

September 19, 2017

BY ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: *Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20161115-00118*

*Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service
Systems and Related Matters, IB Docket No. 16-408*

Dear Ms. Dortch:

Space Exploration Holdings, LLC (“SpaceX”) hereby responds to the *ex parte* letter recently filed by WorldVu Satellites Limited (“OneWeb”) on the topic of the equivalent power flux-density (“EPFD”) limits applicable to certain non-geostationary orbit (“NGSO”) satellite systems.¹ OneWeb’s letter was written in response to a submission by SpaceX demonstrating that OneWeb’s EPFD assertions result from an improper application of the analytical tools developed by the International Telecommunication Union (“ITU”) to determine compliance.² In fact, SpaceX showed that such a misapplication of the ITU’s EPFD validation software could be used to show that proposed NGSO systems with steerable beams – including OneWeb’s – appear to exceed the EPFD limits.

In its response, OneWeb does not deny that the ITU-approved software can be manipulated to show that its own system does not comply with applicable EPFD limits, nor does it offer any further analysis of its own system in this regard. Instead, OneWeb attempts to raise new questions about the EPFD compliance of several other applicants in the current processing round. Here again, OneWeb has misapplied the validation software in an attempt to exploit ongoing developmental efforts and to drive the Commission to apply a standard to pending applications that was not applied to OneWeb’s application. For the reasons discussed below, the Commission should reject OneWeb’s efforts to hamstring its competitors.

¹ See Letter from Brian D. Weimer to Marlene H. Dortch, IB Docket No. 16-408, et al. (Sep. 10, 2017) (“OneWeb Letter”).

² See Letter from William M. Wiltshire to Marlene H. Dortch, IBFS File No. SAT-LOA-20161115-00118 (Aug. 17, 2017) (SpaceX Aug. 17 Letter”).

At the outset, it is worth remembering what the Commission's rules require with respect to an applicant's EPFD showing. Section 25.146(a) of the Commission's rules requires that an applicant for NGSO authorization demonstrate that its proposed system will not exceed the validation EPFD limits applicable in the 10.7-14.5 GHz band. For this purpose, the rule specifically contemplates that applicants will use ITU-approved software developed in accordance with the specifications stipulated in Recommendation ITU-R S.1503.³ Accordingly, SpaceX used the EPFD validation software developed for and approved by the ITU of Transfinite Systems ("Transfinite") – one of two software packages the ITU uses to determine compliance with its EPFD limits.⁴ That software employs an algorithm specified by Recommendation ITU-R S.1503 § 3 for selecting the worst-case geometries (from an EPFD perspective) for combinations of NGSO and GSO systems. Applying that software in the same way the ITU will apply it to validate compliance, SpaceX demonstrated that its system will comply with all applicable EPFD limits, including those in frequency bands not yet covered by the Commission's EPFD rules.⁵

As OneWeb concedes on the very first slide of its presentation, Recommendation ITU-R S.1503-2 currently controls the EPFD validation issue.⁶ The presentation purports to review the information submitted by various NGSO applicants in search of anomalies and inconsistencies. OneWeb finds nothing to critique on SpaceX's EPFD compliance showing with respect to the first three inputs considered – PFD masks, GSO arc avoidance angle, and earth station density.

Here, SpaceX notes that the PFD mask plotted for the OneWeb system is not consistent with the data provided in its application. Moreover, OneWeb plots the PFD masks of SpaceX and LeoSat with a resolution bandwidth of 40 kHz, while plotting its own and Theia's masks in 4 kHz, resulting in a 10 dB difference on the Y-axis. Thus, the plot showing the null for OneWeb's system of approximately -170 dBW/m² in 4 kHz would translate to approximately -160 dBW/m² in 40 kHz.⁷ That alone would be sufficient to make OneWeb's system non-compliant.

³ See 47 C.F.R. §§ 25.146(a)(1) and (a)(2). Recommendation ITU-R S.1503 (*available at <https://www.itu.int/rec/R-REC-S.1503-2-201312-I/en>*) provides a functional description of the software for use by the ITU to conduct examination of NGSO FSS system notifications for their compliance with the "validation" limits specified in Article 22 of the ITU Radio Regulations.

⁴ See ITU Radiocommunication Bureau, Circular Letter CR/414 (Dec. 6, 2016) (announcing release of final version of validation software), *available at https://www.itu.int/dms_pub/itu-r/md/00/cr/cir/R00-CR-CIR-0414!!PDF-E.pdf*.

⁵ See IBFS File No. SAT-LOA-20161115-00118, Technical Attachment at 36-41 and Annexes 1 and 2 ("SpaceX Application"); Letter from William M. Wiltshire to Marlene H. Dortch, IBFS File No. SAT-LOA-20161115-00118 (July 12, 2017) (submitting supporting databases with corrections for public record).

⁶ See OneWeb Letter, Attachment at Slide 2 ("ITU Rec. S-1503-2 provides an industry standard way of calculating EPFD statistics").

⁷ See *id.* Slide 22.

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It is only with respect to the fourth input OneWeb considered – NGSO constellation parameters – that OneWeb challenges SpaceX’s results. OneWeb argues that the existing validation software approved by the ITU for implementation of Recommendation S.1503-2 may not accurately model NGSO constellations that operate with satellites at multiple altitudes and inclinations. It provides plots that purport to show that SpaceX’s NGSO system would exceed the EPFD limits when interacting with a GSO earth station located at 30° North.⁸ However, because the ITU-approved software does not generate these results, and OneWeb has not provided the worst case geometry and other parameters assumed in its calculations, SpaceX cannot reproduce or analyze these results.

In support of its conclusion, OneWeb cites a proposal currently under consideration by Working Party 4A (“WP4A”) for a new procedure that could apply to NGSO constellations with multiple altitudes and inclinations.⁹ Yet that revision, which would be incorporated into the next version of the recommendation (S.1503-3), has not been completed, let alone ratified. Moreover, on the specific issue cited by OneWeb, the proposed revision is not consistent with the ITU methodology for validating EPFD parameters using the recommendation currently in force. As OneWeb concedes, the official ITU-approved software assumes a single set of constellation orbital parameters, rather than multiple parameters. OneWeb cites proposed text from the Chairman’s report to WP4A for a revision under which NGSO constellations with multiple altitudes and inclinations would conduct multiple runs of the software, with compliance determined based on the aggregate of those runs.¹⁰ But that is not consistent with the recommendation currently in force or the software developed to implement that recommendation.¹¹

In addition, this is just one potential revision Recommendation S.1503-2 currently under consideration. As SpaceX noted previously,¹² WP4A has recognized that the model may overestimate the EPFD produced by large NGSO constellations that employ steerable downlink beams. “Non-GSO constellations using steerable beams provide more flexibility to ensure the protection of GSO earth stations and the GSO arc. The more satellites in view, the more options there are. However, the use of a satellite selection based on Recommendation ITU-R S.1503-2

⁸ See *id.* Slide 31. Curiously, three of the eleven plots indicated that they are for an earth station at 45° North.

⁹ See *id.* Slide 29.

¹⁰ *Id.*

¹¹ See also EPFD Validation Software User Guide at 21 (recommending that NGSO systems with multiple orbits “define separate examination scenarios for each individual type orbit by creating several runs with only one type of orbit to be used,” but not calling for aggregation of results), available at <http://www.itu.int/en/ITU-R/space/Documents/EPFDsoftwareUserGuide.pdf>.

¹² See SpaceX Aug. 17 Letter at 3-4.

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clearly induces degradation when the number of satellites is growing.”¹³ Thus, a party willing to search out cases involving extreme geometries that are unlikely to occur can manipulate the software by forcing it to consider these extreme cases and yield exaggerated EPFD results. Indeed, such an analysis can be used to show that OneWeb’s system would appear to exceed EPFD limits.

Modelling EPFD is difficult and involves application of a sophisticated algorithm. Not surprisingly, that algorithm can be improved as developers gain additional experience with it. However, at present, compliance is determined under Recommendation S.1503-2, and it would be inappropriate to apply some other not-yet-adopted standard in this processing round. Moreover, it would be fundamentally unfair to apply some proposed revisions that may tend to result in higher EPFD levels while ignoring other proposed revisions that may tend to lower them.¹⁴ OneWeb’s selective application of non-sanctioned analytical constructs has no bearing on EPFD validation for purposes of the current processing round.

The ITU has approved EPFD validation software. The Commission should, like the ITU, accept the validation analysis that software yields when implementing the approved algorithms. Under that standard – which is the standard applied in granting U.S. market access to OneWeb’s NGSO system in this processing round¹⁵ – SpaceX’s proposed system complies with all applicable EPFD limits. The Commission should reject OneWeb’s self-serving calls for application of a different and evolving standard.

Respectfully submitted,



William M. Wiltshire
Counsel to SpaceX

¹³ Annex 20 to Working Part 4A Chairman’s Report, Document 4A/Temp/162, at 14 (May 17, 2017), *available at* <https://www.itu.int/md/R15-WP4A-C-0364/en>. Stated another way, “the increase of the satellite number has led to a more favorable operational situation, but has, in parallel, degraded the regulatory compliance.” *Id.* at 15.

¹⁴ SpaceX will also employ beam allocation algorithm that favors maximizing elevation angle while balancing other radio management constraints, and plans to use a given frequency to serve a given location less than half the time, significantly reducing the potential for interference further still. *See* SpaceX Aug. 17 Letter at 4. While OneWeb asserts that such strategies may not ensure EPFD compliance (OneWeb Letter, Attachment at Slide 33), it does not even attempt to capture them in its analysis. SpaceX is confident that, when such operational strategies are taken into account, its system will be deemed to comply with EPFD limits even in the most challenging cases.

¹⁵ If anything, OneWeb’s authorization was granted based on a less rigorous EPFD analysis, since it used the beta version of software prior to finalization and approval by the ITU. *See WorldVu Satellites Limited*, 32 FCC Rcd. 5366, ¶ 19 (2017).

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