Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

COMMENTS OF NCTA – THE INTERNET & TELEVISION ASSOCIATION

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I. INTRODUCTION AND SUMMARY

Wi-Fi is the workhorse of the 21st century internet. Every American knows that Wi-Fi is central to the functioning of their home, school, and workplace—along with airports, libraries, stadiums, convention centers, and retail stores. American businesses depend on Wi-Fi to deliver essential services to American consumers, like healthcare monitoring and connected medical devices, smart farming solutions, and home security monitoring. Across the country, Wi-Fi provides networking and connectivity for universities, military bases, hospitals, and other large institutions, and is key to processing billions of dollars in secure financial transactions. With all that activity, it is no surprise that Wi-Fi carried half of all internet traffic in the U.S. in 2017, and that this number will grow to 56.6 percent by 2022.[1] The annual economic contribution of unlicensed technologies to the U.S. economy is huge—approximately $499 billion in 2018 alone and $993 billion annually by 2023.[2]

The continued success of Wi-Fi depends on the Commission's opening additional mid-band spectrum for unlicensed use, particularly in the 5.9 GHz and 6 GHz bands. NCTA – The Internet & Television Association (NCTA) therefore strongly supports the Commission's 5.9 GHz Notice of Proposed Rulemaking (NPRM).[3] The 5.9 GHz U-NII-4 band is the best immediate opportunity available to keep the unlicensed economic engine running. Because the

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1 Comments of Cisco Systems, Inc. at 4, ET Docket No. 18-295, GN Docket No. 17-183 (filed Feb. 15, 2019) (Cisco 6 GHz Comments) (citing Cisco Systems Inc., VNI Forecast Highlights Tool, https://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html).

2 Raul Katz & Fernando Callorda, Telecom Advisory Services, LLC, *The Economic Value of Wi-Fi: A Global View (2018 and 2023)* at 6-7, 33-34 (2018), https://morningconsult.com/wp-content/uploads/2018/10/Economic_Value_of_Wi-Fi_2018.pdf (Wi-Fi Global View).

3 *Use of the 5.850-5.925 GHz Band*, Notice of Proposed Rulemaking, 34 FCC Rcd. 12,603 (2019) (*5.9 GHz NPRM*).

band sits directly adjacent to the successful U-NII-3 band—and is essentially unused today—industry can quickly adapt existing devices to facilitate rapid, low-cost access to U-NII-4. And combining U-NII-3 and U-NII-4 spectrum will create the first widely available, contiguous 160-megahertz channel that next-generation Wi-Fi requires.

In 1997, a long list of automotive interests and their allies, through ITS America, petitioned the Federal Communications Commission (FCC or Commission) to gift them 75 megahertz of spectrum in the 5.9 GHz band for Dedicated Short Range Communications (DSRC), based on claims that they would use the spectrum to save lives and revolutionize highway transportation.[4] But the DSRC experiment failed, and automobile manufacturers pursued the development of different technologies to improve vehicle safety. Because of failures like DSRC, the Commission typically avoids attempts to manage spectrum by handing it out to a single technology without an auction or unlicensed sharing requirements.

Now, two decades later and after years of bipartisan effort, the Commission—supported by technology, telecommunications, and automotive companies, as well as think tanks and consumer groups—has unanimously recognized that it is time to move on, and has proposed rules that would enable unlicensed broadband operations in the lower 45 megahertz of the band. NCTA applauds the Commission and enthusiastically supports the NPRM.

The Commission can make the most efficient and effective use of this valuable mid-band spectrum by permitting unlicensed operations in the entire band, and letting Intelligent Transportation Systems (ITS) services operate either in (1) another dedicated spectrum band

[4] *See* Petition for Rulemaking of ITS America, ET Docket No. 98-95, RM-9096 (filed May 19, 1997).

(such as 4.9 GHz), or (2) flexible-use licensed or unlicensed spectrum in the same way that countless other technologies do—including services that contribute to automotive safety.

While NCTA's members strongly support and prefer the arrangement described above, they nonetheless support the Commission's compromise proposal identified in the NPRM. The NPRM proposes a reasonable path forward to address the urgent need to put mid-band unlicensed spectrum to use while allowing ITS proponents a second opportunity to demonstrate that the marketplace will support connected vehicle technologies in this band. As described below, and as cellular vehicle-to-everything (C-V2X) advocates have agreed, the 30 megahertz the Commission proposes would be more than sufficient to deliver the subset of safety messages that cannot use existing licensed LTE bands or other spectrum. Furthermore, the Commission has ample legal authority to pursue a sensible transition to its proposed new band plan.

Whichever options the Commission chooses, it should adopt technical rules for unlicensed devices in U-NII-4 that promote innovation and widespread broadband deployment. By doing so, the FCC can deliver on the band's promise for Wi-Fi 6 and beyond. Specifically, the Commission should build upon the demonstrated success of the U-NII-3 band by implementing its proposals to enable in-band U-NII-4 operations under similar technical rules, and it should also establish reasonable out-of-band-emission (OOBE) limits for U-NII-4 devices. The Commission should not, however, set any technical rules based on a recently released National Highway Traffic Safety Administration (NHTSA) report, which contains significant flaws.

U-NII-4's proximity to the workhorse U-NII-3 band and the fact that 5.9 GHz frequencies are vacant nearly everywhere in the country at any given point in time uniquely position the band to help meet immediate and long-term needs for more unlicensed broadband

spectrum. Importantly, permitting unlicensed use of the band also will enable the country's first widely available 160-megahertz Wi-Fi channel. NCTA urges the Commission expeditiously to enable unlicensed use of the band under technical rules proven to foster innovation and widespread deployment.

II. THE STATUS QUO IN THE 5.9 GHZ BAND PREVENTS BOTH BROADBAND AND AUTOMOTIVE SAFETY ADVANCES.

A. The 5.9 GHz Band Is Critical for Meeting Increasing Demand for Wi-Fi and Delivering Next-Generation Wi-Fi 6.

The Commission has correctly determined that Wi-Fi contributes greatly to the national economy and is central to the country's leadership in wireless innovation—but that it must identify additional unlicensed frequencies to continue this success.[5] Adopting the NPRM's proposals will advance that goal and promote U.S. leadership in connectivity and innovation.

1. America Needs More Wi-Fi Spectrum.

Wi-Fi carries a significant—and growing—percentage of overall traffic online. According to Cisco's Visual Networking Index (VNI), Wi-Fi carried 50.4 percent of total U.S. internet traffic in 2017, and that figure will grow to 56.6 percent by 2022.[6] With the anticipated growth in internet traffic over that 5-year period, Wi-Fi networks in 2022 will carry more than the total traffic *any medium* carried in 2017.[7]

Wi-Fi carries this enormous amount of data to a diverse and ever-growing number of devices. Cisco's Annual Internet Report predicts that in the United States alone, the number of

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5 *See*, *e.g.*, *5.9 GHz NPRM* ¶ 63; *Unlicensed Use of the 6 GHz Band and Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Proposed Rulemaking, 33 FCC Rcd. 10,496 at 10,498, 10,501-03 ¶¶ 1, 18 (*6 GHz NPRM*).

6 Cisco 6 GHz Comments at 4.

7 *Id.*

networked devices will nearly double from 2.7 billion in 2018 to 4.6 billion by 2023.[8] Approximately 75 percent of those networked devices—3.4 billion—will either be wired or "connected over Wi-Fi."[9] A particularly significant increase in Wi-Fi connected devices will come from an estimated 327.4 million smartphones and 151.7 million connected 4K televisions in 2023—there will likely be tens of millions more of these devices compared to 2018.[10] And some of this growth will also come from applications such as machine-to-machine modules.

These statistics reflect Wi-Fi's critical role in supporting broadband and connected services in every area of modern life—from healthcare monitoring and connected medical devices, to home security, connected education, smart agriculture, in-car navigation and entertainment, to billions of dollars in secure financial transactions. Stable and reliable Wi-Fi connects Americans in their homes, workplaces, and communities. As Cisco puts it, "Wi-Fi has a powerful role to play . . . in delivering key use cases going forward in the 5G Era."[11]

Demands on Wi-Fi capacity will become even more acute as the United States continues to progress into a 5G world. The 5G future will generate vast amounts of new data traffic and will rely on a combination of licensed, unlicensed, and coordinated shared spectrum frequencies. And while unlicensed spectrum will continue to carry the majority of traffic in the 5G environment, even cellular 5G will rely on unlicensed technologies like Wi-Fi to offload large amounts of data: "[t]he paradox of [licensed] 5G is that although it provides more bandwidth"

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8 Cisco Systems, Inc., Cisco Annual Internet Report Highlights Tool, https://www.cisco.com/c/en/us/solutions/executive-perspectives/annual-internet-report/air-highlights.html# (Cisco AIR Tool).

9 *Id.*

10 *Id.*

11 Cisco Systems, Inc., *Cisco Annual Internet Report (2018-2023)* White Paper (updated Feb. 28, 2020), https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html.

compared to previous generations, "it will also support so much more data usage that even more offload is required," including to "unlicensed Wi-Fi technology."[12] Indeed, as Commissioner Rosenworcel has noted, "as much as 70 percent of 5G traffic will be offloaded to Wi-Fi."[13] In addition, Wi-Fi will bring gigabit speeds and higher-capacity connections to areas where cellular 5G will not reach in the near future, such as in rural and remote areas, and to indoor areas where cellular signals may be weak. Simply put, "[g]rowing the 5G ecosystem . . . requires both licensed and unlicensed spectrum,"[14] and an equitable distribution of 5G services depends on unlicensed spectrum and the Wi-Fi services that use that spectrum.

Wi-Fi also supports important use cases for smart cities, as well as vital functions at locations where connectivity makes efficient and reliable communications possible. Airlines use Wi-Fi for baggage reconciliation, for example, and gate agents use tablets and Wi-Fi enabled scanners to guide passengers to their flights. Ports use Wi-Fi for cargo traffic management and communications with port authorities. And federal, state, and local government agencies use Wi-Fi to provide wireless broadband communications to their employees and contractors. Simply put, because of the FCC's flexible, sensible rules facilitating unlicensed operations, Wi-Fi is now an indispensable technology anywhere important information needs to travel from one point to another.

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[12] Wireless Infrastructure Association, *The 5G Paradox: The Need for More Offloading Options in the Next-Generation Wireless Era* 2 (Feb. 8, 2019), https://wia.org/wp-content/uploads/WIA_Offload-web.pdf.

[13] *5.9 GHz NPRM* at Statement of Commissioner Jessica Rosenworcel; *see*, *e.g.*, Broadcom, *Wi-Fi in the 5G Era*, at slide 24 (2019), *available at* https://newamericadotorg.s3.amazonaws.com/documents/Wi-Fi_in_the_5G_Era_-_Broadcom_presentation.pdf.

[14] *5.9 GHz NPRM* at Statement of Commissioner Brendan Carr.

But Wi-Fi's contributions to all these important areas depend on access to enough spectrum to allow reliability and capacity to keep up with consumer demand. The success of Wi-Fi means that this ever-increasing demand already threatens to outstrip the nation's unlicensed spectrum capacity, which would result in significant congestion. The 2.4 GHz band, for instance, is already so congested that equipment vendors say it can no longer be relied upon for enterprise applications.[15] More generally, regardless of band, as Commissioner Starks has noted, "low-income consumers, who are more likely to live in dense urban environments," often face "the worst Wi-Fi congestion."[16] Thus, "[e]xpanding the spectrum dedicated for unlicensed use allows for more access to high-speed internet for more people" and helps close "the digital divide."[17]

Wi-Fi and unlicensed spectrum deliver high-speed broadband connectivity in a cost-effective manner to communities of all sizes, including in rural areas. Consequently, reliable, high-speed Wi-Fi plays a central role in keeping suburban and rural areas connected, as well as enabling small businesses, healthcare providers, and workers to stay competitive with those based in the urban centers of the country. Broadband providers continue to invest enormous amounts of money to deliver "gigabit speed capabilities to homes and businesses across their footprints."[18] But for consumers to experience the full benefits of those investments, Wi-Fi must

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15 Cisco Systems, Inc., *Enterprise Best Practices for iOS Devices and Mac Computers on Cisco Wireless LAN* at 4, 7 (2018), https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/technotes/8-6/Enterprise_Best_Practices_for_iOS_devices_and_Mac_computers_on_Cisco_Wireless_LAN.pdf.

16 *5.9 GHz NPRM* at Statement of Commissioner Geoffrey Starks.

17 Statement of Bertram Lee, Policy Counsel, Public Knowledge (Nov. 20, 2019), https://www.publicknowledge.org/press-release/public-knowledge-applauds-fcc-chairman-pai-for-action-on-5-9-ghz-band/.

18 *5.9 GHz NPRM* at Statement of Commissioner Brendan Carr.

be able to keep up with the speeds wireline broadband providers already deliver to the home, given that today's devices in homes and businesses infrequently, if ever, access broadband through a wired connection. As Commissioner Carr has explained, "[t]he bottleneck soon may be not that last mile but those last few feet or inches."[19] The next-generation Wi-Fi standard, Wi-Fi 6, has made significant speed and spectrum efficiency advancements, but relies on wide 160-megahertz channels, and there are no widely usable, contiguous 160-megahertz channels of mid-band unlicensed spectrum available today. As a result, it simply is not possible to meaningfully alleviate existing congestion and usher in the next generation of Wi-Fi until the Commission designates more mid-band spectrum for unlicensed use.

Experts have warned that access to significant amounts of new unlicensed spectrum is needed to address these existing and near-term demands. For example, Quotient Associates, in a study for the Wi-Fi Alliance, concluded that the United States will need between 788 megahertz and 1.6 gigahertz of new mid-band unlicensed spectrum by 2025 to meet the country's needs.[20] Qualcomm, using its own methodology, concluded that the country will need "around 1280 MHz of unlicensed spectrum centered around the 5 GHz band" to keep up with demand for Wi-Fi and other unlicensed technologies.[21] Here as well, the Commission has recognized that "[u]nlicensed Wi-Fi wireless routers provide the crucial link between many users' devices and the Internet" and that action is needed to address the "explosive demand for unlicensed spectrum."[22]

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19 *Id.*

20 Steve Methley & William Webb, Quotient Associates Limited, *Wi-Fi Spectrum Needs Study* at 26 (2017), https://www.wi-fi.org/downloads-registered-guest/Wi-Fi%2BSpectrum%2BNeeds%2BStudy_0.pdf/33364 (Wi-Fi Needs Study).

21 Rolf de Vegt et al., Qualcomm Technologies, Inc., *A Quantification of 5 GHz Unlicensed Band Spectrum Needs* at 5 (2016), https://www.qualcomm.com/media/documents/files/a-quantification-of-5-ghz-unlicensed-band-spectrum-needs.pdf.

22 *6 GHz NPRM* at 2 & ¶ 5 (capitalization altered).

2. The 5.9 GHz Band Is Uniquely Positioned to Rapidly Deliver the Bandwidth the Country Needs.

Permitting unlicensed use of the 5.9 GHz band will substantially advance the goal of addressing consumers' demand for more Wi-Fi spectrum. The 5.9 GHz band is ideal because, first, allowing unlicensed use in the 5.9 GHz band would facilitate the first widely available contiguous 160-megahertz channel for Wi-Fi 6. As Broadcom has explained, "[w]ith 160 MHz channels, we get the fastest Wi-Fi yet, delivering multi-gigabit low latency connections."[23] Using a contiguous 160-megahertz channel, when combined with an advanced waveform, higher-order modulation schemes and other features, Wi-Fi 6 devices can deliver speeds up to six times as fast as the previous generation of Wi-Fi and reach peak data rates of 1 Gb/s.[24] Channels in bands like U-NII-2 that are subject to a regulatory mandate to share with government users through dynamic frequency selection (DFS) are "less used than other channels" because of the significant added complexity of access points that comply with applicable rules[25] and false positives that knock users off the air.[26] The 5.9 GHz band is therefore "essential for the larger channels needed to support innovative use cases" as quickly as

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[23] Vijay Nagarajan, Broadcom, *160 MHz Channels: The Wi-Fi 6 Superhighway* (Aug. 23, 2019), https://www.broadcom.com/blog/160-mhz-channels-wi-fi-6-superhighway (Wi-Fi 6 Superhighway); Broadcom Inc., *IEEE 802.11ax: The Sixth Generation of Wi-Fi* at 6 (2018), https://docs.broadcom.com/docs/80211ax-WP (explaining Wi-Fi 6's "ability to dramatically improve speed") (Sixth Generation of Wi-Fi).

[24] Sixth Generation of Wi-Fi at 1.

[25] Wi-Fi Needs Study at 23-24; *see also 5.9 GHz NPRM* ¶ 17 & n.38 (dynamic frequency selection requirements "could cause network-acquisition delays and service interruptions that could reduce the utility of the band for broadband access"); Comments of NCTA – The Internet & Television Association at 10-12, GN Docket No. 17-183 (filed Oct. 2, 2017).

[26] *See* Cisco Systems, Inc., Radar Detection in Dynamic Frequency Selection (DFS) Channels (updated Nov. 6, 2018), https://www.cisco.com/c/en/us/support/docs/wireless-mobility/80211/213882-radar-detection-in-dynamic-frequency-sel.html (describing "false DFS events," explaining that it is "very difficult to determine whether or not radar detection events are 'false,'" and warning of "up to four false DFS events" per access point radio).

possible.[27] Moreover, as the Commission has recognized, enabling the first "160 megahertz channel available for use without dynamic frequency selection" would further "the U.S.'s role as an innovator and global spectrum policy leader."[28]

Second, the 5.9 GHz band is ideal because it is adjacent to the workhorse U-NII-3 band. This means that many existing Wi-Fi access points will be able to use the band almost immediately, with only software or firmware changes, saving years of delay compared to any other band and lowering costs across the board.[29] Consumers and businesses would see the improvements right away. Most importantly, the new 160-megahertz Wi-Fi 6 channel would dramatically improve throughput. This improvement would mean that customers of wireline broadband networks that deliver gigabit service to the home would be able to enjoy the full capacity of their wireline broadband wirelessly on Wi-Fi-connected devices.

Third, in addition to a 160-megahertz channel, the 5.9 GHz band would allow for additional smaller channels in more congested locations. That is particularly the case in urban multi-dwelling units. The 5.9 GHz band will expand existing Wi-Fi spectrum and allow for additional resources to address these spectrally crowded situations, and as Commissioner Starks has noted, can help "reliev[e] that congestion and allow[] consumers to make the most of their broadband connections, at whatever speed they can afford."[30] With the implementation of Wi-Fi 6, which "will provide significant benefits even when connected to devices using smaller bandwidths" than 160 megahertz, efficient use of this additional spectrum will go a long way.[31]

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27 *5.9 GHz NPRM* at Statement of Chairman Ajit Pai.

28 *Id.* ¶ 17.

29 *See*, *e.g.*, Comments of Wi-Fi Alliance at 2, ET Docket No. 13-49 (filed Nov. 28, 2018)

30 *5.9 GHz NPRM* at Statement of Commissioner Geoffrey Starks.

31 Wi-Fi 6 Superhighway.

Fourth, allowing unlicensed use of the 5.9 GHz band will complement the Commission's proposed action in the 6 GHz band. As Commissioner O'Rielly has noted, the 5.9 GHz band is "the missing link between the 5 GHz and 6 GHz bands."[32] And Commissioner Rosenworcel has correctly stated that both "the 6 GHz band and 5.9 GHz band" are together "the right place to start" for enabling additional Wi-Fi spectrum.[33] In the 6 GHz NPRM, the Commission has recognized the benefits of "creat[ing] an enhanced ecosystem of unlicensed use in the 6 GHz band and the nearby U-NII bands."[34] The best way to achieve that unlicensed "ecosystem" is for the Commission to connect the 5 GHz bands and the 6 GHz bands while it has the chance. To be clear, though, while the 6 GHz band could be a valuable complement to the expanded capacity the 5.9 GHz band will provide, it is not a substitute. The coexistence mechanisms and power restrictions the Commission is considering in 6 GHz to provide necessary protection for incumbents in that band will result in different use cases than those that will be enabled by effectively expanding the U-NII-3 rules into 5.9 GHz without such restrictions.

B. DSRC—the Only Technology Permitted in the Band Today—Has Failed, and Most of the Automotive Industry Has Moved On.

The current rules for the 5.9 GHz band block not only Wi-Fi, but also any other technology that does not "comply with" the ASTM E2213-03 DSRC Standard.[35] This means that today's rules prevent C-V2X from using the band.[36] Indeed, as the Commission has recognized, its rules do not even reflect the current IEEE 802.11p standard for DSRC

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[32] *6 GHz NPRM* at Statement of Commissioner Michael O'Rielly.

[33] *Id.* at Statement of Commissioner Jessica Rosenworcel.

[34] *Id.* ¶ 20.

[35] 47 C.F.R. § 90.379.

[36] *See 5.9 GHz NPRM* ¶ 44.

communications.[37] These technology-specific rules are a regulatory fossil—a snapshot of the lofty and unmet promises DSRC proponents made in 1999 when convincing the Commission to reserve the band for the then-nascent technology.

DSRC, despite the advantages of the FCC's extraordinary gift of exclusive no-auction spectrum and more than a billion dollars of government funding,[38] has failed, and the automotive industry has turned to other, more effective technologies to improve safety on American roads. As the Department of Transportation (DOT) has explained, the promised safety benefits of vehicle-to-vehicle technology can only be achieved in the 5.9 GHz band if there is a "critical mass of communicating vehicles in the American fleet."[39] But little measurable progress has been made on that front. DOT advertises "18,877" total devices—and even this small number is inflated. It includes not only "operational" devices but also so-called "planned" deployments.[40] Even crediting the "planned" devices, a total of 18,877 devices is miniscule compared to the over 270 million registered highway vehicles in the United States as of 2017.[41] Clearly DSRC has failed to achieve the "critical mass" that DOT has said is a prerequisite to effectiveness, and is

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37 *See id.*; *see also id.* at Statement of Commissioner Michael O'Rielly ("DSRC has moved beyond the standard that is codified in our rules").

38 *See* U.S. Dep't of Transportation, *Preserving the 5.9 GHz Safety Band for Transportation*, at slide 2 (Feb. 20, 2020), https://www.transportation.gov/research-and-technology/preserving-59ghz-safety-band-transportation-0 (DOT Slide Deck).

39 *Federal Motor Vehicle Safety Standards; V2V Communications*, Notice of Proposed Rulemaking, 82 Fed. Reg. 3,854, 3,879 (2017).

40 U.S. Dep't of Transportation, *MAP: Current Deployments on the Safety Band*, https://www.transportation.gov/research-and-technology/map-current-deployments-safety-band.

41 U.S. Dep't of Transportation, Bureau of Transportation Statistics, *Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances*, https://www.bts.gov/content/number-us-aircraft-vehicles-vessels-and-other-conveyances.

unlikely to do so absent a government mandate that is no longer under active consideration at DOT.[42]

Additionally, because of the lack of automaker interest in adopting DSRC, the ubiquitous deployments it needs to deliver on its vehicle-to-vehicle safety promises simply will not manifest. No automaker has current plans to deploy DSRC radios in new vehicles,[43] and many automakers prefer C-V2X. Ford, for example, has committed to "install[ing] [C-V2X] on its newly launched U.S. vehicles beginning in 2022,"[44] if the FCC makes 5.9 GHz spectrum available. Industry analysts have called Ford's announcement a "turning point" in the automotive industry.[45] Chairman Pai notes that C-V2X is "backed by" other automakers, too, including "Audi, BMW, Daimler, and Tesla."[46] Yet without the Commission's action in this proceeding, no company could deploy C-V2X anywhere in the 5.9 GHz band given its express reservation for an outdated DSRC standard.

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42 *See* National Science & Technology Council and U.S. Department of Transportation, *Automated Vehicles 4.0: Ensuring American Leadership in Automated Vehicle Technologies* at 4 (Jan. 2020), https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf (government will "adopt . . . technology-neutral policies"); U.S. Department of Transportation, *Automated Vehicles 3.0: Preparing for the Future of Transportation* at iv, 7 (Oct. 2018), https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf.

43 *See 5.9 GHz NPRM* ¶ 22 (describing Toyota' s announcement that it would not deploy DSRC in vehicles as planned).

44 Letter from James P. Hackett, President and Chief Executive Officer, Ford, to Ajit Pai, Chairman, FCC, ET Docket No. 19-138, at 1 (filed Nov. 25, 2019).

45 Sue Marek, Light Reading, *Connected Car Industry Struggles With C-V2X vs. DSRC Questions* (Jan. 22, 2020), https://www.lightreading.com/connected-car-industry-struggles-with-c-v2x-vs-dsrc-questions/d/d-id/756970.

46 *5.9 GHz NPRM* at Statement of Chairman Ajit Pai.

Further, the sparse "planned" and "operational" DSRC deployments cited by DOT and other DSRC advocates are not an indication of true progress. Many, including those described on the record in this proceeding, are subsidized by massive taxpayer-funded grants. The City of Columbus, for example, has developed plans to outfit intersections and vehicles with DSRC technology using "$40 million" from the U.S. DOT.[47] The Colorado Department of Transportation similarly describes how it has "nearly 200 deployed devices that utilize DSRC or CV2X technologies," a number that might "triple"—to nearly 600 total—"enabled largely by federal funding support" in the form of a "$20 million" grant from the U.S. DOT.[48] In total, the U.S. DOT says that "over $1.5 *billion* in taxpayer funded" projects exist today.[49] Crediting DOT's estimate of 18,877 existing *or planned* devices with DSRC radios, the bill for federal taxpayers alone (*i.e.*, putting aside whatever state subsidies also exist) is nearly $80,000 per DSRC-connected device. While taxpayer-funded research and development has its place, these enormous expenditures of public funds have not changed the core fact that "[t]he promise of ubiquitous vehicle-to-vehicle and vehicle-to-infrastructure communications in this band has never materialized"[50] in the more than twenty years DSRC has held exclusive rights to this spectrum and will not do so any time soon.

These ongoing, isolated, taxpayer-subsidized DSRC projects make even less sense in light of the automotive industry's ongoing shift to C-V2X. Consider Ford's announcement that

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47 Letter from Michael H. Stevens, Chief Innovation Officer, City of Columbus, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1 (filed Jan. 17, 2020).

48 Letter from Shoshana Lew, Executive Director, Colorado Department of Transportation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 2 (filed Jan. 3, 2020).

49 DOT Slide Deck at slide 2 (emphasis added).

50 *5.9 GHz NPRM* ¶ 1.

it has adopted C-V2X, a technology "incompatible" with DSRC operations.[51] Ford's vehicles will not be able to communicate with DSRC-equipped infrastructure deployments or vehicles, wherever they may be. Worse, a C-V2X-equipped vehicle would not even be able to use the same channels, as DSRC and C-V2X "cannot . . . operate on a single channel without causing harmful interference."[52] And unless the Commission acts to modernize the band in this proceeding, C-V2X cannot deploy in the first place given the technology- and standard-specific rules governing the band.

In short, because of DSRC's failure to achieve commercial acceptance in the two decades since the FCC issued its original rules, the valuable 5.9 GHz band remains almost completely unused throughout the country. Without FCC action, the U.S. risks compromising existing Wi-Fi connectivity upon which Americans heavily rely, undermining the next generation of Wi-Fi, and stifling the advancement of connected automotive technologies. The time has come to move on.

III. THE COMMISSION SHOULD FINALLY PUT THE 5.9 GHZ BAND TO WORK FOR THE COUNTRY BY PERMITTING UNLICENSED OPERATIONS.

The Commission is right: this is "an opportune time to take a fresh look at the optimal use of this 75 megahertz of valuable spectrum that makes up the 5.9 GHz band."[53] The optimal decision—the one that would "maximize the effective and efficient use of the 5.9 GHz band"[54]—would be to permit unlicensed operations in the entire 5.9 GHz band. But NCTA's members nonetheless also support the Commission's compromise proposal to designate only 45 megahertz

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51 *Id.* ¶ 31.

52 *Id.*

53 *Id.* ¶ 9.

54 *Id.* ¶ 68.

for unlicensed operations and reserve the rest of the band for safety-of-life ITS functions. Adopting the NPRM proposal would be a major step forward for next-generation broadband and innovations that will power connected classrooms, smart homes, remote healthcare, and more.

A. The Optimal Solution Is for the Commission to Permit Unlicensed Operations in the Entire 5.9 GHz Band.

1. Opening the Entire Band to Wi-Fi Will Maximize the Potential of Mid-Band Wi-Fi.

Permitting unlicensed operations throughout the 5.9 GHz band will bring powerful benefits for Americans in both the short term and the long term. As described above, the 5.9 GHz band lies between the existing U-NII-3 band and the 6 GHz band, where the Commission is exploring options for unlicensed operations consistent with protecting incumbents. Bridging the gap between these two areas would advance the Commission's goal of an "enhanced ecosystem of unlicensed use."[55]

Linking together U-NII-3, 5.9 GHz, and the 6 GHz bands would "optimize the efficient and effective use" of spectrum.[56] It would eliminate, for example, the need for OOBE limits to protect an island of ITS spectrum in an area zoned for unlicensed use. U-NII-3, U-NII-4, and U-NII-5 could all operate at efficient power levels that maximize throughput for consumers. Access points and client devices would be more effective and less expensive, as there would be less need for expensive filters and other techniques to comply with OOBE limits to protect ITS operations. And Wi-Fi deployments would have maximum flexibility to use the channels most suited to their circumstances—whether that means using 160- or 320- megahertz channels where maximum throughput is needed (and use of those channels is consistent with any 6 GHz

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[55] *6 GHz NPRM* ¶ 20.

[56] *See 5.9 GHz NPRM* ¶ 63.

incumbents), or using numerous 40- or 80-megahertz channels where throughput needs are less extreme but there are more users and devices to accommodate (*e.g.*, in a dense area like a mall or convention center).

Maximizing the potential of the 5.9 GHz band will result in innovations whose full scope remains to be seen. But a key advantage of unlicensed spectrum is that anyone can use it, allowing creative approaches to flourish and, as Commissioner O'Rielly has said, "bring[ing] amazing technological innovations and capabilities forward, far exceeding anything we can imagine today."[57] At a minimum, making the most efficient use of the 5.9 GHz band for Wi-Fi would best position the United States to keep pace with rising demand and avoid a last-few-feet bottleneck just as enormous investments are bringing broadband to American homes at record speeds.

2. Other Non-Radio or Non-DSRC Automotive-Safety Technologies Are Delivering the Safety Benefits DSRC Advocates Promised.

In the 20 years DSRC has failed, other technologies have succeeded, often as a result of the Commission's rules governing use of other frequencies. Thus, the NPRM is correct in finding that "ITS functions originally contemplated for DSRC systems in the 5.9 GHz band are" already provided "in other bands or through other means."[58] Importantly, these successful automotive technologies operate today without blocking efficient use of valuable, scarce mid-band spectrum for other technologies.

As the NPRM explains, while commercial DSRC deployments are virtually non-existent, "[m]any auto manufacturers now include high-tech vehicle safety technologies using other

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[57] *Id.* at Statement of Commissioner Michael O'Rielly.

[58] *Id.* ¶ 60.

spectrum bands."[59] For example, the Commission "recently designated 5 gigahertz of spectrum at 76-81 GHz for . . . radar automotive applications that are integral to many active and passive safety features such as advanced obstacle detection and avoidance."[60] "Vehicle-resident technologies" including "adaptive cruise control, automatic emergency braking . . . , blind spot detection, and lane-keeping assist" are making a difference *today*—without DSRC's limitation of requiring that nearly every other car have the same technology—to improve highway safety.[61] In addition to using the spectrum the Commission recently made available for radar, these technologies also take advantage of developments in "cameras, sonar, . . . and/or LiDAR (light detection and ranging)."[62]

It is conceivable—though likely decades away given DOT's recognition that the "overall potential of V2V . . . is highly dependent on the number of safety applications deployed [and] the penetration of those applications in the fleet"[63]—that vehicle-to-vehicle communications could help alert drivers to unseen hazards that cameras and radar are currently unable to detect.[64] But it is more likely that by the time DSRC (or C-V2X) reached the level of ubiquity needed

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59 *Id.* ¶ 59.

60 *Id.*

61 *Id.* ¶ 59 n.101.

62 *Id.*

63 NHTSA, *Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application*, DOT HS 812 014 at 36 (Aug. 2014).

64 *See 5.9 GHz NPRM* at Statement of Commissioner Michael O'Rielly (V2V "may be able" to assist drivers "when there is no line of sight").

meaningfully to improve highway safety in that one narrow situation, other technologies using other means (or other spectrum) will have met or mooted that need.[65]

3. Other Spectrum, Such as the 4.9 GHz Band and Licensed Mobile Bands, Would Be a Better Home for ITS.

The Commission asks "whether there are other spectrum bands that might be better suited for supporting ITS applications."[66] There are, and we encourage the Commission to consider these options so that the 5.9 GHz band can be put to its highest and best use.

One option, should the Commission want to continue to dedicate spectrum for safety-of-life purposes, is the "grossly underutilized 4.9 GHz public safety band,"[67] on which the Commission currently has an open proceeding, teeing up the question whether all or part of the band should be redesignated for other uses.[68] As New America's Open Technology Institute has argued, "V2X safety applications" could use that band, allowing the Commission to open the 5.9 GHz band to support "contiguous, very wide-channel unlicensed access across the entire [U-NII-3], U-NII-4 and U-NII-5 bands."[69] This "longer-term solution would be a win-win for consumers who will benefit immediately from fast and affordable Wi-Fi 6 connectivity and down the road from more secure auto safety communications."[70]

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65 *See*, *e.g.*, *id.* ¶ 59 n.101 (noting that "further development of these types of technologies continues" and companies are developing "fully automated cars that do not assume widespread connected vehicle technology").

66 *Id.* ¶ 61.

67 Letter from Michael Calabrese, New America's Open Technology Institute, to Marlene H. Dortch, Secretary, FCC, at 1, ET Docket No. 19-138 (filed Dec. 9, 2019) (OTI Dec. 9, 2019 Ex Parte).

68 *Amendment of Part 90 of the Commission's Rules*, Sixth Further Notice of Proposed Rulemaking, 33 FCC Rcd. 3,261, 3,290-91 ¶¶ 85-86 (2018).

69 OTI Dec. 9, 2019 Ex Parte at 1.

70 *Id.*

Another, complementary option is one that C-V2X proponents already endorse—the use of commercial mobile spectrum licensed under the Commission's highly successful flexible-use rules. AT&T, for example, "expects to use existing cellular bands for infrastructure-based 5G automotive services that require ultra-reliable, low-latency communication (URLLC)."[71] Others are similarly exploring URLLC use cases like "autonomous driving for the automotive industry."[72] Given this possibility, the Commission should require proponents of reserving any portion of the 5.9 GHz band for ITS to explain why they need that exclusive spectrum allocation rather than other licensed spectrum already being considered for this purpose.

B. NCTA Also Supports the Proposed Band-Split Compromise, and Agrees the Commission Should Reserve, at Most, 30 Megahertz for ITS.

While the Commission should permit unlicensed operations throughout the 5.9 GHz band, we nonetheless strongly support the Commission's sensible compromise approach, permitting unlicensed operations in the lower 45 megahertz of the band and reserving the remaining spectrum for ITS safety functions. We agree with Chairman Pai that this proposal will "advance both unlicensed wireless innovation and automotive safety technologies."[73]

1. Access to the Lower 45 Megahertz Under Reasonable Operating Rules Is Needed to Create the Nation's First Fully Usable 160-Megahertz Wi-Fi Channel.

As discussed in substantial detail above, there is a great need for additional Wi-Fi spectrum and a correspondingly great opportunity that the 5.9 GHz band presents to help meet

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[71] Stephen Lawson, Light Reading, *For self-driving cars, exotic 5G tech will run on familiar frequencies* (Nov. 28, 2019), https://www.lightreading.com/iot/for-self-driving-cars-exotic-5g-tech-will-run-on-familiar-frequencies/d/d-id/755997.

[72] *See*, *e.g.*, Rohde & Schwarz, *Be ahead in 5G – URLLC testing*, https://www.rohde-schwarz.com/us/solutions/test-and-measurement/wireless-communication/wireless-5g-and-cellular/5g-test-and-measurement/urllc/urllc_233756.html.

[73] *5.9 GHz NPRM* at Statement of Chairman Ajit Pai.

that need. Enabling unlicensed operations in the lower 45 megahertz of the band will (1) create the first widely usable 160-megahertz Wi-Fi channel in the United States in combination with the U-NII-3 band, (2) relieve congestion and increase Wi-Fi capacity immediately, without new equipment in many cases, through software or firmware upgrades to existing devices, and (3) support licensed 5G (and existing licensed cellular traffic) through greater capacity for offloading.

2. 30 Megahertz Will Be Sufficient to Support ITS Safety Functions in the 5.9 GHz Band.

As described above, there is good reason to believe that no dedicated spectrum is needed for ITS technologies to deliver safety-of-life services, particularly in the 5.9 GHz band. Yet even if the Commission is persuaded that some spectrum in 5.9 GHz is needed for that purpose, the 30 megahertz the Commission proposes reserving will be more than sufficient and would be consistent both with C-V2X advocacy and Europe's approach to ITS spectrum. We defer to the Commission's judgment on how best to allot that spectrum, including whether to divide it between DSRC and C-V2X communications. But we agree with the Commission that vague, speculative use cases do not justify reserving more than 30 megahertz.[74]

V2X functions other than safety-of-life uses do not need or warrant exclusive spectrum. ITS advocates in this proceeding refer repeatedly to the 5.9 GHz band as the "safety band" or "safety spectrum," a mantra that is, of course, meant to give the misleading impression that the band is currently reserved for safety functions. As the Commission knows, that is not the case: only Channels 172 and 184 are reserved for safety-of-life and public safety.[75] Other messages

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[74] *See*, *e.g.*, *id.* ¶ 21.

[75] *Amendment of the Commission's Rules Regarding Dedicated Short-Range Communication Services in the 5.850-5.925 GHz Band (5.9 GHz Band); Amendment of Parts 2 and 90 of the*

(non-priority communications) are permitted in every other channel and need only give priority to safety messages.[76]

In fact, DSRC advocates made their intentions to use the band for a variety of non-safety applications clear by vehemently opposing a proposal that would ensure that the ITS portion of the 5.9 GHz band be used only for safety.[77] And even NHTSA has suggested that DSRC service channels could be used for everything from paying tolls,[78] to finding parking spots and paying parking fees,[79] paying at drive-thrus,[80] sending notifications to the driving public about "points of interest[],"[81] route guidance and navigation,[82] sending instant messages between vehicles,[83] and even video downloads.[84] ITS advocates have also admitted that DSRC "can support the entire suite of communications capabilities necessary for V2X services" that go beyond crash avoidance.[85] Many parties, including 5GAA, anticipate that C-V2X will be used for non-safety

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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, Memorandum Opinion and Order, 21 FCC Rcd. 8,961, 8,961, 8,980 ¶¶ 1, 38 (2006) (*2006 DSRC Order*); *see* 47 C.F.R. § 90.377(b) & nn.2, 4.

76 47 C.F.R. § 90.377(e).

77 *See* Letter from Harold Feld, Senior Vice President, Public Knowledge, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 et al., at 3 (filed Feb. 18, 2020).

78 Nat'l Highway Traffic & Safety Admin., *Vehicle Safety Communications Project Task 3 Final Report—Identify Intelligent Vehicle Safety Applications Enabled by DSRC* at 33 (Mar. 2005), https://rosap.ntl.bts.gov/view/dot/3925.

79 *Id.* at 39.

80 *Id.*

81 *Id.* at 37.

82 *Id.* at 36.

83 *Id.* at 34-35.

84 *Id.* at 39.

85 Letter from Scott Delacourt, Counsel, Association of Global Automakers, to Marlene H. Dortch, Secretary, Federal Communications Commission, ET Docket No. 13-49, GN Docket No. 18-357, at 4 (filed May 21, 2019).

purposes such as "infotainment."[86] 5G Americas has said that "enhanced road safety" is only "the initial goal" of the C-V2X project, and the "focus will expand to enable auxiliary services such as informational, social media and internet."[87] 5GAA itself says that it intends to use C-V2X not only to "improve safety," but for "productivity, mobility, and energy efficiency" use cases.[88] Laudable as those ends may be, they do not justify reverting back to outdated command-and-control-style spectrum management, and other unlicensed and auctioned bands can accommodate these commercial goals.

If the Commission is going to deviate from decades of its spectrum-management practices and give the automotive industry free access to valuable mid-band spectrum on the basis of its use for safety, it should allocate only the amount of spectrum that is genuinely needed for safety-critical uses. If the automotive industry wants a wireless technology for increasing fuel efficiency, paying tolls or parking fees, or ordering at a drive-thru,[89] it should either purchase access to licensed spectrum or share with others in unlicensed spectrum bands like its competitors in the marketplace.

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86 *E.g.*, GSMA, *Cellular Vehicle-to-Everything (C-V2X): Enabling Intelligent Transport* at 1 (2017), https://www.gsma.com/iot/wp-content/uploads/2017/12/C-2VX-Enabling-Intelligent-Transport_2.pdf; 5GAA, *5GAA Live Demos Show C-V2X as a Market Reality* (Nov. 14, 2019), https://5gaa.org/news/5gaa-live-demos-show-c-v2x-as-a-market-reality.

87 5G Americas, *V2X Cellular Solutions* at 16 (2016), https://www.5gamericas.org/wp-content/uploads/2019/07/5GA_V2X_Report_FINAL_for_upload-1.pdf.

88 Letter from Sean T. Conway, Counsel, 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-357, ET Docket No. 13-49, at 10 (filed Apr. 3, 2019) (5GAA April 3, 2019 Ex Parte).

89 John Kenney, Toyota Info Technology Center, USA, *Dedicated Short Range Communication (DSRC) Applications Tutorial*, at 23 (May 14, 2013), https://mentor.ieee.org/802.11/dcn/13/11-13-0541-01-0wng-dsrc-applications-tutorial.pptx// (listing these and other non-safety uses for DSRC).

C-V2X proponents have agreed that only 20 megahertz are needed to deliver safety messages. In arguing for its preferred band plan to the Commission, 5GAA has explained that its testing "demonstrate[s] C-V2X's ability to deliver important safety messages over a 20 MHz channel."[90] A 20-megahertz channel would be capable of delivering not only the Basic Safety Message, but also a whole host of others: "Signal Phase and Timing (SPaT), Emergency Vehicle Alert (EVA), Probe Data Management (PDM), Probe Vehicle Data (PVD), Signal Request Message (SRM), Signal Status Message (SSM), Geometric Intersection Description (GID/MAP), Traveler Information Message (TIM), and others encompassed by the Road Safety Message."[91] In other words, it would provide sufficient spectrum for C-V2X to deliver "many important safety applications, such as red light warnings and intersection movement applications, to enhance traffic systems and operations."[92] Indeed, C-V2X could also function in a 10-megahertz channel, according to 5GAA—though increasing the channel width to 20 megahertz apparently would help with "congestion control," "resiliency," and "soft multiplexing of the various peer-to-peer mode communications supported by C-V2X" and facilitate "channel sensing."[93] Thus, according to 5GAA, "20 MHz is the ideal channel size" for C-V2X.[94]

Reserving 30 megahertz of ITS spectrum is consistent with what Europe has set aside for automotive safety. The Commission rightly notes that "several countries have provided for ITS applications in spectrum blocks that are similarly sized to or even smaller than" what the

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90 Letter from Sean T. Conway, Counsel, 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-357, ET Docket No. 13-49, at 2 (filed July 8, 2019).

91 5GAA April 3, 2019 Ex Parte at 11-12.

92 *Id.* at 12.

93 *Id.* at 12 n.41.

94 *Id.* at 11.

Commission proposes to reserve here.[95] Europe, for example, "has provided a harmonized 30-megahertz channel (5.875-5.905 GHz) for ITS-based" safety applications.[96] Indeed, 5GAA has even argued that DSRC and C-V2X can coexist in the 30 megahertz of spectrum available in Europe.[97]

The Commission should assign no credit to broad, vague, or conclusory assertions regarding the "potential" for other, speculative V2X use cases. Even if the Commission does reserve 30 megahertz for ITS functions, it should not double down on the mistakes of the past by allocating additional spectrum for DSRC or C-V2X based on their assertions that more spectrum could support "advanced features" that may be "difficult to predict."[98] By distinguishing these undefined services from so-called "Basic-C-V2X," 5GAA acknowledges that these "advanced features" will not involve transmission of the Basic Safety Message that 5GAA has been testing or other messages it says are "encompassed by the Road Safety Message."[99] DSRC advocates make similar admissions: DriveOhio, for example, argues for reserving the full 5.9 GHz band in case "future development of additional V2X technologies" could make use of it.[100]

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95 *5.9 GHz NPRM* ¶ 21.

96 *Id.*; *see* 2008/671/EC: Commission Decision of 5 August 2008 on the harmonised use of radio spectrum in the 5875 - 5905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS), *available at*, *e.g.*, https://www.ecodocdb.dk/download/03f9ec4f-27f0/2008671EC.PDF.

97 *See* 5GAA, Position Paper, *Coexistence of C-V2X and ITS-G5 at 5.9 GHz*, at 2-5 (2018), http://5gaa.org/wp-content/uploads/2018/10/Position-Paper-ITG5.pdf.

98 *5.9 GHz NPRM* ¶ 21; *see also id.* ¶ 30 (describing 5GAA's argument regarding an "evolutionary path to 5G and subsequent wireless generations" that might use wider channels); 5GAA April 3, 2019 Ex Parte at 9, 13-16.

99 *See* 5GAA April 3, 2019 Ex Parte at 9, 11-12.

100 Letter from Patrick Smith, Interim Executive Director, DriveOhio, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1 (filed Jan. 17, 2020).

We agree with the Commission that "in the future, important vehicular-related applications can and will be accomplished by using a combination of both licensed and unlicensed devices and technologies and will not be limited to ITS operations in the 5.9 GHz band."[101] Thirty megahertz of precious spectrum in the 5.9 GHz band may be "part of [that] larger wireless ecosystem."[102] But the Commission is right that authorizing more than what is needed now does not "make[] much sense."[103] The failed DSRC experiment is a stark reminder of the perils of using government regulation to predict (and inevitably, influence) the course of technological progress. If 5G advocates' promises regarding its potential (such as for URLLC use cases described above) are accurate, more than the 30 megahertz the Commission proposed to reserve "appears unnecessary."[104] If their promises are inaccurate, it would be a mistake for the Commission to rely on the same kinds of promises here and leave precious spectrum vacant, rather than put it to use immediately for Wi-Fi 6 and other unlicensed technologies.

IV. DESIGNATING 5.9 GHZ SPECTRUM FOR UNLICENSED USE WILL CREATE SUBSTANTIAL ECONOMIC VALUE.

Enabling unlicensed operations in all of the 5.9 GHz band, or at least in the lower 45 megahertz, will result in substantial benefits. The Commission is correct that its actions will "create economic value by resolving uncertainty concerning the future designation of the 5.9 GHz band for both unlicensed uses and ITS services."[105] Moving forward now is far better than maintaining an uncertain status quo, and the NPRM's proposal is clearly better than earlier

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[101] *5.9 GHz NPRM* ¶ 21.

[102] *Id.*

[103] *Id.* ¶ 30.

[104] *Id.*

[105] *Id.* ¶ 64.

calls for a complicated, more regulatory co-channel detect-and-vacate mechanism that practically no party in this proceeding favors pursuing.[106]

Permitting unlicensed operations in the 5.9 GHz band will create enormous value for the U.S. economy by creating the first widely usable 160-megahertz Wi-Fi channel, relieving congestion and increasing Wi-Fi capacity, and supporting licensed 5G (and existing licensed cellular traffic) through greater capacity for offloading. Furthermore, this action will come at effectively no cost, because true safety functions can be delivered through the 30 megahertz the Commission proposes to reserve for ITS (to the extent the Commission determines that ITS interests need 5.9 GHz spectrum in the first place). Moving forward in this proceeding will result in consumers benefiting "immediately from fast and affordable Wi-Fi 6 connectivity" and from the Commission's modernized approach to ITS spectrum.[107]

A. Opening the Lower 45 Megahertz of the Band for Unlicensed Use Would Create Substantial Economic Benefits.

Opening the 5.9 GHz band for unlicensed use would create enormous economic benefits. As the Commission notes, previous research has attempted to quantify the benefits of unlicensed spectrum more generally,[108] with one recent study by Dr. Raul Katz concluding that Wi-Fi and other unlicensed technologies contributed at least $478 billion in economic surplus and $20 billion to gross domestic product annually as of 2018.[109] The economic contribution of Wi-Fi generally is expected to reach nearly a full trillion dollars by 2023.[110]

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106 *See id.*

107 OTI Dec. 9, 2019 Ex Parte at 1.

108 *5.9 GHz NPRM* ¶ 65.

109 Wi-Fi Global View at 33.

110 *Id.* at 6-7, 34.

The Commission can readily conclude that permitting unlicensed operations in the lower 45 megahertz of the 5.9 GHz band would build significantly on those economic contributions. In calculating the overall economic contribution to Wi-Fi, analysts have considered factors including the "[v]alue of residential Wi-Fi," the "[v]alue of enterprise Wi-Fi," the "[v]alue of cellular off-loading," the "[v]alue of locally manufactured Wi-Fi devices," the "[v]alue of bridging the digital divide," and the efficiency and innovation supported by higher speeds from Wi-Fi compared to other networks.[111] Newly available unlicensed spectrum, including a powerful 160-megahertz Wi-Fi channel, will help preserve and build upon those contributions. It is clear that freeing up additional spectrum and allowing for broader channels "enables both more traffic—from consumer use and from mobile off-loading from cellular networks—and faster data rates (speed) from the larger-bandwidth channels."[112] Although economists recognize the "data and methodological" challenges to quantifying these benefits,[113] those challenges do not change the fact that additional unlicensed spectrum is needed to keep up with "explosive demand."[114]

The Commission asks whether there are "appropriate way[s] to measure the benefits of introducing unlicensed operations in the 5.9 GHz band" apart from attempting to "estimat[e] the contribution to GDP of increases in Wi-Fi throughput."[115] There are. In the short term, for

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111 *Id.* at 34.

112 Diana Gelhaus Carew et al., *The Potential Economic Value of Unlicensed Spectrum in the 5.9 GHz Frequency Band* 9 (Dec. 2018), *as attached to* Letter from Diana Gelhaus Carew, Doctoral Fellow, RAND Corporation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49 (filed Dec. 13, 2018).

113 *Id.* at iii.

114 *See 6 GHz NPRM* at 2 & ¶ 5 (capitalization altered).

115 *5.9 GHz NPRM* at ¶ 65.

example, in addition to preventing a bottleneck that reduces the value of the highest-speed wired broadband offerings, new spectrum in 5.9 GHz will help alleviate congestion even for people on lower-speed plans. There is undoubted value, though perhaps difficult to quantify with precision, in ensuring that every consumer benefits fully from the capacity of the wireline network. And as discussed above, that effect will benefit consumers very quickly, as many existing 5 GHz-capable devices can take advantage of 5.9 GHz spectrum with software or firmware upgrades. In the longer term, this new spectrum and the higher speeds it enables will likely "bring amazing technological innovations and capabilities forward, far exceeding anything we can imagine today."[116] As the Commission moves forward in this proceeding, it should not lose sight of that great potential, notwithstanding the challenges of measuring with precision the incremental benefits of additional Wi-Fi spectrum.

B. There Is Effectively No Cost to Designating the Lower 45 Megahertz of the Band for Wi-Fi.

To weigh the "benefits . . . of designating" 45 megahertz for unlicensed operations like Wi-Fi against the "costs" of reducing the current spectrum reservation for DSRC, it is important to recognize a key aspect of the Commission's NPRM.[117] Because the NPRM proposes to reserve 30 megahertz for ITS, the "costs" side of the equation is a null set. As described above, all currently planned automotive safety use cases can be delivered in 30 megahertz, and 5G technologies such as URLLC that do not rely on dedicated 5.9 GHz spectrum are already being pursued to provide advanced safety functions that C-V2X is not currently capable of providing. Moreover, other vehicle-resident safety technologies that do not rely on 5.9 GHz spectrum are already providing many of the safety benefits DSRC advocates promised decades ago.

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[116] *Id.* at Statement of Commissioner Michael O'Rielly.

[117] *Id.* ¶¶ 65-66.

As a result, the Commission should recognize that comments that invoke unsupported figures like "$1 trillion annual cost associated with roadway crashes"[118] are flawed. The unstated, unproven, and clearly incorrect premises of this argument are that V2X technologies (1) would successfully prevent all or nearly all "roadway crashes" that currently occur and (2) would be unable to improve roadway safety without the entire 75 megahertz of the 5.9 GHz band. Likewise, "decreas[ing] traffic congestion," reducing "air pollution," and "conserv[ing] vital fossil fuels"[119] should not be counted as lost "benefits" from DSRC, as doing so would require assuming that only the technologies considered for the 5.9 GHz band (and not 5G technologies like URLLC) would be able to deliver those benefits. Clearly, these are important applications for automotive technologies, but the NPRM's proposal would not prevent their implementation.

Rather than rely on these unproven assumptions, the Commission should determine that with the 30 megahertz ITS needs for crash-avoidance applications, the NPRM's proposal produces enormous benefits without creating real-world costs.

V. THE COMMISSION HAS AMPLE AUTHORITY TO PUT THE 5.9 GHZ BAND TO PRODUCTIVE USE BY TRANSITIONING THE FEW EXISTING DSRC LICENSES IN THE NEAR TERM.

The Commission seeks comment on "appropriate transition paths" for the 5.9 GHz band, including how "statutory limitations or Commission policy" might "inform [its] actions."[120] Simply put, neither law nor policy limit the Commission's ability to (1) open the entire 5.9 GHz band to unlicensed broadband operations, with ITS either moved to other exclusive spectrum or

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[118] Letter from James M. Bass, Executive Director, Texas Department of Transportation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 5 (filed Feb. 24, 2020).

[119] *5.9 GHz NPRM* ¶ 67.

[120] *Id.* ¶ 34.

delivered over existing spectrum allocations; or (2) in the alternative, adopt the NPRM's proposal to split the band between unlicensed and ITS. Title III provides the Commission expansive authority to change spectrum rules in the "public interest," and Section 316 and the DSRC regulations also give the Commission the power to modify the small number of existing licenses for DSRC roadside units. Accordingly, the Commission can move expeditiously to ensure that the 5.9 GHz band can be used to improve broadband for consumers throughout the United States.

A. The Commission Has Authority to Transition the 5.9 GHz Band from the Current DSRC-Specific Rules to Enable Unlicensed Use.

The Communications Act requires the Commission to "[a]ssign bands of frequencies to the various classes of stations, and assign frequencies for each individual station;"[121] to issue "regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the provisions of this chapter;"[122] and to "[m]ake such rules and regulations and prescribe such restrictions and conditions, not inconsistent with law, as may be necessary to carry out the provisions of" the Act.[123] In the area of radio communications, the Commission is further charged with issuing, "consistent with the public interest, convenience, and necessity, . . . reasonable regulations . . . governing the interference potential of devices which in their operation are capable of emitting radio frequency energy."[124] Section 303 is thus

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[121] 47 U.S.C. § 303(c).

[122] *Id.* § 303(f).

[123] *Id.* § 303(r); *see also id.* § 154(i) ("The Commission may perform any and all acts, make such rules and regulations, and issue such orders, not inconsistent with this chapter, as may be necessary in the execution of its functions.").

[124] *Id.* § 302a(a).

both expansive and directly applicable here; it supplies ample authority for the Commission to revise the current DSRC-specific rules as contemplated in the NPRM.

The Commission has long relied on these broad grants of authority, without controversy, to issue and revise rules governing the 5.9 GHz band. The Commission relied on "Sections 1, 4(i), 302, 303(f) and (r), and 332 of the Communications Act of 1934" when "establish[ing] service rules to govern the licensing and use" of the 5.9 GHz band for DSRC in 2004.[125] It cited the same authority in 2006 in designating two channels in the band specifically for "safety of life and property applications" and "public safety applications involving safety of life and property" and amended rules regarding site construction and power reduction.[126] It also relied on these and other broad grants of authority when previously making spectrum available for unlicensed operations and adopting related rule modifications.[127] Congress has explicitly provided the Commission authority over "spectrum reallocation," an area in which the Commission has "expertise" and receives a "heightened degree of deference."[128] The NPRM's proposals are therefore well within the FCC's authority.

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[125] *Amendment of the Commission's Rules Regarding Dedicated Short-Range Communication Services in the 5.850-5.925 GHz Band (5.9 GHz Band); 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, 19 FCC Rcd. 2,458, 2,461, 2,497 ¶¶ 5, 90 (2004) (*DSRC Licensing Order*).

[126] *2006 DSRC Order* at 8,961 ¶ 1.

[127] *See*, *e.g.*, *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. 4,127 ¶¶ 2, 138 (2014) (citing Sections 4(i), 301, 302, 303(e), 303(f), 303(g), and 303(r) of the Communications Act of 1934), *recon. denied*, Memorandum Opinion and Order, 31 FCC Rcd. 2,317 (2016).

[128] *Teledesic LLC v. FCC*, 275 F.3d 75, 84 (D.C. Cir. 2001); *see also infra* Section V(B)(2).

The Amateur Radio Emergency Data Network (AREDN) asserts that the Commission "apparently does not have authority to re-purpose the 5.9 GHz band" for several reasons, but none of their arguments are persuasive.[129]

AREDN first points out that, in 1998, Congress directed the Secretary of Transportation to "develop and maintain a national ITS architecture,"[130] while also requiring the Commission to "complete[] a rulemaking *considering* the allocation of spectrum for [ITS]."[131] According to AREDN, Congress thereby "effectively told the FCC to allocate spectrum to ITS" and "indicated its expectation that" the particular allocation the Commission selected "would remain in place."[132] That simply does not follow. There is an obvious difference between directing the Commission to "consider" a particular allocation and mandating such an allocation, let alone one that may never change. Here, the Commission fulfilled its directive—but is plainly entitled to revisit the specifics of the allocation.

Second, AREDN argues that statutes directing the Department of Transportation to conduct an ITS program trump the Communications Act's broad delegations of authority to the FCC over wireless communications, particularly given Congress's continued funding of the ITS program.[133] But the Department of Transportation itself has never raised this argument, and for good reason: none of the statutes AREDN cites discusses the 5.9 GHz band or otherwise requires any particular spectrum allocation. There is no conflict between Title 47 and Title 23,

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[129] Comments of AREDN at 1, ET Docket No. 19-138 (filed Feb. 7, 2020) (AREDN Comments).

[130] *Id* at 17.

[131] Transportation Equity Act for the 21st Century, Pub. L. No. 105-178, § 5206(f), 112 Stat. 107, 457 (1998) (emphasis added).

[132] AREDN Comments at 18, 20.

[133] *See id.* at 18-20.

and the Communications Act certainly is not "superseded by transportation statutes."[134] While Congress has accorded the Secretary of Transportation authority related to transportation policy aspects of a national ITS program, spectrum allocation remains the responsibility of the Commission.

Finally, AREDN argues that because the Spectrum Act of 2012 *required* the Commission to "begin a proceeding to allocate" the U-NII-2B band, but mentioned that NTIA should *study* the use of the 5.9 GHz band for unlicensed use, there is a "negative implication" that the FCC *may not* permit unlicensed operations in the band.[135] There is no such negative implication, whether based on the Spectrum Act alone, or the "Spectrum Act and the ITS Act" together.[136] To start, the statute AREDN cites—47 U.S.C. § 1453—directed NTIA (not the Commission) to evaluate the "risk to Federal users" if unlicensed devices operated in the 5.9 GHz band.[137] Directing NTIA to study the effect on Federal users of introducing U-NII devices in the band simply cannot reasonably be interpreted to diminish the Commission's authority to permit unlicensed operations in the band. Indeed, the NTIA study itself indicates that it provides an

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[134] *Id.* at 27. AREDN also appears to argue that *Chevron* deference does not apply to the Commission's interpretation of Section 303 and other areas of the Communications Act because *Chevron* deference does not apply to interpretations of statutes establishing an agency's jurisdiction. *Id.* at 34-35. The Supreme Court has rejected that understanding of *Chevron* deference as "false." *City of Arlington v. FCC*, 569 U.S. 290, 297 (2013). The Commission need not rely on *Chevron* deference here, however, where the provisions of the Communications Act clearly provide the Commission authority to determine spectrum allocations.

[135] AREDN Comments at 32-33. Notably, AREDN's argument that Congress *forbade* the Commission from putting the 5.9 GHz band to productive use by telling it to "consider" unlicensed operations in the band contradicts AREDN's other argument that "[b]y telling the FCC to *consider* the spectrum needs of ITS, Congress effectively *told the FCC to allocate spectrum to ITS*." *Id.* at 18 (emphasis added). The fact is, however, that "consider" means exactly that—it does not *require* any specific outcome.

[136] *Id.* at 34.

[137] 47 U.S.C. § 1453(b)(1).

assessment of "the risk to federal users if the Federal Communications Commission (FCC) allows U-NII devices to operate in the . . . 5850-5925 MHz band[]."[138]

Notably, AREDN is incorrect to suggest that *Motion Picture Association of America, Inc. v. FCC* (*MPAA*)[139] is relevant to the question of FCC authority over the 5.9 GHz band.[140] This proceeding is completely unlike *MPAA*, in which the question was whether Congress had *implicitly* granted the Commission authority to issue rules mandating programming content, an area fraught with First Amendment concerns.[141] The constitutional concerns raised in that case do not apply in this situation, and as noted above the Commission receives significant deference in the context of spectrum reallocation.

B. The Commission Has Authority to Apply any New Rules Necessary to Put Idle Spectrum to Productive Use.

1. On-Board Units

In the case of on-board units (OBUs), the Commission should proceed by revising its rules, as opposed to individual license modifications. As the Commission notes in the NPRM, OBUs "operate under our Part 95 rules and do not require individual license authorizations (i.e., they are 'licensed by rule')."[142] Operations "without individual licenses . . . must comply with

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[138] National Telecommunications and Information Administration, *Evaluation of the 5350-5470 MHz and 5850-5925 MHz Bands Pursuant To Section 6406(B) Of The Middle Class Tax Relief And Job Creation Act Of 2012* at i (Jan. 2013).

[139] 309 F.3d 796 (D.C. Cir. 2002).

[140] AREDN Comments at 33-34.

[141] *See MPAA*, 309 F.3d at 801-07.

[142] *5.9 GHz NPRM* ¶ 35; *see* 47 C.F.R. § 95.305.

all applicable rules in [Part 95]."[143] The Commission can, of course, change the "applicable rules" in Part 95 and has done so in the past.[144]

The Commission asks whether, given the "limited nature of deployment of [OBUs] in vehicles," it should take action "to remove [existing OBUs] from service or require other suitable modifications consistent with the revisions to the 5.9 GHz band that we ultimately adopt."[145] It should. It is undisputed that automakers have installed very few OBUs on commercially marketed vehicles. Accordingly, notwithstanding enormous spectrum availability, current OBUs are almost entirely limited to testing or pilot projects. Requiring "suitable modifications" to those few OBUs—consistent with the new rules—will actually *benefit* operators, since those units' only practical use is to communicate with other ITS radios. Such radios will, of course, have to be produced in compliance with the new rules.

Requiring operators to "phase out" the use of these frequencies is also consistent with Commission precedent.[146] For example, the Commission's 2017 Report and Order modifying the Part 95 rules concluded that "prohibiting voice-obscuring features in the Personal Radio Services" was "in the public interest."[147] The Commission declared it would "no longer allow equipment to be certified under Part 95" that did not comply with the new rules "90 days after the effective date" of the new rules. It further prohibited manufacture, sale, or import of

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[143] 47 C.F.R. § 95.305.

[144] *See*, *e.g.*, *Review of the Commission's Part 95 Personal Radio Services Rules*, Report and Order, 32 FCC Rcd. 4,292, 4,293, 4,301-02 ¶¶ 1-2, 25-26 (2017) (*Part 95 PRS Revision*) ("comprehensive reorganization of and update to the Commission's Part 95 Personal Radio Services (PRS) rules," including substantive "changes . . . in the interest of public safety" and prohibiting the use of equipment inconsistent with the new rules).

[145] *5.9 GHz NPRM* ¶ 35.

[146] *Part 95 PRS Revision* ¶ 25.

[147] *Id.* ¶ 26.

"previously certified" radios as of "two years after the effective date" of the new rules.[148] The Commission did not "prohibit[] the use of the older units," finding that it would have "place[d] a significant burden on consumers and manufacturers, while also creating an enforcement challenge" given the widespread consumer use of devices that "include[d] such features."[149] Here, those concerns do not apply—as set forth above, there is virtually no consumer use of OBUs, and the few currently employed for other purposes will need to be modified to remain useful after the Commission acts in this proceeding.

2. Roadside Units

In the case of roadside units (RSUs), the Commission should adopt its proposal to "modify existing DSRC licenses to allow operation in only" the bands reserved for DSRC and C-V2X.[150] Unlike OBUs, RSUs are individually licensed under Part 90. But Section 316 permits the Commission to modify those licenses if, in its judgment, doing so "will promote the public interest, convenience, and necessity."[151] As the D.C. Circuit has explained, "Section 316 grants the Commission broad power to modify licenses; the Commission need only find that the proposed modification serves the public interest, convenience and necessity," and the Commission may even "override" licensees' "strong and legitimate interest in administrative repose . . . if doing so serves the public interest, convenience and necessity."[152]

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[148] *Id.* ¶ 25.

[149] *Id.* ¶ 26.

[150] *5.9 GHz NPRM* ¶ 34.

[151] 47 U.S.C. § 316(a)(1).

[152] *Cal. Metro Mobile Commc'ns, Inc. v. FCC*, 365 F.3d 38, 45 (D.C. Cir. 2004).

Section 316 is, of course, closely tied to the Commission's authority to "regulat[e] and oversee[] radio spectrum," under Section 303 of the Communications Act.[153] This is an area in which the Commission's authority is at its zenith—"spectrum reallocation rules . . . are just the sort of technical rules within its area of expertise" that merit a "heightened degree of deference."[154] As the D.C. Circuit explained in detail in *Teledesic*, in managing spectrum "[t]he Commission correctly conceives of its role in prophetic and managerial terms"—it must "predict the effect and growth rate of technological newcomers on the spectrum, while striking a balance between protecting valuable existing uses and making room for . . . new technologies."[155] "Its decisions about how best to strike this balance" are "therefore entitled" to the heightened "deference traditionally accorded decisions regarding spectrum management."[156]

In the current proceeding, the Commission's extensive authority under Sections 303 and 316 is further bolstered by other statutory provisions directing the Commission to encourage the deployment of broadband, including through the identification of suitable mid-band spectrum for unlicensed use. The MOBILE NOW Act, for example, requires the Commission to identify at least 100 megahertz of new spectrum below 8 GHz for unlicensed use.[157] Adopting the NPRM proposal, or permitting unlicensed operations throughout the 5.9 GHz band, would contribute to satisfying that requirement. Likewise, and more broadly, Section 706(a) of the Telecommunications Act of 1996 directs the Commission in relevant part to "encourage the

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[153] *Teledesic*, 275 F.3d at 79; *see supra* Section V(A) (setting forth the most pertinent portions of Section 303).

[154] *Teledesic*, 275 F.3d at 84.

[155] *Id.*

[156] *Id.* (citing *Telocator Network of Am. v. FCC*, 691 F.2d 525, 538 (D.C. Cir. 1982)).

[157] 47 U.S.C. § 1502(a)(2)(A).

deployment . . . of advanced telecommunications capability to all Americans . . . by utilizing, in a manner consistent with the public interest, convenience, and necessity . . . regulating methods that remove barriers to infrastructure investment."[158] The statute further defines "advanced telecommunications capability" to include "broadband telecommunications capability."[159] As set forth above, NCTA and others urge the Commission here to use its regulatory authority to remove barriers to investment in additional broadband capability by ensuring that the 5.9 GHz band can be used to improve delivery of broadband services to all Americans.

Modifying existing licenses consistent with such new rules for the band is clearly in the public interest under Sections 303 and 316 of the Communications Act, as well as these other statutory authorities. The public will benefit greatly from advances in wireless broadband in the portion of the band permitting unlicensed operations. At the same time, in the vast majority of the country, there are simply *no* RSU licensees—and certainly no DSRC transmissions—to speak of. The Commission has significant latitude in these circumstances to modify existing licenses or simply to decide, in its "judgment," that the use by RSUs of "any channel" no longer reserved for ITS "is not in the public interest."[160]

Moreover, RSU license holders have minimal interests in repose compared to many other licensees. From the time of the *DSRC Licensing Order* establishing licensing and service rules for DSRC in the 5.9 GHz band, it has been clear that "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," and the "use of any such channel may be restricted as to

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[158] *Id.* § 1302(a).

[159] *Id.* § 1302(d)(1).

[160] 47 C.F.R. § 90.377(c).

specified geographical areas, maximum power, or such other operating conditions, contained in this part or in the station authorization."[161]

Licensees also have had notice since at least 2013 that the Commission had begun to consider "allowing U-NII devices to share the 5.9 GHz band with DSRC operations."[162] Since 2016, the prospect of re-channelizing the band to put "safety-of-life DSRC operations in the upper 30 megahertz of spectrum," with no priority for other DSRC communications elsewhere, has been expressly on the table.[163] When the Commission released the 2016 Public Notice, Commissioners O'Rielly and Rosenworcel specifically noted that it had "been nearly 17 years since the Commission allocated 5.9 GHz spectrum for DSRC"; that in the "intervening years . . . there have been enormous changes in technology"; and that the Commission was looking for the "best means to ensure the most effective and efficient use of the 5.9 GHz band," including for "unlicensed" use.[164] Then-Commissioner Pai likewise noted that when the Commission made the DSRC allocation "at the end of the last century," "we did not have the commercial applications or new radar technologies that can play a key role in improving highway safety and thus saving lives."[165] Licensees in such situations are rightly expected to develop their

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[161] *Id.*; *see DSRC Licensing Order* App. A (describing final rules adopted).

[162] *5.9 GHz NPRM* ¶ 7; *see 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. 1,769, 1,776 ¶ 22 (2013) (*2013 5 GHz NPRM*).

[163] *The Commission Seeks to Update and Refresh the Record in the "Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band" Proceeding*, Public Notice, 31 FCC Rcd. 6,130, 6,137-38 (2016).

[164] *Id.* at Joint Statement of Commissioners Michael O'Rielly and Jessica Rosenworcel.

[165] *Id.* at Statement of Commissioner Ajit Pai.

operations with the Commission's long-open proceedings "in mind."[166] Commissioners O'Rielly and Rosenworcel even specifically warned Toyota, in a letter open to the public, that it should "keep in mind" the Commission's ongoing consideration of the band, including "re-channeliz[ing]" it, "when committing capital expenditures to DSRC technology."[167]

As the Commission notes in the NPRM, the D.C. Circuit has interpreted Section 316 "not to extend to any 'fundamental change' to the terms of a license."[168] But tailoring existing licenses to match the Commission's proposed new band-split will cause no more than a "minor disruption" in actual DSRC safety "operations,"[169] because there are so few existing ITS radios and 30 megahertz will more than adequately house these licenses. It would be no more disruptive under the Commission's precedent for the few existing operations to move to new spectrum, should the Commission choose to do so in order to make the entire 5.9 GHz band available for unlicensed use.[170] This is a factor that courts and the Commission have considered

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166 *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands*, Report and Order and Order of Proposed Modification, 27 FCC Rcd. 16,102, 16,154 ¶ 124 (2012) (noting that the Commission's "proceeding proposing full power flexible use . . . has been open since 2004, before satellites operating in the 2000-2020 MHz band were launched, or even . . . designed," so the Commission "expect[ed] that the satellites were designed with this overload scenario in mind").

167 Letter from Michael O'Rielly, Commissioner, FCC, and Jessica Rosenworcel, Commissioner, FCC, to James E. Lentz, Chief Executive Officer, Toyota Motor North America (May 10, 2018), https://docs.fcc.gov/public/attachments/DOC-350655A1.pdf.

168 *5.9 GHz NPRM* ¶ 34 (citing *Cellco Partnership v. FCC*, 700 F.3d 534, 543-44 (D.C. Cir. 2012)).

169 *Cal. Metro Mobile*, 365 F.3d at 46 (internal quotation marks omitted); *see Improving Public Safety Communications in the 800 MHz Band*, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order, 19 FCC Rcd. 14,969, 15,011 n. 214 (2004).

170 *See*, *e.g.*, *Establishing Rules and Policies for the Use of Spectrum for Mobile Satellite Services in the Upper and Lower L-band*, Report and Order, 17 FCC Rcd. 2,704 2,705-06 ¶¶ 1, 3 (2002) (migrating incumbents to new spectrum).

when evaluating whether a modification served the public interest under Section 316. Indeed, earlier this year, the Commission reasoned that "the primary consideration in determining whether a 316 modification is valid is whether the licensee will be able to provide substantially the same service after the modification as it was able to provide before."[171] In the C-Band proceeding, the Commission concluded under that standard that reclaiming *300 megahertz* of spectrum from incumbent satellite operators was not a fundamental change under Section 316 because, even though incumbents had significant operations in the band across the United States, they could continue their existing services in the remaining 200 megahertz of the C-Band by using technologies like compression.[172]

The case for Section 316's application is significantly stronger here. DSRC as envisioned by the Commission in 1999 has failed to materialize; rather than the "widespread . . . base" the Commission envisioned when endorsing the DSRC standard,[173] DSRC deployments are few and far between, with RSU deployments limited to particular heavily subsidized testing areas and pilots. Requiring licensees to halt use of all frequencies in the 5.9 GHz band, if the Commission makes the entire band available to unlicensed operations, would cause no significant disruption to operations that are in effect non-existent, and even that would be mitigated if licensees use other spectrum to deliver their services. Moreover, as the NPRM notes, if the Commission adopts its proposal to reserve 30 megahertz for automotive safety, that amount of spectrum will be "greater than the amount that was dedicated for public

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[171] *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Order of Proposed Modification, FCC 20-22, GN Docket No. 18-122, ¶ 135 (rel. Mar. 3, 2020) (*C-Band Order*).

[172] *See id.* at ¶¶ 130-31, 138-39.

[173] *DSRC Licensing Order* ¶ 22.

safety purposes" before the issuance of the NPRM.[174] In those 30 megahertz, licensees could continue to "provide essentially the same services" (to the limited extent that any exist).[175] The Commission need not even modify the licenses themselves to distinguish between the authorizations to use C-V2X spectrum and any DSRC spectrum, as the licenses themselves grant permission to operate in the Intelligent Transportation Service, rather than to use a particular technological standard for transmissions.[176]

C. The Commission Should Transition Existing DSRC Licenses as Quickly as Possible.

The Commission asks whether it should "allow existing DSRC roadside infrastructure to continue to operate under the licenses they hold until the end of their license term without renewal expectation," or whether that "approach would adversely affect the introduction of unlicensed operations and C-V2X applications."[177] It also asks what an "appropriate transition timeline for all DSRC operations" would be if the Commission does not let these licenses expire at the end of their terms.[178]

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[174] *5.9 GHz NPRM* ¶ 31 n.66.

[175] *Cmty. Television, Inc. v. FCC*, 216 F.3d 1133, 1141 (D.C. Cir. 2000). Importantly, the question for purposes of Section 316 is *not* whether the spectrum still reserved for ITS is ideal for DSRC, C-V2X, or any other ITS technology assuming it becomes ubiquitous, but rather whether, in the case of the particular licensee at issue, the licensee could deliver essentially the same services it does now. *See C-Band Order* ¶ 139 & n. 392. The former question may well be relevant to the Commission's broader decision-making regarding the ideal allocation of scarce spectrum in the band, but that is different from the "fundamental change" principle for analysis under Section 316.

[176] *See*, *e.g.*, Public Safety and Homeland Security Bureau, *Radio Station Authorization*, Call Sign WQBG981, File No. 0006360217 (July 9, 2014), http://wireless2.fcc.gov/UlsApp/letterPdf/LetterPdfController?licId=2660457&letterVersionId=64&autoLetterId=7950929&letterCode=AZ&radioServiceCode=IQ&op=LetterPdf&licSide=Y&archive=null&letterTo=L.

[177] *5.9 GHz NPRM* ¶ 36.

[178] *Id.*

The Commission should exercise its authority to modify licenses and require all DSRC RSUs and OBUs to modify their operations consistent with the Commission's final rules. A six-month transition period, as the Commission proposes, would be reasonable.[179] There is no good reason to let either OBUs or licensed RSUs transmit DSRC signals across the entire 5.9 GHz band when there is a viable alternative, even if only in the limited areas of the country where those OBUs and RSUs actually exist. Unnecessarily leaving them in place would undermine whatever new policy the Commission adopts for the band, both for C-V2X and unlicensed technologies like Wi-Fi—particularly where the RSUs are licensed to broadcast in urban centers and other populated or frequented areas. The City of Columbus, for example, has one registered transmitter under call sign WRCM688, in the River South District next to Bicentennial Park. There may be few OBUs that receive transmissions from that RSU, but if it broadcasts in all channels of the 5.9 GHz band until the license expires in 2028, it is bound to impact unlicensed devices taking advantage of U-NII-4 spectrum. Modifying that station to transmit DSRC signals only in 10 megahertz, or installing a radio capable of transmitting C-V2X signals in any channels made available by the FCC, is a reasonable consequence of the Commission's important actions to put the 5.9 GHz band to efficient, productive use.

VI. THE COMMISSION SHOULD ADOPT TECHNICAL RULES FOR THE U-NII-4 BAND THAT PROMOTE INNOVATION AND BROADBAND DEPLOYMENT.

As the Commission has recognized, the 5.9 GHz U-NII-4 band is "especially well positioned to deliver immediate and potentially significant benefits when used by unlicensed devices and can help the Commission find new ways to meet the continued demand for spectrum access" because of its proximity to the U-NII-3 band.[180] NCTA agrees. By any measure,

[179] *Id.*

[180] *Id.* ¶16.

unlicensed operations under the U-NII-3 rules have been an enormous success.[181] To ensure that the new U-NII-4 band can build upon this success, the Commission should adopt its proposals to enable in-band U-NII-4 operations under "technical and operational rules . . . [similar] to the U-NII-3 band."[182] In addition, the Commission should establish reasonable OOBE limits informed by the longstanding unlicensed use of the adjacent U-NII-3 band. The Commission's decisions should not, however, be guided by a recent NHTSA 5.9 GHz testing report that contains significant flaws.

A. The Commission Should Adopt Its Proposal to Enable In-Band Operations Under Technical Rules that Align with the Current U-NII-3 Band.

The Commission correctly concludes "that U-NII-4 devices [should] be permitted to operate at the same power levels as U-NII-3 devices," including adherence to the same in-band radiated power and power spectral density limits.[183]

Today, 5 GHz unlicensed operations are a "vital component of the communications landscape."[184] This is largely due to the flexible operating rules the Commission established for the U-NII-3 band.[185] These rules have made U-NII-3 particularly attractive for Wi-Fi, resulting in widespread, intensive use of this spectrum.[186] Indeed, in cable Wi-Fi networks U-NII-3 has long been the workhorse U-NII band. Applying the U-NII-3 power limits, including the 1 W

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[181] *See supra* Section II(A)(1)-(2).

[182] *5.9 GHz NPRM* ¶ 53.

[183] *Id.* ¶¶ 53, 57; s*ee also id.* at Appendix B, Proposed Rules § 15.407(a).

[184] *Id.* ¶ 6.

[185] *See, e.g.*, Comments of NCTA – The National Cable & Television Association at 18, ET Docket No. 13-49 (filed May 28, 2013) (NCTA 2013 Comments); Reply Comments of NCTA – The National Cable & Television Association at 22-23, ET Docket No. 13-49 (filed July 24, 2013) (NCTA 2013 Reply Comments).

[186] *See, e.g.*, NCTA 2013 Comments at 18; NCTA 2013 Reply Comments at 22-23.

maximum conducted power limit, to U-NII-4 will enable network operators and device manufacturers to build on the success of U-NII-3.

In addition, the Commission should adopt its proposal to authorize U-NII-4 devices without requiring any "special frequency avoidance techniques" or similar constraints.[187] As discussed above, imposing restrictions such as DFS or the "detect and avoid" approach considered earlier in this proceeding unnecessarily would introduce complexity and delay and result in degraded performance.[188]

Fortunately, such restrictions are unnecessary to protect incumbents. For example, as the Commission has recognized, U-NII-3 devices have shared spectrum with co-channel federal incumbents for years without any specialized frequency avoidance techniques, and "in general sharing has been successful."[189] Similarly, the Commission explains that the "expected unlicensed device use cases [for the U-NII-4 band], which primarily involve delivery of Wi-Fi signals along with the distance to FSS satellites in geostationary orbit, should protect FSS uplink operations from harmful interference."[190] Thus, the Commission should not impose restrictive operating rules in U-NII-4, which would dramatically decrease the band's utility with no offsetting public benefit.

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187 *5.9 GHz NPRM* ¶¶ 57-58.

188 *See supra* pp. 9-10; *see also 5.9 GHz NPRM* ¶ 17.

189 *5.9 GHz NPRM* ¶ 57.

190 *Id.* ¶ 58.

B. The Commission Should Establish Reasonable OOBE Limits for the U-NII-4 Band.

The Commission seeks comment on appropriate OOBE limits for U-NII-4 devices assuming it designates only the 5850-5895 MHz portion of the band for unlicensed operations.[191] The Commission should establish baseline OOBE rules based on its proposal to harmonize these requirements with existing U-NII-3 limits, while recognizing that, depending on how it measures emissions, these limits may be too aggressive. Moreover, signals from U-NII-4 devices that operate exclusively indoors would be subject to substantial attenuation. The Commission's rules should reflect this fact by establishing more flexible OOBE limits for these devices.

1. The Commission Should Establish Reasonable Default OOBE Limits for U-NII-4.

The Commission proposes to set an "OOBE limit of -27 dBm/MHz at or above 5.925 GHz" for U-NII-4 devices, noting that existing U-NII-3 devices already comply with this limit today.[192] The existing U-NII-3 OOBE limits provide a reasonable starting point for considering the most stringent limits that the Commission should apply to a U-NII-4 device. Because the top of the 5850-5895 MHz band is 45 MHz closer to the upper edge of the 5.9 GHz band than U-NII-3, U-NII-4 device emissions would need a steeper "roll off" in order to meet -27 dBm/MHz at or above 5925 MHz. Thus, there is no need to explicitly set interim OOBE limits for the upper U-NII-4 band edge beginning at 5895 MHz.[193]

Using the existing U-NII-3 OOBE limits as a starting point for U-NII-4 is particularly appropriate for establishing co-existence with ITS operations. This is because the Commission

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[191] *Id.* ¶¶ 53-56.

[192] *Id.* ¶ 54.

[193] *See id*. (seeking comment on whether to establish a separate OOBE limit at 5895 MHz).

has already repeatedly made clear that ITS would be operating in this spectral environment. Indeed, the Commission did so in its very first order in 1999 that allocated the 5.9 GHz band for ITS and set basic technical rules for DSRC operations.[194] In that order, the Commission noted generally that FCC rules "already permit a variety of unlicensed operations" in the adjacent 5.8 GHz band, and specifically that its rules permit "unlicensed spread spectrum communications devices to operate in the 5.725-5.850 GHz band with a maximum peak transmitter output power of 1 watt with antenna gain of up to 6 dBi."[195]

More recently, the Commission has on two occasions considered and rejected requests by DSRC interests to dramatically lower the OOBE limits for adjacent unlicensed users under new Part 15 Subpart E rules, reiterating that "[u]nlicensed devices are *already allowed* to operate within the 5.825-5.85 GHz band."[196] As the Commission concluded in 2016, the "level of protection afforded to DSRC systems [by the current U-NII-3 OOBE limits] is sufficient," and it "[does not] consider additional protections from adjacent band signals to be necessary."[197] This conclusion would apply equally to new U-NII-4 devices that adhere to those same OOBE limits.

But even if the Commission had not been so explicit, DSRC proponents are—or certainly should have been—well aware of the 5.9 GHz operating environment that has been in place since

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[194] *See generally 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. 18,221 (1999).

[195] *Id.* ¶ 28.

[196] *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. 4,127 ¶ 94 (emphasis added) (2014); *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Memorandum Opinion and Order, 31 FCC Rcd. 2,317 ¶ 23 (2016) (*5 GHz U-NII Devices Memorandum Opinion and Order*).

[197] *5 GHz U-NII Devices Memorandum Opinion and Order* ¶ 23.

the turn of the last century. After all, when IEEE adopted the 802.11p standard for DSRC operations in 2010, Wi-Fi operations in the adjacent 5.8 GHz band had already been standardized for over a decade.[198] As the FCC's Technological Advisory Council has explained, "basic principles of spectrum utilization" dictate that "services should plan for non-harmful interference from [the] signals that are nearby in frequency, space or time."[199] Thus, it is "important to design systems to operate effectively as if other systems occupied" that spectrum.[200]

For these reasons, the Commission can confidently begin its examination of OOBE limits for U-NII-4 based on the existing U-NII-3 OOBE requirements and reject requests by ITS interests to impose OOBE restrictions in excess of those limits.

2. U-NII-4 OOBE Rules Should Provide Additional Flexibility for Indoor-Only Operations.

The Commission's U-NII-4 OOBE rules should also reflect the fact that indoor-only operations are unlikely to result in harmful interference to any incumbent systems. This is due primarily to the substantial attenuation experienced by signals propagating at the top of the 5 GHz band as a result of building entry loss. Thus, a class of unlicensed devices that would be restricted to indoor operation—*e.g.*, because they could function only when connected to AC power and do not have enclosures that protect against ingress from water or other outdoor elements—could successfully operate using a far less restrictive transmit mask.

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198 *See* IEEE Standards Association, *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*, https://standards.ieee.org/standard/802_11p-2010.html.

199 FCC Technological Advisory Council, *Basic Principles for Assessing Compatibility of New Spectrum Allocations*, at 8 (Dec. 11, 2015), https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting121015/Principles-White-Paper-Release-1.1.pdf.

200 *Id.* at 9.

This is important, because complying with a reasonable OOBE limit for outdoor operations very likely can only be done through using sophisticated filtering and other radiofrequency techniques that are not economical for many consumer devices, including existing U-NII-3 devices that could be updated to access U-NII-4. Thus, in order to fully realize the benefits of a significant use case—indoor use, particularly for homes and businesses—it will be important for the FCC's rules to give Wi-Fi network operators and device manufacturers the option of complying with a less-restrictive OOBE mask in situations where doing so does not increase the risk of harmful interference to incumbent operations. For this reason, the Commission should carefully consider proposals in this proceeding to adopt separate OOBE limits for devices whose signals are subject to additional, substantial attenuation.

C. The December 2019 NHTSA Report Contains Substantial Flaws.

Shortly after the Commission initiated this proceeding, NHTSA released a "pre-final" version of a report that purports to assess the potential impact of the Commission's proposal on DSRC operations.[201] However, as set forth in the accompanying declaration of Joseph Padden, an expert on modeling, measurement, and analytics for digitally modulated wireless communications technologies, this report contains significant flaws. Thus, it is inappropriate for the Commission to rely on the NHTSA Report when determining appropriate technical parameters for U-NII-4 device operations.

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[201] Crash Avoidance Metrics Partners LLC, Dept. of Transportation, *Vehicle-to-Vehicle Communications Research Project: DSRC and Wi-Fi Baseline Cross-channel Interference Test and Measurement Report* (Pre-Final Version, Dec. 2019), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/v2v-cr_dsrc_wifi_baseline_cross-channel_interference_test_report_pre_final_dec_2019-121219-v1-tag.pdf (NHTSA Report).

1. The Access Point Tested by NHTSA Bears Little Resemblance to Real-World Wi-Fi Operations.

NHTSA claims that a primary objective of its study was to "establish baseline interference characteristics of Wi-Fi (802.11ac) emissions on DSRC messaging performance."[202] But as the Padden Declaration explains, "NHTSA modified the Wi-Fi access point device (AP) used in its test in a manner that rendered it inappropriate for the report's goals because it differs from a real-world Wi-Fi device in significant ways."[203] This is inconsistent with Department of Transportation Scientific Integrity Policy mandates to "communicate . . . technical findings by including a clear explanation of underlying assumptions" and "include[e] best-case and worst-case scenarios where appropriate."[204] The report does not clearly communicate its assumptions and includes only cases that are beyond worst case because they depend on inputs that are not supportable.

First, "in an effort to force the modified AP to transmit immediately adjacent to 5895 MHz at the highest power levels the FCC's existing rules permit for the existing U-NII-3 . . . band, NHTSA used a bi-directional RF amplifier attached to the AP."[205] NHTSA's results produced emissions consistent with overdriving this amplifier—though the report does not acknowledge or attempt to explain this.[206]

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[202] *Id.* at 7.

[203] *See* Declaration of Joseph Padden at ¶ 4, ET Docket No. 19-138 (filed Mar. 9, 2020), Attached as Appendix A (Padden Declaration).

[204] Memorandum from John D. Porcari to Heads of Operating Administrations and Secretarial Officers on Implementation of Departmental Scientific Integrity Policy, at 2 (Apr. 10, 2012), https://www.transportation.gov/sites/dot.gov/files/docs/mission/administrations/assistant-secretary-research-and-technology/282391/scientificintegritypolicy.pdf.

[205] Padden Declaration ¶ 5.

[206] *See id.*

Overdriving an amplifier can have a significant impact on test results, because doing so increases undesired emissions both within and outside of the device's assigned transmit frequencies.[207] Real-world digitally modulated wideband communications devices—including Wi-Fi transmitters—are specifically designed to avoid this result.[208] By way of analogy, microphone systems similarly seek to avoid overdriving amplifiers in a way that would severely distort the user's voice and make her more difficult—or even impossible—for listeners to understand. Thus, the emissions produced by the NHTSA AP device in the adjacent ITS channels "inappropriately contain noise and intermodulation products" that are inconsistent with levels that "would be expected by actual W-Fi deployments in the 5850-5895 MHz band."[209]

NHTSA also "appears to assume that typical Wi-Fi access point adjacent channel emissions would approach" the transmit mask depicted in the IEEE 802.11 standard "across a broad range of frequencies."[210] As the Padden Declaration explains, however, "Wi-Fi equipment typically performs better" than the IEEE mask "by about 10 dB across most adjacent band frequencies, with a limited number of spikes or 'spurs' approaching the IEEE mask threshold."[211] "As a result, the NHTSA test setup produced significantly more power in the adjacent channel than a typical Wi-Fi radio. . . would produce"—even when transmitting at a maximum power of 36 dBm EIRP.[212]

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[207] *Id.* ¶ 6.

[208] *Id.*

[209] *Id.*

[210] *Id.* ¶ 7.

[211] *Id.*

[212] *Id.*

In addition, the NHTSA testing approach only accounted for AP transmit power "as close to 36 dBm EIRP as possible" at all times.[213] But the current rules for Wi-Fi only allow this maximum power when using antennas with directional gain.[214] This means that peak power levels will occur only at a fraction of the elevation angles of the AP, and in many other directions gain will be less. For example, a CEPT report released last year determined that an "outdoor high power" AP is likely to reach peak gain in less than 15% of its elevation angles given its antenna pattern.[215] Thus, an AP would not transmit at 4 Watts in every direction.

Moreover, although an outdoor, strand-mounted AP may operate at 4 watts EIRP directionally in some circumstances, such deployments are a small fraction of overall Wi-Fi operations in any band, and therefore represent a worst-case view of DSRC-Wi-Fi coexistence that is not representative of the vast majority of potential DSRC-Wi-Fi interactions. Deployment data from NCTA's members and other industry data suggest that only approximately 1 percent of total Wi-Fi deployments are outdoors.[216]

Finally, Wi-Fi devices in the real world "transmit in bursts rather than continuously."[217] "Nevertheless, NHTSA's test setup used only full buffer Wi-Fi traffic, producing tests that

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[213] NHTSA Report at 13.

[214] *See* 47 C.F.R. § 15.407(a)(3).

[215] *See* CEPT, Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz, ECC Report 302, at 151, fig. 94 (May 29, 2019) https://www.ecodocdb.dk/download/cc03c766-35f8/ECC%20Report%20302.pdf.

[216] Opposition of NCTA – The Internet & Television Association at 3, 11, RM-11808, (filed July 6, 2018); Letter from Paul Margie, Counsel, Apple Inc., Broadcom Corporation, Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 17-183, at attachment pp. 13-14 (filed Jan. 26, 2018).

[217] Padden Declaration ¶ 8.

significantly overstated RF emissions impacts."[218] "Specifically, NHTSA tested only unrealistically high Wi-Fi 'duty cycles' or on-channel times that ranged between 62% and 92% depending on channel bandwidth. In contrast, Wi-Fi duty cycle averages in real world deployments are around 0.4%, and 90% of the time Wi-Fi duty cycles are 1% or less."[219]

For each of these reasons, the NHTSA test setup artificially increases interference into adjacent DSRC operations relative to an actual Wi-Fi access point that would be deployed in the U-NII-4 band. Thus, the NHTSA Report does not accurately convey even the "worst-case scenarios" contemplated by DOT's Scientific Integrity Policy, let alone best cases.

2. The NHTSA Report Produced Inconsistent Results that Were Not Repeatable.

The NHTSA Report results exhibit other methodological issues as well. First, the ability to reproduce a result increases confidence in that result. This is why, for example, Department of Transportation policies governing public access to federally funded research "[a]ffirm DOT's support for the reproducibility of Scientific Research results."[220] But NHTSA was unable to reproduce important results even within the confines of its own controlled test setup.

For example, NHTSA performed two test runs to attempt to assess the potential for interference from a 20-megahertz Wi-Fi channel operating immediately adjacent to a DSRC channel.[221] Yet after a connector failure, NHTSA was unable to replicate the Wi-Fi set up it had

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[218] *Id.*

[219] *Id.* (footnotes omitted).

[220] U.S. Dep't of Transportation, *U.S. Department of Transportation Public Access Plan: Increasing Access to Federally Funded Research Results*, 2, https://www.transportation.gov/sites/dot.gov/files/docs/Official%20DOT%20Public%20Access%20Plan.pdf; *see also id.* at 13 (requiring data sets to adhere to certain requirements "to ensure that the claims presented in peer-reviewed scholarly publications are verifiable and reproducible").

[221] Padden Declaration ¶ 10.

for the first test run.[222] This is important, because the "results from the second run are very different from the first"—interference ranges differed as much as 460%.[223] But instead of disregarding these datasets, NHTSA instead speculated that results from the first run "may be more reflective of the potential levels of cross-channel interference."[224] "Results that are not reproducible (at least within some tolerance) should not be considered significant."[225]

The NHTSA Report also includes other inconsistencies. For example, the NHTSA tests routinely produced substantially different packet error rates for vehicles positioned an identical distance away from the AP. Indeed, this phenomenon was widespread, occurring in multiple test runs as well as at multiple distances.[226] It would not be reasonable to expect receivers placed at an identical distance from a transmitter to produce vastly different and inconsistent packet error rates, which further suggests methodological problems in NHTSA's test set up.[227] Yet these inconsistencies are not discussed or analyzed in the NHTSA Report in any detail. For example, while the NHTSA Report attempts to attribute some of its unusual results to ground reflection effects "beyond 200 meters from the AP,"[228] this would not explain numerous inconsistencies in the test data at distances less than 200 meters.[229] The failure to recognize and account for these anomalous results itself calls into question the report's reliability.

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[222] *Id.*

[223] *Id.* ¶ 11.

[224] NHTSA Report at 21.

[225] Padden Declaration ¶ 12.

[226] *Id.* ¶¶ 13-14.

[227] *Id.* ¶ 14.

[228] NHTSA Report at 20.

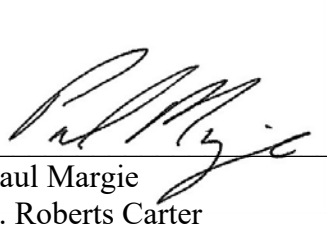
[229] Padden Declaration ¶ 14.

VII. CONCLUSION

Permitting unlicensed operations in the 5.9 GHz band is a unique opportunity to quickly advance U.S. leadership in next-generation broadband, address the pressing need for more Wi-Fi spectrum, and keep pace with American consumers' and businesses' rapidly growing connectivity needs. We commend the Commission for taking this critical step for America's connected future and positioning itself to create the country's first widely available 160-megahertz Wi-Fi channel. The Commission's actions will help to alleviate the strain on existing unlicensed spectrum bands and usher in next-generation gigabit and faster Wi-Fi speeds in communities of all sizes across the country.

Allowing unlicensed operations to utilize the entire band is the best way to quickly put this valuable mid-band spectrum to use and significantly enhance connectivity for Americans in their homes and businesses. Nonetheless, the Commission's proposal strikes a reasonable balance by proposing to allow unlicensed use of the lower 45 megahertz of the band and reserve 30 megahertz of spectrum for ITS technologies to develop and deliver automotive safety benefits.

Respectfully submitted,



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March 9, 2020

APPENDIX A

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

DECLARATION OF JOSEPH PADDEN

1. My name is Joseph Padden. I currently serve as Distinguished Technologist for Wireless Technologies and Director of 3GPP Standardization at CableLabs, a non-profit innovation and research and development organization, where I lead engineering projects that involve modeling, measurement, and analytics for digitally modulated wireless communications technologies, including Wi-Fi and LTE.

2. Before assuming my current role in 2018, I held a number of other positions at CableLabs that involved technical assessment, testing, and measurement for digital communications technologies, including Principal Architect (2016-2018); Lead Architect (2014-2015); Architect, Access Network & Protocols (2011-2014); and Systems Engineer (2007-2011). I am the listed inventor or co-inventor on 15 patents related to digital communications, including systems and methods for wireless co-existence involving unlicensed spectrum and capacity sharing between wireless systems, and have also authored 15 publications on issues related to network co-existence. I received my Master of Science in Electrical Engineering and Bachelor of Science in Mechanical Engineering from the University of Colorado.

3. I have reviewed the "Pre-Final Version" of the Vehicle-to-Vehicle Communications Research Project (V2V-CR): DSRC and Wi-Fi Baseline Cross-channel

Interference Test and Measurement Report released by the National Highway Traffic Safety Administration in December 2019 (the "NHTSA Report").[1] This declaration contains my analysis of certain aspects of the NHTSA Report.

THE MODIFIED ACCESS POINT TESTED BY NHTSA

4. NHTSA states that a primary objective of its test was to "establish baseline interference characteristics of Wi-Fi (802.11ac) emissions on DSRC messaging performance."[2] However, NHTSA modified the Wi-Fi access point device ("AP") used in its test in a manner that rendered it inappropriate for the report's goals because it differs from a real-world Wi-Fi device in significant ways.

5. In an effort to force the modified AP to transmit immediately adjacent to 5895 MHz at the highest power levels the FCC's existing rules permit for the existing U-NII-3 band (5725-5850 MHz), NHTSA used a bi-directional RF amplifier attached to the AP.[3] The spectral plots of AP channel power in the NHTSA Report depict emissions that are consistent with overdriving this amplifier.[4] Specifically, NHTSA's tests used a "trial and error approach" that appears to have overdriven its amplifier in an attempt to

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1 Crash Avoidance Metrics Partners LLC, Dept. of Transportation, Vehicle-to-Vehicle Communications Research Project: DSRC and Wi-Fi Baseline Cross-channel Interference Test and Measurement Report (Pre-Final, December 2019), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/v2v-cr_dsrc_wifi_baseline_cross-channel_interference_test_report_pre_final_dec_2019-121219-v1-tag.pdf ("NHTSA Report").

2 *Id.* at 7.

3 *See id*. at 14-15 and Figure 5.

4 *See, e.g.*, Figure 10.

create what NHTSA refers to as "transmit spectral occupancy" results that were "as close to the defined [IEEE 802.11] mask as possible."[5]

6. Overdriving an RF amplifier has the effect of increasing undesired emissions—both within and outside of a defined transmit band—via intermodulation products, spectral regrowth, and other non-linear response products. Real-world digitally modulated wireless wideband communications systems such as Wi-Fi radios are specifically designed to avoid operating in a manner that produces intermodulation products, spectral regrowth, and other amplifier non-linearity products. This is similar to the engineering concern that leads designers of microphone systems to design their technologies to avoid overdriving amplifiers in a way that would distort the user's voice and make her more difficult for listeners to understand. Thus, the emissions produced by the NHTSA AP in the adjacent DSRC channel inappropriately contain noise and intermodulation products at levels that are inconsistent with levels would be expected by actual Wi-Fi deployments in the 5850-5895 MHz band.

7. In addition, NHTSA appears to assume that typical Wi-Fi access point adjacent channel emissions would approach the IEEE transmit mask across a broad range of frequencies. In reality, Wi-Fi equipment typically performs better than the mask in the international standard set by the IEEE by about 10 dB across most adjacent band frequencies, with a limited number of spikes or "spurs" approaching the IEEE mask

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[5] *Id.* at 15. The term "spectrum occupancy" is more commonly used in assessing channel availability. *See, e.g.*, A.D. Spaulding, G.H. Hagn, "On the Definition and Estimation of Spectrum Occupancy," EMC-19 No. 3 IEEE Transactions on Electromagnetic Compatibility (1977).

threshold. As a result, the NHTSA test setup produced significantly more power in the adjacent channel than a typical Wi-Fi radio transmitting at 36 dBm EIRP would produce.

8. Finally, Wi-Fi devices transmit in bursts rather than continuously. Nevertheless, NHTSA's test setup used only full buffer Wi-Fi traffic, producing tests that significantly overstated RF emissions impacts. Specifically, NHTSA tested only unrealistically high Wi-Fi "duty cycles" or on-channel times that ranged between 62% and 92% depending on channel bandwidth.[6] In contrast, Wi-Fi duty cycle averages in real world deployments are around 0.4%, and 90% of the time Wi-Fi duty cycles are 1% or less.[7]

9. For each of these reasons, the NHTSA test setup artificially increases interference into adjacent DSRC operations relative to an actual Wi-Fi access point that would be deployed in the U-NII-4 band.

METHODOLOGY PRODUCED INCONSISTENT RESULTS THAT WERE NOT REPEATABLE

10. The NHTSA Report results exhibit other methodological issues. First, NHTSA was unable to replicate some of the results used to support its conclusions about the potential for cross-channel interference. For example, NHTSA did two test runs looking at the potential for interference from a 20 MHz Wi-Fi channel operating immediately adjacent to a DSRC channel.[8] But for the second test run, after discovering a failed connector in the setup, the NHTSA testing could not replicate the Wi-Fi setup it

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6 NHTSA Report at 19.

7 Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at Attachment p. 5 (filed Dec. 20, 2019).

8 *See* NHTSA Report at 23-24.

had for the first test run. Instead of discarding the first dataset, NHTSA speculated that "the results from this [first] run may be more reflective of the potential levels of cross-channel interference caused by Wi-Fi and the impact to DSRC performance."[9]

11. The results from the second run are very different from the first. Specifically, results from the first run showed DSRC packet error rates ("PER") (or how many DSRC packets fail to arrive at their destination) of up to 97% (Table 1) and significant interference at DSRC receivers 575 meters away from the Wi-Fi AP.[10] In contrast, results from the second run showed DSRC PER of no more than 2% (Table 2) and the range of any measurable interference limited to 125 meters.[11] This represents an interference range fluctuation of 460% between the two tests.

12. NHTSA also performed two tests examining the potential for an 802.11ac Wi-Fi device configured for a 160 MHz channel centered on channel 163 to interfere with an adjacent DSRC device operating on channel 180.[12] As Table 11 and Table 14 of the NHTSA Report demonstrate, these test results were also problematic.[13] *Table 1*, below, summarizes side-by-side the results of the two test runs as shown in Table 11 and Table 14 of the NHTSA Report.

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9 *Id*. at 21.

10 *See id*. at 23.

11 *See id*. at 24.

12 *See id*. § 4.3.4.

13 *See id*. at 35, 40.

DSRC "Device 1" DSRC Ch 180, Wi-Fi 160 MHz / Ch 163 Two test run comparison				
Distance	**Table 11 (% PER values)**		**Table 14 (% PER values)**	
(meters)	**near vehicle**	**far vehicle**	**near vehicle**	**far vehicle**
75	57	0	0	61
100	0	66	70	2
125	0	14	68	0
150	2	28	70	56
175	0	33	74	69
200	0	0	0	51
225	0	50	0	0
250	0	0	0	51
275	n/a	n/a	0	61

Table 1: DSRC ch. 180/Wi-Fi ch. 160 NHTSA Test Run PER Comparison

As the data in *Table 1* illustrates, there is no clear trend or consistency in the NHTSA results. For a given distance, the "near" and "far" vehicles located an identical distance from the AP exhibit very different interference results, with PER differing by up to 68%. In addition, this data illustrates the NHTSA Report's inability to reproduce a data point within a reasonable tolerance. For example, at 100 meters, the "near" car result varies by 70% PER and the "far" car result varies by 64%. The NHTSA results include many similar examples. NHTSA does try to explain the result discrepancy between Table 11 and Table 14, attributing the difference as "likely due to the increased spectral occupancy of the 802.11ac signal compared to the previous test."[14] However, this explanation fails to address multiple issues with the data, including the difference between the near and far vehicle performance for a given distance, the significant fluctuations at distances below 200 meters, and the inability to reproduce a set of results for a given test setup. Variations of this magnitude between identical test runs indicate an error in the setup or

[14] *Id.* at 38.

methodology, or both. Results that are not reproducible (at least within some tolerance) should not be considered significant.

13. Other NHTSA tests also routinely produced substantially different PER for vehicles positioned at an identical distance away from the Wi-Fi AP, further suggesting methodological problems in the test setup. Specifically, the NHTSA test setup separated two vehicles by 75 meters, with one vehicle "near" the AP and the other "far" vehicle an additional 75 meters away.[15] Because NHTSA tested a range of separation distances from the AP while maintaining the relative distance between the two vehicles, the tests often subsequently placed the "near" vehicle exactly the same distance from the AP as the "far" vehicle in a previous test round (e.g. one test round put the "near" vehicle separation at 0 meters from the AP and the "far" vehicle 75 meters from the AP, while a subsequent round put the "near" vehicle 75 meters from the AP and the "far" vehicle 150 meters from the AP). Even though the "near" and "far" vehicle were often the same distance from the AP, NHTSA's tests often produced very different packet error rates at these identical distances.[16] This suggests that the study's results are not reliable.

14. The inconsistencies identified above are not discussed or explained in any detail, further calling into question the report's reliability. For example, in Section 4.2, the report attempts to attribute result inconsistencies "to cancelling reflections of the 802.11ac AP signal from the road surface," displaying a plot of a 2-ray ground reflection

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[15] *Id.* at 3.

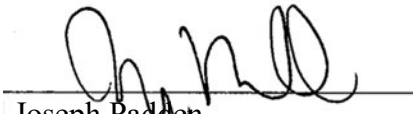
[16] *See, e.g.*, *id.* at Table 1 (significant near/far vehicle PER variation at the same distance for approximately 2/3s of the results); Table 3 (significant near/far vehicle PER variation at 100m distance); Table 6 (significant near/far vehicle per variation at 75m, 100m, 125m, and 150m).

propagation model.[17] The report further states that, "[g]iven the approximate distance at which the cancellation takes place, this effect is only exhibited in tests where the cross-channel interference range went beyond 200 meters from the AP."[18] However, as shown in the preceding discussion and *Table 1* above, many examples of result inconsistencies below 200 meters exist and are not explained by the NHTSA Report.

15. Given the totality of the methodological issues and result inconsistency found in the NHTSA Report, it should not be used to support any conclusions about the real-world interference potential between Wi-Fi and DSRC systems. The only conclusion that can be safely drawn from the NHTSA Report is that is possible to create a transmission which interferes with DSRC operation. How typical that transmission is, at what distance that interference effect is realized, and to what degree the DSRC system is impacted are not sufficiently supported by this report to be concluded in a reliable manner.

I declare under penalty of perjury that the foregoing declaration is true and correct.

Executed on March 9, 2020



Joseph Padden

[17] *See id*. at 19-20.

[18] *Id*. at 20.