



**FILED VIA ECFS**

March 8, 2020

Marlene H. Dortch Secretary  
Federal Communications Commission 445 12th Street, SW  
Washington, DC 20510

***Re: Notice of Ex Parte Communication, RM-11847, ET Docket No. 18-21***

Dear Ms. Dortch:

The mmWave Coalition, ("mmWC") responds to the late filed *Opposition* of the National Academy of Sciences, through its Committee on Radio Frequencies ("CORF")<sup>1</sup> to mmWC's *Petition for Rulemaking*<sup>2</sup> ("*Petition*") requesting a modification of Allocation Table<sup>3</sup> Footnote US246. The ever-increasing membership of mmWC is shown in Attachment I.

CORF's filing, like an earlier filing by Boeing<sup>4</sup> which we addressed previously<sup>5</sup>, makes both (1) a substantive claim of a harmful interference threat to passive satellites resulting from the proposed rule change; and (2) a procedural claim - in this case that implementation of the requested US246 changed would create a "Catch 22" situation with respect to ITU's procedures. We will address both of CORF's claims below.

**CORF: "mmWC's PETITION CANNOT PROTECT INNOVATIVE, NEW FUTURE SCIENTIFIC USES OF THESE BANDS"<sup>6</sup>**

mmWC fully agrees with CORF that it is critical to protect actual passive EESS satellites from harmful interference. Indeed, the details of our proposed changes were drafted with this goal in mind. However, CORF failed to address the specific text of the proposal to revise US246 and used only generic arguments to represent the longstanding views of the *status quo*. (For convenience, the mmWC proposed new text for US246 is contained in the Attachment II herein.)

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<sup>1</sup> *Opposition of CORF to Petition for Rulemaking*, RM-11847, November 21, 2019.

<sup>2</sup> *Petition for Rulemaking* of mmWC, RM-11847, August 12, 2019.

<sup>3</sup> 47 C.F.R. § 2.106.

<sup>4</sup> *Opposition of Boeing to Petition for Rulemaking*, RM-11847, September 13, 2019.

<sup>5</sup> *Reply of mmWC to Boeing's Opposition*, October 11, 2019.

<sup>6</sup> CORF *Opposition* at p. 14

***CORF fails to address basic realities of possible antenna configurations and power levels to achieve interference-free sharing***

CORF focuses mainly on future needs for passive spectrum in satellites include “space weather.” For example, CORF states:

In other words, protection of U.S. space-borne assets, including the Global Positioning System (GPS), the International Space Station, and commercial satellites, among others, requires a whole-atmosphere approach to developing accurate space weather models.<sup>7</sup>

But in presenting the possible long term need for possible space weather measurements in the existing US246 band, CORF does not indicate why these would be compromised by terrestrial communications signals at very low or negative elevation angles that do not illuminate the sky.

It would appear that most if not all space weather measurements would involve antennas on satellites pointing either away from the Earth or at angles that point at the limb of the earth. Satellites pointed away from the earth would have high front-to-back ratio antennas that could reject the low power flux density at orbits heights that would result from meeting the protection goals stated in the cited ITU-R recommendation. Similarly, limb pointing sensors would also be subject to ITU-R stated limits but in addition such paths have huge propagation losses on signals from earth reaching the satellite that have passed through long distances at low altitude and have incurred accumulated path losses from atmospheric absorption.<sup>8</sup>

***It is not reasonable to block access to the entire range of spectrum allocated to passive services (ten blocks consisting of over 33 GHz of spectrum) based on speculation that long-dormant bands may be used in the future.***

mmWC respectfully submits that CORF is espousing an outdated approach to spectrum resources (arguing squatters rights), rather than engage in reasoned analysis of mmWC’s modest proposal. US246 presently requires that “No station shall be authorized to transmit” in a total of 33.35 GHz of the 152 GHz between 100 GHz and 252 GHz, or 22% of the spectrum in that region. But this impact is more severe than this number indicates: In the 100-252 GHz region there are 10 US246 separate forbidden bands that CORF seeks to maintain the *status quo* for. These bands chop up available spectrum into small bands. As a result, the only bands with available bandwidth greater than 15 GHz in 100-252 are show below:

<b>Band available between present passive allocations</b>	<b>Bandwidth</b>
116-148.5 GHz	32.5 GHz
167-182 GHz	15 GHz
231.5-250 GHz	18.5 GHz

**Table 1: Bands between present US246 passive allocations**

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<sup>7</sup> CORF *Opposition* at p. 5

<sup>8</sup> T.S. Rappaport *et al.*, “Wireless Communications and Applications Above 100 GHz: Opportunities and Challenges for 6G and Beyond”, *IEEE Access* , Vol. 7 , p. 78729 – 78757 ([https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga\\_193551.pdf](https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_193551.pdf))

At the recent WRC-19, Resolution 731 on “Consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz” was updated.<sup>9</sup> It now states, “to the extent practicable, the burden of sharing among active and passive services should be equitably distributed among the services to which allocations are made.”<sup>10</sup> We believe the increased sharing of spectrum subject to strict technical conditions meets the “sharing burden” that ITU has stated as a spectrum management goal here. While mmWC commends the U.S. for its global leadership in innovative, forward-thinking spectrum policy, this is one instance where the intransigence of incumbent users threatens to keep the U.S. behind the international community.

Although our *Petition* addresses all 10 passive bands in 100-252 GHz, a possible compromise might be to have it apply to only some of the present bands list in US246. Our goal is to create more bands with large bandwidths for high speed systems and broadband signals like terahertz spectroscopy.<sup>11</sup> Thus, the emphasis should be on extending this alternative protection approach to select bands whose sharing would enable large contiguous licensed Fixed Service terrestrial bands for uses such as backhaul for mobile systems in places where fiber optics are not practical and for emergency restorations of wideband telecommunications networks. There is no need to extend the proposal to all the US246 bands above 100 GHz at this time, if grant of the *Petition* for a subset of bands would be more expeditious.

***The Petition’s reliance on quantitative emissions limits is consistent with precedent.*** CORF also does not comment on the fact that the “No station shall be authorized to transmit” provision of US246 already differs from the “All emissions are prohibited in the following bands” provision of ITU RR 5.340. The RR 5.340 provision is actually not physically possible as Fourier Theory teaches that time limited signals can **never** be bandwidth limited and must always have out-of-band-emissions (“OOBE”). Thus, transmitters in bands adjacent to or near 5.340 bands will always have a finite emission level into the protected bands. ITU first recognized this in Resolution 750 at WRC-12<sup>12</sup> which is incorporated the Radio Regulations by RR 5.338A.

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<sup>9</sup> ITU, Provisional Final Acts WRC-19, p. 334-335 ([https://www.itu.int/dms\\_pub/itu-r/opb/act/R-ACT-WRC.13-2019-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.13-2019-PDF-E.pdf))

<sup>10</sup> RESOLUTION 731 (REV.WRC-19), “Consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz, ITU, *World Radiocommunication Conference 2019 (WRC-19) Provisional Final Acts* at p.334

<sup>11</sup> We note that the record in Docket 18-21 demonstrate that at least one manufacturer is presently selling terahertz spectroscopy equipment that “are/have been used to image the Space Shuttle external tank, the Space Shuttle thermal protection system, Orion spacecraft thermal protection system, military aircraft coatings, military ship coatings, radomes, . . . , and other products.” , “has been deployed worldwide by industry, academia, the U.S. D.O.D., and NASA.” And “is a well-developed commercial field with nearly 20 years of established industrial, scientific, and military applications”. This manufacturer’s technology is narrow pulse time domain system that can not avoid the passive bands enumerated in US246. In view of this record, it is unclear why CORF, Boeing, and other advocates of the present US246 terms have not objected to the continuing use of this equipment by the private sector and agencies whose spectrum use is regulated by NTIA. *Comments* of TeraMetrix, a Division of Luna Innovations, Inc., FCC Docket 18-21, May 15, 2018

<sup>12</sup> Resolution 750, “Compatibility between the Earth exploration-satellite service (passive) and relevant active services”, ITU Final Acts WRC-12 World Radiocommunication Conference at p. 359

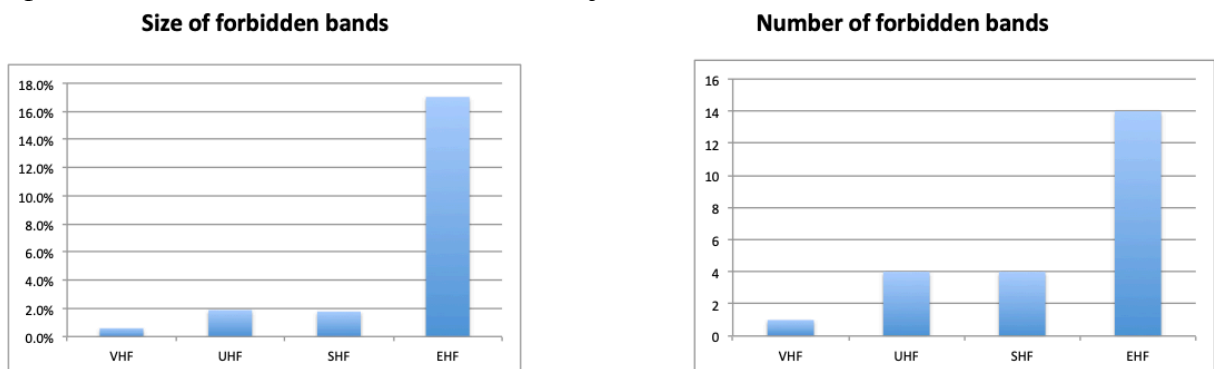
More recently at WRC-19 in Resolution 750 extended this concept to include quantitative limits for protection of the 23.6-24 GHz US246 passive band from OOB coming from the nearby 5G band.<sup>13</sup> Thus our request in the *Petition* for quantitative emission limits is consistent with previous ITU actions for such limits in the case of OOB.

**CORF: “THE NEED TO MAINTAIN CLEAN SPECTRAL “WINDOWS” FOR INNOVATIVE FUTURE SCIENTIFIC EXPLORATION”**

In its Opposition, CORF states:

Satellite remote sensing and radio astronomy both have a long history of innovation and remarkable discoveries, using observations of Earth and the universe through certain spectral “windows.” Just like the commercial innovation that mmWC seeks to promote, scientific innovation relying on passive observation will undoubtedly continue to occur. Yet, with increasingly sensitive instruments, such innovation will require spectral windows that have not been “fogged” by human-made interference.<sup>14</sup>

mmWC fully agrees that future innovation should be allowed to flourish. CORF, however, fails to achieve the correct balance, by unnecessarily obstructing innovation in terrestrial use of bands above 95 GHz without commensurate benefit to passive services. As we described in our *Petition*, while passive allocations in US246 are only a few percent of available spectrum at lower bands, at EHF (30-300 GHz) they are both a much larger fraction of available spectrum but fragment it significantly due to the large increase in the number of passive bands. Figure 1, below, demonstrates this. Put simply, whoever missed TV channel 37 (608-614 MHz)? In lower bands, US246 protection is a minor issue in spectrum planning due to the minor amount of spectrum involved, above 100 GHz it is a major issue.



**Figure 1: Impact of US246 forbidden bands in different spectrum regions**

mmWC’s proposal specifically excludes both mobile transmitters and unlicensed devices from operating in the spectrum under consideration at this time.<sup>15</sup> Assuming *arguendo* that some

<sup>13</sup> Resolution 750, “Compatibility between the Earth exploration-satellite service (passive) and relevant active services”, ITU, *World Radiocommunication Conference 2019 (WRC-19) Provisional Final Acts* at p.349

<sup>14</sup> CORF Opposition at p. 13

<sup>15</sup> The proposed change to US246 given in Attachment II states “all unlicensed devices and all mobile stations are forbidden”. The was intended to simplify the feasibility of sharing with EESS and increase the confidence of protecting EESS with today’s technology. It is easiest to guarantee the very low

future need might develop for passive satellite sensors with sensitivities much greater than those given in the cited current ITU-R recommendations, any licensing action by FCC in these bands could be revoked. For example, the final service rules could condition such licensing on noninterference to the original primary service.

We seek the proposed changes in US246 to permit larger contiguous bands of spectrum for wide band transmissions to provide fiber optic-like capacity in circumstances where fiber optics is not practical due to cost of installation or urgent need for new capacity. As noted above, this does not necessitate the need for changes applying to all 10 enumerated bands above 100 GHz and a rulemaking process could prioritize the bands to balance the concerns expressed by CORF with the needs for terrestrial communications.

In the case of terahertz spectroscopy applications all the US246 bands would be needed since time domain terahertz spectroscopy, pioneered by NASA for use in assuring the safety of the Space Shuttle program, cannot eliminate use of such bands. However different power spectral density limits could be selected for the case of out outdoor terahertz spectroscopy use. It is expected that the vast majority of Non-Federal use of this technology permitted by FCC regulations will be indoors and that building losses will eliminate any threat to satellites from such use.

mmWC's outreach to CORF (and Boeing) to discuss this issue have proved unsuccessful. We welcome such dialogue should these parties choose to engage on the substantive details of the mmWC proposal.

**CORF: “mmWC’s PETITION IS INCONSISTENT WITH AND COULD NOT BE IMPLEMENTED UNDER STANDARD ITU REGULATIONS AND PROCEDURES”**

The final CORF point deals with the Commission's possible implementation of the proposal under the terms of RR 4.4 and a possible “Catch-22” problem resulting from the terms of the ITU Rules of Procedure (“RoP”).<sup>16</sup> CORF states:

Under RoP's 1.5 and 1.6, the notifying administration must establish that the non-conforming assignment will not cause harmful interference to other administrations, demonstrate a plan for shutting down devices if they do so interfere, and afford other administrations the ability to make their own determination of the potential for interference. In addition to those obligations, however, the grant of such U.S. assignments would trigger notification requirements under ITU Article 4.4, but the relevant ITU procedures essentially prohibit such notifications for frequencies listed in ITU RR 5.340.<sup>17</sup>

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emissions at high elevation angles when the transmitting antenna is physically fixed in **both** location and physical orientation. We believe that with evolving technology it will become possible to do so with mobile equipment also but that that decision should be made in a later Commission deliberation as the technology matures.

<sup>16</sup> International Telecommunications Union, “Rules of Procedure,” 2017, <https://www.itu.int/pub/R-REG-ROP-2017>.

<sup>17</sup> CORF *Opposition* at p. 17

While CORF refers to “RoP’s 1.5 and 1.6” requirements, it omits mention of RoP 1.3 which states:

The scope of No. 4.4 is therefore limited to derogations to the Table of Frequency Allocations and to the provisions listed in the Rules of Procedure on No. 11.31 with regard to the “other provisions”. In particular, administrations<sup>18</sup> intending to authorize the use of spectrum under No. 4.4 still have the obligation, under Sections I and II of Article 9, Nos. 11.2 and 11.3, to notify to the Bureau “any frequency assignment if its use is capable of causing harmful interference to any service of another administration.”<sup>19</sup> (Emphasis added)

Thus, the obligation to notify the ITU of a frequency assignment only applies if “its use is capable of causing harmful interference to any service of another administration.” The point of this proposed modification is to set strict conditions to assure that the proposed spectrum use honors the goal of protecting actual use of the protected US246 spectrum. Thus, if the Commission determines that the proposed terms protects the primary service, it has no obligation to notify ITU.

The proposed modification of US246 would not be the first time the FCC has made a domestic allocation which is not consistent with ITU allocations and used its flexibility permitted by RR 4.4. Consider the case of 5000-5010 MHz. The US and ITU allocations for this bands are shown in Table 2.

Table of Frequency Allocations			3500-5460 MHz (SHF)		Page 41
International Table			United States Table		FCC Rule Part(s)
Region 1 Table	Region 2 Table	Region 3 Table	Federal Table	Non-Federal Table	
5000-5010 AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION RADIONAVIGATION-SATELLITE (Earth-to-space)			5000-5010 AERONAUTICAL MOBILE (R) US115 AERONAUTICAL MOBILE-SATELLITE (R) 5.443AA AERONAUTICAL RADIONAVIGATION US260 RADIONAVIGATION-SATELLITE (Earth-to-space) US211		Aviation (87)

**Table 2: ITU and US allocations for 5000-5010 MHz -- an example of a domestic allocation noncompliant with ITU allocations**

Note the US allocations include 4 different radio services including AERONAUTICAL MOBILE (R)<sup>20</sup>, while the International Table contains only 3 other services. Such inconsistencies are a long standing practice in the US and its interpretation of RR 4.4, but more importantly the US Administration does not notify ITU of assignments in such cases as CORF feels is necessary under RoP’s 1.5 and 1.6 for the simple reason that such inconsistencies are only adopted if they are found to be not “capable of causing harmful interference to any service of another administration.” Thus, in practice, the Catch-22 situation that CORF alleges will not exist if the FCC adopts the requested changes while assuring that the ITU-R recommended limits are adequate for EESS protection.

<sup>18</sup> “Administration” in ITU jargon means the national spectrum regulator of an ITU member nation.

<sup>19</sup> ITU Rules of Procedure 1.3

<sup>20</sup> Authorized by 47 C.F.R. § 2.105, fn US115

## CONCLUSION

The CORF *Opposition* is based on two claims regarding the *Petition*, which we show fail under the most basic of scrutiny. First, as demonstrated above CORF's claim that the proposed change would cause harmful interference to present passive EESS satellites and future satellites is not correct as a technical matter and is contrary to U.S. policy to promote innovation. Second, we demonstrate that there is no Catch-22 situation resulting from RoP's 1.5 and 1.6 in light of the terms of RoP 1.3 (omitted from CORF's *Opposition*) and the consistent historic US practice of not notifying ITU of RR 4.4-based assignments since it only makes such assignment that meet the "capable of causing harmful interference" test of RoP 1.3.

mmWC reiterates that the changes to US 246 need not provide access to all ten spectrum blocks identified in the *Petition*, in the event certain blocks involve more sensitive incumbent uses not amenable to sharing. The issue of what specific bands should be covered by the proposed changes to US 246 in 100-252 GHz should be handled in the notice and comment period of the requested rulemaking.

Based on the foregoing, as well as our other submissions in this docket, mmWC urges the Commission to issue a Notice of Proposed Rulemaking without further delay to develop a full record on this issue.

*/s/Mark Cudak*

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Mark Cudak  
Chair of Steering Group  
mmWave Coalition

cc: Ronald Repasi  
Monisha Ghosh  
Jamison Prime  
Michael Ha  
Nicholas Oros

## **Attachment I: mmWave Coalition membership**

- American Certification Body, Inc.
- Azbil North America Research and Development, Inc.
- Global Foundries, Inc.
- Keysight Technologies
- National Instruments
- Nokia Corporation
- NSI-MI Technologies
- Nuvotronics, Inc.
- NYU WIRELESS
- Qorvo, Inc.
- RaySecur
- Samsung Research America Inc.
- VEGA Americas
- Virginia Diodes, Inc.
- VUBIQ Networks



## **Attachment II: mmWC Proposal for Change of Provisions Above 95 GHz**

**US246** No station shall be authorized to transmit in the following bands: 73-74.6 MHz, 608-614 MHz, except for medical telemetry equipment<sup>1</sup> and white space devices<sup>2</sup>, 1400-1427 MHz, 1660.5-1668.4 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.7 GHz, 15.35-15.4 GHz, 23.6-24 GHz, 31.3-31.8 GHz, 50.2-50.4 GHz, 52.6-54.25 GHz, 86-92 GHz,

In the following bands all unlicensed devices and all mobile stations are forbidden and FCC and NTIA will only issue licenses or assignments under mutually agreed procedures that assure that authorized Radio Astronomy Service facilities and Earth Exploration Satellite Service stations are protected from both the individual and aggregate emissions to the criteria given in ITU-R RS.2017, ITU-R RS.1858, ITU-R RA.517, ITU-R RA.517, ITU-R RA.611, ITU-R RA.769-2 and ITU-R RA.1031.: 100-102 GHz, 109.5-111.8 GHz, 114.25-116 GHz, 148.5-151.5 GHz, 164-167 GHz, 182-185 GHz, 190-191.8 GHz, 200-209 GHz, 226-231.5 GHz, 250-252 GHz.

In cases where there is a formal coordinated FCC/NTIA/DOS US proposal to ITU-R to adopt a stricter standard protection limit, that draft position will apply as long as the draft is pending in ITU-R.

<sup>1</sup> Medical telemetry equipment shall not cause harmful interference to radio astronomy operations in the band 608-614 MHz and shall be coordinated under the requirements found in 47 CFR 95.1119.

<sup>2</sup> White space devices shall not cause harmful interference to radio astronomy operations in the band 608-614 MHz and shall not operate within the areas described in 47 CFR 15.712(h).