Europe 5G Priorities

The Second Opinion on 5G networks issued by the Radio Spectrum Policy Group (RSPG)[4] presents the European (initial) priorities for 5G, which are the provision of wide-area coverage and high-reliability low-latency communications.

The underlying objectives are to:

- grant high-speed internet access to sparsely-populated areas,
- boost the efficiency of industrial/production/service processes by introducing robust massive machine-type communications (mMTC), and
- enable the mass deployment of Smart Mobility Solutions/ Intelligent Transport Systems

As far as radio spectrum is concerned, the focus is on harmonising regulations for the 3.4-5.9 GHz band.

The current timeline foresees deployment of 5G in at least one major city in each EU Member State by the end of 2020. All urban areas and major terrestrial transport paths should have uninterrupted 5G coverage by 2025.[5]

European network operators are prioritizing connected cars over factories and cities.[6]

[3] Idem.

[4] Radio Spectrum Policy Group (RSPG), "STRATEGIC SPECTRUM ROADMAP TOWARDS 5G FOR EUROPE, RSPG Second Opinion on 5G networks," European Commission, Brussels, 30 January 2018.

[5] P. O'Donohue, "EuCNC 2017: 5G European Roadmap, Global Impact," European Commission, 21 June 2017. [Online]. Available: https://ec.europa.eu/digital-single-market/en/blog/eucnc-2017-5g-european-roadmap-global-impact. [Accessed 27 May 2019]

[6] J. Blackman, "Cars take pole on grid of Euro carriers' IoT priorities, ahead of factories and cities," 3 April 2018. [Online]. Available: https://enterpriseiotinsights.com/20180403/channels/news/cars-take-pole-on-grid-of-euro-carriers-iot-priorities-ahead-of-factories-and-cities-tag40.

2.3.2 China 5G Priorities

Chinese 5G priorities include:

- Industrial internet and car internet will be 5G key industry applications.[7]
- V2X will be a key application of 5G URLLC.[8]
- LTE/5G-V2X trial cities: Beijing, Shanghai, Chongqing, Hangzhou, Wuhan, Changchun.[9]
- On 5 January 2018, China's National Development and Reform Commission (NDRC) issued a draft Strategy for Innovation and Development of Intelligent Vehicles ("Draft Strategy") for public comment. The public consultation was closed on 20 January 2018. Visions set out in the Draft Strategy include that 90% of the highways in China's big cities will be covered with LTE–V2X by 2020 and 5G by 2025.[10]
- The C band (4-8 GHz) will be the key 5G band[11]
- Artificial Intelligence (AI) and Machine learning.[12]
- 5G is key to the future growth of China's vibrant digital economy, as well as its national ambitions in AI. Indeed, Chinese AI plans include a focus on 5G and seek to improve low-latency, high-throughput transmission capabilities that these technologies will deliver. Anticipating its economic benefits, China has taken a very proactive approach to the testing and commercialization of 5G, on track to start its rollout in 2019, and China's 5G industry is expected to become a market of 1.15 trillion RMB ($180.5 billion) by 2026.[13]

2.3.3 Europe V2X Priorities

The Road Transport business and eco-system is going to evolve significantly in the next decade. Reasons include the growing deterioration of the traffic conditions, population concentration in urban areas, the need to reduce impact of transport on climate and environment and, last but not least, EU Member states targeting Vision Zero for accidents, injuries and fatalities. Business models for road transport are also going to change rapidly from owning and using vehicle usage towards Mobility as a Service concept.

In the last 5 years, a new paradigm has emerged for road transport: self-driving. The rapid evolution of IT technologies, going from sensors till Artificial Intelligence made self-driving vehicle a reality, without transforming the road infrastructure.

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[7] Q. Hang, "5G Progress in China," MIIT, November 9, 2016.

[8] K. Runtian, "Radio Spectrum Management in China," ITU, 11 September 2017.

[9] X. Ying, "Emerging Radiocommunication Technologies and Applications," 11 September 2017.

[10] M. S. a. A. Zhao, "NDRC Issues Development Strategy for Autonomous Vehicle," King & Wood Mallesons, 10 January 2018. [Online]. Available: https://www.chinalawinsight.com/2018/01/articles/corporate/ndrc-issues-development-strategy-for-autonomous-vehicle/. [Accessed 27 May 2019].

[11] K. Runtian, "Radio Spectrum Management in China," ITU, 11 September 2017.

[12] E. Kania, "China's AI Agenda Advances," The Diplomat, 14 February 2018. [Online]. Available: https://thediplomat.com/2018/02/chinas-ai-agenda-advances/.

[13] E. Kania, "China's Play for 5G Dominance: Standards and the Digital Silk Road," Center for Advanced China Research, 18 June 2018. [Online]. Available: https://www.ccpwatch.org/single-post/2018/06/25/Chinas-Play-for-5G-Dominance-Standards-and-the-Digital-Silk-Road.

The above revolutions in the domain of road transport will benefit from V2X technology evolutions. High level of automated driving requires collecting information about the driving environment and updating vehicle High Definition (HD) maps with data from sensors located outside the vehicles, like for instance cameras, road sensors or data provided directly from other vehicles.

V2X communication and wireless performances are very critical for the next generation of vehicles and 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. These requirements are even matching very well the new performance categories to be provided by 5G New Radio:

- Higher throughputs (eMBB), which are required to transmit for instance high volume of HD video from vehicle to the infrastructure or to other vehicles;
- Ultra-Low latency communications (urLLC) to allow relying on timely delivering data and thus react in real time to driving environment information provided by connectivity;
- Higher density of user equipment (mMTC) like for instance vehicle but also 1000s of sensors surrounding vehicles and able to deliver useful information about the driving environment.

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

2.3.4 China V2X Priorities

According to the Internet of vehicles white paper published by China Academy of Information and Communications Technology (CAICT)[14], there are three categories where the V2X technologies will play important roles to transfer the transportation sector, which are

- Improved user experience in smart mobility, by utilizing the communication technology and information from various sensors on the car to enable improved and new services for driver and passengers.
- Intelligent driving, through connected and collaborated mobility technologies for safety, traffic efficiency, smart parking, etc.
- Intelligent transportation, based on automated driving and smart traffic management, to optimize overall traffic and infrastructure utilization in the region.

The priorities in V2X include the following areas:

- Automobile electronics, from chipset to system, to integrated intelligence and networking to vehicles, and support new energy vehicles.
- LTE-V2X, from trial to commercial deployment, built upon the largest 4G network in the world.
- Multi-access edge computing (MEC) for low latency applications, green light optimized speed advisory (GLOSA), pedestrian collision avoidance and V2I2V, Integrated MEC with LTE for V2X support.
- Terminal - Pipe - Cloud architecture for connected and collaborated mobility platform.
- Security in all levels from vehicles, software platform, hardware platform, to cloud. Introducing PKI for authentication in V2X.

[14] CAICT, "Internet of vehicles white paper (2018)," December 2018

3 Plan for Standardization Design Approach

The following section presents the methodology behind the Standardization Plan as well as the target outcomes and key performance indicators (KPIs) in the scope of standardization.

3.1 Methodology

As Task Leader for standardization activities, Mandat International (MI) designed a concise methodology in order to capture the interests for standardization in the 5G DRIVE Consortium. Defining a Plan for Standardization for 5G DRIVE at an initial stage of the project presented a number of challenges. Indeed, due to the early stage of the project, most partners had a hard time identifying the assets they wanted to standardise. Furthermore, due to the fact than not all partners are members of SDOs, they were not autonomously initiating activities in the field of standardization.

The methodology based on the "three Ws questions" below:

A. What is likely to be submitted to standardization?

B. Where (which SDO/Working group) this will be best suited and where to put the priority effort?

C. Who can lead and support the standardization effort on each track?

3.2 Target outcomes and KPIs

As indicated in the grant agreement, one of the objectives of the deliverable includes 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 a consultation with all the consortium members during the face-to-face meeting in Brussels in April 2019, it has been agreed that the project would follow the three following 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 3: KPIs and targets

4 First Results

The aforementioned methodology has allowed identifying four foreseen standardization assets. The following section provides a closer look at each of them.

4.1 Foreseen Standardization Assets

As a result of the "3 Ws questions" described in the previous section, the following foreseen standardization assets have been identified by the partners:

- V2I connectivity and sharing point-clouds in collaborative sensing framework could potentially be standardised by VTT at ETSI with support of SENSORIS work group.
- The JRC plans to share experimental results from the ITS-G5/LTE-V2X coexistence tests in T4.3 in various SDO (ETSI) and international coordinating bodies (CEPT, European Commission).
- UL has started IPv6 based V2X communications standardisation within the ETSI IP6 ISG.
- Orange is considering submitting contributions to ITU-T SG13 in the field of network slicing.

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

The 5G-DRIVE project is engaged with developing and trialing the automotive C-V2X related use cases both in Europa and China. The aim is not to develop something completely new but rather take lessons learned to bring the following two different use case to the markets:

- *GLOSA - Traffic Light Signaling (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 signalized intersections)*
- *Intersection collision avoidance (ETSI TS 101 539-2 Intelligent Transport Systems (ITS); V2X Applications; Part 2: Intersection Collision Risk Warning (ICRW) application requirements specification)*

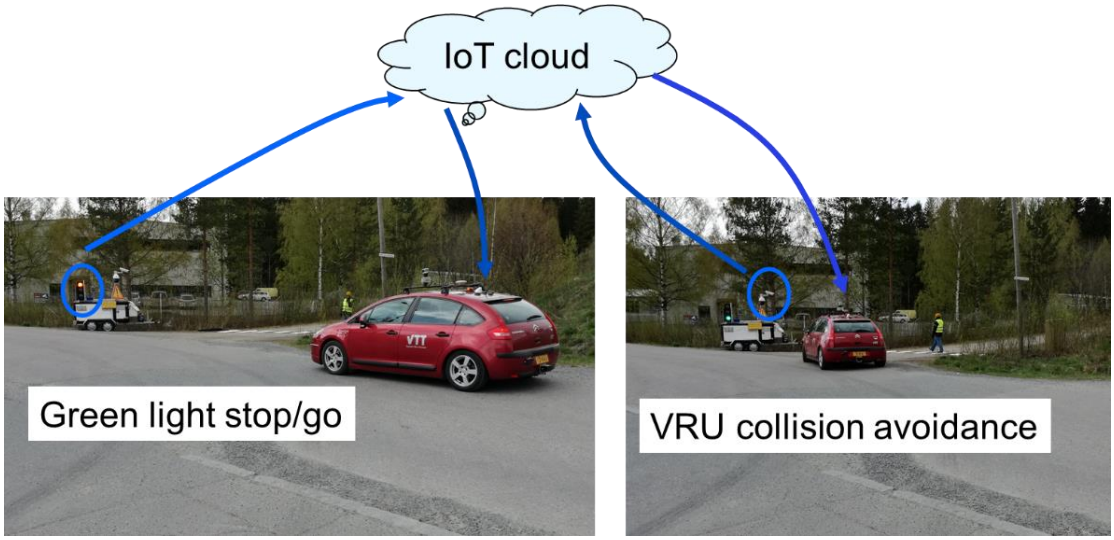

Figure 3: 5G-DRIVE trial experiment (EU-China) for having GLOSA and VRU collision avoidance trials and optimising the messages between IoT devices

Both of the use cases have been designed and standardized 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, eMMB and slicing features could potentially be improved with optimizing message content.

SENSORIS work group is originated by map providers and is enabling collaborative sensing via the dynamic map layers. C-V2X can potentially improve the optimizing dynamic layers of map data with providing real-time (low-latency) data to the maps.

The roll out of the possible changes to the standards is expected after the trial periods (i.e. Q3/2020). The trial is expected to reveal the potential harmonization expectations in message formats between EU and China.

4.3 Experimental results from the ITS-G5/LTE-V2X coexistence tests

Coexistence of ITS-G5 and LTE-V2X in the 5.9 GHz band is a hot topic from both the technical and policy points of view. The JRC is currently collaborating with ETSI technical group ERM TG37 in the context of work items DTR/ERM-TG37-273 and DTR/ERM-TG37-274. The aim of ERM TG37 is to define coexistence mechanisms for ITS-G5 and LTE-V2X in the 5.9 GHz band. In addition, the JRC is also collaborating with ERM TG37 in the revision of ETSI document EN 302 571 — the European Harmonised Standard for the 5.9 GHz band. The JRC participates in ERM TG37 discussions as an ETSI Counsellor (i.e., it attends the meetings, shares information with the group members, makes suggestions about the ongoing work, etc.); however, it does not actively contribute to the definition of coexistence mechanisms to avoid any conflict of interest stemming from its dual role as a research institution and a Directorate-General of the European Commission.

Similarly, the JRC is also planning to share results from the ITS-G5/LTE-V2X coexistence tests CEPT, ETSI and policy DGs in the European Commission (e.g. DG CNECT, DG MOVE). The CEPT has received a mandate from the European Commission to study coexistence issues in the 5.9 GHz band. Similarly, DG CNECT and DG MOVE are actively working on C-ITS and telecommunications-related policy files, as part of their institutional role in the European Commission.

4.4 IPv6 V2X Standardization

The sooner a cohesive strategy for 5G and IPv6 is developed and applied into among others in standardization and research, the sooner the benefits and risks of using IPv6 in 5G will be validated. In 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 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 as well noted that one of the operators in USA announced that in new 5G deployments only the IPv6-only solution will be applied.

The aim if the ETSI paper on IPv6-based V2X communications is to describe the IPv6 Transition Strategies in Vehicular Network (**IPv4 only, Coexistence of IPv4 and IPv6, IPv6 only**, **Enhanced IPv6 only + NAT64, Enhanced IPv6 only + 464XLAT).** It is however, 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 taken into account.

The paper will also outline the different strategies that are currently or planned to be implemented in Europe, USA, China and Japan. Moreover, the ETSI paper will detail the World Wide V2X Standardisation Initiatives carried out within different standardisation institutions such as:

- Internet Engineering Task Force (IETF) IPWave
- 3rd Generation Partnership Project (3GPP)
- IEEE Wave
- 5G Automotive Association (5G-AA)
- 5G-IA and 5G Infrastructure Public Private Partnership (5G-PPP)
- ETSI TC ITS

A special focus will be 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[15] and ETSI[16].
- IPv6 over Geo Networking.
- Commercial Probe Vehicle Data (or Floating car data, FCD) services using IPv6.

UL and the other contributors to the ETSI paper aim to have a stable draft by end of November 2019. The final draft is planned to be published by end of December 2019.

4.5 Network Slicing

Network slicing is a fundamental enabling technology for 5G mobile networks, especially as multiple parallel 5G networks, operated by a serious number of operators (especially vertical industries) and individually tailored for supported services specificity, are expected. Those networks will be settled on the open pool interconnected infrastructural resources delivered by various owners, resellers, integrators and brokers. Major reshaping of the market, business models will happen, which implies also changes in 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.

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

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

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

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.

According to our view, the Infrastructure Broker is responsible for the selection of infrastructure resources that are based on Network Slice Provider’s criteria (price, QoS, area). The Slice Broker provides aggregation of infrastructure resources of different infrastructure providers, if necessary. It exposes the infrastructure to its requesters. However, it provides mechanisms for resource negotiation. In the negotiation process, there can be involved a slice requester (e.g. Network Slice Tenant or Communications Service Provider), Network Slice Provider and the Infrastructure Broker. As a result of the iterative feasibility check and negotiations, there can be selected not only a proper subset of resources but also a slice template. The Infrastructure Broker supports multi-tenancy, i.e. is able to serve multiple Network Slice Providers. Moreover, it should have mechanisms for infrastructure resource discovery.

The management and orchestration architecture have to undergo changes to support the described role and functionality of the Resource Broker. First of all, the interaction with the Infrastructure Broker and appropriate negotiations have to be supported. The broker should be a part of the overall architecture, and its functions should be standardized. Orange plans to prepare the relevant contributions to the ITU-T SG13 documents listed in the chapter 5.3 (Table 7).

5 Opportunities at Target Standards Developing Organizations

Beyond the foreseen standardisation assets identified earlier, partners have the opportunity to make contributions to relevant standards developing organizations on topics that are related to the scope of the 5G-DRIVE project. In the context of the Plan for Standardization, six SDOs have been identified: IEEE, IETF, ITU, ISO, 3GPPP and ETSI. Furthermore, each of these organizations has been closely examined in order to distinguish the relevant working groups. The following table offers a general overview of this research, and outlines the pertinent working groups in each SDO. This section provides a more detailed analysis of each SDO and their respective areas of work.

SDO	Relevant Working Groups
IEEE	"IEEE WAVE Security" Working Group
IETF	"IP Wireless Access in Vehicular Environments" Working Group
	"IPv6 Operations" Working Group
	"Deterministic Networking" Working Group
	"Service Function Chaining" Working Group
ITU	ITU-T Study Group 13 on "Future Networks"
	ITU-T Study Group 17 on "Security"
	ITU-T Study Group 20 on "IoT and Smart Cities and Communities"
	Focus Group on "Vehicular Multimedia"
	Focus Group on "Machine Learning for Future Networks including 5G"
ISO	"Data security" Working Group
	"Trustworthiness" Working Group
	"Security evaluation, testing and specification" Working Group
	"Data communication" Sub committee
	"Integrated transport information, management and control" Working Group
	"Communications" Working Group
	"Cooperative systems" Working Group
3GPPP	Technical Specification Group on "Radio Access Network"

ETSI	EMC and Radio Spectrum Matters (ERM) Technical Committee
	Intelligent Transport Systems (ITS) Technical Committee
	Network Technologies (NTECH) Technical Committee
	IPV6 Integration (IP6) Technical Committee
	Multi-Access Edge Computing (MEC) Technical Committee
	Network Functions Virtualisation (NFV) Technical Committee

Table 4: Target Standards Developing Organizations

5.1 IEEE

IEEE serves as one of the largest technical professional organizations which focuses on advancing technology. Together with several core experts, IEEE has been developing over 1300 standards, which boost the functional capabilities and interoperability of ICT products and services.

The following table 5 identifies the key working group of relevance to 5G-DRIVE.

Working Group	Committee	Relevance
WAVE Security_P1609.2.1 - Wireless Access in Vehicular Environments (WAVE) -- Security Services	Intelligent Transportation Systems	**High**

Table 5: Target Working Groups at IEEE

5.2 IETF

The Internet Engineering Task Force (IETF), through its Working Groups develops technical documents relating to the use of the internet including Internet of Things (IoT). The table below presents the working groups that are of relevance to the 5G-DRIVE project, where contributions can be made.

Working Group	Relevance
IP Wireless Access in Vehicular Environments	**High**
IPv6 Operations	Medium
Deterministic Networking	Medium
Service Function Chaining	Medium

Table 6: Relevant Working Groups at IETF

5.3 ITU

The International Telecommunication Union (ITU) is the United Nations agency for information and communication technologies. It also functions as one of the three international standards developing organizations as designated by WTO. ITU develops international standards (also known as ITU-T Recommendations) within their technical groups known as Study Groups. Each study group focusses on core areas related to ICTs. ITU has 11 Study Groups, out of which the following ones are of high interest to the scope of the 5G-DRIVE project: ITU-T Study Group 13 on "Future Networks (& cloud)", ITU-T Study Group 15 "Transport, access and home", ITU-T Study Group 17 on "Security", ITU-T Study Group 20 on "IoT and Smart Cities", ITU-T Focus Group on Data Processing and Management.

The following table 7 gives an overview of the existing work items that can be contributed to on behalf of the project.

Existing Work Item	Study Group	Question	Relevance
Y.IMT2020-NSAA-reqts: Requirements for network slicing with AI-assisted analysis in IMT-2020 networks	ITU-T SG13	Q21/13: Network softwarization including software-defined networking, network slicing and orchestration	**High**
X.fstiscv: Framework of security threat information sharing for connected vehicles	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	**High**
X.itssec-2: Security guidelines for V2X communication systems	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	**High**
X.itssec-5: Security guidelines for vehicular edge computing	ITU-SG17	Q13/17: Security aspects for Intelligent Transport System	**High**
X.stcv: Security threats in connected vehicles	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	**High**
Y.NGNe-O-arch: Functional architecture of orchestration in NGNe	ITU-T SG13	Q21/13: Network softwarization including software-defined networking, network slicing and orchestration	Medium
G.7702 Amd.1: Architecture for SDN control of transport networks	ITU-T SG15	Q12/15: Transport network architectures	Medium
X.SDSec: Guideline on software-defined security in SDN (Software-Defined Networking)/NFV (Network Function Virtualization) network	ITU-T SG17	Q2/17: Security architecture and framework	Medium
X.srnv: Security requirements of network virtualization	ITU-T SG17	Q2/17: Security architecture and framework	Medium

X.5Gsec-t: Security framework based on trust relationship in 5G ecosystem	ITU-T SG17	Q6/17: Security aspects of telecommunication services, networks and Internet of Things	Medium
X.5Gsec-ecs: Security Framework for 5G Edge Computing Services	ITU-T SG17	Q6/17: Security aspects of telecommunication services, networks and Internet of Things	Medium
X.5Gsec-guide: Security guideline for 5G communication system based on ITU-T X.805	ITU-T SG17	Q6/17: Security aspects of telecommunication services, networks and Internet of Things	Medium
X.1373rev: Secure software update capability for intelligent transportation system communication devices	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium
X.edrsec: Security guidelines for cloud-based event data recorders in automotive environment	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium
X.itssec-3: Security requirements for vehicle accessible external devices	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium
X.itssec-4: Methodologies for intrusion detection system on in-vehicle systems	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium
X.mdcv: Security-related misbehaviour detection mechanism based on big data analysis for connected vehicles	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium
X.srcd: Security requirements for categorized data in V2X communication	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System	Medium

Table 7: Existing Work Items to be contributed to within the ITU-T Study Groups

Table 8 underscores the various working groups and Questions under which project partners could propose new work items (deliverables for the standard).

Target Working Group/Question	Type of Deliverable to be proposed	Focus Group/Study Group
Q2/13: Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization	Technical Report	ITU-T SG13

(NFV)		
Q12/15: Transport network architectures	Technical Report	ITU-T SG15
Q2/17: Security architecture and framework	Technical Report	ITU-T SG17
Q6/17: Security aspects of telecommunication services, networks and Internet of Things	Technical Report	ITU-T SG17
Q13/17: Security aspects for Intelligent Transport System	Technical Report	ITU-T SG17
Q5/20: Research and emerging technologies, terminology and definitions	ITU-T Recommendation	ITU-T SG20
WG3 - Data sharing, Interoperability and Blockchain	FG-DPM-O-150 – Draft Technical Specification "Blockchain-based data exchange and sharing technology"	Focus Group on Data Processing and Management
WG4 - Security, Privacy and Trust including Governance	FG-DPM-O-148 – Draft Technical Report "Framework for Security, Privacy and Governance in DPM"	Focus Group on Data Processing and Management

Table 8: Target Working Groups and Questions within the ITU-T Study Groups and Focus Groups

5.4 3GPP

The 3rd Generation Partnership Project (3GPP) provides a platform for combining the efforts of different standard development organizations including ARIB, ATIS, CCSA, ETSI, TSDSI, TTA. 3GPP assists its members to develop reports and specifications related to 3GPP technologies. The project focuses on cellular telecommunications network technologies, including radio access, the core transport network, and service capabilities - including work on codecs, security, quality of service - and thus provides complete system specifications. 3GPP is composed of 3 technical specification groups.

Table 9 below details the relevant technical specification group and working group, in relevance with the scope of 5G-DRIVE.

Technical Specification Group	Working Group	Relevance
Radio Access Network	Protocol aspects	Medium

Table 9: Relevant Working Group at 3GPP

5.5 ETSI

The European Telecommunications Standards Institute (ETSI) is an independent European standards developing organization which 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

5G mobile communications. The table 10 below presents the working groups of interest relevant to 5G-DRIVE, where contributions can be made.

Working Group	Relevance
EMC And Radio Spectrum Matters (ERM)	**High**
Intelligent Transport Systems (ITS)	**High**
Network Technologies (NTECH)	Medium
IPv6 Integration (IP6)	Medium
Multi-Access Edge Computing (MEC)	Medium
Network Functions Virtualisation (NFV)	Medium

Table 10: Relevant Working Groups at ETSI

5.6 ISO

The International Organization for Standardisation (ISO) is an independent, non-governmental international organization 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 11 below provides an overview of the existing working groups and sub committees of high relevance to the project.

Technical Committee	Working Group/Sub committee	Relevance
ISO/IEC JTC 1 - Information technology	ISO/IEC JTC 1/SC 27/SG 1: Data security	**High**
	ISO/IEC JTC 1/SC 27/SG 2: Trustworthiness	**High**
	ISO/IEC JTC 1/SC 27/WG 3: Security evaluation, testing and specification	**High**
ISO/TC 22 - Road vehicles	ISO/TC 22/SC 31: Data communication	**High**
ISO/TC 204 - Intelligent transport systems	ISO/TC 204/WG 9: Integrated transport information, management and control	**High**
	ISO/TC 204/WG 16: Communications	**High**
	ISO/TC 204/WG 18: Cooperative systems	**High**

Table 11: Relevant Technical Committees and Working Groups at ISO

6 Upcoming timeline

Beyond the identification of the relevant fora for standardization, it is also necessary to be mindful of the relevant events at the target SDOs, oftentimes aligned with the deadlines for the submission of contributions.

It is important to point out that not all SDOs have a clear agenda for submission, and not all events have yet been confirmed for the upcoming periods, which is why, the 5G-DRIVE partners interested in standardization should regularly keep track of the agenda of their target SDOs. Deadlines may vary between two weeks and a month prior to the event, depending on the SDO. The Table 12 below gives an indication of the timing of the relevant events and provides a tentative calendar for the future standardization contributions.

SDO	Study/Working Group	Date	Location
ITU	ITU-T SG13	17-28 June 2019	Geneva, Switzerland
	ITU-T SG15	1-12 July 2019	Geneva, Switzerland
	ITU-T SG17	27 August-5 September 2019	Geneva, Switzerland
	ITU-T SG20	25 November-6 December 2019	Geneva, Switzerland
ISO	ISO/IEC JTC 1/SC 27/	April 2020	TBD
	ISO/TC 22/SC 31	23-27 September 2019	Walkerhill-ro, Republic of Korea
	ISO/TC 204/	14-18 October 2019	Singapore, Singapore
IETF	IETF 105 (ipwave)	TBD	TBD
ETSI	ERM, ITS, NTECH, IP6, MEC, NFV	N/A	N/A
IEEE	WAVE Security_P1609.2.1	NA	NA
3GPPP	Protocol aspects	N/A	N/A

Table 12: Upcoming meetings in target SDOs

7 Conclusion

The Plan for Standardization sought to provide a basis for steering and controlling standardization action within the scope of the 5G-DRIVE project. Thanks to the application of the 3Ws methodology, the D6.2 allowed identifying four foreseen standardization activities at the current stage (M10) of the research:

- V2I connectivity and sharing point-clouds in collaborative sensing framework could potentially be standardised by VTT at ETSI with support of SENSORIS work group.
- The JRC plans to share experimental results from the ITS-G5/LTE-V2X coexistence tests in T4.3 in various SDO (ETSI) and international coordinating bodies (CEPT, European Commission).
- UL has started IPv6-based V2X communications standardisation within the ETSI IPv6.
- Orange is considering submitting contributions to ITU-T SG13 in the field of network slicing.

The Plan for Standardization allowed defining the target key performance indicators in the field of standardization, designed according to the priority of the consortium members.

Finally, the document reported on the existing opportunities at target Standards Developing Organizations (particularly: ITU, IEEE, IETF, ETSI, ISO and 3GPP), where the partners can contribute to, within the scope of the research. The table 13 below provides a synthesis of the identified fora of high relevance to the 5G-DRIVE project. As part of T6.3, MI, UL and Orange will support the 5G-DRIVE partners in their standardization initiatives. Reporting on the progress of the standardization activities will be further provided in D6.3 'Intermediate dissemination, standardization, exploitation and joint activities report' in M15 and D6.4 'Final dissemination, standardization, exploitation and joint activities report' in M30.

SDO	Technical Committee/Study Group	Working Group/Subcommittee/Question
ISO	ISO/IEC JTC 1 - Information technology	ISO/IEC JTC 1/SC 27/SG 1: Data security
		ISO/IEC JTC 1/SC 27/SG 2: Trustworthiness
		ISO/IEC JTC 1/SC 27/WG 3: Security evaluation, testing and specification
	ISO/TC 22 - Road vehicles	ISO/TC 22/SC 31: Data communication
	ISO/TC 204 - Intelligent transport systems	ISO/TC 204/WG 9: Integrated transport information, management and control
		ISO/TC 204/WG 16: Communications
		ISO/TC 204/WG 18: Cooperative systems
ITU	ITU-T SG13	Q21/13: Network softwarization including software-defined networking, network slicing and orchestration
	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System
	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System
	ITU-SG17	Q13/17: Security aspects for Intelligent Transport System

	ITU-T SG17	Q13/17: Security aspects for Intelligent Transport System
IETF	IP Wireless Access in Vehicular Environments	/
IEEE	Intelligent Transportation Systems	WAVE Security_P1609.2.1 - Wireless Access in Vehicular Environments (WAVE) -- Security Services
3GPP	Radio Access Network	Protocol aspects

Table 13: Summary of high relevance fora for standardization

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