
**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)
)
Use of the 5.850-5.925 GHz Band) ET Docket No.19-138
)

Comments of IEEE 802

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03 March 2020

1 Introduction

IEEE 802 LAN/MAN Standards Committee (LMSC) is pleased to provide comments on the above-captioned proceeding to the NPRM on the use of the 5850-5925 MHz Band dated 17 December 2019.

IEEE 802 LMSC is a leading- consensus-based industry standards body, producing standards for wireless networking devices, including wireless local area networks (“WLANs”), wireless specialty networks (“WSNs”), wireless metropolitan area networks (“Wireless MANs”), and wireless regional area networks (“WRANs”). We appreciate the opportunity to provide these comments to the Commission.

IEEE 802 is a committee of the IEEE Standards Association and Technical Activities, two of the Major Organizational Units of the Institute of Electrical and Electronics Engineers (IEEE). IEEE has about 420,000 members in about 190 countries and supports the needs and interests of engineers and scientists broadly. In submitting this document, IEEE 802 acknowledges and respects that other components of IEEE Organizational Units may have perspectives that differ from, or compete with, those of IEEE 802. Therefore, this submission should not be construed as representing the views of IEEE as a whole.¹

¹ This document solely represents the views of the IEEE 802 LAN/MAN Standards Committee and does not necessarily represent a position of either the IEEE, the IEEE Standards Association or IEEE Technical Activities.

With the release of FCC NPRM 19-129 (E.T. Docket 19-138), the United States Federal Communications Commission has requested comments regarding assessing the 5.9 GHz band rules and proposing appropriate changes to ensure the spectrum supports its highest and best use. In this NPRM it is proposed to: "... continue to dedicate spectrum—the upper 30 megahertz portion of the band—for transportation and vehicle safety purposes, while repurposing the remaining lower 45 megahertz part of the band for unlicensed operations to support high-throughput broadband applications."

The IEEE Std 802.11p-2010 amendment, now incorporated into IEEE Std 802.11-2016, provides core technology for Dedicated Short-Range Communication (DSRC). The term "OCB" (outside the context of a BSS (Basic Service Set)) was introduced in IEEE 802.11p, which specified "Wireless Access in Vehicular Environments". The OCB specifications within IEEE Std 802.11 continue to support DSRC-compatible operation.

The IEEE 802.11 Working Group (WG) is now specifying an IEEE Next Generation V2X (Vehicle-to-everything) (IEEE NGV) amendment with the IEEE P802.11bd project. As described below, the IEEE P802.11bd amendment is intended to provide a seamless evolution path from DSRC in the 5.9 GHz DSRC band. Any consideration of the rules governing use of the 5.9 GHz band must recognize the societal value of allowing DSRC and IEEE P802.11bd to operate together in the ITS band. It should be noted that one of the advanced features being considered for the IEEE P802.11bd project is 20 MHz bandwidth operation.

1.1 Current deployments are using the entire band

As the US Department of Transportation noted, in October 2018 [1], there were already more than 70 active DSRC deployments, using all seven channels and with thousands of vehicles on the road. IEEE 802 believes that allowing automakers and infrastructure owner-operators to evolve their deployments to IEEE P802.11bd over time will protect past and future investments in DSRC, providing a critical incentive for additional deployment of these life-saving technologies. As outlined below, we are concerned that hybrid ITS allocations, such as splitting spectrum for ITS with incompatible technologies e.g. C-V2X and IEEE P802.11bd will undermine existing investments and discourage widespread deployment of V2X technology.

1.2 On Interoperability and Coexistence.

To facilitate this discussion, we offer specific definitions of key terms. These definitions describe various relationships between IEEE Std 802.11-2016 OCB (802.11p) devices and IEEE P802.11bd devices (also known as DSRC and IEEE NGV devices, respectively). While these definitions are for devices implementing the DSRC and IEEE NGV technologies, they may also be applied more generally to analyze the relationship between other V2X technologies. These definitions are agreed [2] within the IEEE P802.11bd Task Group (the task group developing the IEEE P802.11bd amendment):

- **Interoperability** – IEEE 802.11p devices to be able to decode at least one mode of transmission of IEEE 802.11bd devices, and IEEE 802.11bd devices to be able to decode IEEE 802.11p transmissions
- **Co-existence** – IEEE 802.11p devices to be able to detect IEEE 802.11bd transmissions (and hence defer from transmissions during IEEE 802.11bd transmissions causing collisions) and vice versa
- **Backward compatibility** – Ability of IEEE 802.11bd devices to operate in a mode in which they can interoperate with IEEE 802.11p devices

- **Fairness** – Ability of IEEE 802.11p devices to have the same opportunities as IEEE 802.11bd devices to access the channel

We recommend that the Commission’s decision on how to allocate spectrum to ITS technologies be based on service deployment and V2X technologies evolution to meet safety message interoperability and device coexistence with the existing IEEE Std 802.11p technology. The safety message should be interoperable by supporting a common interface to IEEE Std 1609.x protocol stacks. In addition, devices should be able to coexist and support backward compatibility, in terms of radio access scheme, with existing and deployed IEEE Std. 802.11-2016 OCB based devices.

2 Comments on the proposal to “... repurpose the lower 45 megahertz of the 5.9 GHz band (5.850–5.895 GHz) to allow unlicensed operations, and retain use of the upper 30 megahertz of the band (5.895–5.925 GHz) for ITS purposes,” [3], paragraph 5

2.1 IEEE 802.11 support of the full band

IEEE Std 802.11-2016, including its draft amendments IEEE P802.11ax and IEEE P802.11bd currently in development, provides specifications that are applicable for supporting WLAN and ITS (Intelligent Transportation System) applications (use cases) for the full 75 MHz of spectrum between 5850 and 5925 MHz. IEEE 802 notes that the proposed rules designed to extend wider channels across 5850-5925 MHz enable IEEE Std 802.11-2016 and IEEE P802.11ax based devices to use 80 MHz and 160 MHz channels.

2.2 IEEE 802.11 support of existing worldwide ITS frequency bands

The IEEE Std 802.11-2016 OCB functionality (802.11p) and ongoing work in the IEEE P802.11bd Task Group provide technical capabilities for ITS in the defined ITS band in multiple regulatory domains around the world, not just in the USA. The ITS band has been thoroughly studied at previous World Radio Conferences. IEEE Std 802.11-2016 OCB functionality (IEEE Std 802.11p-2010) is being deployed in various regions around the world in the 5.9 GHz ITS band. Technological innovations such as those currently being developed in the IEEE P802.11bd Task Group will bring next generation V2X functionality to this 5.9 GHz ITS band, while maintaining backward compatibility with IEEE Std 802.11-2016 OCB.

In summary, IEEE 802.11 is continuing to evolve the radio technology for various applications, including WLAN connectivity and ITS, in all regions around the world.

3 Comments on “... the transportation and vehicular safety related applications that are particularly well-suited for the 5.9 GHz band as compared to spectrum outside of the 5.9 GHz band, and how spectrum outside the 5.9 GHz band can be used efficiently and effectively to provide transportation and vehicular safety-related applications.” [3], paragraph 9

3.1 On the spectrum needs for achieving the full benefit of traffic safety technologies:

Over the past decade, a lot of effort has been dedicated to validating the spectrum requirements and needs to guarantee that the full potential of traffic safety goals is met in order to save more lives. The US Department of Transportation (DoT) in its latest report “*Preparing for the Future of Transportation*” [1] has highlighted the need for sufficient spectrum to enable V2X communications throughout the US.

IEEE 802 believes that further splitting the 30 MHz as proposed in the NPRM between two incompatible ITS technologies will significantly damage existing deployments and diminish the benefits from deploying ITS services in the band.

4 Comments on “The Commission proposes to authorize C-V2X operations in the upper 20 megahertz of the 5.9 GHz band (5.905-5.925 GHz) as a means of authorizing the ITS technology that is most capable of ensuring the rapid development and deployment of continually improving transportation and vehicular safety-related applications now and into the future, that is robust, secure, and spectrally efficient, and that is able to integrate spectrum resources from other bands as part of its transportation and vehicular safety-related system.” [3] paragraph 11

4.1 On the rapid development and deployment of C-V2X ITS technology

IEEE 802 disagrees with the Commission’s statement that C-V2X is “the technology most capable of ...”. C-V2X is a technology under development; the standards are not yet complete and are changing often as problems arise with prototypes being tested in the laboratory and the field. To date, we are unaware of any field tests of C-V2X at scale with hundreds of units in complex RF environments.

IEEE Std 802.11p-2010 (updated reference is IEEE 802.11-2016 Annex D) has been demonstrated to be the ITS communications technology that is most capable of ensuring the rapid development and deployment of continually improving transportation and vehicular safety-related applications now and into the future. It has been demonstrated to be robust, secure, and spectrally efficient in the 5.9 GHz band, and is just as robust, secure and spectrally efficient in all other frequency bands if and when they become part of the ITS communications infrastructure for transportation and vehicular safety-related services.

- a) Products implementing IEEE Std 802.11p-2010 exist today in the market and are available from many vendors, with multiple chipset suppliers.
- b) Products implementing IEEE Std 802.11p-2010 have been deployed in hundreds of trials, demonstration projects, and more recently pilot deployments.
- c) Existing products and deployments implement ITS services in the existing allocated 75 MHz of spectrum.
- d) The IEEE Std 802.11p-2010 protocol has been demonstrated to be optimal, robust, and spectrally efficient for ITS deployments of safety-related services.
- e) Security has been addressed by the IEEE Std 1609.2 set of standards, and several vendors have developed and deployed the components of the necessary Security Credential Management System to secure DSRC and other communications in the ITS space.

IEEE 802 also notes that products that currently have DSRC communications technology incorporated also have at a minimum some form of cellular technology included as well. This use of multiple communications interfaces is not new; every smart phone in existence today has at least one IEEE 802.11 WLAN and one cellular interface in addition to a GPS module and more than likely a Bluetooth² interface. While current ITS deployments take optimal advantage of these means of

² Bluetooth® is a registered trademark of the Bluetooth Special Interest Group (Bluetooth SIG)

communication for implementing value-added ITS services, they all use 5.9 GHz DSRC technology for critical safety-related services, and IEEE 802 strongly recommends this be mandated going forward.

4.2 On the suitability of C-V2X for Vehicle-to-Pedestrian Communications (V2P)

Mobile phones of cyclists or pedestrians are not compatible with the C-V2X PC5 (direct communications between vehicle and other devices) sidelink interface for direct peer-to-peer communication with vehicles at 5.9 GHz. Despite strong similarities, the cellular 4G/5G interface and the C-V2X PC5 interface cannot be integrated into a single radio interface because most pedestrians would not be willing to sacrifice cellular data connectivity in order to receive V2P messages. In order to enable simultaneous cellular data connectivity and V2P connectivity, a second radio interface for C-V2X PC5 would be required, which will be very challenging to integrate due to cost, power and size constraints for each of the many components in modern smart phones.

On the contrary, DSRC enables V2P communications at significantly lower cost and complexity. Most new mobile phones are now equipped with IEEE 802.11ac/ax WLAN modules. As DSRC is based on IEEE 802.11 protocols, the entire digital baseband processing could be performed on this existing hardware without significant changes. Furthermore, the analog radio frontends of WLAN modules already support channels up to 5825 MHz and could be easily modified to cover the proposed ITS band, which would already allow direct communication between vehicles and phones. Furthermore, prototype developments indicate that additional changes to the analog power amplifier designs could even allow high transmit powers of up to 760 mW for IEEE 802.11p transmissions originating from mobile phones without reducing the power efficiency of WLAN transmissions [4]. Therefore, the mobile phones of pedestrians and cyclists could be easily modified to directly communicate with vehicles based on DSRC technology, warning each other about their presence and possible collisions even at large distances. DSRC-based V2P and regular WLAN can reside on the same WLAN radio interface on a mobile phone, which can be switched to V2P mode when the pedestrian is on the road and to regular WLAN connectivity when the user is at home or at work. Thus, DSRC technology will in the future allow direct V2P communications using inexpensive mobile phones without the need for additional hardware.

5 Comments on “... on available technical studies on C-V2X that could inform its consideration of C-V2X, including any recent studies that provide information about how C-V2X would operate in the 5.9 GHz band.” [3], paragraph 12.

5.1 C-V2X capabilities

It is often wrongly assumed that the anticipated benefits of 5G connectivity can only accrue with the PC5 sidelink interface of C-V2X. Despite the name, this is not true. C-V2X in its current form [3, paragraph 27] is only capable of broadcasting packets and is not capable of establishing direct peer-to-peer communications over any network including a 5G network. Furthermore, the capability of 5G in terms of Vehicle-to-Network (V2N) communication achieved through the communication interface (Uu-logical interface between the User Equipment and the eNodeB, base station) is widely confused with C-V2X using PC5 for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). It is important to clarify that the capability to connect to a commercial mobile network is a distinct function generally using separate frequency resources and a completely different mode of operation of an LTE module, usually in the spectrum below 3 GHz. While IEEE 802 agrees that cellular V2N connectivity could complement V2V and V2I safety-related functionality to enable additional services when the vehicles are inside the coverage area of a cellular network, this in no way replaces the need for optimized 5.9 GHz DSRC communications for ITS safety-related services. IEEE 802 notes that the European SCOOP

project with a fleet of 3000 vehicles outfitted with ITS stations with both a DSRC (called G5 in Europe) and a cellular interface demonstrated that cellular 4G connectivity for V2N can be successfully and efficiently combined with DSRC for V2V safety [5].

6 Comments on “... whether it should continue to set aside the 10 megahertz of spectrum at 5.895- 5.905 GHz for DSRC.” [3] paragraph 16

6.1 On setting aside 10 MHz of spectrum for DSRC

IEEE 802 believes that 10 MHz of spectrum is insufficient for achieving maximum benefit from deployment of ITS safety-related services. IEEE 802 notes that current deployments of DSRC technology have provisions (i.e., congestion control) for handling situations where there is a need for more resources than are currently available. This situation is only going to be exacerbated when personal devices (smart phones) are outfitted with 5.9 GHz DSRC technology and ITS safety-related services that prevent pedestrians and cyclists from becoming casualties.

The ITS operational environment has the following characteristics:

- Many devices in communication range, most of which are moving relative to each other at a wide range of velocities; the higher the velocity, the more important information exchange becomes to prevent accidents
- To prevent accidents, a large amount of information must be continually exchanged between devices using messages whose size varies by an order of magnitude or more
- In some critical situations, devices need to have the ability to communicate with each other directly to perform such tasks as such as maneuver coordination and platooning
- Continuous, ubiquitous access to a source for time synchronization is not possible

These characteristics lead directly to the following requirements for any communications technology to optimally perform in such environments. In layman’s terms, the communication system should:

- Have a level of performance that does not degrade in high-risk scenarios (high relative speeds)
- Handle information exchanges of varying message sizes in the most efficient manner
- Be able to identify nearby devices with which peer-to-peer communications is necessary
- Not rely on time synchronization to perform any of its tasks

| Requirement | DSRC | C-V2X |
|---|------|-------|
| Information carrying capacity remains constant in stressful scenarios | YES | NO |
| Designed to efficiently handle messages of varying sizes | YES | NO |
| Has (lower-layer) addresses that allow peer-to-peer sessions | YES | NO |
| Communications can be carried out without time synchronization of all devices | YES | NO |

To summarize the drawbacks of C-V2X, its information carrying capacity is reduced in the more critical scenarios, it allocates resources of a fixed size and therefore is very inefficient when messages sizes vary, it has no unique lower-layer addresses and is therefore only suitable for broadcasting messages which is a subset of the communications necessary for ITS safety-related services, and it cannot function without tight time synchronization of all devices which is impractical.

These technical facts support IEEE 802's recommendation that all spectrum reserved for ITS safety-related services be allocated to IEEE 802.11 technologies as those technologies have been proven to be optimal in ITS RF environments and continues to be deployed in the US and around the world. DSRC leverages ubiquitous IEEE 802.11 products in mass production for over a decade to also provide life-saving benefits (which are hard to quantify) at a cost consistent with IEEE 802.11 based products.

7 Comments on “The Commission proposes to modify existing DSRC licenses to allow operation in only the 5.895–5.925 GHz sub-band to the extent that licensees want to operate a C–V2X system or only in 5.895–5.905 GHz to the extent this sub-band is retained for DSRC systems and the licensees want to continue their DSRC operations.” [3], paragraph 20

7.1 V2X Channel Needs

The currently proposed NPRM cites preliminary studies submitted by the 5GAA claiming that a single 20 MHz channel provides sufficient throughput for many anticipated V2X features. However, we strongly disagree that a single channel can provide sufficient throughput for both basic safety messages (BSMs) and non-safety-critical messages. Despite the use of intelligent prioritization of BSMs, there is a possibility that BSMs suffer from interference by hidden nodes, i.e., vehicles and RSUs that did not understand that a BSM is being transmitted, which can ultimately lead to vehicular collisions. The probability for such interference will only increase with increasing market adoption of V2X. Therefore, non-safety critical messages must not be allowed to transmit on the same channel as BSMs.

IEEE 802's position is aligned with the Commission's statements that “vehicle-to-vehicle collision avoidance and mitigation applications are exceptionally time-sensitive and should not be conducted on potentially congested channels” and “shared use of a time-critical DSRC channel could be literally life-threatening in the context of collision avoidance.” [6]

On the other hand, non-safety critical messages may constitute the major economic driver for market adoption of V2X. For example, platooning of trucks on highways was shown to improve average fuel efficiency by up to 13% for the involved vehicles [7], potentially leading to billions of dollars in savings for the trucking industry and thus providing a major investment incentive. However, it was shown that the involved vehicles must exchange information at a very high rate of up to 30 messages per second [8, p. 14] in order to maintain speed and distance, thus creating frequent potential interference of BSMs.

We conclude that a single channel will be insufficient to support both safety critical V2X communication as well as V2X features that accelerate market adoption. Instead, we anticipate that at least 2 or 3 different parallel channels will be required for successful adoption of V2X, regardless of whether these channels will use C-V2X or DSRC technology.

8 Comment on “... on the extent to which its proposals would make ITS based technologies either more or less effective.” [3] paragraph 48

8.1 Need for common V2X safety format/broadcast type:

8.1.1 DOT position on interoperability and robust safety/public safety

Quoted from [9]: “We note that DOT envisions DSRC units in every new motor vehicle for life-saving communications. To ensure interoperability and robust safety/public safety [10] communications

among these DSRC devices nationwide, we adopt the standard supported by most commenters and developed under an accredited standard setting process (ASTM E2213-03 or “ASTM-DSRC”). [10]

We refer herein to “safety/public safety” communication interchangeably because DSRC involves both safety-of-life communication transmitted from any vehicle, *e.g.*, vehicle-to-vehicle imminent crash warnings, as well as communication transmitted by public safety entities, *e.g.*, infrastructure-to-vehicle intersection collision warnings.

Fair coexistence, backward compatibility, and interoperability are required characteristics of the Next Generation V2X amendment under development in IEEE 802.11. There are two aspects of V2X communication that argue for these requirements:

a) V2X is ad hoc communication; devices communicate directly with one another, and there are no base stations or access points to translate between protocols or between generations of the same protocol; and

b) Vehicle safety features must work throughout the lifetime of the vehicle, which can be expected to span several generations of wireless technology.

We note that the fourth and fifth generations of cellular V2X sidelink technology (*i.e.* Release 14 and 16) do not have any of these characteristics: same-channel coexistence, backward compatibility, or interoperability.[21] The Commission should not allocate scarce ITS spectrum to 4G LTE-V2X technology that cannot evolve to 5G. Societal interests in the spectrum are better served if it remains allocated to the IEEE 802.11 family of V2X protocols, which will provide a seamless technology evolution path into the future.

9 Comments on “... how to evaluate the benefits and costs of its proposal given the evolving nature of transportation and vehicular safety related technologies, both within and outside of the 5.9 GHz band.”, [3] paragraph 48

9.1 IEEE 802 vision of V2X technology evolution:

The IEEE 802 vision for V2X technology evolution is documented in the approved Project Authorization Request for the IEEE P802.11bd amendment [11], which requires that:

“This amendment shall provide interoperability, coexistence, backward compatibility, and fairness with deployed OCB (Outside the Context of a BSS) devices.”

In other words, IEEE 802 next generation V2X technology (IEEE P802.11bd) will have fair same-channel coexistence with DSRC and will be interoperable and backward compatible with DSRC.

Furthermore, this vision is extensible to further generations. A future extension of IEEE Std 802.11p and IEEE P802.11bd will also be able to achieve fair, same-channel coexistence, interoperability, and backward compatibility with previous generations. Backward compatibility across generations of IEEE 802.11 technology is fundamentally based on use of a common packet preamble and channel access mechanism.

The IEEE 802 vision of V2X technology evolution ensures that investments in DSRC are protected over the long lifetimes of automotive on-board units (OBUs) and roadside units (RSUs). This protection is critical for encouraging DSRC deployments today and in the near future. By contrast, any

proposals that threaten to impair these investments will discourage deployment and delay the realization of societal benefits from ITS spectrum.

9.2 3GPP vision of V2X technology evolution:

By contrast, the 3GPP vision for technology evolution appears to be that none of these attributes will apply between two V2X technologies or two generations of the same technology. LTE V2X PC5 has been specified in a way that it does not achieve fair same-channel coexistence with incumbent DSRC technology, nor does it interoperate with DSRC, nor is it backward compatible with DSRC.

3GPP is now specifying a new generation of cellular V2X (i.e. New Radio, NR). The study item phase of NR V2X PC5 is complete and the terms for the specification phase have been agreed. It is now clear that NR V2X PC5 will fail to achieve any of these key evolution characteristics not only with DSRC but also with the previous generation cellular V2X (LTE V2X PC5). To be clear, NR V2X PC5 will not be able to coexist in the same channel, interoperate, or be backward compatible with LTE V2X PC5 (for example, they use different modulation waveforms and different channel coding).

9.3 Implications of different evolution models:

The C-V2X technology evolution model implies a high societal cost, a cost that is completely avoided in the IEEE 802 V2X evolution model. The C-V2X model implies that V2X spectrum must be fragmented into sub-bands associated with every different V2X technology. [22]

Band fragmentation carries significant costs. First, it disrupts the Commission's vision of uniformly interoperable communication among all V2X devices based on a single technology family. With multiple non-interoperable technologies operating in different sub-bands, some devices will not be able to communicate with others. For example, if two automakers choose different technologies and different sub-bands for sending Basic Safety Messages (BSMs), vehicle collisions that could have been prevented if those BSMs were successfully exchanged will not be prevented, leading to unnecessary loss of life and property. Many vehicles are already equipped to send BSMs with DSRC. Allowing some automakers to send BSMs using only DSRC, LTE V2X PC5 or NR V2X PC5 will cause a loss of interoperability and attendant increase in road fatalities as a direct result of the fragmentation evolution model. This also extends to all other use cases supported by DSRC and by non-interoperable cellular V2X technologies. V2X evolution under the IEEE 802 model does not suffer this cost. Every vehicle will be interoperable with every other vehicle, whether the vehicles are DSRC-capable or IEEE P802.11bd-capable.

9.4 Implications of different access models:

Contrary to DSRC protocols, which are able to manage access to the wireless channel in a distributed manner without requiring a central coordination entity, the C-V2X PC5 sidelink generally uses GNSS (Global Navigation Satellite System) signals like GPS to meet strict time synchronization requirements when accessing the channel [12]. The studies cited by the 5GAA Waiver Request [13], as well as studies conducted by the 3GPP [14], all assume that ideal time synchronization is provided by GNSS signals. Even though this demand for GNSS does not lead to any additional costs because V2X systems already require GNSS systems for positioning, GNSS signals cannot be received in deep tunnels, which could lead to a loss of time synchronization, which could in turn reduce the efficiency and reliability of C-V2X systems in tunnels. The 3GPP or 5GAA have not provided any studies to address such concerns.

However, it is paramount for any V2X technology to provide reliable communication of safety messages in tunnels. On several past occasions, fires that resulted from traffic collisions in tunnels have spread rapidly and led to catastrophic loss of life. DSRC systems do not require time synchronization on a microsecond level and are therefore not impaired by the lack of GNSS reception in tunnels.

We note here that the lack of GNSS reception will not entirely prevent positioning. The vehicle's position inside the tunnel could still be estimated by combining dead-reckoning systems, RADAR, LIDAR, and camera data. We acknowledge that positioning could be further improved by installing additional road-side units, which would also provide the time synchronization that is necessary for C-V2X. Nevertheless, it remains unclear whether public authorities will have sufficient funds to install these units.

9.5 V2X communication technology standards

The ITU-R has studied radio interface standards for vehicle-to-vehicle and vehicle-to-infrastructure two-way communications for the current and planned ITS applications in Recommendation M.2121 [15]. Recommendation M.2084 [16] provides information on V2X standards and technical specifications which have developed by SDOs such as ETSI, IEEE, ARIB, TTA, IMDA, CCSA, 3GPP and ATIS [16]. It states that V2V/V2I communication technologies for ITS applications should apply industrial standards.

10 **Comments on: "... the state of DSRC-based deployment and the extent to which existing licensees currently operate on some or all of the existing channels in the 5.9 GHz band."** [3] **Paragraph 9** **And: "... the DSRC service has evolved slowly and has not been widely deployed within the consumer automobile market ..."** [3] **Paragraph 55**

10.1 Choosing LTE-V2X as a V2X technology does not address the slow market adoption of V2X:

While it is true that the adoption of DSRC did not move as quickly as it was originally anticipated, the reasons for this were related neither to the technological aspects of DSRC nor to its maturity for mass deployment. On the contrary, the US DoT pilot programs, of which many have already started their operation phases, provide increasing evidence to show that the technology is ready for mass market rollout. In fact, GM, Toyota, and other automotive manufacturers [17], [18], [19] made prior commitments to mass deployment of DSRC based system across their respective brands. It is possible that the slow adoption of DSRC in the past was more related to the lack of incentive and motivation from road operators scaling up their deployments as well as a reluctance of automotive manufacturers to voluntarily invest in a technology whose benefits to customers are only now becoming more evident as a more significant level of penetration of the technology is being reached.

Furthermore, the uncertainty that would be created by the proposed switch from already tested and deployed DSRC technology to C-V2X technology without significant deployments would significantly slow down investments and market adoption of V2X technology in general.

10.2 Comments on the DSRC service

IEEE 802 is somewhat in agreement with the observation by the Commission that "the DSRC service has evolved slowly and has not been widely deployed within the consumer automobile market (it

has found use in certain specialized, traffic-related projects)”. IEEE 802 notes that DSRC is not a service. As defined in the US, DSRC is a communications technology that has been and continues to be optimized to allow the provisioning of a large number of ITS-related services including safety-of-life and property in the 5850-5925 MHz ITS band. While deployments have been slow to materialize for a variety of market-driven reasons, there are nonetheless today a significant number of deployments in the US with tens of thousands of vehicular units and thousands of infrastructure units in operation, currently preventing accidents and saving lives.

IEEE 802 emphasizes that the opinion that DSRC technology has not been proven and has not been productized is simply incorrect. *DSRC technology including the Link Layer protocol component was standardized in IEEE Std 802.11p-2010* (now IEEE Std 802.11-2016 Annex D) and products implementing the DSRC technology have been in the market for purchase from multiple vendors for over 10 years. Furthermore, the protocol specified in IEEE Std 802.11p-2010 was designed specifically for the technical characteristics of V2V/V2I applications (peer-to-peer operation, dynamically changing network topologies, support for both unicast and broadcast operation, use of a common 802.11 preamble to enable straightforward evolution and backwards compatibility) and has been shown to work as designed in hundreds of demonstrations, trials and numerous deployments globally e.g. the CV Safety Pilots in Tampa, New York, Wyoming, and Columbus, Safety Pilot project in MI and CVIS in Europe [20]. A summary of the completed and ongoing relevant standards development and product availability milestones is listed below:

Milestones in DSRC Link Layer IEEE Std 802.11p-2010 standard and product development:

| | |
|-------------|---|
| 2003 | FCC licensing and service rules for DSRC operations in 2003 |
| 2006 | Initial IEEE 802.11 WG draft of P802.11p MAC/PHY amendment available, implementation begins: April 2006 |
| 2008 | Initial IEEE P802.11p hardware available |
| 2010 | IEEE Std 802.11p-2010 publication: July 2010 |
| 2008 – 2020 | IEEE Std 802.11p-2010 Chipset/system products available for purchase from multiple vendors globally |
| 2018 | IEEE P802.11bd project approved, re: Enhancements for Next Generation V2X: December 2018 |

IEEE 802 believes that the slow adoption of the DSRC technology is due to factors other than the link layer specified in IEEE 802.11. The existing defined link layer is optimized for ITS applications, robust, proven, tested and deployed. Protocol extensions to and evolution of the IEEE Std 802.11-2016 OCB based link layer are under development, adding capabilities of the very widely adopted IEEE Std 802.11-2016 (802.11n and 802.11ac technologies) standards to the DSRC PHY. Based on the current status of developments and deployments, IEEE 802 believe all the 5.9 GHz spectrum to be allocated to ITS services under this NPRM should remain allocated to the implemented, tested and proven DSRC technology to ensure a seamless, non-disruptive path forward with existing products and chipsets, enabling interoperability, coexistence, and backward compatibility goals to be met.

11 Comment on IEEE 802.11 standards referencing in [3] PART 2, paragraphs 21, 23, 37, and 39

11.1 Incorporation by reference to IEEE 802.11 standards

In Paragraphs 21, 23, 37 and 39 of PART 2 of NPRM [3] there are references to the “IEEE 802.11p-2010 standard”. We respectfully request that the reference not be made to the superseded IEEE

Std 802.11p-2010 standard, but instead to the current IEEE Std 802.11-2016. In addition, we suggest not incorporating the entire standard, but only the relevant RF performance aspects that are applicable. A reference to IEEE Std 802.11-2016 Annex D would be appropriate to cover radio regulations for “IEEE 802.11p-2010”. This suggested change will cover the necessary technical aspects of the IEEE Std 802.11p-2010 radio, as well as be inclusive of the IEEE P802.11bd radio design and potential future backwards compatible IEEE 802.11-based ITS radio designs.

IEEE 802.11 Working Group has a long history of innovation and we expect the same principles of backwards compatibility and same-channel coexistence can be applied in the 5.9 GHz ITS band starting with IEEE Std 802.11p-2010 and continuing with IEEE P802.11bd and future amendments as technology evolves.

12 Conclusion:

IEEE 802 continues to provide open standards for WLAN connectivity and ITS applications supporting various regulatory domains, worldwide. Specifically, for ITS applications IEEE 802.11 has developed the wireless interface for DSRC in IEEE Std 802.11-2016, via the OCB functionality. In addition, IEEE 802.11 is currently developing a next generation V2X standard in the IEEE P802.11bd amendment.

IEEE 802 thanks the Commission for providing an opportunity to comment on the NPRM ET Docket 19-138 and respectfully requests these comments be considered by the Commission during the final rule making process.

Regards,

By: /s/ Paul Nikolich

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