Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Wireless Telecommunications Bureau,	)	GN Docket No. 18-122
International Bureau, Office of Engineering	)	RM-11791
and Technology, and Office of Economics	)	RM-11778
and Analytics Seek Focused Additional	)	
Comment in 3.7-4.2 GHz Band Proceeding	)	

REPLY COMMENTS OF VERIZON

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I. INTRODUCTION AND SUMMARY.

The record reflects substantial progress on a technical framework to enable 5G to flourish in repurposed 3.7 to 4.2 GHz spectrum while ensuring that traffic delivered over existing C-Band earth station receivers is protected from harmful interference. The C-Band Alliance ("CBA") constructively revised several elements of its interference protection framework. We welcome CBA's recognition "that certain of its original proposals can be adjusted to provide increased flexibility to mobile operators without increasing the risk of interference to FSS operations."[1] These updated positions should help the Commission find the right balance in adopting a technical framework.

CBA now recognizes that restrictive, across-the-board out-of-band emissions ("OOBE") limits—far lower than the levels established in the 3GPP standards for Band n77 (3.3-4.2 GHz)—are not needed, because a receiver protection threshold will limit the impact of 5G operations at C-Band earth station locations. CBA also updated other elements of its proposal in ways that

[1] Comments of the C-Band Alliance, GN Docket No. 18-122, at 26 (filed Aug. 7, 2019) ("CBA Comments").

will apply the receiver protection threshold more reasonably, addressing many of the issues raised in our initial comments. And Verizon shares in the growing agreement on 5G power levels and OOBE limits as well.

We look forward to ironing out a sound interference protection approach, to the Commission promptly moving to order, and to repurposing 3.7-4.2 GHz spectrum.

II. THE RECORD IDENTIFIES A SOUND APPROACH TO REPURPOSING 3.7-4.2 GHz SPECTRUM—A RECEIVER PROTECTION THRESHOLD APPLIED REASONABLY NEAR EARTH STATIONS.

A. A Receiver Protection Threshold Obviates the Need for Restrictive OOBE Limits, and the Record Provides Ample Support for Adoption of a Reasonable Threshold.

As we noted in our initial comments, with a reasonable receiver protection threshold that would limit 5G operations at registered earth station locations, the Commission need not adopt restrictive, across-the-board power level and OOBE limits that would force significant, unnecessary reductions in 5G transmissions (both base stations and end-user devices).[2] The drag of overly restrictive standards on 5G would greatly limit the utility of the band, requiring a new U.S.-specific band designation, delay in deployment, and costlier U.S.-specific 5G equipment. In contrast, flexibility and reliance on 3GPP standards-based equipment will better optimize the 5G opportunity—all while protecting C-Band earth stations where they exist through the receiver protection threshold.

CBA's updated proposal generally embodies this framework. CBA acknowledges that wireless operators "have a number of tools at their disposal" that can be "deployed by wireless operators on a localized, case-by-case basis" to manage their networks and reduce emissions into

[2] Comments of Verizon, GN Docket No. 18-122, at 10-11 (filed Aug. 7, 2019) ("Verizon Comments").

the repacked FSS band at C-Band earth station locations, without imposing onerous OOBE limits.[3] With this flexibility and under its updated receiver protection threshold, CBA "does not see the need to specify OOBE masks for both base stations and user equipment beyond that which has been specified by 3GPP for band n77."[4]

But the receiver protection threshold values proposed by CBA continue to be overly stringent. As we noted in our initial comments, its proposal to set the aggregate power and OOBE levels of all base and fixed stations deployed by a flexible-use licensee within 40 km of an earth station location at no more than -128 dBm/MHz in the earth station passband is overly conservative.[5] Distance does not always drive interference; other factors, such as terrain, also play an important role.

CBA's updated receiver protection threshold formula also adds factors that could increase unnecessarily the level of interference predicted (thus reducing the opportunities for 5G). First, CBA now proposes that the receiver protection threshold aggregate levels should incorporate transmissions from both base stations and end user equipment, but as a technical matter these operations are not additive for interference calculations. 5G networks will operate using Time Division Duplexing, so base stations and user equipment will never transmit at the same time. And all 5G operators in the band will operate on a synchronized basis using the same frame format to eliminate adjacent-channel interference among operators. Aggregate levels of user device transmissions are also much less likely to cause interference, as user device locations are random and propagation conditions between user devices and satellite earth stations are much

[3] CBA Comments at 33.

[4] *Id.* at 34 (citation omitted).

[5] Verizon Comments at 8.

more likely to be obstructed by buildings, foliage, terrain, or other features than conditions between base stations and satellite earth stations.

Second, CBA now proposes that the receiver protection threshold be shared among licensees in the band by dividing the threshold evenly among the number of licensees within the protection area (i.e., by subtracting 10 $\log_{10}$ (n) from the threshold, where n is the number of licensees in the protection area).[6] A simple division among licensees may be equal but not equitable, as different licensees may have differently sized license holdings and a licensee with greater spectrum holdings would be unfairly restricted. We recommend instead that the formula divide the threshold based on the relative aggregate bandwidth assigned to each licensee in the protection area, i.e., by adding 10 $\log_{10}$ (proportion of total bandwidth) to the threshold for each licensee. For example, if wireless provider A is licensed in 40 percent of the available C-Band spectrum, and wireless providers B and C are each licensed in 30 percent of the available C-Band spectrum, each provider is then allotted a corresponding portion of the receiver protection threshold. So, for the power level threshold, provider A would be held to -59 dBm/MHz + $10\log_{10}(0.4)$ = -63.0 dBm/MHz, and providers B and C would each be held to -59 dBm/MHz + $10\log_{10}(0.3)$ = -64.2 dBm/MHz. If the protection zone crosses a license boundary, the aggregate calculation should average across both areas.

Finally, CBA's proposed -133 dBm/MHz protection level for TT&C earth station operations is unnecessary. As CTIA observed, the Commission declined to protect TT&C stations in the 3.5 GHz CBRS band more than other earth stations, and there is no basis to do so

[6] *Id.*

here.[7] The Commission should refrain from adopting protections in the C-Band that it determined were not warranted in the adjacent band CBRS proceeding.

Verizon supports a reasonable receiver protection threshold that limits the impact of 5G operations at earth station locations while still allowing 5G operations to thrive in the 3.7 to 4.2 GHz spectrum.

B. CBA's Updated Proposals Take Steps Towards More Reasonably Applying a Receiver Protection Threshold.

CBA's initial comments contained multiple revisions to elements of its earth station interference protection regime that will help develop a reasonably applied receiver protection threshold framework. As CBA observed, it "has determined that some of its original proposals were conservative … [and] has made adjustments to its proposals to provide further flexibility to mobile operators while maintaining interference protections for FSS operations."[8] These updates are helpful and well supported by the record, and they should lead to parameters that optimize use of spectrum repurposed for 5G operations while protecting existing earth stations.

1. Protection Radius Around Earth Stations.

As noted in our initial comments, CBA's original proposal to extend the receiver protection threshold to a 150-meter protection area around all registered C-Band earth station locations would significantly expand predicted interference levels to cover areas where earth stations do not exist, with dramatic impact in dense urban and suburban scenarios.[9] CBA now recognizes that "reliev[ing] terrestrial mobile operators from having to assume a 150-meter

[7] Comments of CTIA, GN Docket No. 18-122, at 9 (filed Aug. 7, 2019) ("CTIA Comments").

[8] CBA Comments at 27.

[9] *Id.* at 9. *See also* CTIA Comments at 8, 9.

radius protection zone around all earth stations" would "lead to more fulsome operations."[10] And CBA now proposes to apply the Commission's existing Section 25.118 rule allowing earth station operators to move antennas operating in shared bands up to one arc second in latitude or longitude from the originally authorized coordinates,[11] up to 30 meters in latitude and 20-28 meters in longitude according to CBA, *after* the FCC opens one more filing window for registration of receive-only earth stations.[12]

CBA is right to remove its proposed 150-meter protection area but opening another earth station registration filing window would be counterproductive. Last year, the FCC instituted a freeze on new C-Band earth stations but opened a 90-day filing window (and extended it for an additional 90 days, to a total of six months) to allow earth station operators to register and update their antenna information.[13] In particular, the *Public Notice* established that "[a]pplicants with multiple existing receive-only antennas at the same geographic location may include each antenna on the Form 312, Schedule B of a registration application" and only pay a single application fee.[14] There should be no further bites at the apple. Opening an additional filing window would cause unnecessary delays after the Commission already extended the window and simplified the filing process for multi-antenna sites. As CBA notes, Section 25.118 already

[10] CBA Comments at 29.

[11] *See* 47 C.F.R. § 25.118(a)(4)(vi).

[12] CBA Comments at 28, 29.

[13] *International Bureau Announces 90-Day Extension of Filing Window, to October 17, 2018, to File Applications for Earth Stations Currently Operating in 3.7-4.2 GHz Band; Filing Options for Operators with Multiple Earth Station Antennas*, Public Notice, 33 FCC Rcd 6115 (2018).

[14] *Temporary Freeze on Applications for New or Modified Fixed Satellite Service Earth Stations and Fixed Microwave Stations in the 3.7-4.2 GHz Band; 90-Day Window to File Applications for Earth Stations Currently Operating in 3.7-4.2 GHz Band*, Public Notice, 33 FCC Rcd 3841, 3847 (2018).

allows for reasonable updates to earth station locations, within 28-30 meters from the originally authorized location.

2. Earth Station Filters.

CBA's comments show there are real and continuing improvements in C-Band earth station receive filter mask technology that will be installed on all repacked earth stations.[15] As CBA notes, "[w]ith each successive prototype, higher levels of 5G in-band emissions attenuation has been attained over the levels previously proposed by the CBA."[16] We share T-Mobile's view that the Commission should continue to evaluate the performance of satellite receive filters.[17]

3. Elevation Angles.

Our initial comments expressed concern with "full-arc" protection for earth stations communicating with satellites at elevation angles down to 5 degrees, without accounting for practical realities like the longitude of the earth station.[18] CBA acknowledges that "[a]ntenna elevation angles can be defined by a limited orbital arc," and it proposes an arc between 89° W.L. and 139° W.L.[19] We examined this revised orbital arc, focusing on how it would impact protected elevation angles at the corners of the continental United States. Satellites in the extreme western end of that portion of the arc (at or near the 139º W orbital location) would

[15] CBA Comments at 31. Verizon updates its initial comments, Verizon Comments at 9, to clarify that, because the threshold is applied at the output of the filter and not at the input, changes to the filter characteristics will not impact the protection threshold but will enable higher power levels for 5G operations.

[16] CBA Comments at 30 (citation omitted).

[17] Comments of T-Mobile USA, Inc., GN Docket No. 18-122, at 15 (filed Aug. 7, 2019) ("T-Mobile Comments").

[18] Verizon Comments at 10.

[19] CBA Comments at 27, 28.

require very low elevation angles for earth stations operating in the Northeast. A sample of the elevation angles investigated are shown in the table below:

Location	Elevation	
	89º W	139º W
San Diego	41.2º	44.9º
Seattle	25.9º	32.7º
Miami	58.0º	19.4º
Northern Maine	32.2º	4.2º
Boston	38.1º	7.5º
New York	41.2º	10.3º

So, CBA was right to re-examine the extent of the orbital arc to be protected, but it should go further and substantiate the need for nationwide access (or at least Northeastern access) to satellites at or near the 139º W orbital location given the impact that the proposed arc's western end would have on 5G deployment in the Northeast.

Lockheed Martin sought full-azimuth capability (i.e., operation at all azimuths and at elevation angles down to 5 degrees) for earth stations operating as part of launch and early orbit phase ("LEOP") operations for future launches.[20] Lockheed Martin's comments seem to suggest that, following Commission action to repurpose the lower portion of the 3.7-4.2 GHz band for flexible-use services like 5G, LEOP will continue to operate at or near the 3.7 GHz edge of the band. If FSS content delivery operations are repacked into the upper portion of the 3.7-4.2 GHz band, LEOP operations should migrate to the upper part of the band as well.

4. TT&C Operations.

CBA continues to propose a 150-km radius to protect TT&C earth stations operating in the repurposed portion of the band, but it proposes to reduce TT&C locations to four sites and

[20] Comments of Lockheed Martin Corporation, GN Docket No. 18-122, at 5 (filed Aug. 7, 2019) ("Lockheed Comments").

locate these four sites away from metropolitan areas so as to further reduce any wireless service impairments.[21] CBA identifies two potential locations—Brewster, Washington and Hawley, Pennsylvania—with small populations. But remote locations like these may nonetheless have a far greater impact than CBA suggests. A 150-km radius around Hawley, for example, encompasses nearly 22 million people (including New York City and all of northern New Jersey). A TT&C-operated site cannot be located there if a 150-km radius applies. If CBA insists on a 150-km radius, it should work with its members and propose four TT&C locations that reflect the importance of the surrounding areas within that radius, not just the site itself.

And, as we noted previously, satellite operators should commit that they will move any future TT&C operations to the repacked FSS spectrum so that ultimately this issue goes away. Relocating TT&C operations into the repacked spectrum will also alleviate the concerns raised by Lockheed Martin with respect to TT&C and LEOP operations at the 3700 MHz band edge.[22]

5. Interdependency of Protections.

Finally, the Content Companies are wrong to claim that the protections in the CBA proposal are an interdependent "package deal" that can "only sufficiently protect video content delivery in their totality."[23] CBA's numerous updates to its proposal belies the claim that its original interference protection plan is an "all-or-nothing, take-it-or-leave-it" approach.

[21] CBA Comments at 29, 30 (citing *C-Band Alliance Transition Implementation Process* at 10, filed as attachment to Letter from Jennifer D. Hindin, Counsel for the C-Band Alliance, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Apr. 9, 2019)).

[22] Lockheed Comments at 3, 4.

[23] *See* Comments of CBS Corporation, Discovery, Inc., FOX Corporation, The Walt Disney Company, Univision Communications Inc., and Viacom Inc., GN Docket No. 18-122, at 3 (filed Aug. 7, 2019) (filed as Content Companies).

III. THE RECORD ESTABLISHES THAT THE COMMISSION SHOULD ADOPT 3GPP-APPROVED OUT-OF-BAND EMISSION LIMITS AND STANDARD POWER LEVELS.

CBA now correctly recognizes that a receiver protection threshold limiting the impact of 5G operations at earth station locations obviates the need for OOBE limits that are more restrictive than 3GPP standards. As a result, the Commission should adopt the OOBE limits and 5G power levels as described below.

A. The Commission Should Adopt an OOBE Limit of -13 dBm/MHz.

The record reflects general support for the OOBE limits we proposed in our initial comments: standard unwanted emission level of -13 dBm/MHz, which will accommodate equipment built to the 3GPP standards for both base stations and user in Band n77.[24] Qualcomm, for example, explains that the typical -13 dBm/MHz OOBE limit that applies to most other mobile bands will also work for new 3.7 GHz band flexible-use licensees in areas where there are no adjacent C-Band satellite operations.[25] As noted above, with its updated receiver protection threshold formula, CBA does not see the need to specify OOBE masks for both base stations and user equipment beyond that which has been specified by 3GPP for band n77.[26] We look forward to resolving the receiver protection threshold values and setting the OOBE levels at the typical -13 dBm/MHz limit.

[24] Verizon Comments at 11.

[25] Comments of Qualcomm Incorporated, GN Docket No. 18-122, at 6 (filed Aug. 7, 2019) ("Qualcomm Comments").

[26] CBA Comments at 34.

Although some commenters supported OOBE limits that would require significant power reductions to be able to meet the limits,[27] Verizon agrees with CTIA and Qualcomm that overly stringent OOBE limits, like those initially proposed by the CBA, would have significant detrimental effects on 5G deployment.[28] The Commission should thus adopt the -13 dBm/MHz limit for OOBE, and require 5G operators to avoid causing interference to repacked satellite earth stations.

B. Higher Power Levels Will Allow 5G Operations to Thrive.

In response to the *Public Notice*, Verizon encouraged the Commission to adopt a 30 dBm power limit for end user devices that will accommodate user equipment built to 3GPP standards and a total power limit of 75 dBm for base stations. T-Mobile and Nokia expressed support for the Commission's initial proposal for 62 dBm/MHz for non-rural areas and 65 dBm/MHz for rural areas (in excess of 1 MHz),[29] which is consistent with AT&T's views regarding full power operation in the lower portion of the C-Band.[30] With other parties coalescing around this position, we drop our encouragement of different power density limits (with no total cap on base station power).

[27] T-Mobile Comments at 17; Comments of Nokia, GN Docket No. 18-122, at 1, 2 (filed Aug. 7, 2019) ("Nokia Comments").

[28] CTIA Comments at 10; Qualcomm Comments at 5.

[29] T-Mobile Comments at 18; Nokia Comments at 2.

[30] Letter from Henry G. Hultquist, Vice President, Federal Regulatory, AT&T Services, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 4 (filed May 23, 2019).

IV. CONCLUSION.

The Commission should adopt a reasonable technical framework as described above to ensure that all spectrum cleared in the 3.7 to 4.2 GHz spectrum band can be used as quickly as possible for new 5G operations that can thrive.

Respectfully submitted,

/s/

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