

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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| In the Matter of |) | |
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| ViaSat, Inc. |) | Call Sign: S2985 |
| |) | |
| Petition for Declaratory Ruling Granting |) | File No. SAT-PDR-20161115-00120 |
| Access to the U.S. for a Non-U.S.-Licensed |) | |
| Nongeostationary Orbit Satellite Network |) | |

COMMENTS OF WORLDTVU SATELLITES LIMITED

WorldVu Satellites Limited, d/b/a OneWeb (“OneWeb”), pursuant to Section 25.154(a) of the rules of the Federal Communications Commission (the “FCC” or “Commission”) and the Commission’s recent public notice,¹ hereby comments on the application of ViaSat, Inc. (“ViaSat”) for operating authority for a non-geostationary orbit (“NGSO”), medium-Earth orbit (“MEO”) satellite system in the Fixed Satellite Service (“FSS”) using Ka-band frequencies (the “Application”).²

¹ See 47 C.F.R. § 25.154(a). See also Satellite Policy Branch Information; *Applications Accepted for Filing; Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*, Public Notice, DA 17-524 (rel. May 26, 2017) (“Public Notice”).

² ViaSat, Inc. *Petition for Declaratory Ruling Granting Access to the U.S. for a Non-U.S.-Licensed Nongeostationary Orbit Satellite Network*, File No. SAT-PDR-20161115-00120 (filed Nov. 15, 2016) (“ViaSat Petition” or “Petition”).

I. THE COMMISSION SHOULD DEFER CONSIDERATION OF VIASAT'S REQUEST TO OPERATE INTER-SATELLITE LINKS IN THE KA-BAND

In addition to Earth-to-space and space-to-Earth communications, ViaSat proposes to use spectrum allocated for FSS to support satellite-to-satellite communications between its newly-proposed NGSO constellation and its pre-existing geostationary orbit (“GSO”) constellation.³ ViaSat asserts that such use is consistent with the Commission’s definition of “fixed-satellite service” and does not require consideration in a separate processing round.⁴ Although inter-satellite links are included within the Commission’s definition of FSS “in some cases,”⁵ ViaSat has not provided a technical analysis demonstrating that these satellite-to-satellite links will not become a source of interference to other NGSO FSS systems. Accordingly, consideration of this part of ViaSat’s application should be deferred until ViaSat submits such an analysis for review by the Commission and other interested parties.

The Ka-band FSS designations in Article 5 of the Radio Regulations of the International Telecommunications Union (“ITU”),⁶ as well as in the U.S. Table of Frequency Allocations,⁷ clearly state that FSS must involve either “Earth-to-space” or “space-to-Earth” communications – and one reason for this is demonstrated below, as inter-satellite links of this nature are inherently geometrically different than Earth-to-space and space-to-Earth links. Further, the Commission has specifically designated spectrum for the inter-satellite service, although ViaSat

³ ViaSat Petition at 5.

⁴ *Id.* at 6, 30 n.74.

⁵ *See* 47 C.F.R. § 25.103.

⁶ Int’l Telecomm. Union, Radio Regulations, Vol. 1, Ch. II, Article 5.511, 5.521, 5.534 (RR5-116, RR5-119, RR5-124) (2016).

⁷ 47 C.F.R. § 2.106.

does not request authority for operations utilizing those bands.⁸ ViaSat’s proposal to use Ka-band FSS spectrum for its inter-satellite links was discussed at some length at the ITU’s May 2017 Working Party 4A meeting, with no conclusion being reached with respect to use of the Ka-band for inter-satellite service links.⁹ At the meeting, “[t]here were views expressed that the history of the definition of fixed-satellite service and the development of FSS allocations over multiple revisions to the Radio Regulations suggested that satellite-to-satellite links in the FSS would require an allocation to the FSS (space-to-space), and suggestions were made that the best way to address the technical and regulatory questions associated with the potential use described in the document would be to seek a specific agenda item for WRC-23.”¹⁰

In addition to the regulatory uncertainty, there are also technical reasons why permitting inter-satellite use could negatively impact critically important and evolving uses of the Ka-band. The Ka-band is already heavily used worldwide for GSO high-throughput satellites (“HTS”) that provide critical internet connectivity to millions of people. Overlaying the type of inter-satellite service proposed by ViaSat on this existing infrastructure will make coordination with GSO and NGSO satellite systems more difficult, and could result in interference into terrestrial stations for the following reasons:

- Creating dynamic links between GSO and NGSO satellites in the Ka-band will require constantly moving spot beams (uplink and downlink) on GSO satellites that will scan the entire Earth’s surface and even beyond, which would be very different from the current

⁸ See ViaSat Petition at 10.

⁹ Chairman, Working Party 4A, Int’l Telecomm. Union [ITU], *Document 4A/364-E, Report on the Meeting of Working Party 4A*, Section 4.3, “WRC-19 agenda item 7, issue H,” at 21-23 (June 9, 2017).

¹⁰ *Id.* at 22.

architecture of GSO HTS satellites. Such GSO satellites typically serve only a restricted and pre-defined portion of the Earth's surface, rather than every point on the Earth's surface that is visible to the GSO satellite, allowing them to effectively coordinate with other nearby or collocated GSO satellites that may serve different geographic areas. This provides increased spectral efficiency by exploiting the spatial separation of the beams and service areas of the GSO satellites. If, instead, each GSO satellite has beams that constantly scan a large percentage of the Earth's surface, as would be necessary for ViaSat's proposed satellite-to-satellite application, then the ability to reuse Ka-band spectrum in this way would no longer exist.

- The Earth-to-space (uplink) portion of the Ka-band is meant for transmissions from earth stations to GSO FSS and NGSO FSS satellites. If in addition, as proposed by ViaSat, Ka-band uplinks are also operated from MEO satellites to GSO satellites, this presents a potential new geometry for interference into the NGSO FSS links of NGSO FSS operators utilizing orbital altitudes higher than ViaSat's. ViaSat has simply not addressed this challenge. Currently, any NGSO FSS system needs to protect itself from interference only from transmitting earth stations located on the surface of the Earth, or at most, on aircraft relatively close to the Earth's surface. If the interference source is now a MEO satellite directing its beam at the NGSO FSS satellite, then an interference analysis needs to be made to show that an NGSO FSS satellite would not be subject to interference levels higher than would occur with an Earth-based Ka-band transmitter. ViaSat's simple assertion that the victim NGSO satellites would have a "high degree of off-axis gain reduction in the receiving antenna"¹¹ cannot be ensured, since some systems operate with

¹¹ ViaSat Petition, Attachment A (Technical Annex) at 26.

low angles of arrival for their gateway or user links, such that the gain towards the edge of the Earth may not be significantly lower than the peak receive gain.

- Similarly, ViaSat does not acknowledge that its links from MEO to GSO in the 28 GHz band could also impact terrestrial networks when the geometry of the link involves a path that passes close to the Earth's surface. In the 28 GHz band there are no power flux density ("PFD") limits in Article 21 of the ITU's Radio Regulations or in the Commission's rules because this band was never intended for transmissions towards the Earth. The figures contained in ViaSat's Technical Annex seem to imply that the links from MEO to GSO are always such that the MEO satellite points away from the Earth.¹² However, ViaSat does recognize that there is a possibility of trans-horizon links passing close to the Earth's surface, and such transmissions could directly impact terrestrial receivers in the 28 GHz band.

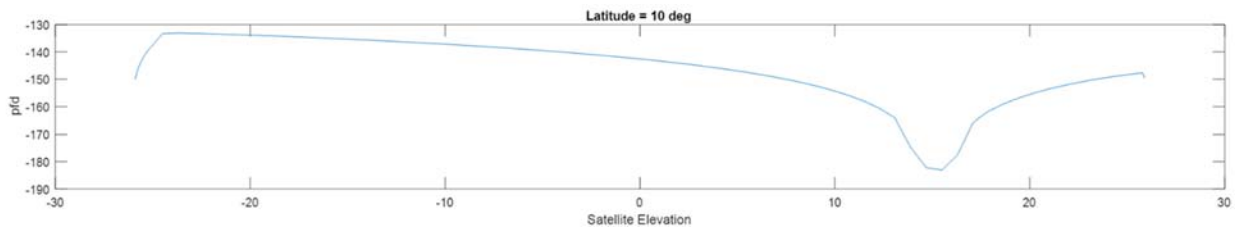
The Commission should not process the ViaSat Petition until ViaSat has supplied a full technical analysis of this potentially serious interference issue. Interested parties should also be afforded an opportunity to comment on this specific issue raised by the ViaSat Petition, perhaps in a separate comment cycle.

II. VIASAT'S EPFD ANALYSIS CONTAINS FLAWED ASSUMPTIONS THAT MAY INVALIDATE ITS EPFD COMPLIANCE SHOWING

OneWeb has significant concerns with respect to ViaSat's satellite PFD masks with are used for the EPFD_{down} analysis. Specifically, they do not appear to represent the operation of the

¹² See ViaSat Petition, Attachment A (Technical Annex) at 22-27.

system as described. A part of one of ViaSat's PFD masks is shown below (for an NGSO satellite latitude of 10 degrees).¹³



This mask suggests that outside of the 3-degree GSO exclusion zone (either side of the trough in the diagram above at 15 degrees off-axis from the sub-satellite point), the operational PFD very gradually increases from -160 dBW/m²/40 kHz to -133 dBW/m²/40 kHz, which means the service links would need to span 27 dB of signal range. Having such a large variation in operating PFD across the service area amounts to extremely inefficient use of spectrum – contrary to ViaSat's repeated claims of how its system design achieves very high efficiency in this regard.

The pattern of this PFD mask appears to mimic the gain pattern of a large satellite transmit antenna inverted rather than a true satellite PFD mask, which would need to represent the PFD for all possible positions of the satellite beam. Outside of the GSO exclusion zone, the PFD levels shown in a PFD mask should essentially be a near-constant level. Instead, the ViaSat PFD levels in its mask gradually increase logarithmically, which indicates that ViaSat may not be presenting a PFD mask that reflects the operations of a steerable beam, and instead has taken a single antenna pointing direction and inverted it at $\alpha = 0$. If ViaSat indeed plans to operate at peak PFD over only a small fraction of its service area, as indicated by its PFD masks, then it should make that intention clear and explain the consequences of that approach. Otherwise the

¹³ This graph of PFD versus Earth elevation angle has been derived from the raw PFD mask data provided by ViaSat in its application.

masks should reflect realistic operations, and should accurately account for the proper antenna rejections, including all of ViaSat's various satellite antenna beams ranging from 13.9 dBi to 46.5 dBi for the downlink beams in the Ka-band.¹⁴

In addition, ViaSat's EPFD_{up} analysis may also be overly optimistic. To estimate the user density, ViaSat starts with a single NGSO satellite's field of view ("FOV") and calculates the area to be $6.358e7 \text{ km}^2$.¹⁵ ViaSat explains that each satellite can have 20 users on the same channel transmitting simultaneously,¹⁶ so the area of each cell is therefore $6.358e7/20$ or $3.18e6 \text{ km}^2$ and the user density would be the inverse of this. This analysis is an underestimation, as it spreads simulated users out in an unrealistically optimistic manner, and does not account for the fact that equivalent power flux density ("EPFD") levels are higher when co-frequency users are more geographically concentrated. This is particularly true considering the use of multiple steerable beams on ViaSat's NGSO satellites, which provide the capability to concentrate all their beam coverage over restricted geographic regions.

To address this problem, OneWeb believes a more realistic calculation would be to take the entire area of the Earth, divide it by each of the 24 satellites, and then divide it again by the 20 user links to each satellite. Even this approach would likely not represent the limiting case for the maximum level of user density that its system will support. Neither does it take account of the fact that users are more likely to be concentrated on land and in habitable regions. Nevertheless, this still-optimistic approach would give an average area per user of $5.1e8/24/20$,

¹⁴ See ViaSat Schedule S.

¹⁵ ViaSat Petition, Attachment A (Technical Annex), Exhibit 1 at 6.

¹⁶ *Id.*

or 1.06e6 km², which corresponds to a user density that is three times higher than ViaSat calculates. This will significantly impact the calculated EPFD_{up} levels.

As ViaSat has acknowledged, EPFD limits are a critical tool to ensure that NGSO networks do not cause harmful interference into the geostationary arc.¹⁷ ViaSat's EPFD analysis should be updated to accurately reflect its intended operational parameters, thus allowing the Commission and other interested parties an opportunity to gain confidence that ViaSat's NGSO network will not cause harmful interference into GSO operations.

III. VIASAT'S PFD CALCULATIONS ARE MINIMAL AND DO NOT DEMONSTRATE THAT TERRESTRIAL STATIONS WILL BE ADEQUATELY PROTECTED

The ability of ViaSat's NGSO network to meet the Commission's and the ITU's PFD limits is not clear.¹⁸ Accordingly, ViaSat should update its applications with a PFD analysis that correctly demonstrates compliance with the Commission's applicable PFD limits.

ViaSat only demonstrates compliance with the PFD limits for elevation angles of 25 degrees and greater. ViaSat merely asserts, without any demonstration, that the PFD limits for elevation angles below 25 degrees are met.¹⁹ ViaSat's assertion relies on the belief that its satellite transmit beam gain is rolling off faster than the PFD limit reductions for the elevation angles below 25 degrees.²⁰ This should be quantified so that PFD limit compliance can be ensured.

¹⁷ See *Reply Comments of ViaSat, Inc.*, IB Docket No. 16-408, at 8 (filed Apr. 10, 2017) (noting that "it is essential that the Commission develop and adopt EPFD limits for *both* the Ka band *and* the V band that adequately protect current GSO network technology from NGSO interference").

¹⁸ 47 C.F.R. § 25.208(e); Int'l Telecomm. Union, Radio Regulations, Vol. 1, Ch. VI, Article 21, Table 21-4, RR21-7 (2016).

¹⁹ ViaSat Petition, Attachment A (Technical Annex) at 18.

²⁰ *Id.*

IV. CONCLUSION

The Commission should defer ViaSat's request to use scarce Ka-band spectrum for inter-satellite links pending further study to ensure that these links do not cause harmful interference to other NGSO systems. In addition, ViaSat should be required to revise and update its EPFD and PFD showings to accurately reflect operational levels compliant with the Commission's rules prior to any disposition of its Petition.

Respectfully submitted,

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June 26, 2017

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in these Comments, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in these Comments, and that it is complete and accurate to the best of my knowledge and belief.

Dated: June 26, 2016

/s/ Marc Dupuis

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CERTIFICATE OF SERVICE

I, Ashley Yeager, hereby certify that on this 26th day of June 2017, a copy of the foregoing Comments is being sent via first class, U.S. Mail, postage paid, to the following:

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