

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

In the Matter of)	
)	
Amendment of Footnote US246 of)	RM No. _____
Section 2.106 of the Commission's Rules)	
To Enable More Efficient Interference-Free)	
Sharing of Spectrum Above 95 GHz)	
)	
Spectrum Horizons)	ET Docket 18-21
)	

PETITION FOR RULEMAKING

OF THE

mmWAVE COALITION

August 9, 2019

/s/ Prakash Moorut

Prakash Moorut
Chair of Steering Group
mmWave Coalition

SUMMARY

The mmWave Coalition a group of companies and university researchers interested in promoting practical uses of spectrum above 95 GHz submits this petition to further that goal. Until the Commission's bold March 15, 2019 decision in the Report and Order in Docket 18-21 virtually all use of this spectrum was implicitly forbidden due to the lack of service rules in this spectrum, although all spectrum up to 275 GHz US has allocations.

This Petition for Rulemaking addresses the unusual treatment of this spectrum in Allocation Table footnote US246. US246 was intended to protect passive spectrum, *e.g.* the Radio Astronomy Service and the Earth Exploration Satellite (passive) Service. The terms of US246, which say "(n)o station shall be authorized to transmit" covers a total of 23 bands ranging in frequency from 73 MHz to 252 GHz. The restriction on the 13 bands listed in US246 below 95 GHz has little impact on restricting broad spectrum use opportunities since they occupy a very small fraction of the electromagnetic spectrum in the spectrum bands where they are and are widely scattered throughout the bands up to 95 GHz. However, due to the large number and high density of molecular resonances above 95 GHz, the width and number of the restricted bands above 95 GHz have a large impact on spectrum use opportunities for non-Federal Government entities regulated by the Commission.

The scientific services protected by US246 contribute greatly to scientific knowledge, weather forecasting, and environmental research and must be protected from harmful interference. The Coalition does not doubt the need to continue to protect these scientific services which are often passively sensing our earth and its environment. The question here is whether, for the special case of spectrum above 95 GHz, is there an alternative way to both protect the key passive services and also enable new terrestrial uses of spectrum under a strict framework that encourages privately funded research and development and commercialization of the spectrum above 95 GHz while also protecting the passive services adequately.

Our approach in this petition is to propose a modification to US246 that bases protection above 95 GHz not on the existing prohibition of all use, but rather on a performance goal that must apply individually and collectively for all users of the protected spectrum bands. This allocation table change would then enable Commission deliberations in later rule makings on specific terms applicable for each band and each type of use.

This change will enhance transparency in spectrum policy in the frequencies above 95 GHz listed in US246, and encourage capital formation for private sector research and development by decreasing regulatory uncertainty.

PETITIONER

The mmWave Coalition ("mmWC"), a group of innovative companies and universities united in the objective of removing regulatory barriers to technologies and using frequencies ranging from 95 GHz to 275 GHz supports the initiation of this proceeding to permit use of spectrum above 95 GHz and offers suggestions to make above-95 GHz spectrum more accessible and useful for

innovative services and technologies. mmWC has been an active participant in Docket 18-21. Attachment 1 contains a list of the present membership.

BACKGROUND

The Commission adopted the *Notice of Proposed Rulemaking* ("*NPRM*") in Docket 18-21 on February 22, 2018.¹ The *NPRM* sought "comment on a plan to make the spectrum above 95 GHz more readily accessible for new innovative services and technologies". In its timely comments, mmWC recommended that the:

"Commission should work with NTIA to eliminate US246's flat ban on stations transmitting in the affected frequencies and, instead simply require stations transmitting in such frequencies to protect passive systems from interference. For example, above 95 GHz, a revised US246 might replace the total prohibition with a requirement that any service rules adopted must be based on meeting the international passive systems protection requirements stated in Recommendation ITU-R RA.1272² and Recommendation ITU-R RS.2017³. In effect, this would replace a total prohibition based on analyses at lower frequencies with a performance-based goal using well-documented international standards for protection of vital passive services. Doing so would result in transparency for the criteria used and would enable market access for new technologies that meet these performance criteria, which in turn would facilitate private capital formation for development of such new, innovative technologies."⁴

The present text of US246 is

US246 No station shall be authorized to transmit in the following bands: 73-74.6 MHz, 608-614 MHz, except for medical telemetry equipment¹ and white space devices,² 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, 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. (footnotes omitted)

This total transmitter prohibition deals with a total of 23 bands ranging in frequency from 73 MHz to 252 GHz. The 13 bands below 95 GHz have little impact on spectrum use opportunities since they occupy a small fraction of such spectrum and are widely scattered. This is shown in Figures 1 and 2 below which indicate the impact of US246 on different bands from VHF to EHF (30-300 GHz).

¹ NPRM, Docket 18-21, March 15, 2019

² Recommendation ITU-R RA.1272, *Protection of Radio Astronomy Measurements Above 60 GHz From Ground Based Interference*.

³ Recommendation ITU-R RS.2017, *Performance and Interference Criteria for Satellite Passive Remote Sensing*.

⁴ Comments of mmWC, Docket 18-21, May 2, 2018

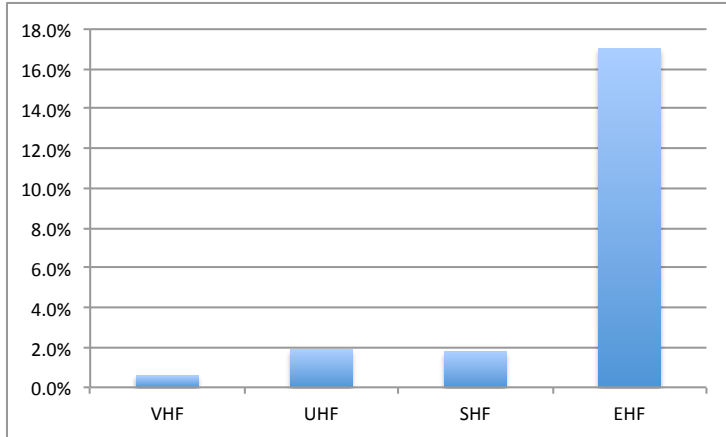


Figure 1: Fraction of band where transmitters are banned by terms of US246

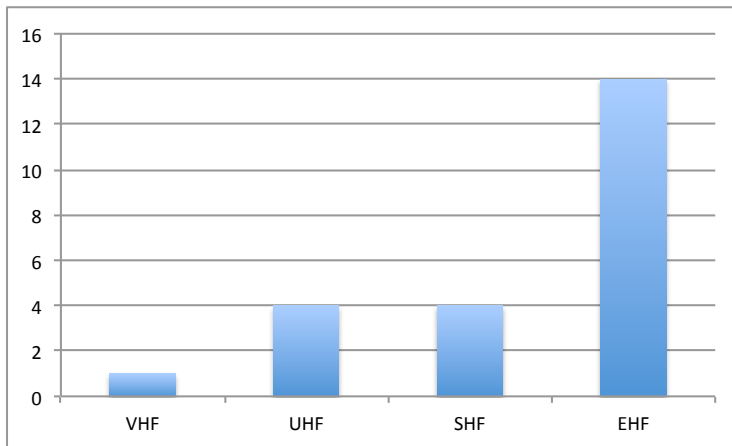


Figure 2: Number of blocks in each band where transmitters are banned by terms of US246

It can be seen in Figure 1 that the fraction of the EHF band where transmitters are banned is much greater than in any of the lower bands. Figure 2 shows the much greater number of banned segments in EHF which in turn fragments/balkanizes the remaining segments into smaller size blocks. Indeed, the largest contiguous block in US spectrum allocations⁵ available for any use involving transmitting a radio signal without impinging on blocks forbidden by US246 is the 32.5 GHz spectrum block between 116 GHz and 148.5 GHz. Present US allocations have only modest blocks for normal radio services between the blocks protected by US246. So, the upper limit of 32.5 GHz bandwidth would apply to point-to-point communications such as is authorized in lower bands in Part 101 and mobile communications services as well terahertz spectroscopy, short range (less than 1m) technology which is used for real time quality control of manufactured protected to confirm their structure.

⁵ 47 C.F.R. 2.106 (US National Table of Allocations – updated version is available at <https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf>)

US246 has not been immutable. Twice in recent decades it has been amended with footnotes added when alternative schemes were developed to protect one of its enumerated bands in order to allow transmitters authorized by the Commission. Thus new technology had previously been accepted by the Commission as an alternative approach for protecting vital passive bands. Similarly in this petition, mmWC seeks an alternative approach to protect the passive bands above 95 GHz

US246 is derived in part from ITU Radio Regulation 5.340 ("RR 5.340") which is a treaty obligation of the US. The text of RR 5.340 is

5.340 All emissions are prohibited in the following bands:1400-1427 MHz, 2690-2700 MHz, except those provided for by No. 5.422, 10.68-10.7 GHz, except those provided for by No. 5.483, 15.35-15.4 GHz, except those provided for by No. 5.511, 23.6-24 GHz, 31.3-31.5 GHz, 31.5-31.8 GHz, in Region 2,48.94-49.04 GHz, from airborne stations 50.2-50.4 GHz, 52.6-54.25 GHz, 86-92 GHz, 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

RR 5.340 prohibits "all emissions" in 21 bands from 1400 MHz to 252 GHz.⁶ Many, but not all, US246 bands are included in RR5.340. Although the "all emissions" phrasing of RR5.340 would appear stricter than the "No station shall be authorized to transmit" phrasing of US246, ITU signatories such as the US also are enabled by the terms of ITU RR4.4 to authorize any use of transmitters that does not actually cause harmful interference to systems of other signatories that were properly authorized under the provisions of the ITU Radio Regulations.⁷

mmWC previously filed the text of our proposed change of US 246 in response to NTIA's National Spectrum Strategy Request for Comments⁸ and with the Commission in Docket 18-21⁹. In the *Report and Order* in Docket 18-21 this introduction of a change to US246 in that docket was found to be "beyond the scope of this proceeding"¹⁰.

Therefore, we are using this Petition for Rulemaking under the provisions of Section 1.401 as an appropriate way to seek Commission consideration of this vital issue.

Research on use of spectrum above 95 GHz has been going on around the world, often supported by national government funding and with the cooperation of other national spectrum regulators,

⁶ The ITU choice of "all emissions" wording includes out-of-band emissions which are unintentional. However, all practical transmitters that transmit energy produce *some* out-of-band emissions according to Fourier Theory.

⁷ ITU Radio Regulation 4.4: "Administrations of the Member States shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations." (<https://life.itu.int/radioclub/rr/art4.pdf>)

⁸ Comments of mmWC, NTIA Docket No. 181130999-8999-01, January 22, 2019

⁹ mmWC *ex parte* filing, Docket 18-21, January 30, 2019

¹⁰ *1st Report and Order*, Docket 18-21, March 15, 2019 at fn. 32

which in some countries have control over such R&D funding.¹¹ Figure 3 below shows data on research reported in technical journals with both frequency used and data rate achieved. The letters next to each data point shows the country of the research and it can be seen that the US has not been a major contributor. Research in the US is more dependent on private sector and entrepreneurial funding and uncertainty about spectrum access may well be discouraging such private investment at this time.

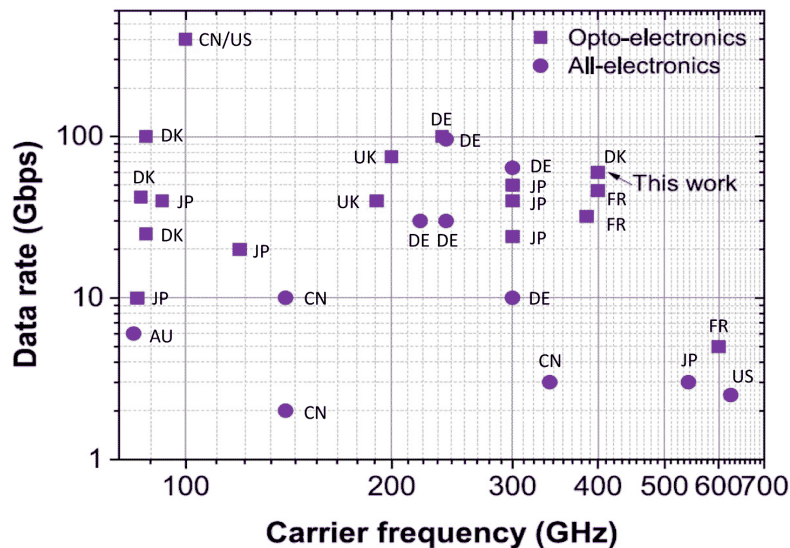


Figure 3: Published research on mmWave data transmission experiments¹²

PROPOSED MODIFICATION OF US246

Our proposed modification of US246, given in Attachment 2, has protection terms identical to the present terms for all frequencies below 95 GHz. However, for frequencies above 95 GHz it replaces the present "No station shall be authorized to transmit" restriction with a performance-based standard that would limit unwanted signals at passive satellites and radio astronomy¹³ facilities to levels that have been accepted as adequate in ITU-R recommendations.

¹¹ T.S. Rappaport, et. al., "Wireless Communications and Applications Above 100 GHz: Opportunities and Challenges for 6G and Beyond," *IEEE Access*, June 2019, Vol. 70, pp. 78729 – 78757, <https://ieeexplore.ieee.org/document/8732419>).

¹² Yu, Asif, et al., "400-GHz Wireless Transmission of 60-Gb/s Nyquist-QPSK Signals Using UTC-PD and Heterodyne Mixer," *IEEE Transactions on Terahertz Science and Technology*, Issue No. 99, p. 1-6 (August 2016) (<http://ieeexplore.ieee.org/document/7556985/>); <https://www.sciencedaily.com/releases/2017/02/170205190911.htm>

¹³ US246 protects allocations of both the Radio Astronomy Service (RAS) and the Earth Exploration Satellite (passive) Service (EESS), usually in the same bands. In practice RAS protection has little impact on other potential spectrum users at frequencies above 95 GHz as most observations are made at high altitude observatories in arid areas which are usually remote from uses of state-of-the-art radio technology. In addition, the longstanding provisions and practices associated with coordination under the terms Section 2.107 has resulted in timely and effective coordination between the RAS community and users at the upper end of the spectrum with adequate transparency. Unfortunately there is no comparable tradition of coordination with EESS users.

The draft change goes beyond the present text of the ITU-R recommendations and would make any change to these recommendations proposed by the US and formally sent to ITU-R binding on both FCC and NTIA while that proposed change is pending before ITU-R. Thus, a multiyear ITU-R cycle would not be necessary to implement a change if it was urgently warranted by unforeseen developments.

BENEFITS OF PROPOSAL

The benefits of this proposed change to US246 change are several:

1. It would increase significantly the amount of contiguous spectrum available above 95 GHz while maintaining rigid interference protections for the passive radio services. Under the present terms of US246 the 32.5 GHz in 116-148.5GHz is the largest single block available for either communications or short range terahertz spectroscopy operations. The main interest in higher frequencies is for large contiguous bands for point-to-point communications at fiber optic-like speeds or industry terahertz spectroscopy applications to improve manufacturing quality control industrial operations²⁰. While we do not expect millimeterwave communications links to replace fiber optics as the main medium for high speed point to point communications, there are always situations where fiber optics is not a practical solution due to either installation costs in difficult terrain or time urgency. The digital divide in the USA could be addressed by providing high speed point-to-point links with capacities comparable to fiber, and this is a priority for the Commission.
2. It would make access to this spectrum more transparent and thus facilitate capital formation for R&D for fixed service/cellular backhaul, mobile service, and terahertz spectroscopy to improve manufacturing productivity. Under present policies, any proposed spectrum use above 95 GHz needing more than 32.5 GHz of contiguous spectrum will overlap a US246 protected band, and thus will require nonroutine action involving both FCC and NTIA to meet protection criteria that are not codified and not even readily available. While the new Spectrum Horizon rules nominally permit access to any spectrum above 95 GHz, the "Necessary Showing" requirement of § 5.702 necessitates a proponent to meet the nebulous requirement such that a "proposed experiment would not cause harmful interference to other services". The proposed new text would clarify what standard is needed.
3. It is expected that the increase in transparency for access to this spectrum would in turn increase private capital formation in US industry for R&D in this spectrum which is already targeted by other countries which are economic competitors of the US with government supported R&D funding.

²⁰ See T.S. Rappaport, *et al.*, (June 2019) *op.cit.*

CONCLUSION

The proposed change to US246 given in Attachment 2 would have a major impact on the amount of contiguous spectrum available for both communications uses and terahertz spectroscopy above 95 GHz while protecting critical passive scientific uses with quantitative protection levels. This increased transparency is then expected to spur private capital formation in this technology to allow the US to be more competitive with other countries that are using national government funds to support R&D, while enabling market forces to solve existing and anticipated needs in the United States.

The present provisions of US246 also create regulatory ambiguity for terahertz spectroscopy which is most efficient with large contiguous bandwidths and may be effectively banned by the present US246. While this will not likely to be a high dollar value market by itself, use of this technology in factories manufacturing many types of products can increase quality control, lower final productions costs, and help restore the competitiveness of US manufacturing.

/s/ Prakash Moorut

Prakash Moorut
Chair of Steering Group
mmWave Coalition

cc: Julius Knapp

Attachment 1: 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
- VEGA Americas
- Virginia Diodes, Inc.

Attachment 2: 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 equipment¹ and white space devices², 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.

¹ 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.

² 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).