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

FIRST REPORT AND ORDER, FURTHER NOTICE OF PROPOSED RULEMAKING, AND ORDER OF PROPOSED MODIFICATION

Adopted: November 18, 2020 **Released: November 20, 2020**

Comment Date: 30 days after Federal Register publication
Reply Comment Date: 60 days after Federal Register publication

By the Commission: Chairman Pai and Commissioners O'Rielly and Carr issuing separate statements; Commissioners Rosenworcel and Starks concurring.

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I. INTRODUCTION

1. In this First Report and Order, we repurpose 45 megahertz of the 5.850-5.925 GHz band (the 5.9 GHz band) to allow for the expansion of unlicensed mid-band spectrum operations, while continuing to dedicate 30 megahertz of spectrum for vital intelligent transportation system (ITS) operations.[1] In addition, to promote the most efficient and effective use of this ITS spectrum, we are requiring the ITS service to use cellular vehicle-to-everything (C-V2X) based technology at the end of a transition period. By splitting the 5.9 GHz band between unlicensed and ITS uses, today's decision puts the 5.9 GHz band in the best position to serve the needs of the American public.

2. Unlicensed devices using such technologies as Wi-Fi[2] have become indispensable for providing low-cost wireless connectivity in countless products used by American consumers. To meet this demand, we take steps in this First Report and Order to promote unlicensed use of the 5.850-5.895 GHz portion of the 5.9 GHz band as soon as possible so that the American people can immediately begin receiving the benefits of unlicensed operations. Specifically, we adopt rules to repurpose for unlicensed operations the 5.850-5.895 GHz portion of the 5.9 GHz band (lower 45 megahertz), which, when added to the adjacent spectrum available for Unlicensed National Information Infrastructure (U-NII) devices below 5.850 GHz, will allow for increased high-throughput broadband unlicensed applications in spectrum that is a core component of today's unlicensed ecosystem. On the effective date of this First Report and Order, we will allow immediate access for unlicensed indoor operations (at specified low power levels) across the 5.850-5.895 GHz portion of the 5.9 GHz band. We also will consider requests to allow for outdoor unlicensed operations through our existing regulatory process (Special Temporary Authority (STA) and/or waiver), which will be coordinated with the National Telecommunications and Information Administration (NTIA) to ensure that federal incumbents are protected from harmful interference.

3. At the same time, we recognize that the 5.9 GHz band plays an important role in supporting ITS applications. Therefore, we retain 30 megahertz of spectrum in the 5.895-5.925 GHz portion of the 5.9 GHz band (upper 30 megahertz) for use by the ITS radio service and sunset the current technological standard authorized in the band in favor of C-V2X. In 1999, the Commission adopted a different standard for ITS services in the 5.9 GHz band. Dedicated Short-Range Communications,[3] or DSRC, has barely been deployed, in the more than 20 years since adoption of DSRC meaning this spectrum has been largely unused. In the intervening period, several automobile manufacturers and other stakeholders have turned their attention to C-V2X, in part because of its use of cellular-based protocols

[1] ITS is a national program intended to improve the efficiency and safety of surface transportation systems. *See* Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6051, 105 Stat. 1914 (1991).

[2] Wi-Fi is a family of wireless network protocols, based on the IEEE 802.11 set of standards, which are commonly used for local area networking of devices and Internet access.

[3] Under the Commission's rules, Dedicated Short Range Communications (DSRC) pertain to radio systems in the 5.9 GHz band whose rules and protocols are designed to enable transportation and vehicle safety-related communications. 47 CFR § 90.371(a).

and ability to enable rapid development and deployment of ITS applications. We therefore modernize our rules to allow for deployment of C-V2X in the 5.895-5.925 GHz band.

4. In the Further Notice, we address the remaining issues before the Commission in this proceeding as we finalize the transition of the 5.9 GHz band under the modified band plan adopted in this First Report and Order. Specifically, we seek comment on: transitioning all ITS operations in the upper 30 megahertz to C-V2X-based technology, including the appropriate timeline for implementation; the adoption of C-V2X technical parameters for operation in the upper 30-megahertz portion; and the power and emission limits, and other issues, related to full-power outdoor unlicensed operations across the 5.850-5.895 GHz band portion of the 5.9 GHz band.

II. BACKGROUND

5. The demand for wireless broadband is growing at a phenomenal pace, as the American public and businesses increasingly rely on Internet connectivity. To meet this demand, the Commission continuously evaluates spectrum use and its rules in efforts to enable more efficient spectrum usage through a variety of methods, including authorizing unlicensed operations. In various proceedings over the past two decades, the Commission has established and expanded the spectrum available for U-NII devices throughout the mid-band spectrum located in the 5 GHz band.[4] As a result, for many years most of the spectrum between 5.150 GHz and the lower edge of the 5.9 GHz band[5] has been available for unlicensed operations. This year, the Commission adopted rules to make the spectrum directly adjacent to the 5.9 GHz band, at 5.925 GHz-7.125 GHz (the 6 GHz band) available for unlicensed operations.[6] Despite the Commission's commitment to increasing the availability of mid-band spectrum that can be used for unlicensed operations, there continues to be steadily increasing demand for additional spectrum that can accommodate such operations.

6. Twenty years ago, the Commission reserved the entire 75 megahertz that makes up the 5.9 GHz band for the ITS radio service and, in particular, Dedicated Short-Range Communications

[4] Spectrum between 5 GHz and 6 GHz is part of the larger mid-band spectrum (a designation generally applied to spectrum between 2.5 GHz and 24 GHz). Mid-band spectrum has become highly desirable as a key component for future 5G buildout because of its balanced coverage and capacity characteristics. *See, e.g.*, The FCC's 5G FAST Plan (Sept. 28, 2018), https://www.fcc.gov/document/fccs-5g-fast-plan.

[5] *See Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, ET Docket No. 96-102, Report and Order, 12 FCC Rcd 1576 (1997) (*U-NII Report and Order*), Memorandum Opinion and Order, 13 FCC Rcd 14355 (1998) (establishing the 5.15-5.25 GHz (U-NII-1), the 5.25-5.35 GHz (U-NII-2A), and the 5.725-5.825 GHz (U-NII-3) bands); *Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz Band*, ET Docket No. 03-122, Report and Order, 18 FCC Rcd 24484 (2003) (*U-NII-2C Report and Order*) (establishing the 5.47-5.725 GHz (U-NII-2C) band); *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, First Report and Order, 29 FCC Rcd 4127 (2014) (*U-NII 5 GHz Report and Order*) (adding 5.825-5.850 GHz to the 5.725-5.825 GHz (U-NII-3) band and deferring a decision on whether to allow unlicensed devices to use the 5.350-5.470 GHz U-NII-2B and 5.850-5.925 GHz U-NII-4 bands). In 2013, the Commission began to refer to the U-NII band segments by number to make it easier for the reader to follow U-NII discussions in the rulemaking docket and documents. *See Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, Notice of Proposed Rulemaking, 28 FCC Rcd 1769, 1771, n.5 (2013) (*U-NII 5 GHz NPRM*).

[6] *See Unlicensed Use of the 6 GHz Band,* ET Docket No. 18-295; *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz,* GN Docket No. 17-183, Report and Order and Further Notice of Proposed Rulemaking, FCC 20-51, 35 FCC Rcd 3852 (2020) (*6 GHz Report and Order*) (unlicensed use of 5.925-7.125 GHz (U-NII-5 to -8)).

(DSRC) service.[7] In doing so, the Commission noted the contemporaneous enactment of the Transportation Equity Act for the 21st Century, in which Congress directed the Commission to consider, in consultation with the Secretary of the U.S. Department of Transportation (U.S. DOT), spectrum needs for the operation of the ITS, including spectrum that could support operations using the DSRC vehicle-to-wayside wireless standard.[8] At the time the Commission reserved the 5.9 GHz band for ITS, it was expected that the band would support widespread deployment of systems that would improve efficiency and promote safety within the nation's transportation infrastructure.[9] In 2003, the Commission adopted licensing and service rules for DSRC operations that specified a single technological standard based on the expectation that, despite the Commission's general preference for leaving the selection of technologies to licensees, a single standard in this band was most likely to promote interoperability between vehicles and infrastructure, enable robust automotive safety communications, and accelerate the nationwide deployment of DSRC-based applications while reducing implementation costs.[10]

7. Since that time, the DSRC-based service has evolved slowly and has not been widely deployed within the consumer automobile market. Meanwhile, numerous technologies that operate outside the 5.9 GHz band have been or are being developed and deployed to improve transportation safety and efficiency, such as long-range and short-range radar systems in the 76-81 GHz band, safety and convenience features integrated into cellphone apps and connected to on-board displays through unlicensed spectrum protocols, optical cameras, sonar, and LiDAR (light detection and ranging).

8. Recently, C-V2X-based technology has gained momentum as a means of providing transportation and vehicle safety-related communications.[11] As envisioned, C-V2X would be part of a connected vehicle ecosystem that provides direct communications between vehicles, between vehicles and infrastructure, between vehicles and other road users, and between vehicles and cellular communications providers' mobile broadband networks.[12] Proponents of C-V2X anticipate that it will

[7] *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*, ET Docket No. 98-95, Report and Order, 14 FCC Rcd 18221 (1999) (*DSRC Report and Order*).

[8] *DSRC Report and Order*, 14 FCC Rcd at 18222-23, paras. 2-3; Transportation Equity Act for the 21st Century, Pub. L.105-178, § 5206(f), 112 Stat. 107 (1998) (TEA). The TEA did not require that the Commission allocate the 5.9 GHz band for ITS, only that the Commission consider doing so.

[9] *DSRC Report and Order*, 14 FCC Rcd at 18225, para. 9 (allocating the 5.9 GHz band for DSRC based on a finding that "DSRC applications are a key element in meeting the nation's transportation needs into the next century and in improving the safety of our nation's highways.").

[10] *Amendment of the Commission's Rules Regarding Dedicated Short Range Communications Services in the 5.850-5.925 GHz Band (5.9 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*, ET Docket No. 98-95, Report and Order, 19 FCC Rcd 2458, 2466-68, paras. 13-16 (2003) (*DSRC Service Rules Order*). *See also* 47 CFR §§ 90.379 and 95.3159 (incorporating by reference the American Society for Testing and Materials (ASTM) E2213-03 DSRC standard (the ASTM-DSRC Standard)). In 2010, IEEE adopted a new standard, 802.11p, for wireless access in vehicular environments. *See* https://standards.ieee.org/standard/802_11p-2010.html.

[11] On November 21, 2018, the 5G Automotive Association (5GAA), an association representing automotive, technology, and telecommunications companies, requested that the Commission waive the DSRC-specific rules to allow deployment of C-V2X in the 20-megahertz channel located at the upper edge of the 5.9 GHz band (i.e., the 5.905-5.925 GHz portion of the band). 5GAA Petition for Waiver (filed Nov. 21, 2018); *see Office of Engineering and Technology and Wireless Telecommunications Bureau Seek Comment on 5GAA Petition for Waiver to Allow Deployment of Cellular Vehicle-to-Everything (C-V2X) Technology in the 5.9 GHz Band*, GN Docket No. 18-357, Public Notice, DA 18-1231 (Dec. 6, 2018).

[12] *See Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, Notice of Proposed Rulemaking, 34 FCC Rcd 12603, 12605-606, para. 5 (2019) (*5.9 GHz NPRM*). According to 5G Automotive Association (5GAA), C-V2X has two modes of operation. In direct mode, transportation and vehicle safety-related communications are transmitted

(continued….)

serve as the foundation for vehicles to communicate with a wide range of other vehicles and infrastructure around them, providing non-line-of-sight awareness, providing their operators with notice of changing driving conditions with a high level of predictability for enhanced road safety, and engaging in automated driving.[13] Notably, C-V2X uses a different radio technology standard that is incompatible with DSRC-based operations.[14]

9. *5.9 GHz NPRM.* In December 2019, we initiated this rulemaking proceeding to take a "fresh look" at the optimal use of the valuable 75 megahertz that makes up the 5.9 GHz band, given (1) the exponentially growing demands for unlicensed applications' access to mid-band spectrum; (2) the relatively slow deployment of DSRC equipment; (3) the significant evolution of transportation and vehicular safety-related technologies outside the 5.9 GHz band; and (4) the rising interest in C-V2X as an alternative radio technology that could provide transportation and safety-related communications in the 5.9 GHz band. To that end, we proposed to create sub-bands within the 5.9 GHz band to allow unlicensed operations in the lower 45 megahertz of the band (5.850-5.895 GHz) and reserve the upper 30 megahertz of the band (5.895-5.925 GHz) for ITS.[15] We reasoned that this 45/30 megahertz split for unlicensed devices and ITS applications would optimize the use of spectrum resources in the 5.9 GHz band. Under this proposal, the unlicensed portion of the band could be combined with spectrum in adjacent bands that support heavy unlicensed device use to provide cutting-edge high-throughput broadband applications on channels up to 160 megahertz wide, while the ITS portion of the band would remain dedicated to meet current and future ITS needs within the transportation and vehicular-safety related ecosystem.

10. The proposal specifically called for the uppermost 20 megahertz (5.905-5.925 GHz) to be dedicated to C-V2X and asked whether to designate the remaining 10 megahertz (5.895-5.905 GHz) for C-V2X or retain that 10 megahertz for DSRC.[16]

directly between vehicles (vehicle-to-vehicle (V2V)), between vehicles and roadside infrastructure (vehicle-to-infrastructure (V2I)), and between vehicles and other road users such as pedestrians and bicyclists (vehicle-to-pedestrian (V2P)). In network mode (vehicle-to-network (V2N)), communications are transmitted through cellular providers' mobile broadband networks rather than in the 5.9 GHz band. *See* 5GAA Comments at i, Executive Summary, and 3; 5GAA Reply at 25; Qualcomm Comments at 6.

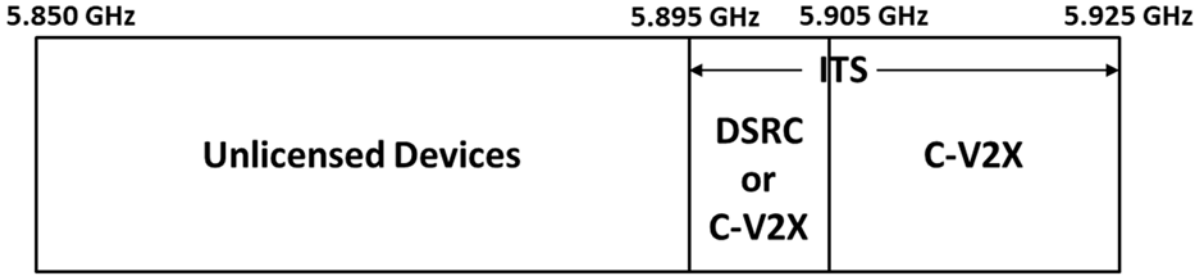
[13] *See* Qualcomm Connecting vehicles to everything with C-V2X at 2. https://www.qualcomm.com/invention/5g/cellular-v2x; Accelerating C-V2X commercialization at 15, https://www.qualcomm.com/media/documents/files/accelerating-c-v2x-commercialization.pdf; 5G NR based C-V2X, https://www.qualcomm.com/media/documents/files/5g-nr-based-c-v2x-presentation.pdf (last visited Oct. 27, 2020); 5G Americas March 2018 White Paper, Cellular V2X Communications Towards 5G, at 3, https://www.5gamericas.org/white-papers/. Some of these functions would be supported by the evolution to 5G New Radio-based C-V2X. *Id.*

[14] C-V2X standards development began in 2015 when 3GPP specified C-V2X features based on the 4G LTE-Pro system in 3GPP Release 14. While C-V2X is based on the 3GPP LTE family of standards, DSRC is based on the IEEE 802.11 family of standards.

[15] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12608, para. 11.

[16] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12613-16, paras. 24-31.

Proposed Band plan



11. Acknowledging that the proposals in the *5.9 GHz NPRM* could result in the need for DSRC incumbents to transition their operations out of some or all of the 5.9 GHz band, we sought comment on possible transition paths and the Commission's authority under section 316 of the Communications Act to modify or discontinue DSRC operations.[17] In the *5.9 GHz NPRM* we also proposed technical rules that would govern the transportation and unlicensed uses in the 5.9 GHz band.[18] We proposed that devices in the U-NII-4 band (5.850-5.895 GHz), or devices that operate across a single channel that spans the U-NII-3 (5.725-5.850 GHz) and U-NII-4 bands, protect ITS from harmful interference by meeting certain out-of-band emissions (OOBE) limits.[19] We also proposed that U-NII-4 devices be permitted to operate at the same power levels as U-NII-3 devices.[20]

12. In addition to the primary non-Federal Mobile Service allocation for DSRC in the ITS radio service, the 5.9 GHz band is also allocated, in the U.S. Table of Frequency Allocations, for the Federal Radiolocation Service and the non-Federal Fixed Satellite Service (Earth-to-space) on a primary basis and the Amateur Service on a secondary basis for non-federal use.[21] The 5.850-5.875 GHz segment of the 5.9 GHz band is designated internationally for industrial, scientific, and medical (ISM) applications.[22] In the *5.9 GHz NPRM*, we proposed rules that would ensure interference protections for federal operations in the Federal Radiolocation Service.[23] We proposed that no additional provisions were needed to protect the non-Federal Fixed Satellite Service operations in the 5.9 GHz band from C-V2X devices, or to protect C-V2X devices from Amateur Services or ISM operation.[24] We sought comment on the extent to which the transportation and vehicle-safety functions originally contemplated under the DSRC model are being, or are anticipated to be, provided in other bands or through other

[17] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12616-18, paras. 32-36. *See* 47 U.S.C § 316 (modification by Commission of station licenses). On Dec. 19, 2019, the Commission temporarily froze the acceptance and processing of new and expanded use applications related to part 90 services operating in certain portions (specifically, 5.850-5.895 GHz and 5.905-5.925 GHz) of the 5.850-5.925 GHz band (5.9 GHz band) and on the processing of applications to renew part 90 licenses in the 5.9 GHz band).

[18] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12618-20, paras. 37-45, 12622-24, paras. 53-58.

[19] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12622-24, paras. 53-56.

[20] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12622-23, para. 53, n.93.

[21] *See* 47 CFR § 2.106, NG160.

[22] *See* 47 CFR § 2.106 Footnote 5.150.

[23] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12620-21, 24, paras. 47-48, 57.

[24] *See* 5.9 GHz NPRM, 34 FCC Rcd at 12621-22, paras. 49-51. Under the Commission's rules, stations of a secondary service must not cause harmful interference to, and cannot claim protection from harmful interference from, stations of primary services to which frequencies are already assigned or may be assigned at a later date. 47 CFR § 2.104(d)(3)(i), (ii).

means.[25] Finally, we laid the groundwork for evaluating and calculating the costs and benefits of designating a significant portion of this band for unlicensed operations.[26]

III. REPORT AND ORDER

13. In this First Report and Order, we conclude that the most efficient use of the 75 megahertz of mid-band spectrum in the 5.9 GHz band will be achieved by allowing unlicensed use in the lower 45 megahertz of the band (5.850-5.895 GHz) and designating the upper 30 megahertz of the band (5.895-5.925 GHz) for ITS service applications. We also take steps in this First Report and Order to authorize unlicensed service in the 5.850-5.895 GHz portion of the 5.9 GHz band as soon as possible so that the American people can begin receiving the benefits of unlicensed operations without any unnecessary delay. Specifically, as of the effective date of this First Report and Order, we will allow immediate access for unlicensed indoor operations across the entire 5.850-5.895 GHz portion of the 5.9 GHz band, under specified power and other technical limitations designed to protect ITS service and federal radar operations from harmful interference. We also will consider requests for full power outdoor operations through our existing regulatory process for individualized and temporary access to spectrum (e.g., STA and/or waiver), which will be coordinated with NTIA to ensure that federal incumbents are protected from harmful interference. We further conclude that, to promote the most efficient and effective use of the spectrum that will continue to be designated for ITS, only a single technology is appropriate, and we will require use of C-V2X technology. Pending resolution of the transition of ITS operations to C-V2X, ITS licensees will be able to continue their DSRC-based operations or, alternatively, to deploy C-V2X-based operations by obtaining a waiver subject to specified conditions.

A. Dividing the 5.9 GHz Band for Unlicensed Operations and for ITS

14. In the *5.9 GHz NPRM*, we proposed two sub-bands within the 75 megahertz in the 5.9 GHz band – allowing 45 megahertz for unlicensed operations and 30 megahertz for ITS – believing that this would optimize the use of the 5.9 GHz spectrum resources to fully and effectively serve the American people.[27] Since the Commission first designated the 5.9 GHz band for ITS in 1999, transportation and vehicular safety-related technologies have evolved significantly, as have demands for access to mid-band spectrum, particularly for unlicensed operations. Based on our evaluation of these changed circumstances, we have determined that the optimal use of this band has changed as well, and that the public interest would be better served by reconfiguring the 5.9 GHz band in accordance with our proposal to designate 45 megahertz (at 5.850-5.895 GHz) as a lower sub-band for new unlicensed use, and 30 megahertz (at 5.895-5.925 GHz) as an upper sub-band for ITS applications. Repurposing this valuable 75-megahertz portion of spectrum in this manner will ensure the quickest path towards its most efficient and effective use.

1. Unlicensed Operations in the Lower 45 Megahertz of the 5.9 GHz Band

15. Demand for spectrum to support unlicensed use has intensified in recent years.[28] Wi-Fi access points (and their associated connected devices) provide high data rate local area network connections for smart phones, tablets, computers, television, and other devices inside and outside the home to interconnect with and access the Internet Wi-Fi has become a staple in American life, and many households rely on Wi-Fi to connect to the Internet. It also enables data-offloading from commercial wireless networks to relieve congestion when consumer demand is high.[29] Industry studies project that

[25] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12624-25, paras. 59-62.

[26] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12625-27, paras. 63-67.

[27] *5.9 GHz NPRM*, 34 FCC Rcd at 12608-16, paras. 11-31.

[28] *5.9 GHz NPRM*, 34 FCC Rcd at 12609, para. 14.

[29] *5.9 GHz NPRM*, 34 FCC Rcd at 12609, paras. 13-14. Offloading reduces the amount of data flowing through a carrier's network, which reduces the potential for network congestion by freeing bandwidth (especially in indoor environments) resulting in increased performance for all users. As large amounts of data transmission are expected (continued….)

the U.S. will need between 788 megahertz and 1.6 gigahertz of new mid-band spectrum by 2025 to accommodate the growing demand for Wi-Fi.[30] We continue to seek ways to meet the growing demand for spectrum to support unlicensed use[31] and earlier this year authorized additional U-NII bands in the 6 GHz band, as a start toward meeting that burgeoning demand.[32]

16. Mobile operators routinely use unlicensed spectrum for network offloading and mobile carriers have widely implemented Wi-Fi calling.[33] The ongoing pandemic in the U.S has further increased reliance on Wi-Fi as more households are turning to distance learning, teleworking, and social networking. Since the pandemic began, the nation's reliance on in-home connectivity has increased dramatically and this dependence and reliance on unlicensed spectrum during these uncertain times is expected to continue.[34] For example, in March AT&T reported a 76% over-the-average increase in Wi-Fi calling minutes.[35] Similarly, Comcast's Xfinity Mobile has seen a 49% increase in its Wi-Fi offloading from its mobile devices.[36] Verizon has reported week-over-week increases during peak hour usage with a 75% increase for gaming, 34% increase for virtual private networks (VPNs), 20% increase in web traffic, and 12% increase in video streaming.[37] The availability of spectrum for unlicensed use is more critical than ever before.

17. The latest Wi-Fi standards, IEEE 802.11ax (marketed as "Wi-Fi 6") and 802.11ac can deliver gigabit speeds, superior performance in crowded environments, and better device battery life than earlier versions of Wi-Fi. In particular, new unlicensed devices are expected to provision maximum speeds that are two-and-a-half-times faster than predecessor technology, and incorporate features such as multi-user multiple input and multiple output (MU-MIMO) and orthogonal frequency division multiple access (OFDMA) to optimize data transmission.[38] The latest standards provide flexibility—permitting operation using a variety of bandwidths in the 5 GHz and 6 GHz bands—but require wide-bandwidth 160-megahertz channels to deliver the most capacity and advanced features.[39]

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from new connected consumer and commercial devices operating on 5G networks, the demand for offloading is expected to rise significantly.

[30] *5.9 GHz NPRM*, 34 FCC Rcd at 12609, para. 14. *See* Steve Methley & William Webb, Quotient Assocs. Ltd., *Wi-Fi Spectrum Needs Study* at 26, 28 (Feb. 2017), Rolf de Vegt et al., Qualcomm Techs., Inc., *A Quantification of 5 GHz Unlicensed Band Spectrum Needs* at 5 (2017).

[31] *5.9 GHz NPRM*, 34 FCC Rcd at 12609, para. 14.

[32] *Unlicensed Use of the 6 GHz Band*, *et al*., ET Docket No. 18-295 and GN Docket No. 17-183, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) (*6 GHz Report and Order*).

[33] T-Mobile Comments at 4.

[34] Comcast Reply at 3.

[35] *See* Monica Alleven, *AT&T: Wi-Fi Calling Up 76%*, FierceWireless (Mar. 30, 2020), https://www.fiercewireless.com/wireless/at-t-wi-fi-calling-up-76.

[36] S*ee* Comcast, COVID-19 Network Update (last updated Apr. 15, 2020), https://corporate.comcast.com/covid-19/network.

[37] Kiki Intarasuwan, How Coronovisrus Affects Internet Usage and What you can Do to Make your Wi-Fi Faster (Mar. 18, 2020) https://www.nbcnewyork.com/news/local/how-coronavirus-affects-internet-usage-and-what-you-can-do-to-make-your-wi-fi-faster/2332117/.

[38] *See, e.g.*, Jacob Kastrenakes, *Wi-Fi 6: is it really that much faster?* (Feb. 21, 2019), https://www.theverge.com/2019/2/21/18232026/wi-fi-6-speed-explained-router-wifi-how-does-work.

[39] *See*, IEEE Standards Association, *IEEE P802.11ax = IEEE Draft Standard for Information Technology – Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks – Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment Enhancements for High Efficiency WLAN*, https://standards.ieee.org/project/802_11ax.html (last visited Oct. 27, 2020).

18. As we discussed in the *5.9 GHz NPRM*, the U-NII bands that span much of the 5 GHz band play a crucial role in accommodating the needs of businesses and consumers for fixed and mobile broadband communications and represent a core component of today's unlicensed device ecosystem.[40] When specifically proposing to authorize unlicensed operations in the lower 45 megahertz of the 5.9 GHz band, we explained that this particular spectrum is especially well-positioned to deliver immediate and significant benefits for unlicensed devices and can help the Commission meet the continued demand for spectrum access.[41] We noted that this 45 megahertz of spectrum could be combined with the adjacent U-NII-3 band (5.725-5.850 GHz) to provide a large contiguous block of unlicensed spectrum that could accommodate a variety of options—including two 80-megahertz Wi-Fi channels, four 40-megahertz Wi-Fi channels, or a single contiguous 160-megahertz Wi-Fi channel. We further noted that, because the 5.850-5.895 GHz sub-band is adjacent to the U-NII-3 band that supports unlicensed operations, equipment manufacturers should be able to readily and cost-effectively manufacture devices to expand operations into this sub-band.[42] We sought comment on our proposal to authorize unlicensed operations in this particular spectrum in the 5.9 GHz band.[43]

19. The Wi-Fi Alliance, Wireless Internet Service Providers Association (WISPA), NCTA – The Internet & Television Association (NCTA), NTCA – The Rural Broadband Association (NTCA), Broadcom/Facebook, Cisco Systems, Inc. (Cisco), Comcast Corporation (Comcast), and others support our proposal for making this 45 megahertz available for unlicensed operations.[44] Comcast states that the Commission's proposal would produce a contiguous 160-megahertz unlicensed channel that can be used on a widespread basis, supporting next-generation Wi-Fi, advancing 5G, and addressing the strain on today's overburdened Wi-Fi frequencies.[45] Broadcom and Facebook state that the additional 45 megahertz of the U-NII-4 band combined with the existing, adjacent U-NII-3 band will enable the deployment of next-generation Wi-Fi, which operates on wider channels allowing gigabit connectivity with lower latency, improved coverage, and power efficiency to be deployed in the band.[46] Proponents of ITS, however, oppose separating the band into segments and expanding unlicensed use to the lower 45 megahertz. 5G Automotive Association (5GAA), the Alliance for Automotive Innovation, the American Public Transportation Association (APTA), Car 2 Car Communication Consortium (Car 2 Car), Toyota Motor North America, Inc. (Toyota), and several other commenters generally contend that all 75 megahertz is needed for ITS.[47] The U.S. DOT also contends that the full 75 megahertz of the 5.9 GHz

[40] *5.9 GHz NPRM*, 34 FCC Rcd at 12609, paras. 13-14.

[41] *5.9 GHz NPRM*, 34 FCC Rcd at 12610, para. 16.

[42] *5.9 GHz NPRM*, 34 FCC Rcd at 12610, para. 16.

[43] *5.9 GHz NPRM*, 34 FCC Rcd at 12610-11, para. 17.

[44] *See*, *e.g.*, Wi-Fi Alliance Comments at 2-4, WISPA Comments at 1-2, NCTA Comments at 1-3, NTCA Reply at 1, Broadcom/Facebook Comments at 1, Cisco Comments at 14-16, Comcast Comments at 7-10.

[45] Comcast Comments at 6-7.

[46] Broadcom/Facebook Comments at 1-2.

[47] 5GAA Comments at 36 (contending that the public interest is not best served by making the lower 45 megahertz of the 5.9 GHz band available for unlicensed services given the recent history of the Commission's unlicensed efforts; proposing that some portions of the 5.9 GHz band be available for C-V2X technology, and other for DSRC technology); Alliance for Automotive Innovation Reply at 29 (recommending that for the first 5 years after adoption the Commission should reserve the upper 20 megahertz of the 5.9 GHz band for Long Term Evolution Cellular-Vehicle to Everything (LTE C-V2X), reserve the lower 20 megahertz of the 5.9 GHz band for DSRC, and make the middle 30 megahertz of the 5.9 GHz band available on a priority basis for Next-Gen DSRC and Advanced (5G) C-V2X applications as they are developed and deployed); APTA Comments at 2 (contending that the 5.9 GHz spectrum is essential for current and future safety critical communications system deployments in all types of vehicles, including those serving the needs of public transportation); Car 2 Car Comments at 1 (preserve the 75-megahertz spectrum band for transportation safety); Toyota Reply at 5 (urges maintaining the entire 75 megahertz of (continued….)

band should be retained for safety and other transportation purposes.[48] In addition, some commenters have suggested that we postpone consideration of our proposal for several more years to see if ITS providers can substantially implement operations in the 5.9 GHz band.[49]

20. We adopt our proposal to make the 45 megahertz at 5.850-5.895 GHz available for unlicensed operations. We believe that this approach will provide the American public with the most efficient use of spectrum, based on current and future needs. The combination of the U-NII-3 band with this new U-NII-4 band is greater than the sum of its parts. Whereas the upper portion of the U-NII-3 band can only support at most one 80-megahertz channel and the U-NII-4 band (in isolation) could only support a single 40-megahertz channel, together they can enable a single 160-megahertz channel for U-NII operations. Not only is this the widest, highest throughput channel permitted today by industry-developed standards for U-NII devices, it is also the only 160-megahertz wide channel currently available below 6 GHz not required to use dynamic frequency selection (DFS)[50] technology. Thus, the entirety of the U.S. would have continuous access to this wide channel.

21. Commenters who support making this 45 megahertz of spectrum available for unlicensed operations agree that the 5.850-5.895 GHz sub-band is especially well-positioned to deliver immediate and potentially significant benefits. They assert that this spectrum will allow the Commission to take proactive action to ensure that limited spectrum resources provide maximum benefits to American consumers who continue to demand access to additional unlicensed spectrum.[51] They also agree that providing 45 megahertz of 5.9 GHz spectrum that can be combined with the adjacent U-NII-3 band (5.725-5.850 GHz) will provide a large contiguous block of spectrum that provides flexibility to deliver a wide variety of applications—including one 160-megahertz Wi-Fi channel, two 80-megahertz Wi-Fi channels, four 40-megahertz Wi-Fi channels, or eight 20-megahertz Wi-Fi channels.[52]

22. We expect the benefits arising from this reallocation of the lower band will be available to American consumers shortly after the rules in this proceeding become effective. Comcast submits that, because of its proximity to the U-NII-3 band, only software or firmware upgrades to much of the Wi-Fi equipment already deployed and operating are needed to allow consumers to access the 5.9 GHz spectrum, a benefit that would not be possible in any other band.[53] NCTA agrees that, since the 5.9 GHz band is adjacent to the U-NII-3 band, existing Wi-Fi access points will be able to use the band immediately, with only software or firmware changes, saving years of delay compared to any other band and lowering costs across the board.[54] NCTA contends that since many existing 5 GHz-capable devices can take advantage of 5.9 GHz spectrum with software or firmware changes, the congestion-easing capacity attendant with adding new unlicensed spectrum in the 5.9 GHz band will benefit consumers very

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spectrum in the 5.9 GHz band for ITS, contending that a wide and diverse group of stakeholders with a strong and enduring commitment to transportation safety are united in wanting all 75 megahertz of spectrum for ITS).

[48] U.S. DOT Reply at 3 (filed under NTIA).

[49] *See, e.g.*, Applied Information Comments at 3 (recommending that ITS have another seven years).

[50] Dynamic Frequency Selection is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with these systems, notably radar systems. 47 CFR §15.403.

[51] *See, e.g.*, NCTA Comments at 9-11; WISPA Comments at 2.

[52] *See, e.g.,* Comcast Comments at 8-9; WISPA Reply at 7; Joint Reply of Broadcom and Facebook at 3; Wi-Fi Alliance Comments at 4; Letter from Tiago Rodrigues, CEO, Wireless Broadband Alliance, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1(filed Nov. 10, 2020) (Wireless Broadband Alliance Nov. 10, 2020 *Ex Parte*).

[53] *See* Comcast Comments at 8. Firmware is software that is embedded in a piece of hardware. *See* Lifewire, *What is Firmware?* A definition of firmware and how firmware works, by Tim Fisher (Feb. 28, 2020), https://lifewire.com/whar-is-firmware-2625881.

[54] NCTA Comments at 10.

quickly.[55] Under the Commission's equipment authorization rules and policies, a change to an approved device to add a new frequency band subject to new technical requirements is permitted as a Class II permissive change for a device not approved as a Software Defined Radio, as long as such changes are performed by software and do not require any hardware changes.[56] We anticipate that many Wi-Fi access points currently operating using U-NII-3 spectrum, in addition to being capable of software upgrades, will be able to meet the requirements we adopt for indoor-only devices.[57]

23. Additionally, proponents of unlicensed operations generally agree that equipment manufacturers will be able to readily and cost-effectively manufacture new devices capable of expanding operations in the U-NII-3 band to include this sub-band.[58] The rules adopted today will, in combination with those rules governing the adjacent U-NII-3 band, enable the first contiguous 160-megahertz channel for U-NII devices below 6 GHz that will not require use of DFS interference mitigation technologies, the equipment approval process will be straightforward and not entail additional complex tests to verify DFS operation. The Wi-Fi Alliance states that requiring the use of DFS technologies would impede spectrum use in some cases because it cannot be accommodated by some applications, require additional certification and approval, extending time-to-market, and add to device design complexity and costs.[59] Comcast states that equipment developed without DFS for the 5.9 GHz band will be available sooner than equipment subject to DFS test procedures.[60] In the 5.9 GHz band, not adopting a requirement that unlicensed devices incorporate DFS technologies means that the equipment approval process will be straightforward and not entail additional complex tests to verify DFS operation. The readily available 160-megahertz channel will enable new applications that will help maintain the United States' role as an innovator and global spectrum policy leader.

24. Additionally, it appears that many wireless Internet service providers (WISPs) currently have the capability to use the 45 megahertz of the 5.9 GHz spectrum and believe that there is sufficient customer demand to warrant its use.[61] While we are not allowing outdoor unlicensed use today as a general rule, we are proposing rules for outdoor use in the Further Notice below. However, we may allow some outdoor operations in certain specified locations in the band through the STA process (i.e., on a non-interference basis), where such operations would not cause harmful interference to any incumbent operations.

25. We conclude that authorizing 45 megahertz of spectrum for unlicensed operations, while

[55] NCTA Comments at 29.

[56] 47 CFR § 2.1043; Federal Communications Commission Office of Engineering and Technology Laboratory Division Permissive Change Policy at 5, Sec. V. A., B., and 7, Sec. V. G. (178919 D01 Permissive Change Policy v06) (Oct. 16, 2015), https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=33013. In such a case, the filing for equipment authorization must include a complete test report demonstrating compliance with the new rules and may also require a change in equipment class associated with the new rules. *Id*.

[57] Wireless Broadband Alliance Nov. 10, 2020 *Ex Parte* at 1.

[58] *See, e.g.*, Comcast Comments at 9; Open Technology Institute and Public Knowledge Comments at 7; WISPA Comments at 4-5.

[59] Wi-Fi Alliance Comments at 4.

[60] Comcast Comments at 9.

[61] We note that in late March, the FCC's Wireless Telecommunications Bureau (WTB) began granting temporary access to 5.9 GHz spectrum (via STA) for certain WISPs that serve largely rural and suburban communities. The STAs allow WISPs to use the lower 45 megahertz of the band to help serve their customers. To date, the FCC has granted STAs to more than 100 WISPs, and many of those providers have reported that the spectrum is helping to address the increased demand for broadband associated with the COVID-19 pandemic. *See* FCC, *5.9 GHz Band Boosts Consumer Internet Access During Covid-19 Pandemic*, (May 4, 2020), https://www.fcc.gov/document/59-ghz-band-boosts-consumer-internet-access-during-covid-19-pandemic; Letter from Michael Calabrese, Director, Wireless Future Program, Open Technology Institute, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 at 2 (filed Nov. 11, 2020) (Open Technology Institute Nov. 11, 2020 *Ex Parte*).

providing 30 megahertz for ITS, best serves the public interest.

2. Safety-Related Intelligent Transportation Systems in the Upper 30 Megahertz (5.895-5.925 GHz) of the 5.9 GHz Band

26. As stated in the *5.9 GHz NPRM*, we recognize the importance of promoting vehicular safety and other benefits of ITS; we also see a continuing role for the 5.9 GHz band, as part of a larger ecosystem enabling ITS services, in providing these benefits to the American public.[62] Certain ITS-related functions are well-suited for the 5.9 GHz band—including non-line-of-site applications and certain vehicle-to-infrastructure applications—and could improve transportation and vehicular-safety related applications in the coming years.[63] Therefore, based on our consideration of the record, we adopt our proposal and will continue to make the upper 30-megahertz portion (5.895-5.925 GHz) of the 5.9 GHz band available for ITS.

27. Our decision will ensure continued availability of spectrum sufficient for DSRC licensees to continue existing operations and deploy those same services at scale. We conclude, as supported by many of the commenters, that reserving the entire 5.9 GHz band for possible additional services by ITS licensees is not the most efficient or effective use of that band, nor is it in the best public interest to do so. WISPA rightly points out that the original concept for DSRC use of the band has not come to fruition, and changes to the band plan we adopted over 20 years ago are essential to maximize the use of this valuable spectrum for the public's greatest well-being, particularly Americans in rural areas that lack adequate broadband access.[64] To that end, we note that many of WISPA's members have been able to make temporary use of unused spectrum in the 5.9 GHz band to deliver broadband Internet access service to rural and underserved areas during the current COVID-19 pandemic.[65]

28. Several factors guide our determination of how much spectrum to retain for ITS: (1) the failure of the 5.9 GHz band to become used ubiquitously for the broad range of ITS applications that were originally anticipated; (2) the strong public interest benefits that will accrue by allowing unlicensed use in 45 megahertz of the 5.9 GHz band; and (3) the need for dedicated 5.9 GHz spectrum to support core vehicular safety applications. We find that reserving 30 megahertz of spectrum for ITS will support the provision of core safety-related functions and provide continuing spectrum access for existing ITS licensees authorized in the band.

a. 30 megahertz for ITS

29. When the Commission first set aside the 5.9 GHz band in 1999,[66] an extensive set of potential DSRC applications was identified for the band—things such as "traffic light control, traffic monitoring, travelers' alerts, automatic toll collection, traffic congestion detection, emergency vehicle signal preemption of traffic lights, and electronic inspection of moving trucks through data transmissions with roadside inspection facilities."[67] In its 2003 Order, the Commission adopted service rules for the

[62] *5.9 GHz NPRM*, 34 FCC Rcd at 12611, paras. 18-19.

[63] *5.9 GHz NPRM*, 34 FCC Rcd at 12611, para. 19.

[64] WISPA Reply at 2.

[65] *See* FCC, *5.9 GHz Band Boosts Consumer Internet Access During Covid-19 Pandemic* (May 4, 2020), https://www.fcc.gov/document/59-ghz-band-boosts-consumer-internet-access-during-covid-19-pandemic.

[66] *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*, ET Docket No. 98-95, Report and Order, 14 FCC Rcd 18221 (1999) (*DSRC Report and Order*). ITS is a national program intended to improve the efficiency and safety of surface transportation systems. *See* Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6051, 105 Stat. 1914 (1991).

[67] Press Release, FCC, FCC Allocations Spectrum in 5.9 GHz Range for Intelligent Transportation Systems Use; Action Will Improve the Efficiency of the Nation's Transportation Infrastructure (Oct 21, 1999) https://docs.fcc.gov/public/attachments/DOC-177370A1.doc. In defining DSRC, the rule stated that it would

(continued….)

band[68] and recognized that DSRC deployment could involve both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications, and it established a two-part licensing regime consisting of vehicle-mounted and portable on-board units (OBUs) licensed-by-rule under part 95 of the rules and fixed roadside units (RSUs) individually licensed under part 90 of the rules.[69] In the record supporting that decision, numerous parties described an environment where both public safety and private users would share the band, with protocols to ensure that public safety activities (defined expansively) would have priority over private transmissions.[70]

30. In the 20 years since the Commission designated the 5.9 GHz band for DSRC use, certain vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X) basic safety and related applications have been standardized. The technical standards for these basic vehicle-to-vehicle and vehicle-to-infrastructure applications (e.g., Basic Safety Message, Personal Safety Message, and related applications) were developed and standardized several years ago—indeed, the DSRC 1.0 standard was released in 2006.[71]

31. But actual DSRC-based ITS service has not been widely deployed. There are 118 active DSRC licenses in the Commission's database.[72] According to the American Association of State

"perform operations related to the improvement of traffic flow, traffic safety and other intelligent transportation service applications in a variety of public and commercial environments." *DSRC Report and Order* at Appx. A, 47 C.F.R. § 90.7.

[68] *Amendment of the Commission's Rules Regarding Dedicated Short Range Communications Services in the 5.850-5.925 GHz Band (5.9 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*, ET Docket No. 98-95, Report and Order, 19 FCC Rcd 2458 (2003) (*DSRC Service Rules Order*). *See also* 47 CFR §§ 90.379 and 95.3159 (incorporating by reference the American Society for Testing and Materials (ASTM) E2213-03 DSRC standard (the ASTM-DSRC Standard)). In 2010, IEEE adopted a new standard, 802.11p, for wireless access in vehicular environments. *See* https://standards.ieee.org/standard/802_11p-2010.html. The latest version of the DSRC message standard was published in 2016. *See* https://www.standards.its.dot.gov/StdsSummary/StandardsGroup?stdgroup=407. Our rules continue to reference the ASTM-DSRC Standard.

[69] A roadside unit (RSU) is a transceiver that is mounted along a road or pedestrian passageway. An RSU may also be mounted on a vehicle or hand-carried, but it may operate only when the vehicle or hand-carried unit is stationary. An RSU broadcasts data to on-board units (OBUs) or exchanges data with OBUs in its communications zone. RSUs operate under part 90 of the Commission's rules, while on-board units (OBUs) are mounted in vehicles or are portable units and are licensed by rule under part 95 of the Commission's rules. Portable RSUs may be operated upon grant of the geographic-area license. Licensees must register appropriate data (e.g., channels, location, power, etc.) for each fixed site RSU with the Commission prior to its operation. While no individual license is required to operate an OBU, such units may only transmit data associated with a valid part 90 license.

[70] *See, e.g.*, ITS America Comments, ET Docket No. 98-95, at 2 ("DSRC-based ITS services will provide the traveling public access via a wireless link to a wide variety of public safety and non-public safety services and information. Through an installed transceiver unit in a vehicle, for example, a driver could pay tolls, pay for parking, receive traffic and road condition updates and hear public safety warning messages."); MARK IV Industries LTD Reply, ET Docket No. 98-95, at 1 ("We propose that the scope of such Public Safety uses be expansive and inclusive so that all of the public functions related to electronic toll collection, traffic monitoring, commercial vehicle and airport facility access operations, in addition to many others, are included."); Technical Affairs Committee of the Association of International Automobile Manufacturers Reply, ET Docket No 98-95, at 1.

[71] A DSRC Fact Sheet was released by U.S. DOT in September 2009, based on the December 2006 Version 1.0 of the DSRC standard. It states: "The basic safety message contains vehicle safety-related information that is periodically broadcast to surrounding vehicles." *See* https://www.standards.its.dot.gov/Factsheets/Factsheet/71. The latest version of the DSRC message standard was published in 2016. *See* https://www.standards.its.dot.gov/StdsSummary/StandardsGroup?stdgroup=407.

[72] FCC ULS database inquiry of October 26, 2020. An authorization to operate in the DSRC service may be obtained by any territory, possession, state, city, county, town, or similar governmental entity; and any public safety (continued….)

Highway and Transportation Officials (AASHTO), these include 38 state or local licensees that are involved with 57 operational projects, and include 6,182 DSRC roadside units (RSUs) and 15,506 vehicles equipped with DSRC on-board units (OBUs), and an additional 1,916 roadside units and 3,371 additional on-board units being planned.[73] However, the operations are limited to particular geographic areas, and most of the vehicles that have on-board units are limited to certain fleet units (e.g., buses and police cars) and are being tested for specific traffic safety and related applications in those particular areas.[74] In short, deployments for the most part have been limited to government-funded demonstration projects[75] that have been designed to test DSRC use to address particular traffic and safety concerns.[76] Considering that there are approximately 274 million registered vehicles in the United States[77] operating across approximately 4.2 million miles of paved and unpaved roadways,[78] there has not been any widescale deployment of DSRC. Indeed, there currently is no deployment within the commercial consumer automobile market. In short, DSRC-based ITS has not lived up to the original promise of achieving the ITS goals identified when the spectrum was allocated—leaving valuable mid-band spectrum underused.

32. Meanwhile, numerous technologies that operate outside the 5.9 GHz band have been or are being developed and deployed on a wide scale throughout the vehicular marketplace, including the commercial consumer automobile market, to improve transportation safety and efficiency. Additionally, safety and convenience features are increasingly being integrated into cellphone apps and connect to on-board displays through unlicensed spectrum protocols. For example, the Waze driving app uses real-time data sourced by other drivers to deliver, among other things, updated accident and construction zone

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or industrial/business entity meeting the pertinent eligibility requirements. Prior to operation, applicants are issued a non-exclusive, geographic area license: governmental entities are authorized based on that entity's legal jurisdictional area of operations; and non-governmental entities are licensed based on each applicant's area of operation (i.e., by county, state, multi-state, or nationwide). *See* 47 CFR § 90.373.

[73] AASHTO Comments at 7 (stating that 34 states and 4 localities have roadside unit licenses). *See also* Central Ohio Transit Authority Comments at 10; and Intelligent Transportation Society of America Comments at 19-20.

[74] *See, e.g.*, Letter from Steven Lederman, Counsel for ITS America, to Marlen H. Dortch, Secretary, FCC, ET Docket No. 19-138, at Attachment (slide deck) (filed Oct. 8, 2020) (discussing deployment of V2X in New York City, Michigan, Tampa, and Texas).

[75] According to U.S. DOT, it has provided more than $1 billion in funding for DSRC testing and deployment. NCTA Comments at 12 (citing U.S. DOT February 20. 2020 slide deck); *Preserving the 5.9 GHz Safety Band for Transportation,* at slide 2 (Feb. 20, 2020), https://www.transportation.gov/research-and-technology/preserving59ghz-safety-band-transportation-0. State and county DOT agencies have also issued grants according to the American Association of State Highway and Transportation Officials (AASHTO). *See* AASHTO Comments, July 7, 2016, at 9-16 to 5.9 GHz *Public Notice*, ET Docket No. 13-49, 31 FCC Rcd 6130 (2016).

[76] For example, the American Association of State Highway and Transportation Officials (AASHTO) states that the California DOT (CalTrans) and the University of California, with funding from the U.S. DOT and a number of states, deployed DSRC units at 10 intersections in Palo Alto, CA to test and evaluate Multi-Modal Intelligent Traffic Signal System (MMITSS) software, which balances priorities between transit, emergency vehicles, and freight traffic; Utah DOT and Utah Transit Authority have begun deployment of DSRC units along a corridor in the Salt Lake City area running MMITSS software to provide signal priority to transit buses, with the goal of improving schedule reliability; and Pennsylvania DOT and Carnegie Mellon University have installed DSRC at 35 intersections in the neighborhoods of Pittsburgh to broadcast Signal Phase and Timing data as the first step of a 25-year plan to install DSRC in signals and vehicles throughout the area. *See* AASHTO Comments, ET Docket No. 13-49, at 9-16 (July 7, 2016).

[77] *See* Statista.com, Number of motor vehicles registered in the United States from 1990 to 2018, https://www.statista.com/statistics/183505/number-of-vehicles-in-the-united-states-since-1990/ (last visited Oct. 27, 2020).

[78] *See* Bureau of Transportation Statistics, Public Road and Street Mileage in the United States by Type of Surface, https://www.bts.gov/content/public-road-and-street-mileage-united-states-type-surfacea (last visited Oct. 27, 2020).

warnings. The app is now being integrated into vehicle display systems.[79] A Valeo system being deployed on 2020 General Motors truck models allows drivers to "see through" objects in tow by integrating images wirelessly transmitted from a camera mounted on the back of a trailer into the in-cabin display.[80] Optical cameras, sonar, and LiDAR (light detection and ranging) are commonly found in many of today's vehicles. These new technologies have materially and significantly advanced overall automotive safety, generally surpassing many functions that were originally envisioned to be performed by DSRC (e.g., lane-keeping alerts, lane merge, etc.).[81] The Commission has also made more spectrum available for vehicular radars.[82] Long-range radar systems in the 76-81 GHz band are especially useful for automatic emergency braking systems and adaptive cruise control systems.[83]

33. Proponents of the Commission's proposal contend that 30 megahertz of spectrum is the appropriate amount of spectrum for ITS safety-related services in the band. Open Technology Institute at New America and Public Knowledge (Open Technology Institute and Public Knowledge) together argue that real-time V2X safety communication requires no more than 30 megahertz of spectrum.[84] NCTA asserts that 30 megahertz of spectrum for V2X technologies is sufficient to continue to offer the kinds of safety-of-life services in the band now being provided,[85] albeit currently at a very small scale in certain geographic areas. NCTA argues that exclusive-use spectrum rights should be limited to safety-of-life V2X functions that cannot be achieved through other technologies.[86] NCTA notes that many automotive safety functions originally contemplated for V2X in the 5.9 GHz band 20 years ago—such as alerting drivers to vehicles or other objects, lane-merging alerts, and emergency braking—are already being met by other technologies like radar, LiDAR, cameras, and sensors.[87] NCTA contends that only crash-avoidance information such as Basic Safety Messages (which includes the "core" message functionality) should be preserved for ITS in the band, and that V2X technology, whether DSRC-based or C-V2X-based, requires less than 30 megahertz; thus 30 megahertz should be sufficient for existing connected vehicle applications.[88] Broadcom, Facebook, the Dynamic Spectrum Alliance, the Institute for Policy

[79] Zac Estrada, Ford connects Waze through its infotainment system, The Verge (Jan. 10, 2018), https://www.theverge.com/2018/1/10/16874976/ford-waze-infotainment-ces-2018.

[80] Brian Dorr, Invisible Tow-Behind: GMC Launches 'Transparent Trailer View,' Gear Junkie (Feb. 12, 2019), https://gearjunkie.com/gmc-transparent-trailer-view. Valeo, World premiere at CES 2019 of Valeo XtraVue Trailer, the invisible trailer system (Jan. 8, 2019), https://www.valeo.com/en/world-premiere-at-ces-2019-of-valeo-xtravue-trailer-the-invisible-trailer-system/.

[81] *See, e.g.*, *DSRC Service Rules Order*, 19 FCC Rcd at 2519-2520, Appx. C (listing many potential DSRC-based advanced vehicle safety systems—including road departure, lane merge, work zone warning, vehicle stopped or slowing, vehicle-to-vehicle collision avoidance—that appear to be available today using non-DSRC technologies).

[82] *See Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26, Report and Order, 32 FCC Rcd 8822 (2017).

[83] Paul Pickering, The Radar Technology Behind Autonomous Vehicles, ECN (Dec. 7, 2017), https://www.ecnmag.com/article/2017/12/radar-technology-behind-autonomous-vehicles. *See also* Continental AG, Continental's Next Generation Radar Technology Enables New Safety Features (Aug. 19, 2019), https://www.continental.com/en-us/press-/press-releases/next-gen-short-range-radar-181454 (announcing a new 77 GHz short-range radar that offers improved performance over a prior 24 GHz model and describing radar sensors as "a fundamental tool for advanced driver assistance systems" that "enable more advanced features for the vehicle of the future").

[84] Open Technology Institute and Public Knowledge Comments at 20.

[85] NCTA Reply at 17-27; NCTA Nov. 10, 2020 *Ex Parte* at 1-7.

[86] NCTA Reply at 19-20.

[87] NCTA Reply at 19-20.

[88] NCTA Reply at 20-23.

Innovation, and others similarly support the Commission's proposal.[89] Some proponents of preserving the band for DSRC operations acknowledge that 30 megahertz is sufficient to support basic safety messaging.[90]

34. Although ITS proponent 5GAA indicates that its "greatly preferred" option is for the Commission to continue to allocate the entire 5.9 GHz band for ITS, 5GAA also indicates that it would support, as an alternative, an allocation of the upper 30 megahertz for C-V2X Direct operations.[91] Under either option, so-called "Basic C-V2X Direct services" could be deployed in the upper 30 megahertz.[92] Qualcomm supports 5GAA's second option in the event the Commission designates the lower 45 megahertz for unlicensed operations.[93] 5GAA states that C-V2X Direct would enable (1) vehicle-to-everything (V2X) communications which are used to communicate basic safety information between nearby vehicles to prevent collisions and improve traffic flow; (2) vehicle-to-infrastructure (V2I) communications (e.g., traffic signals, variable message signs, etc.), which are used to communicate safety and traffic information, prevent accidents associated with roadway conditions, and improve traffic efficiency; and (3) vehicle-to-pedestrian communications to communicate safety information between vehicles and other road users (e.g., pedestrians, bicyclists, scooter riders, etc.) to prevent accidents.[94] Qualcomm asserts that if 30 megahertz of spectrum is made available for C-V2X-based ITS, it will be effectively used by automakers, technology providers, and service providers.[95]

35. We agree with these commenters that 30 megahertz is sufficient for ITS services in the 5.9 GHz band. *First*, we find 30 megahertz is sufficient for the provision of core vehicle safety-related ITS functions foreseen under established standards and contemplated when the Commission originally provided for ITS services in the band. These include vehicle-to-vehicle basic safety applications, including Basic Safety Messages,[96] Personal Safety Message applications,[97] as well as vehicle-to-

[89] *See, e.g.*, Broadcom, Inc. and Facebook, Inc. Comments at 1, Dynamic Spectrum Alliance Comments at 1-4, Institute for Policy Innovation at 1-3, WISPA Comments at 1; Tech Freedom Comments at 7; Free State Foundation Comments at 3.

[90] *See, e.g.,* Tampa Hillsborough Expressway Authority Comments at 3 (filed Mar. 5, 2020) (acknowledging that "30 MHz is sufficient to support existing [connected vehicle] applications for basic driver warnings"); Cisco Comments at 9-10 ("[I]t appears that V2V crash avoidance can be supported, and possibly other applications" in 30 megahertz).

[91] Letter from Sean T. Conway, Counsel for 5GAA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 2 (filed Oct. 1, 2020) (5GAA Oct. 1, 2020 *Ex Parte*). 5GAA's alternative proposal is contingent upon our imposing specific safeguards on unlicensed use of the lower portion for unlicensed use, including limiting such use to indoor operations, to protect ITS operations in the upper 30 megahertz, and identifying 40 megahertz of dedicated mid-band spectrum elsewhere for advanced C-V2X operations. *Id.*

[92] 5GAA Oct. 1, 2020 *Ex Parte* at 2.

[93] Letter from John W. Kuzin, Vice President and Regulatory Counsel, Qualcomm, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1-3 (filed Oct. 16, 2020) (Qualcomm Oct. 16, 2020 *Ex Parte*).

[94] 5GAA Oct. 1, 2020 *Ex Parte* at 2, n.1.

[95] Qualcomm Oct. 16, 2020 *Ex Parte* at 1.

[96] Basic Safety Message (BSM) functions are designed to provide speed, direction, turning angle, path history, and acceleration/deceleration from the connected vehicle to nearby connected vehicles to support crash warning applications. Example applications include intersection movement assist, left-turn assist, forward collision warning, and lane change warning. *See, e.g.*, Letter from Paul G. Schomburg, Director, Government & Public Affairs, Panasonic Corporation of North America, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, Attachment ("Spectrum Requirements for Intelligent Transportation Systems") at 6 (referencing Car 2 Car study) (filed Oct. 6, 2020) (Panasonic Oct. 6, 2020 *Ex Parte*).

[97] Personal Safety Message (PSM) functions are designed to provide warning messages between connected vehicles and connected Vulnerable Road Users (VRUs), such as pedestrians, bicyclists, and road workers. *See* IEEE 1609 Working Group Comments at 6-7.

infrastructure applications.[98] Notably, the existing DSRC band plan designated only 20 megahertz for two safety channels (Channel 172 exclusively for vehicle-to-vehicle safety communications for accident avoidance and mitigation, and safety of life and property applications; and Channel 184 exclusively for high-power, longer-distance communications to be used for public safety applications involving safety of life and property, including road intersection collision mitigation). And Car 2 Car's filings reflect that 30 megahertz, even if channelized with no overlap, can accommodate various core safety-related functions, including vehicle-to-vehicle and vehicle-to-infrastructure functions such as Basic Safety Message and Personal Safety Message functions, with more spectrum potentially available for platooning and other services.[99]

36. *Second*, the record demonstrates that 30 megahertz is more than sufficient to preserve ITS licensees' ability to expand their existing safety-related services to millions more vehicles. As U.S. DOT and others have recognized, the benefits of V2X services in the 5.9 GHz band require a "critical mass of communicating vehicles" in the American fleet to achieve many of the safety-related benefits.[100] ITS (both DSRC and C-V2X) are designed to reuse spectrum geographically, so we are confident that 30 megahertz is sufficient to deploy ITS-based services at scale. In other words, despite the limited deployment of DSRC to date for the testing of targeted safety applications, we expect reserving 30 megahertz for ITS is still sufficient to enable the widespread deployment of ITS services to the American automotive public.

37. *Third*, we find that 30 megahertz will be sufficient for the basic safety applications of the next-generation of ITS—C-V2X. 5GAA has delineated multiple accident avoidance and other safety use cases, including vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian applications, that can be supported in 30 megahertz of spectrum.[101] We also agree with Qualcomm that, with this 30 megahertz of spectrum made available for C-V2X-based ITS, automakers, technology providers, and service providers will be able to effectively use the spectrum for vehicle safety-related applications.[102] With this 30 megahertz, incumbent licensees will be able to provide on a widescale basis the same types of ITS services that, up until this point, have been developed and deployed on a limited basis, including the use of ITS technology in millions of commercially available vehicles (e.g., automobiles, trucks) to bring the benefits of these ITS safety-related services more broadly to the American public.

38. *Fourth*, prudent management of radio spectrum demands that we take into account the maturation and increasing prevalence of other technologies for the provision of messages to provide core safety in the ITS system. For example, the Commission has dedicated spectrum in the 76-81 GHz band for vehicular radars, which is actively used today in providing enhanced safety features,[103] and which does not rely on use of the 5.9 GHz band. Commercial cellular services and frequently updated databases

[98] V2I functions include a collection of messages providing information to the driver of the connected vehicle and to that vehicle from smart road infrastructure. These include three components: (a) signal, phase and timing (SPAT) information, which is sent by red lights to provide the next green phase; (b) map data, which describes road lane topology, intersections, and to some extent traffic maneuvers, such as traffic changes through construction zones; and (c) in-vehicle information, which carries information such as speed limits. *See* Car 2 Car Comments at 3.

[99] Car 2 Car Comments at 2, Table 1.

[100] NCTA Comments at 12 (quoting U.S. DOT).

[101] 5GAA Comments at 6-7.

[102] Qualcomm Oct. 16, 2020 *Ex Parte* at 1.

[103] Short-range radar safety services in the 76-81 GHz band include obstacle avoidance, collision warning, lane departure warning, lane change aids, blind spot detection, parking aids, airbag arming, autonomous braking, and pedestrian detection. Long-range radar safety services in the 76-81 GHz band include collision avoidance and adaptive cruise control. *Amendment of Part1 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26, Report and Order, 32 FCC Rcd 8822, 8823-24, para. 3, n.8 (2017) (*76-81 GHz R&O*).

can provide important roadway-related information—indeed, Wi-Fi operations in the 5.9 GHz band could take the place of many of the non-safety-related applications originally contemplated for ITS. If spectrum is to be put to its highest and best use, ITS services in the 5.9 GHz band should not duplicate information that is already readily available, nor should excess 5.9 GHz band spectrum continue to be reserved for applications that can or have already been provided using other spectrum bands or alternative technology. Instead, dedicated ITS spectrum must be reserved for safety-related ITS services that cannot be readily achieved through other means. While ITS proponents contend that future advanced ITS functions that may be developed may offer potential enhancements to technologies developed and widely deployed in vehicles today using spectrum outside of the 5.9 GHz band (radars, LiDAR, etc.), there are likely to be other technological developments, including automated driving capabilities, that are being more rapidly deployed, and more importantly achieve the kind of critical fleet penetration, to provide the same or similar vehicular safety benefits. As U.S. DOT and others have acknowledged, V2X in the 5.9 GHz band is not a requirement for deployment of automated driving systems.[104]

39. *Fifth*, we are not persuaded that more than 30 megahertz is needed for potential new applications that extend beyond the types of safety-related services currently being offered by DSRC licensees pursuant to the Commission's rules. The 75 megahertz in the 5.9 GHz band has been underused for many years, and DSRC service has not been widely deployed. Potential future advanced applications, however, are still under development and have not been deployed and widescale commercial deployment would at best still be years away (if it occurred at all).

40. *Sixth*, the Commission has used a variety of techniques to achieve greater spectrum efficiency in other bands. For example, we have reduced the amount of spectrum being used (such as by requiring more spectrally efficient technologies) or increased the number of possible users through advanced sharing techniques. Here, we find the more appropriate action is to divide the band into two separate spectrum segments. This is the quickest, most efficient way to realize our goals, rather than subjecting the band to additional testing to determine appropriate sharing techniques.

41. *Seventh*, preserving 30 megahertz for ITS use in the 5.9 GHz will comport with the use many other countries have designated for this band and allow global harmonization. We start by noting that many countries are providing for ITS use in the 5.9 GHz band, with variances in the upper and lower channel bounds, available bandwidth, technology, and nature of services being developed. Notably, it appears that no other countries have reserved 75 megahertz for safety-of-life ITS uses.[105] For example, Open Technology Institute and Public Knowledge describe Japan's use of a single 10-megahertz channel to provide V2X safety-related benefits.[106] And China has only allocated 20 megahertz for such ITS use.[107] Although some countries have allocated more to ITS,[108] we find that, based on the worldwide experience, each jurisdiction appears to have made an individual policy choice that it has found to be most appropriate for its particular circumstances. To the extent that there is a broad allocation of spectrum in the 5.9 GHz band to support ITS technologies (even if there is no overall consensus on which

[104] U.S. DOT Reply at 2; AASHTO Comments at 19 (typical "autonomous" vehicles do not require any vehicle-to-vehicle communications, and current autonomous vehicle testing does not use direct V2V communication between and among vehicles operating on the public road).

[105] NCTA Reply at 27-32.

[106] Open Technology Institute and Public Knowledge Comments at 20. *See also* Motor & Equipment Manufacturers Association Reply at 7 (stating that, out of 80 megahertz, 10 megahertz is "dedicated exclusively for transportation safety communications.").

[107] *See* R Street Institute Comments at 6.

[108] ITS allocations (not limited to safety-of-life) in this camp include Europe (50 megahertz, 5.875–5.925 GHz); Singapore (50 megahertz, 5.875–5.925 GHz); Australia (70 megahertz, 5.855–5.925 GHz); and Korea (70 megahertz, 5.855–5.925 GHz). *See* R Street Institute Comments at 6; Autotalks Comments at 6-7.

technology or applications will ultimately be deployed in specific portion(s) of the band),[109] there are potential harmonization benefits in retaining some dedicated spectrum for ITS in this frequency range—especially in the upper 20 megahertz, which R Street identifies as "the only spectrum in common use across all countries."[110] Our plan to introduce C-V2X in the band, in conjunction with other administrations' support for such use within the 5.9 GHz band, should facilitate economies of scale in the production and deployment of equipment and, ultimately, provision of the core safety functions originally contemplated for the band.

42. We disagree with ITS proponents who insist that the entire band be preserved for future ITS developments that could make use of the entire 75 megahertz in the 5.9 GHz band. Although it is possible that ITS might ultimately make use of the entire 75 megahertz if it continued to be set aside for ITS, such a decision would not optimize use of this valuable spectrum—and the credibility of such arguments is lacking given that these same arguments have been advanced by ITS proponents for years and years with no discernible change in the marketplace. We agree with 5GAA and Qualcomm that 30 megahertz is sufficient for providing basic safety and related services, consistent with those originally contemplated when the Commission authorized DSRC-based ITS service in the 5.9 GHz band, and sufficient to provide new services should operators use spectrum efficiently. We find that the public interest is best served by dividing the 5.9 GHz band to address the needs of both ITS and unlicensed users.

43. We disagree with the position of Car 2 Car and other commenters that argue that more than 30 megahertz should be reserved to accommodate future advanced ITS safety-related services that are under development.[111] Car 2 Car , referencing its own spectrum study, acknowledges that 30 megahertz is more than sufficient to support the initial phases of ITS that are related to "awareness driving," including several vehicle-to-vehicle applications (including Basic Safety Message and Personal Safety Message) and vehicle-to-infrastructure applications.[112] But Car 2 Car goes on to claim that limiting the spectrum to this amount may provide insufficient support for platooning[113] or protection of unconnected "vulnerable road users" (e.g., pedestrians, bicyclists, and road workers who cannot send/receive Personal Safety Messages to/from connected vehicles),[114] and would not support later phases of ITS currently under study associated with "sensing driving" and "cooperative awareness driving"

[109] The International Telecommunication Union Radiocommunication Sector (ITU-R) recommends designating the 5.9 GHz band for ITS. *See* Car 2 Car Comments at 4.

[110] *See e.g.*, R Street Institute Comments at 7.

[111] *See* Car 2 Car Comments at 1-8, 18-19. *See also* Panasonic Oct. 6, 2020 *Ex Parte*, Attachment ("Spectrum Requirements for Intelligent Transportation Systems") at 2-4 (referencing Car 2 Car study); Volkswagen Comments at 9 (30 megahertz is needed for vehicle-to-vehicle and vehicle-to-infrastructure safety applications today).

[112] *See* Car 2 Car Comments at 1-8, 18-19.

[113] Platooning functions relate to a type of cooperative automated driving for connected vehicles, generally trucks, that travel together in a coordinated manner. *See* Continental Reply at 16.

[114] Vulnerable road users (VRUs) include pedestrians, bicyclists, motorcyclists, scooter users, and road workers. *See* IEEE 1609 Working Group Comments at 6; Qualcomm Comments at 3.

(including Collective Perception Messages[115] and Maneuver Coordination Messages[116]), which could require more spectrum and could help enable future autonomous driving services.[117]

44. We disagree with Car 2 Car's premise that 70 megahertz of spectrum may be needed to accommodate all of the various message types (e.g., urban, suburban, and highway use cases), including possible future applications.[118] Continental Automotive Systems (Continental), the IEEE 1609 Working Group, and others similarly contend that 30 megahertz would not be sufficient for potential future, but not yet developed or deployed, advanced services (including cooperative awareness driving, maneuver coordination, and platooning).[119] 5GAA agrees that 30 megahertz would not be sufficient for "advanced" applications that are currently under development, which would need an additional 40 megahertz of spectrum,[120] and the Alliance for Automotive Innovation asserts that providing only 30 megahertz for vehicle-to-everything (V2X) applications would undercut the technology's possible benefits by eliminating spectrum needed for anticipated technological innovations.[121] U.S. DOT contends that all 75 megahertz should be preserved for ITS[122] arguing that limiting ITS to 30 megahertz would reduce the utility of V2X and that safety innovations under development, including cooperative automated driving systems, may be lost.[123] U.S. DOT and others also contend that the 5.9 GHz band is ideally suited for V2X because of the band's non-line-of-sight communication capabilities, asserting for instance that this can promote advanced driver assistance systems by enabling sensor data that is being provided by on-

[115] Collective Perception Message (CPM) functions, which are under development at this time, are anticipated to involve smart roadside infrastructure and connected vehicles detecting and providing information to other connected vehicles about all traffic participants in the vicinity, including non-connected vulnerable road users and vehicles. Example applications include accident avoidance with vulnerable road users, overtaking warnings with collective perception, extended intersection collision warning with collective perception, cooperative awareness of objects on the street, and wrong-way vehicle warnings in cases of non-V2X equipped wrong-way vehicles. Continental Reply at 16.

[116] Maneuver Coordination Message (MCM) functions, which are under development, are anticipated to facilitate negotiations between connected vehicles for non-ordinary highway situations. Example applications may include: cooperative lane change: opening gaps for vehicles to safely change lanes; cooperative overtaking (opening gaps for vehicles to safely overtake), maneuver coordination for automated driving (exchange of intended driving paths); cooperative merging; improved cooperative driving applications (e.g., improved intersection movement assist and improved left turn assist). *Id*.

[117] *See* Car 2 Car Comments at 1-8, 18-19.

[118] Car 2 Car Comments at 2. Car 2 Car provides a chart that purports to show the spectrum requirements, in megahertz, for six message types (basic safety message, infrastructure to vehicle, personal safety message, collective perception message, platooning control message and maneuver coordination message) for urban, suburban and highway driving use cases.

[119] Continental Reply at 15-17; Letter from Alan G. Fishel, Jeffrey E. Rummel, Counsel for Continental Automotive Systems, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at attached slide presentation (filed June 9, 2020) (Continental June 9, 2020 *Ex Parte*); Letter from Alan G. Fishel, Counsel for Continental Automotive Systems, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1-2 (filed Oct. 7, 2020); Letter from Alan G. Fishel, Counsel for Continental Automotive Systems, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1-3 (filed Oct. 22, 2020); Continental Comments at 4-7; IEEE 1609 Working Group Comments at 5-10 (75 megahertz is needed for the wide range of safety-related ITS applications, including Basic Safety Message, vulnerable road users, and connected and automated vehicles that are under development, citing Car 2 Car spectrum study); U.S Technical Advisory Group Comments at 5-10 (same).

[120] 5GAA Comments at 22-31 (30 megahertz would support "C-V2X Direct" operations but not "advanced" C-V2X); *see also* Panasonic Oct. 6, 2020 *Ex Parte*, Attachment ("Spectrum Requirements for Intelligent Transportation Systems") at 2-4 (referencing 5GAA analysis).

[121] Alliance for Automotive Innovation Reply at 22-24.

[122] *See generally* U.S. DOT Reply.

[123] U.S. DOT Reply at 1-3; *see also id.* at 14-19.

board sensors in individual vehicles using other spectrum and technologies (e.g., radar, LiDAR, cameras) to be shared cooperatively (at low latency) to improve vehicular safety among more users.[124] Some ITS proponents contend that limiting the amount of available spectrum to 30 megahertz may eliminate or significantly delay development and deployment of certain ITS capabilities.[125] In addition, the Commission received comments from other interested parties, including automakers and related entities,[126] transportation-related associations and state departments of transportation,[127] public safety entities,[128] and others[129] advocating for retention of the entire 5.9 GHz band for ITS to ensure that there is sufficient spectrum for both current and future safety-related applications.

45. NCTA, WISPA, and others dispute that any additional spectrum should be made available for these potential, future ITS applications. NCTA notes that Car 2 Car's own study indicates that 30 megahertz is sufficient for Basic Safety Messages (which requires no more than 10 megahertz) and various vehicle-to-infrastructure (V2I) applications, including signal phase and timing, road/lane topology maneuver, in-vehicle information and other similar messages, as well as the Personal Safety Message (which require only 20 megahertz).[130] NCTA further notes that even after 20 years there are currently no commercially-marketed vehicles that includes DSRC radios to even provide ITS basic safety services.[131] NCTA contends that the Commission should not consider the potential spectrum needs of future versions of ITS technologies because these other potential future V2X applications are "speculative developments" that may or may not develop.[132] NCTA states that this would invite repeat of the same error made in 1999, which resulted in underuse of valuable mid-band while awaiting research and development.[133] WISPA contends that commenters seeking to continue to reserve the existing ITS spectrum reservation without modification, fail to make the case that the entire band must be withheld from other uses. It further argues that to continue to wait for benefits that have proven elusive for more

[124] *See. e.g.*, U.S. DOT Reply at 16, 29-32; IEEE 1609 Working Group Comments at 8; Panasonic Comments at 14.

[125] *See, e.g.*, Car 2 Car Comments at 4; Continental June 9, 2020 *Ex Parte* at 1, 4.

[126] *See, e.g.*, GM Comments at 8-9 (potential safety benefits related to protecting vulnerable road users, cooperative driving, platooning, and advanced driving with sensors will be lost or limited); Honda Comments at 10; Jaguar Land Rover Comments at 3; Nissan Comments at 1; Volkswagen Comments at 4-5; Volvo Comments at 2; BMW Comments at 3; Fiat-Chrysler Comments at 3; Ford Reply at 6-7; Toyota Reply at 5-9; Autotalks Comments at 2; European Automobile Manufacturers Association Comments at 1-2; Bosch Comments at 4.

[127] *See, e.g.*, ITS America Comments at 3; American Trucking Association Comments at 2; American Highway Users Alliance Comments at 3; American Public Transportation Association Comments at 2; Automotive Safety Council Comments at 1-2; AASHTO Comments at 3; California DOT Comments at 3; City of New York Comments at 5-6; Colorado DOT Comments at 1-2; Georgia DOT Comments at 15; Michigan DOT Comments at 1-3; Pennsylvania DOT Comments at 1; Texas DOT Comments at 2-4.

[128] *See, e.g.*, National Public Safety Telecommunications Council Comments at 1; National Sheriff's Association Comments at 1.

[129] *See, e.g.*, Consumer Reports Comments at 1; LG Electronics Comments at 1; Qualcomm Comments at 9-16; Bosch Comments at 5; NXP Semiconductors Comments at 1; AT&T Comments at 1; T-Mobile Comments at 1; League of American Bicyclists Comments.

[130] NCTA Reply at 24 (citing Car 2 Car Position Paper on Road Safety and Road Efficiency Spectrum Needs in the 5.9 GHz for C-ITS and Cooperative Automated Driving (Feb. 28. 2020)).

[131] NCTA Reply at 26. We note that GM's Cadillac brand included one model (CTS sedan) that installed DSRC on-board units from 2017 through mid-2019, when such installations were discontinued. *See* https://www.theverge.com/2017/3/9/14869110/cadillac-cts-sedan-v2v-communication-dsrc-gm; http://cadillacsociety.com/2018/12/04/cadillac-ct6-to-be-discontinued-in-mid-2019/#:~:text=Cadillac%20CT6%20To%20Be%20Discontinued%20In%20Mid-2019.%20It%E2%80%99s,the%20CT6%20being%20a%20casualty%20of%20the%20move.

[132] NCTA Reply at 24-27.

[133] NCTA Reply at 26-27.

than two decades,[134] are based on speculation about "future potential" or the "potential evolution" ITS applications needs and a desire to "future proof" possible future uses.[135] In addition, Open Technology Institute and Public Knowledge argue that leaving the entire 5.9 GHz allocated for auto-related communications (whether under the DSRC or C-V2X standards) would impose high costs on consumers with little return on the horizon and, hence, a stalled 5.9 GHz band would only remain a roadblock to the realization of consumer and public benefits.[136]

46. Given the significant advances that have been made in automotive connectivity using a variety of means in different spectrum bands outside of 5.9 GHz, an ever-greater portion of the overall valuable spectrum resource is being used to support automotive-related functions, including those related to safety. Viewed from this perspective, we are not persuaded by arguments that the entire 5.9 GHz band is needed for ITS in order to ensure that possible future developments can be accommodated, even if it is possible that such future developments could potentially provide some additional safety benefits. Even if each of the message types identified may be needed to deliver specific applications, basic safety messages and collective perception messages would not be delivered simultaneously, and each type of message will have varying requirements for frequency and duration. Thus, we believe that the ITS messaging system must work to prioritize and deliver messages more efficiently in the 30 megahertz that will be available for ITS, such as by adjusting message timing to provide multiple types of messages on a single channel to provide the same level of safety to vehicles as can be done on the existing spectrum.

47. Finally, we disagree with ITS proponents that assert that our decision will undercut U.S. leadership in innovation based on other countries around the world that have made more spectrum available for ITS in the 5.9 GHz band.[137] As noted, the actual amount of spectrum varies by country. And we are not aware of any widespread deployments that use the full 75 megahertz that proponents say is needed to maintain U.S. leadership—indeed, it appears that the United States is not the only country where the long-time promises of ITS have failed to bear fruit.[138] As such, we conclude that targeting the upper 30 megahertz for ITS use (and transitioning that spectrum to C-V2X over time) will enable America to lead in this wireless sector, as it has in others.

b. Transitioning ITS out of the 5.850-5.895 GHz Portion of the 5.9 GHz Band

48. We adopt rules establishing a timeline for existing ITS operations to cease use of the lower 45-megahertz (i.e. 5.850-5.895 GHz) band segment. In the *5.9 GHz NPRM*, we recognized that a limited number of DSRC systems have been authorized and constructed within the larger 75 megahertz-wide 5.9 GHz band and sought comment on the transition of these operations to the spectrum that would be retained for ITS.[139] In particular, we asked whether we should adopt a six-month period in which existing DSRC operations, licensed under part 90 of our rules, and all on-board units operating pursuant to our part 95 rules would have to re-channelize or discontinue service, as well as whether a shorter or longer period would be appropriate.[140] We also proposed to modify existing ITS licenses to allow operation in only the 5.895-5.925 GHz portion of the band, to the extent that licensees wanted to operate a

[134] WISPA Reply at 2-3.

[135] WISPA Reply at 11.

[136] WISPA Reply at 6-7.

[137] *See, e.g.*, 5GAA Comments at 34-35 (many other countries have allocated amounts similar to 75 megahertz for ITS); Car 2 Car Comments at 4-5 (other countries are allocating spectrum for cooperative automated driving); Autotalks Comments at 6-7 (many other countries allocate more than 30 megahertz for ITS); Alliance for Automotive Innovation Reply at 25-27; Continental Reply at 17-19; ITS America Reply at 35.

[138] NCTA Reply at 28-29.

[139] *5.9 GHz NPRM*, 34 FCC Rcd at 12616-18, paras. 32-36.

[140] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 36.

C-V2X system, or in the 5.895-5.905 GHz portion of the band, to the extent that licensees wanted to continue their DSRC operations.[141]

49. We adopt our proposal to require existing ITS licensees to cease use of the 5.850-5.895 GHz portion of the 5.9 GHz band and will provide ITS licensees up to one year from the effective date of this First Report and Order to cease operating in this portion of the band. Some commenters support requiring the ITS operations in the lower 45 megahertz to transition out of this spectrum within six months of our decision,[142] while others state that six months is not sufficient but one year would suffice.[143] Taking the record into account, we believe providing ITS licensees one year from the effective date of this First Report and Order provides a sufficient and reasonable amount of time for them to take the necessary steps to transition from the lower 45 megahertz of spectrum and to engage in the same types of operations in the upper 30 megahertz that they were conducting in the band. Thus, our action today will accommodate the needs of these incumbent licensees and provide sufficient time to consolidate their operations to the upper portion of the band, while enabling unlicensed system operators to begin taking advantage of the U-NII-4 band with indoor-only deployments as soon as possible.

50. The Commission first suggested a six-month transition period nearly a year ago,[144] providing licensees as well as manufacturers with notice that the Commission was contemplating adopting rules that would require them to vacate the lower portion of the band. Based on the record before us, we believe that allowing one year from the effective date of this First Report and Order is more than adequate for ITS licensees and equipment manufacturers to take the steps needed to complete the transition to the modified ITS band. We do not believe this transition period presents an undue burden to the ITS licensees as, to date, there have only been limited ITS deployments with relatively few installed transmitters. Because the majority of the installed base is being used in trials for roadside units (RSUs) at known locations, it should be simple to identify and modify that equipment. All ITS equipment authorized in the U.S. has the ability to operate over the upper 70 megahertz of the 5.9 GHz band. Hence, moving operations to the upper 30 megahertz should be possible within the proposed one-year period time frame through firmware upgrades. Furthermore, we do not expect our decision to delay introduction of on-board units (OBUs) as, under normal vehicle development cycles, we would expect at least two years before such equipment could be deployed in vehicles in large numbers.[145] Manufacturers should have ample time to integrate new on-board units that comply with our rules into future model year vehicles.

51. Accordingly, we use our authority under sections 301, 309, and 316 of the Communications Act to modify all existing ITS licenses to permit operation only in the 5.895-5.925 GHz portion of the 5.9 GHz band following the one-year transition period. Thus, under the terms of these modified licenses, the authority to operate in the lower 45 megahertz will expire at the end of this one-year period.[146] In addition, because licensees are required to register their roadside units (RSUs) on

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[141] *5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 34.

[142] *See* NCTA Comments at 44; T-Mobile Comments at 2, n.5.

[143] *See, e.g.,* Letter from Scott Delacourt, counsel for Alliance for Automotive Innovation to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 3 (filed Nov. 10, 2020) (stating that one year would provide sufficient time for incumbents to transition out of the lower 45 megahertz); OmniAir Consortium, Inc. (OmniAir) Comments at 11.

[144] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 36.

[145] *See* National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT), Federal Motor Vehicle Safety Standards; V2V Communications Notice of Proposed Rulemaking (NPRM). 82 FR 3854, which states new V2X requirements, if adopted, would phase-in two model years after the final rule is adopted to accommodate vehicle manufacturers' product cycles.

[146] As per 47 U.S.C. § 316, we provide for a 30-day protest period before these modifications can become final. *See infra.* paragraph 204.

specific channels, and not all RSUs are currently registered to operate throughout the band's upper 30 megahertz of spectrum, we are modifying all licenses to add the 5.895-5.925 GHz channel block to the channels on which each RSU is authorized to operate.[147] We find that such modifications are consistent with our statutory authority, supported by judicial and Commission precedent, and will serve the public interest.

52. Section 316 of the Communications Act vests the Commission with broad authority to modify licenses "if in the judgment of the Commission such action will promote the public interest, convenience, and necessity."[148] We find that modifying existing ITS authorizations to sunset use of the lower 45 megahertz of spectrum in the 5.850-5.895 GHz portion of the 5.9 GHz band (and confine their operations to the upper 30 megahertz of spectrum in the 5.895-5.925 GHz portion of the band) is within the Commission's statutory authority, consistent with prior Commission practice, and will promote the public interest, convenience, and necessity. We accordingly will modify all ITS licenses by sunsetting their authorizations to operate at 5.850-5.895 GHz, in order to carry out the clearing of this portion of the band. In addition, the Commission will modify all active ITS licenses to authorize all individually registered roadside units (RSUs) not currently registered for operation on the full 30 megahertz of spectrum in the 5.895-5.925 GHz segment of the 5.9 GHz band to operate on that segment. We also add as a condition on ITS part 90 licenses a notification requirement consistent with the transition deadline of one year from the effective date of this First Report and Order, which will require licensees to certify by that deadline that they have ceased operating in the 5.850-5.895 GHz portion of the band. Any licensee that does not transition to the upper 30 megahertz of spectrum in the 5.895-5.925 GHz segment of the 5.9 GHz band, as evidenced by failure to file the required notification advising the Commission of its transition, will have their license terminated automatically without specific Commission action; and at a reasonable time after the transition deadline, the Wireless Telecommunications Bureau will automatically remove all frequencies in the 5.850-5.895 GHz portion of the band that remain on any ITS license, including on individually registered RSUs. We believe the notification requirement will ensure clearing of the lower 45 megahertz of spectrum and provide transparency to all stakeholders regarding the status of the band. We direct the Wireless Telecommunications Bureau to establish the procedural requirements of the notification process via Public Notice.

53. We revise our rules to prohibit new ITS applications for the 5.850-5.895 GHz portion of the band, as well as modify section 95.3163 to reflect that licensed by rule on-board units are similarly limited to operate only in the 5.895-5.925 GHz band as of the end of the one-year sunset period.[149] While some existing ITS licenses have expiration dates that stretch to 2030,[150] we are not terminating any license or any licensee's renewal expectancy, and we believe that this transition plan treats each license in a consistent manner.

54. We direct the Wireless Telecommunications Bureau to modify the existing licensing

[147] These license modifications are subject to the protest period provided by section 316, as clarified in the ordering clauses.

[148] 47 U.S.C. § 316. *See also California Metro Mobile Commc'ns, Inc. v. FCC*, 365 F.3d 38, 45 (D.C. Cir. 2004) ("Section 316 grants the Commission broad power to modify licenses.").

[149] We note that vehicle owners do not necessarily have control over on-board unit operations. The rule change here is procedural in nature and the Commission does not intend to seek enforcement action on vehicle owners with on-board DSRC units that continue to operate throughout the 5.9 GHz band. As these units operate at low power levels, we do not believe they pose a significant risk of harmful interference.

[150] The Commission instituted a freeze on new ITS licenses in the 5.9 GHz band in December 2019. *Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Announce Temporary Freeze on the Acceptance and Processing of Part 90 Applications for Certain 5850-5925 MHz (5.9 GHz Band) Spectrum*, ET Docket No. 19-138, Public Notice, 34 FCC Rcd 12333 (WTB & PSHSB 2019) (temporarily freezing the acceptance and processing of new and expanded use applications related to part 90 services operating in certain portions (specifically, 5.850-5.895 GHz and 5.905-5.925 GHz) of the 5.850-5.925 GHz band (5.9 GHz band) and on the processing of applications to renew part 90 licenses in the 5.9 GHz band).

freeze consistent with decisions we adopt today to allow licensees to register new roadside units to operate only within the modified ITS band of 5.895-5.925 GHz. Licensees may, at any time prior to the end of the one-year transition period, modify their currently existing roadside unit location registrations on their own motion to delete frequency usage in the lower 45 megahertz, so that the remaining roadside unit registrations on their licenses would reflect only the 5.895-5.925 GHz frequencies in the modified ITS band (either because the license had already specified a registered roadside unit in that upper portion of the band, or by virtue of the Commission's modification by rule authorizing incumbent registered roadside units that were outside of that portion of the band to operate throughout that portion). By no later than the transition date, licensees would be required to cease all operations in the 5.850-5.895 GHz band, as any ITS operation in the band on or after that date would violate the Commission's rules and the terms of their modified licenses.[151]

55. Existing ITS licensees that currently operate on channels in the 5.850-5.895 GHz portion of the 5.9 GHz band may move any of their DSRC-based operations to channels in the 5.895-5.925 GHz portion of the band at any time before they are required to cease operations in the 5.850-5.895 GHz portion. Furthermore, we anticipate that some ITS licensees may wish to operate C-V2X-based ITS in the 5.895-5.925 GHz ITS band, and note that some automotive, technology, and telecommunications companies request that we permit C-V2X operations in the 5.895-5.925 GHz band as soon as possible.[152] Accordingly, we will permit any existing or future part 90 ITS licensee to operate C-V2X-based roadside units (RSUs) in the 5.895-5.925 GHz band within its geographic licensing areas by requesting and obtaining a waiver of the Commission's rules, subject to specific conditions.[153] Each such ITS licensee obtaining a waiver would be required to coordinate its C-V2X-based roadside unit (RSU) operations with any existing licensee within that same geographic area to ensure that no C-V2X-based roadside units would interfere with any DSRC-based roadside units that operate in the 5.895-5.925 GHz band.[154] Under this waiver approach, we also would condition C-V2X operations on complying with specified technical rules (e.g., power and out-of-band emission limits consistent with current DSRC-based rules) and the requirement that these operations must comply with any final rules that the Commission adopts for C-V2X operations.[155] We direct the Wireless Telecommunications Bureau and the Public Safety and Homeland Security Bureau to issue a public notice within 30 days of the effective date of this Report and Order to establish and provide further clarity on a streamlined waiver process for providing ITS licensees authority to operate roadside units with C-V2X-based technology in the 5.895-5.925 GHz band in the near term.

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[151] This includes portable RSUs not subject to registration requirements.

[152] *See, e.g.*, Letter from Mitch Bainwol, Chief Government Relations Counsel, Ford Motor Company, Stephen Rober, V.P., Fiat Chrysler Automobiles U.S. LLC, et al. to Ajit Pai, Chairman, FCC, ET Docket No. 19-138, at 1-2 (filed Nov. 5, 2020) (letter filed by representatives of Ford, Fiat Chrysler, Daimler, Applied Information, T-Mobile, Nokia, Qualcomm); Letter from John W. Kuzin, Vice President and Regulatory Counsel, Qualcomm, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 1 (filed Nov. 5, 2020) (Qualcomm Nov. 5. 2020 *Ex Parte*). We note that Qualcomm also requests that we grant the 2018 5GAA request for waiver to allow C-V2X deployments in the 5.905-5.925 GHz portion of the 5.9 GHz band. *See, e.g.*, Qualcomm Nov. 5, 2020 *Ex Parte* at 1 (referencing the 5GAA Petition for Waiver (filed Nov. 21, 2018)).

[153] 47 CFR § 1.925(b)(3) (grant of a waiver request requires a showing that "the underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and that a grant of the requested waiver would be in the public interest; or in view of unique or unusual factual circumstances of the instant case, application of the rule(s) would be inequitable, unduly burdensome or contrary to the public interest, or the applicant has no reasonable alternative").

[154] ITS licensees that obtain a waiver must coordinate their C-V2X-based roadside unit operations to ensure that those roadside units do not cause harmful interference to any DSRC-based roadside units that are operating in the 5.895-5.925 GHz band either as a result of their transitioning to this band prior to the one year sunset date for operations in the 5.850-5.895 GHz band or following the transition deadline.

[155] In the Further Notice, we seek comment on the final rules for C-V2X operations in the 5.895-5.925 GHz band.

56. We also will take action to enable use of C-V2X-based on-board units as expeditiously as possible. Because on-board units are licensed by rule under part 95, manufacturers will need waivers to obtain equipment certification of C-V2X-based on-board units as well as a waiver to permit such device operation prior to the Commission adopting final rules for C-V2X-based on-board units. We encourage parties interested in pursuing development, installation, and use of C-V2X-based on-board units in advance of final rules to discuss their equipment with the Wireless Telecommunications Bureau, the Public Safety and Homeland Security Bureau, and the Office of Engineering and Technology to determine the appropriate course of action to enable the expeditious roll-out of these devices on vehicles in a manner that is consistent with existing technical rules and that will not cause harmful interference to DSRC-based operations that have not yet transitioned to C-V2X operations.[156] Our actions here provide needed certainty that will enable a smoother and more rapid development and deployment of C-V2X-based ITS operations in the future.

57. We note that ITS America suggested that the Commission consider according ITS licensees reasonable compensation related to our decision to require relocation of ITS out of the lower 45 megahertz of spectrum, although it did not propose a specific mechanism for such funding.[157] The Alliance for Automotive Innovation likewise asked the Commission to specify in this order that unlicensed entrants in the 5.9 GHz band must provide the reasonable costs incurred by existing ITS licensees transitioning out of the band.[158] While some mechanism for funding the transition might be appropriate, we decline to adopt a specific mechanism in this First Report and Order because we did not propose a compensation mechanism in the *5.9 GHz NPRM*, and therefore have not provided parties an adequate opportunity to comment on such a mechanism. In addition, given the limited deployment and the fact that licensees are typically government entities, we expect that there will be little practical difficulty or disruption caused by delaying the resolution of this issue to the Further Notice.

B. Unlicensed Operations in the 5.850-5.895 GHz Band

58. As discussed above, we are designating 45 megahertz in the 5.850-5.895 GHz portion of the 5.9 GHz band for unlicensed operations. This 45-megahertz band will expand the unlicensed ecosystem by providing additional spectrum adjacent to the upper edge of the U-NII-3 band for unlicensed devices.[159]

59. Below, we set out the technical and operational rules for unlicensed operations in the 5.850-5.895 GHz band as well as rules for protecting incumbents in the band. After review of the pertinent technical and legal issues before us and an examination of the record, we adopt a staged approach to effectuate the band-repurposing actions taken herein. The approach we take is designed to optimize use of the 5.850-5.895 GHz band by unlicensed operations as soon as possible in this portion of the 5.9 GHz band with full consideration of the need to protect incumbent operations in this band. Specifically, at this time we will permit only indoor unlicensed operations to operate across the entire 5.850-5.895 GHz portion of the band. We limit unlicensed use to indoor operations in recognition of the potential that ITS licensees may currently be operating in portions of the 5.850-5.895 GHz band in particular geographic areas, as well as the need to protect federal incumbents operating in particular geographic zones in the 5.850-5.895 GHz band. We decline to allow full-power unlicensed outdoor

[156] While we expect that current DSRC-based ITS licensees will seek to transition to C-V2X-based operations expeditiously, such licensees are permitted to continue to operate in the 5.850-5.895 GHz band for up to one year after the effective date of the Report and Order, and to operate in the 5.895-5.925 GHz band up until the date that they will be required to transition to C-V2X-based operations, which will be established in the Second Report and Order.

[157] ITS America Reply at 44.

[158] Alliance for Automotive Innovation Nov. 10, 2020 *Ex Parte* at 4-5.

[159] In this band, ultra-wideband devices have been permitted to operate, but at very low power levels (see 47 CFR part 15, subpart F), and unlicensed in general has been authorized to operate, but also at low power levels (i.e., the limits in 47 CFR § 15.209).

operations at this time. Instead, such use across the band will be allowed at a later time, after ITS operations have ceased to operate in the 5.850-5.895 GHz band and after we have adopted rules that will ensure protection of federal operations from these outdoor operations. We nonetheless will allow some outdoor operations in certain specified locations in the band through the STA process (i.e., on a non-interference basis), where such operations would not cause harmful interference to any incumbent operations.

1. Technical and Operational Rules for Unlicensed Operations

60. In the *5.9 GHz NPRM*, we proposed to place the U-NII-4 unlicensed device rules in part 15, subpart E along with the existing U-NII rules and subject to all of the general part 15 operational principles. We also proposed that U-NII-4 devices be subject to similar technical and operational rules as apply to the U-NII-3 band. Proponents of ITS services suggest that U-NII-4 operations should be restricted to indoor-only use to protect adjacent-band ITS operations from harmful interference.[160] 5GAA, Cisco, and Qualcomm submit that restricting U-NII-4 operations to indoor-only use would also allow for relaxation of the OOBE limits on frequencies outside of the 5.850-5.895 GHz band, which would allow for more flexible use of the band and enable robust wideband operations indoors.[161] Proponents of unlicensed operations suggest that the Commission should consider separate rules for indoor and outdoor U-NII-4 band operations, rather than adopting indoor-only use restrictions or applying more stringent OOBE limits across all unlicensed operations in the U-NII-4 band.[162]

a. Indoor Unlicensed Operations to Protect Federal Incumbents and ITS Operations while ITS Remains in the 5.850-5.895 GHz Band

61. We conclude that in order to protect incumbent 5.9 GHz band services from potential interference by unlicensed operations– including federal incumbents and ITS operations while those remain in the 5.850-5.925 GHz portion of the band – we will permit only indoor unlicensed operations to operate across the band at this time.

(i) Protection of Federal Incumbents

62. The 5.650-5.925 GHz band is allocated on a primary basis for the Federal Radiolocation Service and is used by the Department of Defense (DoD) for fixed and mobile radar operations.[163] Unlicensed U-NII-3 devices currently share spectrum with DoD radar operations in the 5.725-5.850 GHz band without implementing any special frequency avoidance techniques. Unlicensed devices generally operate without incident in the U-NII-3 band. There have been some isolated instances of harmful interference, however, which the Commission worked with NTIA and DoD to resolve.[164] Notably, at the time the Commission adopted rules for the U-NII-3 band, it was unaware of these DoD radars.[165] In the

[160] *See, e.g.*, 5GAA Comments at 42, n.123; Car 2 Car Comments at 18; Cisco Comments at 15-16; Ford Reply at 8; IEEE 1609 Working Group Comments at 15; OmniAir Comments at 10; Qualcomm Comments at 18-19; Toyota Reply at 14; and U.S. TAG Comments at 11.

[161] *See* 5GAA Comments at 42, n.123; Cisco Comments at 15-16; Qualcomm Comments at 18-19.

[162] *See, e.g.*, Broadcom/Facebook Comments at 6; Comcast Reply at 12; Dynamic Spectrum Alliance Comments at 5; NCTA Comments at 49-50; Open Technology Institute at New America with the American Library Association, Benton Foundation, Next Century Cities, and Public Knowledge Reply at 22-24; Wi-Fi Alliance Comments at 7-8; and WISPA Comments at 6-7.

[163] *See* 47 CFR § 2.106.

[164] We are aware of harmful interference that occurred to an Air Force radar tracking system that has become operational at Cape Canaveral. *See* Advisory Notice 5 GHz Interference to Patrick Air Force Base and Cape Canaveral Air Force Station Tracking Radars, FCC Enforcement Bureau Office of the Field Director (rel. Jul. 27, 2016).

[165] U-NII Report and Order, 12 FCC Rcd at 1596-97 para. 46, 1610, para. 82 (establishing the 5.725-5.825 GHz (UNII-3) band); U-NII 5 GHz Report and Order, 29 FCC Rcd at 4151, para. 88 (adding 5.825-5.850 GHz to the

(continued….)

5.9 GHz NPRM, we proposed to adopt the same technical rules (e.g., radiated power, power spectral density, etc.) for U-NII-4 devices as apply to U-NII-3 devices. The Commission also sought comment on whether there are any mitigation measures, such as technical or operational conditions or constraints that could be imposed on U-NII-4 devices, to protect DoD radars in the band.[166] And the Commission committed to continue working with NTIA and DoD to consider whether there are policies or procedures that could minimize the potential for harmful interference to DoD radars from U-NII-4 devices.

63. Comcast submits that the Commission should adopt its proposal for U-NII-4 devices to adhere to the same technical rules as U-NII-3 devices with respect to federal DoD radar operations.[167] WISPA agrees with the Commission's judgment that no other mitigation measures are required to protect DoD radar operations in the 5.9 GHz band.[168] NCTA states that the Commission should adopt its proposal to authorize U-NII-4 devices without requiring any special frequency avoidance techniques or similar constraints since 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.[169] NTIA conducted analyses to assess the potential of U-NII-4 devices to cause harmful interference to DoD radar operations. That analysis concludes that a 33 dBm/20 MHz equivalent isotropically radiated power (EIRP) limit for indoor U-NII-4 devices is unlikely to cause harmful interference to federal radar operations in the 5.9 GHz band.[170] We support NTIA's recommended power limit as we believe it properly balances federal radar protection levels with ensuring that U-NII-4 devices can operate with enough power to provide reliable connections to the American public. As NTIA expresses the power level as a density of 20 dBm/MHz, we are adopting rules consistent with that recommendation.

64. While we agree with NTIA's power density limit recommendation for U-NII-4 indoor devices, it is worth noting that there are a number of NTIA's assumptions that differ from our assumptions in the *6 GHz Report and Order* analysis. For example, one distinction is with respect to the probability that a Wi-Fi channel is operating in the U-NII-4 band. In general, this probability depends on channel bandwidth, the total number of available channels across the unlicensed bands with the corresponding bandwidth, as well as the channel bandwidth use distribution (20, 40, 80 or 160 megahertz). However, NTIA's analysis incorporates a channel-scaling parameter that broadly reflects the number of effective users in the U-NII-4 band and thus considers this probability using a single parameter.[171] This and other varying assumptions can lead to some differences in the final numerical results. Nevertheless, we agree with NTIA's recommendation that 33dBm/20 MHz EIRP limit will not

5.725-5.825 GHz (U-NII-3) band); 47 CFR § 15.407(a)(3). In its comments in the initial proceeding that established the U-NII-3 band, NTIA did not mention radar tracking system operations at Cape Canaveral. See NTIA Reply, Docket No. 96-102, filed Aug. 16, 1996, Appendix D at D-5. See also NTIA Comments in the U-NII-3 expansion proceeding, Docket No. 13-49, filed June 10, 2013.

[166] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12624, para. 57.

[167] Comcast Comments at 10, n.28.

[168] WISPA Comments at 7.

[169] NCTA Comments at 46.

[170] NTIA Technical Report 21-551 Compatibility of Federal Systems Operating in the 5850-5925 MHz Band with Intelligent Transportation Systems and Unlicensed National Information Infrastructure Devices, Edward Drocella, Yang Weng, Michael Ghorbanzadeh, Edison Juleau, Nickolas LaSorte, at 17.

[171] NTIA assumed a scaling factor of 25%. Given that there are seven 160-megahertz channels available in the 6 GHz band plus the one being made available here by combining the U-NII-3 and U-NII-4 bands, we believe NTIA is taking a conservative approach, overestimates the number of unlicensed users that may operate in this band. Even with this assumption, NTIA's analysis results in maximum power (i.e., 36 dBm) for bandwidths greater than 20 megahertz. Thus, we accept their analysis for the purposes of authorizing power for unlicensed devices in the 5.9 GHz band.

cause harmful interference to DoD radar operations.

65. For the U-NII-4 band, indoor access point EIRP will be limited to 33 dBm/20 MHz and 36 dBm/40 MHz. When combined with U-NII-3 band spectrum, indoor access point EIRP can scale to 36 dBm for 80 and 160 megahertz channels. Under this framework, operators relying on indoor U-NII-4 devices will be able to operate at the highest power levels we permit for U-NII devices (i.e., 36 dBm EIRP) using the wider channels to maximize throughput and utility of the band. At the same time, the limit on power density across all possible U-NII device bandwidths will ensure that DoD radars are protected from harmful interference. In addition to the power limit on *indoor* U-NII-4 devices, NTIA recommends further reducing the potential for harmful interference by adopting rules ensuring that indoor devices are not deployed outdoors and that expedient and effective corrective measures be put in place to eliminate interference should it occur.[172] For example, NTIA points out that we could limit devices to indoor use by requiring U-NII-4 access points to get their power through a wired connection (not battery-powered), have an integrated antenna, and not have a weatherized enclosure.[173] NTIA contends that should harmful interference occur, U-NII-4 service providers should have the capability to remotely block the interfering device(s) from using certain channels and/or to reduce the operating power of the devices. NTIA recommends that such measures be taken if U-NII-4 devices are causing harmful interference to DoD radars, noting that one of the primary operating conditions under part 15 is that the operator must correct harmful interference *even if it requires ceasing operation*.[174] NTIA further recommends that service providers and operators be expected to respond promptly to such FCC directives upon receipt.[175]

66. We believe the basic measures recommended by NTIA can be taken to protect primary federal radiolocation operations in the band from indoor unlicensed operations without imposing undue burdens on equipment manufacturers, service providers or users. Specifically, consistent with the rules the Commission adopted for 6 GHz low-power indoor access points[176] and consistent with NTIA's recommendations, we will require U-NII-4 devices to incorporate design measures to ensure indoor devices are not deployed outdoors. Since building attenuation is a key factor in minimizing the potential for harmful interference from indoor access points to incumbents' receivers, we are adopting reasonable and practical measures that will restrict access points at this time to indoor operations. Specifically, we adopt three equipment-related hardware requirements that are designed to keep these low-power access points indoors. *First*, as suggested by NTIA, we will require that the access point devices cannot be weather resistant.[177] *Second*, we will require that the access points have integrated antennas[178] or otherwise prohibit the capability of connecting other antennas to the devices, which will prevent substituting higher gain directional antennas and make the devices less capable or suitable for outdoor use. *Third*, we will prohibit these access points from operating on battery power (except for back-up power in case of a power outage). Furthermore, we will require that the access points be marketed "for indoor use only" and include a label attached to the equipment stating that "FCC regulations restrict

[172] *See* letter from Charles Cooper, Associate Administrator, Office of Spectrum Management, NTIA, to Mr. Ronald Repasi, Chief, Office of Engineering and Technology, FCC, dated Sept. 8, 2020 (*NTIA Sept. 8, 2020 Letter*) at 4. S*ee also Unlicensed Use of the 6 GHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020), https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf.

[173] *See*, *e.g.*, 47 CFR §§ 15.257, 15.403, and 15.517.

[174] *See* 47 CFR § 15.5.

[175] *See* NTIA Sept. 8, 2020 Letter at 4.

[176] *6 GHz Report and Order*, 35 FCC Rcd at 3891, para. 107 (requiring that access points not be weather resistant, have integrated antennas and prohibit the capability of connecting other antennas to the devices, and prohibit operation on battery power).

[177] NTIA Sept. 8, 2020 Letter at 4.

[178] We clarify that antennas located outside of an equipment's enclosure, but which are permanently attached to the device (e.g. consumer Wi-Fi routers with multi-array antennas) are considered as having "integrated" antennas.

operation to indoor use only." We will also require that this statement be placed in the device's user manual. This statement, along with existing Commission requirements for part 15 equipment,[179] will inform consumers of the appropriate use.[180] We find that these requirements will make outdoor operations impractical and unsuitable.

67. Consistent with our recent action in the *6 GHz Report and Order*, we adopt an exception to accommodate devices such as Wi-Fi extenders and mesh networking equipment intended to work in conjunction with an indoor access point and share the same propagation path and thus the same power requirements.[181] We will permit such devices to operate at the same power levels as an indoor access point provided that they comply with all the requirements we set out for those devices (i.e., the device cannot be weather resistant, must have an integrated antenna and cannot have capability of connecting other antennas, cannot be capable of operating on battery power, and must include a label regarding proper usage) and the end unit obtains its own equipment certification.[182] Under these requirements, modules do not qualify for higher power. Further, such devices may be used as part of a mesh network but may only be used within a single structure and not to connect separate buildings or structures. We believe such relief is a reasonable accommodation to keep most popular consumer devices less complex and more affordable without increasing the potential of harmful interference to incumbent licensees as these devices will be installed and used in a manner analogous to an access point.

68. Prospective U-NII-4 operations providers have committed, as an industry best practice, to remotely block device(s) from using certain channels and/or to reduce the operating power of the device(s) upon notification by the Commission of harmful interference to DoD radars.[183] By limiting their power density and implementing the control of the access point operation, we agree with NTIA that U-NII-4 devices can operate indoors at locations across the United States so that the American public will enjoy the widest deployment of devices possible.

(ii) Protecting ITS Operations During the Transition Period

69. Under the rules we adopt today, DSRC devices are allowed to continue to operate in the lower 45 megahertz of the 5.9 GHz band for one year after the effective date of the First Report and Order. Accordingly, U-NII devices in the lower 45 megahertz of the 5.9 GHz band will be temporarily

[179] For example, 47 CFR § 15.19(a)(3) requires devices to bear the general conditions associated with part 15 operation and 47 CFR § 15.21 requires the user manual to caution users that equipment modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

[180] If manufacturers seek permissive changes to their equipment authorizations to extend U-NII-3 band equipment into the U-NII-4 band and are not able to comply with the labeling requirement, we encourage manufacturers to file for a waiver of that requirement along with their application for permissive change. Specifically, if the equipment otherwise meets the rule criteria for indoor equipment (i.e., power cord, integrated antenna, non-weatherized enclosure), a quick and favorable determination of good cause to grant the waiver request should be possible, barring any unforeseen circumstances in a given case. We can conclude now that waiver requests meeting the stated criteria are likely to serve the public interest because granting them will expeditiously enable equipment to serve consumers and expand access to broadband services and are highly unlikely to create any risk of harmful interference. The Office of Engineering and Technology will act on such waiver requests as part of its delegated authority to oversee the equipment authorization program. *See* 47 CFR 0.241(b). This action to a priori find such waiver requests in the public interest and treat expeditiously is consistent with prior Commission action. *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*, ET Docket No. 13-49, *Report and Order*, 29 FCC Rcd 4127, 4139-40, paras. 41-42 where the Commission stated that it would similarly treat U-NII-3 equipment modified to also operate in the U-NII-1 band.

[181] *6 GHz Report and Order*, 35 FCC Rcd at 3923-24, para. 193.

[182] These devices are referred to as subordinate devices in the rules.

[183] *See* Letter from Danielle J. Piñeres, Vice President & Associate General Counsel, NCTA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 2 (filed Oct. 9. 2020) (NCTA Oct. 9, 2020 *Ex Parte*).

operating on a co-channel basis with ITS operations in the few geographic areas in which DSRC-based ITS operations remain in the band in the near term.

70. These co-channel operations require us to develop rules that minimize the impact of unlicensed device operation on ITS operations. As a first step, we must evaluate the probability of harmful interference that may occur under current DSRC system deployment densities. Once determined, that probability provides a basis for analyzing the potential that unlicensed operations might have on co-channel DSRC operations. Our analysis is based on an approach similar to that which we used when introducing unlicensed devices into the 6 GHz band, where low power indoor unlicensed Wi-Fi devices share spectrum with the licensed Fixed and Mobile Services.[184] That band provides a blueprint for similar analysis in the 5.9 GHz band as the initial sharing regime is similar; new unlicensed devices will be sharing spectrum, albeit on a temporary basis, with incumbent DSRC roadside units (RSUs) and on-board units (OBUs).

71. According to the American Association of State Highway and Transportation Officials there are 6,182 DSRC-based roadside units (RSUs) deployed throughout the U.S. and 15,506 vehicles equipped with DSRC-based on-board units (OBUs)-.[185] For context, there are approximately 274 million registered vehicles in the United States[186] operating across approximately 4.2 million miles of paved and unpaved roadways.[187] Thus, the vast majority of vehicles are not equipped with DSRC-based on-board units, just as vast stretches of roadways do not have any DSRC-based roadside unit installations. The relative number of OBU-equipped vehicles or roadway miles with installed roadside units is unlikely to change in any significant way before ITS operations move out of the lower 45 megahertz.

72. In the vehicle-to-vehicle (V2V) communications scenario, interference from an unlicensed device can only occur if there are at least two vehicles with overlapping coverage areas and there is at least one unlicensed device transmitting within that coverage area on the same channel. According to U.S. DOT report FHWA-JPO-17-483, the maximum "PER-Free range" (the range within which the ITS Packet Error Rate (PER) is below 20%) is 600 meters in an unobstructed environment.[188] We estimate that in a typical scenario, at any instant of time there can be as many as 200 vehicles in the PER-Free range.[189] Therefore, the probability that two or more randomly selected vehicles are equipped with an OBU and are within the PER-Free communication range is 0.00006326.[190] To simplify the

[184] *See* 35 FCC Rcd at 3888, Subsection B. Although the approach for the link analysis is similar, the overall situation in the 5.9 GHz band is different in that 1) ITS will only be operating co-channel with unlicensed operations in the lower 45 megahertz of the 5.9 GHz band on a temporary basis; and 2) the density of 5.9 GHz-band incumbent ITS operations across the U.S is significantly less than that of incumbent operations in the 6 GHz band.

[185] AASHTO Comments at 7.

[186] *See* Statista.com, Number of motor vehicles registered in the United States from 1990 to 2018, https://www.statista.com/statistics/183505/number-of-vehicles-in-the-united-states-since-1990/ (last visited Oct. 27, 2020).

[187] *See* bts.gov, Public Road and Street Mileage in the United States by Type of Surface, https://www.bts.gov/content/public-road-and-street-mileage-united-states-type-surfacea (last visited Oct. 27, 2020).

[188] *See* U.S. DOT report FHWA-JPO-17-483, at 48-52, Table 7, https://rosap.ntl.bts.gov/view/dot/31627 (last visited Oct. 27, 2020).

[189] In a four-lane roadway with a vehicle every 12 meters there will be 200 vehicles in a 600-meter stretch. *See* https://www.drivingtestsuccess.com/blog/safe-separation-distance (last visited Oct. 27, 2020). This is also consistent with the typical scenario as defined in the U.S. DOT report FHWA-JPO-17-483 (*See* the report at 207, and 41). Furthermore, the maximum number of devices the DSRC system can handle is about 200 vehicles.

[190] The probability that a randomly selected registered vehicle in the United States is equipped with an OBU is 15,506/274,000,000 or 0.000057. The probability that at least two randomly selected vehicles out of 200 registered vehicles are equipped with an OBU in a PER-Free range is 0.00006326.

(continued….)

calculation, and look at the worst case situation, we further assume that the probability of an unlicensed device transmitting within the coverage area on the same channel is one.[191] Thus, the probability of interference is essentially a function of the probability of two or more OBUs operating in the PER-Free range, which is 0.00006326.[192]

73. Similarly, in the vehicle to infrastructure (V2I) communications situation, interference from an unlicensed device can only occur if there is at least one vehicle and at least one unlicensed device transmitting within a roadside unit's coverage area on the same channel. Because the on-board unit transmits at lower power, its operating range sets the limit over which analysis should be conducted. Thus, for the V2I scenario, our analysis assumes the same PER-Free range and the same number of vehicles as for the V2V link. The probability of a randomly selected vehicle equipped with an on-board unit and within the PER-Free range of a roadside unit is 0.0000061.[193] As in the V2V scenario, the worst case would occur when the probability of an unlicensed device transmitting within a roadside unit's coverage area and on the same channel is one.[194] Thus, the probability of interference is a function of the probability that a randomly selected vehicle within the PER-Free range of a roadside unit is equipped with an OBU, 0.0000061.

74. As with our 6 GHz band analysis, we consider other important factors such as building entry loss, probability of frequency overlap, unlicensed device antenna discrimination, path loss, clutter loss, and polarization loss. In considering these factors, we treat all of the statistical quantities using a median or average value, as is commonly done in link budget analyses.[195] Because we are limiting the unlicensed devices to in-building use until one year after the effective date of this First Report and Order, the co-channel analysis includes building entry loss and uses a median value of 20.5 dB, consistent with the 70/30 building entry loss (a mix of 70% traditional and 30% thermally efficient building types) that the Commission recognized in the *6 GHz Report and Order*.[196] The probability of frequency overlap depends on the number of unlicensed device channels available; the higher the number of available

$$p_n(k_1 \le k \le k_2) = \sum_{k=k_1}^{k_2} \binom{n}{k} p^k (1-p)^{n-k}$$

See Bernoulli Trials (Papoulis, A. (1984) *Probability, Random Variables, And Stochastic Processes*, McGraw-Hill, at 42-46).

[191] Because the actual probability of this situation occurring is less than one, real-world results will result in probabilities less than that calculated here.

[192] We recognize that the probability of two or more OBUs operating in the PER-Free range may be marginally higher in certain cities/localities with a higher probability of vehicles being equipped with an OBU. However, so long as the total number of OBUs remains unchanged in the United States, any marginal increase in probability in one or more area(s) will correspondingly reduce the probability in the remaining areas of the United States. Therefore, uniform distribution of vehicles equipped with an OBU is representative and appropriate when considering a nationwide license.

[193] The probability that a roadside unit exists in a PER-Free range and at least one car is equipped with an on-board unit is equal to product of the probability that a roadside unit exists in a PER-Free range and the conditional probability that one or more vehicles out of 200 registered vehicles is equipped with an on-board unit. The probability that a roadside unit exists in a PER-Free range is given by the number of roadside units times the probability of PER-Free ranges in the U.S. roadways, 6,182 * (600 / (4.2e6 * 1609.3)) = 0.0005487. The conditional probability that one or more vehicles out of 200 registered vehicles is equipped with an on-board unit follows the above combinatorial analysis with respect to V2V.

[194] Because the actual probability of this situation occurring is less than one, real-world results will result in probabilities less than that calculated here.

[195] *See* 35 FCC Rcd at 3898, para. 127.

[196] *See* 35 FCC Rcd at 3933, para. 218.

channels, the lower the probability that a given channel, in the vicinity of an ITS roadside unit or on-board unit, overlaps the respective ITS channel in the lower 45 megahertz of 5.9 GHz band. We again make a simplifying assumption and consider the worst case where an unlicensed device uses the combined U-NII-3 and U-NII-4 band to transmit over a 160-megahertz channel, resulting in an assumption of 100% overlap probability of an unlicensed device and an ITS device.[197]

75. In the *6 GHz Report and Order*, the Commission determined that typical indoor enterprise and consumer access point antenna EIRP patterns exhibit less gain toward the horizon and that a 5 dB antenna discrimination correction is required to account for this real-world behavior.[198] In our analysis, we assume the worst-case, direct line-of-sight propagation condition. We note, however, the free-space-path-loss model has a limited range of applicability because it ignores environmental clutter, which over long distances can result in extremely conservative calculations that under-predict the amount of actual path loss. This is particularly true for urban and suburban environments, as well as vehicular communication environments, where clutter loss can be quite substantial depending on the separation distance. We also assume a polarization loss factor of 3 dB that accounts for losses due to the relative orientation of transmit and receive antennas.[199]

76. In the *6 GHz Report and Order* the Commission recognized that inference from Wi-Fi devices is dominated by the single closest Wi-Fi device to the victim.[200] Consistent with that approach, we assume a single Wi-Fi interferer for our co-channel interference analysis. Assuming the maximum separation distance between two on-board units transmitting with a maximum power of 20 dBm EIRP is 600 meters, the received power is -83.38 dBm/10MHz under free space path loss conditions. Since the access point can be located anywhere between the two on-board units, the expected position is midway between the two (i.e., 300 meters from each on-board unit). Assuming a maximum 20 dBm/MHz access point transmit power over the 160-megahertz channel,[201] the received interference power at the on-board units is approximately -96 dBm/10MHz, over 12 dB below on-board unit received power.

77. Access points and their associated client devices must share network capacity. The 802.11 Wi-Fi standards implement sharing and control access to the spectrum through a contention-based protocol.[202] Similarly, DSRC also implements a contention-based protocol that allows vehicles to share the spectrum while transmitting basic safety messages.[203] Several unlicensed proponents assert that use of a contention-based protocol is not needed.[204] The Alliance for Automotive Innovation asserts that it is.[205] We are not requiring unlicensed devices in the 5.9 GHz band to include a contention-based protocol because the co-channel DSRC operations that would be protected by such a protocol are not widely deployed and those that are deployed are required to vacate the band in one year. Thus, any requirement

[197] Because devices will use a mix of 20-megahertz, 40-megahertz, 80-megahertz and 160-megahertz channels, the actual overlap probability is less than one and the potential for harmful interference occurring will be less than the probability calculated here.

[198] *See* 35 FCC Rcd at 3898, para. 125.

[199] *See* 35 FCC Rcd at 3880, para. 75.

[200] *See* 35 FCC Rcd at 3879, para. 71.

[201] Our rules limit the maximum EIRP to 36 dBm for all channels. Thus, the EIRP power density is given by 36 dBm – 10*log10(160) = 14 dBm/MHz.

[202] Stallings, W., Data and Computer Communications 405-409 (2014).

[203] *See* U.S. Department of Transportation, Development of DSRC Device and Communication System Performance Measures Recommendations for DSRC OBE Performance and Security Requirements at 41 (2016), https://rosap.ntl.bts.gov/view/dot/31627/Share.

[204] *See, e.g.*, NCTA Nov. 4, 2020 *Ex Parte* at 2; Microsoft Nov. 9, 2020 *Ex Parte* at 1; WISPA Nov. 10, 2020 *Ex Parte* at 2.

[205] Alliance for Automotive Innovation Nov. 10, 2020 *Ex Parte* at 6.

for a contention-based protocol would be of limited utility and only applicable for limited duration. Nevertheless, because we expect that most, if not all, devices designed to operate in the band will incorporate such a capability which allows multiple users to share spectrum by providing a reasonable opportunity for the different users to transmit,[206] even without a requirement, existing DSRC operations will benefit during the one-year transition period as that capability will prevent unlicensed devices from transmitting when another signal is present. Moreover, the contention-based protocol in conjunction with the expected low Wi-Fi activity[207] can result in lower device EIRP. We recognize that not all access points may be located at the midpoint between on-board units but inherent features such as the Wi-Fi contention-based protocol provide assurance of interference-free operation. Thus, given that the probability of interference potential in the PER-Free range is 0.00006326, a low load factor on the ITS network,[208] a 12 dB margin below the on-board unit received power, the contention-based protocol and low activity factor of Wi-Fi devices, we conclude that the 20 dBm/MHz we are adopting to protect federal operations will similarly protect DSRC-based vehicle-to-vehicle (V2V) operations from co-channel harmful interference during the transition period.

78. We reach a similar conclusion with respect to V2I links. Because the OBU to RSU link limits the operating distance, we assume the same PER-Free range and the same number of vehicles as for the V2V link analysis. As the probability of interference for the V2I link (0.0000061) is an order of magnitude lower than the V2V link (0.00006326) and following the same logic, we conclude that the 20 dBm/MHz we are adopting to protect federal operations will similarly protect DSRC V2I operations from co-channel harmful interference while they are still operating in the lower 45 megahertz.

79. *Client Devices.* Consistent with the rules for the 6 GHz band as well as the U-NII-1 band, we are adopting rules that limit client devices to power levels 6 dB below the power limits for access points.[209] We find this appropriate to reduce the potential of harmful interference to co-channel operation within the band—both with DSRC operations (until such time as they move out of the band) and with DoD radar operations that will remain in the band. In general, a client device operates under the control of an access point but, depending on the separation distance from the access point, the client device may have a slightly different propagation path and hence, a slightly different interference potential to a victim receiver. To ensure that client devices remain in close proximity to the indoor access points and thus keep the potential for causing harmful interference low, we are requiring client devices to operate only under the control of an access point and limiting their PSD and maximum transmit power to 6 dB below the power permitted for the access points. The requirement that client devices operate only under the control of an access point is similar to the requirement the Commission adopted for 6 GHz U-NII devices to protect co-channel incumbent operations.[210] In essence, this limitation prevents outdoor client-to-client communications that could cause harmful interference to federal radiolocation stations and to co-channel ITS operations pending their move to the 5.895-5.925 GHz band. We explore in the Further Notice whether we can remove the prohibition on client-to-client communications after ITS systems move out of the U-NII-4 band and only federal radiolocation sites will need to be protected.

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[206] *See* 35 FCC Rcd at 3889, para. 101.

[207] CableLabs claims that "empirical 5 GHz Wi-Fi activity data from 500,000 Aps measured over ten days reveals that the 99th percentile peak Wi-Fi activity level is in fact 7%, and the weighted average activity factor is 0.4%." *See* NCTA Reply, Attachment A at 17.

[208] As noted above, the probability of two or more vehicles being in the PER-Free range is 0.00006326. Even assuming two vehicles are in the PER-Free range, for a network that can handle 204 vehicles this is a very low network load.

[209] *See* 35 FCC Rcd at 3922, para. 189 and 47 CFR § 15.407(a)(1)(iv) limiting U-NII-1 client devices to 250 mW or 6 dB below the 1 W permitted for access points.

[210] 47 CFR 15.407(d)(5).

(iii) Out-of-Band Emission Limits

80. In the *5.9 GHz NPRM*, we proposed to limit the OOBE from U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and UNII-4 bands, to -27 dBm/MHz at or above 5.925 GHz, which is the same limit required for U-NII-3 devices at this frequency; we sought comment generally on the OOBE limits we should apply at the upper end of the U-NII-4 band.[211] We further proposed that U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, meet the same OOBE limits as U-NII-3 devices at the lower edge of the combined U-NII-3 and U-NII-4 band, i.e., at 5.725 GHz, while not imposing an OOBE limit for U-NII-4 devices at the U-NII-3/U-NII-4 band edge (i.e., at 5.850 GHz).[212] These proposals were intended to support separate U-NII-3 and U-NII-4 bands to provide flexibility for designing U-NII-3 equipment under the less stringent OOBE rules at the upper edge of the band, and provide flexibility for devices to operate across the U-NII-3 and U-NII-4 bands using the widest bandwidths permitted under the IEEE 802.11 standard.[213]

81. Proponents of ITS operations contend that the proposed unlicensed device OOBE limit at 5.925 GHz is not restrictive enough to protect ITS operations in the 5.895-5.925 GHz band from harmful interference. ITS proponents suggest that U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, meet OOBE limits that are much more restrictive than the existing U-NII-3 OOBE limits: General Motors suggests that U-NII-4 unlicensed devices limit their OOBE to -17 dBm/MHz in the first 10 megahertz beyond the band edge (5.895-5.905 GHz) and -27 dBm/MHz at or above 5.905 GHz; Toyota suggests that the OOBE be limited to -27 dBm/MHz at or above 5.895 GHz; Car 2 Car, IEEE 1609 Working Group, US Technical Advisory Group, and Volkswagen separately suggest that U-NII-4 OOBE be limited to -40 dBm/MHz at 10 megahertz above the band edge, the same as the out-of-channel limit for ITS devices; and Ford suggests that OOBE be limited to -108 dBm/MHz, measured at the C-V2X device.[214] However, ITS proponents offer that the OOBE limits can be relaxed as long as U-NII-4 devices are restricted to indoor-only use. 5GAA and Cisco separately state that if U-NII-4 band operations are restricted to indoor-only use, then the OOBE limits could be relaxed to 0 dBm/MHz at 5.895 GHz, decreasing linearly to -17 dBm/MHz at or above 5.905 GHz.[215] Qualcomm asserts that 5GAA's suggested approach would protect C-V2X Direct operations in the upper 30 megahertz of the 5.9 GHz band while enabling robust wideband unlicensed operations indoors, where almost all unlicensed Wi-Fi operations occur today. Qualcomm states that restricting U-NII-4 operations to indoor use would allow the Commission to adopt a more relaxed mask for U-NII-4 operations than what is needed outdoors to protect C-V2X Direct because the indoor unlicensed signals would be attenuated by building entry loss.[216]

82. Proponents of unlicensed operations oppose the proposed -27 dBm/MHz OOBE limit at

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[211] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12623, para. 54. Under the Commission's current rules, emissions from transmitters operating in the U-NII-3 band are limited to a level of -27 dBm/MHz at 75 megahertz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 megahertz above or below the band edge, and from 25 megahertz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 megahertz above or below the band edge, and from 5 megahertz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. 47 CFR § 15.407(b)(4)(i). These specifications result in OOBE limits of -5 dBm/MHz at 5.895 GHz, decreasing linearly to -27 dBm/MHz at 5.925 GHz.

[212] *5.9 GHz NPRM*, 34 FCC Rcd at 12623, para. 55.

[213] *5.9 GHz NPRM*, 34 FCC Rcd at 12263-64, para. 56.

[214] GM Comments at 11; Toyota Comments at 18; Car 2 Car Comments at 18; IEEE 1609 Working Group Comments at 15, US Technical Advisory Group Comments at 11; Volkswagen Comments at 9; and Ford Comments at 10.

[215] 5GAA Comments at 44; Cisco Comments at 15-16; *see also* Alliance for Automotive Innovation Nov. 10. 2020 *Ex Parte* at 1-2.

[216] Qualcomm Comments at 19.

the upper end of the U-NII-4 band. They contend that this limit would necessitate low transmit power levels for all devices operating in the U-NII-4 band, thereby significantly reducing or even eliminating the possibility of unlicensed deployments in the band, especially with wider-bandwidth operation, which is intended to be a primary benefit of the proposed designation.[217] Instead, unlicensed proponents suggest more relaxed OOBE limits for unlicensed operations in the U-NII-4 band than proposed in the *5.9 GHz NPRM*. WISPA submits that indoor unlicensed operations could have a -5 dBm/MHz OOBE limit at or above 5.895 GHz.[218] Broadcom, CableLabs, Facebook, and NCTA together suggest that the OOBE for indoor unlicensed operations be limited to 7 dBm/MHz at 5.895 GHz, decreasing linearly to -9 dBm/MHz at 5.925 GHz, measured using the root mean square method.[219] The Wi-Fi Alliance suggests 15 dBm/MHz OOBE limits for indoor unlicensed devices at 5.895 GHz, decreasing linearly to -7 dBm/MHz at 5.925 GHz.[220] The Wi-Fi Alliance contends that after building attenuation and signal path losses are accounted for, these OOBE limits would mirror the existing U-NII-3 OOBE limits at and above 5.895 GHz, which would allow U-NII-4 devices to provide protection to ITS services in the adjacent spectrum even with OOBE levels 20 dB higher than those currently required for U-NII-3 devices.[221] Wi-Fi Alliance also supports applying the existing U-NII-3 OOBE limits at the lower edge of the U-NII-3 band for U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, i.e., at 5.725 GHz, while not imposing any OOBE limit for U-NII-4 devices at the U-NII-3/U-NII-4 band edge (i.e., at 5.850 GHz).[222]

83. The Commission previously affirmed that the U-NII-3 OOBE limits protect DSRC operations, and those limits have proven to be effective for the protection of incumbent operations in the 5.9 GHz band.[223] Thus, we will impose the same level of protection from U-NII-4 devices. However, in doing so, we will take advantage of building attenuation, as well as other factors, to provide flexibility and maximum utility to American consumers. This flexibility can be provided by adopting Wi-Fi Alliance's proposed indoor unlicensed device OOBE limits of 15 dBm/MHz at 5.895 GHz, decreasing linearly to -7 dBm/MHz at 5.925 GHz. The record supports these protection levels, which are the same as the current OOBE limits after accounting for building attenuation. We further expect the separation distance between indoor U-NII-4 devices and ITS operations would further improve the OOBE limits compared to the existing U-NII-3 OOBE limits. We are not persuaded that the more restrictive OOBE limits suggested by ITS proponents are needed to protect DSRC operations since those limits are more restrictive than the U-NII-3 OOBE limits, which the Commission previously affirmed would protect DSRC operations.[224] We are also not persuaded that the more relaxed OOBE limits suggested by

[217] *See*, *e.g.*, Broadcom, Inc. and Facebook, Inc. Comments at 5-6; Dynamic Spectrum Alliance Comments at 4; Wi-Fi Alliance Comments at 6-7.

[218] WISPA Comments at 6.

[219] Letter from Chris Szymanski, Broadcom; Rob Alderfer, CableLabs; Alan Norman, Facebook, and Danielle Piñeres, NCTA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 (filed July 31, 2020) (Compromise Proposal Letter) at 4.

[220] Wi-Fi Alliance Comments at 8.

[221] Wi-Fi Alliance Reply at 7-8. 5GAA disagrees with the Wi-fi Alliance's proposed emission mask, asserting that not all buildings exhibit 20 dB of attenuation loss. 5GAA Nov. 9, 2020 *Ex Parte* at 3.

[222] Wi-Fi Alliance Comments at 2-3.

[223] *See Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127 (2014) (*UNII 5 GHz Report and Order*) (adding 5.825-5.850 GHz to the 5.725-5.825 GHz (U-NII-3) band and deferring a decision on whether to allow unlicensed devices to use the 5.350-5.470 GHz U-NII-2B and 5.850-5.925 GHz U-NII-4 bands), *recon. denied*; *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 2317, 2324, para. 23 (2016).

[224] *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 2317, 2324, para. 23 (2016).

unlicensed proponents would adequately protect ITS operations from harmful interference since those limits are less restrictive than the existing U-NII-3 OOBE limits. No commenter disagreed with our proposals to apply the existing U-NII-3 OOBE limits at the lower edge of the U-NII-3 band for U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, i.e., at 5.725 GHz, while not imposing any OOBE limits for U-NII-4 devices at the U-NII-3/U-NII-4 band edge, i.e., at 5.850 GHz. These limits will protect adjacent-band ITS operations from harmful interference due to unlicensed operations in the U-NII-4 band while also supporting separate U-NII-3 and U-NII-4 bands. These limits will provide flexibility to design U-NII-3 equipment under the less stringent OOBE rules at the upper edge of the band as well as for devices to operate across the U-NII-3 and U-NII-4 bands using the widest channel bandwidths permitted under the IEEE 802.11 standard. We therefore adopt those limits too.

84. *Measurement procedures.* Finally, we address the measurement procedures for 5.9 GHz unlicensed devices. Broadcom, CableLabs, Facebook, and NCTA state that their proposed OOBE values should be measured using a root mean square (RMS) measurement. These parties contend that an RMS average measurement is the most appropriate method to ensure protection for adjacent operations, as the Commission found in the 6 GHz proceeding. They similarly claim that, since 5GAA agreed that RMS measurement was the appropriate approach at the top of the 5.9 GHz band, it is likewise appropriate for the bottom of the 5.9 GHz band.[225] WISPA submits that using an RMS (i.e., average) measurement for ensuring OOBE from unlicensed operations at the 5.925 GHz band edge should not cause harmful interference to federal users or incumbent licensees. WISPA argues that peak-hold measurements, which result in signal levels that are generally between 10 and 20 dB higher than the RMS method, are less demonstrative of the actual potential for causing harmful interference. WISPA contends that although federal radiolocation systems operate in the 5.850-5.925 GHz band, those operations are in-band and protected by the geographic prohibition on operation near them. WISPA further contends that the RMS measurement is more appropriate for determining potential interference both to ITS systems and to part 101 fixed systems operating above 5.925 GHz.[226] NCTA suggests that OOBE limits should be verified using an RMS detector or other appropriate techniques for measuring average power, as the Commission recognized in the *6 GHz Report and Order*, because 5 GHz U-NII-band measurement guidance specifying peak power was instituted to mitigate a known interference issue with federal radars that is not present in the 5.9 GHz band.[227]

85. An RMS detector may be used to conduct 5.9 GHz unlicensed device OOBE measurements. This decision is consistent with the decision in the *6 GHz Report and Order* that the OOBE limit adopted to protect adjacent ITS services at the top of the 5.9 GHz band should be verified using an RMS detector or other appropriate techniques for measuring average power.[228] We will provide guidance to the test labs and telecommunications certification bodies which conduct equipment approval measurements and equipment approval oversight. Because RMS measurements represent the continuous power being generated from a device, as opposed to peak power, which may only be reached occasionally and for short periods of time, we believe an RMS measurement is more appropriate for ensuring that U-NII devices' potential for causing harmful interference to adjacent-band operations is significantly minimized. We note the Commission has provided a measurement guidance in the past for similar

[225] Letter from Chris Szymanski, Broadcom; Rob Alderfer, CableLabs; Alan Norman, Facebook; and Danielle Piñeres, NCTA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 4-5, n.16 (filed July 31, 2020) (*Compromise Proposal Letter*) (citing the *6 GHz Report and Order*, 35 FCC Rcd at 3926, para. 198, that decided the -27 dBm/MHz OOBE limit adopted to protect adjacent ITS services at the top of the 5.9 GHz band should be verified using an RMS detector or other appropriate techniques for measuring average power).

[226] *See* letter from WISPA to Marlene H. Dortch, Secretary, FCC, at 2 (Aug. 27, 2020).

[227] *See* NCTA Reply at 60, n.236; *see also 6 GHz Report and Order*, 35 FCC Rcd at 3926, para. 198

[228] *6 GHz Report and Order*, 35 FCC Rcd at 3926, para. 198.

devices in the 5 GHz band where a peak measurement is specified.[229] However, that procedure was instituted to mitigate potential interference with terminal Doppler weather radars which are not present in the 5.9 GHz band. We will update our Knowledge Database guidance consistent with this decision.

b. Outdoor Unlicensed Operations

86. Although we are not permitting outdoor unlicensed operations across the 5.850-5.895 GHz portion of the 5.9 GHz band at this time, we nonetheless will allow limited outdoor operations (on a non-interference basis) through either the STA or other existing regulatory processes. The Commission will coordinate requests for outdoor unlicensed operations with NTIA, until such time as ITS operations will have ceased operating in the 5.850-5.895 GHz portion of the 5.9 GHz band and we develop a mechanism to ensure protection of federal operations.[230]

2. Protection of Other Incumbents in the 5.850-5.895 GHz Band

87. The 5.9 GHz band also contains allocations for the non-Federal Fixed-Satellite Service (FSS) (Earth-to-space) on a primary basis and the Amateur Service on a secondary basis for non-federal use.[231] Since certain of these services operate in the 5.850-5.895 GHz portion of the 5.9 GHz band, in the Further Notice we propose provisions to ensure that these services are protected from harmful interference from the outdoor operation of unlicensed devices in the 5.850-5.895 GHz band.

a. Fixed-Satellite Service Operations

88. In the *5.9 GHz NPRM*, we proposed not to adopt any restrictions on U-NII-4 devices to account for the existing FSS uplink operations because the expected unlicensed device use cases, which primarily involve delivery of Wi-Fi signals, along with the distance to FSS satellites in geo-stationary orbit, should protect FSS uplink operations from harmful interference. Nevertheless, the Commission sought comment on whether any targeted rules were needed to ensure that incumbent FSS uplink operations are protected and, if so, what types of sharing technology or techniques would be appropriate and what are the implications for manufacturers, vendors, and consumers.[232]

89. SES Americom and Intelsat , who provide fixed satellite services relying on the 5.9 GHz band for uplinks, express concerns about the potential for harmful interference to FSS space stations from aggregate unlicensed operations and request that the Commission adopt a maximum permissible aggregate power limit that would be monitored and controlled by an Automatic Frequency Coordination (AFC) system.[233] While SES Americom and Intelsat indicate a general concern about potential harmful interference, including aggregate interference, from low-power devices due to the potential that the large geographic coverage of a satellite receiver's beam could see large numbers of unlicensed devices,[234] they do not include any specific technical analysis or maximum aggregate power level for their particular position. SES Americom and Intelsat suggest that, at a minimum, the Commission should limit the EIRP of transmissions from 5.9 GHz terrestrial devices above a 30-degree elevation angle to protect FSS

[229] *See* KDB Publication No. 789033.

[230] Because we seek comment in the Further Notice on how to protect federal radiolocation operations in the U-NII-4 band from harmful interference from outdoor unlicensed devices, including through NTIA recommended exclusion zones, the Commission, absent compelling demonstration of how such operations would not cause such harmful interference and subject to coordination with NTIA, will not grant any interim requests (through waiver, STA, or other regulatory process) to engage in unlicensed operations outdoors within the exclusion zones NTIA has proposed. *See* NTIA Sept. 8, 2020 Letter at Tbl. 2.

[231] 47 CFR § 2.106.

[232] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12624, para. 58.

[233] SES Americom and Intelsat Comments at 4, 8-9.

[234] SES Americom and Intelsat Comments at 4.

networks.[235]

90. NCTA contends that special frequency avoidance techniques or similar constraints are unnecessary to protect incumbents, and states that the Commission should not impose constrictive operational rules for U-NII-4 operations, which would dramatically decrease the band's utility with no offsetting public benefit.[236] The Wi-Fi Alliance agrees with the Commission's tentative conclusion that U-NII-4 devices will not interfere with FSS uplink operations; it contends that years of operational experience amply demonstrate that low-power Wi-Fi transmissions pose no harmful interference potential to FSS satellite uplinks in geostationary orbit.[237] WISPA agrees with the Commission's judgment that no other mitigation measures for unlicensed devices are required to protect other users in the band. WISPA asserts that the compatible transmission characteristics of the adjacent and co-frequency services should allow both unlicensed devices and FSS uplink operations to operate successfully without any harmful interference to either.[238]

91. Considering that the FSS satellites receiving in the 5.850-5.925 GHz band are limited to geostationary orbits, approximately 35,800 kilometers above the equator, we believe it is unlikely that relatively low-power unlicensed devices would cause harmful interference to the space station receivers, especially since such devices are not expected to radiate significant power skyward. Furthermore, designing and operating an AFC system to undertake aggregate power limit monitoring in this band would be very complex, requiring the AFC system to know how much energy is being emitted to each portion of the geostationary arc for each unlicensed device. That, in turn, would require the AFC system to have knowledge of each outdoor access point's antenna pattern, orientation, actual transmit power levels, and percent of time it transmits as well as similar information for unlicensed client devices operating outdoors. We conclude that an AFC system with this level of complexity would be extraordinarily burdensome to design and operate and is not required to ensure that FSS space station receivers are protected from harmful interference. Thus, we decline to adopt SES Americom's and Intelsat's suggestion for an aggregate power limit from unlicensed devices to be enforced through use of an AFC system. As a precautionary measure, however, and to further protect FSS operations, we propose in the Further Notice to limit access points' EIRP above a 30 degree elevation angle to 21dBm, as suggested by SES Americom and Intelsat, which is similar to what the Commission already requires in the U-NII-1, U-NII-5, and U-NII-7 bands to protect FSS operations.

b. Amateur Operations

92. In the *5.9 GHz NPRM*, we tentatively concluded that our proposal to apply the existing U-NII-3 power rules to the 5.850-5.895 GHz band would protect co-channel secondary Amateur Service operations from harmful interference and sought comment on this approach. Proponents of Amateur Services contend that authorizing unlicensed operations in the 5.9 GHz band will cause harmful interference to co-channel Amateur Service operations.[239] However, they do not include any specific technical analysis for their particular position. These commenters suggest that the Commission should abandon its proposal to authorize unlicensed operations in the U-NII-4 band to avoid harmful interference to amateur operations.[240]

93. We believe that U-NII devices operating in the U-NII-4 band will not cause harmful interference to amateur operations because of the relatively low power with which U-NII devices will

[235] SES Americom and Intelsat Reply at 5.

[236] NCTA Comments at 46.

[237] Wi-Fi Alliance Comments at 5.

[238] WISPA Comments at 7.

[239] *See, e.g.*, Amateur Radio Emergency Data Network Comments at 3; Amateur Television Network Comments at 1.

[240] Amateur Television Network Comments at 2; San Bernardino Microwave Society at 6.

operate as compared to amateur stations, which are permitted to operate with as much as 1.5 kW (62 dBm) peak envelope power.[241] Furthermore, as noted above, the Amateur Service is an allocated service that is entitled to interference protection within the 5 GHz spectrum, whereas U-NII devices operate under our part 15 rules on the conditions of not causing harmful interference and accepting any interference from an authorized radio station.[242]

94. Commenters also oppose reallocating the lower 45 megahertz of the 5.9 GHz band from the Amateur Service to part 15 unlicensed operations.[243] As an initial matter, part 15 unlicensed devices do not operate pursuant to an allocation.[244] Thus, in the *5.9 GHz NPRM*, the Commission did not propose to reallocate the lower 45 megahertz of the 5.9 GHz band from the Amateur Service to part 15 unlicensed operations; it proposed to authorize unlicensed operations under part 15 in the lower 45 megahertz of the 5.9 GHz band.[245] Therefore, we dismiss such concerns as beyond the scope of this proceeding.

C. ITS in the 5.895-5.925 GHz Band

95. To promote the most effective and efficient use of the upper 30 megahertz of spectrum in the 5.9 GHz band that we dedicate for ITS, we determine that the service should be based on use of one technology, and we further conclude that C-V2X technology provides the best means of achieving our goals for ITS in the coming years. In this First Report and Order, we provide sufficient technical flexibility to enable ITS licensees currently using DSRC-based technology to operate in this 30-megahertz ITS band until the time by which ITS services must operate using C-V2X technology. Because we believe that many (if not most) of the few active ITS licensees will want to transition to C-V2X technology as soon as possible to speed development and deployment of ITS services, we also will permit, through our waiver process, the deployment of C-V2X technology during the transition period in such a way that it would not interfere with existing DSRC-based operations. Finally, in the Further Notice below, we seek comment on the date by which all ITS operations in this band must use C-V2X-based technology, as well as on the final technical rules for C-V2X use of the 30 megahertz of spectrum that promotes the most effective ITS operations and applications using this spectrum.

1. ITS Operations using C-V2X Technology

96. In the *5.9 GHz NPRM*, we proposed to authorize C-V2X operations in the upper 20 megahertz of the revised ITS band (5.905-5.925 GHz),[246] and we sought comment on whether the remaining 10 megahertz of the band (5.895-5.905 GHz) should be dedicated for C-V2X as well or instead be reserved for DSRC operations.[247] In proposing the use of C-V2X, we sought to authorize use of technology that would be most capable of rapid development and deployment of transportation and vehicular safety-related applications now and making continuous improvements into the future. We explained that C-V2X should be able to achieve network effects necessary to maximize transportation and vehicular safety-related benefits; facilitate rapid development and deployment; enable improvements, learning, and upgrades; and be robust and secure.[248] At the same time, we recognized that some commenters might support continued use of the DSRC-based technology in the ITS band.[249] We further

[241] 47 CFR § 97.313(b).

[242] 47 CFR §§ 2.106, 15.5(b)-(c).

[243] *See, e.g.*, Amateur Television Network Comments at 1.

[244] 47 CFR § 2.105(e), n.1.

[245] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12608, para. 11; 12622-23, para. 53.

[246] *5.9 GHz NPRM*, 34 FCC Rcd at 12613-15, paras. 24-27.

[247] *5.9 GHz NPRM*, 34 FCC Rcd at 12615-16, paras. 28-31.

[248] *5.9 GHz NPRM*, 34 FCC Rcd at 12613, para. 24.

[249] *5.9 GHz NPRM*, 34 FCC Rcd at 12616, para. 31.

noted that DSRC and C-V2X were technically incompatible.[250] We underscored our goal of promoting the most spectrally efficient use of the ITS band, and invited comment on how best to ensure that we optimize the band for delivery of ITS.[251]

97. In the years since the Commission first adopted DSRC technology for ITS operation in the 5.9 GHz band, communications applications that rely on cellular-based technologies have become increasingly ubiquitous. C-V2X reflects the efforts of a diverse group of communications and transportation industry stakeholders to integrate this technology into ITS use. Based on the information in the record, we find the public interest will be served by adopting C-V2X as the ITS delivery technology in the entire 30 megahertz of the ITS band, which in turn requires phasing-out the existing DSRC technology.

98. The Commission received numerous comments from automobile manufacturers and significant elements of the automotive and technology industries that support the use of C-V2X technology.[252] None of these commenters support limiting C-V2X technology to only the 20-megahertz portion of the ITS band as proposed in the *5.9 GHz NPRM* and, to the extent the Commission provides only 30 megahertz for ITS, support use of the entire 30 for C-V2X.[253] Some of these commenters suggest that we go further and set aside the entire 75 megahertz for ITS using C-V2X technology.[254] Supporters of C-V2X technology cite benefits over DSRC, such as better performance and linkage to 5G technology, which enables applications to continue evolving and provides for faster implementation.[255] We additionally note that several entities with ongoing interest in DSRC operations also generally support retaining as much ITS spectrum as possible and, among these, some expressed a willingness to consider the use of C-V2X technology as a means toward that end.[256]

99. As discussed in the *5.9 GHz NPRM*, we seek to provide the most spectrally efficient means of ensuring the availability of ITS.[257] Given that DSRC and C-V2X are technically incompatible with each other, we believe that allowing use of only a single delivery technology for ITS is important for the sake of efficient use of the 30 megahertz of spectrum as well as maximizing the safety benefits ITS can deliver to the American public. As in 2003 when the Commission specified a single technological standard, and as the Commission reiterated in the *5.9 GHz NPRM*, we continue to believe that a single standard for ITS in this band is most likely to promote interoperability between vehicles and infrastructure in the United States, enable robust automotive safety communications, and accelerate the nationwide deployment of ITS applications while reducing implementation costs.[258] Safety-related applications, such as collision-avoidance functions, must be "heard" by vehicles using ITS, and having a single technological standard will ensure that all such equipped vehicles will have compatible

[250] *5.9 GHz NPRM*, 34 FCC Rcd at 12615, para. 28.

[251] *5.9 GHz NPRM*, 34 FCC Rcd at 12615, para. 28.

[252] *See, e.g.*, 5GAA Comments, Nokia Reply at 1-2; Ford Comments at 6.

[253] *See, e.g.*, 5GAA Comments at 8.

[254] *See, e.g.*, 5GAAComments at 5-6; Fiat Chrysler Comments at 4; Harman Comments.

[255] 5GAA Comments at 9-16; Nokia Reply at 3-5; Ford Comments at 6.

[256] *See, e.g.*, American Highway Users Alliance Comments at 2-3.

[257] *5.9 GHz NPRM*, 34 FCC Rcd at 12615, para. 28.

[258] *See Amendment of the Commission's Rules Regarding Dedicated Short Range Communications Services in the 5.850-5.925 GHz Band (5.9 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*, ET Docket No. 98-95, Report and Order, 19 FCC Rcd 2458, 2466-68, paras. 13-16 (2003); *5.9 GHz NPRM*, 34 FCC Rcd at 12604, para. 3.

technology;[259] specifying only one technology as the standard will remove any technological compatibility risk and lead to a more safe, secure, and trustworthy vehicular safety ecosystem. Accordingly, although some commenters request that we take a "technology neutral" approach,[260] we decline to do so here. Given that we are limiting the 5.9 GHz ITS spectrum to 30 megahertz, we believe we must ensure that it can be used most efficiently, and that requires use of only one technology.[261]

100. We also believe it important at this time to remove any uncertainty as to the technology that will be used in this revised ITS band so that automobile manufacturers, the automotive and technology industries, and those implementing ITS services can focus on building out the ITS infrastructure and equipping vehicles rather than continuing to divide resources across two competing standards in the coming years.[262]

101. We consider a variety of issues when making spectrum decisions that will affect the implementation of essential public safety and transportation services. Such decisions have the potential to impact a broad group of stakeholders, including state and local governments, equipment (automotive and communications) manufacturers, and communications service providers. After careful consideration of the technology-related issues, including the advantages and disadvantages of both DSRC and C-V2X, in the record before us, we conclude the public interest will best be served by adopting C-V2X as the ITS delivery technology and phasing out the existing DSRC technology. We consider issues related to implementing this decision, such as timing, the authorization process, and technical rule requirements, in the Further Notice of Proposed Rulemaking that follows this First Report and Order.

102. *Spurring investment and fast deployment in the band*. We observe that DSRC has not enjoyed widespread deployment as the ITS technology mandated in the U.S.[263] At the same time, momentum both domestically and globally, appears to be shifting toward the use of C-V2X for ITS.[264] International deployment and uses of DSRC remain in flux, and as 5GAA notes, many automakers and

[259] Preliminary Technical Assessment by U.S DOT submitted in ET Docket 19-138 titled "Concerns with Draft FCC NPRM: Use of 5.850-5.925 GHz Band," at 1.

[260] *See, e.g.*, U.S. DOT Reply at 44-45 (supporting a technology neutral approach while additional testing is conducted examining the performance of C-V2X and DSRC). We note that some administrations like the European Union have adopted a more technology neutral approach. Autotalks Comments at 6-7 (In Europe, 30 megahertz is allocated for V2X, arranged as three channels of 10 megahertz each (5875-5905 MHz); a channel is allocated per service, and not per technology). This model is unproven, however, as EU regulations are still being revised and are not currently finalized. Car 2 Car Communication Consortium (Commission Decision 2008/671/EC9 and Commission Implementing Decision (EU) 2019/1345) is currently being revised).

[261] *See, e.g.*, Cisco Comments at 13-14 (one strong ecosystem is better than two weakened ecosystems).

[262] *See, e.g.*, Cisco Comments at 13-14 (providing a clear technology path will provide much-needed certainty to the market).

[263] According to the American Association of State Highway and Transportation Officials (AASHTO), there are 6,182 DSRC RSUs deployed throughout the U.S. and 15,506 vehicles equipped with DSRC OBUs. AASHTO Comments at 7. For context, there are approximately 274 million registered vehicles in the United States operating over approximately 4.2 million miles of paved and unpaved roadways. *See* Statista.com, Number of motor vehicles registered in the United States from 1990 to 2018, https://www.statista.com/statistics/183505/number-of-vehicles-in-the-united-states-since-1990/ (last visited Oct. 27, 2020) and bts.gov, Public Road and Street Mileage in the United States by Type of Surface, https://www.bts.gov/content/public-road-and-street-mileage-united-states-type-surfacea (last visited Oct. 27, 2020).

[264] *See, e.g.*, 5GAA Comments at 18-21 (noting that Ford intends to deploy C-V2X in all of its new vehicle models sold in America (pending favorable regulatory action) and that several other automobile manufacturers, including Audi, Daimler North America Corp., BMW of North America, and Jaguar Land Rover all have tested C-V2X equipment).

developers are moving toward C-V2X.[265] China has adopted C-V2X in lieu of DSRC, and the European Union is exploring whether to implement policies to create a path for C-V2X Direct deployment in Europe.[266] By designating C-V2X for ITS delivery, the U.S. is positioning itself as a global leader to be at the forefront of continued C-V2X technology development as it becomes more globally harmonized.

103. We base our decision on the record before us and the spectrum realities that exist today. The record presents multiple factors that shape our view. Advocates for C-V2X claim that there are several benefits that establish C-V2X is the better choice at this time. 5GAA claims that C-V2X Direct technology outperforms DSRC on reliability, range and resilience to interference , which in turn will help improve non-line-of-site capabilities to promote safety benefits.[267] Further, 5GAA asserts that during times of peak congestion, C-V2X functionality can offload less time-critical V2V, V2I, and V2P (vehicle-to-pedestrian) communications to the cellular network, thus supporting safety-critical communications.[268] 5GAA and Qualcomm contend that C-V2X is better for achieving network effects insofar as cost efficiencies support deployment on a more accelerated basis.[269] 5GAA further states that new vehicles now generally are equipped with C-V2X network mode chipsets,[270] and it and Qualcomm assert that C-V2X technology can leverage cellular networks and thereby reduce the infrastructure costs associated with deploying V2X.[271] 5GAA and Cisco also note that because C-V2X operates on both 20 and 10 megahertz channels it could support throughput throughout the 30 megahertz of spectrum that would be available.[272]

104. Advocates for DSRC, in turn, assert that it may have certain advantages over C-V2X.[273] For example, many state DOT agencies express a preference for DSRC over C-V2X because they are concerned about potential negative impacts on current DSRC installations and operations and the resources that would be required to redesign the ITS system.[274] In addition, NXP states that recent test results do not demonstrate clear advantages of C-V2X over DSRC and believes that taking the band away from DSRC would be against the principle of technology neutrality.[275] Several commenters also express concern that C-V2X is a new vehicular technology that is untested and unproven compared to DSRC, which is a mature system ready for mass deployment.[276] NXP observes that worldwide roll-out of DSRC technology accelerated in 2019; noting that in Europe, all versions of the new Volkswagen Golf model 8

[265] 5GAA Comments at 18-21; 5GAA Reply at 7-10; *see also, e.g.*, Ford Comments at 6; Jaguar Land Rover Comments at 1; BMW Group Comments at 1-3; Cisco Comments at 7; Qualcomm Comments at 6-9.

[266] Autotalks Comments 6-7; 5GAA Comments at 21. According to 5GAA, Chinese regulators allocated spectrum for C-V2X in 2018 and major automakers will deploy C-V2X-enabled vehicles in China next year; the European Union rejected DSRC as the preferred ITS technology in 2019 and is now exploring an approach that would create a path for C-V2X deployment in Europe. 5GAA Comments at 21. Global automotive manufacturers are already making deployment plans based on adoption of C-V2X, according to 5GAA. *Id.*

[267] 5GAA Comments at 10-11.

[268] 5GAA Comments at 12-13.

[269] 5GAA Comments at 15; Qualcomm Comments at 5-6.

[270] 5GAA Comments at 15.

[271] 5GAA Comments at 15; Qualcomm Comments at 5-6 (C-V2X Direct enables cellular communications directly, without connecting to any cellular network and without requiring any network service subscription).

[272] 5GAA Comments at 26; Cisco Comments at 13-14.

[273] *See, e.g.*, NXP Reply at 2; DSRC Auto Safety Coalition Comments at 8-13.

[274] *See, e.g.*, City of Freemont Comments; Macomb County Department of Roads Comments; TennSmart Comments; Letter from Gregory J. Dunn, Counsel for NW U.S. 33 Corridor Council of Governments, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 at 1 (filed Nov. 12, 2020).

[275] NXP Reply at 2.

[276] New York City Comments at 1-2; *see* Intelligent Transportation Society of Michigan Comments at 2-3.

are equipped with DSRC technology and that road operators are rolling out DSRC across several countries.[277] Further, NXP opines that because C-V2X is based on classic 4G LTE, it is "old technology."[278]

105. We conclude that choosing C-V2X as the sole ITS connected vehicle technology in the U.S. is the best decision for promoting more robust ITS deployment in the 5.9 GHz band in the coming years. While each technology has the capability of providing safety-related ITS services, we are persuaded that C-V2X, through its ability to achieve greater network effects and leverage cellular networks to reduce infrastructure costs, promises a more efficient and effective use of the spectrum. We do not anticipate any appreciable delay in deployment of this newer technology as many companies are already producing C-V2X devices (including dual-mode devices that can operate using either DSRC or C-V2X technology) and readying their availability for use,[279] and many states are already deploying C-V2X or dual-mode equipment. We are also not convinced that the limited examples of recent DSRC deployments in other countries outweigh the U.S. automotive industry's focus on deploying C-V2X technology, or that those limited deployments portend a significant growth in DSRC deployments here in the U.S. We are confident that our action today will expedite and expand the deployment of ITS safety benefits while ensuring efficient use of the spectrum.

106. We reject claims by Institute for Policy Innovations (IPI) that ITS is an idea whose time has passed and that vehicle connectivity is not critical to potential automotive safety benefits. By reducing the ITS band, future ITS deployment can be focused on deploying critical vehicular safety applications and take its position as part of a larger framework of technology solutions currently available to make road travel safer for the American people. We also reject the requests by various local entities, state departments of transportation, and others, arguing that the Commission should continue to conduct testing in coordination with the U.S. DOT, both with C-V2X and DSRC technology, to fully understand the operational impacts of these services to each other.[280] We are choosing a single technology for the entire ITS band that we determine is best suited for ITS in the coming years. Further delay will not serve the American public. Rather, it is best to move forward with a revised 5.9 GHz band plan which supports C-V2X technology so that these vehicle related safety applications can be fully deployed quickly. Automotive stakeholders have had ample time to evaluate the various technologies and make their case as to the better approach. Based on the record before us, we believe that opting to permit a single technology—C-V2X—in the revised band plan best serves the American public.

2. Transitioning to C-V2X Operations in the ITS Band

107. In proposing to authorize C-V2X operations in most or all of the 30 megahertz of spectrum in the new ITS band (5.895-5.925 GHz), we sought comment on possible transition paths for ITS licensees using DSRC-based technology in some or all of the existing 5.9 GHz band.[281] We sought up-to-date information on actual DSRC operations (e.g. information on the on-board units and roadside units deployed), noting that DSRC deployment had been limited and that many DSRC operations appeared to be demonstration or pilot projects.[282] We inquired generally about possible transition paths to C-V2X-based solutions.[283] To facilitate the transition of existing ITS licensees, we proposed to modify existing licenses to allow operation of C-V2X and invited comment on how this would affect current

[277] NXP Comments Attachment at 3-4.

[278] NXP Comments Attachment at 4.

[279] *See, e.g.*, Panasonic Comments; Bosch Comments at 3.

[280] *See, e.g.*, U.S. DOT Reply at 6.

[281] *5.9 GHz* NPRM, 34 FCC Rcd at 12616-17, para. 32.

[282] *5.9 GHz NPRM*, 34 FCC Rcd at 12617-18, paras. 33, 35.

[283] *5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 33.

licensees with operational sites.[284] We also inquired about any legal considerations relating to the transition.[285] These included how long to allow existing licensees to continue DSRC-based operations (e.g., roadside infrastructure or on-board units), where we sought comment on whether six months would be sufficient for migrating to C-V2X-based operations.[286] We also asked that commenters address any other considerations or approaches that the Commission should take to effectuate an appropriate transition of DSRC operations to C-V2X.[287] With regard to the technical rules for operating C-V2X in the 30 megahertz of ITS spectrum, we proposed to adopt rules that largely follow the approach taken when the rules for DSRC were adopted.[288]

108. Several ITS licensees and proponents provided various types of information about the state of DSRC operations. We note that the Commission's database currently lists 124 active ITS licenses on channels in the 5.850-5.925 GHz band: 91 licensees are considered "public safety eligible" with the remaining 33 qualified under the Industrial/Business Pool requirements. While 52 licensees have been granted registrations for fixed site RSUs we do not know the extent of portable/mobile roadside units and/or on-board unit to on-board unit communications. We have no direct data on how many OBUs are operating under a given DSRC-based ITS license because there is no requirement to obtain a Commission license to operate an on-board unit.

109. We received very limited response with respect to our inquiry about the considerations and best methods for transitioning current DSRC-based ITS licensees to C-V2X. While some unlicensed proponents commented that migrating to C-V2X in the upper 30 megahertz should be required to be completed in six months,[289] we received no substantive comments on how the transition from DSRC-based to C-V2X-based technology could be implemented, or the actual timeline that should be established. Most ITS proponents focused their comments on seeking to retain use of the entire 75 megahertz of spectrum in the 5.9 GHz band, not on transition matters. Accordingly, we would benefit from additional information how best to proceed with regard to these transition matters before making a decision. In the Further Notice, we seek comment on these issues to develop a more complete record with respect to the date by which all ITS operations will be required to use C-V2X-based technology in the upper 30 megahertz of the 5.9 GHz band. Now that we have decided on the band plan for the 5.9 GHz band and our approach for ITS operations, we expect to develop a sufficiently complete record that can more fully inform our decisions.

110. As proposed in the *5.9 GHz NPRM,* we will modify existing ITS licenses to allow operation only in the 5.895-5.925 GHz band.[290] We will require licensees to transition out of the 5.850-5.895 GHz segment of the band within one year of the effective date of this First Report and Order and

[284] *5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 34.

[285] *5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 34.

[286] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 36.

[287] *5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 33, 12618, para. 36.

[288] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 37.

[289] NCTA Comments at 44; T-Mobile Comments at 2, n.5. In recently filed *ex parte* comments, some automotive, technology, and telecommunications companies request that we permit C-V2X operations in the 5.895-5.925 GHz band as soon as possible through coordination with licensees providing DSRC-based operations in that spectrum. Letter from Mitch Bainwol, Chief Government Relations Counsel, Ford Motor Company, Stephen Rober, V.P., Fiat Chrysler Automobiles U.S. LLC, et al. to Ajit Pai, Chairman, FCC, ET Docket No. 19-138 at 1-2 (filed Nov. 5, 2020) (letter filed by representatives of Ford, Fiat Chrysler, Daimler, Harmon, Applied Information, T-Mobile, Nokia, Qualcomm); Qualcomm Nov. 5, 2020 *Ex Parte* at 1; Letter from Chris Marchand, V.P., Government and Industry Relations, Americas, Jaguar Land Rover North America, LLC, to Chairman Ajit Pai, FCC, ET Docket No. 19-138 at 2 (filed Nov. 10, 2020); 5GAA Nov. 9, 2020 *Ex Parte* at 1-2 (representatives of Ford, Fiat Chrysler, Audi of America, Daimler North America, Qualcomm, Nokia, Panasonic).

[290] *See 5.9 GHz NPRM*, para. 34.

adopt rules designating C-V2X technology as the ITS delivery system once the Commission adopts a deadline and the transition to the revised ITS band is complete. Our decision here begins the transition of DSRC-based ITS in the 5.9 GHz band to the 5.895-5.925 GHz portion of the band while we develop a more complete record to determine the appropriate date and procedures by which all ITS operations must transition to C-V2X technology. Furthermore, we anticipate that some DSRC-based ITS licensees may wish to operate C-V2X-based ITS in the 5.895-5.925 GHz ITS band, and we will allow them to do so at any time through the STA, experimental licensing or other existing regulatory processes,[291] on a non-interference basis upon proper showing. This flexible, case-by-case approach will enable a smoother and more rapid development and deployment of C-V2X-based ITS operations in the near term.

3. Protecting Federal Operations

111. In the *5.9 GHz NPRM*, we proposed to retain for licensees using C-V2X technology the existing coordination rules that currently apply to DSRC RSUs, including compliance with existing DSRC rules to protect the 5.9 GHz band primary Federal Radiolocation Service.[292] We noted that DSRC RSUs are not protected from harmful interference caused by incumbent federal operations.[293] The existing DSRC rules that protect the 5.9 GHz federal radars require that RSU installations within 75 kilometers of 59 specified federal radar locations must be coordinated with NTIA.[294] As we also observed, requiring C-V2X equipment to coordinate installations within the 75-kilometer coordination zones represents "the most straightforward approach for enabling compatibility with federal operations."[295] We sought comment on this proposal.

112. NTIA, the only commenting party, agrees with the Commission that requiring ITS RSUs to coordinate installations within a coordination zone is the best approach to facilitate sharing with federal systems.[296] Based upon its analysis, NTIA believes the coordination zones set forth in section 90.371(b) of the Commission's rules for DSRC RSUs can equally apply to C-V2X RSUs. However, to optimize unencumbered non-federal operations, NTIA examined current federal radar usage and determined that the number of protection zones can be reduced from 59 to 30, and rather than applying a single protection distance to all federal stations, most of the coordination zones could be tailored to the operating parameters of each station and generally reduced from the current 75 kilometers.[297] The remaining 30 coordination zones are shown in Table 1 of NTIA's Sept. 8, 2020 letter to the Chief of the FCC's Office of Engineering and Technology. Since under existing rules, NTIA may authorize additional federal radiolocation services,[298] NTIA requests that the rules be clarified to specifically recognize its authority to amend, modify, or revoke such assignments[299] that could affect the coordination zones. Accordingly, NTIA requests that section 90.371(b) be revised as follows: "…Operation of RSU stations within…kilometers of the locations listed in the table below, to which NTIA may amend, modify, or revoke locations and associated parameters, must be coordinated through the National

[291] We note that currently there are 18 existing experimental licenses authorizing the operation of C-V2X. FCC Universal Licensing System, September 23, 2020.

[292] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12620, paras. 46-47.

[293] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12620, para. 47 (citing 47 C.F.R. § 90.371(b)).

[294] *See* 47 CFR 90.371(b).

[295] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12620, para. 47.

[296] *See* NTIA Sept. 8, 2020 Letter at 3.

[297] The protection requirements contained herein are premised upon the power and out-of-band emission levels contemplated by the Commission. Any deviation from those parameters may result in a change to these requirements.

[298] *See* 47 CFR 90.371(c).

[299] 47 U.S.C. 902(b)(2)(A).

Telecommunications and Information Administration."[300]

113. NTIA also performed an analysis assessing the potential impact of C-V2X OBUs on federal operations. The NTIA analysis, based upon the Commission's proposed rules for C-V2X OBUs, indicates that coordinating these devices would not be necessary to protect federal operations.

114. We agree that sharing between ITS and Government operations is permitted if proper coordination is performed, and thus we adopt the NTIA recommendation. We find that this coordination requirement will enable ITS deployment across the U.S. We will replace the current table in section 90.371 with NTIA's revised table.

D. Statutory Considerations

115. Here we set forth in greater detail the Commission's authority to transition ITS licensees to the upper 30 megahertz of the band, as well as its authority to ultimately transition ITS licenses from DSRC-based to C-V2X-based technology.[301] As explained below, both actions are well within the Commission's broad authority to regulate spectrum in the "public interest" under Title III of the Act. In this regard, we focus only on DSRC licensees, because under the Commission's existing licensing rules the only ITS service permitted under those rules is DSRC service.[302]

116. *Relocating DSRC to the upper 30 megahertz.* We find that relocating DSRC operations to the upper 30 megahertz of the band is within the Commission's authority under section 316 of the Communications Act.[303] Section 316 gives the Commission authority to modify, by rulemaking or adjudication, any license "either for a limited time or for the duration of the term thereof, if in the judgment of the Commission such action will promote the public interest, convenience, and necessity."[304] But courts have held that the Commission's authority to "modify" licenses under section 316 does not confer on the Commission the ability to effect a "fundamental change" to those licenses.[305] This means that the Commission can permissibly exercise its authority under section 316 if (1) it finds that doing so serves the "public interest" and (2) the modification is not so sweeping as to amount to a "fundamental change" to the licenses being modified. We address each of these questions in turn.

117. As explained more fully above, this modification is manifestly in the public interest.[306] The modification will make room for valuable new unlicensed uses in the lower 45 megahertz of the band, while providing existing DSRC licensees sufficient spectrum to provide substantially the same basic vehicular safety services they now provide.[307] This modification is therefore consistent with the long line of Commission actions changing or reducing frequencies where it has found that doing so is in

[300] *See* NTIA Sept. 8, 2020 Letter at 3.

[301] We sought comment on these statutory considerations in the *5.9 GHz NPRM*. *See 5.9 GHz NPRM*, 34 FCC Rcd at 12617, para. 34.

[302] 47 CFR § 90.379; *see also* NCTA Comments at 11 (noting that "[t]he 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").

[303] 47 U.S.C. § 316.

[304] 47 U.S.C. § 316(a)(1); *see also California Metro Mobile Communications Inc. v. FCC*, 365 F.3d 38, 45 (D.C. Cir. 2004) ("Section 316 grants the Commission broad power to modify licenses.").

[305] *See, e.g., MCI Telecommunications Corp. v. AT&T,* 512 U.S. 218, 228 (1994) (holding that statutory "authority to 'modify' does not contemplate fundamental changes"); *Cmty Television, Inc. v. FCC*, 216 F.3d 1133, 1140–41 (D.C. Cir. 2000) (applying that reasoning to section 316 and suggesting that impairing the ability of a licensee to provide the same services as those enabled by the original license might be considered a fundamental change), *cert. denied*, 531 U.S. 1071 (2001).

[306] *See* Section III.A.2, *supra*.

[307] *See, e.g.*, NCTA Nov. 10, 2020 *Ex Parte* at 2-3 (noting the lack of DSRC deployments in the country, and pointing out that existing DSRC trials will be able to continue in a 30 MHz band).

the public interest.[308]

118. That leaves only the question whether relocating ITS operations to the upper 30 megahertz constitutes a "fundamental change" to the licenses of incumbent DSRC operations. Several commenters argue that it would, because DSRC requires the entire 75 megahertz to provide a mix of current safety-related uses plus future uses that are under development.[309] We disagree. Although effectively revoking a license or substantially disrupting a licensee's ability to provide service may amount to a fundamental change, courts have repeatedly found that if a licensee can continue to provide substantially the same service, a modification to that license is not a fundamental change.[310] As explained above, our review of the extensive record in this proceeding supports our conclusion that relocating DSRC licensees to the upper 30 megahertz of the band will not meaningfully interfere with the ability of incumbents to provide the same types of safety-related services that they are currently offering.[311] Indeed, this 30 megahertz will accommodate basic ITS services for not only the limited number of vehicles currently equipped with DSRC as currently allowed for under the Commission's rules (e.g., certain fleet vehicles, which are mostly involved in pilot projects), but also additional commercial vehicles (e.g., fleet vehicles, trucks, cars) that might incorporate DSRC-based equipment and that could become available for American consumers on a wider basis across the country in the future—notwithstanding current trends by many manufacturers for introduction of the newer C-V2X technology.[312]

119. What is more, the transition path in this order is designed to accommodate a transition that minimizes any potential disruption to DSRC operations. *First*, it is technically feasible. As described above, we find that it is technologically possible for ITS to operate on 30 megahertz in the upper part of the band, as we designate the lower 45 megahertz of the 5.9 GHz band for unlicensed use. Reconfiguring DSRC-based devices by updating firmware and/or software should allow current ITS licensees using DSRC to operate in the three adjacent channels in the revised band plan.[313] *Second*, to minimize any disruption, we provide a reasonable time for any transition activities. We will not require

[308] *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Proposed Modification, 35 FCC Rcd 2343, para. 126 (2020) (*3.7 GHz Report and Order*) (finding that "[t]he Commission has long relied on section 316 to change or reduce the frequencies used by a licensed service where it has found that doing so would serve the public interest" and describing examples of such Commission action).

[309] *See* Letter from Steven G. Bradbury, General Counsel, Dept. of Transportation to The Honorable Ajit Pai, Chairman, FCC, ET Docket No. 19-138, Addendum at 14 (filed Nov. 9, 2020) ("The loss of 45 MHz of ITS spectrum represents a fundamental change, since it will result in a significant change in the overall utility of the band from its long-established use.") (filed under NTIA); Alliance for Automotive Innovation Comments at 2, 33-36 (the FCC lacks authority to adopt and implement the proposed band plan; fundamentally changing the incumbents' 5.9 GHz licenses as the Commission proposed in the *5.9 GHz NPRM* would violate sections 316 and 312 of the Communications Act). *See also, e.g.*, American Association of State Highway and Transportation Officials Comments at 3-4, 11, 15; National School Transportation Assoc. Comments at 2-3; OmniAir Comments at 1; TennSMART Comments at 1; Toyota Comments at 7-8; US TAG Comments at 4, 12; DSRC Auto Safety Coalition Comments at i-ii; Car 2 Car Comments at 2.

[310] *See, e.g., Cmty Television*, 216 F.3d at 1136, 1140-41 (finding that the Commission's actions will not effect a "fundamental change" where affected licensees could "begin and end the transition period broadcasting television programming to the public under very similar terms" and could "provide essentially the same services, with some flexibility to provide ancillary services as well, under their licenses during the transition").

[311] *See, e.g.*, NCTA Nov. 10, 2020 *Ex Parte* at 1-8 (noting that incumbent licensees will be able to continue their current operations and grow those operations after the move to the upper 30 megahertz and that section 316 does not require the Commission to reserve spectrum for speculative future services).

[312] *See* NCTA Nov. 10 *Ex Parte* at 3 (noting that existing DSRC "licensees will be able to expand their operations to new RSU locations and many more vehicles capable of receiving their DSRC transmissions in a 30-megahertz band, although the automotive market's shift away from DSRC makes such growth unlikely.").

[313] *See* NCTA Nov. 10 *Ex Parte* at 3 (asserting that "the record supports the Commission's conclusion that existing licensees will be able to re-channelize their operations via firmware and/or software upgrades.").

existing licensees to vacate use of channels in the lower 45-megahertz portion of the 5.9 GHz band immediately; instead, we will give incumbent licensees a reasonable amount of time of one year to develop and implement a transition path out of that portion of the 5.9 GHz band, as we discuss earlier in this First Report and Order, thereby ensuring that the incumbents will be able to transition their services to the upper portion of the band. *Finally*, we find that these accommodations are particularly reasonable in light of the minimal current deployment of DSRC.

120. At bottom, the argument that the Commission's action amounts to a "fundamental change" rests on the assertion that it will upend the *future* plans of DSRC licensees to provide certain advanced ITS services, which some commenters argue require the use of the full 75 megahertz currently allocated to DSRC licensees.[314] But as we explain at length above, our review of the record—including the history, current deployment of basic safety-related DSRC-based ITS services, and status of future plans for these advanced services—leaves us unconvinced that relocation to the upper 30 megahertz will upend any concrete business plans of DSRC licensees.[315] 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."[316] In making this determination, we conclude that the potential deployment of future advanced DSRC-based ITS services that may or may not develop years into the future are too uncertain and remote to warrant the further reservation of spectrum for their deployment. After 20 years, with no widescale deployment of even the basic vehicle safety applications that have been available for years, the Commission cannot reasonably justify the protection of such possible future deployment of advanced ITS service at the expense of proven and market-ready technologies that stand ready to make use of the lower 45 megahertz.[317]

121. *Transition to C-V2X.* The Commission likewise has the authority under Title III to transition operations in the upper 30 megahertz from DSRC to C-V2X. As we explain above, we find that transitioning to C-V2X is in the public interest.[318] We note that the exercise of our authority under Title III to transition operations to a new technology is consistent with past Commission actions modifying technical operational rules and mandating the use of newer technologies to maximize spectral efficiency.[319] Licenses in the 5.9 GHz band are for the provision of ITS services, for which the

[314] *See, e.g.*, AT&T Comments at 4 (allocating 30 megahertz to the ITS would allow both technologies to support the Basic Safety Message, although it would preclude their use for advanced ITS applications (*i.e.*, not the basic safety-of-life/property applications contemplated when the service was authorized) and the evolution of C-V2X to 5G); American Association of State Highway and Transportation Officials Comments at 15 (the Commission proposal represents a fundamental change to the terms of the DSRC licenses because it would leave insufficient bandwidth for the effective development of the planned safety applications).

[315] As noted above, the focus of our section 316 inquiry is the effect of our proposal on DSRC service authorized under our existing licensing rules—not the prospects for a proposed new C-V2X set of services not currently authorized under the rules.

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

[317] *See, e.g.*, NCTA Nov. 10 *Ex Parte* at 3-6 (explaining the lack of nationwide deployment of DSRC-based ITS services).

[318] As we discuss above, *see supra* at Section C.1, as part of our analysis of the most spectrally efficient use of the band, we find it in the public interest to adopt a single ITS standard to remove any technological compatibility issues and ensure a safer vehicular safety ecosystem. We are seeking comment on the details of this transition in the Further Notice of Proposed Rulemaking.

[319] *See, e.g.*, *Committee for Effective Cellular Rules v. FCC*, 53 F.3d 1309, 1319-20 (D.C. Cir. 1995) (upholding technical rule modifications that effectively increased service areas of incumbent licenses); *Replacement of Part 90 by Part 88*, Report and Order and Further Notice of Proposed Rule Making, 10 FCC Rcd 10076 (1995) (establishing a narrowband channel plan for incumbent public land mobile radio service (PLMRS) licensees, along with new (continued….)

Commission has required the use of DSRC technology. In revising our rules to require ITS licensees to use of C-V2X technology, we are acting pursuant to our broad Title III spectrum management authority and consistent with our obligation to "generally encourage the larger and more effective use of radio in the public interest."[320]

122. The Alliance for Automotive Innovation and ITS America claim that if the Commission adopts a band plan that provides no spectrum for ITS licenses using DSRC technology, then the licenses effectively will be revoked and thus the Commission would exceed its section 312 authority.[321] However, our decisions today do not represent a termination of DSRC licenses. Licensees will continue to be able to provide the same vehicular safety services on the upper 30 megahertz of the band that they provide under the current ITS band designation,[322] and the ultimate transition from DSRC to C-V2X will similarly not result in any change in or reduction of vehicular-safety services. Licenses that operate under the new technical rules will maintain the same renewal expectancy they have today.[323] Furthermore, we are providing flexibility for ITS licensees to choose to migrate to C-V2X technologies in the upper 30 megahertz sooner than required by our rules if the C-V2X operations would not interfere with any existing ITS licensee that continues to use DSRC-based technology before it ultimately transitions to C-V2X.

123. *Other statutory considerations.* Cisco argues that the Commission must explain how its repurposing of the 5.9 GHz band will be consistent with the directives of the Transportation Equity Act for the 21st Century (TEA),[324] and how the revised rules will continue to foster the objectives identified by the U.S. DOT in its implementation of the TEA[325] Similarly, the Alliance for Automotive Innovation argues that the reallocation of spectrum we adopt here exceeds the Commission's authority by "undercutting DOT's authority to implement the nationwide ITS program."[326] As the Alliance for Automotive Innovation acknowledges, in the TEA, Congress directed the Commission to consider, in consultation with the Secretary of the U.S. DOT, spectrum needs for the operation of the ITS, including spectrum for the dedicated short-range vehicle-to-wayside wireless standard. However, the TEA did not require that the Commission designate the 5.9 GHz band – or any band – for ITS, only that the

equipment type acceptance requirements, to transition existing and new PLMRS services to more spectrally efficient technologies). *See also Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Proposed Modification, 35 FCC Rcd, 2343 (2020) (determining that incumbent satellite licensees could be relocated to smaller portion of C-band without restricting the ability of incumbents to provide comparable service, in part because of availability of compression technologies).

[320] 47 U.S.C. § 303(g).

[321] Alliance for Automotive Innovation Comments at 36; ITS America Comments at 15. *See also* General Motors Comments at 13 (cutting 60% of the ITS spectrum may violate section 312). Section 312 of the Communications Act sets out the Commission's authority to revoke a license. *See* 47 U.S.C. § 312.

[322] *See* NCTA Nov. 10 *Ex Parte* at 6-7 (agreeing with the Commission that "a license modification still providing 30 megahertz to deliver the safety-related services that have been the focus of [DSRC] technology for years" is not a fundamental change to existing DSRC licenses).

[323] We note here the particularities of ITS licensing. Roadside units (RSUs) are individually, geographically licensed, while on-board units (OBUs) are licensed by rule. *See* 47 U.S.C. § 301(e)(1) (authorizing the Commission to authorize "by rule…the operations of radio stations without individual licenses" in specific radio services); 47 CFR § 95.305. To the extent that we do shorten the terms of, terminate or modify the renewal expectancy of roadside unit licenses, the Commission's broad regulatory authority covers the comparable modification of the related license-by-rule service through the rulemaking process. Here, the fate of the on-board units, as the licensed by rule dimension of the ITS, would be tied to that of the roadside units, as the individually licensed dimension.

[324] Pub. L.105-178, § 5206(f), 112 Stat. 107 (1998).

[325] Cisco Comments at 5-6.

[326] Letter from Scott Delacourt, counsel to the Alliance for Automotive Innovation, to Marlene H. Dortch, Secretary, FCC at 1 (Oct. 30, 2020).

Commission *consider* doing so.[327] The TEA directed the Commission to complete a rulemaking on ITS spectrum by January 1, 2000, which it did.[328] That was all that Congress required for the Commission to achieve its statutory duties. By contrast, the Communications Act gives the Commission broad authority to ensure the efficient use of spectrum in the public interest.[329] Contrary to the Alliance for Automotive Innovation's claims, the Commission's decision today is not in conflict with any role assigned to it by Congress, nor does the action we take today infringe on DOT's ability to continue to administer the ITS program. The action we take on the spectrum we designated for ITS is done pursuant to our general authority to act in the public interest, convenience and necessity, which, as the D.C. Circuit has explained, is the sort of spectrum management issue for which the Commission's authority is at its zenith.[330]

124. ITS America claims that based on concerns expressed by the U.S. DOT and other transportation safety experts, adopting our proposal to reduce the amount of ITS spectrum in the 5.9 GHz band would not satisfy the requirements of section 1 of the Communications Act as it relates to the Commission's responsibility to manage spectrum to ensure safety-of-life and property through the use of wire and radio communications.[331] We disagree. The record shows significant support for ensuring safety of life and property through the use of ITS in the upper 30 megahertz of the band, allowing us to repurpose the lower 45 megahertz of the band for unlicensed operations. Furthermore, we disagree with ITS America's suggestion that section 1 of the Communications Act binds the Commission so that it may only modify 5.9 GHz band licenses consistent with U.S. DOT's recommendations.[332] ITS America appears to fundamentally misunderstand the role Congress afforded the Commission to oversee non-federal use of spectrum (including state and local governmental spectrum use), whether for public safety or commercial purposes.[333]

E. Benefits and Costs: Economic Analysis

125. We have reviewed the benefits of repurposing the lower 45 megahertz of the 5.9 GHz band for unlicensed use and the direct costs associated with transitioning existing ITS licensees to the upper 30 megahertz of the band. The evidence leads to the conclusion that the benefits, in terms of new economic activity, are well above the costs. We expect to realize substantial benefits by expanding Wi-Fi capacity. Even using a highly conservative approach to calculate benefits, we anticipate a present value of approximately $6 billion in benefits in each of the years 2023-2025, or $17.2 billion over that time frame.[334] We present the methodology and steps underlying this calculation in Appendix C. We also note that unlicensed use of the 5.9 GHz band may lead to benefits well beyond 2025, which underscores the conservative nature of our estimates. At the same time, by preserving the upper 30 megahertz for ITS, we are permitting current and future licensees to continue to offer such service in the band. We therefore take into consideration the one-time transaction costs associated with incumbent licensees transitioning

[327] Indeed, Cisco admits that "it is true the [TEA] did not call out the 5.9 GHz band or require anything other than a rulemaking proceeding be conducted." *Id.* at n.4.

[328] *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*, ET Docket No. 98-95, RM-9096, Report and Order, 14 FCC Rcd 18221 (1999) (*1999 DSRC Allocation R&O*).

[329] *See, e.g.*, 47 U.S.C. § 303, 307, 309.

[330] 47 U.S.C. § 303; *Teledesic*, 275 F.3d at 79.

[331] ITS America Comments at ii-iii, 12-15.

[332] ITS America Comments at ii-iii, 12-15.

[333] 47 U.S.C. § 151.

[334] This specification discounts benefits by 7% each year. *See* Office of Management and Budget, Circular A-4, *Regulatory Analysis*, 33 (Sept. 17, 2003), https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/#a (OMB Circular A-4) (stating that a real discount rate of 7% should be used as a base-case for regulatory analysis). If we instead discount by 3%, the present value of benefits over 2023-2025 is $19.3 billion.

their operations to the upper 30 megahertz of spectrum,[335] and determine that these costs are significantly less than the present value of the benefits.

1. Record

126. *Benefits*. Proponents of the Commission proposal generally refer to a RAND Corporation study (RAND 5.9 GHz Study) which finds that repurposing the 5.9 GHz for unlicensed use could generate between $82.2 billion and $189.9 billion in economic welfare per year,[336] or the substantially lower benefits estimate of approximately $28 billion between 2022 and 2025 put forth by WiFiForward (2020 WiFiForward Study)[337] to argue that costs related to the automotive industry were small by comparison. Conversely, advocates for ITS argued that unlicensed benefits put forth in these studies were outweighed by those of retaining the band for ITS.[338] While few commenters disputed the benefits put forth by RAND and WiFiForward,[339] below, we present our own estimate, which errs toward underestimating benefits by using an approach that likely overcounts prospective usage of the 6 GHz band and omits various consumer benefits as well as benefits that could be achieved prior to 2023 or after 2025.

127. Other commenters supporting the Commission's proposal refer to the economic value of Wi-Fi in general and the numerous use cases that Wi-Fi enables.[340] Commenters argue that increased Wi-Fi capacity will allow new data-intensive Internet of Things applications[341] and complement 5G development by facilitating the off-loading of a growing percentage of mobile traffic.[342] Other Wi-Fi

[335] Specifically, we limit cost considerations to the costs of transitioning existing licensees to the upper 30 megahertz of the 5.9 GHz band. As discussed below, we do not recognize additional costs of transitioning to C-V2X or irrecoverable, sunk costs. *Infra* para. 143. Nor do we recognize costs associated with advanced applications without demonstration that such applications would yield benefits above and beyond those already anticipated from basic ITS and non-ITS safety applications. *Infra* para. 140.

[336] Letter from Diana Gehlhaus Carew, Doctoral Fellow, RAND Corporation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, Attach. at x (filed Dec. 13, 2018) (RAND 5.9 GHz Study); *see* Open Technology Institute and Public Knowledge Comments at 10; TechFreedom at 5; *see also* Letter from Thomas A. Schatz, President, Citizens Against Government Waste, et al., to Ajit Pai, Chairman, FCC, ET Docket No. 19-138, at 2 (filed Dec. 4, 2019) (CAGW, et al. Dec. 4, 2019 *Ex Parte*) (claiming that "opening the 5.9 GHz spectrum for unlicensed use will contribute up to $100 billion to GDP").

[337] Raul Katz, Telecom Advisory Services, LLC, Assessing the Economic Value of Unlicensed Use in the 5.9 GHz & 6 GHz Bands at 5 (Apr. 2020), http://wififorward.org/wp-content/uploads/2020/04/5.9-6.0-FINAL-for-distribution.pdf (2020 WiFiForward Study); *see* CAGW Reply at 2; Comcast Reply at 6; ICLE Reply at 3; NCTA Reply at 61-62; Letter from Bartlett Cleland, Executive Director, Innovation Economy Institute, et al., to Ajit Pai, Chairman, FCC, ET Docket No. 19-138, at 1 (filed Apr. 27, 2020).

[338] American Association of State Highway and Transportation Officials Comments at 21; Honda Comments at 10; IEEE 1609 Working Group Comments at 3; ITS of America (ITS America) Comments at 24; New York City Comments at 3; US TAG Comments at 4; Washington State DOT Comments at 3; Dr. Richard Roy Reply at 3; ITS America Reply at 13.

[339] Some commenters argue that the RAND estimates are based on Wi-Fi usage in all 75 megahertz of the 5.9 GHz band rather than 45 megahertz as the Commission proposed. *See, e.g.*, Dynamic Spectrum Alliance Comments at 3; IEEE 1609 Working Group Comments at 4; ITS America Comments at 24; Panasonic Comments at 10; US TAG Comments at 4.

[340] NCTA Comments at 27, n.109; Open Technology Institute and Public Knowledge Comments at 9, n.14; Comcast Reply at 5.

[341] NCTA Comments at 5; Open Technology Institute and Public Knowledge Comments at 10.

[342] CAGW, et al. Dec. 4, 2019 *Ex Parte* at 1; NCTA Comments at 5-6; Open Technology Institute and Public Knowledge Comments at 10.

benefits include its importance to education, medicine, smart agriculture, and industry.[343] Commenters assert that benefits from repurposing the 5.9 GHz band would arise from the increased Wi-Fi capacity attendant with the creation of additional channels—including an 80-megahertz channel and a 160-megahertz channel.[344]

128. *Costs*. Various commenters claim that the costs of reducing the spectrum dedicated for ITS substantially outweigh the benefits of dedicating 45 megahertz for unlicensed operations. However, rather than quantifying costs specific to the reduction in ITS, most commenters point to the economic impact caused by automobile collisions in aggregate throughout the United States each year. Commenters generally refer to U.S. DOT estimates of the economic impact of lives lost and injuries resulting from police-reported vehicle crashes in the United States[345] as well as other studies and statistics that were not ITS-specific.[346] Some commenters, however, refer to ITS-specific analyses, including to National Highway Traffic Safety Administration (NHTSA) estimates of economic cost savings associated with V2V[347] and other studies.[348]

129. Commenters also argue that repurposing ITS spectrum would lead to costs associated with traffic congestion, fuel consumption, and auto emissions, but in most instances, do not connect these costs to ITS.[349] Certain commenters refer to annual traffic reductions and reduced carbon dioxide

[343] NCTA Comments at 5; Open Technology Institute and Public Knowledge Comments at 11-15; NCTA Reply at 1-2.

[344] Dynamic Spectrum Alliance Comments at 2-3; NCTA Comments at 16-17; Open Technology Institute and Public Knowledge Comments at 7, 15, 31; WISPA Comments at 3-4; Comcast Reply at 10-12.

[345] Commenters citing a November 20, 2019 *Ex Parte* include American Association of State Highway and Transportation Officials Comments at 2-3, 6, 20-21; COTA Comments at 7; CVSA Comments at 1; DSRC Auto Safety Alliance Comments at 5; GWTCA Comments at 2; HATCI at 2; Honda Comments at 10; IEEE 1609 Working Group Comments at 4; ITS MI Comments at 2; MEMA Comments at 3; SAFE Comments at 3; US TAG Comments at 5; AAI Reply at 14; Dr. Richard Roy Reply at 3. *See* Letter from Elaine L. Chao, Secretary, U.S. DOT, to Ajit Pai, Chairman, FCC at 1 (filed Nov. 20, 2019), https://www.highways.org/wp-content/uploads/2019/12/sec-chao-letter-5.9-11-20-19.pdf. Commenters citing U.S. DOT Reply include AT&T Reply at 13-14; Continental Reply at 26; ITS America Reply at 10; Texas DOT Reply at 1-2. *See* U.S. DOT Reply, attaching Letter from Steven G. Bradbury, General Counsel, U.S. DOT, to Ajit Pai, Chairman, FCC, Supplementary Technical Comments at 8.

[346] Car 2 Car Comments at 7; COTA Comments at 7; DSRC Auto Safety Coalition Comments at 4, n.6; HATCI Comments at 18; Minnesota DOT at 2, n.iii; NAFA Comments at 2; SANDAG Comments at 4-5; Volkswagen Comments, Attach. at 5; Advocates for Highway & Auto Safety at 1.

[347] AAI Comments at 7; DSRC Auto Safety Alliance Comments at 10; Car 2 Car Comments at 7; HATCI Comments at 2; ITS America Comments at 25; NXP Semiconductors Comments, Attach. at 1; Panasonic Comments at 6; AAI Reply at 9; ITS America Reply at 10; TxDOT Reply at 2. The NTHSA analysis is part of NHTSA's 2017 V2V NPRM. *See* U.S. DOT, NHTSA, Federal Motor Vehicle Safety Standards; V2V Communications, 82 Fed. Reg. 3854 (January 12, 2017), https://www.govinfo.gov/content/pkg/FR-2017-01-12/pdf/2016-31059.pdf (NHTSA V2V NPRM).

[348] AAI Comments at 7; u-blox comments at 3-4 (citing James R. Sayer, Carol A. C. Flannagan, Andrew J. Leslie, *The Cost in Fatalities, Injuries and Crashes Associated with Waiting to Deploy Vehicle-to-Vehicle Communication*, University of Michigan Transportation Research Institute Report (Mar. 1, 2018), http://www.umtri.umich.edu/what-were-doing/news/cost-fatalities-injuries-and-crashes-associated-waiting-deploy-vehicle-vehicle (University of Michigan V2V Report)); IEEE 1609 Working Group Comments at 8-9; US TAG Comments at 8 (citing J. Chang et al., Estimated Benefits of Connected Vehicle Applications: Dynamic Mobility Applications, AERIS, V2I Safety, and Road Weather Management Applications, U.S. DOT, ITS Joint Program Office Report No. FHWA-JPO-15-255, at vii (Aug. 2015), https://rosap.ntl.bts.gov/view/dot/3569 (U.S. DOT 2015 Connected Vehicle Report)).

[349] AAI Comments at 13; American Association of State Highway and Transportation Officials Comments at 3; Honda Comments at 10; ITS America Comments at 14; Panasonic Comments at 7; SAFE Comments at 3;

(continued….)

emissions associated with V2X,[350] while others claim that the repurposing could inhibit technology advancements, including in truck platooning, road weather information technologies, and logistics.[351]

130. More generally, commenters express concern that repurposing spectrum in the 5.9 GHz band would delay the spread of ITS applications in the United States.[352] Relatedly, Alliance for Automotive Innovation (AAI) asserts that "[w]ithin 5 years, a total of at least 5 million radios on vehicles and roadway infrastructure will have been deployed, including any previous V2X deployments," but only if the entire 5.9 GHz band is preserved for ITS.[353]

131. Finally, ITS advocates argue that existing ITS licensees would face a transition cost above $500 million,[354] with specific reference to U.S. DOT estimates of infrastructure and equipment replacement, engineering, and related costs.[355] Commenters also claim that substantial investments in research, development, and testing would be lost as a result of the Commission's proposed rule.[356]

132. In response, various commenters argue that the Commission's proposal leaves sufficient spectrum to meet automotive needs[357] and that references to economic valuations based on the sum of U.S. police-reported vehicle crashes erroneously suggest that 100% of crashes and congestion will be avoided if all 75 megahertz in the 5.9 GHz band is dedicated to ITS.[358] Commenters also note claims about advanced ITS-based applications that could permit congestion-related and environmental benefits are speculative and that automotive technologies could use other licensed or unlicensed spectrum for many of the non-safety-of-life services that automakers contend would rely on ITS.[359] Proponents of the Commission's proposal agree that there would be costs associated with moving ITS licensees from the lower 45 megahertz, but that these were overstated by the U.S. DOT[360] and should not include sunk costs that cannot be recouped regardless of Commission action.[361]

2. Benefits of Unlicensed Spectrum in the Lower 45 Megahertz of the 5.9 GHz

Washington State DOT Comments at 3; U.S. DOT Reply at 2; AAI Reply at 7; ITS America Reply at 13-14; Texas DOT Reply at 2.

[350] ITS America Comments at 26-27; SAFE Comments at 3; US TAG Comments at 4, 8; Dr. Richard Roy Reply at 3; ITS America Reply at 11-12.

[351] *See e.g.*, Minnesota DOT Comments at 2; NXP Semiconductors Comments, Attach. at 2, 3. Truck platooning refers to the use of ITS to link multiple trucks in a convoy.

[352] *See, e.g.*, American Association of State Highway and Transportation Officials Comments at 3; Car 2 Car Comments at 1; Continental Comments at 9; Minnesota DOT Comments at 2; U.S. DOT Reply at 35, 38-39.

[353] Letter from John Bozzella, President and CEO, AAI, to Elaine Chao, Secretary, U.S. DOT and Ajit Pai, Chairman, FCC, ET Docket No. 19-138, at 2 (filed Apr. 23, 2020) (AAI Apr. 23, 2020 *Ex Parte*).

[354] American Association of State Highway and Transportation Officials Comments at 7; DSRC Auto Safety Coalition Comments at 13; Minnesota DOT Comments at 2; NXP Semiconductors Comments, Attach. at 2; AAI Reply at 13.

[355] U.S. DOT Reply at 37-38. Certain state DOTs also enumerated costs specific to DSRC projects in their state. *See, e.g.*, Minnesota DOT Comments at 5; Georgia DOT Comments at 2.

[356] Idaho DOT Comments at 2; Montana DOT Comments at 2; New York City Comments at 1-2; North Dakota DOT Comments at 2; Washington State DOT Comments at 2; Wyoming DoT Comments at 3; U.S. DOT Reply at 35-36.

[357] CAGW Reply at 2-3; Comcast Reply at 17; ICLE Reply at 5; NCTA Reply at 65; Brattle 5.9 GHz Analysis at 5-7.

[358] Brattle 5.9 GHz Analysis at 9-10.

[359] Comcast Reply at 17; NCTA Reply at 23-26, 65.

[360] Brattle 5.9 GHz Analysis at 14.

[361] NCTA Reply at 67-68; Brattle 5.9 GHz Analysis at 12.

Band

133. We evaluate the economic benefits of dedicating the lower 45 megahertz of the 5.9 GHz band for unlicensed use by estimating the expected contribution to Gross Domestic Product (GDP) resulting from additional Wi-Fi traffic once this spectrum is made available to augment existing Wi-Fi capacity. Additional Wi-Fi capacity is valuable as future U.S. Wi-Fi demand is expected to greatly increase.[362] The additional, wider channels made possible by repurposing spectrum in the 5.9 GHz band will allow more devices to connect at a given time. The additional traffic will produce new productive economic activity, including through additional online transactions between Internet users and additional transactions between Internet users and Internet Service Providers (ISPs), which together, comprise the added value of additional spectrum. We focus here on the additional GDP created by transactions between ISPs and their customers since estimating additional online transactions between Internet users is difficult due to lack of data. Thus, our estimate is conservative, capturing the economic value to the ISPs directly (i.e., producer surplus), while ignoring consumer surplus gains.

134. Wi-Fi traffic occurs on discrete channels of 20 megahertz, 40 megahertz, 80 megahertz and potentially 160-megahertz bandwidth. Larger bandwidths improve the speed of traffic on the bands and additional channels increase the aggregate capacity of Wi-Fi. Our baseline calculation of the increase in traffic is based on the idea that the additional 45 megahertz of 5.9 GHz spectrum will, when combined with spectrum from the 5.725-5.850 GHz (U-NII-3) band, enable Wi-Fi users to access an additional 160-megahertz channel and 80-megahertz channel,[363] two additional 40-megahertz channels, and three additional 20-megahertz channels in addition to channels that are already available, including those in the 6 GHz band.[364] This will give consumer devices additional channels to establish connections to mitigate congestion. Because future Wi-Fi traffic is expected to greatly increase and strain capacity today and in the future, we assume that the additional 5.9 GHz spectrum will be fully used by consumers.[365] This implies that we can estimate additional traffic for channels of a specific bandwidth as a proportion of new Wi-Fi channels that this spectrum would create relative to existing channels of that bandwidth.[366] Using this and reasonable assumptions on the distribution of traffic across Wi-Fi channels of different bandwidths, we calculate that Wi-Fi traffic would increase by 8.4%.[367] We note that although there are means to augment capacity other than through additional spectrum, such as with greater

[362] The Free State Foundation Comments at 7-8; Open Technology Institute and Public Knowledge Comments at 16-17.

[363] Although much of the spectrum that makes up these additional channels is located in the U-NII-3 band, we attribute the entire benefit to the spectrum being made available because these channels would not exist but for the additional 45 megahertz of spectrum made available in the U-NII-4 band through this First Report and Order.

[364] For a table of available channels, including those in the 6 GHz band, *see 6 GHz Report and Order*, 35 FCC Rcd at 3902, Table 6. We note that because we include channels in the 6 GHz band, our calculations are likely conservative because of the power limitations in that band compared to those in the U-NII-4 band, which would likely lead to greater reliance on the latter. For examples, indoor devices using 160-megahertz channels in the U-NII-4 band will be able to rely on 36 dBm of power compared to 27 dBm in the 6 GHz band. *See 6 GHz Report and Order*, 35 FCC Rcd at 3889-90, para. 103.

[365] The Free State Foundation Comments at 7-8 (noting that existing unlicensed bands "could be rendered unusable by increasing demand," and that "by one estimate we're going to need to find 1600 [megahertz] of additional unlicensed spectrum to meet busy-hour demand by 2025"); NCTA Comments at 5-7 (asserting that although 5G will provide more bandwidth, "it will also support so much more data usage that even more [Wi-Fi] offload is require[ed]."). Moreover, as we show in Appendix C, our finding that benefits outweigh costs does not require full use of the U-NII-4 band. *Infra* Appendix C, para. 11.

[366] For example, there are already two 80-megahertz channels used commonly by Wi-Fi. The additional spectrum would allow use of one additional 80-megahertz channel. Assuming that this new channel would be fully used, traffic would increase by 50% based on the proportion, one new channel to two old channels.

[367] Our traffic distribution assumptions are specified in Electronic Communications Committee, ECC Report 302, at 22 (May 29, 2019), https://docdb.cept.org/download/cc03c766-35f8/ECC%20Report%20302.pdf.

investment in infrastructure,[368] our result maintains as long as capacity remains a bottleneck to service quality.

135. As we show in greater detail in Appendix C, to calculate additional GDP, we multiply 8.4% by an extrapolation of U.S. Wi-Fi traffic to determine additional traffic per year in gigabytes (GBs).[369] We then multiply this figure by an estimate of the average ISP revenue generated by an additional GB of traffic.[370] We estimate benefits only through 2025 to avoid relying on current data for projecting too far into the future, but note that because our estimates incorporate existing sources of unlicensed spectrum, including in the 6 GHz band, we believe that the benefits of repurposing the 5.9 GHz band would continue beyond 2025. Moreover, although we anticipate that benefits could arise earlier, we do not calculate benefits prior to 2023 to allow time for devices to be updated and adopted by consumers. Using a discount rate of 7%, our conservative approach leads to a present value of approximately $6 billion in benefits in each of the years 2023-2025, or $17.2 billion over that time frame.[371]

136. *Alternative Estimates of Unlicensed Spectrum Value in the Record.* In the *5.9 GHz NPRM*, we noted that the RAND 5.9 GHz Study attempted to value additional traffic expected to result from repurposing the entire 5.9 GHz band for unlicensed use.[372] Although commenters generally did not dispute RAND's assessment, per the *5.9 GHz NPRM*, we had reservations with these valuations.[373] The RAND evaluation of additional traffic was the sum of extra value from the additional number of gigabytes (GBs) transmitted times an average broadband price per GB, plus the cost to consumers of new Wi-Fi-using devices that RAND found would have to be purchased to support this new traffic.[374] While we agree that the availability of additional unlicensed spectrum in the 5.9 GHz band will create additional traffic, we find that RAND's device-based component likely overstates benefits because it assumes that Wi-Fi devices in use are substantially limited by capacity constraints, and thus, any increase in Wi-Fi

[368] Additional infrastructure investment includes alternatives such as multiple input/multiple output (MIMO). With massive MIMO, a future is envisioned where hundreds or thousands of antennas are used to serve a set of users. There are, however, practical limits to how many antennas can be deployed at conventional towers and rooftop locations, for example, determined by the array dimensions allowed by the site owner, the weight, and the wind load. Additionally, massive MIMO faces deployment challenges, including pilot contamination, channel estimation, precoding, user scheduling, hardware impairments, energy efficiency, and signal detection that need to be addressed before it can achieve its promised advantages. *See, e.g.*, Björnson, Emil, et al., *Massive MIMO is a reality—What is next?: Five promising research directions for antenna arrays*, 94 Digital Signal Processing (2019); Robin Chataut and Robert Akl, *Massive MIMO Systems for 5G and beyond Networks—Overview, Recent Trends, Challenges, and Future Research Direction*, 20 Sensors (2020).

[369] CISCO, VNI Complete Forecast Highlights, United States - 2022 Forecast Highlights, at 1-2 (2018).

[370] Specifically, we use projections of the price per GB for fixed U.S. broadband plans based on the Consumer Price Index (CPI) for "Internet services and electronic information providers" and a baseline price estimate from the Commission's 2018 International Broadband Data Report. U.S. Bureau of Labor Statistics, Databases, Tables & Calculators by Subject, *Internet Services and Electronic Information Providers*, https://data.bls.gov/timeseries/CUUR0000SEEE03?output_view=data (last visited Oct. 27, 2020); *International Comparison Requirements Pursuant to the Broadband Data Improvement Act*, GN Docket No. 17-199, Sixth Report, 32 FCC Rcd 978, 1035, Table 3. We also used alternative approaches that led to higher GDP estimates. Every approach assumes that Wi-Fi revenue from transactions between ISPs and their customers is proportional to increases in Wi-Fi traffic. Additionally, each approach incorporates fixed broadband prices and revenues because Wi-Fi traffic is typically paid for indirectly via a fixed broadband subscription.

[371] If we instead discount by 3%, the present value of benefits over 2023-2025 is $19.3 billion. Alternatively, discounting by 7%, but relying instead on the Census Bureau's national revenues data for fixed Internet services, we estimated a present value of benefits of $34.8 billion over 2023-2025.

[372] *5.9 GHz NPRM*, 34 FCC Rcd at 12626-27, para. 65.

[373] *5.9 GHz NPRM*, 34 FCC Rcd at 12626, para. 65 & n.108.

[374] RAND 5.9 GHz Study at 25-32.

capacity would generate new traffic that would be accommodated entirely by the purchase of new devices. We anticipate that existing Wi-Fi devices will handle most of the additional traffic, focusing instead on the value of the extra traffic itself based on our calculation above. Additionally, unlike the RAND 5.9 GHz Study, we incorporate 6 GHz spectrum into our analysis.

137. We also previously addressed another approach to evaluating unlicensed use: estimating the GDP increase due to the resulting broadband speed increase.[375] An alternative quantification in the RAND 5.9 GHz Study as well as the 2020 WiFiForward Study of the value of repurposing 5.9 GHz both rely on such estimates, but based on different data. We have not found an appropriate way to address our concerns regarding this estimate in either comments to this proceeding, the public record, or in the academic literature, and so decline to include a benefit of speed increases in our analysis.[376]

3. Costs of Repurposing the Band to Limit ITS Use to the Upper 30 Megahertz of the 5.9 GHz Band

138. In conducting our analysis of benefits and costs, an underlying objective is to identify benefits and costs causally related to the Commission action being undertaken.[377] As such, we can credit economic losses only if they would be expected to result from repurposing the 5.9 GHz band; we cannot (and should not) attempt to attribute losses to this proceeding that would have occurred regardless of our rule changes.[378] Thus, we reject cost quantifications based on enumerations of the economic harms resulting from police-reported vehicle crashes in the U.S. that are not specifically tied to changes to ITS spectrum.[379]

139. In general, commenters have provided very limited information that would allow us to quantify any costs associated with a reduction in ITS spectrum. Certain commenters pointed to analyses, such as in the NHTSA V2V NPRM,[380] seeking to quantify specific safety benefits of ITS to argue that such benefits may be diminished by the Commission. We find that benefits attributed to ITS in these studies are likely overstated and inappropriate to view as costs resulting from the Commission's proposal. As discussed above, we find that the 30 megahertz of spectrum that is being retained for ITS applications is sufficient to support many ITS applications. For example, in estimating the benefits of a proposal to mandate DSRC-based vehicle-to-vehicle (V2V) communications, the NHTSA V2V NPRM found that substantial benefits could be achieved using 10 megahertz of ITS spectrum,[381] 20 megahertz less than the

[375] *5.9 GHz NPRM*, 34 FCC Rcd at 12626-27, para. 65 & n.109. Specifically, the RAND 5.9 GHz study attempts to estimate the percent by which GDP would increase in response to a broadband speed percentage increase (an elasticity) by regressing U.S. state GDPs on U.S. state broadband speeds. RAND then uses this elasticity to predict the added GDP based on their estimate of the increased broadband speed from repurposing 5.9 GHz spectrum. RAND 5.9 GHz Study at 14-21.

[376] The 2020 WiFiForward Study attempted to resolve our concerns with the regression found in the RAND 5.9 GHz Study by including quarterly-lags of GDP as an independent variable to capture factors omitted from the RAND regression. 2020 WiFiForward Study at 25-26. However, this does not address our core concern that speeds could be explained by GDP, as we noted that GDP could determine speeds over long time periods when we discussed the use of lagged speeds in the RAND 5.9 GHz Study. *5.9 GHz NPRM*, 34 FCC Rcd at 12626-27, para. 65 & n.109.

[377] *See* OMB Circular A-4 at 2 (stating that in evaluating properly the benefits and costs of regulations, we must explain how the actions required by the rule are linked to expected benefits).

[378] As an example of how actions required by a rule are linked to expected benefits, OMB Circular A-4 suggests that agencies might "indicate how additional safety equipment will reduce safety risks." We interpret this guidance to mean that we cannot accept commenter assessments of prospective safety improvements or reductions unless these are linked to the Commission's proposal. OMB Circular A-4 at 2.

[379] In doing so, we reject comments advancing such quantifications for the purpose of comparing benefits and costs.

[380] *See* NHTSA V2V NPRM.

[381] NHTSA V2V NPRM, 82 Fed. Reg. 3885, 3969, 3986. Specifically, NHTSA proposed to require basic safety message transmissions on a single 10 megahertz channel paired with secondary cellular, Wi-Fi, or satellite

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spectrum that we retain for ITS. Additionally, NHTSA analysis forecasts benefits based on the state of technology in the 2010-2013 base period, which likely substantially overestimates the benefits of DSRC in later years, when reliance on complementary or substitute safety systems (e.g., based on cameras, lasers, and radars) would likely be far more widespread than in 2010-2013.[382] Because commenters neither show that hypothetical ITS benefits described in the NHTSA and other studies would be lost as a result of our actions, nor establish that such benefits are accurately calculated, we reject comments advancing quantifications from these studies.[383]

140. More generally, we do not believe that this proceeding will lead to cognizable costs due to automobile collisions that may be linked to our actions. Commenters argue that certain advanced features, including those pertaining to life and property, may require additional bandwidth.[384] NHTSA's own prior analysis suggests, however, that V2V safety applications that could eliminate a large proportion of crashes may require much less spectrum.[385] And while commenters speculate about certain additional benefits (i.e., to pedestrians), they have not demonstrated whether such benefits would arise nor quantified the incremental benefit given the V2V safety applications that would be expected to be preserved. Further, commenters have not demonstrated that advanced applications, even if presumed to offer additional safety benefits,[386] need to rely on ITS spectrum or would be largely obviated by developing safety features outside ITS.

141. Commenters also claim various benefits of ITS from non-safety applications. As explained above, we decline to rely upon estimates of use of ITS spectrum for applications like road weather information technologies that are more appropriately provided using other spectrum bands not dedicated for safety-of-life applications. Moreover, we find that commenters have not effectively demonstrated that advanced ITS features would reduce congestion or environmental or other costs that are not directly related to safety. We have already noted that 30 megahertz of spectrum is sufficient to support many ITS applications and existing studies do not show that more spectrum would give rise to additional benefits.[387] For example, whereas commenters claim that commercial platooning systems are

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communications. NHTSA V2V NPRM, 82 Fed. Reg. 3969, 3986. NHTSA's analysis focused on the intersection movement assist and left turn across path applications, safety benefits the agency viewed as being least likely to be replicated by alternative non-ITS safety enhancing technologies. NHTSA V2V NPRM, 82 Fed. Reg. 3969.

[382] Similarly, the University of Michigan V2V Report sought to estimate the cumulative cost associated with a delay in mandating V2V capability on new vehicles caused by waiting for a new technology like C-V2X (University of Michigan V2V Report at 2-4). The report relied on the counterfactual assumption that a DSRC-based V2V technology could be ready to deploy on all new vehicles starting in 2019. Because we know this was not the case, the ensuing cost estimate is made inaccurate by continued development of C-V2X technology.

[383] Specifically, we disagree with comments of Alliance for Automotive Innovation, DSRC Auto Safety Alliance; Car 2 Car, HATCI, ITS America, NXP Semiconductors, Panasonic, TxDOT, u-blox, IEEE 1609 Working Group, and US TAG on this point.

[384] *See, e.g.*, Car 2 Car Comments at 2-4; Continental Comments at 4-5; U.S. DOT Reply at 30-32.

[385] NHTSA V2V NPRM, 82 Fed. Reg. 3885, 3969, 3986.

[386] *See e.g.*, 5GAA Comments at 28-31.

[387] For example, extrapolating from estimates in a U.S. DOT connected vehicle report, commenters (US TAG Comments at 4, 8; Dr. Richard Roy Reply at 3) claim an estimated annual reduction in traffic of 280 million hours and reduced carbon dioxide emissions of 400,000 tons associated with V2I. However, this and other studies do not stipulate that 75 megahertz of ITS spectrum is necessary to achieve this. U.S. DOT 2015 Connected Vehicle Report at 18. In particular, many connected vehicle studies studying the potential environmental benefit of ITS assess the efficacy of algorithms (e.g., for signal control) in a simulated environment irrespective of the underlying communications technology or spectrum band that permits connectivity. *See e.g.*, Hao Liu, Xiao-Yun Lu, and Steven E. Shladover, Traffic signal control by leveraging Cooperative Adaptive Cruise Control (CACC) vehicle platooning capabilities, 104 Transportation Research Part C: Emerging Technologies (2019); Jongryeol Jeong et al., *Implementation of Model Predictive Control into Closed-Loop Micro-Traffic Simulation for Connected Automated*

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expected to improve fuel efficiency by 7.25%,[388] other public estimates of these impacts are lower,[389] and there may be offsetting congestion, safety, and other concerns that could diminish the benefits from this technology (if not eliminate them entirely),[390] leading certain truck manufacturers to reconsider its use.[391]

142. Nor do we view the transition by existing DSRC licensees to the upper 30 megahertz in the 5.9 GHz band to be a substantial cause of delays to deployment of basic ITS applications in the foreseeable future. First, as other commenters point out, we note that C-V2X has had no spectrum dedicated to its deployment, but this has not prevented rapid innovation in that technology, which in part, necessitates this proceeding.[392] Second, the band plan proposed by Alliance for Automotive Innovation suggests that a transition by DSRC licensees would have been necessitated, even if our rules proceeded exactly as AAI envisioned.[393] Alliance for Automotive Innovation proposal initially stipulates a transition of DSRC licensees from the upper 20 megahertz of the 5.9 GHz band to make way for C-V2X.[394] The proposal then stipulates a second transition after five years, following selection of a single technology (either DSRC or C-V2X) with a ten-year phaseout period for the technology that does not prevail.[395] Because there is no guarantee that DSRC would prevail, this would forestall its transition by several years, even assuming it was ultimately determined to be the prevailing technology—an assumption we find unconvincing for the reasons discussed above. Moreover, we find that AAI's proposed commitment to deploy 5 million radios if the entire 5.9 GHz band is preserved for ITS is not enforceable,[396] and importantly, represents a relatively modest ITS deployment that is not necessarily at variance with deployments that might be anticipated without the proposal.[397] The proposed commitment and band plan

Vehicle, 52 IFAC-PapersOnLine (2019); Yunfei Hou and Qing He, *Cooperative and Integrated Vehicle and Intersection Control for Energy Efficiency (CIVIC-E2)*, 19 IEEE Transactions of Intelligent Transportation Systems (2018).

[388] ITS America Comments at 27.

[389] *See, e.g.*, Department of Energy, Office of Energy Efficiency & Renewable Energy, *Platooning Trucks to Cut Cost and Improve Efficiency* (Feb. 5, 2018), https://www.energy.gov/eere/articles/platooning-trucks-cut-cost-and-improve-efficiency (citing a figure of 4%).

[390] Recent research is concerned with potential adverse impacts of truck platoons on other traffic and safety. *See e.g.*, Meng Wang, et al., *Benefits and Risks of Truck Platooning on Freeway Operations Near Entrance Ramp*, 2673 Transportation Research Record, 588 (2019); Timo Faber, et al., *Evaluating Traffic Efficiency and Safety by Varying Truck Platoon Characteristics in a Critical Traffic Situation*, Transportation Research Record, DOI: 10.1177/0361198120935443 (2020).

[391] Press Release, Daimler, Daimler Trucks invests half a billion Euros in highly automated trucks (Jan. 2019), https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-Trucks-invests-half-a-billion-Euros-in-highly-automated-trucks.xhtml?oid=42188247 (Daimler notes that it is "reassessing its view of platooning" because years of testing "show that fuel savings, even in perfect platooning conditions, are less than expected and that those savings are further diminished when the platoon gets disconnected and the trucks must accelerate to reconnect." Daimler further indicated that its analysis "shows no business case for customers driving platoons" in the U.S.)

[392] Brattle 5.9 GHz Analysis at 10-11.

[393] Letter from John Bozzella, President and CEO, Alliance for Automotive Innovation (AAI), to Elaine Chao, Secretary, US DOT, ET Docket No. 19-138, at 1-2 (filed Apr. 28, 2020) (AAI Apr. 28, 2020 *Ex Parte*).

[394] Alliance for Automotive Innovation Apr. 28, 2020 *Ex Parte* at 1.

[395] Alliance for Automotive Innovation Apr. 28, 2020 *Ex Parte* at 1-2.

[396] In particular, the "industry-wide build out requirement" (Alliance for Automotive Innovation Apr. 23, 2020 *Ex Parte* at 2) does not lay out an enforcement mechanism for individual participants to ensure that the proposed commitment is satisfied in the aggregate. *See* NCTA Reply at 40.

[397] For instance, the proposed commitment is incremental to existing deployments and consists of two, competing, non-interoperable technologies. Moreover, even if each radio represented deployment of a single V2X capable vehicle—which the proposed commitment makes clear is likely not the case—the final deployment would represent

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do not contemplate the additional length of time necessary to deploy the prevailing technology nor the time that it would take for sufficient adoption by consumers to have meaningful benefits, a timeframe during which alternative safety applications may substantially diminish the incremental benefits achievable from ITS. For these reasons, we decline to credit claims that our actions could impose costs stemming from delays in ITS deployment.

143. Finally, we believe that the U.S. DOT's estimate of transitioning existing licensees is at the high end of total ITS transition costs, and is, in any event, well below our estimated benefits of repurposing the 5.9 GHz band for unlicensed use. In particular, the U.S. DOT confounds the costs of transitioning to the upper 30 megahertz of the 5.9 GHz band with those of transitioning to C-V2X.[398] However, the latter cost is necessitated by market factors, including substantial support for the C-V2X technology by proponents of ITS, coupled with a general understanding that a single interoperable ITS standard best promotes public safety.[399] Moreover, existing DSRC licensees have recently begun to employ C-V2X on an experimental basis, telling us that the transition to C-V2X is already ongoing.[400] Thus, we view it as inappropriate to include as part of the transition calculation, costs of transitioning to C-V2X.[401] Additionally, in general, expenses on research, development, and testing referenced by ITS proponents represent typical examples of sunk costs that are irrecoverable irrespective of any action that we take.[402] Specifically, we agree with comments noting that expenses on grants and research projects referenced by the U.S. DOT,[403] represent typical examples of such sunk costs, which we decline to recognize.

IV. FURTHER NOTICE OF PROPOSED RULEMAKING

144. In the First Report and Order we adopted a revised band plan for the 5.9 GHz band that continues to designate the upper 30-megahertz portion (5.895-5.925 GHz) of the 5.9 GHz band for ITS and stipulates rules for unlicensed devices operating in the lower 45-megahertz portion of the band (5.850-5.895 GHz). With respect to unlicensed operations under the revised band plan, we established technical and operational rules that (1) allow immediate access for unlicensed indoor operations at specified power levels across the entire 5.850-5.895 GHz portion of the 5.9 GHz band; and (2) allow for limited full power outdoor operations through the STA or other existing regulatory process, during the transition period.

145. The First Report and Order determined that ITS operations on channels in the 5.850-5.895 GHz band portion of the 5.9 GHz band will be required to cease within one year of the effective date of the First Report and Order, and that ITS operations in the revised ITS band ultimately must use C-V2X technology instead of DSRC-based technology. In this Further Notice, we address the remaining issues before the Commission as we finalize the 5.9 GHz band restructuring to the modified band plan. Specifically, we address: (1) the transition of all ITS operations to C-V2X-based technology; (2) the codification of C-V2X technical parameters in the Commission's rules; (3) other transition

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less than 2% of the more than 270 million registered vehicles in the U.S. *See* AAI Apr. 23, 2020 *Ex Parte* at 2; U.S. DOT, 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 (last visited Oct. 27, 2020).

[398] U.S. DOT Reply at 37.

[399] For instance, the Alliance for Automotive Innovation notes that the selection of a single technology would put the auto industry in a position that maximizes benefits for road travelers. Alliance for Automotive Innovation Apr. 28, 2020 *Ex Parte* at 2.

[400] *See, e.g.*, Colorado DOT Comments at 1-2; Georgia DOT Comments at 4.

[401] We note that this is notwithstanding certain commenters' alternative arguments for why transition costs are likely overstated. See, e.g., Brattle 5.9 GHz Analysis at 13-15.

[402] *See, e.g.*, Brattle 5.9 GHz Analysis at 12-13.

[403] U.S. DOT Reply at 36.

considerations; and (4) the transmitter power and emission limits, and other issues, related to full-power outdoor unlicensed operations across the entire 5.850-5.895 GHz portion of the 5.9 GHz band.

A. Transitioning Licensed ITS Operations in the 5.9 GHz Band to C-V2X Technology

146. Under the First Report and Order, all existing ITS operations using channels in the lower 45 megahertz of the 5.9 GHz band are required to transition out of that spectrum and into the upper 30 megahertz (5.895-5.925 GHz) of the 5.9 GHz band that will continue to be designated for ITS. ITS licensees must take necessary steps to assess their existing equipment and infrastructure and either retune their devices to access only the spectrum in the 30 megahertz that will remain available for ITS operations or replace their equipment with transmitters designed to use only the revised ITS band. In this Further Notice, we propose to address remaining issues that must be resolved regarding the transition of ITS in the upper 30 megahertz from DSRC to C-V2X operations, including the timing and procedures needed to ensure a smooth transition to the 5.895-5.925 GHz band. We also seek comment on additional or alternative measures that may be helpful, appropriate, or necessary.

1. Timeline

147. In the First Report and Order, we require that ITS operations in the 5.895-5.925 GHz band ultimately must use C-V2X technology. In order to complete the transition of the band to C-V2X, we propose that all ITS operations in the 5.895-5.925 GHz band either convert to C-V2X or cease operating two years after the effective date of a Second Report and Order adopted in response to this Further Notice. We seek comment on this proposal.

148. Since we first proposed in December 2019 to authorize C-V2X operations in the 5.9 GHz band, manufacturers and licensees have had significant time to begin planning for the possible entry of C-V2X into the band. We seek comment on the state of development and availability of C-V2X equipment, both roadside and on-board units. We believe that two-years beyond the effective date of the rules the Commission adopts in the Second Report and Order will allow the ITS supply chains to become replete with C-V2X equipment. This timeframe is consistent with the Department of Transportation's view that vehicle manufacturer product cycles necessitate two years lead time to ensure new V2X equipment is installed in new vehicles.[404] And in some instances, this timeframe may not be needed as some commenters have explained that they have already deployed equipment that is both DSRC and C-V2X compatible.[405] We seek comment on whether manufacturers can distribute C-V2X equipment through their existing supply chains, and on whether vehicle manufacturers can install C-V2X equipment into new vehicles, within this timeframe. Moreover, we expect that many licensees will begin planning for the eventual transition to C-V2X now and, thus, may take advantage of available opportunities to immediately operate C-V2X facilities in the upper 30 megahertz of the band under our STA, experimental licensing, or other existing regulatory process without first implementing interim DSRC operations. We seek comment on the number of licensees that may decide to operate in such a fashion and the number that plan to continue offering DSRC in the 30-megahertz band during the transition period. We assume that the transition process to C-V2X would primarily involve replacing DSRC transmitters with C-V2X transmitters, since we propose C-V2X technical rules consistent with the current rules for DSRC and therefore no antenna changes are needed to cover the same area based on the identical propagation characteristics between DSRC and C-V2X. We seek comment on the steps involved with converting all ITS operations in the 5.9 GHz band to C-V2X technology and the expected time to complete the entire process. We note that, as stipulated in the First Report and Order, licensees will not need to initiate changes to their authorizations when they transition to C-V2X; they simply will need to use equipment that meets the operational and technical rules we adopt in the Second Report and Order for C-V2X

[404] *See* National Highway Traffic Safety Administration (NHTSA), U.S.DOT, Federal Motor Vehicle Safety Standards; V2V Communications Notice of Proposed Rulemaking (NPRM). 82 FR 3854, which states new V2X requirements, if adopted, would phase-in two model years after the final rule is adopted to accommodate vehicle manufacturers' product cycles.

[405] GDOT Comments at 4.

technology. If, however, a licensee needs to concurrently make adjustments to its system to add sites, increase power, or modify emissions, those changes will require modifications to the underlying RSU registration information.

149. We also seek comment on how to treat DSRC OBUs at the final transition date. Can manufacturers or DSRC system operators send over-the-air instructions to these units to turn off? Can OBUs be modified through software or hardware changes to operate using C-V2X-based technology? Absent other operating DSRC infrastructure (such as RSUs), would OBUs continue to communicate with each other and, if so, what would such communications entail? Is there any potential for harmful interference into C-V2X operations that could occur if DSRC OBUs continue to operate after the final transition date and, if so, how can such interference best be prevented? We seek comment on our proposed two-year sunset date for DSRC-based OBU operations and any alternative date that commenters might suggest. Commenters should be specific as to the merits of any date they recommend for ceasing DSRC operations in the 5.9 GHz band.

150. Finally, recognizing that OBUs are licensed by rule under part 95[406] and, as a result, the Commission does not have detailed information and records on the exact number and location of users of such equipment, we seek comment on whether there are any specific issues related to modifying OBUs that are not reflected in the questions already raised. As an initial matter, we assume that most OBUs should be easily identified because very few vehicles sold to date are equipped with OBUs and the vast majority of existing units are associated with the various ITS trial programs occurring throughout the U.S. We seek comment on this notion. Are there estimates of the number of vehicles on the road today that incorporate DSRC-based OBUs independent of a trial or pilot program (i.e., as part of a commercial deployment of DSRC services)? Does the Commission need to take steps to make owners of these vehicles aware of the changes being adopted? Or would automobile manufacturers take primary responsibility for notifying their customers of these rule changes? If the Commission should make owners aware of rule changes affecting OBUs, then how should the Commission conduct such consumer outreach? Commenters should provide specific details to justify their positions regarding our proposals.

2. Technical Parameters

151. The Commission's ITS rules set forth basic technical parameters such as power, height, and available channels.[407] Further, to ensure interoperability within the ITS, DSRC operations are required to adhere to the provisions specified in the ASTM E2213-03 Standard (ASTM-DSRC), which is incorporated by reference in the Commission's rules.[408] These rules divide the current 5.9 GHz band into seven, 10-megahertz channels, with an allowance to combine two pairs of channels into 20-megahertz channels.[409] Further, specific channels are intended for public safety use only; one channel in particular, the "control channel," which is outside the modified ITS band plan,[410] is intended to be used for messages that coordinate channel usage and prioritize public safety messages.[411] The modified ITS band plan

[406] 47 CFR § 95.305 Authorization to operate Personal Radio Services stations; Part 95, Subpart L: DSRCS On-Board Units. Part 95 rules apply to the Personal Radio Services and provide for a variety of personal communications, radio signaling, and business communications. "Licensed-by-rule" means that an authorized user can access the entire available spectrum without an individual station license document and is instead authorized to operate as long as the operations are in accordance with the applicable service rules. *See* 47 U.S.C. § 307(e). Thus, while all spectrum use is shared among users who meet the eligibility and technical qualifications and no one has exclusive rights to any portion of the spectrum, those users are collectively afforded interference protection *vis-à-vis* other services, based on the allocation status under which they operate.

[407] 47 CFR 90.377.

[408] 47 CFR §§ 90.375, 90.379, 95.3189.

[409] 47 CFR §§ 90.377(b), 95.3163.

[410] 47 CFR §§ 90.377(b), 95.3163.

[411] 47 CFR §§ 90.377(b), 90.377(d)(2), 95.3163, 95.3159(a)(2).

eliminates the lower four, 10-megahertz channels, including the current control channel, and one of the public safety channels. These changes necessitate that we further propose to modify the ITS technical rules to ensure that ITS delivers its intended safety-related applications to the American public.

152. Our goal is to facilitate a smooth transition and ensure that existing ITS services continue with minimal or no interruption. Accordingly, we must address the technical rules through the transition process whereby C-V2X will replace DSRC technology in the 5.9 GHz band and after that transition when C-V2X is the sole technology in the 5.9 GHz ITS band. In the sections below, we seek comment on the technical considerations related to the simultaneous operation of DSRC and C-V2X in the 5.895-5.925 GHz portion of the 5.9 GHz band and, ultimately, exclusive operation of C-V2X in that band. In particular, as commenters consider the various technical issues addressed here, they should also frame their comments around considerations necessary during and after the transition. Specifically, for each technical issue, commenters should also answer whether there are technical issues that preclude simultaneous DSRC and C-V2X operations in this band. What spectral and/or geographic separation requirements, if any, are necessary to prevent harmful interference between the two types of operations? As ITS licenses generally specify a defined geographic area and are required to operate within as small a "communications zone" as necessary, can we permit existing licensees to modify to C-V2X operations premised simply on not exceeding their existing footprint? Can new licensees be authorized to use C-V2X before the final transition date, provided that they avoid existing geographic licensed areas or simply avoid existing registered roadside units? Are there any adjacent-channel issues that need to be considered between DSRC and C-V2X to enable nearby operation? For example, do C-V2X operations in the upper 30 megahertz need to initiate any mitigation measures to accommodate DSRC operations that continue in the lower 45 megahertz during the one-year transition period? What accommodations can be made to protect roadside unit sites operated pursuant to the four incumbent nationwide ITS authorizations? Commenters should consider how best to balance C-V2X band entry and co-existence with DSRC during the transition period, in light of the technical rules we are proposing herein and recommend if there are any interim measures that may be needed to ensure short-term compatibility prior to exclusive C-V2X use. We also seek information informed by current C-V2X tests being conducted under experimental licenses as to how best to enable a smooth transition from DSRC to C-V2X.

153. *Bandwidth.* We propose light touch changes to minimize disruption and simplify the transition from DSRC-based technology to C-V2X-based technology. The existing ITS band plan contains three, 10-megahertz channels that will comprise the new ITS band: channels 180, 182, and 184 corresponding to 5.895-5.905, 5.905-5.915 and 5.915-5.925 GHz, respectively. We seek comment on whether this band plan, specifying three 10-megahertz channels, should continue for C-V2X. We also seek comment on whether the band plan should continue to accommodate combining two channels to provide a single 20-megahertz channel. Currently, channels 180 and 182 can be combined into channel 181 (5.895-5.915 GHz).[412] Should such channel combining be permitted under the modified ITS band plan? Alternatively, should channels 182 and 184 be permitted to combine into a single 20-megahertz channel spanning 5.905-5.925 GHz? Should the Commission permit maximum flexibility by allowing each of these potential channel combinations to be used as necessary to accommodate various ITS applications and services? What about allowing all three channels to be combined and used as a single 30-megahertz channel? What are the consequences for any of these channel bandwidth choices on the deployment and adoption of C-V2X? How would a completely flexible band plan versus a prescriptive band plan affect the ability of C-V2X to maximize efficient use of the band? We seek comment on each of these possibilities and how best to strike the right balance to ensure efficient and effective band use can be maximized. Further, commenters should provide sufficient detail regarding their preferred band plan and how that may work with C-V2X and all other operational and technical rules that are addressed herein, such as power limits, out-of-band emission limits, and channel use designations.

154. *The control channel and the public safety priority channel.* Currently the rules designate channel 178 (5.885-5.895 GHz) as the control channel and channel 184 (5.915-5.925 GHz) as a public

[412] 47 CFR §§ 90.377(b), 95.3163.

safety channel.[413] We seek comment on whether there is a compelling reason to have specific use designations on any or all of the channels used by C-V2X. Would designating any of the channels for a specific purpose, e.g., a control channel, help maximize band use efficiency? Does C-V2X need access to a control channel in a similar fashion as DSRC? If so, what is the best alternative for accommodating a control channel for C-V2X? Commenters should provide specific reasoning to support their preference. How would any channel designation work with the potential flexibility to combine any two or all three channels?

155. Commenters in favor of any channel designations should include detail regarding which designations they prefer we retain, which channel(s) those designations should pertain to, why they make those particular choices and how those choices will maximize use of the band and promote safety-related vehicular services. Alternatively, we could leave the issue of how best to use any of the channels to the standards-setting process and permit the industry to agree on use standards, but not designate those in our rules. We seek comment on the advantages and disadvantages of deferring to industry standardization processes in lieu of adopting prescriptive rules. Commenters in favor of using the standards process should also comment on expected timeframes for such bodies to produce relevant standards and how those timeframes complement the transition timeframe we propose in this Further Notice.

156. Relatedly, the existing ITS rules lay out a hierarchical priority system for messages.[414] Communications involving the safety of life have access priority over all other ITS communications. Communications involving public safety have the next priority level with a presumption that roadside units operated by state or local governmental entities are engaged in public safety priority communications. At the lowest tier of the hierarchy are non-priority communications, which are all other communications. We seek comment on whether to retain this message priority hierarchy for C-V2X deployment. Because the stated purpose of the ITS is to promote safety, our inclination is that this message prioritization system should be retained as it helps to ensure that the most important messages are successfully transmitted. This may become even more important as ITS operations must adjust to delivering service in less spectrum than under the current band plan. We seek comment on this position. Would such a system work with C-V2X? If we retain the channel designations, do they need to be modified for C-V2X? More broadly, are the existing channel designations and operating protocols still technically relevant under the new band plan? Further, commenters should address whether this priority system should be modified in any way. Should there be more granularity in the priority tiers? If so, then how should such messages be designated? Should they continue to be associated with specific types of licensees or should the message type be the determining factor? Should we continue to maintain a priority system based on our expectation that dedicated ITS spectrum will be used primarily (if not exclusively) for safety-of-life applications?

157. *Power and antenna height.* The 5.9 GHz band ITS spectrum is shared and licensed on a non-exclusive geographic area basis based on geo-political boundaries.[415] To maximize the use within this shared spectrum, the rules require that each registered roadside unit designate its intended area of operation or "communication zone" and that such communication zones be the smallest necessary.[416] The rules provide for four communication zones designated "A" through "D" for coverage areas ranging from 15 meters to 1000 meters. Correspondingly, each zone is associated with a maximum permitted output power ranging from 0 dBm to 28.8 dBm. While this rule specifies output power, which is power supplied to the antenna,[417] another rule specifies the maximum radiated power permitted on each channel ranging generally from 23 dBm to 33 dBm, but permitting state and local government entities to radiate at higher

[413] 47 CFR §§ 90.377(b), 95.3163.

[414] 47 CFR §§ 90.377(d), (e).

[415] 47 CFR § 90.375(a).

[416] 47 CFR § 90.375(c).

[417] 47 CFR § 90.7.

levels on the control channel (channel 178) at up to 44.8 dBm and on the public safety priority channel (channel 184) at up to 40 dBm.[418] The Commission's rules also limit roadside unit antenna height as another way of ensuring these units do not transmit beyond their designated zone. Roadside unit antenna height is limited to 8 meters at full power and may be as high as 15 meters with a corresponding power reduction.[419] Notably, these rules working together require licensees in many cases to use directional antennas to attain the highest radiated power levels, which also serves to focus the energy to only the desired coverage areas.

158. We seek comment on what the appropriate power levels under the modified ITS band plan should be. As an initial matter, to maximize spectrum use among all users, we propose to retain the "communication zone" designations currently in the rules and require roadside units to specify their intended zone. We believe this will continue to ensure that stations only cover their intended area and provide opportunities for other licensees to install roadside units for other nearby areas without mutually interfering. We seek comment on this proposal and what effect, if any, it will have on C-V2X. 5GAA in a recent filing modified its initial position and now requests that the Commission delete the "communication zone" rules.[420] Thus, we ask commenters to address whether the current communication zone distance limits should be retained or are there reasons to modify or eliminate them? Should they provide for more extended coverage areas? Or smaller areas? Or are they effective without change? Commenters advocating changes to the communication zones should provide specific information on what limits they favor and why and what effect those changes will have on the ability for C-V2X to deploy new systems and continue operating into the future.

159. We also seek comment on the appropriate output and radiated power levels that should be associated with each communication zone, channel, and user. The Commission, based on 5GAA's waiver petition, proposed in the *5.9 GHz NPRM* power limits based on the most recent 3GPP standard (which at the time was Release 14).[421] Specifically, the Commission proposed that C-V2X devices limit output power to no more than 20 dBm and limit EIRP to no more than 33 dBm.[422] We are not aware of any changes to the power requirements in subsequent iterations of the 3GPP standard and thus, propose that C-V2X roadside units comply with that limit. Should the rules continue to permit higher radiated power for state and local governmental entities? Or should the rules be consistent among all users as a way of maximizing spectrum use and controlling potential interference between users? Should we limit radiated power to 23 dBm as specified for some channels, 33 dBm as specified for others or some other value, such as permitting higher power on a control channel? Likewise, should we continue to specify both output power and radiated power levels for communication zone / channel combinations? Or would it be more appropriate to specify only a radiated power limit, as requested by 5GAA in its comments?[423] Based on how parties envision future use of the ITS band, are there advantages to continuing to specify both limits and requiring certain installations to use directional antennas to reach maximum power?

160. An alternative would be to specify power as a power density to normalize power for wider bandwidth channels, if we continue to permit such operations. We seek comment on whether that would serve C-V2X better than the current method, which associates a lower power density with wider bandwidth channels. We also seek comment on whether the current antenna height limitations are justified. Are there reasons to permit higher antenna heights? Should we continue to require that licensees reduce their power for higher antenna heights as a way of controlling coverage area and

[418] 47 CFR § 90.377(b).

[419] 47 CFR § 90.377(b) n.1.

[420] 5GAA Comments, Appx. A, at A-7.

[421] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 38; *see also* 5GAA Petition for Waiver at 16 and 3GPP, Release 14, http://www.3gpp.org/release-14.

[422] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 38.

[423] 5GAA Comments at 27.

reducing the potential for interference? Further, we seek comment on whether we should specify measurement standards for equipment approval and compliance purposes. For example, should the Commission specify that these values should be measured as root mean square (i.e., average) or peak values? And should the Commission specify the resolution bandwidth settings for compliance measurements in the rules?[424] Commenters should address these questions in conjunction with their comments regarding retention or modifications of the existing communication zones and provide technical information regarding their preference for rules and how they would work to ensure maximum access to the band.

161. Finally, we seek comment on whether we should modify the power rules for C-V2X on-board units. The current rules specify a 1 mW output power maximum for portable on-board units.[425] As with roadside units, the Commission proposed in the *5.9 GHz NPRM* limits compatible with the 3GPP Release 14 standard for C-V2X vehicular and portable (i.e. on-board) units, which would limit output power to no more than 20 dBm and EIRP to no more than 23 dBm.[426] We believe these power levels continue to be appropriate for C-V2X vehicular and portable devices and propose those levels here. 5GAA, however, recently requested that the Commission eliminate the output power requirement and increase the OBU EIRP limit to 33 dBm.[427] Should we adopt this higher power level instead? What effect would such an increase have on the ability of C-V2X roadside units to co-exist with and protect federal radiolocation stations?[428] In commenting on these power levels, commenters should keep in mind the need to simultaneously ensure that such portable on-board units comply with the Commission's RF radiation exposure limits.[429]

162. We also seek comment on how we should handle the standards issue with respect to C-V2X. The *5.9 GHz NPRM* sought comment on incorporating 3GPP Release 14 by reference[430] in the Commission's rules. We did not receive significant comment on this issue. Subsequent to the NPRM, in July 2020, 3GPP announced the completion of Release 16,[431] which further enhanced the 5G network capabilities, including C-V2X that were addressed in Release 15. In light of the evolution of the C-V2X standard to a 5G network technology, we seek comment on whether our rules should incorporate the 3GPP standard by reference. Commenters in favor of incorporation by reference should also provide details regarding which version should be incorporated – Release 14 which is based on LTE technology or Release 16 which incorporates 5G technology. Commenters who advocate for Release 16 should address how vehicular safety applications will be delivered to all users given that 5G is not backwards compatible with LTE. One alternative could be to incorporate Release 14 now with a planned transition to Release 16 (or the current version) at some date certain in the future. We seek comment on such an option. Alternatively, is there a compelling argument for not incorporating any C-V2X standard into the rules? We seek comment on each of these options. Commenters should address how the option they favor would promote safety services among all users. Finally, we seek comment on whether we should only incorporate by reference specific aspects of either the 3GPP Release 14 or Release 16 standard? If

[424] The Commission asked similar questions regarding measurement standards in the 5.9 GHz NPRM but received little comment. *See 5.9 GHz NPRM*. 34 FCC Rcd at 12618-19, paras. 39-41.

[425] 47 CFR § 95.3167.

[426] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 38.

[427] 5GAA Comments at 27.

[428] *See* "Compatibility of Federal Systems Operating in the 5850-5925 MHz Band with Intelligent Transportation Systems and Unlicensed National Information Infrastructure Devices." National Telecommunications and Information Administration, Section ITS Deployment and Technical Parameters at 11.

[429] 47 CFR § 1.1310.

[430] 47 CFR § 1.1310.

[431] 3GPP Release 16, 3rd Generation Partnership Project Technical Specification Group Services and System Aspects (2020). https://www.3gpp.org/release-16.

so, which sections? Or if the Commission does not incorporate by reference any 3GPP standard, are there portions of the standard that need to be placed in our rules?[432]

163. *C-V2X out-of-band emission limits.* Because the existing rules for DSRC do not specify out-of-band emission limits necessary to protect adjacent band services from harmful interference, the Commission sought comment in the *5.9 GHz NPRM* on appropriate out-of-band emission limits for C-V2X devices.[433] Regardless of whether we incorporate the 3GPP standard or not, we continue to believe it is good practice to adopt specific out-of-band emission limits into our rules. Doing so would provide equipment manufacturers with clear guidelines for equipment approval compliance. Furthermore, it would provide adjacent-channel licensees and equipment manufacturers with clear guidelines regarding the expected spectrum environment so they can incorporate appropriate filters and mitigation measures into their products to protect from harmful interference from adjacent channel emissions. Because our previous proposals were consistent with the current 3GPP standard, we propose the same out-of-band emission limits for C-V2X here as we did in the *5.9 GHz NPRM*. Specifically, we propose that all C-V2X equipment limit out-of-band emission limits measured at the antenna input (i.e., conducted limits) to

- -29 dBm/100 kHz at the band edge;
- -35 dBm/100 kHz ± 1 megahertz from the band edge;
- -43 dBm/100 kHz ± 10 megahertz from the band edge; and
- -53 dBm ± 20 megahertz from the band edge.

We also propose to limit out-of-band radiated emissions to -25 dBm/100 kHz EIRP or less outside the band edges of 5.895 GHz and 5.925 GHz.[434]

164. We seek comment on these out-of-band emission limits and whether they continue to be appropriate for C-V2X equipment. In this connection, we note that 5GAA recently requested that we adopt more relaxed OOBE requirements.[435] It specifically requests that RSUs limit out-of-band emissions to:

- -16 dBm/100 kHz ± 1 megahertz of the band edge;
- -13 dBm/MHz ± 5 megahertz of the band edge;
- -16 dBm/MHz ± 30 megahertz of the band edge; and
- -28 dBm/MHz beyond 30 megahertz from the band edges.

Should we adopt these alternative OOBE limits instead? What would the effect of these relaxed limits be on the ability to design and manufacture C-V2X equipment? How would they affect equipment cost? Will these limits ensure compatibility with adjacent U-NII devices in both the U-NII-4 and U-NII-5 bands, which are below and above the modified ITS band, respectively? What effect would these limits have on adjacent band fixed services in the 6 GHz band? We also seek comment on the measurement standards that should be associated with equipment approval compliance for verifying that C-V2X equipment meets whatever OOBE limits we adopt.

3. Other Transition Considerations

165. In *5.9 GHz NPRM*, we requested comment generally on the various transition-related

[432] Given our adoption of C-V2X as the sole technology permitted in the 5.9 GHz ITS band after the transition, Continental has raised concerns about the resolution of potential licensing disputes regarding that technology. *See, e.g.,* Continental Nov. 7, 2020 *Ex Parte*. We also request comment on this issue.

[433] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 38.

[434] These out-of-band emission limits are consistent with those requested by 5GAA. *See* Letter from Sean T. Conway, Counsel to 5GAA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-357. at Appx. C (Apr. 3, 2019).

[435] 5GAA Comments, Appx. A, at A-9.

considerations that we should take into account if we adopted our proposal to provide only 30 megahertz for ITS. For example, we asked about any re-channelization of DSRC-based operations in the upper 30 megahertz or the migration of ITS to C-V2X-based technology in the spectrum that remains reserved for ITS.[436] To inform our consideration of issues relating to transitioning of ITS operations, we asked that commenters provide up-to-date information on actual DSRC operations under existing licenses (including the number of roadside units and on-board units) and the various uses that have been implemented.[437] The Commission received several comments that involved some estimation of the potential cost considerations associated with these transition issues.[438]

166. We take this opportunity to update the record on our inquiry in the *5.9 GHz band NPRM* regarding transition cost considerations in light of the 5.9 GHz band plan that we have adopted in the First Report and Order. We recognize that, in light of our decision, commenters will be in a much better position to evaluate the necessary transitions of their respective systems We note that many of the DSRC projects appeared to be associated with demonstration projects designed to address particular traffic and safety concerns,[439] and we seek any updates about DSRC demonstration projects or deployment, as well as any C-V2X demonstration or pilot projects, including any funding grants that have been provided or are anticipated.[440] To what extent can existing funding at the federal or state or local level readily be used with regard to the necessary transition costs, including use of C-V2X-based technology?

167. While we did not propose in the *5.9 GHz NPRM* to provide compensation for such relocation, we nonetheless seek further comment, including suggestions on which particular types of costs should be considered as appropriate for possible compensation (including how such costs would be documented) as well as the process by which such compensation might be determined or implemented. Finally, we request comment on any other actions the Commission should consider that would be helpful to ITS licensees with respect to these transition matters.

168. We seek comment on whether we should limit use of the 5.895-5.925 GHz band to non-commercial services or safety-of-life applications. Open Technology Institute at New America and Public Knowledge previously filed a petition for rulemaking asking the Commission to prohibit commercial operations in ITS spectrum.[441] Should we modify our rules to prohibit commercial operations in this spectrum or otherwise limit services to safety-of-life applications? How would the Commission define "safety-of-life" applications? How would the Commission delineate between safety-of-life and non-safety-of-life applications? In such instances, would the Commission need to specifically list permitted applications in its rules or would a general prohibition suffice? Or, could such a prohibition on commercial operations be accomplished by limiting license eligibility to only certain licensees, such as governmental entities or entities eligible for licensing in the Private Land Mobile Radio Service Public Safety Pool under part 90?[442] At what point would a use or licensing restriction so alter the current authorizations so as to constitute a fundamental license change that would exceed the Commission's

[436] *5.9 GHz NPRM*, 34 FCC Rcd at 12618, para. 36.

[437] *5.9 GHz NPRM*, 34 FCC Rcd at 12616-17, para. 32.

[438] *See, e.g.*, U.S. DOT Reply at 35-39; MnDOT Comments at 5; GDOT Comments at 1-2, 9-13; Texas DOT Comments at 2; Pennsylvania DOT Comments at 4; Connecticut DOT Comments at 3.

[439] *5.9 GHz NPRM*, 34 FCC Rcd at 12611, para. 18.

[440] As the U.S. DOT has indicated, ITS operations to date have received substantial research and deployment investments, including federal, state, and local investment, over the years, and we seek comment on the availability of that or similar funding for transitioning associated with the new band plan for ITS.

[441] Petition for Rulemaking and Request for Emergency Stay of Operation of Dedicated Short-Range Communications Service in the 5.850-5.925 GHz Band (5.9 GHz Band), RM-11771 (filed June 28, 2016).

[442] *See* 47 CFR 90.20(a) which specifies eligibility for a part 90 public safety pool license and includes governmental entities as well as entities engaged in life support services, medical services, fire protection, forestry-conservation, etc.

authority to effectuate under section 316 of the Communications Act, as amended? We seek comment on the challenges and benefits associated with adopting restrictions on the types of ITS services that may operate in the 5.895-5.925 GHz band.

B. More Flexible Use of Unlicensed Service

169. The First Report and Order takes an initial step at providing unlicensed U-NII device access to the 5.850-5.895 GHz band. Our decision to generally restrict U-NII devices to indoor locations[443] until ITS operations transition to the 5.895-5.925 GHz band provides flexibility for unlicensed devices to begin using the 5.850-5.895 GHz band, but in a way that avoids the potential for harmful interference to vehicular safety-related applications. Once ITS operations have finished transitioning to the upper 30 megahertz, however, we can permit outdoor operations at full power, subject to such outdoor use protecting from harmful interference both co-channel federal radiolocation operations (which will remain in the band) and adjacent-band ITS operations.

1. Federal Radiolocation System Protection from Outdoor Unlicensed Operations

170. In the *5.9 GHz NPRM*, we sought comment on whether there are any mitigation measures, such as technical or operational conditions or constraints that the Commission should consider for U-NII-4 operations to protect federal radars in the 5.9 GHz band.[444] Comcast submitted that the Commission should adopt its proposal to implement the same technical rules as U-NII-3 with respect to U-NII-4 devices and federal DoD radar operations.[445] WISPA agreed with the Commission's suggestion that no other mitigation measures are required to protect DoD radar operations in the 5.9 GHz band from U-NII-4 devices.[446] NCTA stated that the Commission should adopt its proposal to authorize U-NII-4 devices without requiring any special frequency avoidance techniques or similar constraints since 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.[447]

171. NTIA reviewed the federal radar operations authorized in the 5.9 GHz band and determined that the number of radar sites needing protection could be reduced to from 59 to 30 sites. NTIA's analysis concludes that exclusion zones are needed to protect federal radiolocation systems only from U-NII-4 *outdoor* point-to-point (P2P) and point-to-multipoint (P2MP) devices. The exclusion zones recommended by NTIA are set forth in Table 2 of its Sept. 8, 2020 letter. To enforce the exclusion zones, NTIA recommends that interference mitigation techniques such as geo-fencing be employed to protect federal radiolocation operations. NTIA emphasizes that it is important that outdoor U-NII devices are not permitted to operate inside of these exclusion zones to ensure that federal radiolocation systems are protected from harmful interference.[448] NTIA also requests that the new rules make clear that it may authorize additional exclusion zones or modify the existing exclusion zones listed in Table 2 as necessary

[443] The First Report and Order allows outdoor U-NII device operation under certain conditions and with Commission-authorized special temporary authority.

[444] 47 U.S.C. § 902(b)(2)(A).

[445] Comcast Comments at 10, n.28.

[446] WISPA Comments at 7.

[447] NCTA Comments at 46.

[448] *See* National Telecommunication and Information Administration Technical Report TR 20-544 *Lessons Learned from the Development and Deployment of 5 GHz Unlicensed National Information Infrastructure (U-NII) Dynamic Frequency Selection (DFS) Devices*, https://www.ntia.doc.gov/report/2019/lessons-learned-development-and-deployment-5-ghz-unlicensed-national-information. Section 8 describes interference to a federal radar from a U-NII device.

to ensure federal radiolocation stations are protected.[449]

172. We agree that some mitigation measures are needed to ensure that outdoor U-NII point-to-point and point-to-multipoint operations do not cause harmful interference to federal radiolocation systems. We seek comment on whether exclusion zones would be the best method for ensuring such protection. We note that some commenters express disagreement with the technical analysis provided by NTIA,[450] including questioning whether NTIA's interference analysis is consistent with the assumptions in the *6 GHz Report and Order*.[451] We seek comment on NTIA's technical analysis, as well as comment on any alternate methods for determining the parameters of exclusion zones. Commenters advocating opinions that differ from NTIA's analysis should provide specific technical detail and analysis regarding how unlicensed devices would provide the required protection to federal radars. Alternatively, are other protection mechanisms, such as coordination, feasible methods of protecting federal operations in certain areas? Commenters favoring coordination or other methods should describe how such methods can be implemented and maintained such that federal radar operators have assurances that their installations are and continue to be protected from harmful interference in the future as more unlicensed devices may be installed or existing devices may be relocated.

173. Compliance with an exclusion zone implies some degree of location awareness, either within a device or by an installer. In crafting rules for outdoor use, we seek to protect important DoD radars from harmful interference, provide flexibility to U-NII system operators, minimize equipment complexity and capitalize on the greatest degree of harmonization with U-NII-3 devices as possible. We seek comment on how best to adopt rules that satisfy each of these goals to the greatest extent possible.

174. The Commission has required other unlicensed devices to incorporate geographic awareness (i.e., a geolocation capability) and use a database to avoid areas where the potential for causing harmful interference would exist. For example, white space devices are required to incorporate a geolocation capability and check a white space database for a list of available channels before they can operate[452] and 6 GHz standard power U-NII devices are similarly required to incorporate a geolocation capability and consult an automated frequency coordination database prior to operating to avoid causing harmful interference to fixed service incumbents.[453] Should the Commission require a similar system here? The advantage of using geolocation and a database is that such systems have already been successfully deployed and we believe protecting only 30 federal radiolocation sites would be a relatively simple undertaking under this regime. But incorporating geolocation capability does increase the complexity of a device and add overhead (both hardware and software) necessary for such a system to work. In addition, requiring U-NII-4 devices to operate in this manner would entail many differences from U-NII-3 device operation and could limit their usefulness in providing the ability to use a 160-megahertz wide channel that spans the U-NII-3 and U-NII-4 bands. On the other hand, we expect many devices to operate throughout all the U-NII bands including the 6 GHz U-NII-5 and U-NII-7 bands[454] which would already require this capability. In this case, how difficult would it be to similarly add the geolocation and database capability to U-NII-4 devices? Would there be any incremental cost for incorporating such a requirement? How would such a requirement affect the utility of U-NII-4 devices and their ability to work seamlessly with U-NII-3 devices to deliver applications over a 160-megahertz channel? If we were to adopt such a requirement, we anticipate the rules being consistent with the 6 GHz

[449] *See* NTIA Sept. 8, 2020 Letter at 3-4.

[450] *See NTIA Technical Report 21-551* at 26-27.

[451] *See* Facebook Nov. 6, 2020 *Ex Parte* at 2-3.

[452] 47 CFR § 15.711.

[453] 47 CFR § 15.407(k).

[454] For example, we expect that new devices would have capability to operate across multiple bands including the 5.150-5.250 U-NII-1 band, the 5.725-5.850 U-NII-3 band, the 5.850-5.895 GHz U-NII-4 band, the 5.925-6.425 U-NII-5 band and the 6.525-6.875 U-NII-7 band.

automatic frequency coordination rules, except that the exclusion zones are already known and do not need to be calculated by the automated frequency coordination system. We seek comment on using the 6 GHz framework for outdoor U-NII-4 devices.

175. Because the U-NII-4 band exclusion zones are known in advance, are there simpler methods for ensuring that outdoor U-NII-4 devices respect the need to avoid operating near the federal radiolocation systems? For example, could we simply rely on professional installation to ensure that outdoor U-NII-4 devices do not operate in those areas? Under a professional installation regime, what rules and requirements would the Commission need to put in place to ensure that U-NII-4 devices do not operate in any of the exclusion zones? Similarly, because these exclusion zones are known, could devices simply have a geolocation capability and either be preloaded with the exclusion zone coordinates and/or download those coordinates once or on a periodic basis, such as every time the device is turned on or at some set interval (e.g., once a week or once a month)? We seek comment on whether this is a viable alternative to the other suggested methods. Commenters in favor of such a mitigation method should provide detailed comment regarding how the internal device database would work, the necessary update frequency, and the costs involved in developing equipment. We also seek comment on other alternatives that achieve the same goal; that is, methods that achieve the required protection and are easy and cost effective to implement and maximize utility of the U-NII-4 band.

2. Outdoor Unlicensed Operations Transmitted Power and Emission Limits

176. *Transmitter Power*. In the *5.9 GHz NPRM*, the Commission proposed that U-NII-4 devices be permitted to operate at the same power levels (e.g., radiated power, power spectral density) as U-NII-3 devices and sought comment on whether it should adopt different power levels.[455]

177. The Wi-Fi Alliance agrees that the Commission should adopt its proposal to apply the same power levels (radiated power, PSD) to U-NII-4 devices as apply to U-NII-3 devices because their efficacy has been proven by years of application in practice. Wi-Fi Alliance contends that to recognize the full benefit of the U-NII-4 spectrum, including expanded operations of existing U-NII devices, the technical rules governing the band must be aligned with the rules covering the U-NII-3 band; permitting U-NII-4 devices to operate at the same power levels as U-NII-4 devices will maximize the utility of both bands. It states that if a different power level is adopted for the U-NII-4 band, U-NII devices would not be able to operate across both the U-NII-3 and U-NII-4 bands, eliminating the potential use of wider channels, equipment commonality, reduced cost and complexity, superior performance, and other benefits that may be realized by the Commission's proposal.[456] WISPA states the Commission's proposal to allow U-NII-4 devices to operate at the same power level as U-NII-3 devices is a sensible and efficient approach and consistent with WISPA's recommendations in ET Docket No. 13-49 in that it would permit higher-EIRP fixed wireless operations that will enable use of the 5.9 GHz band for rural broadband deployment, including both outdoor point-to-point operations and point-to-multipoint operations.[457] Comcast asserts that harmonizing the U-NII-4 technical rules with those of the U-NII-3 band, particularly the Commission's proposal to allow U-NII-4 devices to operate at the same power levels as U-NII-3 devices, would substantially improve its ability to bring the band into use for consumers quickly and to

[455] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12622-23, para. 53. The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. 47 CFR § 15.407(a)(3).

[456] Wi-Fi Alliance Comments at 2-3, 5-6.

[457] WISPA Comments at 6. *See also* Letter from Claude Aiken, President and CEO, WISPA, to Marlen H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 1 (dated Oct. 26, 2018).

put it to its best use.[458] NCTA states that applying the U-NII-3 power limits to U-NII-4 will enable network operators and device manufacturers to build on the success of U-NII-3.[459] Microsoft states that extending the U-NII-3 technical rules to the U-NII-4 band, except for the existing OOBE limits, will enable the public to realize the maximum benefits from the U-NII-4 band, including accelerating the timeline for initial deployments using this 45 megahertz of spectrum; establishing the same power levels in the U-NII-4 band as the U-NII-3 band is essential for deployment of larger channels.[460]

178. On the other hand, 5GAA and Qualcomm separately recommend that the Commission impose a power spectral density limit to protect C-V2X receivers from portable client devices that may be operating temporarily outdoors with relaxed OOBE limits but connected to an indoor access point in the U-NII-4 band, but did not recommend any specific limit.[461] Car 2 Car and US Technical Advisory Group separately urge the Commission to revisit its proposals for maximum transmit power from U-NII-4 devices to avoid harmful interference to ITS operations, but did not recommend any specific level for the maximum transmit power.[462] The Alliance for Automotive Innovation expresses concern that the National Highway Transportation Safety Administration's (NHTSA's) testing, which showed varying levels of harmful interference, underestimates the potential for harmful interference from unlicensed operations, since the NHTSA's tests were conducted with a 36 dBm EIRP, but fixed point-to-point U-NII devices could operate at power levels of 62 dBm EIRP using 5G antennas that have 32 dBi of gain.[463] Qualcomm also expresses concern that outdoor point-to-point unlicensed operations with high EIRP signals in the U-NII-4 band could have serious performance impacts to installed RSUs and create C-V2X dead zones when vehicles pass nearby, regardless of the OOBE level.[464] Intelligent Transportation Society of America (ITSA) also expresses concern that outdoor unlicensed point-to-point U-NII-4 band operations from a tower or rooftop alongside a roadway could cause harmful interference to ITS receivers.[465]

179. For outdoor operation of U-NII-4 access point device after ITS operations move out of the U-NII-4 band, we propose a radiated power of 23 dBm/MHz or 36 dBm radiated power for all bandwidths. When combined with U-NII-3-band spectrum, outdoor access point EIRP can scale to 36 dBm for 40, 80, and 160 megahertz channels. We agree with the Wi-Fi Alliance that permitting U-NII-4 devices to operate at the same power levels as U-NII-3 devices is essential to achieving the full benefits of the U-NII-4 band and maximizing the utility of both bands while protecting incumbent operations in the U-NII-4 band from harmful interference. Allowing outdoor U-NII-4 devices to operate at the full power level permitted for U-NII-3 devices will enable the use of wider channels, promote equipment commonality, reduce costs and complexity, and facilitate broadband deployments in rural areas, including both outdoor point-to-point operations and point-to-multipoint operations. However, to avoid the need for much larger unlicensed exclusion zones where unlicensed operations would be prohibited in order to protect federal radar operations from harmful interference, we propose not to adopt the U-NII-3 point-to-point power limits in the U-NII-4 rules. We also propose that client devices be permitted to operate in the 5.850-5.895 GHz band at power levels that are 6 dB lower than those permitted for outdoor access point devices. We seek comment on these proposals.

180. *OOBE Limits*. In the *5.9 GHz NPRM*, the Commission proposed that U-NII-4 devices, or

[458] Comcast Comments at 10.

[459] NCTA Comments at 45-46.

[460] Microsoft Comments at 4, 7.

[461] 5GAA Comments at 44, n.129; Qualcomm Comments at 23.

[462] Car 2 Car Comments at 18; US Technical Advisory Group Comments at 11.

[463] AAI Comments at 26, n.27.

[464] Qualcomm Comments at 19-20.

[465] ITS America Reply at 23, n.59.

devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, meet the same OOBE limits as U-NII-3 devices at the upper and lower edges of those bands with no limit at the U-NII-3/U-NII-4 band edge.[466] Proponents of ITS suggest that U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, meet OOBE limits that are much more restrictive than the existing U-NII-3 OOBE limits to protect adjacent-band ITS operations. Under GM's suggestion (-27 dBm/MHz at or above 5.905 GHz), U-NII-4 devices' OOBE would need to be 15 dB lower than the OOBE limit (-12 dBm/MHz) for a U-NII-3 device at the same frequency; under the suggestion from Car 2 Car, IEEE 1609 Working Group, US Technical Advisory Group, and Volkswagen (-40 dBm/MHz at 10 megahertz above the band edge), U-NII-4 devices' OOBE would need to be approximately 28 dB lower than the OOBE limit (-12 dBm/MHz) for a U-NII-3 device at the same frequency.[467]

181. Proponents of unlicensed operations suggest more relaxed OOBE limits for outdoor unlicensed operations in the U-NII-4 band than proposed in the *5.9 GHz NPRM*.[468] WISPA submits that outdoor U-NII-4 operations' OOBE be limited to -5 dBm/MHz at or above 5.895 GHz.[469] Broadcom, CableLabs, Facebook, and NCTA together suggest that OOBE for outdoor U-NII-4 operations be limited to 7 dBm/MHz at 5.895 GHz, decreasing linearly to -9 dBm/MHz at 5.925 GHz, measured using the root mean square (RMS) method (agreed to by 5GAA for the top of the 5.9 GHz band), to address concerns raised by ITS stakeholders.[470] They claim that -9 dBm at 5.925 GHz will provide more than adequate protection for adjacent ITS operations and is consistent with the roll-off of the IEEE 802.11ac and 802.11ax emission masks. They also assert that this limit would allow 5.9 GHz-capable Wi-Fi devices to deliver sufficient power and throughput to consumers to enable the wide range of use cases—including enhanced in-home Wi-Fi speeds and coverage to support remote learning, telemedicine, and other high-bandwidth applications, as well as more accessible large-scale connectivity to support smart city and agricultural applications in communities across the country—that make the 5.9 GHz band a unique opportunity; too restrictive an OOBE limit would make these kinds of use cases impossible.[471]

182. The Wi-Fi Alliance recommends a more nuanced approach based on a the -27 dBm/MHz limit at or above 5.925 GHz that the Commission has effectively applied to U-NII-3 transmissions to protect ITS operations. Specifically, for outdoor U-NII-4 band devices, Wi-Fi Alliance proposes OOBE limits that mirror the existing limits for U-NII-3 devices at and above 5.895 GHz (i.e., -5 dBm/MHz at 5.895 GHz, decreasing linearly to -27 dBm/MHz at 5.925 GHz).[472] The Wi-Fi Alliance asserts that these U-NII-3 OOBE limits have proven to be effective in protecting ITS; there is no basis for imposing more stringent OOBE limits on operations in the U-NII-4 band since the Commission has already affirmed that the U-NII-3 OOBE limits afford sufficient protection to DSRC systems and C-V2X operations do not require greater protection than DSRC operations. The Wi-Fi Alliance argues that the Commission should reject arguments for more restrictive OOBE limits because imposing prohibitively burdensome and unnecessary band coexistence measures on U-NII-4 devices would preclude commercial viability of this

[466] *See 5.9 GHz NPRM*, 34 FCC Rcd at 12623, paras. 54-55.

[467] GM Comments at 11; Toyota Comments at 18; Car 2 Car Comments at 18; IEEE 1609 Working Group Comments at 15, US Technical Advisory Group Comments at 11; Volkswagen Comments at 9; and Ford Comments at 10.

[468] *See*, *e.g.*, Broadcom, Inc. and Facebook, Inc. Comments at 5-6; Dynamic Spectrum Alliance Comments at 4; Wi-Fi Alliance Comments at 6-7.

[469] WISPA Comments at 6.

[470] Letter from Chris Szymanski, Broadcom; Rob Alderfer, CableLabs; Alan Norman, Facebook; and Danielle Piñeres, NCTA, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 (filed July 31, 2020) (Compromise Proposal Letter) at 4.

[471] *Id*. at 1, 5.

[472] Wi-Fi Alliance Comments at 7-8; Reply at 7.

band and defeat the objective of making additional spectrum available for unlicensed operations.[473] The Wi-Fi Alliance also supports applying the existing U-NII-3 OOBE limits at the lower edge of the U-NII-3 band for outdoor U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, i.e., at 5.725 GHz, while not imposing any OOBE limit for U-NII-4 devices at the U-NII-3/U-NII-4 band edge (i.e., at 5.850 GHz).[474]

183. For outdoor U-NII-4 access point devices or outdoor access point devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, we propose the outdoor U-NII-4 OOBE limits recommended by the Wi-Fi Alliance of -5 dBm/MHz at 5.895 GHz, decreasing linearly to -27 dBm/MHz at 5.925 GHz, measured using an RMS measurement. We are not convinced that the more relaxed OOBE limits suggested by unlicensed proponents would adequately protect ITS operations from harmful interference since they are less restrictive than existing U-NII-3 OOBE limits. We are also not convinced that the more stringent OOBE limits suggested by ITS proponents are necessary to protect adjacent-band ITS operations since they are more restrictive than the existing U-NII-3 OOBE limits, which the Commission previously affirmed would protect DSRC operations and have already proven to be effective in protecting ITS operations from harmful interference.[475] We also propose to apply the existing U-NII-3 OOBE limits at the lower edge of the U-NII-3 band for outdoor U-NII-4 devices, or devices that operate across a single channel that spans the U-NII-3 and U-NII-4 bands, i.e., at 5.725 GHz, while not imposing any OOBE limits for U-NII-4 devices at the U-NII-3/U-NII-4 band edge, i.e., at 5.850 GHz. We believe that these limits will protect adjacent-band ITS operations from harmful interference due to unlicensed operations in the U-NII-4 band, support separate U-NII-3 and U-NII-4 bands to provide flexibility for designing U-NII-3 equipment under the less stringent OOBE rules at the upper edge of the band, and provide flexibility for devices to operate across the U-NII-3 and U-NII-4 bands using the widest channel bandwidths permitted under the IEEE 802.11 standard. We seek comment on these proposals.

184. *Protection of Fixed-Satellite Service Operations*. In the First Report and Order in this proceeding, we declined to adopt SES Americom's and Intelsat's suggestion to establish a maximum permissible aggregate power limit for U-NII-4 band unlicensed devices' operations that would be monitored and controlled by an Automatic Frequency Coordination (AFC) system to help protect FSS operations. However, as a precautionary measure to further protect FSS operations from harmful interference, we propose to require U-NII-4 band outdoor access points to limit the maximum EIRP above a 30 degree elevation angle to 21 dBm, which is similar to what the Commission already requires in the U-NII-1, U-NII-5, and U-NII-7 bands to protect FSS operations.[476] This skyward restriction should address SES Americom's and Intelsat's concerns about potential aggregate interference from U-NII-4 band unlicensed operations.[477] Since we do not expect outdoor access points to radiate significant power skyward, we do not believe this requirement will impose a burden on or affect the utility of outdoor access point users.

185. We do not find it necessary to propose to restrict the power radiated upward from U-NII-

[473] Wi-Fi Alliance Reply at 6-7. *See also Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, First Report and Order, 29 FCC Rcd 4127 (2014) (*U-NII 5 GHz Report and Order*) (adding 5.825-5.850 GHz to the 5.725-5.850 GHz (U-NII-3) band and deferring a decision on whether to allow unlicensed devices to use the 5.350-5.470 GHz (U-NII-2B) and 5.850-5.925 GHz (U-NII-4) bands), *recon. denied*, Memorandum Opinion and Order, 31 FCC Rcd 2317, 2324-25, para. 23 (2016).

[474] Wi-Fi Alliance Comments at 2-3.

[475] *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 2317, 2324, para. 23 (2016).

[476] 47 CFR §§ 15.401(a)(1), 15.407(a)(4). *See also Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852, 3886-87, para. 92 (2020).

[477] SES Americom and Intelsat Comments at 4, 8-9.

4 client devices as we propose to require for outdoor access points. We believe it is unlikely that relatively low-power unlicensed devices will cause harmful interference to receivers on geostationary satellites approximately 35,800 km above the equator and seek comment. We propose to limit upward power from outdoor U-NII-4 access points merely as a precautionary measure, as they are more likely to operate with higher power. While client devices can operate with an EIRP as high as 30 dBm (6 dB lower than access points' maximum allowed power), we find that they are less likely to cause interference to satellite receivers than similarly powered outdoor access points due to the nature of their operation. We expect them to generally operate at much lower power levels to maximize battery life and comply with radiofrequency (RF) exposure limits.[478] In addition, client devices communicate with access points in an asymmetric nature, in that relatively little data is transmitted in the uplink direction (i.e. from the client device) as compared to the downlink direction where any single access point may be serving many client devices. Moreover, client devices typically operate with omnidirectional antennas at low antenna heights and in a mobile or portable mode (i.e., not installed in permanent outdoor locations). Thus, we expect that upwardly directed client device emissions will often be at low power levels and shielded to some extent by buildings, foliage, or other obstructions. We seek comment on these proposals and conclusions.

3. Increased Transmit Power for Indoor U-NII-4 Access Points

186. In the First Report and Order, we adopt a 20 dBm/MHz limit for indoor U-NII-4 access points, largely to protect co-channel ITS incumbent operations. We propose that indoor U-NII-4 devices be permitted to increase power to 23 dBm/MHz or 36 dBm radiated power for all bandwidths upon the later of one year following the effective date of the First Report and Order (i.e., the date by when ITS operations must transition out of the 5.850-5.895 GHz band) or the effective date of a Second Report and Order adopting these proposed power increases. We seek comment on this proposal. We note that these proposed limits are consistent with NTIA's radiolocation protection analysis. In making this proposal, we do not propose to change any other aspect of indoor U-NII-4 devices; they would still be required to incorporate all the mitigation features we adopted in the First Report and Order, including the requirement to obtain power from a wired connection, a prohibition on weatherized enclosures and a requirement for an integrated antenna. Client devices would be limited to power levels 6 dB below the power limits for access points.

4. U-NII-4 Client to Client Communications

187. The rules adopted in the First Report and Order prohibit U-NII-4 client-to-client communications to protect co-channel incumbent ITS operations and federal radiolocation stations. But only the federal radiolocation stations will require protection after ITS operations transition out of the 5.850-5.895 GHz band. We seek comment on whether we can remove the client-to-client communications prohibition upon the later of one year following the effective date of the First Report and Order (i.e., the date by when ITS operations must transition out of the 5.850-5.895 GHz band) or the effective date of a Second Report and Order eliminating the prohibition. As an initial matter, we note that NTIA's analysis for protecting these 30 radiolocation sites concludes that C-V2X on-board units can operate throughout the U.S. with no limitation. That analysis assumed that such on-board units operate with power levels up to 17 dBm/20 MHz or 50 mW.[479] The equivalent power for wider channels is 20 dBm / 40 MHz (100 mW), 23 dBm/ 80 MHz (200 mW) and 26 dBm/160 MHz (400 mW). Our proposal for C-V2X on-board units would limit power to no more than 23 dBm EIRP. We therefore seek comment on whether we can allow U-NII-4 client-to-client device communications at that same 23 dBm EIRP power level. Such communications could enable innovative new virtual reality or augmented reality

[478] Although one filer submitted letters on RF radiation concerns, that issue is outside the scope of this proceeding. *See, e.g.*, Letter from Kevin Mottus, Outreach Director, California Brain Tumor Association (Aug. 20, 2020).

[479] *See* "Compatibility of Federal Systems Operating in the 5850-5925 MHz Band with Intelligent Systems and Unlicensed National Information Infrastructure Devices." National Telecommunications and Information Administration, ITS Deployment and Technical Parameters at 11.

applications in much the way similar applications have been envisioned under the Commission's proposals for ubiquitous operation of very low power devices in the 6 GHz U-NII bands.

188. Although U-NII-4 devices would not necessarily be in moving vehicles like C-V2X on-board units, would their operations still be functionally similar to such operations so as to allow the same power levels and still protect federal radiolocation operations? If concerns regarding potential harmful interference to federal operations persists, are there measures we could take to enable U-NII-4 client-to-client communications in areas outside the exclusion zones or with lower power within the exclusion zones? For example, because client devices are often smart phones with embedded geolocation technology, could an app or database connection or other mitigation method be used to control power or avoid certain areas where the potential for causing harmful interference is the greatest? We also note that 5GAA requests that we permit on-board units to transmit with as much at 33 dBm EIRP.[480] How would on-board units at higher power levels affect the ability to permit client-to-client communications? 5GAA also states that U-NII-4 client-to-client operations could reduce the effectiveness of adjacent band C-V2X safety services.[481] We seek comment on whether we can permit client-to-client communication and under what conditions. Commenters should provide technical and operations details as to how devices operating in a client to client mode would avoid causing harmful interference to co-channel federal radiolocation operations as well as to adjacent band C-V2X safety services.

C. Other Spectrum for ITS

189. As discussed in the First Report and Order, the record supports 30 megahertz of spectrum as sufficient to provide basic safety functions of ITS currently deployed and under consideration in the near future. Commenters have suggested, however, that additional spectrum may be needed either to support simultaneous deployment of 4G and 5G-NR C-V2X service or to support other advanced capabilities beyond the basic safety messages currently available.[482]

190. We seek comment on whether, notwithstanding our determination that current safety-of-life services can continue to operate using 30 megahertz of spectrum, we should consider allocating additional spectrum for ITS applications. For what purposes would additional spectrum be needed? We note that the record evidence indicates that several categories of transportation-related communications and other ITS applications are currently being met through spectrum outside of the 5.9 GHz band. For example, capabilities like blind spot detection, lane-keep assist, and features that do not operate in the 5.9 GHz band, which provide substantial automotive and vehicular safety functions.[483] Panasonic in its comments states that technologies like LiDAR, 76-81 GHz band radar, or other line-of-sight sensors can support advance driver assistance systems (e.g. automatic emergency braking or lane-keeping).[484] To the extent some ITS applications (or their functional equivalent) are currently being provided using alternative spectrum bands, commenters should explain with specificity why existing spectrum resources are inadequate and what specific safety benefits would result from making additional spectrum available for such services.

191. Panasonic suggests that harnessing the advantages of fully automated transportation requires cooperation between different vehicles with different levels of automation and the transportation infrastructure.[485] Similarly, the U.S. DOT stated that in-vehicle sensors are susceptible to "blind spots"

[480] 5GAA Mar. 9, 2020 *Ex Parte*.

[481] 5GAA Nov. 10, 2020 *Ex Parte*.

[482] *See, e.g.,* Letter from Sean T. Conway, Counsel to the 5G Automotive Association, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138 (filed Sept. 9, 2020).

[483] NCTA Reply at 2-4.

[484] Panasonic Comments at 14.

[485] Panasonic Comments at 14.

when they are operating outside of line-of-sight scenarios.[486] U.S. DOT claims that the combination of sensors and V2X, with access to dedicated spectrum, will best provide enhancements to driver safety and will support automated driving behavior in the future.[487]

192. We have already recognized that C-V2X is the preferred choice for deployment in the upper 30 megahertz portion of the band.[488] How, in particular, would additional spectrum be used to leverage this technology and aid in its deployment? Should we determine that additional spectrum is needed to provide advanced ITS applications, what spectrum band(s) should we consider? Open Technology Institute and Public Knowledge have mentioned the 3450-3550 MHz band.[489] Other commenters, like Dynamic Spectrum Alliance and NCTA, proposed allowing C-V2X to operate in the 4.9 GHz band.[490] Other commenters provided similar views.[491] In the intervening period since adoption of the *5.9 GHz NPRM*, however, the Commission has adopted rule changes for the 4.9 GHz band to allow for non-public safety operation and leasing arrangements and has proposed allocating the 3.45-3.55 GHz band for flexible-use service.[492] We also note that that commenters have mentioned a "clean sheet" approach when considering the best spectrum band in which to locate the proposed C-V2X operations.[493] Others mention allowing ITS to use flexible use licensed or unlicensed spectrum in the way other technologies do.[494] Commenters addressing this issue should provide specific information regarding spectrum bands that could support ITS operations, the types of applications or services they envision for that particular band and how C-V2X could coexist with existing spectrum users in that band(s). We also note that the commenters should consider the propagation characteristics of the spectrum they identify relative to the technology needs of ITS services (e.g. low latency, reliability, non-line of sight communications, processing capabilities, international trends, and relevant standards-setting factors). Are there other rule changes we could make to enable vehicular safety-related applications in other bands on a shared basis?

V. PROCEDURAL MATTERS

193. *Final Regulatory Flexibility Analysis*.—As required by the Regulatory Flexibility Act of 1980 (RFA),[495] as amended, the Commission has prepared a Final Regulatory Flexibility Analysis (FRFA) regarding the possible significant economic impact on small entities of the policies and rules

[486] U.S. DOT Reply at 16.

[487] U.S. DOT Reply at 9.

[488] Don Butler, Ford Executive Director for Connected Vehicle and Services, Why We're Working with Qualcomm to Ensure Everything in Cities Speaks the Same Language, Medium (Jan. 9, 2018), https://medium.com/cityoftomorrow/why-were-working-with-qualcomm-to-ensure-everything-in-cities-speaks-the-same-language-98e0cc1bff18 (accessed Sept. 28 2020); 5GAA Comments at 9-10.

[489] Michael Calabrese and Amir Nasr, Open Technology Institute at New America, "The 5.9 GHz Band: Removing the Roadblock to Gigabit Wi-Fi" at 36 (2020).

[490] Dynamic Spectrum Alliance Comments at 6; NCTA Comments at 2-3, 19.

[491] ITS America Comments at 11-12; NCTA Comments at 2-3, and 19; Open Technology Institute and Public Knowledge Comments at 4-5, 26-28; ; Michael Calabrese and Amir Nasr, Open Technology Institute at New America, "The 5.9 GHz Band: Removing the Roadblock to Gigabit Wi-Fi" at 28-35 (2020); Dynamic Spectrum Alliance Comments at 6.

[492] *Amendment of Part 90 of the Commission's Rules*, WP Docket No. 07-100, Sixth Report and Order and Seventh Notice of Proposed Rulemaking, FCC 20-137 (rel. Oct. 2, 2020); *Facilitating Shared Use in the 3100-3550 MHz Band*, WT Docket No. 19-348, Report and Order and Further Notice of Proposed Rulemaking, FCC 20-138 (rel. Oct. 2, 2020).

[493] Dynamic Spectrum Alliance Comments at 6.

[494] NCTA Comments at 3.

[495] *See* 5 U.S.C. § 603.

adopted in this First Report and Order, which is found in Appendix D. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of the First Report and Order, including the FRFA, to the Chief Counsel for Advocacy of the Small Business Administration.[496]

194. *Initial Regulatory Flexibility Analysis.*—As required by the RFA, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities of the proposals addressed in this Further Notice of Proposed Rulemaking. The IRFA is found in Appendix E. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines for comments on the Further Notice, and they should have a separate and distinct heading designating them as responses to the IRFA. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of this Further Notice, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration, in accordance with the RFA.[497]

195. *Paperwork Reduction Act*.—This document contains new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law No. 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under section 3507(d) of the PRA. OMB, the general public, and other Federal agencies will be invited to comment on the new or modified information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4), we previously sought comment on how we might "further reduce the information collection burden for small business concerns with fewer than 25 employees." We have described impacts that might affect small businesses, which includes most businesses with fewer than 25 employees, in the Final Regulatory Flexibility Analysis (FRFA), attached as Appendix D.

196. *Congressional Review Act*. — The Commission has determined, and the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget concurs, that this rule is "major" under the Congressional Review Act, 5 U.S.C. § 804(2). The Commission will send a copy of this First Report and Order to Congress and the Government Accountability Office pursuant to 5 U.S.C. § 801(a)(1)(A).

197. *Ex Parte Rules – Permit but Disclose.* Pursuant to section 1.1200(a) of the Commission's rules,[498] this Further Notice of Proposed Rulemaking shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.[499] Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing

[496] *See* 5 U.S.C. § 603(a). In addition, the *Notice* and RFA (or summaries thereof) will be published in the Federal Register.

[497] *See* 5 U.S.C. § 603(a).

[498] 47 CFR § 1.1200(a).

[499] 47 CFR §§ 1.1200 *et seq.*

oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

198. *Comment Period and Filing Procedures.* Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. All filings must refer to ET Docket No. 19-138.

- Electronic filers: Comments may be filed electronically using the Internet by accessing the Commission's Electronic Comment Filing System (ECFS): https://www.fcc.gov/ecfs. *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing.

    - Filings can be sent by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.
    - Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
    - U.S. Postal Service first-class, Express, and Priority mail must be addressed to 45 L Street NE, Washington, DC 20554.

- Effective March 19, 2020, and until further notice, the Commission no longer accepts any hand or messenger delivered filings. This is a temporary measure taken to help protect the health and safety of individuals, and to mitigate the transmission of COVID-19. *See* FCC Announces Closure of FCC Headquarters Open Window and Change in Hand-Delivery Policy, Public Notice, DA 20-304 (March 19, 2020). https://www.fcc.gov/document/fcc-closes-headquarters-open-window-and-changes-hand-delivery-policy.

199. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

200. Availability of Documents: Comments, reply comments, and *ex parte* submissions will be publicly available online via ECFS.[500] When the FCC Headquarters reopens to the public, these documents will also be available for public inspection during regular business hours in the FCC Reference Center, Federal Communications Commission, 45 L Street NE, Washington, DC 20554.

201. *Further Information*.—For further information, contact Jamie Coleman of the Office of Engineering and Technology, at 202-418-2705 or jamie.coleman@fcc.gov.

VI. ORDERING CLAUSES

202. Accordingly, **IT IS ORDERED** that, pursuant to the authority found in sections 1, 4(i), 301, 302, 303, 309, 316, and 332 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 301, 302, 303, 309, 316, and 332, and section 1.411 of the Commission's Rules, 47 CFR § 1.411,

[500] Documents will generally be available electronically in ASCII, Microsoft Word, and/or Adobe Acrobat.

that this First Report and Order, Further Notice of Proposed Rulemaking, and Order of Proposed Modification IS HEREBY ADOPTED and, except as otherwise provide below, is effective sixty days from the date of publication of each respective component in the Federal Register.

203. IT IS FURTHER ORDERED that the amendments of the Commission's rules as set forth in Appendix A ARE ADOPTED, effective sixty days from the date of publication in the Federal Register, with the exception of section 90.372, which contains new or modified information collection requirements that require review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act. The Commission directs the Wireless Telecommunications Bureau to establish and announce the effective date of section 90.372 in a document published in the Federal Register after the Commission receives OMB approval.

204. IT IS FURTHER ORDERED that, pursuant to sections 309 and 316 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 309 and 316, in this Order of Proposed Modification, the Commission modifies all ITS licenses in the 5.9 GHz band pursuant to the conditions specified in this First Report and Order. Specifically, the Commission modifies the licenses of all DSRC incumbents to add authorization to operate in the 5.895-5.925 GHz band to any RSU registrations currently lacking authority to do so. In addition, the Commission will modify all DSRC licenses to provide that after the end of the sunset period their authorizations will be limited to the 5.895-5.925 GHz band. These modifications will be effective 60 days after publication of this Order of Proposed Modification in the Federal Register; provided, however, that in the event that any ITS licensee, or any other licensee or permittee who believes that its license or permit would be modified by this action, seeks to protest these modifications, such license modifications specified herein and contested by the licensee or permittee shall not be made final as to such licensee or permittee unless and until the Commission orders otherwise. Pursuant to section 316(a)(1) of the Communications Act of 1934, as amended, 47 U.S.C. § 316(a)(1), publication of this Order of Proposed Modification in the Federal Register shall constitute notification in writing of our Order proposing the modification of the ITS licenses, and of the grounds and reasons therefore, and those licensees and any other party seeking to file a protest pursuant to section 316 shall have 30 days from the date of such publication to protest such Order.

205. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order, Further Notice of Proposed Rulemaking, and Order of Proposed Modification, including the Initial and Final Regulatory Flexibility Analyses, to the Chief Counsel for Advocacy of the Small Business Administration.

206. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order, Further Notice of Proposed Rulemaking, and Order of Proposed Modification, including the Initial and Final Regulatory Flexibility Analysis, to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

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

Part 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

The authority citation for part 2 continues to read as follows:

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

1. Amend section 2.106 by revising footnote NG160 to read as follows

§ 2.106 Table of Frequency Allocations.

* * * * *

NG160 In the band 5895-5925 MHz, the use of the non-federal mobile service is limited to operations in the Intelligent Transportation System radio service.

* * * * *

Part 15 – Radio Frequency Devices

The authority citation for part 15 continues to read as follows**:**

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

2. Amend section 15.401 to read as follows:

§ 15.401 Scope.

This subpart sets out the regulations for Unlicensed National Information Infrastructure (U-NII) devices operating in the 5.15-5.35 GHz, 5.47-5.895 GHz bands, and 5.925-7.125 GHz bands.

3. Amend section 15.403 by revising the definitions for Indoor Access Point and U-NII devices to read as follows:

§ 15.403 Definitions.

* * * * *

Indoor Access Point. For the purpose of this subpart, an access point that operates in the 5.850-5.895 GHz or the 5.925-7.125 GHz band, is supplied power from a wired connection, has an integrated antenna, is not battery powered, and does not have a weatherized enclosure. Indoor access point devices must bear the following statement in a conspicuous location on the device and in the user's manual: FCC regulations restrict operation of this device to indoor use only.

Subordinate Device. For the purpose of this subpart, a device that operates in the 5.850-5.895 GHz band or in the 5.925-7.125 GHz band under the control of an Indoor Access Point, is supplied power from a wired connection, has an integrated antenna, is not battery powered, does not have a weatherized enclosure, and does not have a direct connection to the Internet. Subordinate devices must not be used to connect devices between separate buildings or structures. Subordinate devices must be authorized under certification procedures in part 2 of this chapter. Modules may not be certified as subordinate devices.

U-NII devices. Intentional radiators operating in the frequency bands 5.15-5.35 GHz, 5.470-5.895 GHz, and 5.925-7.125 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions.

4. Amend section 15.407 by revising paragraphs (a)(3), republishing NOTE TO PARAGRAPH (a)(3), revising paragraph (a)(12), revising paragraph (b)(4), redesignating paragraphs (b)(5) through

(b)(10) as paragraphs (b)(6) through (b)(11), adding new paragraph (b)(5), and revising paragraph (e) to read as follows:

§ 15.407 General technical requirements.

* * *

(a) * * *

(3) For the band 5.725-5.895 GHz

(i) For the band 5.725-5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(ii) For an indoor access point operating in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. Indoor access points operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

(iii) For client devices operating under the control of an indoor access point in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 14 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm. Client devices operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 30 dBm.

(iv) For a subordinate device operating under the control of an indoor access point in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm.

(v) In the 5.850-5.895 GHz band, client devices must operate under the control of an indoor access point. In all cases, an exception exists for transmitting brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel. Access points may connect to other access points. Client devices are prohibited from connecting directly to another client device.

* * * * *

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

* * * * *

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

(i) * * *

(ii) * * *

(b)(5) For transmitters operating solely in the 5.850-5.895 GHz band or operating on a channel that spans across 5.725-5.895 GHz:

(i) For an indoor access point or subordinate device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 15 dBm/MHz and shall decrease linearly to an e.i.r.p. of -7 dBm/MHz at or above 5.925 GHz.

(ii) For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of -5 dBm/MHz and shall decrease linearly to an e.i.r.p. of -27 dBm/MHz at or above 5.925 GHz.

(iii) For a client device or indoor access point or subordinate device, all emissions below 5.725 GHz shall not exceed an e.i.r.p. of −27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.

* * * * *

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

* * * * *

Part 90 – PRIVATE LAND MOBILE RADIO SERVICES

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

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

5. Amend subpart M to the Table of Contents of part 90 by revising the subheading after section 90.365 and add section 90.370 and section 90.372 to read as follows:

Subpart M – Intelligent Transportation Systems Radio Service

* * * * *

Regulations Governing the Licensing and Use of Frequencies in the 5895-5925 MHz Band for Dedicated Short-Range Communications Service (DSRCS).

* * * * *

§ 90.370 Permitted Frequencies.

* * * * *

§ 90.372 DSRCS Notification Requirement.

* * * * *

Subpart B—PUBLIC SAFETY RADIO POOL

6. Amend section 90.20 by revising the table in paragraph (c)(3) to read as follows:

[Insert public safety pool frequency table – revise frequency to read 5895-5925]

Subpart C—INDUSTRIAL/BUSINESS RADIO POOL

7. Amend section 90.35 by revising the table in paragraph (b)(3) to read as follows:

[Insert industrial/business pool frequency table – revise frequency to read 5895-5925]

Subpart G—APPLICATIONS AND AUTHORIZATIONS

8. Amend section 90.149 by revising paragraph (b) to read as follows:

§ 90.149 License term.

* * * * *

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

9. Amend section 90.155 by revising paragraph (i) to read as follows:

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

* * * * *

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

Subpart H—POLICIES GOVERNING THE ASSIGNMENT OF FREQUENCIES

10. Amend section 90.175 by revising paragraph (j)(16) to read as follows:

§ 90.175 Frequency coordinator requirements.

* * * * *

(j) * * *

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

* * * * *

Subpart I—GENERAL TECHNICAL STANDARDS

11. Amend section 90.203 by redesignating paragraph (a)(2) as paragraph (a)(3) and adding new paragraph (a)(2).

§ 90.203 Certification Required.

* * * * *

(2) Effective [Insert date of DSRC sunset], an equipment approval may no longer be obtained for DSRCS equipment (RSUs and OBUs) operating under the provisions of this part.

12. Amend section 90.205 by revising paragraph (q) to read as follows:

§ 90.205 Power and antenna height limits.

* * * * *

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

* * * * *

13. Amend section 90.210 by revising the entry for 5850-5925 in the table and footnote 4 of the table to read as follows:

§ 90.210 Emission masks.

* * * * *

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

[4] DSRCS Roadside Units in the 5.895-5.925 GHz band are governed under subpart M of this part.

* * * * *

14. Amend section 90.213 by revising footnote 10 of the table in paragraph (a) to read as follows:

§ 90.213 Frequency stability.

(a) * * *

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

* * * * *

SUBPART M—INTELLIGENT TRANSPORTATION SYSTEMS RADIO SERVICE

15. Amend subpart M to the Table of Contents of part 90 by modifying the subheading after section 90.365 to read as follows:

Regulations Governing the Licensing and Use of Frequencies in the 5895-5925 MHz Band for Dedicated Short-Range Communications Service (DSRCS)

* * * * *

16. Amend subpart M by adding section 90.370 to read as follows:

§ 90.370 Permitted frequencies.

(a) Dedicated Short-Range Communications Service (DSRCS) systems are permitted to operate in the 5895-5925 MHz band.

(b) DSRCS authorizations granted prior to the [insert R&O effective date] may remain on existing frequencies in the 5850-5895 MHz band until [insert date one year after R&O effective date], at which time they may only operate in the 5895-5925 MHz band.

(c) Frequencies in the 5895-5925 MHz band will not be assigned for the exclusive use of any licensee; Channels are available on a shared basis only for use in accordance with the Commission's rules. All licensees shall cooperate in the selection and use of channels in order to reduce interference. This includes monitoring for communications in progress and any other measures as may be necessary to minimize interference.

(d) Licensees of Roadside Units (RSUs) suffering or causing harmful interference within a communications zone, as defined in section 90.375 of this part, are expected to cooperate and resolve this problem by mutually satisfactory arrangements. If the licensees are unable to do so, the Commission may impose restrictions including specifying the transmitter power, antenna height and direction, additional filtering, or area or hours of operation of the stations concerned. The use of any channel at a given geographical location may be denied when, in the judgment of the Commission, its use at that location is not in the public interest; use of any such channel may be restricted as to specified geographical areas, maximum power, or such other operating conditions, contained in this part or in the station authorization.

17. Amend section 90.371 by revising paragraph (b) and (c) to read as follows:

§ 90.371 Dedicated Short Range Communications Service.

* * * * *

(b) DSRCS Roadside Units (RSUs) operating in the band 5850-5925 MHz shall not receive protection from Government Radiolocation services in operation prior to the establishment of the DSRCS station. Operation of DSRCS RSU stations within the radius centered on the locations listed in the table below must be coordinated through the National Telecommunications and Information Administration.

Location	Latitude DD-MM-SS North	Longitude DD-MM-SS West	Coordination Zone Radius (km)
Anclote, Florida	28-11-18	82-47-40	45
Cape Canaveral, Florida	28-28-54	80-34-35	47
Cape San Blas, Florida	29-40-31	85-20-48	47
Carabelle Field, Florida	29-50-38	84-39-46	36
Charleston, South Carolina	32-51-48	79-57-48	16
Edwards, California	34-56-43	117-54-50	53
Eglin, Florida	30-37-51	86-24-16	103
Fort Walton Beach, Florida	30-24-53	86-39-58	41
Kennedy Space Center, Florida	28-25-29	80-39-51	47
Key West, Florida	24-33-09	81-48-28	12
Kirtland AFB, New Mexico	34-59-51	106-28-54	15
Kokeepark, Hawaii	22-07-35	159-40-06	5
MacDill, Florida	27-50-37	82-30-04	47
NV Test Training Range, Nevada	37-18-27	116-10-24	186
Patuxent River, Maryland	38-16-55	76-25-12	6
Pearl Harbor, Hawaii	21-21-17	157-57-51	16
Pillar Point, California	37-29-52	122-29-59	36
Poker Flat, Alaska	65-07-36	147-29-21	13
Port Canaveral, Florida	28-24-42	80-36-17	19
Port Hueneme, California	34-08-60	119-12-24	24
Point Mugu, California	34-07-17	119-09-1	18
Saddlebunch Keys, Florida	24-38-51	81-36-22	29
San Diego, California	32-43-00	117-11-00	11
San Nicolas Island,	33-14-47	119-31-07	195
Tonopah Test Range,	37-44-00	116-43-00	2
Vandenberg, California	34-34-58	120-33-42	55
Venice, Florida	27-04-37	82-27-03	50
Wallops Island, Virginia	37-51-23	75-30-41	48
White Sands Missile	32-58-26	106-23-43	158
Yuma, Arizona	32-54-03	114-23-10	2

(c) NTIA may authorize additional station assignments in the federal radiolocation service and may amend, modify, or revoke existing or additional assignments for such service. Once a federal assignment action is taken, the Commission's Universal Licensing System database will be updated accordingly and the list in paragraph (b) of this section will be updated as soon as practicable.

18. Amend subpart M by adding section 90.372 to read as follows:

§ 90.372 DSRCS Notification Requirement.

(a) DSRCS licensees authorized pursuant to 90.370(b) must notify the Commission that as of the transition deadline of [insert sunset date], they have ceased operating in the 5.850-5.895 GHz portion of the band. This notification must be filed via ULS within 15 days of the expiration of the transition deadline.

(b) Continued operation in the 5.850-5.895 GHz portion of the band after the transition deadline, will result in automatic termination of that licensee's authorization without specific Commission action.

19. Amend section 90.375 by revising paragraph (a) and paragraph (c) to read as follows:

§ 90.375 RSU license areas, communication zones, and registrations

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

* * * * *

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

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

1 As described in the IEEE 802.11p-2010 (incorporated by reference, see § 90.379).

20. Amend section 90.379 to read as follows:

§ 90.379 Technical standards for Roadside Units

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

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

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

21. Amend section 90.383 by revising the introductory text and paragraph (b) to read as follows:

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

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

* * * * *

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

Part 95 -Personal Radio Services

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

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

Subpart L -DSRCS On-Board Units

22. Amend section 95.3101 to read as follows:

§ 95.3101 Scope.

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

23. Remove and reserve section 95.3159.

24. Amend section 95.3163 to read as follows:

§ 95.3163 OBU frequencies.

DSRCS On-Board Units (OBUs) are permitted to operate in the 5895-5925 MHz band.

25. Amend section 95.3167 to read as follows:

§ 95.3167 OBU transmit power limit.

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

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

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

26. Amend section 95.3189 to read as follows:

§ 95.3189 OBU technical standard.

(a) DSRCS On-Board Unit (OBU) transmitter types operating in the 5895-5925 MHz band must be designed to comply with the technical standard Institute of Electrical and Electronics Engineers (IEEE) 802.11p-2010.

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

(1) 802.11p-2010, IEEE Standard for Information technology – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments (2010). This standard

is available from the Institute of Electrical and Electronics Engineers (IEEE), 3025 Boardwalk Drive, Suite 220, Ann Arbor, MI 48108, 1-855-999-9870, http://www.techstreet.com/ieee.

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

APPENDIX B

Proposed Rules

Part 15 – Radio Frequency Devices

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

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

1. Amend section 15.407 by revising paragraphs (a)(3) and (b)(5) to read as follows:

§ 15.407 General technical requirements.

* * *

(a) * * *

(3) For the band 5.725-5.895 GHz

(i) ***

(ii) For an indoor access point operating in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 23 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. Indoor access points operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

(iii) For client devices operating under the control of an indoor access point in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 17 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm. Client devices operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 30 dBm.

(iv) For a subordinate device operating under the control of an indoor access point in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 23 dBm e.i.r.p in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm.

(v) For an outdoor access point operating in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 23 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. Outdoor access points must limit their maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon to 21 dBm (125 mW) to protect fixed satellite services. Outdoor access points operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

(vi) In the 5.850-5.895 GHz band, client devices must operate under the control of an indoor access point. In all cases, an exception exists for transmitting brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel. Access points may connect to other access points.

(vii) For client devices operating under the control of an outdoor access point in the 5.850-5.895 GHz band, the maximum power spectral density e.i.r.p. must not exceed 17 dBm in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm. Client devices operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 30 dBm.

(viii) Operation of outdoor U-NII devices in the 5.850-5.895 GHz band within the exclusion zones listed in the table below, to which NTIA may amend, modify, or

revoke locations and associated parameters, is not permitted. The outdoor U-NII exclusion zones for each federal facility location are characterized by a center point (latitude/longitude) and radius (to define a circular area) to facilitate the regulator process of coordination.

Facility Name	Latitude DD-MM-SS North	Longitude DD-MM-SS West	Exclusion Zone Radius (km)
Anclote, Florida	28-11-18	82-47-40	54
Cape Canaveral, Florida	28-28-54	80-34-35	53
Cape San Blas, Florida	29-40-31	85-20-48	55
Carabelle Field, Florida	29-50-38	84-39-46	54
Charleston, South Carolina	32-51-48	79-57-48	55
Edwards, California	34-56-43	117-54-50	51
Eglin, Florida	30-37-51	86-24-16	116
Fort Walton Beach, Florida	30-24-53	86-39-58	56
Kennedy Space Center, Florida	28-25-29	80-39-51	98
Key West, Florida	24-33-09	81-48-28	54
Kirtland AFB, New Mexico	34-59-51	106-28-54	15
Kokeepark, Hawaii	22-07-35	159-40-06	49
MacDill, Florida	27-50-37	82-30-04	58
NV Test Training Range, Nevada	37-18-27	116-10-24	184
Patuxent River, Maryland	38-16-55	76-25-12	7
Pearl Harbor, Hawaii	21-21-17	157-57-51	55
Pillar Point, California	37-29-52	122-29-59	10
Poker Flat, Alaska	65-07-36	147-29-21	58
Port Canaveral, Florida	28-24-42	80-36-17	54
Port Hueneme, California	34-08-60	119-12-24	54
Point Mugu, California	34-07-17	119-9-01	81
Saddlebunch Keys, Florida	24-38-51	81-36-22	54
San Diego, California	32-43-00	117-11-00	54
San Nicolas Island, California	33-14-47	119-31-07	166
Tonopah Test Range, Nevada	37-44-00	116-43-00	48
Vandenberg, California	34-34-58	120-33-42	74
Venice, Florida	27-04-37	82-27-03	54
Wallops Island, Virginia	37-51-23	75-30-41	68
White Sands Missile Range, New Mexico	32-58-26	106-23-43	160
Yuma, Arizona	32-54-03	114-23-10	49

NOTE TO PARAGRAPH (a)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

* * * * *(b)(5) For transmitters operating solely in the 5.850-5.895 GHz band or operating on a channel that spans across 5.725-5.895 GHz:

(i) * * *

(ii) For a client device or an outdoor access point, all emissions at or above 5.895 GHz shall not

exceed an e.i.r.p. of -5 dBm/MHz and shall decrease linearly to an e.i.r.p. of -27 dBm/MHz at or above 5.925 GHz.

(iii) All emissions below 5.725 GHz shall not exceed an e.i.r.p. of −27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.

* * * * *

Part 90 – PRIVATE LAND MOBILE RADIO SERVICES

2. Amend subpart M to the Table of Contents of part 90 by modifying the subheading after section 90.365 and add section 90.370 to read as follows:

Subpart M – Intelligent Transportation Systems Radio Service

* * * * *

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

90.370 Permitted Frequencies.

* * * * *

3. The authority citation for part 90 continues to read as follows:

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

Subpart A – GENERAL INFORMATION

4. Amend section 90.7 is by removing the entry to Dedicated Short Range Communication Service (DSRCS), adding an entry for Cellular Vehicle to Everything Service (CV2X) in alphabetical order, and modifying the entries for On-Board unit (OBU), Roadside unit (RSU) and Roadway bed surface to read as follows:

§ 90.7 Definitions.

* * * * *

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

* * * * *

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

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

Roadway bed surface. For C-V2X, the road surface at ground level.

Subpart H—POLICIES GOVERNING THE ASSIGNMENT OF FREQUENCIES

5. Amend section 90.175 by revising paragraph (j)(16) to read as follows:

§ 90.175 Frequency coordinator requirements.

* * * * *

(j) * * *

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

* * * * *

6. Amend section 90.179 by revising paragraph (f) to read as follows:

§ 90.179 Shared use of radio stations.

* * * * *

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

Subpart I—GENERAL TECHNICAL STANDARDS

7. Amend section 90.210 by revising footnote 4 of the table to read as follows:

§ 90.210 Emission masks.

* * * * *

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

4 CV2X Service Roadside Units equipment in the 5895-5925 MHz band is governed under subpart M of this part.

* * * * *

8. Amend section 90.213 by revising footnote 10 of the table in paragraph (a) to read as follows:

§ 90.213 Frequency stability.

(a) * * *

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

* * * * *

Subpart M—Intelligent Transportation Systems Radio Service

9. Amend section 90.350 to read as follows:

§ 90.350 Scope.

The Intelligent Transportation Systems (ITS) radio service is for the purpose of integrating radio-based technologies into the nation's transportation infrastructure and to develop and implement the nation's intelligent transportation systems. It includes the Location and Monitoring Service (LMS) and the

Cellular Vehicle to Everything Service (C-V2X). Rules as to eligibility for licensing, frequencies available, and any special requirements for services in the Intelligent Transportation Systems radio service are set forth in this subpart.

10. Amend the heading prior to section 90.370 to read as follows:

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

11. Amend section 90.370 by revising paragraph (a) to read as follows:

§ 90.370 Permitted frequencies.

(a) C-V2X Roadside Units (RSUs) are permitted to operate in the 5895-5925 MHz band.

12. Amend section 90.371 to read as follows:

§ 90.371 C-V2X.

(a) C-V2X Roadside Units (RSUs) operating in the band 5895-5925 MHz shall not receive protection from Government Radiolocation services in operation prior to the establishment of the RSU. Operation of RSU stations within the zones listed in the table below, to which NTIA may amend, modify, or revoke locations and associated parameters, must be coordinated through the National Telecommunications and Information Administration.

(b) C-V2X Roadside Units (RSUs) operating in the band 5895-5925 MHz shall not receive protection from Government Radiolocation services in operation prior to the establishment of the C-V2X station. Operation of C-V2X RSU stations within the radius centered on the locations listed in the table below, to which NTIA may amend, modify, or revoke locations and associated parameters, must be coordinated through the National Telecommunications and Information Administration.

* * * * *

13. Amend section 90.373 by revising the heading and the introductory text to read as follows:

§ 90.373 Eligibility in C-V2X.

The following entities are eligible to hold an authorization to operate Roadside units in C-V2X:

* * * * *

14. Amend section 90.375 to read as follows:

§ 90.375 License areas, communication zones, and registrations

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

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

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

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

[1] As described in the ATIS transposed standards of the 3GPP (incorporated by reference, *see* § 90.379).

15. Amend section 90.377 to read as follows:

§ 90.377 Maximum EIRP and antenna height.

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

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

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

16. Amend section 90.379 to read as follows:

§ 90.379 Technical standards for Roadside Units

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

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

(1) 3GPP Release 14, 3rd Generation Partnership Project Technical Specification Group Services and System Aspects (2018). This standard is available from ATIS, 1200 G Street NW Suite 500, Washington, D.C. 20005, https://www.atis.org/docstore/default.aspx.

17. Amend subpart M adding section 90.381 to read as follows:

§ 90.381 C-V2X emissions limits.

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

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

(1) -29 dBm/100 kHz at the band edge (The band is defined in section 90.370 of this part);

(2) -35 dBm/100 kHz ± 1 megahertz from the band edge;

(3) -43 dBm/100 kHz ± 10 megahertz from the band edge; and

(4) -53 dBm/100 kHz ± 20 megahertz from the band edge.

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

Subpart N—OPERATING REQUIREMENTS

18. Amend section 90.415 by revising paragraph (b) to read as follows:

* * * * *

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

19. Amend section 90.421 by adding paragraph (d) to read as follows:

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

* * * * *

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

20. Amend section 90.425 by revising paragraph (d)(10) to read as follows:

§ 90.425 Station identification.

* * * * *

(d) * * *

(10) It is a Roadside Unit (RSU) in a C-V2X system.

Part 95 -Personal Radio Services

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

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

21. Amend the subtitle for subpart L to read as follows:

Subpart L—C-V2X Service On-Board Units

22. Amend section 95.3101 to read as follows:

§ 95.3101 Scope.

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

23. Amend section 95.3103 by removing the definition for Dedicated Short-Range Communications Services (DSRCS), adding a definition for Cellular Vehicle to Everything Service (CV2X) in alphabetical order, and revising the definition of On-Board Unit (OBU) to read as follows:

§ 95.3103 Definitions, OBUs.

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

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

* * * * *

24. Amend section 95.3161 by revising paragraph (a) to read as follows:

§ 95.3161 OBU transmitter certification.

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

* * * * *

25. Amend section 95.3163 to read as follows:

§ 95.3163 OBU frequencies.

C-V2X Service OBUs are permitted to operate in the 5895-5925 MHz band.

26. Amend section 95.3167 by revising paragraph (a) to read as follows:

§ 95.3167 OBU transmit power limit.

(a) The maximum equivalent isotropically radiated power (EIRP) for vehicular and portable C-V2X OBU transmitter types is limited to 33 dBm.

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

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

27. Add section 95.3179 to subpart L as follows:

§ 95.3179 Unwanted emissions limits.

C-V2X On Board Units must comply with the following out-of-band emissions limits.

Conducted limits measured at the antenna input shall not exceed:

(a) 29 dBm/100 kHz at the band edge (The band is defined in section 95.3163 of this part.);

(b) -35 dBm/100 kHz ± 1 megahertz from the band edge;

(c) -43 dBm/100 kHz ± 10 megahertz from the band edge; and

(d) -53 dBm/100 kHz ± 20 megahertz from the band edge.

28. Amend section 95.3189 to read as follows:

§ 95.3189 OBU technical standard.

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

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

(1) 3GPP Release 14, 3rd Generation Partnership Project Technical Specification Group Services and System Aspects (2018). This standard is available from ATIS, 1200 G Street NW Suite 500, Washington, D.C. 20005, https://www.atis.org/docstore/default.aspx.

29. Amend Appendix A to part 95 by removing the entry in the table for "95.1509 - ASTM E221-03 DSRC Standard.".

APPENDIX C

Cost Benefit Analysis

1. In this appendix, we supplement our earlier exposition explaining our estimate of the value of unlicensed spectrum in the lower 45 megahertz. We note that our baseline estimation is conservative, as it is limited to expected benefits starting in 2023 and only up to 2025, thereby ignoring likely substantial benefits beyond 2025. The estimate also assumes that unlicensed spectrum made available in the *6 GHz Report and Order* will be used as quickly and heavily as the spectrum made available here in spite of more stringent power limitations across the 6 GHz band and its potentially longer adoption timescale.[1] Additionally, commenters have noted that unlicensed spectrum in the lower 45 megahertz likely offers numerous benefits to consumers, who use Wi-Fi to off-load traffic and benefit from the various applications that Wi-Fi enables in, among other areas, agriculture, education, and medicine. However, due to a lack of quantifiable data on these varied, sometimes only-nascent benefits, we are unable to construct reliable quantitative estimates of associated surplus.[2] However, we find that the added GDP associated with the transactions between ISPs and their customers are substantial, even while excluding the additional economic value of Wi-Fi supported activities to consumers.

2. We calculate the contribution to GDP of the unlicensed 5.9 GHz spectrum using two approaches that estimate the present value of additional Wi-Fi traffic from new transactions between ISPs and their customers over the period 2023-2025.[3] In our baseline model, we assume that the increase in traffic is based on the idea that the additional 45 megahertz of 5.9 GHz spectrum will enable Wi-Fi users of the 2.4 GHz, 5.150-5.250 (U-NII-1), and 5.725-5.850 GHz (U-NII-3), and 6 GHz bands to access an additional 160-megahertz channel compared to the seven they would otherwise have, an additional 80-megahertz channel compared to the 16 they would otherwise have, two additional 40-megahertz channels compared to the 34 they would otherwise have, and three additional 20-megahertz channels compared to the 71 they would otherwise have.[4] Additionally, because future Wi-Fi traffic is expected to outpace capacity, we assume that the additional 5.9 GHz spectrum will be fully used by consumers, implying that we can estimate additional traffic for channels of a specific bandwidth as a proportion of new Wi-Fi channels that this spectrum would create relative to existing channels of that bandwidth.[5]

3. *Traffic Increase Calculation*. Our baseline assumptions imply that the seven 160-

[1] *See* Letter from Elizabeth Andrion, Senior Vice President, Regulatory Affairs, Charter, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 19-138, at 2 (filed July 2, 2020).

[2] The closest example in the economic literature that could help put a consumer-centric value on each GB is a 2016 study by Nevo, Turner and Williams, but the text does not provide enough information for the Commission to recreate it's results and its data is outdated. Aviv Nevo, John L. Turner, and Jonathan W. Williams, *Usage-based pricing and demand for residential broadband*, 84 Econometrica (2016) (Nevo et al. Study). The Nevo et al. Study divides its sample of households into 16,807 types and with a different dollar value for GB consumed for each, given a data download speed and a consumption level of data. Nevo et al. Study, at 423, 428. However, the Nevo et al. Study does not provide these values or information on every type, so the Commission cannot determine how additional value would increase with more data consumption. Further, the study is based on data from May 2011 to June 2012, where consumer value for data would be lower due to a lower quality and variety of online activities and applications and lower familiarity with technology. For the most common type of consumer (28% of the sample, Nevo et al. Study at 429-430, and type-specific parameters, Nevo et al. Study, Supplement at 11), assuming an unlimited plan, and with 1 Gbps download speed (faster speeds increase data consumption in the model), the expected GB consumed monthly would be 52.7 GB (equation 2, Nevo et al. Study at 425). We estimate that the average household already consumed 122.6 GB in 2017 (*infra* Figure C-2), suggesting that the Nevo et al. Study has been outpaced by changes in technology and consumers tastes.

[3] This includes our baseline approach along with an approach using alternative sources of revenue data.

[4] *Supra* para. 134; *6 GHz Report and Order*, 35 FCC Rcd at 3902, Table 6.

[5] *Supra* para. 134.

megahertz channels located in the 6 GHz band would be augmented by new 160-megahertz Channel 163 comprised of 115 megahertz of U-NII-3 spectrum and the lower 45 megahertz in the 5.9 GHz band (U-NII-4). Assuming that Channel 163 would be fully used, traffic would increase by roughly 14%. Alternatively, the sixteen 80-megahertz channels, including U-NII-1 Channel 42, U-NII-3 Channel 155, and fourteen channels in the 6 GHz band, would be augmented by new 80-megahertz Channel 171 comprised of the upper 35 megahertz of U-NII-3 spectrum and the lower 45 megahertz in the 5.9 GHz band (U-NII-4). Assuming that Channel 171 would be fully used, traffic would increase by roughly 6%. Proceeding similarly for lower bandwidth channels, we find that the additional 5.9 GHz spectrum would increase traffic by 6% when used by 40-megahertz channels and 4% when used by 20-megahertz channels.

4. We assume that during the period 2023-2025, 30% of traffic will occur over 160-megahertz channels, 50% over 80-megahertz channels, and 10% each over 40- and 20-megahertz channels.[6] We note that our use and distributional assumptions lead to highly conservative estimate of the reliance on 5.9 GHz channels relative to other studies.[7] Based on our assumptions, we calculate a weighted traffic increase of 8.4%.[8] We provide detailed calculations in Figure C-1.

Fig. C-1: Detailed Traffic Calculations

	Variables	Values	Note
(a)	% Traffic over 20 MHz Channels w/o Order	10%	*Table 12 in the ECC Report 302*
(b)	% Traffic over 40 MHz Channels w/o Order	10%	*Table 12 in the ECC Report 302*
(c)	% Traffic over 80 MHz Channels w/o Order	50%	*Table 12 in the ECC Report 302*
(d)	% Traffic over 160 MHz Channels w/o Order	30%	*Table 12 in the ECC Report 302*
(e)	Ex Ante 20 MHz Channels	71	
(f)	Ex Ante 40 MHz Channels	34	
(g)	Ex Ante 80 MHz Channels	16	
(h)	Ex Ante 160 MHz Channels	7	
(i)	Ex Post Policy Additional 20 MHz Channels	3	
(j)	Ex Post Policy Additional 40 MHz Channels	2	
(k)	Ex Post Policy Additional 80 MHz Channel	1	
(l)	Ex Post Policy Additional 160 MHz Channel	1	
(m)	% Growth in WiFi Traffic	8.42%	*(a)×(i)/(e)+(b)×(j)/(f)+(c)×(k)/(g)+(d)×(l)/(h)*

5. *Valuing the Increase in Traffic*. For our first approach to calculate the contribution to GDP of additional traffic, we extrapolate the Census Bureau's national revenues number for fixed Internet services between the fourth quarter of 2016 and the first quarter of 2020 to the year 2025.[9] These are total

[6] We do not have data on precise traffic distribution over channels of different bandwidths and instead rely on predictions from a recent Electronic Communications Committee report. Electronic Communications Committee, ECC Report 302, at 22 (May 29, 2019), https://docdb.cept.org/download/cc03c766-35f8/ECC%20Report%20302.pdf.

[7] *See, e.g.*, RAND 5.9 GHz Study at 21-22; 2020 WiFiForward Study at 27.

[8] Our percentage increase calculation does not directly incorporate channel bandwidths. Instead, channel bandwidths are implicit in our assumptions about traffic prior to the 5.9 GHz spectrum being repurposed.

[9] Earlier data exists, but Q4-2016 starts a downward trend that continues until Q1-2020. By incorporating only declining revenues, our extrapolation is conservative, likely underestimating the contributions to GDP. We use the time series for "Wired Telecommunication Carriers," NAICS code 5171 reported from 2010-2019. United States Census Bureau, Business and Industry Time Series / Trend Charts (accessed July 30, 2020),

(continued….)

revenues, so we multiply them by the projected ratio of U.S. Wi-Fi traffic over total U.S. Internet traffic.[10] We multiply the resulting product by 8.4% to find the additional GDP produced by repurposing the 5.9 GHz spectrum. Over the years 2023-2025, this amounts to a present value of $34.8 billion using a 7% discount rate and a present value of $39 billion using a 3% discount rate. We provide detailed calculations in Figure C-2 rows (d) to (h).

6. For the second approach, we obtain two alternative estimates of the price per GB for fixed broadband based on different baselines for the average fixed broadband price. We multiply each of these by estimates of the increase in U.S. Wi-Fi traffic in GBs to find the additional GDP produced by repurposing the 5.9 GHz spectrum. The first baseline price is $0.34/GB, the average for fixed U.S. broadband plans estimated by the Commission in its 2018 International Broadband Data Report (IBDR).[11] This price derives from broadband plan data collected in 2017, so we adjust it forward using a projection of the Consumer Price Index (CPI) for "Internet services and electronic information providers."[12] Because the adjusted number reflects per household pricing, we divide it by a projection of that year's residential traffic per household to reflect a per dollar per GB price.[13] We obtain the second baseline price from the 2020 Urban Rate Survey data that the Commission collects for Universal Service purposes.[14] In that data, the average monthly price is $79.67 per month per household,[15] which we adjust using our projections of the Internet CPI and then divide by our projection of residential Internet traffic to project future prices per GB. However, we note that, "AT&T was oversampled due to a change in its reporting for Form 477 and Urban Rate Survey purposes" in this edition of the Urban Rate Survey, so that we prefer the IBDR-based estimate in our second approach.[16]

https://www.census.gov/econ/currentdata/dbsearch?program=QSS&startYear=2010&endYear=2020&categories=5171T&dataType=QREV&geoLevel=US&notAdjusted=1&submit=GET+DATA&releaseScheduleId=.

[10] We use CISCO estimates of 2017 and 2022 CISCO total Internet and Wi-Fi traffic and extrapolate these numbers to through year 2025. CISCO, VNI Complete Forecast Highlights, United States - 2022 Forecast Highlights, at 1-2 (2018), https://www.cisco.com/c/dam/m/en_us/solutions/service-provider/vni-forecast-highlights/pdf/United_States_Network_Connections.pdf.

[11] *International Comparison Requirements Pursuant to the Broadband Data Improvement Act*, GN Docket No. 17-199, Sixth Report, 32 FCC Rcd 978, 1035, Table 3.

[12] We linearly extrapolate from the average annual CPI in "Internet services and electronic information providers." U.S. Bureau of Labor Statistics, Databases, Tables & Calculators by Subject, https://data.bls.gov/timeseries/CUUR0000SEEE03?output_view=data (last visited Oct. 27, 2020).

[13] According to a study by Telecom Advisory Services, LLC, 43.12% of traffic is accessed through the home. Thus, we obtain residential Internet traffic by multiplying total Internet traffic by 43.12%. Letter from Alex Roytblat, Counsel to Wi-Fi Alliance, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 18-295, Attach. 2 at 84 (filed Oct. 12, 2018) (Wi-Fi Alliance Oct. 12, 2018 *Ex Parte*). To derive the monthly residential traffic per household, we divide U.S. residential traffic by the number of households served by fixed broadband Internet, estimated from December 2016 to June 2019 in the Fixed Broadband Form 477 and linearly extrapolated to 2025.

[14] FCC, Urban Rate Survey Data and Resources, https://www.fcc.gov/economics-analytics/industry-analysis-division/urban-rate-survey-data-resources (last visited Oct. 27, 2020).

[15] This is a weighted average using weights included with the published data. FCC, Urban Rates Survey Broadband Survey Results (2020), https://www.fcc.gov/file/17600/download. The weights are a combination of sampling weights, nonresponse weights, weights to correct for respondents reporting multiple plans, and weights to correct for the number of potential subscribers each respondent has. FCC, 2020 Urban Rate Survey – Fixed Broadband Service Analysis (2020), https://www.fcc.gov/file/17911/download.

[16] FCC, Urban Rate Survey Broadband Survey Results (2020), https://www.fcc.gov/file/17600/download.

7. To estimate the increase in U.S. Wi-Fi traffic, we first extrapolate U.S. Wi-Fi traffic for the years 2023-2025 using Cisco estimates of Wi-Fi traffic in 2017 and 2022.[17] We find the additional traffic per year by multiplying the Cisco estimates by 8.4%. We then multiply the resulting number by our per dollar per GB price estimates to obtain the contribution to GDP. Using the IBDR baseline price, over the years 2023-2025, this amounts to a present value of $17.2 billion using a 7% discount rate and a present value of $19.3 billion using a 3% discount rate. Alternatively, using the Urban Rate Survey baseline, over the years 2023-2025, this amounts to a present value of $32.7 billion using a 7% discount rate and a present value of $36.6 billion using a 3% discount rate. We provide detailed calculations in Figure C-2 rows (a) to (c) together with rows (i) to (w).

8. *Robustness of baseline analysis*. In addition to applying different revenue projections and discount rates to our baseline traffic assumptions, we have also found that our analysis is robust to several variations of our model. In particular, we have repeated our calculations accounting for additional U-NII-2 channels, though we note that most Wi-Fi use occurs within the 2.4 GHz, U-NII-1, and U-NII-3 bands.[18] As in our baseline model, this variation assumes that the 6 GHz channels would be used at the time that 5.9 GHz spectrum would also become available. As we show below, if we alternatively assumed that 6 GHz spectrum would not be available during 2023-2025, our estimates of the contribution of 5.9 GHz spectrum for unlicensed use rise substantially.

9. To further account for potential usage of the U-NII-2 band, we suppose, instead that there are initially eighty-seven 20-megahertz channels, forty-two 40-megahertz channels, twenty 80-megahertz channels, and nine 160-megahertz channels[19] which reduces the baseline weighted traffic increase from repurposing 5.9 GHz spectrum to 6.7%, as opposed to 8.4% in our baseline model.[20] Using our lowest estimate of the value of this traffic leads to a present value GDP contribution of $13.6 billion over the years 2023-2025.[21]

10. If we instead assumed that 6 GHz spectrum would not be available during 2023-2025, while supposing that U-NII-2 channels would be fully used during this timeframe, the weighted traffic increase from repurposing 5.9 GHz spectrum goes up to 25.9%. Using our lowest estimate of the value of this traffic leads to a present value GDP contribution of $53.1 billion over the years 2023-2025. The weighted traffic increase and GDP contribution would rise even further if we excluded usage of U-NII-2 channels.

11. Finally, in our baseline analysis, we assumed that 5.9 GHz spectrum would be fully used by consumers, leading to our baseline weighted traffic increase of 8.4%.[22] However, as we previously

[17] CISCO estimates that United States Internet traffic will be 2.8 exabytes (EB) per day (or 1,022 EB per year) by 2022, up from 924 petabytes (PB) per day (or 337.26 EB per year) in 2017. Additionally, CISCO estimates that the United States fixed/Wi-Fi ratio was 50.4% of total Internet traffic in 2017, and will be 56.6% of total Internet traffic by 2022. CISCO, VNI Complete Forecast Highlights, United States - 2022 Forecast Highlights, at 1-2 (2018).

[18] *6 GHz Report and Order*, 35 FCC Rcd at 3937, n.602 ("most use occurs within the 2.400-2.483.5 GHz band, the 5.150-5.250 GHz U-NII-1 band and the 5.725-5.850 GHz U-NII-3 band").

[19] Specifically, we include additional U-NII-2 channels together with those listed in Table 6 of the *6 GHz Report and Order* as follows. We include 20-megahertz channels 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, and 144. We include 40-megahertz channels 54, 62, 102, 110, 118, 126, 134, and 142. We include 80-megahertz channels 58, 106, 122, 138. We also include 160-megahertz channels 50 and 114, the former of which is comprised of both U-NII-1 and U-NII-3 spectrum.

[20] We observe that U-NII-2 devices must employ dynamic frequency selection to protect federal radar operations and transmit power control to protect the Earth exploration satellite service, leading to lower usage of these channels than those included in our baseline model. *See* C.F.R. § 15.407(h).

[21] This figure is based on our IBDR price per GB estimate and a 7% discount rate.

[22] *Supra* para. 134.

stated, relaxing this assumption does not change our findings.[23] For example, suppose that, conservatively, the increase in traffic were only 1%. Using our lowest estimates of the value of this traffic still leads to a present value GDP contribution of $2 billion over 2023-2025, which is still higher than expected one-time transition costs.

[23] *Supra* note 365.

Fig. C-2: Benefit Calculations

		Year						Notes
		2017	2019	2023	2024	2025	2023-2025	
Traffic Projections								
(a)	Total Internet Traffic (Billions GB)	337.26		1,159	1,296	1,433		*From CISCO Projections*
(b)	Wi-Fi Traffic (Billions GB)			660	742	824		*From CISCO Projections*
(c)	Increase Wi-Fi Traffic (Billions GB)			56	62	69		*8.4% × (b)*
Revenues Based Analysis								
(d)	Wired Revenue ($ Billion)			$298	$295	$291		*From US Census*
(e)	Wi-Fi Revenue ($ Billion)			$170	$169	$168		*(d) × (b) / (a)*
(f)	Impact ($ Billion, Revenues)			$14.3	$14.2	$14.1	$42.6	*8.4% × (e)*
(g)	Impact, 3% Discount ($ Billion, Revenues)			$13.5	$13.0	$12.5	$39.0	*(f) / 1.03%^(Year-2021)*
(h)	Impact, 7% Discount ($ Billion, Revenues)			$12.5	$11.6	$10.8	$34.8	*(f) / 1.07%^(Year-2021)*
IBDR Based Analysis								
(i)	Unit Internet Price Level (100.0 = 1997)	76.5	77.1	77.5	77.6	77.6		*From CPI*
(j)	Residential Traffic (Billions GB)	145		500	559	618		*43.1% × (a)*
(k)	Number of Internet Residential Households (Billions)	0.10		0.12	0.12	0.13		*From Form 477*
(l)	Monthly Residential Per Household GB Usage	123		346	375	403		*(j) / (k) / 12 months*
(m)	Internet Price Level (100.0 = 1997) Per GB	0.62		0.22	0.21	0.19		*(i) / (l)*
(n)	Internet Price Level Per GB (1.00 = 2017)			0.36	0.33	0.31		*(m) / Value from 2017*
(o)	Average Fixed Broadband Price ($/GB)			$0.12	$0.11	$0.10		*$0.34 / GB (From IDBR (2018)) *(n)*
(p)	Impact ($ Billion, IDBR)			$6.8	$7.0	$7.3	$21.1	*(o) × (c)*
(q)	Impact, 3% Discount ($ Billion, Revenues)			$6.4	$6.4	$6.5	$19.3	*(p) / 1.03%^(Year-2021)*
(r)	Impact, 7% Discount ($ Billion, Revenues)			$5.9	$5.7	$5.6	$17.2	*(p) / 1.07%^(Year-2021)*
URS Based Analysis								
(s)	Internet Price Level Household (1.00 = 2019)			1.00	1.01	1.01		*(i) / Value from 2019*
(t)	Average Fixed Broadband Price ($/GB, URS)			$0.23	$0.21	$0.20		*$79.67 (From URS (2020)) × (s) / (l)*
(u)	Impact ($ Billion, URS)			$12.9	$13.3	$13.8	$40.0	*(c) × (t)*
(v)	Impact, 3% Discount ($ Billion, Revenues)			$12.1	$12.2	$12.3	$36.6	*(u) / 1.03%^(Year-2021)*
(w)	Impact, 7% Discount ($ Billion, Revenues)			$11.2	$10.9	$10.5	$32.7	*(u) / 1.07%^(Year-2021)*

APPENDIX D

FINAL REGULATORY FLEXIBILITY ANALYSIS

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[1] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in *Use of the 5.850-5.925 GHz Band*, Notice of Proposed Rule Making (*NPRM*), ET Docket 19-138.[2] The Commission sought written public comment on the proposals in the *NPRM*, including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[3]

A. Need for, and Objectives of, the First Report and Order

1. There is growing demand for Wi-Fi and other unlicensed applications' access to mid-band spectrum to provide low-cost wireless connectivity in countless products used by American consumers. To meet this demand, we adopt rules to repurpose the 5.850-5.895 GHz portion of the 5.9 GHz band, which when added to the adjacent spectrum available for Unlicensed National Information Infrastructure (U-NII) devices below 5.850 GHz, will allow for increased high-throughput broadband unlicensed applications in spectrum that is a core component of today's unlicensed ecosystem. At the same time, we recognize that the 5.9 GHz band plays an important role in supporting intelligent transportation system (ITS) safety-related transportation and vehicular communications. Therefore, we retain 30 megahertz of spectrum in the 5.895-5.925 GHz portion of the 5.9 GHz band for use by the ITS radio service. In addition, we require ITS licensees to transition its technology from the Dedicated Short Range Communications (DSRC) standard to the Cellular Vehicle to Everything (C-V2X) standard. In the Further Notice of Proposed Rulemaking (Further Notice), we propose to resolve the timing, procedures, and technical parameters associated with the transition of the updated 5.9 GHz band plan.

2. This First Report and Order also promotes unlicensed use of the 5.850-5.895 GHz band as soon as possible. We allow immediate access for unlicensed indoor operations (at specified low power levels) across the 5.850-5.895 GHz band. While the First Report and Order would not permit immediate unlicensed outdoor operations across the 5.850-5.895 GHz band, requests to allow for outdoor unlicensed operations would be considered through our existing regulatory process, which will be coordinated with the National Telecommunications and Information Administration (NTIA) to ensure that federal incumbents are protected from harmful interference. In the Further Notice, we propose to establish the rules for full power outdoor unlicensed operations in 5.850-5.895 GHz band.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

3. There were no comments filed that specifically addressed the rules and polices proposed in the IRFA.

C. Response to comments by the Chief Counsel for Advocacy of the Small Business Administration

4. Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the

[1] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 – 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[2] *See Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, Notice of Proposed Rulemaking, 34 FCC Rcd 12603 (2019) (*5.9 GHz NPRM*).

[3] *See* 5 U.S.C. § 604.

proposed rules as a result of those comments.[4] The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities to Which Rules Will Apply

5. The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if adopted.[5] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[6] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[7] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[8]

6. *Small Businesses, Small Organizations, Small Governmental Jurisdictions.* Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.[9] First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the Small Business Administration's (SBA) Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.[10] These types of small businesses represent 99.9% of all businesses in the United States, which translates to 30.7 million businesses.[11]

7. Next, the type of small entity described as a "small organization" is generally "any not-for-profit enterprise which is independently owned and operated and is not dominant in its field."[12] The Internal Revenue Service (IRS) uses a revenue benchmark of $50,000 or less to delineate its annual electronic filing requirements for small exempt organizations.[13] Nationwide, for tax year 2018, there

[4] 5 U.S.C. § 604 (a)(3).

[5] *See* 5 U.S.C. § 603(b)(3).

[6] 5 U.S.C. § 601(6).

[7] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[8] 15 U.S.C. § 632.

[9] *See* 5 U.S.C. § 601(3)-(6).

[10] *See* SBA, Office of Advocacy, "What's New With Small Business?", https://cdn.advocacy.sba.gov/wp-content/uploads/2019/09/23172859/Whats-New-With-Small-Business-2019.pdf (Sept 2019).

[11] *Id*.

[12] 5 U.S.C. § 601(4).

[13] The IRS benchmark is similar to the population of less than 50,000 benchmark in 5 U.S.C § 601(5) that is used to define a small governmental jurisdiction. Therefore, the IRS benchmark has been used to estimate the number small organizations in this small entity description. *See* Annual Electronic Filing Requirement for Small Exempt Organizations — Form 990-N (e-Postcard), "Who must file,"https://www.irs.gov/charities-non-profits/annual-electronic-filing-requirement-for-small-exempt-organizations-form-990-n-e-postcard. We note that the IRS data does not provide information on whether a small exempt organization is independently owned and operated or dominant in its field.

were approximately 571,709 small exempt organizations in the U.S. reporting revenues of $50,000 or less according to the registration and tax data for exempt organizations available from the IRS.[14]

8. Finally, the small entity described as a "small governmental jurisdiction" is defined generally as "governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand."[15] U.S. Census Bureau data from the 2017 Census of Governments[16] indicate that there were 90,075 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.[17] Of this number there were 36,931 general purpose governments (county,[18] municipal and town or township[19]) with populations of less than 50,000 and 12,040 special purpose governments - independent school districts[20] with enrollment populations of less than 50,000.[21] Accordingly, based on the 2017 U.S. Census of Governments data, we estimate that at least 48,971 entities fall into the category of "small governmental jurisdictions."[22]

9. *Radio Frequency Equipment Manufacturers (RF Manufacturers)*. Neither the Commission nor the SBA has developed a small business size standard applicable to Radio Frequency Equipment Manufacturers (RF Manufacturers). There are several analogous SBA small entity categories

[14] *See* Exempt Organizations Business Master File Extract (EO BMF), "CSV Files by Region," https://www.irs.gov/charities-non-profits/exempt-organizations-business-master-file-extract-eo-bmf. The IRS Exempt Organization Business Master File (EO BMF) Extract provides information on all registered tax-exempt/non-profit organizations. The data utilized for purposes of this description was extracted from the IRS EO BMF data for Region 1-Northeast Area (76,886), Region 2-Mid-Atlantic and Great Lakes Areas (221,121), and Region 3-Gulf Coast and Pacific Coast Areas (273,702) which includes the continental U.S., Alaska, and Hawaii. This data does not include information for Puerto Rico.

[15] 5 U.S.C. § 601(5).

[16] *See* 13 U.S.C. § 161. The Census of Governments survey is conducted every five (5) years compiling data for years ending with "2" and "7." *See also* Census of Governments, https://www.census.gov/programs-surveys/cog/about.html.

[17] *See* U.S. Census Bureau, 2017 Census of Governments – Organization Table 2. Local Governments by Type and State: 2017 [CG1700ORG02]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. Local governmental jurisdictions are made up of general purpose governments (county, municipal and town or township) and special purpose governments (special districts and independent school districts). *See also* Table 2. CG1700ORG02 Table Notes_Local Governments by Type and State_2017.

[18] *See id.* at Table 5. County Governments by Population-Size Group and State: 2017 [CG1700ORG05]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 2,105 county governments with populations less than 50,000. This category does not include subcounty (municipal and township) governments.

[19] *See id. at* Table 6. Subcounty General-Purpose Governments by Population-Size Group and State: 2017 [CG1700ORG06]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 18,729 municipal and 16,097 town and township governments with populations less than 50,000.

[20] *See id.* at Table 10. Elementary and Secondary School Systems by Enrollment-Size Group and State: 2017 [CG1700ORG10]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 12,040 independent school districts with enrollment populations less than 50,000. *See also* Table 4. Special-Purpose Local Governments by State Census Years 1942 to 2017 [CG1700ORG04], CG1700ORG04 Table Notes_Special Purpose Local Governments by State_Census Years 1942 to 2017.

[21] While the special purpose governments category also includes local special district governments, the 2017 Census of Governments data does not provide data aggregated based on population size for the special purpose governments category. Therefore, only data from independent school districts is included in the special purpose governments category.

[22] This total is derived from the sum of the number of general purpose governments (county, municipal and town or township) with populations of less than 50,000 (36,931) and the number of special purpose governments - independent school districts with enrollment populations of less than 50,000 (12,040), from the 2017 Census of Governments - Organizations Tables 5, 6, and 10.

applicable to RF Manufacturers -- Fixed Microwave Services, Other Communications Equipment Manufacturing, and Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. A description of these small entity categories and the small business size standards under the SBA rules are detailed below.

10. *Fixed Microwave Services.* Microwave services include common carrier,[23] private-operational fixed,[24] and broadcast auxiliary radio services.[25] They also include the Upper Microwave Flexible Use Service,[26] Millimeter Wave Service,[27] Local Multipoint Distribution Service (LMDS),[28] the Digital Electronic Message Service (DEMS),[29] and the 24 GHz Service,[30] where licensees can choose between common carrier and non-common carrier status.[31] There are approximately 66,680 common carrier fixed licensees, 69,360 private and public safety operational-fixed licensees, 20,150 broadcast auxiliary radio licensees, 411 LMDS licenses, 33 24 GHz DEMS licenses, 777 39 GHz licenses, and five 24 GHz licenses, and 467 Millimeter Wave licenses in the microwave services.[32] The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite)[33] and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.[34] For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.[35] Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.[36] Thus under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

11. The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small business size standard. Consequently, the Commission estimates that there are up to 36,708

[23] *See* 47 CFR part 101, subparts C and I.

[24] *See* 47 CFR part 101, subparts C and H.

[25] Auxiliary Microwave Service is governed by part 74 of Title 47 of the Commission's Rules. *See* 47 CFR part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

[26] *See* 47 CFR part 30.

[27] *See* 47 CFR part 101, subpart Q.

[28] *See* 47 CFR part 101, subpart L.

[29] *See* 47 CFR part 101, subpart G.

[30] See *id*.

[31] *See* 47 CFR §§ 101.533, 101.1017.

[32] These statistics are based on a review of the Universal Licensing System on September 22, 2015.

[33] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers* (*except Satellite*)," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517312&search=2017%20NAICS%20Search.

[34] *See* 13 CFR § 121.201, NAICS Code 517312 (previously 517210).

[35] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ5, *Information: Subject Series, Estab and Firm Size: Employment Size of Firms for the U.S.: 2012,* NAICS Code 517210, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517210&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false&vintage=2012.

[36] *Id*. The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies discussed herein. We note, however, that the microwave fixed licensee category includes some large entities.

12. *Other Communications Equipment Manufacturing*. This industry comprises establishments primarily engaged in manufacturing communications equipment (except telephone apparatus, and radio and television broadcast, and wireless communications equipment).[37] Examples of such manufacturing include fire detection and alarm systems manufacturing, Intercom systems and equipment manufacturing, and signals (e.g., highway, pedestrian, railway, traffic) manufacturing.[38] The SBA has established a size standard for this industry as all such firms having 750 or fewer employees.[39] U.S. Census Bureau data for 2012 show that 383 establishments operated in that year.[40] Of that number, 379 operated with fewer than 500 employees and 4 had 500 to 999 employees.[41] Based on this data, we conclude that the majority of Other Communications Equipment Manufacturers are small.

13. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*. This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.[42] Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.[43] The SBA has established a size standard for this industry of 1,250 employees or less.[44] U.S. Census Bureau data for 2012 show that 841 establishments operated in this industry in that year.[45] Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.[46] Based on this data, we conclude that a majority of manufacturers in this industry are small.

14. *Wireless Telecommunications Carriers (except Satellite)*. This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide

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[37] *See* U.S. Census Bureau, *2017 NAICS Definitions, "334290 Other Communications Equipment Manufacturing,"* https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=334290&search=2017+NAICS+Search&search=2017.

[38] *Id.*

[39] *See* 13 CFR 121.201, NAICS Code 334290.

[40] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012,* NAICS Code 334290, https://data.census.gov/cedsci/table?text=EC1231SG2&n=334290&tid=ECNSIZE2012.EC1231SG2&hidePreview=false&vintage=2012.

[41] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[42] *See* U.S. Census Bureau, *2017 NAICS Definition*, "*334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=334220&search=2017.

[43] *Id.*

[44] *See* 13 CFR § 121.201, NAICS Code 334220.

[45] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012*, NAICS Code 334220, https://data.census.gov/cedsci/table?text=EC1231SG2&n=334220&tid=ECNSIZE2012.EC1231SG2&hidePreview=false.

[46] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular services, paging services, wireless internet access, and wireless video services.[47] The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.[48] For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.[49] Of this total, 955 firms employed fewer than 1,000 employees and 12 firms employed of 1000 employees or more.[50] Thus under this category and the associated size standard, the Commission estimates that the majority of Wireless Telecommunications Carriers (except Satellite) are small entities.

15. *Automobile Manufacturing.* This U.S. industry comprises establishments primarily engaged in (1) manufacturing complete automobiles (i.e., body and chassis or unibody) or (2) manufacturing automobile chassis only.[51] The SBA has established a size standard for this industry, which is 1,500 employees or less.[52] 2012 U.S. Census Bureau data indicate that 185 establishments operated in this industry that year.[53] Of this number, 162 establishments had employment of fewer than 1,000 employees, and 11 establishments had employment of 1,000 to 2,499 employees.[54] Therefore, the Commission estimates that the majority of manufacturers in this industry are small entities.

16. *Internet Service Providers (Non-Broadband).* Internet access service providers such as Dial-up Internet service providers, VoIP service providers using client-supplied telecommunications connections and Internet service providers using client-supplied telecommunications connections (e.g., dial-up ISPs) fall in the category of All Other Telecommunications.[55] The SBA has developed a small business size standard for All Other Telecommunications which consists of all such firms with gross annual receipts of $35 million or less.[56] For this category, U.S. Census Bureau data for 2012 show that there were 1,442 firms that operated for the entire year.[57] Of these firms, a total of 1,400 had gross annual

[47] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers (except Satellite)*," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517312&search=2017+NAICS+Search&search=2017.

[48] *See* 13 CFR § 121.201, NAICS Code 517312 (previously 517210).

[49] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ5, *Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012*, NAICS Code 517210, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517210&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false&vintage=2012.

[50] *Id*. The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[51] *See* U.S. Census Bureau, *2017 NAICS Definitions, "336111 Automotive Manufacturing,"* https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=336111&search=2017+NAICS+Search&search=2017.

[52] *See* 13 CFR § 121.201, NAICS Code 336111.

[53] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size*: *2012,* NAICS Code 336111, https://data.census.gov/cedsci/table?text=EC1231SG2&n=336111&tid=ECNSIZE2012.EC1231SG2&hidePreview=false. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~336111.

[54] *Id*. The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[55] *See* U.S. Census Bureau, *2017 NAICS Definition, "517919 All Other Telecommunications*," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517919&search=2017+NAICS+Search&search=2017.

[56] *See* 13 CFR § 121.201, NAICS Code 517919.

[57] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ4, *Information: Subject Series - Estab and Firm Size: Receipts Size of Firms for the U.S.: 2012*, NAICS Code 517919,

(continued….)

receipts of less than $25 million.[58] Consequently, under this size standard a majority of firms in this industry can be considered small.

17. *Internet Service Providers (Broadband).* Broadband Internet service providers include wired (e.g., cable, DSL) and VoIP service providers using their own operated wired telecommunications infrastructure fall in the category of Wired Telecommunication Carriers.[59] Wired Telecommunications Carriers are comprised of establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.[60] The SBA size standard for this category classifies a business as small if it has 1,500 or fewer employees.[61] U.S. Census Bureau data for 2012 show that there were 3,117 firms that operated that year.[62] Of this total, 3,083 operated with fewer than 1,000 employees.[63] Consequently, under this size standard the majority of firms in this industry can be considered small.

18. *Cable System Operators (Telecom Act Standard).* The Communications Act of 1934, as amended, also contains a size standard for small cable system operators, which is "a cable operator that, directly or through an affiliate, serves in the aggregate fewer than one percent of all subscribers in the United States and is not affiliated with any entity or entities whose gross annual revenues in the aggregate exceed $250,000,000."[64] As of 2019, there were approximately 48,646,056 basic cable video subscribers in the United States.[65] Accordingly, an operator serving fewer than 486,460 subscribers shall be deemed a small operator if its annual revenues, when combined with the total annual revenues of all its affiliates, do not exceed $250 million in the aggregate.[66] Based on available data, we find that all but five cable operators are small entities under this size standard.[67] We note that the Commission neither requests nor collects information on whether cable system operators are affiliated with entities whose gross annual

https://data.census.gov/cedsci/table?text=EC1251SSSZ4&n=517919&tid=ECNSIZE2012.EC1251SSSZ4&hidePreview=false.

[58] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[59] *See* U.S. Census Bureau, *2017 NAICS Definition, "517311 Wired Telecommunications Carriers,"* https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017.

[60] *Id.*

[61] *See* 13 CFR § 121.201, NAICS Code 517311 (previously 517110).

[62] *See* U.S. Census Bureau, *2012 Economic Census of the United States,* Table ID: EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms for the U.S.*: *2012*, NAICS Code 517110, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517110&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false.

[63] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[64] 47 U.S.C. § 543(m)(2); *see also* 47 CFR § 76.901(e).

[65] S&P Global Market Intelligence, *U.S. Cable Subscriber Highlights, Basic Subscribers(actual) 2019*, *U.S. Cable MSO Industry Total, see also U.S. Multichannel Industry Benchmarks, U.S. Cable Industry Benchmarks, Basic Subscribers 2019Y, https://platform.marketintelligence.spglobal.com.*

[66] 47 CFR § 76.901(e).

[67] S&P Global Market Intelligence, *Top Cable MSOs as of 12/2019, https://platform.marketintelligence.spglobal.com.* The five cable operators all had more than 486,460 basic cable subscribers.

revenues exceed $250 million.[68] Therefore, we are unable at this time to estimate with greater precision the number of cable system operators that would qualify as small cable operators under the definition in the Communications Act.

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

19. In this First Report and Order, we adopt rules that require ITS licensees to cease use of the 5.850-5.895 GHz band one year following the effective date of the First Report and Order, operate in only the 5.895-5.925 GHz band thereon, and acknowledge compliance with that requirement with the Commission. We expect that all the filing, recordkeeping and reporting requirements associated with the adopted rules will be the same for large and small businesses. In addition, we believe that this rulemaking, by expanding the availability of unlicensed devices in the 5.850-5.895 GHz band, would provide an advantage to small entities, as these entities would benefit from being able to access this spectrum over a wide geographic area and frequency range without the complication or cost of needing to obtain a license. On balance, this would constitute a significant benefit for small businesses.

F. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

20. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[69]

21. In repurposing the 5.850-5.895 GHz band for unlicensed use, we expect to realize substantial benefits by expanding Wi-Fi capacity for small and large entities alike. At the same time, by preserving 30 megahertz of spectrum in the 5.895-5.925 GHz band for ITS use, the rules adopted in the First Report & Order will be sufficient for the current and future ITS licensees to continue to offer such service in the band. We believe that we have streamlined these rules appropriately to afford small entities new opportunities to access that spectrum in a cost-effective manner. We find that the public interest is best served by addressing the needs of both ITS and unlicensed users for access to distinct parts of the 5.9 GHz band. The adopted rules for unlicensed indoor operation in the 5.850-5.895 GHz band are designed to prevent the unlicensed devices from causing harmful interference to the licensed ITS services operating in the band prior to the deadline for ceasing use of the 5.850-5.895 GHz band. Consequently, we do not expect that the current and future licensees in the band, including small entities, would experience a significant economic impact from additional unlicensed use of the spectrum that would be permitted under the adopted rules.

22. The regulatory burdens, such as filing applications on appropriate forms, are necessary in order to ensure that the public receives the benefits of 5.9 GHz band in a prompt and efficient manner and apply equally to large and small entities, thus without differential impact. We will continue to examine alternatives in the future with the objective of eliminating unnecessary regulations and minimizing any significant impact on small entities.

Report to Congress:

The Commission will send a copy of the First Report & Order, including this FRFA, in a report to be sent

[68] The Commission does receive such information on a case-by-case basis if a cable operator appeals a local franchise authority's finding that the operator does not qualify as a small cable operator pursuant to § 76.901(e) of the Commission's rules. *See* 47 CFR § 76.910(b).

[69] 5 U.S.C. § 603(c)(1)-(c)(4).

to Congress pursuant to the Congressional Review Act.[70] In addition, the Commission will send a copy of the First Report & Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the First Report & Order, including this FRFA (or summaries thereof), will also be published in the Federal Register.[71]

[70] *See* 5 U.S.C. § 801(a)(1)(A).

[71] *See* 5 U.S.C. § 604(b).

APPENDIX E

INITIAL REGULATORY FLEXIBILITY ANALYSIS

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[1] the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this *Use of the 5.850-5.925 GHz Band*, Further Notice of Proposed Rulemaking (Further Notice). Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the Further Notice provided in the item. The Commission will send a copy of the Further Notice, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).[2] In addition, the Further Notice and IRFA (or summaries thereof) will be published in the Federal Register.[3]

A. Need for, and Objectives of, the Proposed Rules

1. In 1999, the Commission reserved 75 megahertz in the 5.9 GHz band (5.850-5.925 GHz) for Intelligent Transportation System (ITS) services designed to enable transportation and vehicular safety-related communications. Since that time, the service's deployment has been relatively limited within the consumer automobile market. Recently, cellular vehicle to everything (C-V2X), based on a different radio technology standard that is incompatible with the current Dedicated Short Range Communications (DSRC) technology, has gained momentum as a means of providing transportation and vehicle safety-related communications.

2. Meanwhile, there is growing demand for Wi-Fi and other unlicensed applications' access to mid-band spectrum to provide low-cost wireless connectivity in countless products used by American consumers. In various proceedings over the past two decades, the Commission has established and expanded the spectrum available for Unlicensed National Information Infrastructure (U-NII) devices throughout the mid-band spectrum located in the 5 GHz band. As a result, for many years most of the spectrum between 5.150 GHz and the lower edge of the 5.9 GHz band (at 5.850 GHz) has been available for unlicensed operations. Recently, the spectrum at the upper edge of the 5.9 GHz band from 5.925 GHz-7.125 GHz also was made available for these operations.

3. In December 2019, the Commission initiated a Notice of Proposed Rulemaking to take a fresh and comprehensive look at the 5.9 GHz band rules and propose appropriate changes to focus on the deployment of core automobile safety communications while freeing up spectrum for Wi-Fi and other unlicensed services. In the resulting First Report and Order, we (1) adopted rules to repurpose 45 megahertz of spectrum in the 5.850-5.895 GHz band from the ITS radio service to U-NII operations; (2) allowed immediate access for unlicensed indoor operations (at specified low power levels) across the 5.850-5.895 GHz band; retained 30 megahertz of spectrum in the 5.895-5.925 GHz band for use by safety-related transportation and vehicular communications in the ITS radio service; required ITS licensees to operate in only the 5.895-5.925 GHz band and cease use of the 5.850-5.895 GHz band one year following the effective date of the First Report and Order; (5) required the transition of the ITS radio service standard from the DSRC technology to the C-V2X technology.

4. In this Further Notice, we propose to resolve the timing, procedures, and technical parameters associated with the transition of the updated 5.9 GHz band plan. Specifically, the Further Notice proposes to allow full-power outdoor unlicensed operations across the 5.850-5.895 GHz band once ITS operations have exited this portion of the band and subject to any further necessary protections for

[1] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601–612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[2] *See* 5 U.S.C. § 603(a).

[3] *See* 5 U.S.C. § 603(a).

federal operations in this spectrum. The draft also seeks to establish power and emission limits and other rules related to outdoor unlicensed operations in the lower 45 megahertz of the band. The draft would address transitioning all ITS operations in the revised ITS band at 5.895-5.925 GHz to C-V2X-based technology, including the appropriate timeline for implementation, and the codification of C-V2X technical parameters for operation in the 5.895-5.925 GHz band. The Further Notice would also seek comment on whether the Commission should consider allocating additional spectrum for ITS applications in the future.

B. Legal Basis

5. The proposed action is taken authority found in sections 1, 4(i), 301, 302, 303, 309, 316, and 332 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 301, 302, 303, 309, 316, and 332, and section 1.411 of the Commission's Rules, 47 CFR § 1.411.

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules Will Apply

6. The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if adopted.[4] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[5] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[6] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[7]

7. *Small Businesses, Small Organizations, Small Governmental Jurisdictions.* Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.[8] First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the Small Business Administration's (SBA) Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.[9] These types of small businesses represent 99.9% of all businesses in the United States, which translates to 30.7 million businesses.[10]

8. Next, the type of small entity described as a "small organization" is generally "any not-for-profit enterprise which is independently owned and operated and is not dominant in its field."[11] The Internal Revenue Service (IRS) uses a revenue benchmark of $50,000 or less to delineate its annual

[4] *See* 5 U.S.C. § 603(b)(3).

[5] 5 U.S.C. § 601(6).

[6] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[7] 15 U.S.C. § 632.

[8] *See* 5 U.S.C. § 601(3)-(6).

[9] *See* SBA, Office of Advocacy, "What's New With Small Business?", https://cdn.advocacy.sba.gov/wp-content/uploads/2019/09/23172859/Whats-New-With-Small-Business-2019.pdf (Sept 2019).

[10] *Id*.

[11] 5 U.S.C. § 601(4).

electronic filing requirements for small exempt organizations.[12] Nationwide, for tax year 2018, there were approximately 571,709 small exempt organizations in the U.S. reporting revenues of $50,000 or less according to the registration and tax data for exempt organizations available from the IRS.[13]

9. Finally, the small entity described as a "small governmental jurisdiction" is defined generally as "governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand."[14] U.S. Census Bureau data from the 2017 Census of Governments[15] indicate that there were 90,075 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.[16] Of this number there were 36,931 general purpose governments (county,[17] municipal and town or township[18]) with populations of less than 50,000 and 12,040 special purpose governments - independent school districts[19] with enrollment

[12] The IRS benchmark is similar to the population of less than 50,000 benchmark in 5 U.S.C § 601(5) that is used to define a small governmental jurisdiction. Therefore, the IRS benchmark has been used to estimate the number small organizations in this small entity description. S*ee* Annual Electronic Filing Requirement for Small Exempt Organizations — Form 990-N (e-Postcard), "Who must file,"https://www.irs.gov/charities-non-profits/annual-electronic-filing-requirement-for-small-exempt-organizations-form-990-n-e-postcard. We note that the IRS data does not provide information on whether a small exempt organization is independently owned and operated or dominant in its field.

[13] *See* Exempt Organizations Business Master File Extract (EO BMF), "CSV Files by Region," https://www.irs.gov/charities-non-profits/exempt-organizations-business-master-file-extract-eo-bmf. The IRS Exempt Organization Business Master File (EO BMF) Extract provides information on all registered tax-exempt/non-profit organizations. The data utilized for purposes of this description was extracted from the IRS EO BMF data for Region 1-Northeast Area (76,886), Region 2-Mid-Atlantic and Great Lakes Areas (221,121), and Region 3-Gulf Coast and Pacific Coast Areas (273,702) which includes the continental U.S., Alaska, and Hawaii. This data does not include information for Puerto Rico.

[14] 5 U.S.C. § 601(5).

[15] *See* 13 U.S.C. § 161. The Census of Governments survey is conducted every five (5) years compiling data for years ending with "2" and "7." *See also* Census of Governments, https://www.census.gov/programs-surveys/cog/about.html.

[16] *See* U.S. Census Bureau, 2017 Census of Governments – Organization Table 2. Local Governments by Type and State: 2017 [CG1700ORG02]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. Local governmental jurisdictions are made up of general purpose governments (county, municipal and town or township) and special purpose governments (special districts and independent school districts). *See also* Table 2. CG1700ORG02 Table Notes_Local Governments by Type and State_2017.

[17] *See id.* at Table 5. County Governments by Population-Size Group and State: 2017 [CG1700ORG05]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 2,105 county governments with populations less than 50,000. This category does not include subcounty (municipal and township) governments.

[18] *See id. at* Table 6. Subcounty General-Purpose Governments by Population-Size Group and State: 2017 [CG1700ORG06]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 18,729 municipal and 16,097 town and township governments with populations less than 50,000.

[19] *See id.* at Table 10. Elementary and Secondary School Systems by Enrollment-Size Group and State: 2017 [CG1700ORG10]. https://www.census.gov/data/tables/2017/econ/gus/2017-governments.html. There were 12,040 independent school districts with enrollment populations less than 50,000. *See also* Table 4. Special-Purpose Local Governments by State Census Years 1942 to 2017 [CG1700ORG04], CG1700ORG04 Table Notes_Special Purpose Local Governments by State_Census Years 1942 to 2017.

populations of less than 50,000.[20] Accordingly, based on the 2017 U.S. Census of Governments data, we estimate that at least 48,971 entities fall into the category of "small governmental jurisdictions."[21]

10. *Radio Frequency Equipment Manufacturers (RF Manufacturers)*. Neither the Commission nor the SBA has developed a small business size standard applicable to Radio Frequency Equipment Manufacturers (RF Manufacturers). There are several analogous SBA small entity categories applicable to RF Manufacturers -- Fixed Microwave Services, Other Communications Equipment Manufacturing, and Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. A description of these small entity categories and the small business size standards under the SBA rules are detailed below.

11. *Fixed Microwave Services.* Microwave services include common carrier,[22] private-operational fixed,[23] and broadcast auxiliary radio services.[24] They also include the Upper Microwave Flexible Use Service,[25] Millimeter Wave Service,[26] Local Multipoint Distribution Service (LMDS),[27] the Digital Electronic Message Service (DEMS),[28] and the 24 GHz Service,[29] where licensees can choose between common carrier and non-common carrier status.[30] There are approximately 66,680 common carrier fixed licensees, 69,360 private and public safety operational-fixed licensees, 20,150 broadcast auxiliary radio licensees, 411 LMDS licenses, 33 24 GHz DEMS licenses, 777 39 GHz licenses, and five 24 GHz licenses, and 467 Millimeter Wave licenses in the microwave services.[31] The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite)[32] and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.[33] For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the

[20] While the special purpose governments category also includes local special district governments, the 2017 Census of Governments data does not provide data aggregated based on population size for the special purpose governments category. Therefore, only data from independent school districts is included in the special purpose governments category.

[21] This total is derived from the sum of the number of general purpose governments (county, municipal and town or township) with populations of less than 50,000 (36,931) and the number of special purpose governments - independent school districts with enrollment populations of less than 50,000 (12,040), from the 2017 Census of Governments - Organizations Tables 5, 6, and 10.

[22] *See* 47 CFR part 101, subparts C and I.

[23] *See* 47 CFR part 101, subparts C and H.

[24] Auxiliary Microwave Service is governed by part 74 of title 47 of the Commission's rules. *See* 47 CFR part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

[25] *See* 47 CFR part 30.

[26] *See* 47 CFR part 101, subpart Q.

[27] *See* 47 CFR part 101, subpart L.

[28] *See* 47 CFR part 101, subpart G.

[29] See *id*.

[30] *See* 47 CFR §§ 101.533, 101.1017.

[31] These statistics are based on a review of the Universal Licensing System on September 22, 2015.

[32] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers* (*except Satellite*)," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517312&search=2017%20NAICS%20Search.

[33] *See* 13 CFR § 121.201, NAICS Code 517312 (previously 517210).

entire year.[34] Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.[35] Thus under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

12. The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small business size standard. Consequently, the Commission estimates that there are up to 36,708 common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies discussed herein. We note, however, that the microwave fixed licensee category includes some large entities.

13. *Other Communications Equipment Manufacturing*. This industry comprises establishments primarily engaged in manufacturing communications equipment (except telephone apparatus, and radio and television broadcast, and wireless communications equipment).[36] Examples of such manufacturing include fire detection and alarm systems manufacturing, Intercom systems and equipment manufacturing, and signals (e.g., highway, pedestrian, railway, traffic) manufacturing.[37] The SBA has established a size standard for this industry as all such firms having 750 or fewer employees.[38] U.S. Census Bureau data for 2012 show that 383 establishments operated in that year.[39] Of that number, 379 operated with fewer than 500 employees and 4 had 500 to 999 employees.[40] Based on this data, we conclude that the majority of Other Communications Equipment Manufacturers are small.

14. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*. This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment.[41] Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.[42] The SBA has established a size standard for this industry of 1,250 employees

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[34] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ5*, Information: Subject Series, Estab and Firm Size: Employment Size of Firms for the U.S.: 2012,* NAICS Code 517210, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517210&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false&vintage=2012.

[35] *Id*. The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[36] *See* U.S. Census Bureau, *2017 NAICS Definitions, "334290 Other Communications Equipment Manufacturing,*" https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=334290&search=2017+NAICS+Search&search=2017.

[37] *Id.*

[38] *See* 13 CFR 121.201, NAICS Code 334290.

[39] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012,* NAICS Code 334290, https://data.census.gov/cedsci/table?text=EC1231SG2&n=334290&tid=ECNSIZE2012.EC1231SG2&hidePreview=false&vintage=2012.

[40] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[41] *See* U.S. Census Bureau, *2017 NAICS Definition*, "*334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=334220&search=2017.

[42] *Id.*

or less.[43] U.S. Census Bureau data for 2012 show that 841 establishments operated in this industry in that year.[44] Of that number, 828 establishments operated with fewer than 1,000 employees, 7 establishments operated with between 1,000 and 2,499 employees and 6 establishments operated with 2,500 or more employees.[45] Based on this data, we conclude that a majority of manufacturers in this industry are small.

15. *Wireless Telecommunications Carriers (except Satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular services, paging services, wireless internet access, and wireless video services.[46] The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.[47] For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.[48] Of this total, 955 firms employed fewer than 1,000 employees and 12 firms employed of 1000 employees or more.[49] Thus under this category and the associated size standard, the Commission estimates that the majority of Wireless Telecommunications Carriers (except Satellite) are small entities.

16. *Automobile Manufacturing.* This U.S. industry comprises establishments primarily engaged in (1) manufacturing complete automobiles (i.e., body and chassis or unibody) or (2) manufacturing automobile chassis only.[50] The SBA has established a size standard for this industry, which is 1,500 employees or less.[51] 2012 U.S. Census Bureau data indicate that 185 establishments operated in this industry that year.[52] Of this number, 162 establishments had employment of fewer than 1,000

[43] *See* 13 CFR § 121.201, NAICS Code 334220.

[44] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012*, NAICS Code 334220, https://data.census.gov/cedsci/table?text=EC1231SG2&n=334220&tid=ECNSIZE2012.EC1231SG2&hidePreview=false.

[45] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[46] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers (except Satellite)," https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517312&search=2017+NAICS+Search&search=2017*.

[47] *See* 13 CFR § 121.201, NAICS Code 517312 (previously 517210).

[48] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ5, *Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012*, NAICS Code 517210, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517210&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false&vintage=2012.

[49] *Id*. The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[50] *See* U.S. Census Bureau, *2017 NAICS Definitions, "336111 Automotive Manufacturing", https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=336111&search=2017+NAICS+Search&search=2017.*

[51] *See* 13 CFR § 121.201, NAICS Code 336111.

[52] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1231SG2, *Manufacturing: Summary Series: General Summary: Industry Statistics for Subsectors and Industries by Employment Size: 2012,* NAICS Code 336111, https://data.census.gov/cedsci/table?text=EC1231SG2&n=336111&tid=ECNSIZE2012.EC1231SG2&hidePreview=false. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~336111.

employees, and 11 establishments had employment of 1,000 to 2,499 employees.[53] Therefore, the Commission estimates that the majority of manufacturers in this industry are small entities.

17. *Internet Service Providers (Non-Broadband).* Internet access service providers such as Dial-up Internet service providers, VoIP service providers using client-supplied telecommunications connections and Internet service providers using client-supplied telecommunications connections (e.g., dial-up ISPs) fall in the category of All Other Telecommunications.[54] The SBA has developed a small business size standard for All Other Telecommunications which consists of all such firms with gross annual receipts of $35 million or less.[55] For this category, U.S. Census Bureau data for 2012 show that there were 1,442 firms that operated for the entire year.[56] Of these firms, a total of 1,400 had gross annual receipts of less than $25 million.[57] Consequently, under this size standard a majority of firms in this industry can be considered small.

18. *Internet Service Providers (Broadband).* Broadband Internet service providers include wired (e.g., cable, DSL) and VoIP service providers using their own operated wired telecommunications infrastructure fall in the category of Wired Telecommunication Carriers.[58] Wired Telecommunications Carriers are comprised of establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.[59] The SBA size standard for this category classifies a business as small if it has 1,500 or fewer employees.[60] U.S. Census Bureau data for 2012 show that there were 3,117 firms that operated that year.[61] Of this total, 3,083 operated with fewer than 1,000 employees.[62] Consequently, under this size standard the majority of firms in this industry can be considered small.

19. *Cable System Operators (Telecom Act Standard).* The Communications Act of 1934, as amended, also contains a size standard for small cable system operators, which is "a cable operator that, directly or through an affiliate, serves in the aggregate fewer than one percent of all subscribers in the United States and is not affiliated with any entity or entities whose gross annual revenues in the aggregate

[53] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[54] *See* U.S. Census Bureau, *2017 NAICS Definition, "517919 All Other Telecommunications,"* https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=517919&search=2017+NAICS+Search&search=2017.

[55] *See* 13 CFR § 121.201, NAICS Code 517919.

[56] *See* U.S. Census Bureau, *2012 Economic Census of the United States*, Table ID: EC1251SSSZ4, *Information: Subject Series - Estab and Firm Size: Receipts Size of Firms for the U.S.: 2012*, NAICS Code 517919, https://data.census.gov/cedsci/table?text=EC1251SSSZ4&n=517919&tid=ECNSIZE2012.EC1251SSSZ4&hidePreview=false.

[57] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[58] *See* U.S. Census Bureau, *2017 NAICS Definition, "517311 Wired Telecommunications Carriers,"* https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017.

[59] *Id.*

[60] *See* 13 CFR § 121.201, NAICS Code 517311 (previously 517110).

[61] *See* U.S. Census Bureau, *2012 Economic Census of the United States,* Table ID: EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms for the U.S.*: *2012*, NAICS Code 517110, https://data.census.gov/cedsci/table?text=EC1251SSSZ5&n=517110&tid=ECNSIZE2012.EC1251SSSZ5&hidePreview=false.

[62] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

exceed $250,000,000."[63] As of 2019, there were approximately 48,646,056 basic cable video subscribers in the United States.[64] Accordingly, an operator serving fewer than 486,460 subscribers shall be deemed a small operator if its annual revenues, when combined with the total annual revenues of all its affiliates, do not exceed $250 million in the aggregate.[65] Based on available data, we find that all but five cable operators are small entities under this size standard.[66] We note that the Commission neither requests nor collects information on whether cable system operators are affiliated with entities whose gross annual revenues exceed $250 million.[67] Therefore, we are unable at this time to estimate with greater precision the number of cable system operators that would qualify as small cable operators under the definition in the Communications Act.

20. *Intelligent Transportation System (ITS).* The Commission's own data—available in its Universal Licensing System—indicate that, as of October 26, 2020, there are 124 active ITS licenses in the Commission's database that will be affected by our actions.[68] An authorization to operate in the ITS service may be obtained by any territory, possession, state, city, county, town, or similar governmental entity, and any public safety or industrial/business entity meeting the pertinent eligibility requirements. Prior to operation, applicants are issued a non-exclusive, geographic area license: governmental entities are authorized based on that entity's legal jurisdictional area of operations; and non-governmental entities are licensed based on each applicant's area of operation (i.e., by county, state, multi-state, or nationwide). 91 licensees are considered "public safety eligible" with the remaining 33 qualified under the Industrial/Business Pool requirements. The Commission does not know how many of these licensees are small, as the Commission does not collect that information for these types of entities.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

21. The Further Notice proposes rules that will affect reporting and other compliance requirements.

22. The Further Notice proposes to resolve the timing, procedures, and technical parameters associated with the transition of the updated 5.9 GHz band plan. Specifically, the Further Notice proposes to allow full-power outdoor unlicensed operations across the 5.850-5.895 GHz band once ITS operations have exited this portion of the band and subject to any further necessary protections for federal operations in this spectrum. The Further Notice also seeks to establish power and emission limits and other rules related to outdoor unlicensed operations in the lower 45 megahertz of the band. The Further Notice addresses transitioning all ITS operations in the revised ITS band at 5.895-5.925 GHz to C-V2X-based technology, including the appropriate timeline for implementation, and the codification of C-V2X technical parameters for operation in the 5.895-5.925 GHz band. The Further Notice also seeks comment

[63] 47 U.S.C. § 543(m)(2); *see also* 47 CFR § 76.901(e).

[64] S&P Global Market Intelligence, *U.S. Cable Subscriber Highlights, Basic Subscribers(actual) 2019*, *U.S. Cable MSO Industry Total, see also U.S. Multichannel Industry Benchmarks, U.S. Cable Industry Benchmarks, Basic Subscribers 2019Y, https://platform.marketintelligence.spglobal.com.*

[65] 47 CFR § 76.901(e).

[66] S&P Global Market Intelligence, *Top Cable MSOs as of 12/2019, https://platform.marketintelligence.spglobal.com.* The five cable operators all had more than 486,460 basic cable subscribers.

[67] The Commission does receive such information on a case-by-case basis if a cable operator appeals a local franchise authority's finding that the operator does not qualify as a small cable operator pursuant to § 76.901(e) of the Commission's rules. *See* 47 CFR § 76.910(b).

[68] *See* Federal Communications Commission, *Universal Licensing System*, http://wireless.fcc.gov/uls. For the purposes of this (IRFA), consistent with Commission practice for wireless services, the Commission estimates the number of licensees based on the number of unique FCC Registration Numbers.

on whether the Commission should consider allocating additional spectrum for ITS applications in the future.

23. This transition will require the Commission, licensees, and manufacturers to take certain actions, such as designing and operating unlicensed devices and C-V2X equipment per the Commission's revised rules.

E. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

24. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[69]

25. The proposals that would require equipment modification or new equipment manufacturing would have an impact on equipment manufacturers, some of which may be small entities. Though we believe that our proposed technical rules for U-NII devices and ITS equipment would provide appropriate rules for this band, we seek comment on alternatives that are based on the existing rules or some other regulatory scheme, with regard to, e.g., power limits and out-of-band emissions limits.

26. The regulatory burdens we have proposed are necessary in order to ensure that the public receives the benefits of innovative services and technologies in a prompt and efficient manner and apply equally to large and small entities, thus without differential impact. We seek comment on any alternatives, and whether the pros and cons of leaving these choices to the industry will assist in reaching the best outcomes. We will continue to examine alternatives in the future with the objectives of eliminating unnecessary regulations and minimizing any significant impact on small entities.

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rules

None.

[69] *See* 5 U.S.C. § 603(c).

APPENDIX F

List of Commenters

5G Americas
5G Automotive Association
A. Catherine Reid, PE
AAA
ACEA, CLEPA
Advocates for Highway and Auto Safety
Airbus UM
Airbus Urban Mobility
Alan R. Chapman, Thomas A. Sever, B. Alexander Hofelich (Gwinnett County Department of Transportation)
Alexandre Petrescu
Alliance for Automotive Innovation
Alliance of Automobile Manufacturers
Aly Geller, Stephen Bingham, Alvin Lester, Julie Mitchell, John Alex Lowell, Fenell Doyle, Jen Holt, Nancy Harrison, Jenny Yu, Amanda Lamb
Alyssa Ryan
Amanda Erickson
Amateur Radio
Amateur Television Network
Amateur Television Network - California Chapter
American Association of State Highway and Transportation Officials (AASHTO)
American Highway Users Alliance
American Honda Motor Co., Inc.
American Public Transportation Association
American Public Works Association (APWA)
American Society of Civil Engineers (ASCE)
American Traffic Safety Services Association
American Trucking Associations
Amul Gadhia
Amy MacKinnon
Andrew Kading
Andrew Ludlum
Ann Dorsey

Applied Information Inc.

Applied Information Inc., Temple, Inc., Traffic Products LLC

AREDN

Argo AI, LLC

Arizona Chapter, Amateur Television Network

Arkansas Department of Transportation

ARRL, National Association of Amateur Radio

Association of Global Automakers, Inc.

Association of Metropolitan Planning Organizations

AT&T Services, Inc.

August H Johnson

Automotive Safety Council

Autonomy Institute

Autotalks

Ben McFarlin

Benjamin K. Derry

Benjamin Mills

Bill Panos

Blayne Ence, Tracy Ence

BMW Group – AJ6AW

Bob Thorpe

Brandon Kay

Brett Popovich

Brian Heinitz

Brian L Short

Brian Worley, Association of Oregon Counties, Oregon Association of County Engineers and Surveyors

Brian Yee

Broadcom Inc.

Broadcom, Inc., CableLabs, Facebook, Inc., NCTA - The Internet & Television Association

Broadcom, Inc., Facebook, Inc.

Bruce Billedeaux

Bruce D. Bonbright

Bruce M. Warren

Burton Peake

C. Rantala

California Department of Transportation
Candace A. Miller – KE6KYA
Car 2 Car Communication Consortium
Carlos Crespo
Center for Auto Safety
Chad J Gross – W0SAV
Charles A. Moorwood
Charles E. Gelm
Charter Communications, Inc.
Chris Spear, President & CEO American Trucking Associations
Christopher Parise
Christopher Peters
Christopher S. Webster
Chuck DeWeese
Cintra US
Cirrus Aircraft
Cisco Systems, Inc.
Citizens Against Government Waste
Citizens Against Government Waste, Innovation Economy Institute, Institute for Freedom, TechFreedom, American Commitment, Institute for Policy Innovation, Less Government, Market Institute, FreedomWorks, Taxpayers Protection Alliance, Center for Individual Freedom, Innovation Defense, National Taxpayers Union, Lincoln Network, American Conservative Union, American Legislative Exchange Council, ALEC Action, Consumer Action for a Strong Economy, Americans for Tax Reform, Digital Liberty, Technology & Democracy Project of the Discovery Institute
City of Arlington, Texas
City of Fremont
City of Frisco, Texas
Cohda Wireless Pty Ltd
Collin Mooney
Colorado Department of Transportation
Comcast Corporation
Commercial Vehicle Safety Alliance
Commercial Vehicle Training Association
Commsignia, Inc.
Competitive Enterprise Institute

Connecticut Department of Transportation
Consumer Action for a Strong Economy, Inc.
Consumer Reports
Continental AG
Continental Automotive Systems
Contra Costa Transportation Authority (CCTA)
Damon Schaefer
Dan D. Tomlinson
Dan Tomlinson
Daniel Krones
Daniel Sohn, Juliet A Sohn
Daniel Ruderman
Darryl Quinn
David A. Lathrop, PhD
David Bauer
David Bell
David Hinkley
David J. Kreizinger
David Kaczorowski
David Molinaro
David West
David Williams
Denis J Couture
Dennis A. Yard
Dennis Baker
DENSO Corporation
Denso International America, Inc.
DJI Technology, Inc.
Donald Backstrom
Donald Hill
Dr. Richard Roy
DriveOhio
DSRC Auto Safety Coalition
Dwight A. Henderson
Dynamic Spectrum Alliance

Edward S. Colonna, K4ESC
Elizabeth Pestolesi
Emiko Thompson, Los Angeles County Public Works
Energy Security Leadership Council (ESLC), Securing America's Future Energy (SAFE)
Engine
Environmental Health Trust
Eric Satterlee
Facebook, Inc.
Faller, Davis and Associates, Inc.
Farren Constable
FCA US LLC
Ford Motor Company
Gary Hinton
Gary Spurr
Gary Thomas
General Aviation Manufacturers Association
General Motors LLC
Georenz Koo
Georgia Department of Transportation
Georgia Lieutenant Governors Office, Georgia DOT, Forsyth County, Atlanta Regional Commission, KCI Technologies, Greater North Fulton Chamber, North Fulton CID, Gresham Smith, Kimley Horn, City of Alpharetta, City of Johns Creek, Stantec Consulting Services, Intelligent Transportation Society - Georgia, Georgia Institute of Technology, Modern Mobility Partners, Atlas Technical Consultants, Utilicom Supply, City of Savannah, Aerotropolis Atlanta CID, Applied Information, Inc, Gwinnett County, Cobb County DOT, Metropolitan Atlanta Rapid Transit Authority, Douglas County DOT, City of Roswell, Barge Design Solutions, HNTB, ACEC Georgia, State Road and Tollway Authority, Georgia Regional Transportation Authority, Atlanta-region Transit Link Authority, Clayton County
German Association of the Automotive Industry
Government Wireless Technology & Communications Association
Governor Bill Lee, State of Tennessee
Gregory T. Lane - K7SDW
Guy S. Chabot
HARMAN International Inc.
Harvey Chin
Hawaii Bicycling League

Heidi Brewer
Heidi J Williams
Hyundai America Technical Center, Inc.
IEEE 1609 Working Group
IEEE 802 LAN/MAN Standards Committee
Innovation Economy Institute, International Center for Law and Economics, Citizens Against Government Waste, Taxpayers Protection Alliance, American Commitment, American Conservative Union, Innovation Defense Foundation, Consumer Action for a Strong Economy, Lincoln Network, Digital Liberty, Center for Individual Freedom, Institute for Policy Innovation, FreedomWorks, Market Institute, National Taxpayers Union, Discovery Institute, Less Government
Institute for Policy Innovation, Dan Garretson
Institute of Transportation Engineers
Intel Corp.
Intelligent Transportation Society of America
Intelligent Transportation Society of America, American Association of State Highway and Transportation Officials
Intelligent Transportation Society of Michigan
International Association of Fire Chiefs
International Association of Fire Fighters
International Center for Law & Economics
International Municipal Signal Association
ISO/TC 204 Intelligent Transport Systems
J. Allison Hollier
J. S. Paige
Jaguar Land Rover Limited
James Bass, Texas Department of Transportation
James C Merritt - KK4IUH
James Dahl
James Erickson, Mansfield Johnson Radio Service
James Gatwood
James J. Stagnone
James Laning
James Nelson
James R. Walls
James S. Paige

James Strasma - N9ZKP

Jason Baack

Jason Levine - Center for Auto Safety

Jeff Beck

Jeff Orr

Jeff Palmer

Jeff Phillips

Jeffrey D. Hendricks

Jeffrey Libby

Jeremiah Bagula

Jeremy Jackson - KE7MWG

Jesse Kanda

Joanna Pinkerton, Patrick Harris

Joe K. Gillis

Joe Kane, Will Rinehart

Joel Jundt, SDDOT

Joel Kelley

John E. Davis

John Hickey

John Penney - AA6JN

John Skier

Jon M. Peha

Jonathan F. Blincoe

Jonathan Riehl, PhD, PE

Jordan Mills

Jose Melendres

Joseph B. Allee - KD6MJR

Joseph David Cook

Joseph W. Partlow

Joseph William Hutchinson

Judy Cox

Julie Evans

Julie McGrew

Juniper Networks

KA7HAK, Chad Smith

Karl MacNair, PE

Katherine Yehl, Volvo Cars

Kathleen Freitag, A.J. O'Connor

Keith S. Gordon

Kenneth Hutchinson - K6KWH

Kenneth Vaughn

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Kyle Henderson

L. Stephen Bell

Larry Kapp

Larry Trullinger

League of American Bicyclists, East Coast Greenway, Bicycle Advocacy of Central Arkansas, California Association of Bicycling Organizations, San Diego County Bicycle Coalition, BikeWalkSolana, Florida Bicycle Association, Georgia Bikes, Treasure Valley Safe Routes to School Program, Ride Illinois, Friends of Cycling Elk Grove, Bicycle Indiana, Bicyclists of Iowa City, MassBike, Bicycle Alliance of Minnesota, Missouri Bicycle & Pedestrian Federation, BikeWalkKC, New Jersey Bike & Walk Coalition, Law Office of Diane Albert, Long Island Steets, Inc, Po Campo Company, Transportation Alternatives NYC, Bike Cleveland, Bicycle Coalition of Greater Philadelphia, Bike Pittsburgh, Palmetto Cycling Coalition, Walk/Bike Nashville, Local Motion- Burlington, VT, Cascade Bicycle Club, West Virginia Connecting Communities, Wyoming Pathways

Lenora R Allee - KE6IRH

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Loren Kellogg - KE7RXD

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Macomb County Department of Roads, Director Bryan Santo, John Abraham

Mansfield-Johnson Amateur Radio Service

Marc Longstreet

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Matthew E. "Matt" Moore, M.A., Idaho Transportation Department

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Matthew Letourneau

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MEMA

Michael H. Stevens

Michael H. Stevens, City of Columbus, Smart Columbus

Michael J. Bailey

Michael Kelly

Michael Newman

Michael T. Schlenker

Michigan Department of Transportation

Microsoft Corporation

Mineta Transportation Institute

Mitchell Mouser

Montana Department of Transportation Director Mike Tooley

Morgan Collins

Motor & Equipment Manufacturers Association (MEMA)

Mr. Gregory Slater, Secretary, Maryland Department of Transportation

NAFA Fleet Management Association

Nathan Fernaays

National Association of City Transportation Officials

National Electrical Manufacturers Association (NEMA)

National Federation of the Blind

National Public Safety Telecommunications Council

National Safety Council
National School Transportation Association
National Sheriffs' Association
National Telecommunications and Information Administration
NCTA - The Internet & Television Association
Neil Gray, Patrick Jones
Niels Peter Skov Andersen
Nissan North America, Inc.
Nokia
North Central Texas Council of Governments
NTCA - The Rural Broadband Association
NXP Semiconductors
Office of Engineering & Technology
OmniAir Consortium, Inc.
Open Technology Institute at New America
Orange County Transportation Authority
Oregon Department of Transportation
Panasonic Corporation of North America
Parkofon
Paul Estes
Pennsylvania Department of Transportation (PennDOT)
Perry Ogletree
Peter A. Laudenslager
Peter R Bergstrom
Peter Skweres
Phil Stegall
Prem Marimuthu
PrePass Safety Alliance
Public Interest Organizations
Public Knowledge
Public Safety & Homeland Security Bureau
Qualcomm Incorporated
R Street Institute
Raj Rajkumar, Carnegie Mellon University
Ray David Congdon

Rep. Jim Cooper
Richard F. Daugherty II
Robert Andrews
Robert Barkley
Robert Bosch LLC
Robert Bowes
Robert Brammer
Robert Casey
Robert Evans
Robert Freeburn - K6RJF
Robert L. Bertini
Robert L. Sumwalt, III
Robert Lovejoy
Robert Moore - KW6B
Robert Pestolesi - KE6GYD
Roger Wentz
Royce F. Crocker
RS&H, Inc
Ryan Pierce
Ryan Promack
SAE International
SAE International: V2X Core Technical Committee & Infrastructure Applications Technical Committee
Safer Motorcycling Research Consortium (SMRC)
Safety Research Using Simulation University Transportation Center
San Bernardino Microwave Society
San Diego Association of Governments
Sandra Cullen
Sandy Klausner
Savari
Seaver Klug
Securing America's Future Energy (SAFE)
SES Americom, Inc., Intelsat License LLC
Seth W. Chalmers
Shane Huston - KG7QWH
Shireesh Verma

Shirley Tseng

Sibrtech inc.

South Dakota Department of Transportation

Stanley Tahara

Stephen Lewis

Stephen Skwarlo

Steve Anness

Steve J. Noll

Steven Cummings

Steven Farinella

Susan Best

Tampa Hillsborough County Expressway Authority (THEA)

TechFreedom

Tennessee Department of Transportation, Chairman of Transportation Committee- Dan Howell

Tennessee Department of Transportation

TennSMART Board of Directors

Texas A&M Transportation Institute

The Association for Unmanned Vehicle Systems International

The City of New York

The Free State Foundation

Thomas C. Eagle

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Tim Irish, Johnson County Amateur Radio Club

T-Mobile USA, Inc.

Tom Preston

Toyota Motor Corporation

Toyota Motor North America, Inc.

Transbase.US, PBC

Transportation for America

Truck and Engine Manufacturers Association

U-blox America

United Parcel Service, Inc.

US Technical Advisory Group to ISO/TC 204 Intelligent Transport Systems

Utah Department of Transportation

Vincent Sabia
Virginia Tech Transportation Institute
Vision Zero Network
Volkswagen Group of America, Inc.
Volvo Group North America
W0SV SCARC
Walker Consultants
Washington State Department of Transportation
Wednesday Warford
Wi-Fi Alliance
William Arthur
William C. Hymes
William Gery
William M VanKirk
William R. Miller - KE6KYH
William Rantala
William T. Panos, Director - North Dakota Department of Transportation
William Woods
Wireless Internet Service Providers Association
WSP USA
Wyoming Department of Transportation

STATEMENT OF
CHAIRMAN AJIT PAI

Re: *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138.

The saga of the 5.9 GHz band brings to the mind of this Chairman of the Board the 1970 song by Chairmen of the Board, *Give Me Just a Little More Time*. In that hit, Chairmen of the Board famously pleaded that, if given just a little bit longer, great things would surely happen (in the case of the song, "our love will surely grow").

Something similar has been true of those who oppose reform of the 5.9 GHz band. More than 20 years ago, the Commission allocated the 75 megahertz of spectrum from 5.850-5.925 GHz for Intelligent Transportation System (ITS) services and designated Dedicated Short-Range Communications (DSRC) as the technological standard for use in this band. Unfortunately, over two decades later, the FCC, the automobile industry, and most importantly, the American people have little to show for that decision. DSRC-based service has evolved slowly and has not been used in a meaningful way to improve automotive safety. For example, according to the American Association of State Highway and Transportation Officials, only 57 operational DSRC projects have been deployed, including 6,182 DSRC roadside units and 15,506 vehicles equipped with DSRC on-board units. By comparison, there are approximately 274 million registered vehicles in the United States operating across approximately 4.2 million miles of roadways. Just think about it: More than 20 years after the FCC allocated the 5.9 GHz band for DSRC, 99.9943% of the 274 million registered vehicles on the road in the United States still don't have DSRC on-board units.

For years, whenever it has been pointed out that most 5.9 GHz band spectrum in the United States is laying fallow, DSRC proponents have claimed that widespread deployment of DSRC-based technology was just around the bend. We just need to give it a little more time. Well, we have given DSRC a little more time . . . many, many times. No more. Perhaps the most damning indictment of the status quo is offered by DSRC advocates themselves. Take this assessment from a former U.S. Department of Transportation official, now the director of a prominent university's transportation institute: "I'll grant you that DSRC is the modern-day equivalent of Morse code, but guess what, Morse code still works."

[1]Today, at long last, we say in a unified, bipartisan voice: - .... . / - .. -- . / .. ... / ..- .--. .-.-.- Time's up.

There are two fundamental reasons why we can no longer tolerate this inefficient use of the 5.9 GHz band.

First, there is a pressing need for us to allocate additional spectrum for unlicensed operations.[2] The pandemic has underscored that consumers need access and more bandwidth to be able to engage in telework, remote learning, telehealth, and other broadband-related services. And we have proof—not a concept, but actual evidence—that 5.9 GHz spectrum can help quickly address this need. We've granted

[1] Joey Capparella and Pete Bigelow, "Toyota Puts Connected-Car Tech Plans on Hold," Car and Driver (Apr. 29, 2019), *available at* https://www.caranddriver.com/news/a19855320/toyota-bets-big-on-connected-car-tech/.

[2] *See*, *e.g.*, Anna Eshoo and Ajit Pai, "The Feds Have to Get America Faster Wi-Fi," WIRED (Feb. 7, 2016), *available at* https://www.wired.com/2016/02/the-feds-have-to-act-to-get-america-faster-wi-fi/; Statement of Commissioner Ajit Pai, Hearing before the Subcommittee on Communications and Technology of the U.S. House of Representatives Committee on Energy and Commerce (Dec. 12, 2012), http://go.usa.gov/4t8Q; Remarks of Commissioner Ajit Pai at CTIA's MobileCon at 5-6 (Oct. 10, 2012), *available at* http://go.usa.gov/4tkA.

temporary access to this very 45 megahertz of spectrum to Wireless Internet Service Providers who have immediately put it to use, establishing or enhancing connectivity to rural and underserved areas.[3] Moreover, unlicensed technologies like Wi-Fi provide wireless connectivity for countless products consumers rely on every day, and the number of such products is expanding rapidly. And the next-generation of Wi-Fi service, Wi-Fi 6, is expected to allow for maximum speeds that are two-and-a-half times faster than its predecessor technology while providing superior performance in crowded environments and improved battery life. Bottom line: More unlicensed spectrum directly benefits consumers in many ways.

Second, the automotive industry has pivoted from DSRC to Cellular Vehicle-to-Everything (C-V2X) technology. C-V2X is more reliable and resilient than DSRC and can take advantage of cellular-based connectivity to offload non-safety-of-life communications. C-V2X has momentum both domestically and internationally, with automakers such as Ford, Audi, Daimler, BMW, and Jaguar Land Rover pursuing deployment of C-V2X equipment.

These two factors lead to our decision today. In this order, we repurpose the lower 45 megahertz of the 5.9 GHz band for unlicensed operations. Specifically, we will immediately allow indoor unlicensed use of the 5.850-5.895 GHz band while seeking comment on rules for outdoor unlicensed operations as part of our Further Notice of Proposed Rulemaking. We will require the limited DSRC operations currently deployed over the full 5.9 GHz band to transition to the upper 30-megahertz segment of the band within one year. We also adopt C-V2X as the new technological standard for ITS operations in the upper 30 megahertz of the band and seek comment on the appropriate rules and timeline for transitioning from DSRC to C-V2X-based operations.

Our action will help to meet the demand for unlicensed spectrum that exists now and is only expected to rise in the coming years. And this 45 megahertz in the 5.9 GHz band punches above its weight: When paired with other adjacent unlicensed spectrum, we will make available, in the near term and on a widespread basis, a 160-megahertz channel for high-throughput unlicensed communications.

Our decision today will also improve automotive safety. By moving from DSRC to C-V2X, we are shifting from a failed technology of the past to a promising technology of the future. And based on the record, I am confident that the upper 30 megahertz of the 5.9 GHz band will provide the spectrum needed for safety-related services. Indeed, right now only 20 megahertz of the band are actually dedicated for safety applications.

Moreover, it is important to remember that spectrum other than the 5.9 GHz band can be used—in fact *is used*—for automotive safety technology. For example, in 2017, the Commission made available a contiguous, five-gigahertz band of spectrum in the 76-81 GHz band for vehicular radar systems. And other services, such as traffic light signal preemption, are readily available in other bands such as the 900 MHz band and the 2.4 GHz band.

So, notwithstanding the irresponsible rhetoric of some, this Commission does care about automotive safety. Indeed, it is precisely because we do that we're shifting from DSRC to C-V2X. The sad fact is that DSRC has done virtually nothing to improve automobile safety. A few corporate interests cannot squat on this spectrum for a generation and expect to maintain a stranglehold on it just by giving it the empty slogan of the "safety spectrum." Nearly two decades of failure is more than enough. The American people deserve better. And I am optimistic that C-V2X will actually deliver what DSRC advocates only promised for years: a widely-adopted, widely-deployed automotive safety technology that will save lives on the road.

Given the balanced approach we are taking today, I am pleased with the support we have

[3] *See*, *e.g.*, "5.9 GHz Band Boosts Consumer Internet Access During COVID-19 Pandemic" (May 4, 2020), *available at* https://docs.fcc.gov/public/attachments/DOC-364138A1.pdf.

garnered across the political spectrum from the Open Technology Institute and Public Knowledge to Citizens Against Government Waste, FreedomWorks, and National Taxpayers Union. I also appreciate the backing we have received from unlicensed proponents including the Wi-Fi Alliance, WISPA, and NCTA and the recognition from forward-looking automotive interests that our decision today provides a path for C-V2X deployment.

Turning back to the song, *Give Me Just A Little More Time*, the Chairmen of the Board sang, "Life's too short to make a mistake, Let's think of each other and hesitate . . . I know we can make it, there's no doubt. We owe it to ourselves to find it out." Well, life is too short for us to make the mistake of continuing to allow valuable spectrum to lay fallow because of the false promise of a technology that has been stuck in the starting blocks for too many years. And hopefully, even they would agree that two decades is more than enough time to think and that the time for hesitation is surely over. We owe it to American consumers to put this spectrum to work for them and to quickly expand the capacity of unlicensed services and modernize transportation safety technology.

I want to thank our staff for their hard work in drafting this item. From the Office of Engineering and Technology: Bahman Badipour, Reza Biazaran, Brian Butler, Jamie Coleman, David Duarte, Patrick Forster, Monisha Ghosh, Howard Griboff, Michael Ha, Syed Hasan, Steve Jones, Ira Keltz, Paul Murray, Siobahn Philemon, Jamison Prime, Ronald Repasi, Rodney Small, Dusmantha Tennakoon, and Aole Wilkinsel; from the Enforcement Bureau: Matthew Gibson, Janet Moran, and Axel Rodriguez; from the Public Safety and Homeland Security Bureau: Renee Roland, Tracy Simmons, and Michael Wilhelm; from the Wireless Telecommunications Bureau: Katherine Nevitt, Roger Noel, Dana Shaffer, Joshua Smith, Donald Stockdale, and Joel Taubenblatt; from the Office of Economics and Analytics: Patrick DeGraba, Cher Li, Catherine Matraves, Patrick Sun, and Aleks Yankelevich; and from the Office of General Counsel: Deborah Broderson, Michael Carlson, David Horowitz, and Bill Richardson.

STATEMENT OF
COMMISSIONER MICHAEL O'RIELLY

Re: *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138.

Today, we put an end to two decades of waste and inefficient use of the valuable 5.9 GHz band. Going forward, this spectrum will not only advance the deployment of state-of-the-art automobile safety systems, but also those cutting-edge technologies that rely on unlicensed spectrum.

Many, many years ago, Commissioner Rosenworcel and I took up the task to champion these frequencies, as the best opportunity for unlicensed expansion, due to their location next to the current 5 GHz Wi-Fi band. Additionally, I proposed the potential split of this 75 megahertz band into a 30 megahertz automobile safety channel and a 45 megahertz unlicensed block, in line with an industry group's similar proposal. Many manufacturers and car companies engaged in this debate fully agree that 30 megahertz meets their current needs and is in line with the global community's approach to 5.9 GHz auto-safety systems. Further, the Commission has provided other spectrum to car companies to deploy safety systems, such as radars and LiDAR, that have been used to introduce some of the safety applications initially planned for DSRC. So, I am extremely pleased – bordering on ecstatic – that, after so many years of talk, there is finally action. After all the obstacles and setbacks we have had to overcome, the vision that I outlined many years ago and for which I took many arrows, and accepted many concessions, is now becoming reality.

What is most promising about this new unlicensed allocation is the ability of Wi-Fi providers to rapidly incorporate it into their existing offerings as soon as the order is effective. Most equipment will be able to take advantage of this spectrum with only a quick software upgrade. The importance of our in-home networks, which rely on the availability of sufficient unlicensed spectrum to meet demand, has been highlighted during this pandemic: we depend on our Wi-Fi systems to do our jobs or schoolwork; communicate with friends and family; video-conference with our doctors; and entertain ourselves while isolating at home. In fact, we can thank Wi-Fi for allowing many of us, including myself, to participate in and observe this Commission meeting.

While I am pleased with the overall direction of today's item, there are some things that we should have done differently. In particular, the transition time to relocate the few DSRC incumbents out of the new unlicensed portion of the band should have been six months instead of one year. While I understand that there are some roadside infrastructure and vehicles equipped with DSRC, most existing equipment is being used for testing purposes and experimental use. After 20 years, just over 15,000 cars were ever equipped with DSRC, and only 3,000 of those cars were commercially sold and none are currently for sale. That's 3,000 cars out of the almost 275 million registered vehicles on the road in the U.S. today, with *none* on the lot waiting to be sold. Amazing. The roadside infrastructure, therefore, is not being used to keep Americans safe, but rather for government-funded demonstrations and trials of a system that will never come to be. That is essentially a road to nowhere. Waiting a full year for this spectrum to be fully available is much, much too long: this spectrum is needed *now* to expand unlicensed capacity and to provide the larger channel sizes needed to increase speed and lower latency. We shouldn't pretend to be unlicensed champions while unnecessarily delaying the full use of the band. Instead, we should be moving to maximize outdoor unlicensed use, even if such use is approved under our special temporary authority process, pending resolution of the remaining issues identified in the Further Notice.

Further, the Order should have clearly stated that the 30 megahertz reserved for the auto industry can only be used for safety purposes. Everyone admits that is the intent, and the auto industry even pledges that this is the case. Then why exactly can't it be certain in our rules? Is it because we all secretly acknowledge that some industry proponents want to misuse the "safety" band? Under no circumstances should the Commission be giving spectrum handouts to an industry to provide services that

are commercially available using other frequencies. Unfortunately, even though I proposed edits to address this problem, they did not carry the day and were not approved by Commission leadership. However, I do appreciate that reserving this spectrum for safety purposes only was added to the Further Notice.

Lastly, I am extremely disappointed that the Commission did not take a technology-neutral approach in this item. It would have been far more beneficial if the Commission had simply provided the spectrum for vehicular safety systems and allowed car manufacturers and the various proponents to determine the best technology path. Alas, there seems to be a consensus that the auto industry will not be able to come to such an agreement, leaving the Commission, which is not an auto safety expert, in the untenable position of picking the winners and losers in this tug of war.

In this vein, history is repeating itself. Once again, we are codifying a technology in our rules. While C-V2X is a very promising safety technology, we do not know what will be available two, five, or ten years from now. I fear we will end up, like we did with DSRC, with our rules being based on a specific technology, precluding technological innovation and advancement. C-V2X is certainly the right direction to go in the immediate future for auto safety, but it doesn't need to be embedded in our rules in order to be successful.

Regardless of these shortcomings, this item overall does a lot of good by permitting both unlicensed use and C-V2X auto-safety applications and creating a framework to ensure that harmful interference will not occur. Further, I appreciate that many of my requested edits were included. Now that C-V2X is the car safety application of the near future, we have to allow industry to actually access the spectrum. The Chairman's proposal posted three weeks ago did not provide any certainty as to when the spectrum would be available. I am pleased that my request to ensure that the spectrum will be accessible for C-V2X, with some limitations, in the near term, using a waiver process was supported by my colleagues. This certainty, as opposed to forcing parties to wait for resolution of the Further Notice, will allow the automobile industry to make definitive plans, place equipment orders, and ultimately get the safety technology into cars.

I am also pleased that my suggestion was implemented to move the discussion of NTIA's proposed exclusion zones for outdoor unlicensed use to the Further Notice. Unlicensed users will need to protect the federal incumbents in the band, but more consideration is needed with regard to exclusion zones versus coordination zones and their appropriate sizes. We never should have considered going down that wrong path in the first place.

In the end, I thank my colleagues for endorsing this important item and for considering my many requested edits. I especially want to thank Commissioner Rosenworcel for working with me over the years on introducing unlicensed use in this band. I also appreciate that Chairman Pai presented us with a draft permitting indoor use before I leave the Commission. I look forward to following the ongoing proceeding as it relates to outdoor use and the completion of the transition of DSRC to C-V2X as an observer, and I hope that it will be concluded with all due haste. I also want to thank the hardworking professionals, especially the staff of the Office of Engineering and Technology, for their efforts and getting us to this point.

People ask me all the time what my experience was like at the Commission. I tell them that with a sound vision, strategic moves, and extraordinary perseverance, a Commissioner can move mountains. This item will always be a testament to my point.

I approve.

STATEMENT OF
COMMISSIONER BRENDAN CARR

Re: *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138.

If there's one thing my FCC colleagues and I all agree on, it's the importance of mid-band spectrum. In our speeches and testimony, in our statements and tweets, we have all made it clear that freeing up additional mid-band spectrum is critical to America's leadership in wireless.

Now, talking about mid-band spectrum is a far easier task than actually freeing up this scarce resource. And that is why I want to give credit to Chairman Pai, his team, and the Bureaus and Offices involved for their efforts over the past few years.

If you look at the trade press headlines over that period of time, I will admit that they have not all been glowing. These are tough fights; a lot of people view this as a zero sum game. Incumbent stakeholders—whether federal or commercial—have pushed back on a lot of our mid-band efforts. All of that is evidence, I think, that this FCC has not just kicked the can down the road. We have not left it to future Commissions to take on the tough spectrum fights.

And our approach to mid-band spectrum has delivered results. At 2.5 GHz, we updated the rules for EBS spectrum that laid fallow for too long. In that same band, we secured nationwide buildout commitments. At 3.5 GHz, we ensured that our rules would work in the real world and completed a successful auction earlier this year. At 3.7 to 4.2 GHz (the C Band), we secured about 300 MHz of mid-band spectrum to enable providers to offer truly mobile 5G. At 6 GHz, we opened up an immense 1,200 MHz of spectrum. Down at 1.6 GHz, we took long overdue action to free up that band. And at 2 GHz (AWS-4), we obtained a commitment to put that spectrum to use for high-speed broadband.

That brings us to the spectrum band before us today—5.9 GHz. Our decision here marks another significant mid-band win. As with all of the other bands, there have been thorny issues to contend with and disagreements to work through. And in the past there's been a fair amount of kicking the can down the road. That ends today.

Our action will deliver 45 MHz of spectrum, creating a contiguous block of 160 MHz when combined with the band below, that can be put to use immediately for the benefit of all Americans. Opening this spectrum up won't just mean faster Wi-Fi for consumers. It will help power all of the advanced applications that 5G promises. That might include wearable devices to improve your health, as we've seen during this pandemic. Or devices for virtual and even augmented reality to make everyday life a little easier. Or even machine-to-machine connectivity to make America even more competitive on the world stage.

I want to thank the Chairman and his team for prioritizing the FCC's work on mid-band spectrum over the past few years. I'd also like to thank the Office of Engineering and Technology and the Wireless Telecommunications Bureau for their work. I'm glad to cast another vote for more mid-band spectrum.