Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of the 5.850-5.925 GHz Band	)	ET Docket No. 19-138
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COMMENTS OF THE 5G AUTOMOTIVE ASSOCIATION

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EXECUTIVE SUMMARY

The Commission was right to identify cellular vehicle-to-everything ("C-V2X") as the superior technology for advancing roadway safety. The 5G Automotive Association thus supports the proposal in the *Notice of Proposed Rulemaking* ("*NPRM*") to dedicate at least 20 MHz of spectrum for direct C-V2X ("C-V2X Direct") communications in the upper portion of the 5.850-5.925 GHz ("5.9 GHz") band. However, the Commission should allocate a larger portion—if not all—of the 5.9 GHz band for C-V2X Direct to unlock the full benefits of the technology's evolution to 5G.

Built on decades of work to develop Intelligent Transportation System ("ITS") services and more recent advancements in the cellular industry, C-V2X leverages 4G and soon 5G technologies to support two communications modes: C-V2X Direct and C-V2X network communications. C-V2X Direct enables (1) vehicle-to-vehicle communications; (2) vehicle-to-roadside infrastructure communications (*e.g.*, traffic signals, variable message signs), and (3) vehicle-to-pedestrian/bicyclist/vulnerable road user communications. C-V2X's network mode allows vehicles to communicate with the rest of the world through cellular networks. Initial C-V2X applications will enable new and improved warnings to drivers and other road users, while emerging 5G-based advanced C-V2X applications will provide support for safe automated driving.

The rapid implementation of C-V2X Direct would address two critical national priorities. First, C-V2X Direct will make America's roads safer, smarter, and more efficient. And second, the widespread deployment of C-V2X Direct will help America maintain global leadership. Other regions of the world are rapidly laying the groundwork for C-V2X Direct implementation. Most notably, China already adopted a C-V2X Direct allocation, and major automakers in that country are moving forward with plans to deploy the technology in vehicles next year.

Transportation stakeholders are embracing this technology in the United States. Ford hopes to begin large-scale deployment of C-V2X Direct in consumer vehicles in 2022. Audi, BMW, Daimler, and Tesla have all endorsed the technology, and a host of other state and local departments of transportation, universities, and private sector transportation stakeholders are also pursuing C-V2X. To meet this growing demand and keep pace with other regions of the world, the Commission should provide immediate relief for C-V2X Direct operations in the 5.905-5.925 GHz band while it resolves broader questions about the remainder of the 5.9 GHz band.

By the same token, while a 20 MHz allocation for C-V2X Direct is a helpful first step, it is not sufficient to accommodate 5G-based "advanced" C-V2X Direct applications that will support safe automated driving. Therefore, at a minimum, the Commission should allocate the additional 10 MHz in the 5.895-5.905 GHz sub-band for advanced C-V2X Direct. While this additional bandwidth will not accommodate all 5G-based advanced C-V2X Direct applications, it will allow for some continued evolution of the technology.

Ultimately, however, the Commission must allocate at least an additional 40 MHz (as opposed to just an additional 10 MHz) to realize the benefits of 5G-based advanced C-V2X Direct communications. 5G-based C-V2X Direct applications can help support highly advanced

automated driving capabilities. But, to unlock these benefits, the technology requires access to an additional 40 MHz of mid-band spectrum to support burst transmissions of large quantities of data and persistent exchange of information between vehicles. The Commission can provide such access by allocating the bottom of the 5.9 GHz band—either in whole or in part—for advanced C-V2X Direct. For example, the Commission could adopt a 40 MHz channel in the 5.865-5.905 GHz sub-band or even a 55 MHz channel in the 5.850-5.905 GHz sub-band for advanced C-V2X Direct.

Rural Americans stand to benefit most from these advanced C-V2X Direct communications. While the *NPRM* notes that commercial 5G network communications will support numerous advanced transportation safety services, the timing for deployment of 5G networks in rural America remains uncertain. The Commission thus risks denying rural Americans the safety and mobility benefits of 5G-based advanced transportation applications if it fails to dedicate additional mid-band spectrum for advanced C-V2X Direct. The negative consequences of this outcome are compounded by the higher traffic fatality rates in rural areas.

Declining to allocate at least an additional 40 MHz for advanced C-V2X Direct applications will also harm America's global competitiveness. While the *NPRM* notes other regions of the world that have allocated much less than 75 MHz for transportation safety services, it overlooks larger ITS allocations in other regions and ignores the global momentum for increasing bandwidth for transportation applications. For example, Australia and South Korea both have allocated 70 MHz of bandwidth for ITS, Europe is in the process of extending its 5.9 GHz ITS band to 80 MHz, and China is actively assessing whether to expand its bandwidth for transportation safety. Indeed, if these other regions act on these proposals and the Commission adopts the reallocation proposal in the *NPRM*, America may soon have one of the world's smallest ITS allocations.

Further, thanks to recent and ongoing Commission efforts to make other spectrum available for Wi-Fi and other unlicensed uses, maintaining the 5.9 GHz band for transportation safety—in this case C-V2X Direct—will not compromise unlicensed innovation. Since the Commission initially proposed unlicensed sharing of the 5.9 GHz band in 2013, it has made or proposed to make a substantial amount of other spectrum available for unlicensed use. In light of these recent and ongoing efforts, there is simply no basis for sacrificing the benefits of advanced C-V2X Direct services at 5.9 GHz. The Commission therefore should continue to explore unlicensed opportunities in other bands while moving forward with advanced C-V2X Direct in the lower portion of the 5.9 GHz band.

However, if the Commission nonetheless decides to proceed with its proposal to reallocate the bottom of the band for unlicensed operations, it must take two actions to accommodate C-V2X Direct. First, it must identify additional mid-band spectrum elsewhere to accommodate C-V2X Direct's evolution to 5G. And second, the Commission must revise its technical rules for unlicensed operations in the bottom portion of the 5.9 GHz band. As currently proposed, these new unlicensed operations would result in significant interference to C-V2X Direct communications in the upper 30 MHz (*i.e.*, 5.895-5.925 GHz). If the Commission does not, at a minimum, take these actions, America will lose the benefits of C-V2X Direct and forfeit its leadership in this technology.

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The 5G Automotive Association ("5GAA"), by its counsel, hereby submits these comments in response to the *Notice of Proposed Rulemaking* ("*NPRM*") adopted by the Federal Communications Commission ("FCC" or "Commission") proposing rules to promote innovation in the 5.850-5.925 GHz band ("5.9 GHz band").[1] 5GAA applauds the Commission's recognition that cellular vehicle-to-everything ("C-V2X") is the superior technology to advance roadway safety and strongly supports the FCC's proposal to allocate the upper portion of the 5.9 GHz band for direct C-V2X ("C-V2X Direct") communications.[2] At the same time and for reasons detailed herein, the FCC should allocate a substantially larger portion—if not all—of the 5.9 GHz band for C-V2X Direct to unlock the full benefits of the technology's evolution to 5G. C-V2X Direct provides the best path for advancing the public interest: it will yield safety,

[1] *Use of the 5.850-5.925 GHz Band*, Notice of Proposed Rulemaking, FCC 19-129 (rel. Dec. 17, 2019) ("*NPRM*"). 5GAA is a global cross-industry organization of companies from the automotive, technology, and telecommunications industries working together to develop end-to-end connectivity solutions for intelligent transportation, future mobility systems and smart cities. *See* 5GAA, www.5gaa.org (last visited Mar. 9, 2020). Visit https://5gaa.org/membership/our-members/ for a complete list of member companies.

[2] C-V2X is comprised of two complementary communications modes for vehicular operations: direct (called PC5 in Third Generation Partnership Project ("3GPP") specifications) communications and network (called Uu in the 3GPP specifications) communications. This filing uses the term "C-V2X Direct" to describe direct communications based on the PC5 interface.

mobility, and efficiency benefits for American travelers and facilitate U.S. leadership in connected and automated vehicle technology. Moreover, thanks to recent and ongoing Commission efforts to make other spectrum available for Wi-Fi and other unlicensed uses, maintaining the 5.9 GHz band for transportation safety—in this case C-V2X Direct—will not compromise unlicensed innovation. Indeed, Americans can have access to *both* modern transportation safety services and better Wi-Fi.

I. INTRODUCTION

In two short years, Ford Motor Company hopes to begin large-scale deployment of C-V2X Direct in consumer vehicles.[3] Ford's deployment plan represents a watershed moment in the history of vehicular transportation, as the automaker would become the first manufacturer to mass produce vehicles in America with a connected car technology that leverages the 5.9 GHz band.

Ford is also not alone in its pursuit of C-V2X. Audi of America recently announced a C-V2X Direct pilot deployment just outside the nation's capital.[4] And a host of other automakers, state and local departments of transportation, universities, and private sector

[3] *See* Don Butler, *How 'Talking' and 'Listening' Vehicles Could Make Roads Safer, Cities Better*, Medium (Jan. 7, 2019), https://medium.com/cityoftomorrow/how-talking-and-listening-vehicles-could-make-roads-safer-cities-better-f215c68f376f ("Back in 1868, English engineer John Peake Knight invented the world's first traffic light to help people move through a congested London intersection that had become dangerous for pedestrians due to the popularity of horse-drawn carriages. At Ford, 150 years later, we are excited to continue advancing this type of thinking by committing to deploy cellular vehicle-to-everything technology—or C-V2X—in all of our new vehicle models in the United States beginning in 2022.").

[4] Press Release, Audi, *Audi of America, Virginia DOT and Qualcomm Announce Initial C-V2X Deployment in Virginia* (Jan. 22, 2020), https://media.audiusa.com/en-us/releases/384.

transportation stakeholders are also pursuing C-V2X, with many taking steps to test, trial, or pilot the technology.[5]

The increasing adoption of C-V2X is not surprising. Built on decades of work to develop Intelligent Transportation System ("ITS") services[6] and more recent advancements in the cellular industry, C-V2X leverages 4G and soon 5G technologies to support two separate modes: C-V2X Direct and C-V2X network communications. C-V2X Direct mode enables (1) vehicle-to-vehicle ("V2V") communications, which are used to communicate safety information between nearby vehicles to prevent collisions; (2) vehicle-to-roadside infrastructure ("V2I") communications (*e.g.*, traffic signals, variable message signs, etc.), which are used to communicate safety and traffic information, prevent accidents associated with roadway conditions, and improve traffic efficiency, and (3) vehicle-to-pedestrian ("V2P") communications, which are expected to be used to communicate safety information between vehicles and other road users such as pedestrians, bicyclists, scooter riders, etc. to prevent accidents. To augment these direct communications, C-V2X's network ("V2N") mode capabilities allow vehicles to communicate with the rest of the world through cellular networks.[7] These two modes can work in concert to improve safety, mobility, and efficiency on America's roads.

The momentum for C-V2X is undeniable. Chairman Ajit Pai recently took note:

> The cars and trucks of the future will use wireless spectrum and advanced technologies to keep us safer on the road. Cellular Vehicle to Everything, or C-V2X, is a new and promising technology that is gaining momentum in the automotive industry as it enables

[5] *See infra* in Section II.C (summarizing increasing adoption of C-V2X).

[6] ITS services utilize advanced communications technology incorporated into vehicles, transportation infrastructure, and other devices to improve safety, mobility, and emissions.

[7] These V2N mode communications enable key supporting functions for C-V2X Direct uses and expand the universe of applications enabled by C-V2X technology.

communications between cars, infrastructure, cyclists, pedestrians, and road workers.[8]

The rapid implementation of C-V2X Direct would address two critical national priorities. First, C-V2X Direct will make America's roads safer, smarter, and more efficient. Hundreds of lives are lost on the nation's roadways every day, with millions injured every year.[9] Pedestrian and bicyclist fatalities are increasing at alarming rates, with both at or near 30 year highs.[10] Moreover, increased road use has contributed significantly to traffic congestion, higher energy consumption, and worsening pollution.[11] Congress, the United States Department of Transportation ("DOT"), and the Commission repeatedly have pointed to ITS services as a potential solution to these problems.[12] While initial efforts to develop ITS focused on Dedicated

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[8] News Release, FCC, *Chairman Pai Statement on Announcement of New C-V2X Deployment in 5.9 GHz Band* (Jan. 22, 2020), https://docs.fcc.gov/public/attachments/DOC-362038A1.pdf.

[9] *See* NHTSA, *2018 Fatal Motor Vehicle Crashes: Overview*, at 1 (Oct. 2019) ("NHTSA 2018 Fatal Motor Vehicle Crashes"), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812826 ("There were 36,560 people killed in motor vehicle traffic crashes on U.S. roadways during 2018….").

[10] *See* NHTSA, Pedestrian Safety, https://www.nhtsa.gov/road-safety/pedestrian-safety (last visited Mar. 9, 2020) ("There was a more than 3% increase in the number of pedestrians killed in traffic crashes in 2018, totaling 6,283 deaths—the most deaths since 1990."); NHTSA, Bicycle Safety, https://www.nhtsa.gov/road-safety/bicycle-safety (last visited Mar. 9, 2020) ("In 2018, there were 857 bicyclists killed in motor vehicle crashes, a more than 6% increase from the year before.").

[11] *See* Martin Knopp, *America's Drivers Continue to Spend More Time Stuck in Traffic, 2016 Data Shows*, Connections – U.S. Department of Transportation Blog (June 12, 2017), https://www.transportation.gov/-connections/america%E2%80%99s-drivers-continue-spend-more-time-stuck-traffic-2016-data-shows, ("[D]rivers are spending more time stuck in rush-hour traffic than ever. … Congestion got worse [from 2016 to 2017] during peak hours in 2016, as represented by the Travel Time Index which compares peak hour or commuter travel times to free flow travel times."); U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2016)*, at Trends 2-11 (Apr. 12, 2018), https://www.epa.gov/sites/production/files/2018-01/documents-/2018_complete_report.pdf, ("Emissions from petroleum consumption for transportation have increased by 21.7 percent since 1990 ….").

[12] ITS traces its modern day origins to the mid-1980s, when the DOT, in partnership with state departments of transportation, academia, and industry, began evaluating how to incorporate

Short Range Communications ("DSRC") technology, C-V2X Direct has emerged as the best technology available today to respond to these pressing societal needs.[13] C-V2X Direct's advantages will immediately result in new and improved ITS services, and in the longer term 5G and subsequent versions of C-V2X will enable a broadly connected mobility ecosystem that supports safe automated driving.

And second, the widespread deployment of C-V2X Direct will help America maintain global leadership. Other regions of the world are rapidly laying the groundwork for C-V2X Direct implementation. China allocated 5.9 GHz spectrum for C-V2X Direct in 2018,[14] and Chinese automakers are moving forward with plans to mass-produce vehicles equipped with this

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communications technology into transportation infrastructure to improve safety, mobility, and emissions. *See* Federal Motor Vehicle Safety Standards; V2V Communications, 82 Fed. Reg. 3854, 3867 (Jan. 12, 2017) ("Federal Motor Vehicle Safety Standards") (discussing the history of ITS research). Shortly thereafter, Congress passed ITS provisions in the Intermodal Surface Transportation Efficiency Act of 1991 ("ISTEA") in an effort to improve traveler safety, decrease traffic congestion, facilitate the reduction of air pollution, and conserve vital fossil fuels. Intelligent Vehicle-Highway Systems Act, Pub. L. No. 102-240 § 6052 (b), 105 Stat. 1914, 2189-90 (1991), https://www.gpo.gov/fdsys/pkg/STATUTE-105/pdf/STATUTE-105-Pg1914.pdf. The passage of ISTEA represented the first in a sequence of collective actions by Congress, the DOT and the Commission that ultimately led to the allocation of the 5.9 GHz band for the ITS Radio Service. *See Amendment of Parts 2 and 90 of the Commission's Rules to Allocate the 5.850-5.925 GHz Band to the Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Services*, Report and Order, 14 FCC Rcd 18221 (1999).

[13] In comparison to DSRC, C-V2X offers significant advantages in important areas such as performance, future evolution, and speed and width of deployment. *See infra* Section II.A-II.B (discussing C-V2X's advantages over DSRC).

[14] Ministry of Industry and Information Technology of the People's Republic of China, MIIT No. 203 regulation (Nov. 2018). *See also* Stephen Lawson, *C-V2X's Momentum in China May Drive Connected-Car Development*, TU-Automotive (Nov. 7, 2018), https://www.tu-auto.com/c-v2xs-momentum-in-china-may-drive-connected-car-development/; Monica Alleven, *Qualcomm expects C-V2X commercial rollouts in 2019, cites progress in China*, FierceWireless (Nov. 2, 2018), https://www.fiercewireless.com/-wireless/qualcomm-expects-c-v2x-commercial-rollouts-2019-cites-progress-china.

technology.[15] The European Union is also in the midst of developing an approach that would open a path for C-V2X Direct deployment.[16] As other regions of the world increasingly embrace C-V2X Direct, the rapid implementation of this technology in America—if permitted by the FCC in accordance with these comments—will ensure continued U.S. leadership.

Unfortunately, the Commission's current 5.9 GHz band rules leave C-V2X Direct stuck in neutral on America's roads. Those rules restrict operations to the DSRC standard, preventing deployment of C-V2X Direct and posing the most significant regulatory roadblock that stands in the way of Ford and all other stakeholders from bringing this technology to the American public.

The *NPRM*'s proposal will help advance C-V2X Direct—in part. Specifically, the proposal to dedicate the upper 20 MHz (*i.e.*, the 5.905-5.925 GHz sub-band) of the 5.9 GHz band for C-V2X Direct will result in important benefits.[17] Using this channel, C-V2X Direct V2V messages would support collision avoidance applications that would prevent a substantial portion of today's crashes. C-V2X Direct V2I messages on this channel would enable additional safety applications, such as red light warnings and intersection movement applications, enhancing traffic systems and operations. And C-V2X Direct vehicle-to-pedestrian communications would help stem the rising tide of pedestrian and bicyclist fatalities on America's roads. To expedite the realization of these benefits, the Commission should move to accelerate the availability of C-

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[15] *See, e.g.*, Adam Frost, *Deal signed for huge V2X launch in China*, Traffic Technology Today (Feb. 27, 2019), https://www.traffictechnologytoday.com/news/connected-vehicles-infrastructure/geely-qualcomm-and-gosuncn-to-launch-5g-and-c-v2x-enabled-vehicles.html.

[16] *See, e.g.*, Foo Yun Chee, *EU opens road to 5G connected cars in boost to BMW, Qualcomm*, Reuters (July 4, 2019), https://www.reuters.com/article/us-eu-autos-tech/eu-opens-road-to-5g-connected-cars-in-boost-to-bmw-qualcomm-idUSKCN1TZ11F; Jeremy Horwitz, *Why Europe just boosted 5G over Wi-Fi for connected cars*, VentureBeat (July 5, 2019), https://venturebeat.com/2019/07/05/why-europe-just-boosted-5g-over-wi-fi-for-connected-cars.

[17] *NPRM* ¶ 24.

V2X Direct services in this 20 MHz channel. The Commission can accomplish this by either granting 5GAA's 2018 waiver request or expeditiously adopting rules for this 20 MHz channel while it considers broader changes for the rest of the band.[18]

Other aspects of the *NPRM* miss the mark. In failing to propose at least an additional 40 MHz for advanced C-V2X Direct communications, the *NPRM* squanders the best opportunity to accommodate the technology's evolution to 5G. In the coming months, the 3rd Generation Partnership Project ("3GPP")[19] will finalize work on 5G New Radio (NR) C-V2X features in Release 16, the first 5G version of C-V2X.[20] 5G-based C-V2X Direct communications are increasingly viewed as critical for supporting highly advanced automated driving capabilities.[21] 5G-based advanced C-V2X Direct communications require access to at least 40 MHz of contiguous dedicated bandwidth to support constant burst transmissions of large quantities of

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[18] *See infra* Section III (urging the Commission to either grant 5GAA's waiver request, which seeks permission to deploy C-V2X in the upper 20 MHz of the 5.9 GHz band, or expeditiously adopt rules for C-V2X in this upper 20 MHz).

[19] 3GPP is the world's preeminent standards body for cellular technologies. 3GPP develops specifications that are codified as accredited standards by the Alliance for Telecommunications Industry Solutions ("ATIS") in the United States and by other "Organizational Partners" in different geographical regions. *See* 3GPP, Partners, http://www.3gpp.org/about-3gpp/partners (last visited Mar. 9, 2020) for a complete list of the accredited Standards Defining Organizations ("SDOs") around the world. Any references to 3GPP herein indicate any relevant 3GPP specification adopted as a standard by the Organizational Partners.

[20] The Release 14 version of 4G LTE-Pro, which was finalized in 2017, was the first cellular standard to incorporate C-V2X features. 3GPP, Release 14, http://www.3gpp.org/release-14 (last visited Mar. 9, 2020). While 3GPP Release 15 incorporated C-V2X enhancements into the 4G LTE-Pro standard, 3GPP Release 16 will incorporate C-V2X features into the 5G (NR) standard. *See* 3GPP, Features and Study Items, http://www.3gpp.org/DynaReport/FeatureList FrameSet.htm (last visited Mar. 9, 2020) (identifying a study on 5G NR Vehicle-to-Everything as part of the feature and study item list for Release 16).

[21] *See infra* Section V.A (discussing how 5G-based C-V2X Direct services can support highly advanced automated driving capabilities) and V.B (discussing the importance of 5G-based advanced C-V2X Direct communications in those areas in which there is insufficient 5G network coverage).

data, ultra-low latency, and high message reliability, among other needs.[22] Unfortunately, the *NPRM*'s proposal provides inadequate bandwidth for the continuing evolution of C-V2X Direct to 5G, which would deprive travelers and pedestrians in America of the safety and mobility benefits supported by 5G-based advanced C-V2X Direct services.

In light of this bandwidth shortage, the Commission should allocate at least an additional 10 MHz in the 5.895-5.905 GHz sub-band for C-V2X Direct.[23] This additional bandwidth will allow for some continued evolution of the technology and will support improved radio performance via more flexible regulations.[24]

Ultimately, however, allocation of at least an additional 40 MHz (as opposed to just an additional 10 MHz) is needed to unlock the full benefits of 5G-based advanced C-V2X Direct services. The Commission can accomplish this by allocating the bottom of the 5.9 GHz band—either in whole or in part—for advanced C-V2X Direct communications. For example, the Commission could adopt a 40 MHz channel in the 5.865-5.905 GHz sub-band or even a 55 MHz channel in the 5.850-5.905 GHz sub-band for advanced C-V2X Direct. Absent the adoption of this additional spectrum for advanced C-V2X Direct, America would lose its chance to capitalize on the benefits of 5G-enabled traffic safety applications.

However, if the Commission nonetheless decides to proceed with its proposal to reallocate the bottom of the band for unlicensed operations,[25] it must take two actions to

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[22] *See infra* Section V.A (discussing the bandwidth requirements of advanced C-V2X Direct services).

[23] *See infra* Section IV (discussing the benefits of designating at least an additional 10 MHz in the 5.895-5.905 GHz sub-band for C-V2X Direct).

[24] *See* proposed rule sections in Appendix A hereto (proposing rules for a 30 MHz C-V2X Direct channel in the 5.895-5.925 GHz sub-band).

[25] *NPRM* ¶¶ 13-17.

accommodate C-V2X Direct. First, it should simultaneously identify additional dedicated, mid-band spectrum elsewhere to accommodate C-V2X Direct's evolution to 5G.[26] And second, the Commission must revise its technical rules for unlicensed operations in the proposed 5.850-5.895 GHz sub-band ("U-NII-4") to protect C-V2X Direct communications in the upper 30 MHz of the 5.9 GHz band. The current proposed rules for U-NII-4 unlicensed operations would result in significant levels of interference to C-V2X Direct communications in the 5.895-5.925 GHz band, and the Commission must address these rules to protect the safety of life services C-V2X Direct will support.[27] If the Commission does not, at a bare minimum, take these actions, America will lose the benefits of C-V2X Direct and forfeit its leadership in this technology.

II. THE COMMISSION WAS RIGHT TO IDENTIFY C-V2X AS THE TECHNOLOGY MOST CAPABLE OF MAKING AMERICA'S ROADS SAFER, SMARTER, AND MORE EFFICIENT

A. C-V2X's Performance, Evolution, and Deployment Advantages Will Result in Numerous Benefits

C-V2X Direct is the best technology to achieve the Commission's objectives for ITS in the 5.9 GHz band. When Ford announced its desire to move forward with C-V2X, it explained its decision in simple terms: "[C]ellular vehicle-to-everything is the technology with the most potential to allow the cars and cities of the future to communicate quickly, safely and securely."[28]

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[26] *See infra* Section VI (discussing the need to identify additional, dedicated mid-band spectrum elsewhere for 5G-based advanced C-V2X communications).

[27] *See infra* Section VI (discussing a potential solution for protecting C-V2X Direct communications in the upper 30 MHz of the 5.9 band from harmful interference caused by U-NII-4 unlicensed operations).

[28] Don Butler, *Why We're Working with Qualcomm to Ensure Everything in Cities Speaks the Same Language*, Medium (Jan. 9, 2018), https://medium.com/cityoftomorrow/why-were-

The Commission similarly identified C-V2X as the "technology most capable of ensuring the rapid development and deployment and of continually improving transportation and vehicular safety-related applications now and into the future."[29] More specifically, the Commission concluded that C-V2X will "achieve network effects necessary to maximize transportation and vehicular safety-related benefits; facilitate rapid development and deployment; enable improvements, learning and upgrades; … be robust and secure[,]" and "integrate spectrum resources from other bands as part of its transportation and vehicular safety-related system."[30]

As discussed in greater detail below, C-V2X provides: (1) a more accurate picture of the road environment due to C-V2X Direct's superior radio performance and ability to leverage C-V2X network communications, (2) continuously improving transportation applications as a result of its evolutionary path to 5G, and (3) an accelerated timeline for deployment based on its cost-efficiency. In all respects, C-V2X is the best choice moving forward.

C-V2X Direct's superior radio performance provides a more accurate view of the road environment. ITS services provide information to help drivers and other road users reach their destinations safely and efficiently. Whether it is ice on an upcoming bridge, a road crew around the bend, or an ambulance racing toward an intersection, ITS provides a more accurate view of the surrounding environment by identifying hidden hazards and changing conditions ahead.

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working-with-qualcomm-to-ensure-everything-in-cities-speaks-the-same-language-98e0cc1bff18.

[29] *NPRM* ¶ 24.

[30] *Id.*

Thanks to its modern radio, C-V2X Direct provides a better view over a greater range than any other ITS technology.

C-V2X Direct's radio outperforms DSRC in a number of key ITS areas, including reliability, range, and resilience to interference.[31] Moreover, these advantages are substantial. For example, C-V2X Direct outperformed DSRC in terms of range by anywhere from 1.3x – 2.9x in recent 5GAA field testing.[32] These performance advantages are particularly important in non-line-of-sight conditions that the 5.9 GHz band is well suited to serve. While current vehicle-resident technologies (*i.e.*, camera and sensor-based technologies) experience limitations in non-line-of-sight conditions, ITS technologies are not so limited, providing the ability to "see"

[31] *See* Letter from Sean T. Conway, Counsel to the 5G Automotive Association, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 18-357, Attachment 1 (filed July 8, 2019) ("*5GAA Benchmark Report*"). The *5GAA Benchmark Report*, which 5GAA submitted in a letter to the Commission dated July 8, 2019, is an amended version of the initial test report 5GAA filed with the 5GAA Waiver Request. *See* Petition of 5G Automotive Association for Waiver, GN Docket No. 18-357 (Nov. 21, 2018) ("5GAA Waiver Request").

[32] *5GAA Benchmark Report* at 110 ("Under varying radio environment conditions [(line-of-sight, non-line-of-sight, and interference)] the field tests have shown that C-V2X [Direct] has a 1.3x-2.9x range advantage over DSRC."). Moreover, while the C-V2X Direct devices used in this testing were loaded with pre-commercial software, C-V2X Direct performance likely will improve with commercial-grade software, which is available today. *See id.* at 11.

around corners and through other vehicles.[33] In 5GAA's testing, C-V2X Direct demonstrated a range of more than twice that achieved by DSRC in non-line-of-sight conditions.[34]

All of this results in meaningful benefits for roadway users. C-V2X Direct's non-line-of-sight capabilities provide a more accurate picture of the threats hidden behind obstructions or around corners. Additionally, C-V2X Direct's greater range provides more advance warning of hazards ahead, and the technology's enhanced reliability and resilience to interference provides more certainty that critical safety messages reach their intended destination. These advantages are particularly beneficial in intersection, highway passing, and braking scenarios.[35]

C-V2X's network mode further augments these advantages. During times of peak congestion, the technology can offload less time-critical V2V, V2I, and V2P communications to the cellular network, ensuring that the increased level of time-sensitive safety messages reach the

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[33] Both the NHTSA and the Commission recognize the importance of ITS in non-line-of-sight conditions. *See*, *e.g.*, Federal Motor Vehicle Safety Standards, 82 Fed. Reg. at 3855 (discussing the ability of V2V ITS communications in the 5.9 GHz band to offer non-line-of-sight capabilities (*i.e.*, the ability to "see" around corners and through other vehicles) that vehicle-resident sensors and cameras cannot match); *NPRM* ¶ 19 (recognizing "non-line-of-sight applications … can be an important part of securing improved transportation and vehicular safety-related applications in the coming years"). In addition to increased non-line-of-sight capabilities, ITS offers a number of additional benefits. For example, ITS basic safety messages contain information, such as path predictions and driver actions, not available from traditional sensors. *See*, Federal Motor Vehicle Safety Standards, 82 Fed. Reg. at 3855. ITS also offers an operational range that far exceeds that of vehicle-resident systems, and ITS technology is not subject to the same system limitations as vehicle-resident sensors, which may be affected by weather, sunlight, shadows, or cleanliness. Federal Motor Vehicle Safety Standards, 82 Fed. Reg. at 3855. These advantages led NHTSA to conclude recently that ITS communications in the 5.9 GHz band can "revolutionize motor vehicle safety." Federal Motor Vehicle Safety Standards, 82 Fed. Reg. at 3855.

[34] *See 5GAA Benchmark Report* at 110 ("The [line-of-sight advantage] was 1.7x, however, the improvements rose to 2.2x in more realistic [non-line-of-sight] conditions involving signal obstruction.").

[35] *See* Federal Motor Vehicle Safety Standards, 82 Fed. Reg. at 3871.

intended recipients as soon as possible. Network mode functionality also offers integration with cellular-enabled smart-city and other connected transportation initiatives, adding increased functionality to C-V2X services. Ultimately, these attributes enable an unparalleled view of the surrounding road environment.

C-V2X Direct's evolution to 5G ensures continuously improving safety applications. The transportation industry—and specifically the automotive industry—is widely viewed as one of the key sectors that will benefit from 5G capabilities and services.[36] C-V2X is the only ITS technology with a path to 5G and subsequent mobile wireless generations.

While the first cellular standards to incorporate C-V2X Direct features were based on 4G,[37] work is nearly complete on 5G New Radio (NR) C-V2X features in 3GPP Release 16, the first 5G version of C-V2X Direct.[38] C-V2X Direct thus will unlock the power of 5G technology, driving further improvements in performance, introducing new capabilities to connected vehicles, and extending the number of use cases for C-V2X. For example, 5G-based C-V2X Direct will use advanced radio technologies to achieve ultra-low latency and ultra-high

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[36] *See, e.g.*, Ajit Pai, *Column: Florida is on the leading edge of 5G*, Tampa Bay Times (May 16, 2018), https://www.tbo.com/-opinion/columns/Column-Florida-is-on-the-leading-edge-of-5G_168227409 ("Imagine a world where everything that can be connected will be connected—where driverless cars talk to smart transportation networks…. That's a snapshot of what the 5G world will look like."); Brendan Carr, Commissioner, FCC, *Remarks on Next Steps on the Path to 5G*, at 1, (Apr. 19, 2018), https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0420/DOC-350348A1.pdf ("5G is a platform that can support transformative applications. It's about autonomous cars—which could reduce the number of traffic deaths from the 40,000 per year we see today to nearly zero.").

[37] *See supra* note 20.

[38] *See* 3GPP Features and Study Items, *supra* note 20 (identifying a study on 5G NR Vehicle-to-Everything as part of the feature and study item list for Release 16). 3GPP has targeted June 2020 as the completion date for Release 16. *See also* 3GPP, Release 16, https://www.3gpp.org/release-16 (updated Oct. 2, 2019).

capacity.[39] 5G-based C-V2X Direct road infrastructure applications will combine high-bandwidth operations and edge computing capabilities to allow for the movement of larger amounts of data, over shorter distances, in smaller amounts of time, maximizing the safety benefits of C-V2X.[40] Ultimately, these improvements will enable advanced C-V2X Direct applications that support safe automated driving.[41]

C-V2X advancements will not stop at 3GPP Release 16. Work is already underway on additional 5G C-V2X Direct features as part of 3GPP Release 17.[42] Indeed, as the commercial wireless industry continues to evolve to 5G and beyond, C-V2X can and will evolve as well. And because C-V2X Direct is designed to be functionally-backwards compatible with earlier versions, new vehicles will be able to communicate with older versions of C-V2X Direct-enabled vehicles and infrastructure, effectively future-proofing the technology. This progression will ensure C-V2X Direct accomplishes the Commission's goal of "continually improving transportation and vehicular safety-related applications now and *into the future*."[43]

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[39] *See* 5G Americas, *Cellular V2X Communications Towards 5G*, at 14 (Whitepaper Mar. 2018) (5G Americas Whitepaper), https://www.5gamericas.org/wp-content/uploads/2019/07/2018_5G_Americas_-White_Paper_Cellular_V2X_Communications_ Towards_5G__Final_ for_Distribution.pdf.

[40] *See* 5G Automotive Association, *Toward fully connected vehicles: Edge computing for advanced automotive communications*, at 6 (White Paper Dec. 2017), http://5gaa.org/wp-content/uploads/2017/12/-5GAA_T-170219-whitepaper-EdgeComputing_-5GAA.pdf.

[41] *See infra* Section V.A for a discussion of advanced C-V2X use cases.

[42] *See* Lorenzo Casaccia, *3GPP charts the next chapter of 5G standards*, Qualcomm OnQ Blog (Dec. 13, 2019), https://www.qualcomm.com/news/onq/2019/12/13/3gpp-charts-next-chapter-5g-standards.

[43] *NPRM* ¶ 24 (emphasis added). This progression is also a reason why the Commission should not tie C-V2X operations in the 5.9 GHz band to a particular 3GPP standard, as more fully discussed in Section VII.

C-V2X's accelerated timeline for deployment. C-V2X is the best ITS technology for achieving the network effects identified by the Commission because C-V2X offers a unique cost efficiency that supports deployment on an accelerated basis.[44] This cost efficiency is based on a number of factors.

First, C-V2X Direct technology can be economically integrated into vehicles. In response to overwhelming consumer demand for in-vehicle communications capabilities, virtually all new vehicles are equipped with C-V2X network mode chipsets.[45] C-V2X Direct can be added as an additional feature in these chipset products, lowering bill of materials costs, simplifying the supply chain and logistics, and reducing vehicle maintenance costs.[46]

Second, C-V2X can leverage today's cellular networks and tomorrow's 5G networks to reduce infrastructure deployment costs. By riding over existing commercial mobile infrastructure in certain situations, C-V2X can reduce costs by limiting the need for new or unique infrastructure. The opportunities for cost-saving synergies will further increase with the

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[44] *NPRM* ¶ 24; Traffic Technology Today, *C-V2X industry: What does the future look like?* (Jan. 7, 2020), https://www.traffictechnology-today.com/features/c-v2x-industry-what-does-the-future-look-like.html.

[45] *See, e.g.*, Peter Leitzinger, *Connected Car Connectivity Growing As Cars Get Smarter* (July 23, 2019), https://www.spglobal.com/marketintelligence/en/news-insights/blog/connected-car-connectivity-growing-as-cars-get-smarter ("The installed base of U.S. vehicles with embedded in-vehicle cellular (3G/4G LTE) systems reached nearly 41 million by year-end 2018, an increase of 22% year over year from just over 33 million in 2017."); Press Release, Ford, *Ford Readies North America's Freshest Lineup By 2020 With Onslaught Of Connected New Trucks, SUVs And Hybrids* (Mar. 15, 2018), https://media.ford.com/content/fordmedia/fna/us/en/news/-2018/03/15/ford-readies-north-americas-freshest-lineup-by-2020.html (announcing that all new Ford vehicles will have 4G LTE connectivity by the end of 2019); Daimler, *Daimler's Perspective on Car-to-X Technologies (5GAA member)*, at 2 (June 2018), http://5gaa.org/wp-content/uploads/2018/06/5.-Daimler-view-on-V2X-5GAA-Policy-Debate.pdf (noting 90% of new Mercedes-Benz cars in 2018 were already connected).

[46] *See* NGMN Alliance, *V2X White Paper v. 1.0*, at 42-43 (June 17, 2018), https://www.ngmn.org/wp-content/uploads/V2X_white_paper_v1_0-1.pdf.

deployment of 5G networks, which is expected to generate an additional $275 billion of investment.[47]

Third, C-V2X's evolutionary path to 5G will help accelerate the development of a market for C-V2X, creating economies of scale and driving down costs. This path to 5G will ensure that future versions of C-V2X modules remain functionally-backwards compatible,[48] providing consumers, automakers, roadway operators, infrastructure providers, and network operators with the assurance that C-V2X products purchased today will retain functionality.

Fourth, C-V2X benefits from economies of scale that follow global harmonization. China—the world's largest automobile market—is already moving forward with C-V2X Direct implementation in the 5.9 GHz band. Moreover, as reflected in 5GAA's global membership, major automotive, technology, and telecommunications companies from all corners of the globe are investing in the development and deployment of this technology. As this international momentum grows, so too will C-V2X's economies of scale.[49]

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[47] *See* Accenture Strategy, *How 5G Can Help Municipalities Become Vibrant Smart Cities*, at 1 (Jan. 2017), https://newsroom.accenture.com/content/1101/files/Accenture_5G-Municipalities-Become-Smart-Cities.pdf. *See also* CTIA, Channel 5G, https://www.ctia.org/homepage/5g-channel (last visited Mar. 9, 2020).

[48] *See* Tom Rebbeck et al., *Socio-economic Benefits of Cellular V2X*, at 2, Analysis Mason (Dec. 2017), https://5gaa.org/wp-content/uploads/2017/12/Final-report-for-5GAA-on-cellular-V2X-socio-economic-benefits-051217_FINAL.pdf (citing the certainty of C-V2X's future evolution to 5G as facilitating earlier deployment and after-market deployment).

[49] C-V2X is also the most secure ITS available. C-V2X network communications will reuse various security components already implemented by the commercial mobile wireless industry. These security components, which are used by millions of connected vehicles on the road today, were developed through billions of dollars of private sector investment by the commercial wireless industry. C-V2X Direct will utilize the established security credential management system ("SCMS") developed in partnership by the DOT and a consortium of major global automakers. While originally developed for DSRC, 5GAA members have optimized the SCMS for C-V2X. *See* Qualcomm, *C-V2X Technical Performance: Frequently Asked Questions*, at 18

B. The Wide Deployment of C-V2X Direct Can Help Address Rising Pedestrian and Bicyclist Deaths and Injuries

C-V2X is the best ITS technology to address the recent rise in pedestrian and bicyclist fatalities in America. According to the most recent annual statistics released by the National Highway Traffic Safety Administration ("NHTSA"), pedestrian traffic fatalities spiked in 2018—totaling 6,283 deaths—and bicyclist fatalities increased by more than six percent from the previous year.[50] For both categories, these figures represent the highest fatality levels since 1990.[51] Thanks to a wide deployment that is expected to encompass not only vehicles but also a variety of commonly used consumer devices, C-V2X Direct can serve as an antidote to these rising fatality rates and improve safety for vulnerable road users.

Here again, C-V2X Direct holds an advantage over DSRC. As an older technology, DSRC is increasingly unlikely to be included in consumer devices, whereas technology developed within 3GPP is often incorporated into the latest smartphones and connected consumer products.[52] C-V2X Direct is no exception: it already supports direct V2P communications, and work is underway in 3GPP Release 17 to optimize the power consumption of C-V2X Direct for battery-powered devices. This work will help expedite the deployment of

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(Oct. 11, 2019), https://www.qualcomm.com/media/documents/files/c-v2x-technical-performance-faq.pdf.

[50] *See* NHTSA Pedestrian Safety, *supra* note 10 ("There was a more than 3% increase in the number of pedestrians killed in traffic crashes in 2018, totaling 6,283 deaths — the most deaths since 1990."); NHTSA Bicycle Safety, *supra* note 10 ("In 2018, there were 857 bicyclists killed in motor vehicle crashes, a more than 6% increase from the year before.").

[51] *See* NHTSA 2018 Fatal Motor Vehicle Crashes at 3.

[52] *See* Ricardo, *Safety of life study*, at 15 (May 7, 2018), https://5gaa.org/wp-content/uploads/-2018/07/-Safety-of-life-study_Final_Issue-4.pdf; 5G Automotive Association, *An assessment of LTE-V2X (PC5) and 802.11p direct communications technologies for improved road safety in the EU*, at 14 (Dec. 5, 2017), https://5gaa.org/wp-content/uploads/2017/12/5GAA-Road-safety-FINAL2017-12-05.pdf.

these features in consumer devices such as smart phones, smart watches, and wearables that are used by pedestrians, by bicyclists and in other small vehicles (*e.g.*, scooters).[53]

As a result, C-V2X Direct-powered V2P warnings will be sent to and from drivers and vulnerable road users. For example, when a pedestrian's smartphone detects that it is in the vicinity of a road, it will use C-V2X Direct to broadcast a signal warning to nearby vehicles of its presence.[54] Similarly, vehicles will be able to send alerts to smartphones or connected wearable devices near the road.[55] These warnings will help drivers and vulnerable road users avoid potential hazards, especially as vehicles increasingly share roads with pedestrians, bicyclists, and micro-mobility solutions.

C. Transportation Stakeholders Are Increasingly Adopting C-V2X Direct

Transportation stakeholders of all stripes are embracing this technology. The highlight, of course, is Ford's plan—pending favorable regulatory action—to deploy C-V2X Direct in all of its new vehicle models sold in America, bringing millions of C-V2X-enabled vehicles to America's roads.[56]

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[53] *See* Qualcomm, Connecting vehicles to everything else with Qualcomm® C-V2X solutions, https://www.qualcomm.com/products/automotive/c-v2x (last visited Mar. 9, 2020) ("Cars with V2P will see nearby people even when other drivers can't—and can be designed to send alerts to drivers, pedestrians, motorcyclists, and bicyclists through smartphone applications or connected wearable devices like smart watches."); Jeremy Horwitz, *3GPP plans 5G wearable, multicasting and 60GHz standards for 2021*, VentureBeat (Dec. 13, 2019), https://venturebeat.com/-2019/12/13/3gpp-plans-5g-wearable-multicasting-and-60ghz-standards-for-2021/.

[54] *See* GSMA, *Connecting Vehicles Today and in the 5G Era with C-V2X (Cellular Vehicle-to-Everything)*, at 10 (Aug. 2019), https://www.gsma.com/iot/wp-content/uploads/2019/08/Connecting-Vehicles-Today-and-in-the-5G-Era-with-C-V2X.pdf.

[55] *See* Qualcomm, Connecting vehicles to everything else with Qualcomm® C-V2X solutions, *supra* note 53.

[56] In 2019, Ford sold approximately 2.4 million vehicles in the U.S. Ford, *Fourth Quarter Sales 2019*, https://s22.q4cdn.com/857684434/files/doc_downloads/2020/01/Ford-4Q2019-US-Sales-Results.pdf.

Yet Ford is hardly the only automaker pursuing C-V2X. As part of its joint project with Qualcomm and the Virginia Department of Transportation, Audi is equipping Q8 SUVs with C-V2X radios to trial (1) work-zone applications that will help keep highway maintenance and construction workers safe and (2) Signal Phase and Timing ("SPaT") applications that will improve traffic efficiency on northern Virginia's congested roadways.[57] Daimler North America Corporation, BMW of North America, and Jaguar Land Rover—each of whom previously urged the Commission to allow C-V2X Direct operations as soon as possible—have also trialed C-V2X applications in recent months.[58] And in recording its support for C-V2X, American automaker Tesla, Inc. noted its vehicles are positioned to utilize C-V2X Direct because the technology "inherently builds upon 4G LTE and the likely eventual migration to 5G."[59]

States are responding to this momentum by implementing C-V2X Direct along their roadways.[60] Colorado has deployed C-V2X Direct in conjunction with 5GAA-member

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[57] Audi Press Release, *supra* note 4 ("We recognize the immediate value of the spectrum that the FCC proposed to allocate to C-V2X, and we endeavor to show our V2X equipped cars on real roads engaging in how transportation safety and mobility could be jump-started.").

[58] *See* Comments of Daimler North America Corporation, GN Docket No. 18-357, at 1 (filed Jan. 18, 2019) ("Daimler Comments") (noting that Daimler is actively assessing C-V2X technology); Comments of BMW of North America, LLC, GN Docket No. 18-357, at 1 (filed Jan. 18, 2019) ("BMW Comments") (urging the Commission to allow C-V2X operations as soon as possible); Comments of Jaguar Land Rover, GN Docket No. 18-357, at 1 (filed Jan. 22, 2019) ("Jaguar Comments") (same). *See also* Press Release, 5G Automotive Association, *C-V2X contributes to safer roads for everyone: 5GAA live demo event in Berlin* (May 23, 2019), https://5gaa.org/news/c-v2x-contributes-to-safer-roads-for-everyone-5gaa-live-demo-event-in-berlin (describing technology demonstrations of C-V2X applications by Daimler (emergency electronic brake light warning; remote-operated driving), BMW (SPaT; red-light violation warning), and Jaguar Land Rover (a two-stage warning system that combines direct and network delivery of C-V2X basic safety messages)).

[59] Comments of Tesla, Inc., DOT-OST-2018-0210, at 1-2 (filed Jan. 31, 2019).

[60] While the Commission's rules do not currently envision C-V2X operations in the 5.9 GHz band, these deployments are made possible through experimental licenses.

Panasonic to collect data on upcoming roadway hazards.[61] The Georgia Department of Transportation and the Atlanta Regional Commission (ARC) recently announced a Regional Connected Vehicle partnership that will connect 1,000 locations in Georgia with C-V2X technology.[62] And Virginia, as part of the previously-mentioned joint venture with Audi, is deploying C-V2X Direct to boost safety around school buses, warn motorists about dangerous road conditions and the presence of roadside maintenance and construction workers, alleviate congestion at traffic chokepoints, and improve the performance of automated vehicles that are nearing commercialization.[63]

States are not the only stakeholders deploying C-V2X Direct-enabled infrastructure. The University of Michigan Transportation Research Institute recently announced plans to deploy C-V2X Direct in the Ann Arbor Connected Environment—one of the nation's premier connected vehicle testbeds—to enable a host of important safety applications such as red light and pedestrian warnings.[64] Similarly, the Infrastructure-Automotive Technology Laboratory—a private-sector innovation center opened by 5GAA-member Applied Information—recently

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[61] *See* Sue Marek, *Colorado Will Be First With C-V2X Vehicle Deployment*, SDXCentral (Jun. 5, 2018), https://www.sdxcentral.com/articles/news/colorado-will-be-first-with-c-v2x-vehicle-deployment/2018/06/.

[62] Georgia Department of Transportation, Press Release, *Georgia DOT Prepares Transportation Infrastructure for Imminent Adoption of Connected Vehicle Technology* (Feb. 6, 2020), https://news.transportation.org/Pages/StateDotNewsDetail.aspx?MessageId=75963.

[63] *See* Audi Press Release, *supra* note 4. In announcing the deployment, Virginia's Director of Transportation Research and Innovation noted the project's ability to provide "essential and practical safety and mobility services, including saving the lives of maintenance and construction personnel in work zones." *Id.*

[64] University of Michigan Transportation Research Institute, *Simultaneous Deployment of C-V2X and DSRC in Ann Arbor Connected Environment* (Dec. 12, 2019), http://www.umtri.umich.edu/-what-were-doing/in-the-news/simultaneous-deployment-c-v2x-and-dsrc-ann-arbor-connected-environment.

deployed C-V2X Direct in the Atlanta metropolitan region to allow automobile manufacturers to develop, test, and trial safety applications under real-world conditions.[65]

Other regions of the world are adopting C-V2X Direct at an even faster rate, and global automotive manufacturers are already making deployment plans. China, in particular, remains in the lead on C-V2X Direct implementation.[66] Chinese regulators allocated spectrum for C-V2X Direct in 2018,[67] and major automakers, most notably Zhejiang Geely Holding Group, are deploying C-V2X-enabled vehicles in China next year.[68] Europe is also trending towards C-V2X Direct. Following last year's rejection of a proposal to effectively establish DSRC[69] as the preferred ITS technology, the European Union is now exploring an approach that would create a path for C-V2X Direct's deployment in Europe.[70]

In the face of this momentum, the need for Commission action is clear.

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[65] *See World's First Laboratory to Help Connected and Autonomous Vehicles Talk to Traffic Signals Opens in Metro Atlanta*, Business Wire (Jan. 10, 2020), https://www.businesswire.com/news/home/20200110005469/en/World%E2%80%99s-Laboratory-Connected-Autonomous-Vehicles-Talk-Traffic; Press Release, Applied Information, Inc., *Applied Information Establishes C-V2X Testing Ecosystem on city Streets Around the iATL in Metro Atlanta* (Feb. 12, 2020), https://appinfoinc.com/applied-information-cv2x-testing-in-metro-atlanta/.

[66] *See* GSMA Europe, *C-V2X, the Future of Connected Transport, is Live Today* (Sept. 13, 2019), https://www.gsma.com/gsmaeurope/whats-new/c-v2x-the-future-of-connected-transport-is-live-today ("China is currently at the forefront of the deployment of C-V2X").

[67] *See* Ministry of Industry and Information Technology of the People's Republic of China, MIIT (2018) No. 203 regulation (Nov. 2018). *See also* Lawson, *supra* note 14.

[68] *See, e.g.*, Adam Frost, *Deal signed for huge V2X launch in China*, Traffic Technology Today (Feb. 27, 2019), https://www.traffictechnologytoday.com/news/connected-vehicles-infrastructure/geely-qualcomm-and-gosuncn-to-launch-5g-and-c-v2x-enabled-vehicles.html.

[69] DSRC is sometimes referred to as ETSI IT-G5 in Europe.

[70] A vote at the Council of the European Union on July 2019 resulted in 21 EU member states—including Germany, France, and Italy—out of 28 opposing a proposal that would have effectively designated DSRC as the official ITS standard. *See* Yun Chee, *supra* note 16; Horwitz, *supra* note 16.

III. THE COMMISSION SHOULD IMMEDIATELY PROVIDE RELIEF FOR C-V2X DIRECT IN THE UPPER 20 MHZ

To meet this growing demand and keep pace with other regions of the world, the Commission should immediately provide relief for C-V2X Direct services in the upper 20 MHz (*i.e.*, the 5.905-5.925 GHz sub-band) of the 5.9 GHz band. Moreover, the Commission should do this while resolving the broader questions about the remainder of the band. This can be accomplished by either expeditiously adopting rules for C-V2X Direct in the upper 20 MHz or granting 5GAA's waiver request now.[71] Both of these options for relief align with the *NPRM*'s proposal, are supported by key constituencies, and will advance key national priorities. Both actions also are consistent with decades of Commission precedent.

More than one year ago, 5GAA petitioned the Commission for waiver of the current rules to allow for C-V2X Direct deployment in the upper 20 MHz of the 5.9 GHz band.[72] As 5GAA explained, a waiver of the rules is the most expedient way to realize the benefits of C-V2X Direct services.[73] In response to the request, a broad and diverse set of commenters voiced interest in C-V2X Direct,[74] and more notably, nearly every automobile manufacturer on record

[71] 5GAA Waiver Request (seeking a waiver of the rules to allow for C-V2X deployment in the upper 20 MHz, *i.e.*, the 5.905-5.925 GHz band, of the 5.9 GHz band,).

[72] *Id.*

[73] *Id.*

[74] *See, e.g.*, Comments of the Maryland Department of Transportation Comments, GN Docket No. 18-357, at 2 (filed Jan. 18, 2019) (noting that a "future including both DSRC and C-V2X would provide the most opportunities for safety benefits to be realized"); Comments of the Association of Global Automakers, Inc., GN Docket No. 18-357, at 3 (filed Feb. 7, 2019) (noting that both DSRC and C-V2X "may be leveraged to support an expanded auto safety application ecosystem"); Comments of the Institute of Transportation Engineers, GN Docket No. 18-357, at 2 (filed Jan. 18, 2019) (submitted as name of filer Jeffrey Lindley) (noting that "C-V2X technology will very likely have a promising future").

urged the Commission to enable this technology.[75] The Commission acknowledges the benefits of C-V2X Direct here. The *NPRM* proposes to permit C-V2X Direct in the very same frequencies at issue in the waiver request,[76] and multiple members of the Commission have extolled the potential benefits of C-V2X Direct services.[77]

In the time since 5GAA filed its request, the urgency for a waiver has increased. Ford repeatedly has stressed the importance of near-term relief in order to meet its 2022 deployment goal.[78] And while other automakers continue to pursue C-V2X Direct, the current regulations are a barrier to the execution of any deployment plans under contemplation. An immediate rule change or waiver grant would help to resolve these issues, permitting near term deployment,

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[75] *See* BMW Comments at 1; Daimler Comments at 1; Comments of Ford Motor Company, GN Docket No. 18-357, at 1 (filed Jan. 28, 2019) (submitted as name of filer Nick Baracos); Comments of General Motors Company, GN Docket No. 18-357, at 1-2 (filed Jan. 18, 2019); Jaguar Comments at 1.

[76] *NPRM* ¶ 24.

[77] *See e.g.*, FCC News Release *supra* note 8 ("Cellular Vehicle to Everything, or C-V2X, is a new and promising technology that is gaining momentum in the automotive industry as it enables communications between cars, infrastructure, cyclists, pedestrians, and road workers. ... The FCC recognizes the promise of C-V2X, having voted unanimously in December on a proposal to designate 20 megahertz for its deployment in the 5.9 GHz band. If this proposal is adopted, it would be a significant step forward for automotive safety...."); Michael O'Rielly, Commissioner, FCC, Remarks on Partnering with Communities Today to Build Smart Cities of Tomorrow, at 3 (Oct. 30, 2018), https://docs.fcc.gov/public/attachments/DOC-354844A1.pdf ("The current focus on cellular vehicle to everything technology, or C-V2X, seems to be a game-changer as it leverages existing LTE networks."); *Use of the 5.850-5.925 GHz Band*, Notice of Proposed Rulemaking, 34 FCC Rcd 12603, 12661 (2019) (Statement of Commissioner Geoffrey Starks) ("C-V2X did not exist only a few years ago, and today we are proposing to dedicate up to 30 megahertz for its use. I am pleased that, rather than continuing to be wed to a technology that appears to be stuck in neutral, this agency is showing it can shift into the fast lane of innovation.").

[78] *See*, *e.g.*, Letter from John F. Kwant, Global Director, Government Relations, Mobility and Advanced Technologies, Ford Motor Company, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-357, at 1-2 (filed Aug. 23, 2019) ("Ford also reiterated its commitment to deploy C-V2X in all of its new vehicle models beginning in 2022, but explained its need for a grant of 5GAA's waiver in the very near term to meet this commitment.").

greater confidence for investment, and ultimately an accelerated path to the network effects the Commission hopes to achieve for ITS. [79]

Near term relief will also help America maintain global competitiveness in connected vehicle technologies. As other regions throughout the world open the road for C-V2X Direct, near term relief will ensure America is not isolated in this critical new market. The Commission—and the Administration—have placed a high priority on preserving U.S. leadership in emerging technologies such as 5G and automated vehicles.[80] That leadership requires permitting C-V2X Direct expeditiously.

While a rule change clearly is consistent with FCC practice, so too is a waiver grant.[81] For example, the Commission has employed such waivers to permit the use of

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[79] *See NPRM* ¶ 24 (stating that the Commission that "[a]mong other things, [the Commission] believe[s] that [C-V2X] should achieve network effects necessary to maximize transportation and vehicular safety-related benefits").

[80] *See, e.g.*, FCC, The FCC's 5G FAST Plan, https://www.fcc.gov/5G (last visited Mar. 9, 2020) ("Under Chairman Pai, the FCC is pursuing a comprehensive strategy to Facilitate America's Superiority in 5G Technology (the 5G FAST Plan)."); National Science and Technology Council and the United States Department of Transportation, *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, at 1 (Jan. 2020), https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf ("The United States Government is committed to fostering surface transportation innovations to ensure the United States leads the world in automated vehicle (AV) technology development and integration while prioritizing safety, security, and privacy and safeguarding the freedoms enjoyed by Americans. The U.S. Government recognizes the value of industry leadership in the research, development, and integration of AV innovations.").

[81] *See, e.g.*, *Amendment of Part 90 of the Commission's Rules to Permit Terrestrial Trunked Radio (TETRA) Technology et al.*, Notice of Proposed Rule Making and Order, 26 FCC Rcd 6503, 6510 ¶ 21 (2011) ("*TETRA Waiver Order*") (granting a waiver of the Commission's private land mobile radio service rules to permit the use—during the pendency of a rulemaking—of a technology that is "an affordable, technologically advanced alternative to currently available equipment"); *Amendment of Part 15 of the Commission's Rules To Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz et al.*, Notice of Proposed Rule Making and Order, 25 FCC Rcd 601, 610 ¶ 25 (2010) (granting a waiver of the Commission's rules for unlicensed devices to allow the operation of tank level probing radars during the pendency of a rulemaking); *Garmin International, Inc., Request for Waiver of*

"an affordable, technologically advanced alternative to currently available equipment,"[82] and to accelerate the availability of a technology that "did not exist at the time the Commission last substantially revised" its rules for a particular radio service.[83] Similar facts are present here. Thus, the Commission can provide relief to operate C-V2X Direct in the upper 20 MHz of the 5.9 GHz band while it resolves the broader questions about the remainder of the band—including whether to permit unlicensed operations in the lower 45 MHz portion of the band.

In contrast, the potential hazards of a potentially long and arduous rulemaking process here are well-understood by the Commission. Just recently, the Commission observed:

> The legal and administrative requirements for conducting rulemaking proceedings can often result in those proceedings extending over long periods of time, and they also are subject to judicial review. Often, competitors petition to deny or oppose the introduction of new technologies or services that may have a negative economic effect on their own service but would otherwise provide significant public interest benefits if the Commission moved quickly to allow the new technologies or services to be offered. … [D]elays can deny the public the benefits of and opportunities

Sections 95.29(f)(1), 95.119(a)(1), 95.181(a), 95.183(a)(4), and 95.631(a) and (f) of the Commission's Rules to Authorize Manufacture, Sale, and Use of GPS Transmission Enhanced GMRS Units, Order, 25 FCC Rcd 14614, 14618 ¶ 9 (WTB 2010) ("*Garmin GMRS Waiver Order*") (granting a waiver of the Commission's General Mobile Radio Service rules—during the pendency of a rulemaking—for the use of a technology that did not exist at the time the Commission last substantially revised its rules at issue); *Request for Waiver to Allow Aeronautical Utility Mobile Stations to Use 1090 MHz for Runway Vehicle Identification and Collision Avoidance*, Order, 25 FCC Rcd 1407 (WTB MD 2010) (granting a waiver of the Commission's aviation services rules to permit—during the pendency of a related rulemaking—operations of vehicle "squitters" used for airport runway collision avoidance); *Administration of the North American Numbering Plan*, Order, 20 FCC Rcd 2957, 2959 ¶ 4 (2005) (waiver of the Commission's numbering rules to enable petitioner—during the pendency of a rulemaking—"to deploy innovative new [Internet Protocol] services and encourage the rapid deployment of new technologies and advanced services that benefit American consumers.").

[82] *TETRA Waiver Order*, 26 FCC Rcd at 6510 ¶ 21.

[83] *Garmin GMRS Waiver Order*, 25 FCC Rcd at 14618 ¶ 9.

> provided by new technological choices and new services, and inventors and entrepreneurs are often left in limbo with little progress to show for their creative efforts.[84]

While the Commission and 5GAA are no doubt committed to an expedited rulemaking on rules for the entirety of the band, the march of global competition necessitates immediate action permitting C-V2X Direct in the upper 20 MHz of the 5.9 GHz band.

IV. THE COMMISSION SHOULD ALLOCATE AT LEAST AN ADDITIONAL 10 MHZ FOR C-V2X DIRECT AND ADOPT MORE PERMISSIVE SERVICE RULES FOR THIS TECHNOLOGY

In light of C-V2X Direct's numerous advantages, the Commission should allocate at least an additional 10 MHz in the 5.895-5.905 GHz to this technology. Doing so will enable C-V2X Direct's continued, but limited, evolution, and will support more robust operations by allowing for improved performance via more flexible regulations.

Allocating this additional 10 MHz of spectrum for C-V2X Direct will advance the public interest regardless of how the Commission proceeds in the lower portion of the band. If, as recommended in Section V herein, the Commission correctly decides to allocate at least 40 MHz for advanced C-V2X Direct,[85] this 10 MHz can help comprise the additional bandwidth necessary to enable 5G-based advanced C-V2X Direct services. For example, these frequencies could help comprise a 40 MHz channel (in the 5.865-5.905 GHz sub-band) or even a 55 MHz channel (in the 5.850-5.905 GHz sub-band) for advanced C-V2X Direct services.[86]

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[84] *Encouraging the Provision of New Technologies and Services to the Public*, Notice of Proposed Rulemaking, 33 FCC Rcd 2512, 2514 ¶ 7 (2018).

[85] *See infra* Section V (discussing the benefits of advanced C-V2X Direct services in the lower portion of the 5.9 GHz band).

[86] As noted in previous filings, providing a 55 MHz channel for advanced C-V2X Direct services will further enhance the capabilities of this technology. *See* Letter from Sean T. Conway, Counsel for the 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, GN Docket

Alternatively, if the Commission reallocates the lower 45 MHz for unlicensed use, this 10 MHz can be combined with the upper 20 MHz already proposed for C-V2X Direct to support some limited evolution of the technology until additional spectrum assets are allocated for advanced C-V2X Direct.[87]

Allocating this 10 MHz for C-V2X Direct will also support more robust C-V2X Direct safety services. The modest C-V2X Direct power and Out-Of-Band Emissions ("OOBE") limits proposed in 5GAA's 2018 waiver request were developed to protect adjacent channel DSRC operations, but now that the Commission is phasing out DSRC, those power and OOBE limits should be revised to provide increased flexibility for C-V2X Direct operations. The Commission should thus adopt maximum EIRP levels of 33 dBm for both C-V2X road side units and on-board units,[88] as well as more relaxed OOBE levels.[89] This additional allocation in combination with more permissive rules will thus facilitate both C-V2X's evolution and more robust safety services for travelers.[90]

No. 18-357, at n.43 (filed Apr. 3, 2019) (encouraging the Commission to adopt a 55 MHz channel for advanced C-V2X Direct services in the event the market abandons DSRC).

[87] *See infra* Section VI (discussing the need to identify mid-band spectrum elsewhere for 5G-based advanced C-V2X if the Commission reallocates the bottom 45 MHz of the 5.9 GHz band for unlicensed use).

[88] *See* Appendix A (proposed 47 C.F.R. §§ 90.377, 95.3167). The proposed EIRP levels of 33 dBm are mirrored after the Commission's current rules for the 5.9 GHz band. *See*, *e.g.*, 47. C.F.R. § 90.377 (establishing maximum EIRP levels of 33 dBm for certain channels). 5GAA member companies and various standards groups are actively studying the appropriate measurement techniques and signal levels. 5GAA plans to update the Commission in the near future on the outcome of these efforts.

[89] *See id.* (proposed 47 C.F.R. §§ 90.381 and 95.3179). These revisions are needed given that DSRC operations are being phased out and there is no need for C-V2X to be unnecessarily restricted by the outdated DSRC rules.

[90] To the extent the Commission allocates the lower portion of the 5.9 GHz band for C-V2X, the Commission should base its final rules on these power and emissions limits.

V. THE PROPOSAL FOR THE BOTTOM PORTION OF THE BAND IS SHORT-SIGHTED AND FAILS TO FUTURE-PROOF AMERICA'S SPECTRUM REGULATIONS TO ENABLE ADVANCED C-V2X DIRECT SERVICES THAT SUPPORT SAFE AUTOMATED DRIVING

While the Commission was right to identify C-V2X Direct as the most capable ITS technology, the proposal to allocate only 20 MHz comes up short. In the dawn of the 5G revolution, C-V2X Direct is evolving to deliver more advanced safety benefits, but additional bandwidth is required. To realize the full potential of C-V2X, the Commission must allocate—in addition to the 20 MHz it already is proposing—at least another 40 MHz for advanced C-V2X Direct services.

Allocating at least an additional 40 MHz—if not more—for 5G-based advanced C-V2X Direct services offers numerous advantages over the *NPRM*'s proposal to reallocate the bottom of the band. It accommodates emerging 5G-based advanced C-V2X Direct applications detailed herein and ensures that America has sufficient bandwidth to maintain global competitiveness. Moreover, thanks to recent and ongoing Commission efforts to make other, much larger spectrum allocations available for Wi-Fi and other unlicensed uses, maintaining the 5.9 GHz band for transportation safety—in this case C-V2X Direct—will not compromise unlicensed innovation.

A. Advanced C-V2X Direct Applications Require Access to at Least Another 40 MHz of Spectrum

C-V2X Direct is evolving to meet the more demanding safety requirements required to support safe automated driving. As automated driving technology evolves, vehicles will need to better understand and interact with the road environment. 5G-based advanced C-V2X Direct services can facilitate this understanding and interaction. With extreme throughput, low latency, and enhanced reliability, advanced C-V2X Direct services will allow vehicles to share increasingly detailed, real-time data with other vehicles, pedestrians, and road infrastructure.

The first evolution of advanced C-V2X Direct is around the corner. As discussed above, 3GPP will soon complete work on 5G New Radio (NR) C-V2X features in 3GPP Release 16, the first 5G version of C-V2X, and additional 5G NR C-V2X features will be in 3GPP Release 17.[91] To meet the more demanding safety requirements for automated driving applications, this technology will require access to large, dedicated bandwidth to support burst transmissions of large quantities of data and persistent exchange of information between vehicles. As will be further explained in a forthcoming 5GAA technical report on the spectrum needs for advanced C-V2X Direct services, a minimum of 40 MHz of dedicated, mid-band spectrum is required for the use cases envisioned for this technology.[92]

While advanced applications will evolve as the technology changes, four categories of safety applications are worth describing in more detail: (1) intent and trajectory sharing, (2) extended sensor sharing, (3) pedestrian and vulnerable road user protections, and (4) high-definition mapping.

Trajectory and intent sharing. Advanced C-V2X Direct will enable vehicles to share trajectory and intent information to better coordinate movements. Specifically, advanced C-V2X Direct services will allow a vehicle to share trajectory data obtained from local sensors and information about its future intent (*i.e.*, lane changes, etc.) with other vehicles and road infrastructure. This information can be used by automated driving applications to better coordinate movements, enhancing safety and traffic efficiency.[93]

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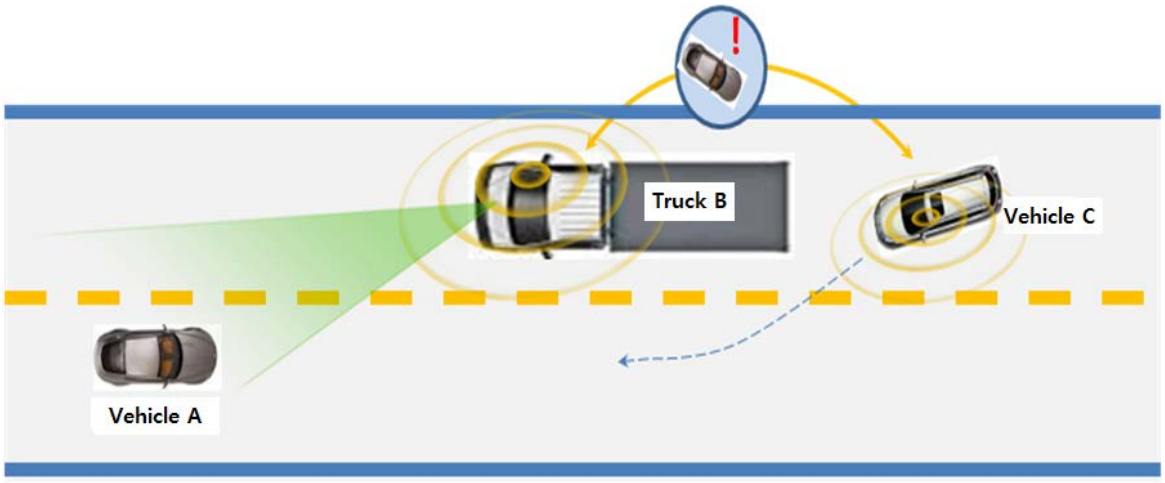
[91] *See* 3GPP Features and Study Items, *supra* note 20 (identifying a study on 5G NR Vehicle-to-Everything as part of the feature and study item list for Release 16).

[92] 5GAA will file this report in this docket in the coming weeks, as soon as it is finalized.

[93] *See* Qualcomm, *5G NR Based C-V2X*, at 28 (2018), https://www.qualcomm.com/media/-documents/files/5g-nr-based-c-v2x-presentation.pdf (illustrating the benefits of intention/trajectory sharing in intersection and lane change scenarios).

Extended sensor sharing. Advanced C-V2X Direct will support extended sensor sharing applications that expand a vehicle's view of the surrounding road. Relying on the technology's higher throughput and lower latency, 5G-based advanced C-V2X Direct will enable the real-time exchange of raw or processed data gathered through local sensors or live video data between vehicles and road infrastructure. While there are a variety of scenarios in which extended sensor applications will improve safety (*e.g.*, intersections, highway on-ramps, certain environmental conditions), one scenario is highway passing scenarios on the type of two lane roads often found in rural areas. The following figure from a recent 3GPP Release 16 study item[94] illustrates a highway passing scenario in which a lead truck (Truck B) shares sensor data with a trailing vehicle (Vehicle C) to warn of an oncoming vehicle (Vehicle A) traveling in the opposite direction in the adjacent lane.



Protecting Pedestrians, Bicyclists, and Road Workers. To accelerate the benefits of C-V2X Direct to pedestrians, bicyclists, road workers and other vulnerable road users, the

[94] 3GPP, Specification TR 22.886 V16.2.0 (Dec. 21, 2018), https://portal.3gpp.org/-desktopmodules/-Specifications/SpecificationDetails.aspx?specificationId=3108.

cellular industry is optimizing the technology for battery-powered devices such as smartphones. This work is already occurring as part of 3GPP Release 17.[95] The integration of these features into various consumer devices can help to address the previously referenced rising pedestrian and bicyclists fatality rates.

HD Mapping. Many advanced automated driving technologies rely on HD mapping to assess the road landscape.[96] Advanced C-V2X Direct services will allow vehicles to share their processed and unprocessed video data with nearby road infrastructure. In turn, road infrastructure will use edge computing to process incoming videos into an updated HD map of the road and share this map with nearby automated vehicles.[97] C-V2X-enabled HD mapping applications will be particularly critical for unlocking the power of automated driving on roads in which there is no 5G network service.

B. Failure to Allocate Additional Mid-Band Spectrum for Advanced C-V2X Direct Will Reduce the Safety of Automated Driving—Especially in Rural America

The *NPRM* questions whether 40 MHz of the 5.9 GHz band is necessary for 5G-based advanced C-V2X services.[98] Specifically, it asserts that the Commission is already on the path to making "5G spectrum" available in other mid-bands, and thus allocating a larger spectrum

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[95] *See* Casaccia, *supra* note 42 ("C-V2X communication involves more than just traditional vehicles like cars and trucks, but also other road users such as pedestrians, bicyclists, and micro-mobility vehicles. To extend the same C-V2X paradigm to those users, sidelink needs to be supported by new device types such as smartphones. To better support sidelink in battery-powered devices, Rel-17 will work on sidelink power and spectral efficiency optimizations.").

[96] *See* Christopher Mims, *The Key to Autonomous Driving? An Impossibly Perfect Map*, Wall St. J. (Oct. 11, 2018), https://www.wsj.com/articles/the-key-to-autonomous-driving-an-impossibly-perfect-map-1539259260.

[97] 3GPP Specification TR 22.886, *supra* note 94 (discussing HD mapping applications supported by C-V2X features in the upcoming 3GPP Release 16 5G standard).

[98] *NPRM* ¶ 30.

designation in the 5.9 GHz band for advanced 5G-based C-V2X Direct services appears to be unnecessary.[99] In effect, the *NPRM* is conflating commercial spectrum used for *5G network services* with the type of dedicated spectrum required for 5G-based advanced C-V2X Direct, and is suggesting that the existence of the former obviates the need for the latter. Spectrum allocated for 5G network services is used in very different ways than spectrum for advanced C-V2X Direct. Mid-band spectrum dedicated for high-capacity, ultra-low latency, highly-reliable, safety critical direct V2V, V2I, and V2P communications is required for 5G-based advanced C-V2X Direct services. This is especially so in rural areas of our country, where the timing of widescale 5G network deployment remains uncertain.

To be clear, commercial networks already provide numerous transportation safety services and will continue to do so moving forward. The continuing rollout of 5G commercial networks will enable new advanced C-V2X applications that rely on V2N communications. Indeed, C-V2X's ability to leverage commercial network infrastructure is a key benefit of this technology.[100]

However, the critical safety functions of certain advanced C-V2X applications and the location-dependent nature of information communicated necessitates dedicated mid-band spectrum for direct V2V, V2I, and V2P communications. 5G-based advanced C-V2X applications require high bandwidth to support burst transmissions of large quantities of data,

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[99] *Id.*

[100] *See, e.g.*, 5G Automotive Association, *C-ITS Vehicle to Infrastructure Services: how C-V2X technology completely changes the cost equation for road operators* (White Paper Jan. 22, 2019), https://5gaa.org/wp-content/uploads/2019/01/5GAA-BMAC-White-Paper_final2.pdf.

ultra-low latency, and high message reliability, among other needs.[101] The range and diversity of these advanced applications necessitates both network and direct communications.

More importantly, limiting advanced C-V2X applications to only those areas with certain 5G network coverage is likely to delay the benefits of safe automated driving in rural America. While the wireless industry continues to invest aggressively in 5G networks, the timing of 5G deployment in rural geographic areas remains uncertain. Chairman Pai implicitly recognized this uncertain timeline with his recent proposal for a 5G Fund, whose aim is to support 5G network deployments in rural America.[102] Moreover, rural Americans potentially stand to benefit most from the improved safety services supported by advanced C-V2X Direct communications. According to statistics from the Department of Transportation, highway fatality rates on a per capita basis remain dramatically higher in rural areas.[103] Advanced C-V2X Direct could address this, but only if the Commission allocates sufficient spectrum for these services.

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[101] *See* 5G Americas Whitepaper at 24-27.

[102] *See, e.g.*, News Release, FCC, *Chairman Pai Announces Plan to Launch $9 Billion 5G Fund for Rural America* (Dec. 4, 2020), https://docs.fcc.gov/public/attachments/DOC-361168A1.pdf. *See also* Forrester Research, *The realities of rural 5G deployment in the US*, ZDNet (June 7, 2019), https://www.zdnet.com-/article/the-realities-of-rural-5g-deployment-in-the-us/ ("Connecting far-flung locations will require additional investment in fiber and microwave links that will balloon the total costs to well over $200 billion. The FCC's goal is to cover 90% of the population within five years. As a function of density, that 90% only covers 36% of the real estate in the US. Extending infrastructure to [rural areas] is extremely difficult, time-consuming, and expensive. Reaching the remaining 64% of the real estate with 5G will take well over a decade – if it happens at all.").

[103] U.S. Department of Transportation, *Rural Opportunities to Use Transportation for Economic Success (ROUTES)*, https://www.transportation.gov/rural (last updated Feb. 28, 2020) ("A disproportionate number of roadway fatalities occur in rural areas. While only one-fifth of the nation's population lives in rural areas, 46% of the nation's highway fatalities occur on rural roads, 39% of all highway-rail crossing fatalities occur in rural areas, and the highway fatality rate is more than twice that in urban areas.").

C. Failure to Allocate an Additional 40 MHz of Spectrum for Advanced C-V2X Direct Will Harm America's Global Competitiveness in Connected Vehicle Technologies

In discussing its proposal to reduce the size of the ITS spectrum block, the *NPRM* notes that Japan and Europe are using less than 75 MHz for transportation safety services.[104] However, the *NPRM* tells only part of the story. It overlooks larger ITS allocations in other regions and ignores the global momentum for increasing bandwidth for transportation applications. More importantly, the *NPRM* does not ask a question of critical national import: what are the spectral requirements to ensure America's global competitiveness in connected vehicle technologies?

Many regions of the world have ITS spectrum blocks of similar size to the current U.S. 75 MHz allocation. For example, Europe, Australia, and South Korea have allocated 70 MHz of bandwidth for ITS.[105] And while Japan has only allocated 10 MHz for DSRC, it has allocated a second 80 MHz band for certain V2I services.[106] Moreover, as the global automotive industry begins to leverage modern advancements in wireless technologies, many regions of the world are

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[104] *NPRM* ¶ 21 (noting that Japan has dedicated a single 10-megahertz channel for DSRC and that Europe provides a 30-megahertz channel for ITS-based applications).

[105] *See* European Conference of Postal and Telecommunications Administrations, Electronic Communications Committee, ECC Decision (08)01, at 5-6 (approved Mar. 14, 2008, amended July 3, 2015) ("ECC Decision"); 5G Automotive Association, *White Paper on ITS spectrum utilization in the Asia Pacific Region*, at 18 (White Paper July 2018) ("5GAA July 2018 White Paper"), https://5gaa.org/wp-content/uploads/2018/07/5GAA_-WhitePaper_ITS-spectrum-utilization-in-the-Asia-Pacific-Region_FINAL_160718docx.pdf. The *NPRM* states that Europe has "provided" a 30 MHz channel for ITS applications. *NPRM* ¶21. While technically true that a 30 MHz channel is available today for road safety ITS applications, Europe's total 5.9 GHz ITS allocation is 70 MHz, part of which is reserved for future advancements in road safety ITS applications. *See* ECC Decision at 5. Moreover, as discussed *infra*, European regulators are in the process of expanding this allocation.

[106] 5GAA July 2018 White Paper at 18.

considering expanding—not shrinking—their ITS spectrum allocations. European regulators are in the process of increasing the continent's ITS allocation by 10 MHz, thereby bringing its bandwidth beyond America's current position.[107] And following its initial allocation for C-V2X Direct, Chinese stakeholders are studying the additional bandwidth necessary for advanced C-V2X Direct applications.[108]

Indeed, if these other regions act on these proposals and the Commission adopts the reallocation proposal in the *NPRM*, America may soon have one of the world's smallest ITS allocations. Such a result would have a devastating effect on U.S. global competitiveness in connected and automated vehicle technology, especially coming on the eve of the initial standards for 5G-based C-V2X. As noted *supra*, the Commission—and this Administration—place a high priority on preserving leadership in emerging technologies. Retreating on ITS will deeply undermine this goal.

[107] European Conference of Postal and Telecommunications Administrations, Electronic Communications Committee, Agenda for 52nd ECC Meeting in March 2020 (issued Jan. 24, 2020).

[108] In China, the FuTURE & Telematics Industry Application Alliance IoV Working Group recently published a whitepaper on 5G NR-V2X sidelink spectrum needs that recommended reserving at least an additional 40 MHz for 5G NR-V2X.

D. The Commission Can Promote Advanced Automotive Safety Technology and Unlicensed Opportunities by Allocating the Bottom Portion of the 5.9 GHz Band for Advanced C-V2X Direct and Focusing on Unlicensed Opportunities in Other Bands

While 5GAA generally has no issue with the Commission's efforts to make more unlicensed spectrum available for Wi-Fi and other services, the question here is whether the public interest is best served by making the lower 45 MHz of the 5.9 GHz band available for unlicensed services notwithstanding the benefits of dedicating that spectrum for advanced C-V2X Direct. The recent history of the Commission's unlicensed efforts suggests that the answer is "no."

Indeed, since the Commission initially proposed unlicensed sharing in 2013, the Commission has made or proposed to make a substantial amount of non-5.9 GHz spectrum available for unlicensed use.[109] For example, in 2014 the Commission removed the indoor-only restriction on and increased the permitted power of U-NII devices in the 5.15-5.25 GHz band (increasing the utility of the spectrum and accommodating the next generation of Wi-Fi technology), and extended the upper edge of the 5.725-5.825 GHz band to 5.85 GHz, bringing the total amount of unlicensed spectrum in the 5 GHz band to 580 MHz.[110] Shortly thereafter, in its 2014 *Incentive Auction R&O*, the Commission permitted unlicensed devices to operate, *inter alia*, on vacant television channels, in the 600 MHz guard bands and on Channel 37.[111] In 2015,

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[109] *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769 (2013).

[110] *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127 (2014).

[111] *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37 et al.*, Report and Order, 30 FCC Rcd 9551, 9559 ¶ 17 (2015) (citing *Expanding the Economic and*

the Commission made a minimum of 80 MHz of spectrum in the 3550-3700 MHz ("3.5 GHz") band available for General Authorized Access, which is comparable to unlicensed access.[112] Thereafter, the Commission shifted its focus to high-band spectrum and allocated 7 GHz of additional unlicensed spectrum in the 60 GHz band and multiple bands above 95 GHz for unlicensed uses.[113] More recently, the Commission proposed rule changes to allow unlicensed white space devices more permissive use of the TV bands (channels 2-35) to provide improved broadband coverage for the benefit of consumers in rural and underserved areas.[114]

On top of all this, and perhaps most relevant here, the Commission recently proposed to make *1200 MHz* of unlicensed mid-band spectrum available in the 6 GHz band, directly above the 5.9 GHz spectrum allocated for ITS.[115] The 1200 MHz of unlicensed 6 GHz spectrum under consideration represents more than 25 times the amount of unlicensed spectrum the Commission is proposing for the 5.9 GHz band in this proceeding. Among other things, the 6 GHz band offers multiple wide, contiguous channels that can accommodate the new Wi-Fi 6E standard.[116]

Innovation Opportunities of Spectrum Through Incentive Auctions, Report and Order, 29 FCC Rcd 6567, 6576-77 ¶ 22 (2014).

[112] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 3962 ¶ 4 (2015); *id*. at 3981 ¶ 64.

[113] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8062-66 ¶¶ 125-131 (2016); *Spectrum Horizons*, First Report and Order, 34 FCC Rcd 1605, 1605-06 ¶ 1 (2019) ("*Spectrum Horizons R&O*").

[114] *See Unlicensed White Space Device Operations in the Television Bands*, Notice of Proposed Rulemaking, FCC 20-17 (rel. Mar. 2, 2020).

[115] *Unlicensed Use of the 6 GHz Band et al.*, Notice of Proposed Rulemaking, 33 FCC Rcd 10496 (2018) ("*6 GHz NPRM*").

[116] *See, e.g.*, Monica Alleven, *Wi-Fi Alliance gears up for 6 GHz opportunity with introduction of Wi-Fi 6E*, FierceWireless (Jan. 3, 2020), https://www.fiercewireless.com/wireless/wi-fi-alliance-gears-up-for-6-ghz-introduction-wi-fi-6e.

The 6 GHz band thus by itself may meet—and even surpass—the demand for new mid-band unlicensed spectrum.

Chairman Pai has praised the potential significance of the 6 GHz band to unlicensed services, especially Wi-Fi:

> As excited as I am about what we're doing with the 5.9 GHz band, the Commission's work on the 6 GHz band could be even bigger. … Now, having grown up in America's heartland, I was raised to value modesty and humility. That's why I would like to use the words of our wise mutual friend Claus Hetting to describe the FCC's 6 GHz proceeding. Quote: "[The 6 GHz band] is without a doubt the single biggest opportunity in Wi-Fi—and probably in wireless—in a generation."[117]

Entities from private industry and public interest groups have been equally effusive in their support of the Commission's 6 GHz proposal. Charter Communications, for instance, has stated that "[t]he 6 GHz band holds great potential for the next generation of WiFi and unlicensed innovation," and that "[o]pening the entire 6 GHz spectrum band for unlicensed use would remove the existing congestion barrier and open up the much needed wide-bandwidth channels essential for the super-fast speeds of next-generation multi-Gigabit WiFi…."[118] NCTA likewise has asserted that "6 GHz is really the future growth home for Wi-Fi and unlicensed innovation. While 5.9 GHz would give us one 160 MHz channel, 6 GHz would enable seven

[117] Ajit Pai, Chairman, FCC, Remarks at the Wi-Fi World Congress 2019, Tysons Corner, VA, at 3 (May 14, 2019), https://docs.fcc.gov/public/attachments/DOC-357456A1.pdf. Commissioner O'Rielly expressed a similar view in his separate statement on the *6 GHz NPRM*: "[The 6 GHz band] is a prime location for unlicensed services for multiple reasons … today's Notice takes a giant step to open a large swath of spectrum needed for increased capacity, higher speeds, and lower latency for unlicensed 5G or technologies not yet envisioned." *6 GHz NPRM*, 33 FCC Rcd at 10545 (Statement of Commissioner Michael O'Rielly).

[118] Charter Communications Blog, *How WiFi in 6 GHz Can Enable the Next Wave of Digital Innovation* (Nov. 19, 2019), https://policy.charter.com/blog/wifi-6ghz-can-enable-next-wave-digital-innovation/.

new 160 MHz channels."[119] And an industry coalition that includes Google has told the FCC that "moving forward and opening up the 6 GHz band is critical."[120]

In sum, whether considered on its own or in tandem with the other unlicensed spectrum discussed above, there very well may be more than sufficient spectrum available for new Wi-Fi and unlicensed uses without infringing upon the 5.9 GHz band. There is simply no basis for sacrificing the benefits of advanced C-V2X Direct services solely to make a relatively miniature amount of additional unlicensed spectrum available at 5.9 GHz. The Commission therefore should continue its efforts to explore unlicensed opportunities in other bands—particularly the 6 GHz band—while moving forward with advanced C-V2X Direct in the lower portion of the 5.9 GHz band. Taking this path will achieve an optimal result—enabling both next-generation Wi-Fi services *and* new 5G-enabled applications that enhance auto safety and facilitate safe automated driving.

E. Allocating the Bottom 45 MHz of the 5.9 GHz Band for Unlicensed Operations Presents a Serious Interference Risk to C-V2X Direct Operations

Finally, the *NPRM's* proposal to reallocate the bottom of the 5.9 GHz band for unlicensed use presents a serious threat of harmful interference to C-V2X Direct operations in the upper 30 MHz (*i.e.*, the 5.895-5.925 GHz sub-band). 5GAA has documented on numerous occasions the critical importance of protecting C-V2X Direct communications from harmful interference

[119] NCTA, *3Q: How More Unlicensed Spectrum Could Impact America* (Jan. 24, 2020), https://www.ncta.com/whats-new/3q-how-more-unlicensed-spectrum-could-impact-america.

[120] Kelly Hill, *Tech, Wi-Fi companies back broader unlicensed use at 6 GHz; public safety and utilities balk*, RCR Wireless News (Nov. 13, 2019), https://www.rcrwireless.com/20191113/-spectrum/the-battle-for-6-ghz-tech-companies-back-broader-unlicensed-use-public-safety-and-utilities-balk.

caused by unlicensed operations in adjacent bands.[121] Unlicensed operations in the proposed U-NII-4 band present an even more serious risk to C-V2X Direct operations. This is because wideband operations enabled by combining the 5.725-5.850 GHz ("U-NII-3") band and the new U-NII-4 band will have a much longer signal rolloff into adjacent bands than currently is the case from operations in the narrower U-NII-3 band. Unfortunately, the *NPRM's* proposed rules for unlicensed operations in the U-NII-4 band do not take this risk of increased interference into account. If adopted as proposed, these rules would jeopardize the integrity of critical C-V2X Direct safety applications, and likely would render the upper 30 MHz of 5.9 GHz band useless for C-V2X Direct safety communications. While 5GAA is exploring potential options for protecting C-V2X Direct from such interference, maintaining the lower 45 MHz for transportation services—in this case C-V2X Direct—is the best course for ensuring robust C-V2X Direct safety services on America's roads.

VI. IF THE COMMISSION NONETHELESS REALLOCATES THE BOTTOM PORTION OF THE BAND FOR UNLICENCED USE DESPITE THE OVERWHELMING CASE FOR ADVANCED C-V2X DIRECT, ADDITIONAL SPECTRUM ASSETS MUST BE IDENTIFIED AND THE PROPOSED UNLICENSED TECHNICAL RULES MUST BE MODIFIED

Designating at least an additional 40 MHz in the 5.9 GHz band for 5G-based advanced C-V2X Direct communications is clearly the best course for promoting the public interest. As previously demonstrated, such action will accommodate emerging advanced C-V2X Direct applications, thereby improving the safety of automated driving (most notably in rural areas) and ensuring America has sufficient bandwidth to maintain global competitiveness. And thanks to recent and ongoing Commission efforts to make other spectrum available for Wi-Fi and other

[121] *See infra* Section VI (summarizing 5GAA's filings in the *6 GHz proceeding* explaining the importance of protecting C-V2X Direct operations from adjacent band interference).

unlicensed uses, maintaining the 5.9 GHz band for transportation safety—in this case C-V2X Direct—will not compromise unlicensed innovation.

Should, however, the Commission nonetheless reallocate the bottom 45 MHz of the band for unlicensed use, it must take two actions to accommodate C-V2X Direct. First, the Commission must simultaneously identify additional dedicated, mid-band spectrum elsewhere to accommodate C-V2X Direct's evolution to 5G. As previously addressed, network communications cannot sufficiently accommodate the types of advanced applications enabled by 5G-based C-V2X Direct communications. Identifying at least an additional 40 MHz of dedicated, contiguous mid-band spectrum for 5G-based advanced C-V2X Direct is therefore necessary to ensure the continued development and deployment of this technology.

Second, the Commission must revise its technical rules for unlicensed operations in the U-NII-4 band to sufficiently protect C-V2X Direct operations in the upper 30 MHz portion of the 5.9 GHz band. Indeed, ensuring protection for these operations is consistent with the FCC's assessment that C-V2X Direct is the technology most capable of meeting the Commission's goals for ITS in this band and the agency's commitment to the provision of ITS in the 5.9 GHz band.[122]

To this end, 5GAA is exploring the viability of a number of potential options for protecting C-V2X Direct communications. While 5GAA continues to review the adequacy of all these options, the most promising protection initially appears to be a U-NII-4 OOBE mask that is relaxed from the flat -27 dBm/MHz level the FCC proposed for 6 GHz unlicensed operations within the 5.9 GHz band, so long as the FCC limits all U-NII-4 operations to indoor use. Based

[122] *See NPRM* ¶ 19 ("We continue to recognize the importance of ITS, and are committed to a regime that enables the provision of ITS—including both transportation and vehicular safety-related communications—in the 5.9 GHz band.").

on 5GAA's preliminary assessment of the interference potential, this option appears to protect C-V2X Direct operations in the upper 30 MHz of the 5.9 GHz band while enabling robust wideband unlicensed operations indoors, which is where the overwhelming majority of unlicensed spectrum use occurs today.[123] Indeed, unlicensed stakeholders themselves acknowledge that 99% of small cells and Wi-Fi Access Points ("APs") projected to be installed in 2021 will be indoors.[124]

Restricting U-NII-4 operations to indoor use potentially would allow the FCC to adopt a more relaxed mask for U-NII-4 operations than what is needed outdoors to protect C-V2X Direct because the unlicensed signals will be attenuated by Building Entry Loss ("BEL"). To be clear, this restriction also would necessarily prohibit point-to-point unlicensed operations in the proposed unlicensed band with very high gain antennas (as currently permitted in the U-NII-3 band) because such operations—which often operate with a very high duty cycle—could overwhelm C-V2X Direct transceivers.

5GAA has thoroughly documented the critical importance of protecting C-V2X Direct communications from harmful interference caused by unlicensed operations in adjacent bands. In the *6 GHz proceeding*, 5GAA submitted detailed technical filings explaining the importance of the Commission's proposed -27 dBm/MHz OOBE level on unlicensed emissions from the

[123] The *NPRM* seeks comment on defining the U-NII-4 OOBE mask by extending the current U-NII-3 OOBE mask (*NPRM* ¶ 54), which provides for a level of -5 dBm/MHz at 5895 MHz and -27 dBm/MHz at 5925 MHz. The 5GAA proposal relaxes the OOBE levels at the edges of the 30 MHz C-V2X band to 0 dBm/MHz at 5895 MHz and -17 dBm/MHz at 5925 MHz for indoor unlicensed U-NII-4 operations. *See* Appendix A, proposed 47 C.F.R. §15.407(b)(5)(i).

[124] The RKF Engineering study, submitted by a group of unlicensed companies advocating for unlicensed use of the 6 GHz band, noted that the 2021 combined forecast of Wi-Fi and small cell outdoor shipments is approximately 1% of total units. *See* RKF Engineering Solutions, LLC, *Frequency Sharing for Radio Local Area Networks in the 6 GHz Band*, at 15 (Jan. 2018).

proposed 5.925-6.425 GHz ("U-NII-5") band into the 5.9 GHz band for protecting C-V2X Direct operations from harmful interference.[125] In those filings, 5GAA also explained the critical importance of prohibiting in-vehicle use or mobile hotspot use of the lowest proposed U-NII-5 channel at the proposed -27 dBm/MHz OOBE level, because such unlicensed operations in close proximity to C-V2X Direct transceivers would cause harmful interference to C-V2X Direct.[126]

Unlicensed operations in the proposed U-NII-4 band present an even more serious risk to C-V2X Direct operations. By opening the lower 45 MHz block of spectrum in the 5.9 GHz band to unlicensed use, the Commission will enable 80 MHz and 160 MHz wide unlicensed channels—when combined with the U-NII-3 band directly below the current 5.9 GHz band—operating directly adjacent to the 30 MHz block of spectrum that will be dedicated for C-V2X operations.[127]

Such wideband operations that combine U-NII-3 and the new U-NII-4 band will be very common and have a much longer signal rolloff, placing significantly more unwanted noise into the C-V2X Direct band than the 20 and 40 MHz wide unlicensed channels supported today by

[125] *See* Letter from John Kwant et al., 5G Automotive Association Task Force Chair, ET Docket No. 18-295 (filed Jan. 24, 2020); Letter from Sean T. Conway, Counsel to the 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 (filed Jan. 9, 2020) ("5GAA 6 GHz January Ex Parte"); Letter from Sean T. Conway, Counsel to the 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 (filed Dec. 9, 2019) ("5GAA 6 GHz December Ex Parte"); Comments of 5G Automotive Association, ET Docket No. 18-295 (filed Feb. 15, 2019).

[126] *See* 5GAA 6 GHz December Ex Parte. Very low power and mobile hotspot operations in the lowermost proposed U-NII-5 channel would need to meet a -60 dBm/MHz OOBE level to adequately protect C-V2X operations in the 5.9 GHz band. *See* 5GAA 6 GHz January Ex Parte.

[127] In the 6 GHz band, unlicensed Wi-Fi and 5G operations will begin 10 or 20 MHz above the 5925 MHz channel edge, at 5935 MHz or 5945 MHz, respectively, thereby providing a protective guard band between unlicensed operations and C-V2X.

the U-NII-3 band.[128] At the same time, such wideband unlicensed operations will be challenged to comply with the -27 dBm/MHz OOBE level that is needed to protect C-V2X operations (e.g., from outdoor fixed access points).[129]

Accordingly, 5GAA is considering the adequacy of revisions included in FCC Rule Section 15.407 in Appendix A to these comments that would relax this OOBE level so long as operations within the 5.850-5.895 GHz U-NII-4 band are "restricted to indoor operations to reduce the potential for harmful interference to adjacent channel C-V2X operations." Specifically, 5GAA is considering the adequacy of a relaxed mask—when compared to extending the current U-NII-3 mask into the proposed U-NII-4 band—that allows 0 dBm/MHz at the 5895 MHz edge and decreases linearly to -17 dBm/MHz at 5905 MHz and does not exceed -17 dBm/MHz above 5905 MHz.[130] The relief afforded at the 5895 MHz edge and within the 30 MHz C-V2X Direct band would allow for higher power wideband unlicensed operations indoors and potentially will sufficiently protect C-V2X Direct operations outdoors. This relaxed mask should allow a 160 MHz unlicensed channel spanning the U-NII-3 and U-NII-4 bands to operate

[128] In contrast to the very relaxed U-NII-3 mask the FCC adopted in part to accommodate Broadcom's old model chips that could not adequately lower their emissions, current Wi-Fi chips have improved performance and can comply with the -27 dBm/MHz level that applies at the U-NII-1 and U-NII-2 band edges.

[129] *See* 5GAA 6 GHz December Ex Parte; 5GAA 6 GHz January Ex Parte. Allowing noise above -27 dBm/MHz into the ITS band from unrestricted unlicensed uses outdoors (e.g., mobile hotspot, in-vehicle use) will cause harmful interference to C-V2X.

5GAA also requests that the FCC consider adopting a Power Spectral Density limit for portable client devices that may be operating temporarily outdoors at the relaxed OOBE limits, but connected to an indoor access point in the U-NII-4 band, in order to protect C-V2X operations.

[130] 5GAA proposes peak and RMS OOBE limits on unlicensed U-NII-4 operations to ensure protection of C-V2X operations from unlicensed services that use modulations other than those commonly used by unlicensed Wi-Fi and 5G services.

with sufficient transmit power to provide viable indoor signal coverage supporting many common unlicensed use cases.

In sum, 5GAA strongly believes the public interest would be best served by designating at least an additional 40 MHz of the 5.9 GHz band for 5G-based advanced C-V2X Direct communications. If the Commission nonetheless reallocates the bottom portion of the band for unlicensed use, the Commission should simultaneously identify additional dedicated, mid-band spectrum for advanced C-V2X Direct and adopt sufficient protections for C-V2X Direct communications in the upper 30 MHz of the 5.9 GHz band. While 5GAA continues to assess the adequacy of a number of options for protecting C-V2X Direct operations in the upper 30 MHz of the 5.9 GHz band, the above-referenced option initially appears to provide the necessary protection to C-V2X Direct operations within 5895-5925 MHz while supporting robust Wi-Fi and 5G unlicensed services indoors—where almost all unlicensed use occurs today.

VII. THE PROPOSAL TO TIE OPERATIONS TO THE 3GPP RELEASE 14 STANDARD WILL DISINCENTIVIZE CONTINUED INNOVATION IN C-V2X

Regardless of how much spectrum the Commission allocates for C-V2X Direct, it should not adopt proposed Sections 90.379(c) and 95.3189(c) in their current form, as both rules tie C-V2X operations to 3GPP Release 14.[131] The Commission is well aware that the standards-setting process can progress rapidly, and this is no less true of C-V2X. As noted *supra*, 3GPP is on the verge of completing its *first* 5G standard for C-V2X (3GPP Release 16), and is preparing to work on the next iteration (3GPP Release 17). If the Commission ties C-V2X to 3GPP Release 14, the technology would be unable to leverage these and future advancements in

[131] *See NPRM* Appendix B, proposed Section 90.379(c) and Section 95.3189(c) (incorporating 3GPP Release 14 into the technical standards for roadside and on-board units, respectively).

cellular technology and thus would remain stagnant. Indeed, such a result would be difficult to square with Commission's prior reluctance to adopt policies that stifle innovation, particularly where newer technologies are involved.[132]

5GAA therefore urges the Commission to address this problem by permitting any sidelink communications that comply with 3GPP and other relevant automotive standards so long as such communications involve an on-board or portable C-V2X unit. This approach would allow the Commission to account for updates to the 3GPP standards without having to amend its rules every time those standards change.

VIII. CONCLUSION

The Commission was correct in proposing at least a 20 MHz spectrum allocation for C-V2X Direct, but should allocate the technology a substantially larger portion—if not all—of the 5.9 GHz band to unlock the full benefits of C-V2X's evolution to 5G. The first step for addressing this bandwidth shortage is to allocate the additional 10 MHz in the 5.895-5.905 GHz sub-band for C-V2X Direct. The second, more critical step for addressing this shortage is to allocate at least an additional 40 MHz (as opposed to just an additional 10 MHz) for advanced C-V2X Direct communications. The Commission can accomplish this by allocating the 5.850-5.895 GHz sub-band—either in whole or in part—for advanced C-V2X Direct services. Absent the adoption of this additional spectrum for advanced C-V2X Direct services, America may lose its chance to capitalize on the benefits of this technology.

If the Commission nonetheless decides to proceed with its proposal to reallocate the bottom of the band for unlicensed operations, it must take two actions to accommodate C-V2X

[132] *See, e.g.*, *Spectrum Horizons R&O*, 34 FCC Rcd at 1609 ¶ 11; *Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval*, Order and Second Memorandum Opinion and Order, 29 FCC Rcd 6366, 6370 ¶ 11 (2014).

Direct. First, it must identify other mid-band spectrum elsewhere to accommodate C-V2X Direct's evolution to 5G. And second, the Commission must ensure that its technical rules for unlicensed operations adequately protect C-V2X Direct communications in the 5.895-5.925 GHz sub-band, as detailed herein. If the Commission does not, at a bare minimum, make these adjustments, America will lose the benefits of C-V2X and forfeit its leadership in this technology.

Respectfully submitted,

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APPENDIX A

5GAA Proposed Rules for a 30 MHz C-V2X Sub-Band in the 5.9 GHz band

For the reasons set forth in the preamble, the Federal Communications Commission proposes to amend Parts 2, 15, 90, and 95 of Title 47 of the Code of Federal Regulations as follows:

Part 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS;

GENERAL RULES AND REGULATIONS

1. The authority citation for Part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

Section 2.106 is amended by revising footnote NG160 to read as follows

§ 2.106 Table of Frequency Allocations.

* * * * *

NG160 In the band 5895-5925 MHz, the use of the non-Federal mobile service is limited to Cellular Vehicle to Everything (C-V2X) Communications operations in the Intelligent Transportation System radio service.

* * * * *

Part 15 – Radio Frequency Devices

The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a, and 549.

Section 15.401 is amended to read as follows:

§ 15.401 Scope.

This subpart sets out the regulations for unlicensed National Information Infrastructure (U-NII) devices operating in the 5.15-5.35 GHz and 5.47-5.895 GHz bands.

Section 15.403 is amended by revising paragraph (s) to read as follows:

§ 15.403 Definitions.

* * * * *

(s) *U-NII devices*. Intentional radiators operating in the frequency bands 5.15-5.35 GHz and 5.470-5.895 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions.

Section 15.407 is amended by redesignating paragraphs (a)(4) and (a)(5) as paragraphs (a)(5) and (a)(6), adding new paragraphs (a)(4), revising redesignated paragraph (a)(6), revising paragraph (b)(4), redesignating paragraphs (b)(5), (b)(6) and (b)(7) as paragraphs (b)(6), (b)(7) and (b)(8), adding new paragraph (b)(5) and revising paragraph (e) to read as follows:

§ 15.407 General technical requirements.

* * * * *

(a) ***

(4) For the band 5.85-5.895 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall

not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. ~~However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.~~ . Any U-NII operations within the 5.850-5.895 GHz band are restricted to indoor operations to reduce the potential for harmful interference to adjacent channel C-V2X operations.

* * * * *

(6) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.895 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

* * * * *

(b)(4) For transmitters operating solely in the 5.725-5.850 GHz band:

(i) ***

(ii) ***

(b)(5) For transmitters operating solely in the 5.850-5.895 GHz band or operating on a channel that spans across 5.850 GHz:

(i) Peak emissions at 5.895 GHz shall be below an e.i.r.p. of 0 dBm/MHz and decrease linearly to an e.i.r.p. of -17 dBm/MHz at 5.905 GHz~~All~~, and peak emissions ~~at or~~ above 5.905~~5.925~~ GHz shall not exceed an e.i.r.p. of −~~2~~17 dBm/MHz. RMS average emissions at 5.895 GHz shall be below an e.i.r.p. of -10 dBm/MHz and decrease linearly to an e.i.r.p. of -27 dBm/MHz at 5.905 GHz, and RMS average emissions above 5.905 GHz shall not exceed an e.i.r.p. of −27 dBm/MHz.

(ii) All emissions below 5.725 GHz shall be limited to a level of −27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.

* * * * *

(e) Within the 5.725-~~.~~5.850 GHz and 5.850-5.895 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

* * * * *

Part 90 – Private Land Mobile Radio Services

Amend Subpart M to the Table of Contents of Part 90 to modify the subheading after section 90.365 and add Section 90.370 to read as follows:

Subpart M – Intelligent Transportation Systems Radio Service

* * * * *

Regulations Governing the Licensing and Use of Frequencies in the 5895-5925 MHz Band for ~~Dedicated Short-Range Communications Service (DSRCS) and~~ Cellular Vehicle to Everything (C-V2X) Service.

90.370 Permitted frequencies.

* * * * *

The authority citation for Part 90 continues to read as follows:

Authority: 47 U.S.C. 154(i), 161, 303(g), 303(r), 332(c)(7), 1401-1473.

Subpart A – GENERAL INFORMATION

Section 90.7 is amended by adding an entry for Cellular Vehicle to Everything (C-V2X) Communications Services in alphabetical order and modifying the entries for On-Board unit (OBU), Roadside unit (RSU) and Roadway bed surface to read as follows:

§ 90.7 Definitions.

* * * * *

Cellular Vehicle to Everything (C-V2X) Service. The use of cellular radio techniques defined by the 3rd Generation Partnership Program (3GPP) to transfer data between roadside and mobile units, between mobile units, and between portable and mobile units to perform operations related to the improvement of traffic flow, traffic safety, and other intelligent transportation service applications in a variety of environments. C-V2X Service systems may also transmit status and instructional messages related to the units involved.

* * * * *

On-Board Unit (OBU). An On-Board Unit is a ~~DSRCS or~~ C-V2X Service transceiver that is normally mounted in or on a vehicle, or which in some instances may be a portable unit. An OBU can be operational while a vehicle or person is either mobile or stationary. The OBUs receive and transmit on one or more radio frequency (RF) channels. Except where specifically excluded, OBU operation is permitted wherever vehicle operation or human passage is permitted. The OBUs mounted in vehicles are licensed by rule under part 95 of this chapter and communicate with Roadside Units (RSUs) and other OBUs. Portable OBUs are also licensed by rule under part 95 of this chapter.

Roadside Unit (RSU). A Roadside Unit is a ~~DSRCS or~~ C-V2X Service transceiver that is mounted along a road or pedestrian passageway. An RSU may also be mounted on a vehicle or is hand carried, but it may only operate when the vehicle or hand-carried unit is stationary. Furthermore, an RSU operating under this part is restricted to the location where it is licensed to operate. However, portable or hand-held RSUs are permitted to operate where they do not interfere with a site-licensed operation. An RSU broadcasts data to or exchanges data with OBUs.

Roadway bed surface. For ~~DSRCS or~~ the C-V2X Service, the road surface at ground level.

Subpart G—APPLICATIONS AND AUTHORIZATIONS

Section 90.149 is amended by revising paragraph (b) to read as follows:

§ 90.149 License term.

* * * * *

(b) Non-exclusive geographic area licenses for Roadside Units (RSUs) under subpart M of this part in the 5895-5925 MHz band will be issued for a term not to exceed ten years from the date of original issuance or renewal. The registration dates of individual RSUs (see § 90.375) will not change the overall renewal period of the single license.

Section 90.155 is amended by revising paragraph (i) to read as follows:

§ 90.155 Time in which station must be placed in operation.

* * * * *

(i) Roadside Units (RSUs) under subpart M of this part in the 5895-5925 MHz band must be placed in operation within 12 months from the effective date of registration (see § 90.375) or the authority to operate the RSUs cancels automatically (see § 1.955 of this chapter). Such registration date(s) do not change the overall renewal period of the single license. Licensees must notify the Commission in accordance with § 1.946 of this chapter when registered units are placed in operation within their construction period.

Subpart H—POLICIES GOVERNING THE ASSIGNMENT OF FREQUENCIES

Section 90.175 is amended by revising paragraph (j)(16) to read as follows:

§ 90.175 Frequency coordinator requirements.

* * * * *

(j) * * *

(16) Applications for ~~DSRCS and~~ C-V2X Service licenses (as well as registrations for Roadside Units) under subpart M of this part in the 5895-5925 GHz band.

* * * * *

Section 90.179 is amended by revising paragraph (f) to read as follows:

§ 90.179 Shared use of radio stations.

* * * * *

(f) Above 800 MHz, shared use on a for-profit private carrier basis is permitted only by SMR, Private Carrier Paging, LMS, ~~DSCRS,~~ and C-V2X Service licensees. See subparts M, P, and S of this part.

Subpart I—GENERAL TECHNICAL STANDARDS

Section 90.205 is amended by revising paragraph (q) to read as follows:

§ 90.205 Power and antenna height limits.

* * * * *

(q) 5895-5925 MHz. Power and height limitations are specified in subpart M of this part.

* * * * *

Section 90.210 is amended by revising the entry for 5850-5925 in the table and footnote 4 of the table to read as follows:

§ 90.210 Emission masks.

* * * * *

Applicable Emission Masks Frequency band (MHz)	**Mask for equipment with audio low pass filter**	**Mask for equipment without audio low pass filter**
* * * * *	* * * * *	* * * * *
5895-5925[4]		
* * * * *	* * * * *	* * * * *

[4] ~~DSRCS and~~ C-V2X Service Roadside Units in the 5.895-5.925 GHz band is governed under Subpart M of this part.

* * * * *

Section 90.213 is amended by revising footnote 10 of the table in paragraph (a) to read as follows:

§ 90.213 Frequency stability.

(a) ***

[10] Frequency stability for ~~DSRCS and~~ C-V2X Service equipment in the 5895-5925 MHz band is specified in subpart M of this part. For all other equipment, frequency stability is to be specified in the station authorization.

* * * * *

Subpart M—Intelligent Transportation Systems Radio Service

Section 90.350 is amended to read as follows:

§ 90.350 Scope.

The Intelligent Transportation Systems (ITS) radio service is for the purpose of integrating radio-based technologies into the nation's transportation infrastructure and to develop and implement the nation's intelligent transportation systems. It includes the Location and Monitoring Service (LMS), ~~the Dedicated Short-Range Communications Service (DSRCS)~~, and the Cellular Vehicle to Everything (C-V2X)

Service. Rules as to eligibility for licensing, frequencies available, and any special requirements for services in the Intelligent Transportation Systems radio service are set forth in this subpart.

New section 90.370 is added to read as follows:

§ 90.370 Permitted frequencies.

~~(a) DSRCS Roadside Units (RSUs) are permitted to operate in the 5895-5905 MHz band.~~

(~~b~~a) C-V2X Service RSUs are permitted to operate in the ~~5905~~5895-5925 MHz band.

(~~c~~b) Channels are available on a shared basis only for use in accordance with the Commission's rules. All licensees shall cooperate in the selection and use of channels in order to reduce interference. This includes monitoring for communications in progress and any other measures as may be necessary to minimize interference. Licensees of RSUs suffering or causing harmful interference within a communications zone as defined in section 90.375 of this part are expected to cooperate and resolve this problem by mutually satisfactory arrangements. If the licensees are unable to do so, the Commission may impose restrictions including specifying the transmitter power, antenna height and direction, additional filtering, or area or hours of operation of the stations concerned. Further the use of any channel at a given geographical location may be denied when, in the judgment of the Commission, its use at that location is not in the public interest; use of any such channel may be restricted as to specified geographical areas, maximum power, or such other operating conditions, contained in this part or in the station authorization.

Frequencies in the 5895-5925 MHz band will not be assigned for the exclusive use of any licensee.

The heading prior to section 90.371 is modified to read as follows and moved prior to newly added Section 90.370:

Regulations Governing the Licensing and Use of Frequencies in the 5895-5925 MHz Band for ~~Dedicated Short Range Communications Service (DSRCS) and~~ Cellular Vehicle to Everything (C-V2X) Service.

Section 90.371 is amended by removing paragraph (a), redesignating paragraphs (b) and (c) as paragraphs (a) and (b) and revising the introductory text of newly redesignated paragraph (a) to read as follows:

§ 90.371 ~~DSRCS and~~ C-V2X Service.

(a) ~~DSRCS and~~ C-V2X Service Roadside Units (RSUs) operating in the band 5895-5925 MHz shall not receive protection from Government Radiolocation services in operation prior to the establishment of the RSU. Operation of RSU stations within 75 kilometers of the locations listed in the table below must be coordinated through the National Telecommunications and Information Administration.

* * * * *

Section 90.373 is amended by revising the introductory text to read as follows:

§ 90.373 Eligibility in the ~~DSRCS and~~ C-V2X Service.

The following entities are eligible to hold an authorization to operate Roadside units in the ~~DSRCS or~~ C-V2X Service:

* * * * *

Section 90.375 is revised to read as follows:

§ 90.375 License areas, communication zones, and registrations

(a) Roadside Units (RSUs) in the 5895-5925 MHz band are licensed on the basis of non-exclusive geographic areas. Governmental applicants will be issued a geographic area license based on the geo-political area encompassing the legal jurisdiction of the entity. All other applicants will be issued a geographic area license for their proposed area of operation based on county(s), state(s) or nationwide.

(b) Applicants who are approved in accordance with FCC Form 601 will be granted non-exclusive licenses for the channel(s) corresponding to their intended operations (see § 90.370). Such licenses serve as a prerequisite of registering individual RSUs located within the licensed geographic area described in paragraph (a) of this section. Licensees must register each RSU in the Universal Licensing System (ULS) before operating such RSU. RSU registrations are subject, inter alia, to the requirements of § 1.923 of this chapter as applicable (antenna structure registration, environmental concerns, international coordination, and quiet zones). Additionally, RSUs at locations subject to NTIA coordination (see § 90.371(a)) may not begin operation until NTIA approval is received. Registrations are not effective until the Commission posts them on the ULS. It is the licensee's responsibility to delete from the registration database any RSUs that have been discontinued.

(c) Licensees must operate each RSU in accordance with the Commission's Rules and the registration data posted on the ULS for such RSU. ~~Licensees must register each RSU for the smallest communication zone needed for the intelligent transportation systems application using one of the following four communication zones:~~

~~RSU class~~	~~Maximum output power (dBm)[1]~~	~~Communications zone (meters)~~
~~A~~	~~0~~	~~15~~
~~B~~	~~10~~	~~100~~
~~C~~	~~20~~	~~400~~
~~D~~	~~28.8~~	~~1000~~

[1] As described in the ~~IEEE 802.11p-2010 and Standard and~~ ATIS transposed standards of the 3GPP (incorporated by reference, *see* § 90.379).

Section 90.377 is revised to read as follows:

§ 90.377 Maximum EIRP and antenna height.

~~(a) DSRCS and C-V2X Service licensees shall transmit only the power (EIRP) needed to communicate with an On-Board Unit (OBU) within the communications zone and must take steps to limit the Roadside Unit (RSU) signal within the zone to the maximum extent practicable.~~

(~~b~~a) ~~DSRCS and~~ C-V2X Service licensees must limit RSU ~~output power to 20 dBm and~~ equivalent isotopically radiated power (EIRP) to 33 dBm. The EIRP is measured as the maximum EIRP toward the horizon or horizontal, whichever is greater, of the gain associated with the main or center of the transmission beam.

(~~c~~b) The radiation center of an RSU antenna shall not exceed 8 meters above the roadway bed surface, except that an RSU may employ an antenna with a height exceeding 8 meters but not exceeding 15 meters provided the EIRP specified in paragraphs (a) and (b) of this section is reduced by a factor of 20 log(Ht/8)

in dB where Ht is the height of the radiation center of the antenna in meters above the roadway bed surface. The RSU antenna height shall not exceed 15 meters above the roadway bed surface.

Section 90.379 is revised to read as follows:

§ 90.379 Technical standards for Roadside Units

~~(a) DSRCS Roadside Units (RSUs) operating in the 5895-5905 MHz band must comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p-2010.~~

(~~b~~a) C-V2X Service RSUs operating in the ~~5905~~5895-5925 MHz band shall comply with the V2X sidelink service for this band as described in the ATIS transposed standards of the 3GPP specifications except where these rules and regulations take precedence.

(~~c~~b) The standards required in this section are incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. § 552(a) and 1 CFR part 51. All approved material is available for inspection at the Federal Communications Commission, 445 12th Street SW., Washington, D.C. 20554 and is available from the sources indicated below. It is also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030 or go to www.archives.gov/federal-register/cfr/ibrlocations.html.

~~*(1) 802.11p-2010, IEEE Standard for Information technology--Local and metropolitan area networks--Specific requirements--Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments (2010). This standard is available from the Institute of Electrical and Electronics Engineers (IEEE), 3025 Boardwalk Drive, Suite 220, Ann Arbor, MI 48108, 1-855-999-9870, http://www.techstreet.com/ieee.*~~

~~*(2) 3GPP*~~ C-V2X Roadside Units operating in the 5895~~50~~-5925 MHz band shall comply with the V2X sidelink service for this band as described in the ATIS transposed standards of the 3GPP specifications except where these rules and regulations take precedence. The published ATIS standards are available at: https://www.atis.org/docstore/default.aspx. The 3GPP specifications can be obtained at http://www.3gpp.org/specifications

~~*Release 14, 3rd Generation Partnership Project Technical Specification Group Services and System Aspects (2018). This standard is available from ATIS, 1200 G Street NW Suite 500, Washington, D.C. 20005, https://www.atis.org/docstore/default.aspx.*~~

Section 90.381 is added to read as follows:

§ 90.381 C-V2X Service emissions limits.

C-V2X Service Roadside Units (RSUs) must comply with the following out-of-band emissions limits:

~~(a)~~ Conducted limits measured at the antenna input shall not exceed:

~~(1) -29 dBm/100 kHz at the band edge (The band is defined in section 90.370 of this part);~~
~~(2) -35 dBm/100 kHz ± 1 megahertz from the band edge;~~
~~(3) -43 dBm/100 kHz ± 10 megahertz from the band edge; and~~
~~(4) -53 dBm/100 kHz ± 20 megahertz from the band edge.~~

(1) -16 dBm/100 kHz within 0 to 1 megahertz from the upper band edge and within -1 megahertz to 0 from the lower band edge;
(2) -13 dBm/MHz within 1 to 5 megahertz from the upper band edge and within -5 megahertz to -1 megahertz from the lower band edge;
(3) -16 dBm/MHz within 5 to 30 megahertz from the upper band edge and within -30 megahertz to -5 megahertz from the lower band edge; and
(4) -28 dBm/MHz beyond 30 megahertz from the band edges.

~~(b) Radiated limits: All C-V2X Service RSUs must limit radiated emissions to -25 dBm/100 kHz EIRP or less outside the band edges where the band is defined in section 90.370 of this part.~~

Section 90.383 is amended by revising the introductory text and paragraph (c) to read as follows:

§ 90.383 RSU sites near the U.S./Canada or U.S./Mexico border.

Until such time as agreements between the United States and Canada or the United States and Mexico, as applicable, become effective governing border area use of the 5895~~50~~-5925 MHz band, authorizations to operate Roadside Units (RSUs) are granted subject to the following conditions:

* * * * *

(b) Authority to operate RSUs is subject to modifications and future agreements between the United States and Canada or the United States and Mexico, as applicable.

Subpart N—OPERATING REQUIREMENTS

Section 90.415 is revised by amending paragraph (b) to read as follows:

* * * * *

(b) Render a communications common carrier service, except for stations in the Public Safety Pool providing communications standby facilities under § 90.20(a)(2)(xi) and stations licensed under this part in the SMR, private carrier paging, Industrial/Business Pool, 220-222 MHz or the ~~DSRCS and~~ C-V2X Service.

Section 90.421 is revised by adding paragraph (d) to read as follows:

§ 90.421 Operation of mobile station units not under the control of the licensee.

* * * * *

(d) ~~DSRCS and~~ C-V2X Service On-Board Units licensed by rule under part 95 of this chapter may communicate with any roadside unit authorized under this part or any licensed commercial mobile radio service station as defined in part 20 of this chapter.

Section 90.425 is revised by amending paragraph (d)(10) to read as follows:

§ 90.425 Station identification.

* * * * *

(d) * * *

(10) It is a Roadside Unit (RSU) in an ITS system.

Part 95 -Personal Radio Services

The authority citation for Part 95 continues to read as follows:

Authority: 47 U.S.C. 154, 303, and 307.

The subtitle for subpart L is revised to read as follows:

Subpart L—~~DSRCS and~~ C-V2X Service On-Board Units

Section 95.3101 is amended to read as follows:

§ 95.3101 Scope.

This subpart contains rules that apply only to On-Board Units (OBUs) transmitting in the 5895-5925 MHz frequency band in ~~the Dedicated Short-Range Communications Services (DSRCS) and~~ the Cellular Vehicle to Everything (C-V2X) Service (see § 90.371 of this chapter).

Section 95.3103 is amended by adding a definition for Cellular Vehicle to Everything (C-V2X) Service in alphabetical order and revising the definition of On-Board Unit (OBU) to read as follows:

§ 95.3103 Definitions, OBUs.

Cellular Vehicle to Everything (C-V2X) Service. A service providing for data transfer between various mobile and roadside transmitting units for the purposes of improving traffic flow, highway safety and performing other intelligent transportation functions. See § 90.7 of this chapter for a more detailed definition.

* * * * *

On-Board Units (OBUs). OBUs are low-power devices on vehicles that transfer data to roadside units or other OBUs in the ~~Dedicated Short-Range Communications Service or the~~ Cellular Vehicle to Everything (C-V2X) Service (see §§ 90.370-90.383 of this chapter), to improve traffic flow and safety, and for other intelligent transportation system purposes. See § 90.7 of this chapter.

* * * * *

Section 95.3131 is revised to read as follows:

§ 95.3131 Permissible uses, OBUs.

On-Board Units (OBUs) may transmit signals to other OBUs and to Roadside Units (RSUs), which are authorized under part 90 of this chapter or to licensees as defined in part 20 of this chapter.

Section 95.3159 is removed.

Section 95.3161 is amended by revising paragraph (a) to read as follows:

§ 95.3161 OBU transmitter certification.

(a) Each On-Board Unit (OBU) ~~C-V2X~~C-V2X that operates or is intended to operate in the ~~DSRCS or~~ C-V2X Service must be certified in accordance with this subpart and subpart J of part 2 of this chapter.

* * * * *

Section 95.3163 is revised to read as follows:

§ 95.3163 OBU frequencies.

~~*(a) DSRCS On-Board Units (OBUs) are permitted to operate in the 5895-5905 MHz band.*~~

~~(b)~~ C-V2X Service OBUs are permitted to operate in the ~~5905~~5895-5925 MHz band.

Section 95.3167 is revised to read as follows:

§ 95.3167 OBU transmit power limit.

~~(a) The maximum output power for portable DSRCS On-Board Unit (OBU) transmitter types is 1.0 mW.~~

(~~b~~a) The ~~maximum output power for vehicular and portable C-V2X Service OBU transmitter types is 20 dBm and the~~ maximum equivalent isotopically radiated power (EIRP) for vehicular and portable C-V2X Service OBU transmitter types is limited to ~~2~~33 dBm.

(~~c~~b) The power limits in paragraph~~s~~ (a) ~~and (b)~~ of this section may be referenced to the antenna input, so that cable losses are taken into account.

(~~d~~c) For purposes of this section, a portable unit is a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

Section 95.3179 is added to read as follows:

§ 95.3179 Unwanted emissions limits.

~~(a)~~ C-V2X Service Roadside Units must comply with the following out-of-band emissions limits:

~~(1)~~ Conducted limits measured at the antenna input shall not exceed:

~~(i) -29 dBm/100 kHz at the band edge (The band is defined in section 95.3163 of this part.);~~
~~(ii) -35 dBm/100 kHz ± 1 megahertz from the band edge;~~
~~(iii) -43 dBm/100 kHz ± 10 megahertz from the band edge; and~~
~~(iv) -53 dBm/100 kHz ± 20 megahertz from the band edge.~~

(i) -16 dBm/100 kHz within 0 to 1 megahertz from the upper band edge and within -1 megahertz to 0 from the lower band edge;
(ii) -13 dBm/MHz within 1 to 5 megahertz from the upper band edge and within -5 megahertz to -1 megahertz from the lower band edge;
(iii) -16 dBm/MHz within 5 to 30 megahertz from the upper band edge and within -30 megahertz to -5 megahertz from the lower band edge; and
(iv) -28 dBm/MHz beyond 30 megahertz from the band edges.

~~(2) Radiated limits: All C-V2X Service On-Board Units must limit radiated emissions to -25 dBm/100 kHz EIRP or less outside the band edges where the band is defined in section 95.3163 of this part.~~

~~(b) DSRCS out-of-band emissions limits are specified in the IEEE 802.11p-2010 standard (See section 95.3189 of this part)~~

Section 95.3189 is amended to read as follows:

§ 95.3189 OBU technical standard.

~~*(a) DSRCS On-Board Unit (OBU) transmitter types operating in the 5895-5905 MHz band must be designed to comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p-2010.*~~

(~~b~~a) C-V2X Service OBU transmitter types operating in the 5895-5925 MHz band shall comply with the V2X sidelink service for this band as described in the ATIS transposed standards of the 3GPP specifications except where these rules and regulations take precedence.

(~~c~~b) The standards required in this section are incorporated by reference into this section with the approval of the Director of the Federal Register under 5 U.S.C. § 552(a) and 1 CFR part 51. All approved material is available for inspection at the Federal Communications Commission, 445 12th Street SW., Washington, D.C. 20554 and is available from the sources indicated below. It is also available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030 or go to www.archives.gov/federal-register/cfr/ibrlocations.html.

~~*(1) 802.11p-2010, IEEE Standard for Information technology—Local and metropolitan area networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments (2010). This standard is available from the Institute of Electrical and Electronics Engineers (IEEE), 3025 Boardwalk Drive, Suite 220, Ann Arbor, MI 48108, 1-855-999-9870, http://www.techstreet.com/ieee.*~~

~~*(2)*~~ C-V2X Roadside Units operating in the 5895-5925 MHz band shall comply with the V2X sidelink service for this band as described in the ATIS transposed standards of the 3GPP specifications except where these rules and regulations take precedence. The published ATIS standards are available at: https://www.atis.org/docstore/default.aspx. The 3GPP specifications can be obtained at http://www.3gpp.org/specifications.~~*3GPP Release 14, 3rd Generation Partnership Project Technical Specification Group Services and System Aspects (2018). This*~~

~~*standard is available from ATIS, 1200 G Street NW Suite 500, Washington, D.C. 20005, https://www.atis.org/docstore/default.aspx.*~~

Appendix A to part 95 is amended by removing the entry in the table for "95.1509 - ASTM E2213-03 DSRC Standard."