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

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
	)	

Comments of
CISCO SYSTEMS, INC.

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Summary

Cisco Systems, Inc. ("Cisco") views mid-band spectrum as an important element in serving the broadband needs of residents and enterprises. Since Cisco began tracking and forecasting demand growth, we have seen unlicensed demand grow in the US from 7.2 exabytes per month in 2010 to 14.7 exabytes per month in 2017, with demand now forecast to reach 49.7 exabytes per month by 2022. A portion of that growth is mobile offloading, which grew from about 8% of mobile device traffic in 2010 to 67% in 2017, and is estimated to reach 74% by 2022 on a growing base of mobile traffic. Industry has innovated to meet demand, but we are reaching the point where we need additional spectrum in order to take full advantage of the innovations coming to market. For that reason, Cisco is delighted to see, from the record as filed, that the weight of the comments agree that 6 GHz can be opened to unlicensed use under some set of conditions, and that the issues have narrowed to a set of technical questions about "how" to allow entry while protecting incumbents.

While the balance of Cisco's views on the technical questions are represented in the filing of the 6 GHz RLAN Group, in this reply, Cisco addresses several issues raised in the comment round. First, in response to commenting parties that have ignored the 6 GHz RLAN Group's technical analysis and presentation of mitigations, this reply highlights the careful work that has been done to date to present a responsible proposal to protect incumbents. Second, Cisco opposes the few commenters who would seek to clear and license the band for licensed mobile services. Third, we urge the Commission to help resolve an out-of-band emissions rule to protect Intelligent Transportation Services. Finally, Cisco opposes a request for the Commission to adopt a technology-specific rule to govern how radios access spectrum.

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I. Introduction and summary

Cisco Systems, Inc. ("Cisco") views mid-band spectrum as an important element in serving the broadband needs of residents and enterprises. In fact, as discussed in our comments, Cisco views mid-band spectrum availability for unlicensed technologies as a foundational requirement if the US is to meet its broadband goals. As our Visual Networking Index study unequivocally demonstrates, unlicensed technology continues to bear a substantial portion of wireless data traffic demand.[1] Since Cisco began tracking and forecasting demand growth, we have seen unlicensed demand grow in the US from 7.2 exabytes per month in 2010 to 14.7 exabytes per month in 2017, with demand now forecast to reach 49.7 exabytes per month by 2022. A portion of that growth is mobile offloading, which grew from about 8% of mobile device traffic in 2010

[1] The Cisco Complete Visual Networking Index, Unlicensed data demand represents more than one half of Internet traffic in 2017, growing to 56.6% by 2022. https://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html

to 67% in 2017, and is estimated to reach 74% by 2022 on a growing base of mobile traffic. Industry has innovated to meet demand, but we are reaching the point where we need additional spectrum in order to take full advantage of the innovations coming to market. For that reason, Cisco is delighted to see, from the record as filed, that the weight of the comments agree that 6 GHz can be opened to unlicensed use under some set of conditions, and that the issues have narrowed to a set of technical questions about "how" to allow entry while protecting incumbents.

While the balance of Cisco's views on the technical questions are represented in the filing of the 6 GHz RLAN Group,[2] in this reply, Cisco addresses several issues raised in the comment round. First, in response to commenting parties that have ignored the 6 GHz RLAN Group's technical analysis and presentation of mitigations, this Reply highlights the careful work that has been done to date to present a responsible proposal to protect incumbents. Second, Cisco opposes the few commenters who would seek to clear and license the band for licensed mobile services. Third, we urge the Commission to help resolve an out-of-band emissions rule to protect Intelligent Transportation Services. Finally, Cisco opposes a request for the Commission to adopt a technology-specific rule to govern how radios access spectrum.

II. Unlicensed interests have demonstrated a commitment to protecting licensed interests in the band

[2] The 6 GHz RLAN Group consists of Apple, Inc., Broadcom, Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Marvell Semiconductor Inc., Microsoft Corporation, Qualcomm Incorporated, Ruckus Networks, an Arris Company. https://ecfsapi.fcc.gov/file/10216633127609/6%20GHz%20RLAN%20Group%20Comments%20(Feb%2015%202019).pdf

It is never easy to take a band where there are holders of primary rights, whether commercially licensed or federal, and open it to unlicensed use. But one fact should be noted from the comments that many incumbent commenting parties tended to ignore - unlicensed interests have not approached this rulemaking with a cavalier attitude that unlicensed devices can simply be plopped into the band, whatever the consequences. The record, both throughout the Notice of Inquiry and through the comment round just completed, demonstrates that the unlicensed community has conducted a careful study of existing primary operations, modeled a sophisticated interference analysis based on a statistically valid view of where unlicensed transmitters are likely to be located, and made a series of analytically-grounded proposals designed to provide extra insurance against harmful interference.

To be clear, the unlicensed community could have relied upon its statistical modeling analysis, which showed interference to be extremely rare, and that no interference would cause a link to fail. Instead, unlicensed interests have moved quickly to understand the incumbent operations and use cases in order to hone a set of entry conditions that represent our best technical view of how to ensure that interference will not occur. These are:

(1) encourage the FCC to adopt the plan proposed in the Notice for Automated Frequency Coordination (AFC) for standard power access points, changing the way outdoor and indoor standard power access points will be deployed relative to 5 GHz devices;[3]

(2) forgo use of U-NII-6 and all but the lower 100 MHz of U-NII-8 for outdoor standard power access points, and indoor standard power access points, thereby eliminating the unlicensed use cases that would arguably present the greatest challenges to incumbent protection;[4]

[3] 6 GHz RLAN Group Comments at 3.

[4] 6 GHz RLAN Group Comments at 3.

(3) forgo use of U-NII-6 and all but the lower 100 MHz of U-NII-8 for outdoor "very low power" devices such as mobile phone tethering, in order to protect mobile licenses;[5]

(4) limit indoor power to 24 dBm with a 21 dBm/MHz power spectral density limit in operations throughout the band;[6]

(5) agree with the fixed microwave interests to protect links at a -6 dBm I/N threshold (while noting that links could tolerate a higher threshold of 0 dBm);[7]

(6) forgo outdoor use in the portion of the U-NII-8 band that houses the Sirius/XM downlink;[8]

(7) no proposal to allow Unmanned Aerial Systems (UAS) due to the inability to geo-locate the transmitters relative to licensed links and because free space path loss from UAS operations could be wholly inadequate to protect licensed receivers; and

(8) agreed to use the AFC to protect other sensitive sites and uses.[9]

To the extent objecting parties ignore these substantial and analytically-informed restrictions on unlicensed operations in the band that proponents have initiated or agreed to, then those parties' objections should be given no weight. In contrast, we appreciate the views of those commenters who have taken the time to thoughtfully present engineering analysis that will help the unlicensed community understand the technical issues, and help the Commission move forward to final rules. While there may be differences of opinion about the technical record, it is extremely helpful to us, and to the Commission, to be able to examine technical analysis as a foundation for final rules.

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[5] 6 GHz RLAN Group Comments at 3.

[6] 6 GHz RLAN Group Comments at 3.

[7] 6 GHz RLAN Group Comments at 4.

[8] *See* Sirius Comments at 11, noting its downlink at 7.025-7.075 GHz.

[9] 6 GHz RLAN Group Comments at 40.

Cisco agrees with the 6 GHz RLAN Group that, given the conditions above, unlicensed entry into the band can be safely achieved. This benefits not simply the unlicensed interests seeking additional spectrum to support the next wave of innovative technology, but – more importantly - consumers who continue to heavily rely on unlicensed connectivity at a rate that will only continue to grow in the 5G era. It also benefits incumbent users of the band, who can continue to freely request licenses as their needs continue to evolve. It has been a fundamental principal of the unlicensed community's position that primary rights holders continue operate in the band as they always have, including future growth.

III. 6 GHz unlicensed underlay should extend throughout the 6 GHz band

Unlike an unlicensed underlay that specifically rests on no disruption to existing or future licensees in the band, two parties presented a high-level concept that would relocate tens of thousands of links. It also represents a significant departure from the Notice. CTIA and Ericsson argue for the Commission to auction spectrum from 6525-7125 MHz for licensed mobile use, and use the proceeds to relocate incumbents to another band, suggesting 7 GHz as a possible new home for incumbent services.[10] Cisco opposes this suggestion. This conceptual "idea" was not supported with any detail, remains wholly undeveloped, and should not be given any further consideration. As presented, the concept is highly disruptive to incumbent licensees, difficult for regulators in the best of circumstances given the diversity of systems that would be affected, and promises to be highly contentious. Moreover, nothing is known about whether the affected

[10] CTIA Comments at 7-16; Ericsson Comments at 5-19.

licensees could be accommodated in 7 GHz. The Commission's reaction to the CTIA idea should be this - the mobile industry's best option is to focus on 3 GHz, where there is a growing momentum for licensed mobile spectrum globally, and where they are far more likely to enjoy economies of scale for equipment.

In contrast, the unlicensed community has presented a highly developed plan for an unlicensed underlay in 6 GHz, based upon an evidentiary showing of demand growth, economic benefit, technological innovation, and significant technical analysis. As Cisco noted in our comments, the increased data traffic that unlicensed systems will bear moving forward is "staggering."[11] Last year, unlicensed networks carried 14.7 exabytes of IP traffic per month. In five years, unlicensed networks are expected to experience demand of 49.7 exabytes per month. That is more than all of the IP traffic – fixed, mobile and unlicensed – that traveled on US networks in 2017, and stands in stark contrast to the projected 5.6 exabytes of data per month that will be carried on licensed mobile networks by 2022 according to our forecast. The economic impacts associated with Wi-Fi use are equally as staggering. As several parties note, the annual Wi-Fi contribution to the U.S. economy is almost $500 billion today, and will nearly double by 2023.[12]

[11] Cisco Comments at 4.

[12] Wi-Fi Alliance Comments at 5, citing Telecom Advisory Services, "The Economic Value of Wi-Fi: A Global View (2018 and 2023)", at 10 (rel. Oct. 2018) https://www.wi-fi.org/value-of-wi-fi ("*Economic Value of Wi-Fi*"). *See also* National Cable Television Association Comments at 7-8.

From the very start of the Commission's consideration of further mid-band spectrum, the unanimous view of the unlicensed community has been that our industry cannot continue to subsist on spectrum first allocated 16 years ago. Since the 5 GHz band was initially opened, we have innovated through multiple generations of equipment to meet exploding consumer demand, and continue to do so, but we need more spectrum. We are acutely aware that the 6 GHz band is encumbered by licensed interests, and that the encumbrances are most heavily present in the lower part of the 6 GHz band. This means that available spectrum for unlicensed use will necessarily be limited by licensed use, and that available spectrum will tend to decrease over time, in particular for outdoor use cases. What makes 6 GHz compelling is that it is adjacent to 5 GHz, making it an attractive expansion band if industry can get to a set of reasonable rules that protect incumbents from harmful interference. That protection means, as the 6 GHz RLAN Group filing has made clear, that full access to 6 GHz for all classes of equipment is difficult. CTIA's suggestion that unlicensed access be limited to 40% of the band, and "offering" the 40% that is most encumbered with incumbent links, is simply not adequate.

Moreover, the Commission should not at this late hour veer off in a direction different from the Notice, stranding investment and disrupting business plans of the unlicensed community. As has been exhaustively discussed, the Wi-Fi industry is poised to introduce Wi-Fi 6, the next iteration of Wi-Fi technology.[13] It is four times more efficient, supports advanced MU-MIMO antenna technologies, improves battery life of consumer devices, and better manages congested environments relative to the generation of technology immediately preceding it. But in order for it to take full advantage of the innovative technologies it contains, more spectrum is required as

[13] Cisco Comments at 10-13; Wi-Fi Alliance Comments at 9.

many benefits of the new technology can best be optimized using wider channels, of which there are too few in 5 GHz. The unlicensed community, including Cisco, is readying this equipment not just for the 5 GHz band, but for 6 GHz band as well. The need is demonstrated, the benefits to the public are apparent, and there is already substantial, albeit not complete, agreement around conditions of entry. The Commission can easily find, and should find, based on the record already before it, that it is in the public interest to establish an unlicensed underlay throughout the band.

IV. Adjacent ITS band requires protection

The adjacent Intelligent Transportation Systems (ITS) band is a licensed band dedicated to enabling safer and more efficient surface transportation through the use of radio technologies. As a result, transmitters in this band have superior spectrum rights relative to unlicensed uses that would be introduced just above the ITS band.

The Notice suggests that all unlicensed devices operating in the 6 GHz band be subject to an out of band emission (OOBE) limit of -27 dBm/MHz. The Notice states that this limit is consistent with the rules that apply for most of the other U-NII bands, which have been successful in preventing harmful interference to services operating in adjacent bands. In Cisco's view, it is not clear that the proposed OOBE limit works for all classes of unlicensed devices proposed by industry for 6 GHz. Below, we recommend steps toward an improved understanding of the band edge issues at and around 5925 MHz.

As an initial matter, the ongoing policy discussions around the 5.9 GHz band are currently complicated by competing technologies, competing sharing proposals, and even a desire by some

parties to relocate ITS entirely. Those discussions should not be imported into the debate over 6 GHz for unlicensed use, and we recommend the Commission reject any attempt to do so. The proceedings are separate. Our point is simply this – whatever the rules for the ITS band are, the Commission needs to inform itself in order to choose the correct OOBE rule.

If the existing rules for use of the ITS band remain in place as the Commission approaches a final decision in the 6 GHz proceeding, the Commission must be prepared to articulate an informed OOBE rule to protect the technologies deployed under existing rules, i.e., Dedicated Short Range Communications (DSRC). To the extent the existing rules do remain in place, Cisco recommends the following to speed consideration of OOBE rules and assure ITS stakeholders that they will be protected. This is important because not only is the ITS band licensed, but certain channels are specially protected under the Commission's rules. DSRC Channel 184, at the top edge of the ITS band, is a public safety channel, and per Part 90, Channel 184 has priority over every other transmission in the band other than Channel 172. [14] Cisco believes that the most pressing concern, therefore, is protection of Channel 184 operations.

As a technical matter, Channel 184 is a 10-MHz wide public safety channel dedicated to public safety applications involving safety of life and property.[15] Only those entities meeting the requirements of 47 CFR §90.373(a) are eligible to hold an authorization to operate on this

[14] Section 90.377(d) of the Commission's rules provides priority for Channel 184. Section 90.377(b) contains a chart of DSRC channels and footnote 4 notes that Channel 184 is designated for public safety applications involving safety of life and property. 47 CFR § 90.377 (b) and (d).

[15] 47 CFR § 90.377 (b) and footnote 4.

channel. Antennas can be no more than 8 meters above the roadbed.[16] Consequently, the rules enable 1 km links at 40 dBm. State highway departments and other eligible highway authorities, are able to use these links in a variety of ways to enable safety communications with their fleets, control intersections, and other infrastructure. The rules state: "Roadside Units (RSUs) operated by state or local governmental entities are presumptively engaged in public safety priority communications."[17]

In Cisco's view, the -27 dBm OOBE limit is likely to protect Channel 184 from the emissions of low power indoor access points and their client devices, given a 10 MHz guardband. We wish to both highlight and acknowledge there are manufacturing concerns with a -27 dBm limit. Engineering to -27 dBm requires expensive filtering. For that reason, industry is evaluating band plans that include a 10-MHz guard band between 6 GHz operations and DSRC that would help to ensure limited emissions into DSRC and Channel 184. Of course, manufacturers may also choose to comply to the mask by not using the lowest 20-MHz wide channel in 6 GHz. With a 10 MHz guardband, the lowest center frequency for a 20 MHz wide channel is 20 MHz away from 5925 MHz – i.e., 5945 MHz. Given a 10 MHz guardband, and if the lowest 20 MHz channel is not utilized, 6 GHz operations would commence at 5955 MHz with a center frequency of 5965 MHz. While forgoing use of the lowest portion of the band is

[16] 47 CFR § 90.377 (b) and footnote 1. Antennas can be up to 15m in height if the EIRP specified in the table above 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 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.

[17] 47 CFR § 90.377(d)(2).

an option, it also reduces the amount of spectrum available to a device. But this is a choice that an access point manufacturer can make.

Industry is asking, however, for various classes of devices, including very low power portable operating outdoors as well as indoors in U-NII-5, and standard power indoor and outdoor in U-NII-5. In order for the Commission and DSRC stakeholders to be satisfied with an OOBE and guard band protection for all classes of devices, Cisco recommends –

- The Office of Engineering and Technology (OET) request a representative sample of DSRC radios and antennas that are being sold in the market today be provided to it for analysis.
- OET then should perform an analysis of the DSRC emissions, including antenna patterns.
- OET next performs an analysis of unlicensed device class emissions based on EIRP and channel sizes proposed by industry, assuming the emitter is 10 MHz, 20 MHz or 30 MHz from the center frequency and adjusting for cabling and antenna pattern losses. Then, for each device class, apply pathloss assumptions over distances from 0.3 meters to 1000 meters to determine the signal strength in the adjacent channel.
- The resulting table of emissions strength, together with an analysis of DSRC antenna patterns, can inform stakeholders if -27 dBm will effectively protect adjacent DSRC operations given the varied device classes, and associated use cases, that would be supported by the new U-NII rules.

This analysis could be performed privately, but it is important for DSRC manufacturers and the ITS community generally to be satisfied that a representative sample of radios is analyzed, and in a transparent way. For this reason, we suggest OET conduct the analysis. Cisco stands ready to assist our colleagues in the DSRC community, and Commission staff, in the conducting such an analysis.

V. Technology specific regulations for 6 GHz unlicensed use should be avoided

In its comments, Qualcomm proposed that the Commission adopt a rule that would dictate how unlicensed devices could access spectrum for U-NII-7.[18] Qualcomm argued that its proposal would enable more efficient spectrum use by allowing LTE-based technologies, and specifically "New Radio-Unlicensed" (NR-U) to more easily use the band when unlike IEEE 802.11 devices are also operating. From what we have been able to discern, Qualcomm seeks to have the 802.11 community make changes to its technology when operating in U-NII-7 so that 802.11 equipment can monitor for synchronous transmissions associated with NR-U. If synchronous transmissions are present, the 802.11 device would have a specific U-NII-7 mode of operation, the details of which are unknown. If synchronous transmissions are not present, then the 802.11 device could continue to operate in its normal mode. As best we can tell, the cost of operating under this proposed rule rests on 802.11 devices, but at present it is unclear precisely what technical parameters Qualcomm would find sufficient, and thus, we are unable to say much about the burden that 802.11 technology would bear should this rule be adopted.[19]

Cisco does not believe regulators should choose rules that favor one technology or another if it can be avoided. Based on the information presented by Qualcomm, it does not appear to us that there is any bar to NR-U in the proposed 6 GHz rules. Rather, the proposal appears to stem from Qualcomm's desire to have a rule that makes it easier for NR-U to operate in U-NII-

[18] Qualcomm Comments at 18-23.

[19] Qualcomm's Comments state that requiring synchronous detection would improve medium access for all devices, but the comment fails to specify at a technical level what medium access behavior the 802.11 device would need to adopt. Further, the assertion that the 802.11EHT group is going to produce a synchronous form of 802.11 appears to be very premature, as that body has not graduated to the standing of a task group and therefore the scoping exercise has not yet occurred.

7. Moreover, the Qualcomm proposal requires close coordination between devices from different administrative domains, which is contrary to the principles that have led to 2.4 GHz and 5 GHz being so successful, and also adds significant complexity. Nor are we aware of this coexistence proposal being presented to standards bodies, where the costs and benefits could be evaluated and considered. As a result, we are not clear on what basis the Commission could or should consider the rule change proposed.

Cisco would welcome learning more about Qualcomm's plan, particularly its thoughts on how Qualcomm thinks 802.11 devices would need to change when operating in U-NII-7. As of today, it is impossible to discern costs or benefits. That is important because, as presented, it appears 802.11 bears the entire cost of sharing. The unlicensed community needs to understand what that cost is, and what the potential benefits are. At this time, we recommend that the Commission not take any action on Qualcomms's request, but encourage Qualcomm to facilitate a consensus view in the unlicensed community first to determine what changes would be required to 802.11 devices, the associated costs and benefits of the effort, whether 802.11 stakeholders could implement this version of sharing by standards change or commercial choice, and whether any action by the FCC is desirable at all.

VI. Conclusion

Cisco looks forward to working with the Commission and interested stakeholders to advance the record received in this rulemaking to a Report and Order. The Wi-Fi industry has waited since 2003 for additional access to spectrum, and with a new allocation, industry will be able to continue to deliver on innovations to benefit consumers and the economy for many years to come.

Respectfully submitted,

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