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Subject: Draft Principles for National Approach to Cooperative Intelligent Transport Systems

We thank the Department of Infrastructure, Transport, Regional Development, Communications and Arts for the possibility to send our feedback to a framework of Cooperative Intelligent Transport Systems (C-ITS) in Australia.

ITS-G5 based systems for road safety related applications are deployed in Europe on the vehicular and infrastructure side.

Europe is leading C-ITS deployment: By the end of 2022, in Europe already 20’000 km of roads are covered by road-side units (RSUs) based on ITS-G5 and 1 million vehicles are equipped with ITS-G5 onboard units based on the ETSI ITS-G5 set of standards. Deployment figures are expected to further increase in the next years.

Please see below our comments and answers to your five questions regarding C-ITS principles. In addition, we provide further details in three Annexes.

Regards

Niels Peter Skov Andersen
General Manager, CAR 2 CAR Communication Consortium

CAR 2 CAR Communication Consortium's reply to Draft Principles for National Approach to Cooperative Intelligent Transport Systems

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Please see our comments and answers to your five questions regarding C-ITS principles. In addition, we provide further details in three Annexes.

1. ***Are principles for a national approach to C-ITS in Australia necessary? And if so, are the draft principles, as articulated, sufficient to inform investment by industry in C-ITS?***

We recommend continuing with guiding principles to facilitate the collaboration between the stakeholders.

Principles are necessary for C-ITS since it serves road safety and is the collision prevention system of future automated driving. Since the system is intended to work cross-border and cross-manufacturer, some rules are necessary for it to work:

- *Interoperability*: all vehicles & RSU that are part of the system have to understand each other
- *Backward compatibility*: vehicles and RSU of the first generation have to be understood by future vehicles and units. First generation also shall maintain their functionality when communicating with second generation. Vehicles and RSU have long life cycles, hence C-ITS and its future roadmap have to adapt to that.
- A *single security authentication system*: if all units can talk to each other, they also need to know that they can trust each other. The EU has installed certificate and security policies: (https://transport.ec.europa.eu/system/files/2018-05/c-its_certificate_policy-v1.1.pdf & https://transport.ec.europa.eu/system/files/2018-06/c-its_security_policy_release_1.pdf) They are implemented under the auspices of the Joint Research Centre in Ispra Italy.
- *Sufficient spectrum* has to be available based on legislated allocation to ensure protection and coexistence with other systems.

2. ***Over the next 5 years, to what extent does your organisation anticipate moving into a C-ITS role or increasing its involvement in C-ITS?***

[1] IEEE 802.11-2020 (2020): "IEEE Standard for Information technology—Telecommunications and information exchange between systems Local and metropolitan area networks—Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications"
[2] HIS Markit, January 2023

CAR 2 CAR Communication Consortium (C2C-CC) is one of the driving organizations for C-ITS deployment. Its C-ITS Basic System Profile (BSP) is the bases for European interoperability and backward compatibility. The BSP is openly available for realization of Day 1 C-ITS safety services and is based on ETSI and ISO/CEN standards. It is operational and C2C-CC has an operational process to maintain the quality and to resolve issues when found in the field.

C-Roads is the infrastructure and authority driven organisation for C-ITS deployment across Europe. The "harmonized C-ITS specifications" are public available and are forming the basis for all infrastructure based deployments within 18 European Member States. These "harmonized C-ITS specifications" are covering Day 1 C-ITS safety services as well as Day 1.5 C-ITS services.

C2C-CC as well as C-Roads are currently working on extending the BSP as well as "harmonized C-ITS specifications" to support Day 2 and beyond services for future deployment.

3. ***How might C-ITS impact other vehicle connectivity systems in Australia, including vehicle/original equipment manufacturer (OEM) connectivity, vehicle/cloud connectivity, heavy vehicle telematics systems, mapping systems, etc?***

Short range communication and long range communication complement each other and have both their unique role in C-ITS, in Europe we call that hybrid communication. With short range communication the direct and ad hoc vehicle-to-vehicle and vehicle-to-infrastructure communication in 5.9 GHz is meant while long range communication (vehicle/cloud connectivity) utilizes the cellular network. A hybrid communication approach is applied in the harmonised communication profile of C-ROADS.

4. ***The draft Principles include a focus on cooperation across industry, government, the research sector, and the community: what structures would be necessary to support the development of an Australian C-ITS system?***

A central security Private Key Infrastructure (PKI) for Australia would be necessary and run by a neutral party to avoid a conflict of interest and facilitate cooperation between automotive OEM and road operators. As example the European PKI could be used as reference.

To support the development of an Australian C-ITS system that builds upon existing systems like the European C-ITS system and at the same time is suitable for Australia's individual needs, a permanent representation of Australian stakeholders in the responsible consortia is recommended. This ensures that all discussions on harmonised specifications take Australian needs into account. That way, less effort in the final Australian deployment will be needed. For the best efficiency it is recommended to establish local, Australian expert organizations such that consolidated Australian feedback can be provided to those consortia. The benefits of working with such consortia is shown in the Annex based on the European experience.

Furthermore, local organizations handling general issues and demands in deployment and operation will support quality of the system.

5. ***After the Principles, what next steps do you think would be most productive?***

We welcome Australia to join C-ROADS[3] and CAR 2 CAR Communication Consortium (C2C-CC). A huge variety of C-ITS use cases are elaborated with referenced standards and detailed specifications and triggering conditions to ensure interoperability and backward compatibility today and in the future

[3] Platform: C-Roads

for vehicle-to-vehicle communication (mainly in the C2C-CC Basic System Profile (BSP)[8], publicly available) and vehicle-to-infrastructure communication (mainly in C-ROADS system profile[9], publicly available). Queensland is already a member of the C-ROADS platform. Joining C2C-CC or C-ROADS as a member not only provides the advantage of introducing Australian needs to the discussion and hence to the specifications, but also provides access to a large network of long time C-ITS experts of many different stakeholder groups.

In parallel, C-ROADS has recently published a deployment statement stating the importance of close cooperation between automotive and road authorities[4]: It says "[vehicles] exchange safety-related messages among themselves, and strongly benefit from infrastructure-based services as of today. The joint deployment of member states and the automobile industry has put Europe in a leading position worldwide."

Additionally, the Agricultural Industry Electronics Foundation (AEF) is in joint cooperation with the C2C-CC supporting the C-ITS principles created and supporting the integration in the Agriculture domain. Besides integrating an agricultural viewpoint to the road safety and traffic efficiency domain, the valuable potential for Cooperative In-Field Work is given and supported due to the included non-safety domain of the technology. This results, most importantly, in a harmonized technology for both domains and therefore less technology effort for all industries. The AEF will also state their contribution to the Public Consultation separately.

Automotive vehicle manufacturers in C2C-CC are Toyota, Hyundai/Kia, GM, VW group (including truck OEM Scania, MAN), Volvo Car Corporation, KTM, Honda, Volvo Group, Group Renault (including Nissan and Mitsubishi), Yamaha Corporation.

Road Operators and Authorities within C2C-CC: Autobahn GmbH (Germany), ASFINAG (Austria).

Other associations: AEF Agricultural, Industry Electronic Foundation.

And several automotive and infrastructure equipment suppliers and development members.

C-ROADS members are Austria, Belgium/Flanders, Belgium/Wallonia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden and United Kingdom. Beyond the member states more than 50 European Cities are member in C-ROADS since 2021. This number is expected to grow to about 100 in 2023. In addition, associated members (Associated Members are representatives of states that follow the C-Roads Platform as well as the pilot deployments of C-ITS services closely) are Croatia, Israel, New Zealand, Queensland/Australia, Switzerland, Turkey.

Apart from the participation the development of harmonized specifications, a security system should be established early on. In Europe the EU CCMS[5] is operational to provide security certificates / authorization tickets for secure and trusted C-ITS communication. We recommend establishing a similar security system in Australia.

Annex 1: The European framework for C-ITS

EU regulatory framework

[4] CEPT, WG FM #103 10-14 Oct 2022, https://www.cept.org/Documents/wg-fm/73544/info21_information-on-the-deployment-of-cooperative-its-in-europe

[5] European Security Credential Management System, C-ITS Point of Contact (europa.eu)

In ‘hard law’ Europe provided sufficient radio spectrum for C-ITS to work. Further to that, Europe invested in building a consensus between public authorities, road operators and automotive OEM (original equipment manufacturers, i.e., car makers) that established rules all actors could trust in. This created the confidence to deploy C-ITS. Now some of these established rules mentioned above, having been tried and tested, are cast into law at EU level to further strengthen the regulatory framework. Things are moving at EU level and in the Member States.

At EU level a revision of the ITS Directive is in the making. The ITS Directive is already in force since 2010. In its Member States and Parliament grant the Commission has the right to adopt ITS specifications to establish rules for ITS across the EU.

From a C-ITS point of view, the revision of the ITS Directive defines C-ITS for a first time. The latest formulation expressed the concept of C-ITS well: "cooperative intelligent transport systems" or "C-ITS" means ‘intelligent transport systems that enable ITS users to interact and cooperate by exchanging secured and trusted messages, in a non-discriminatory manner, between vehicles and other elements of the transport ecosystem, including vehicles, infrastructure and vulnerable road users, via communication technologies, without any prior knowledge of each other’.

The revision also aims at creating a legal basis for the already operational C-ITS security PKI system (EU CCMS) to assure its permanent establishment.

The revision also maintains Annex II of the ITS Directive that deals with fundamental principles. The ITS Directive proposal looks at creating a stable regulatory environment for seamless ITS deployment. For these aspects such as interoperability and backward compatibility, maturity or the link to technology neutrality and spectrum regulation are of key importance. Key here is the prevention of technical disrupts caused by changes in cellular technology generations and the like. Such principles are the key to provide the required certainty for continued investment in C-ITS.

Common C-ITS technical Specifications for all cooperating stakeholders are important:

CAR 2 CAR Communication Consortium[6] and C-ROADS platform[7] have signed a memorandum for understanding to establish a cooperation for joint and harmonized C-ITS specifications. For the automotive industry, Europe is a single market and so common specifications for C-ITS deployment across Europe are seen as an important initiative. For the CAR 2 CAR Communication Consortium (C2C-CC), close cooperation with C-Roads is and has been a unique opportunity to leverage the potential benefits of C-ITS for all parties involved. Working together on common standards for C-ITS and the use cases has allowed both parties to reach a deep understanding of what information is needed and can be made available through C-ITS and how it can and will be used. Furthermore, only this cooperation ensures that specifications meet the needs of all stakeholders and markets involved in C-ITS: automotive, road infrastructure, vulnerable road users and more.

C2C-CC and C-ROADS systems profiles are harmonized to enable European-wide interoperable use cases based on C-ITS vehicle-to-vehicle and vehicle-to-infrastructure communication.

C2C-CC Basic System Profile 1.6.3[8]: harmonized specifications and triggering conditions for deployment (vehicle).

[6] CAR 2 CAR Communication Consortium | CAR 2 CAR Communication Consortium (car-2-car.org)
[7] Platform: C-Roads
[8] C2C-CC Basic System Profile, see Basic System Profile | CAR 2 CAR Communication Consortium (car-2-car.org)

C-ROADS System Profile 2.0[9], harmonized specifications and triggering conditions for deployment (infrastructure).

Annex 2: C-ITS based on ITS-G5

DSRC system is called ITS-G5 in Europe which supports operation based on IEEE 802.11 (2020) and the IEEE802.11bd[10] amendment (probably part of IEEE 802.11 in the 2023 release).

ITS-G5 is the European type of C-ITS communication following the set of ETSI and ISO/CEN interoperability standards, which were and are being developed based on the European ITS mandate of the European Commission "to support the interoperability of co-operative systems for intelligent transport in the European Community". ITS-G5 is based on the physical access technology IEEE 802.11 (2020), which is the key to enabling extremely low latency (< 1ms) and high reliability communication for moving vehicles.

IEEE 802.11 (2020) is also the basis of DSRC in the US. Extensive testing in Europe, the U.S., and other regions, has demonstrated the ability of IEEE 802.11 (2020) based systems to support a wide range of vehicle-to-everything (V2X) use cases for road safety, improved traffic efficiency, reduced emissions, and support of automated driving. These systems have been deployed in Europe, the U.S., Japan and South Korea[11]. Unfortunately, In U.S. any deployment is being stopped by change of spectrum regulation.

Annex 3: The IEEE 802.11bd amendment development of IEEE 802.11 standards

In March 2018, an IEEE Study Group named Next Generation V2X (NGV) was formed to work on an amendment to the IEEE 802.11 standard for enhanced V2X communication technologies. In December 2018, the IEEE-SA approved this project creating a Task Group with the goal of producing IEEE 802.11bd[12], a seamless evolution path for IEEE-based V2X communications.

This amendment targets higher spectral efficiency, increased reliability, and extended range, while ensuring full backwards compatibility with the existing deployed systems in the 5.9 GHz ITS band. The latter is an essential element for IEEE 802.11bd[12] to provide a seamless evolution path from IEEE 802.11p[13]. IEEE802.11bd based devices can receive transmissions from any IEEE 802.11p device and can transmit in a way that IEEE 802.11p devices can receive and decode. With these capabilities of IEEE 802.11bd[12], today's investments in IEEE 802.11p based technologies are fully protected. IEEE 802.11p can continue to be deployed today, since future implementations with IEEE 802.11bd based devices can be seamlessly introduced, fully benefitting from existing 802.11p deployed vehicular and infrastructure ITS stations.

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[9] C-ROADS System Profile, see https://www.c-roads.eu/platform/documents.html

[10] See C2C-CC white paper „ Next Generation V2X – IEEE 802.11bd as fully backward compatible evolution of 11p" https://www.car-2-car.org/fileadmin/documents/General_Documents/C2CCC_WP_2098_IEEE_802.11bd_TheV2XEvolution_V1.0.pdf

[11] Autotalks Deploys V2X Chipsets to Make Seoul Roads Safer - EE Times Europe; Seoul City deployed Autotalks' V2X systems in public buses - Israel Electronics News (techtime.news)

[12] IEEE 802.11bd: https://standards.ieee.org/ieee/802.11bd/7451/

[13] IEEE 802.11-2020 (2020): "IEEE Standard for Information technology—Telecommunications and information exchange between systems Local and metropolitan area networks—Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications"

IEEE has a proven track record of seamless evolution through their releases of key amendments such as IEEE 802.11a/g/n/ac/ax[13] realizing backward compatibility. By contrast to the IEEE evolution approach, a disruptive introduction of a technology incompatible with IEEE 802.11 would undermine and discourage the investments that are needed today for the society to realize the potential of direct V2X communication and might permanently prevent interoperability among major automotive stakeholders (vehicle manufacturers and road authorities).

A cornerstone of achieving the backward compatibility and interoperability goal is that IEEE 802.11bd amendments will use and improve OCB communication, relying on frame formats and channel access rules that are fully compatible with IEEE 802.11 (2020).

The goal of faster and more reliable communication recognizes that IEEE has developed even more advanced capabilities in recent years, for example in the IEEE 802.11ac (60 GHz) and IEEE 802.11ax amendments. Some of these advanced capabilities are not yet available for OCB communication or in the 10 MHz channels that have been chosen to optimize vehicular communication. The IEEE 802.11bd amendment will specify these capabilities for OCB and for 10 MHz channels.

The IEEE 802.11bd amendments introduces improvements, such as specific capability for ranging (distance measurements), a 20 MHz channelization option fully backward compatible to the 10 MHz IEEE 802.11 (2020) channel assignment and an operational mode for use in the 60 GHz band, which is partly allocated in Europe for the use in ITS (63.72-65.88 GHz **Fejl! Henvisningskilde ikke fundet.**), based on the DMG/EDMG OCB feature.

A future ITS system based on ETSI ITS-G5 including the IEEE802.11bd amended features will be support highly demanding C-ITS and Automated Vehicle applications in a multi-channel operational (MCO) environment as specified in ETSI.

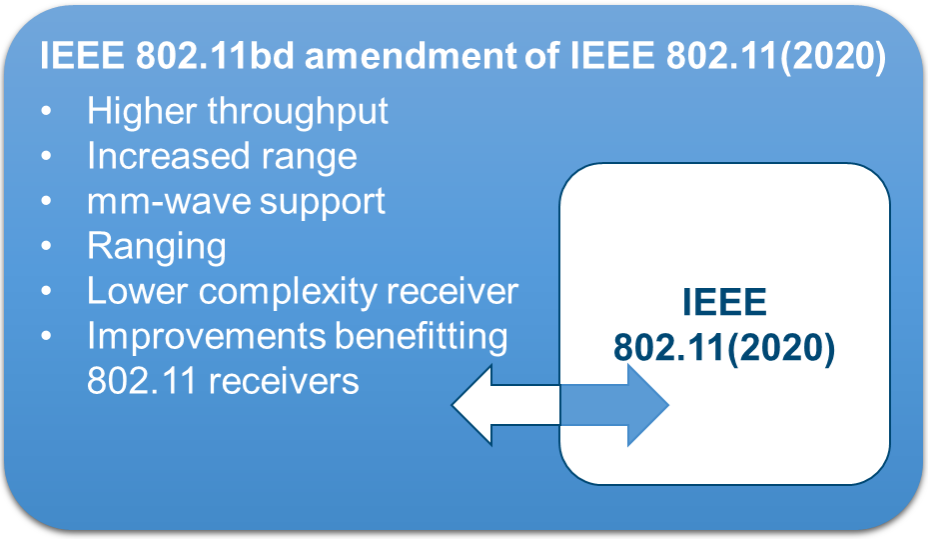

Figure 1: IEEE802.11bd as evolution of IEEE802.11 (2020)