

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of

Amendment of Part 25 of the
Commission's Rules to Update Out-
of Band Emissions From Satellite
Networks

RM-9740

To the Commission:

REPLY COMMENTS

Motorola, Inc. ("Motorola"), by its attorneys, hereby submits these reply comments to the Public Notice issued in the above-captioned matter.¹

Most of the parties commenting in this proceeding agree that the Commission should embark on a rulemaking proceeding to update the spectral mask contained in Section 25.202 of the Rules, 47 C.F.R. §25.202, relating to out-of-band emissions ("OOB") from satellite networks.² As Motorola stated in its Comments, immediate commencement of a rulemaking proceeding is important because the next generation of satellite systems, such as those licensed and proposed in the Ka-band and other spectrum allocations, feature technical parameters that

¹ Public Notice, DA 99-2601 (November 19, 1999).

² See, e.g., Comments of Astrolink International, LLC ("Astrolink"), Final Analysis Communications, Inc. ("Final Analysis"), Leo One Worldwide, Inc. ("Leo One") and Teledesic LLC ("Teledesic"). Cf., e.g., Hughes Space and Communications Corporation ("Hughes") (favoring revision of the Rules after the year 2000 ITU-R Assembly) and CCI International N.V. ("Constellation") (waiting until WRC-2000 is concluded and the applicable ITU Radio Regulations are known). Generally, the radio astronomy commenters oppose any rules that would relax unwanted emissions from satellite networks. See discussion, *infra*.

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were not contemplated when the current rules were promulgated over twenty year ago.³

Moreover, there is work currently underway within TG 1/5 and other groups of the ITU-R that relates to these Rules. In any event, notwithstanding the potential for collateral international and domestic standards development activities, it is perfectly appropriate that the Commission proceed with its rulemaking proceeding to establish standards for U.S. licensees. For these reasons, Motorola urges the Commission to address the issues set forth in the Public Notice in an expeditious fashion, and to convene an informal industry working group to assist in the development of specific rule recommendations for a forthcoming Notice of Proposed Rulemaking.⁴

A. The Commission Should Use Either dBc or dBs Units in Its Out-of-Band (OOB) Masks

In its Comments, Motorola recommended that dBs be used as the generic OOB measurement unit for purposes of changes in Section 25.202 of the Rules. This is because both dBc and PFD masks compare a measured power density level in a given bandwidth with OOB levels in a generally narrower reference bandwidth centered on a frequency outside the

³ Motorola Comments at 1.

⁴ The Wireless Communications Association International, Inc. (“WCAI”) suggests this proceeding should not be treated as a rulemaking “because [the petition] does not contain specific modification proposals.” WCAI Comments at 2. The Commission, however, clearly has the discretion to issue notice of its intent to initiate a rulemaking proceeding based upon the information contained in the joint letter filed by Motorola, Hughes and Teledesic, and, in any event, it has offered sufficient notice of the essential scope of such a rulemaking proceeding in the Public Notice. Based on the comments received to the Public Notice, the Commission can decide to issue a Notice of Proposed Rulemaking, or it may wish to turn to the industry for assistance, as Motorola and others have suggested, before making concrete proposals in an NPRM. See, e.g., Motorola Comments at 2, 6; Astrolink Comments at 5. Indeed, WCAI would be a welcome participant and a valuable contributor in such informal industry meetings.

authorized bandwidth of the transmitted signal. This can produce mean power levels that are not necessarily consistent. On the other hand, dBs allows the direct comparison of mean power levels over the same referenced bandwidth, offering greater consistency of measurement, comparison and evaluation.⁵ While dBs is arguably the preferred unit of measure, Motorola would not object to Commission adoption of either dBs or dBc as the measurement unit for OOB. In any case, Motorola strongly opposes use of PFD masks in the Rules.

In a recent U.S. input document to TG 1/5, the differences between dBs/dBc and PFD were discussed:

The purpose of a PFD limit is to provide in-band protection to affected services. PFD limits are not suitable for the specification of unwanted emissions. Unwanted emissions should be specified with respect to transmitter output power in terms of relative difference of levels or power spectral density. A mask based on dBc or the dBs measurement compares out-of-band emission levels measured in a reference bandwidth centered at a frequency outside the necessary bandwidth of the transmitted signal. In the case of a dBc mask, the OOB emission level is compared to the total power of the transmitted signal.⁶

⁵ The commenters on this issue are generally divided as between dBs, dBc and PFD units. Final Analysis, for example, favors using PFD; Astrolink would find either dBs or dBc acceptable; Leo One and Constellation would use dBc; the radio astronomy commenters generally prefer PFD; and Teledesic favors dBs (reasoning that it is better to measure attenuation outside the authorized band relative to the maximum or average power inside the authorized bandwidth, rather than comparing to the mean power of the transmitter). Hughes opposes using PFD alone, but would accept a mask that takes into account PFD levels “that afford adequate protection of other systems and services.” Hughes Comments at 2. Motorola finds Hughes’ position on PFD flawed because PFD levels would be variable and inconsistent. At the very least, such a dual mask approach should be studied further before it is seriously considered for inclusion in the Rules. For the reasons discussed herein, Motorola also opposes Final Analysis’ position on the PFD approach.

⁶ United States Input Document ITU-R TG 1/5-209, “The Need to Use dBc or dBs Measurements in Creating Masks to Define OOB Emission Limits for Space Services,” August 6, 1999.

For satellite transmitters, compliance with an appropriate mask should be independent of the particular orbit chosen for the spacecraft. Thus, a manufacturer may build the spacecraft transmitter so that it conforms to the mask features that are specified and that are under its control. A mask specified in terms of dBc or dBs assures a defined standard for the performance of the transmitter. The level defined for various offsets from the necessary bandwidth of the emitted spectrum can also accommodate the most recent advances in technology to limit the level of OOB emissions.

Because PFD produced by a transmitter is a function of the EIRP and the distance between the transmitter and the reference location, a mask based on PFD levels does not establish a clear standard for the performance of a transmitter. Other factors also affect the PFD level, such as atmospheric effects, modulation types and receiver characteristics. Further, mitigation techniques will impact the accuracy and utility of PFD masks, as revealed by the work done in ITU-R Joint Working Party 4-9-11.⁷ The principal role of PFDs is in establishing protection criteria for a service and interference thresholds in coordination negotiations. Masks based on PFD levels are not suitable for transmitter OOB limits.⁸

⁷ Id. For GSO satellites, PFD levels are potentially calculable because angles of arrival relative to orbit location are known. For non-GSO satellites, however, especially those that do not have repeating ground tracking or are in highly inclined elliptical orbits, such measurements will be virtually impossible to normalize.

⁸ The National Radio Astronomy Observatory (“NRAO”) and other radio astronomy commenters favor the use of PFD levels. NRAO asserts that dBc and dBs do not account for intermodulation products produced by active-array multi-beam antennas. Neither NRAO nor any other commenter has demonstrated that OOB levels as measured by dBc and dBs techniques do not accommodate such concerns. The only issue is whether it is more appropriate to measure OOB at the transmitter or the receiver. The consensus of manufacturers and service providers is that the measurement should be made at the transmitter, i.e., only dBs or dBc should be used.

Accordingly, Motorola recommends that dBs or dBc be used as the generic OOB measurement unit for Section 25.202 of the Rules. These units allow the direct comparison of mean power levels over the same reference bandwidth, and offer greater consistency of measurement, comparison and evaluation.

B. The Commission Should Look to an Ad Hoc Industry Group for Revisions to Section 25.202(f) To Reconcile OOB Limits Of Multi-Carrier, Wideband and Single Broadband Carrier Systems

In its Comments, Motorola recommended that just one wideband mask be used for OOB limits, independent of the number of carriers used within the subject bandwidth.⁹ Other parties commenting in this proceeding differ on the approach the Commission should take on this issue.¹⁰ Current work in various industry working groups, however, may lead to an approach

⁹ Motorola concluded that while these sources may make it more burdensome for a multi-carrier wideband system to meet a given generic OOB mask than would a single carrier broadband communication system, treating the two systems differently could expose adjacent services to excess interference. Motorola Comments at 3.

¹⁰ Leo One, for example, suggests that a multi-carrier system should be held to the same standard as the collection of individual carriers. It also states, “[A multi-carrier transmitter] should be held to more stringent limits than a single broadband transmitter because the form of the signal as a series of individual carriers allows for greater flexibility in the overall design.” Leo One Comments at 4. Constellation suggests that the spurious emission standards should be related to the transponder bandwidth for space stations employing simple frequency changing transponders. Constellation Comments at 2-3. NRAO suggests that blanket characterization of multi-carrier transmission as the equivalent of a single carrier broadband transmission would lead to levels of OOB and spurious emissions that would exceed those in Recommendation ITU-R RA.769.1. It also claims that “a multicarrier system should not be allowed any level of unwanted emission greater than that of the individual carrier.” NRAO Comments at 4. NRAO makes an erroneous assumption regarding bandwidth and roll-off characteristics. The final output of a system, whether single or multiple carrier, has a specified roll-off based largely on its data rate. A single carrier that is an ensemble of narrower carriers, *i.e.*, a multicarrier system, will display roll-off and bandwidth characteristics similar to a broadband system of the same overall data rate. An individual narrowband carrier that is at the edge of the same band would have a sharp roll-off, unlike an individual carrier that is comprised of multiple carriers. If a

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that accommodates a variety of bandwidths and establish OOB levels more generally acceptable than the current Commission Rules.

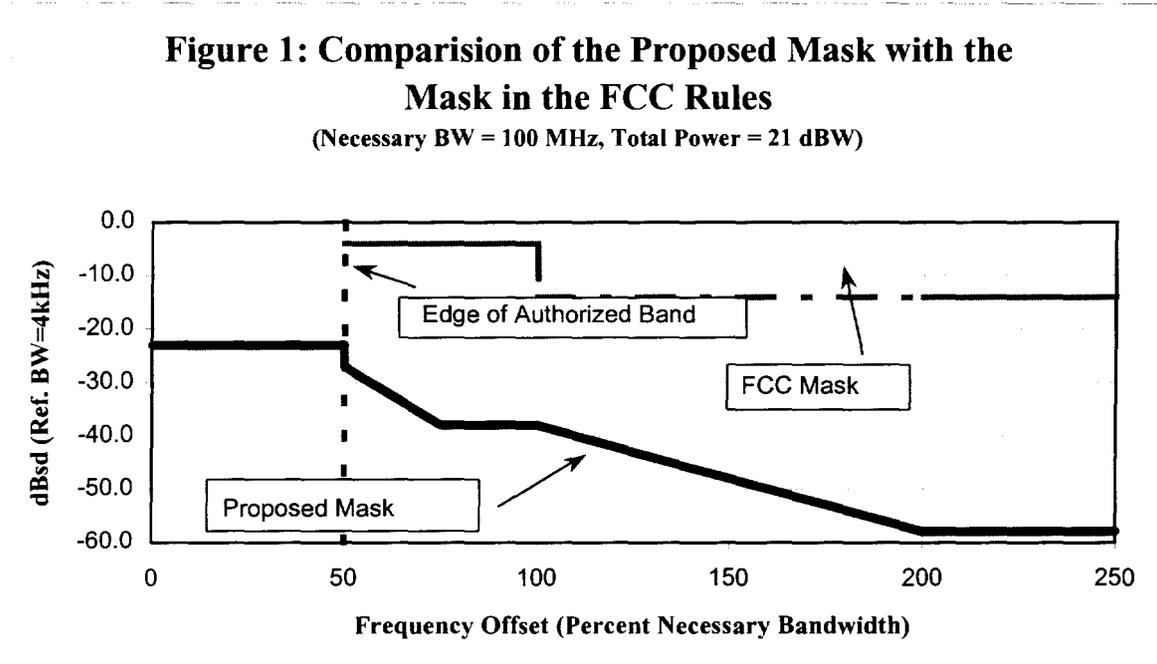
The spectral mask of Section 25.202(f) of the Rules does not address wideband transmitters.¹¹ This is because the mask was developed and optimized in an early environment in which evenly spaced, narrowband channel bandwidths were common. Clearly, the spectral environment has evolved. Indeed, a recent U.S. contribution to the April 1999 meeting of WP-4A has illustrated the differences between the mask contained in Section 25.202(f) of the Rules and the mask produced by at least one space system manufacturer.¹² As indicated in the figure below, the OOB roll-off of the system produced by this manufacturer is far more like the well-defined band-edge roll-off of a filter than the step-curve found in Section 25.202(f). While the OOB restraints of this curve are plainly improved, *i.e.*, more stringent, it should be noted that part of the improvement stems from applying dBs units and recognizing that there may be circumstances under which additional masks may be appropriate. In any event, it is important that the Commission evaluate the kind of approach illustrated by these curves and the work of

multicarrier system is limited to the bandwidth of an individual carrier at the band edge, an artificial and inappropriate limitation would be imposed on all multicarrier systems. In sum, OOB and other spurious emissions are not a function of the number of carriers; they are related to the bandwidth of the signal, whether single or multi-carrier. NRAO simply has not shown that RA.769.1 will be affected by the changes proposed in this proceeding. See also Comments of the National Research Council's Committee on Radio Frequencies ("CORF") at 5. For its part, Astrolink recommends additional study because transponder bandwidth does not apply to some new wideband satellite technologies. Astrolink Comments at 3. Several commenters generally agreed that the OOB limits should be standard for all users, both narrow and broadband systems. See, e.g., Final Analysis Comments at 2; Hughes Comments at 3; Teledesic Comments at 7-8.

¹¹ See U.S. Input Document ITU-R TG 1/5-158/Annex 8 (August 6, 1999).

¹² United States Input Document WP-4A/285, "Working Document Towards a Preliminary Draft New Recommendation on Out-of-Band (OOB) Emissions For the Fixed-Satellite Services on a Band-by-Band Basis," 21 April 1999.

U.S. ITU-R preparatory groups in their efforts to update Section 25.202(f) of the Rules. This, in turn, will serve as a critically important predicate to developing international standards for OOB emissions.



Accordingly, Motorola urges the Commission to seek industry consensus on how best to treat emissions of a multi-carrier system with a wideband frequency allocation as compared to those of a system with a single broadband carrier. While Motorola recommends that one wideband mask can and should be used in both cases, the issue may be more properly addressed by an ad hoc industry group under the aegis of the Commission for reconciliation of the apparent differences in views that currently exist.

C. The Commission Should Continue to Use Authorized Bandwidth

The majority of commenters agree with Motorola that “authorized bandwidth,” which has been relied upon consistently for many years and is generally well understood in the context of the Commission’s Rules, should be used in any revision to Section 25.202.¹³ For its part, Hughes recommends that “[t]here should be further study on the technical and regulatory implications of proposed approaches.”¹⁴ However, Leo One suggests that using the authorized bandwidth eliminates the need for guard bands.¹⁵ Motorola disagrees. Until an ideal filter exists, guard bands will continue to be the most efficient means to protect services operating in adjacent bands. Finally, NRAO and CORF assume that “authorized bandwidth may be much wider than the necessary bandwidth.”¹⁶ Such a conclusion finds no support in any ITU definition.

D. Conclusion

Motorola urges the Commission to address the issues set forth in the Public Notice in an expeditious fashion, and to convene an informal industry working group to assist in the development of specific rule recommendations for a forthcoming Notice of Proposed

¹³ See, e.g., Astrolink Comments at 3-4, Constellation Comments at 3, Final Analysis at 3, Teledesic Comments at 9.

¹⁴ Hughes Comments at 3.

¹⁵ Leo One Comments at 5.

¹⁶ NRAO Comments at 5; see also CORF Comments at 5.

Rulemaking in this proceeding. This approach should hasten the promulgation of needed revisions to Section 25.202 of the Rules so that advances in satellite technology can be implemented under standards that assure a common understanding of out-of-band emissions.

Respectfully submitted,

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