**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, DC 20554**

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| In the Matter of | ) | |
| | ) | |
| Viasat, Inc. Application for Authority to Operate Ka-band Earth Station Antennas Mounted on Aircraft | ) | IBFS File No. SES-LIC-20190411-00503 |
| | ) | E190201 |
| | ) | |

**OPPOSITION OF VIASAT TO O3B PETITION TO DEFER**

Viasat, Inc. ("Viasat") opposes the petition to defer filed by O3b Limited ("O3b") regarding Viasat's request for authority to operate the model G-12 antenna mounted on board aircraft using Ka-band frequencies, including the 18.8-19.3 GHz and 28.6-29.1 GHz band segments that are designated in the United States for NGSO FSS on a primary basis and GSO FSS on a secondary basis.

## I. VIASAT PROVIDED A DETAILED DEMONSTRATION THAT NGSO SYSTEMS WILL BE PROTECTED, AND O3B FAILS TO IDENTIFY ANY DEFICIENCIES

In the Application, Viasat requests authority to operate the model G-12 earth stations in the 17.7-19.3 GHz, 19.7-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz band segments, and provides the requisite demonstrations to support a waiver of the U.S. Table of Frequency Allocations ("U.S. Table") and the Commission's rules to the extent necessary to allow the operation of ESIMs in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments on a non-interference, unprotected basis with respect to allocated services in those bands.[1] Viasat included a detailed compatibility analysis of the proposed earth station operations with the NGSO FSS systems in the Commission's latest Ka-band processing round, including O3b's

[1] *See* Viasat, Inc., File No. SES-LIC-20190411-00503 (filed Apr. 11, 2019) ("Application"), Exhibit A at 4; Attachment 1 at 2-5.

current and planned constellation, demonstrating that the proposed operations would protect those NGSO systems.

Specifically, Viasat explained the methodology and operational assumptions used in simulations conducted using the Visualyse Pro analysis software, including any separation angle from the GSO arc that the NGSO system operator has identified in its satellite application. Viasat also provided all information regarding the earth station necessary for third parties to evaluate any potential impact of the proposed earth station operations: antenna patterns, power levels, emission bandwidths, and target operating satellites. Viasat explained the MF-TDMA nature of the operations, which indicates that the duty cycle of the earth stations will be less than 100 percent. Further, the technical parameters of the target satellites—ViaSat-1 and ViaSat-2—have been approved by the Commission and are readily available in the Commission's public files.[2]

Although the Application thoroughly demonstrates compatibility with NGSO systems and provides sufficient technical information for third parties to fully evaluate Viasat's proposed earth station operations, O3b asks the Commission to defer consideration of the Application, simply asserting that Viasat's technical analysis is "insufficient" and stating that Viasat "fails to provide essential inputs that inform its showing in Table-2 of the Technical Description."[3] Specifically, O3b claims that "[b]y failing to provide, for example, the exclusion zones and avoidance angles that were factored into the calculation of Table-2, ViaSat has not provided

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[2] *See* Viasat, Inc., Call Sign S2747, File Nos. SAT-LOA-20110722-00132, as amended (granted Oct. 14, 2011); SAT-LOI-20080107-00006, as amended (granted Aug. 18, 2009) ("ViaSat-1 Authorization"); Viasat, Inc., Call Sign S2902, File Nos. SAT-LOI-20130319-00040 (granted Dec. 12, 2013); SAT-MOD-20141105-00121; SAT-AMD-20150105-00002 (granted Apr. 15, 2015); SAT-MOD-20160527-00053 (granted Jan. 12, 2017) ("ViaSat-2 Authorization").

[3] O3b Limited Petition to Defer, File No. SES-LIC-20170401-00357; Call Sign E190201, at 2 (filed Aug. 23, 2019) ("O3b Petition").

NGSO stakeholders such as O3b with sufficient information to fully assess ViaSat's interference analysis."[4] To the contrary, Viasat did provide these separation angles for each of the NGSO system applications on file with the Commission and did so in the very same table in Viasat's Technical Description to which O3b cites: the column in Table-2 identified as "Separation Angle (deg)."[5] Further, O3b's reference to an "exclusion zone" that it claims underlies Viasat's Table 2 is incorrect. Viasat's calculations in that Technical Description consider the separation angle identified by the NGSO applicant, but Viasat did not calculate any "exclusion zones" in which its earth stations would not operate in the 18.8-19.3 GHz or 28.6-29.1 GHz bands, because no such exclusion zones are needed.

O3b does not identify any other information that would be needed to assess Viasat's analysis, or otherwise allege that Viasat's analysis is incorrect. Nevertheless, O3b simply states—without any support or technical analysis—that Viasat has not demonstrated that O3b and other Ka-band NGSO networks will be sufficiently protected, and that Viasat has not met the standard for a waiver.[6] For the sake of promptly resolving this matter, Viasat submits the

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[4] O3b Petition at 2, citing Application, Exhibit A at 4.

[5] Application, Attachment 1 Technical Description at 3. The separation angles Viasat referenced are those that the NGSO operators specified that they would maintain toward the GSO arc to satisfy the epfd limits that apply in parts of the Ka band. Viasat expects that NGSO systems will maintain these same operational constraints with respect to their operations in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments. In any event, the Supplemental Technical Description attached to this Opposition as Attachment 1 is not based on any assumption that O3b's NGSO system will maintain any given operational angular separation from the GSO arc in these band segments.

[6] As a threshold matter, O3b's petition should be considered, at most, as an informal comment because it was not properly filed in connection with the application at issue. *See* 47 C.F.R. § 25.154(a), (b). Viasat monitored IBFS for comments upon the expiration of the 30-day public notice period filed in connection with File No. SES-LIC-20190411-00503, which was identified in the public notice for call sign E190201. *See* Public Notice, Satellite Communications Services re: Satellite Radio Applications Accepted for Filing, Rept. No. SES-02184, at 4 (rel. July 24, 2019). O3b's submission does not appear in that file in IBFS. Viasat received O3b's service

Supplemental Technical Description attached as Attachment 1 to provide further detail regarding the simulations and resulting analysis of compatibility with O3b's current and planned NGSO constellations. Like Viasat's original analysis in the Application, the Supplemental Technical Description shows that the proposed earth station operations will not harm O3b's current or planned NGSO system. In fact, O3b's current equatorial system will not be impacted at all by the proposed operations. In addition, the analysis in the Supplemental Technical Description is not based on Viasat's prior assumption that NGSO satellites will maintain any operational angular separation from the GSO arc in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments. Thus, this analysis is even more conservative than the original demonstration in the Application, and still shows that the potential for harm to O3b's planned 70-degree inclined orbiting satellites is almost nonexistent due to the extremely infrequent and fleeting nature of any in-line events that could exceed an I/N greater than -12.2 dB towards O3b's NGSO system.

## II. VIASAT'S COMPATIBLE OPERATIONS WILL RELY ON PREVIOUSLY APPROVED MECHANISMS AND WELL-PROVEN TECHNOLOGIES

Viasat also demonstrated in the Application, and in other authorizations referenced in the Application, that it has effective mechanisms in place to adequately protect primary NGSO system operations in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments. All of the earth stations in Viasat's networks, including the proposed earth station operating with ViaSat-1 and ViaSat-2, operate under control of a Network Management System ("NMS") that coordinates the real-time operations of each individual earth station. Antenna control units in the aircraft installations are capable of calculating in-line events based on ephemeris data for each of the

copy by mail days after the comment deadline, and O3b filed its petition under the wrong file number.

NGSO FSS systems. The NMS will inhibit transmissions or change frequencies of the particular earth station, as appropriate.

The Commission has approved these interference mitigation capabilities in connection with authorizing ViaSat-1 and ViaSat-2, and has granted waivers to operate earth stations in the 18.8-19.3 GHz and 28.6-29.1 GHz bands based on these capabilities.[7] Further, as discussed above, Viasat has provided a detailed technical demonstration showing how NGSO FSS systems to be deployed in the future, including O3b's inclined-orbit satellites, will be protected. Therefore, no further demonstrations are necessary for the Commission to grant the Application.

O3b maintains that Viasat must also show that its earth stations can operate successfully in those instances in which access to the 18.8-19.3 GHz and 28.6-29.1 GHz band segments is unavailable and explain whether other spectrum available would be sufficient for the planned operations.[8] Viasat has indicated that its proposed earth station operations would be on a non-interference, unprotected basis, and thus, such a showing is not relevant for the requested authority. However, Viasat confirms that other spectrum authorized for the target satellites outside of the 18.8-19.3 GHz and 28.6-29.1 GHz band segments would be available and sufficient to sustain operations during the extremely short and infrequent occurrences of any in-line events that even theoretically could harm NGSO operations.

Viasat satisfies the standard for waivers of the U.S. Table for nonconforming uses, which O3b notes "are generally granted 'when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the nonconforming operator

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[7] *See* Viasat, Inc., Call Sign E170088, File No. SES-LIC-20170401-00357 (granted Nov. 9, 2017).

[8] *See* O3b Petition at 4.

accepts any interference from authorized services.'"[9] Notably, such a waiver was granted in the case cited by O3b approving the operation of aeronautical earth stations nearly two decades ago when the technology was in its nascent stages. Today, there is an established regulatory framework for ESIMs, and sharing among GSO and NGSO systems is well understood, with GSO FSS operations having secondary status with respect to NGSO FSS systems in the 18.8-19.3 GHz and 28.6-29.1 GHz bands. Moreover, the Commission has proposed to open these bands to GSO FSS ESIMs on an unprotected, non-interference basis with respect to NGSO FSS systems, recognizing that ESIMs can operate within the same technical envelope as fixed earth stations. Significantly, O3b has expressed full support for this proposal.[10]

The well-known sharing environment and the proven ability of Viasat to operate both fixed and mobile earth stations compatibly with other co-frequency operations reinforce the conclusions in Viasat's technical demonstrations here and in the Application that NGSO operations in the 18.8-19.3 GHz and 28.6-29.1 GHz will be adequately protected.

## III. CONCLUSION

Viasat has thoroughly demonstrated how its G-12 earth station operations are compatible with current and future NGSO system operations in the 18.8-19.3 GHz and 28.6-29.1 GHz band segments, and there is no basis for O3b's suggestions to the contrary. Viasat respectfully requests that the Commission promptly process and grant Viasat's Application to enable the deployment of expanded broadband services to passengers and crew on board aircraft.

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[9] *Id.* at 3, *citing The Boeing Company*, 16 FCC Rcd 22645, 22651 (2001).

[10] *See* Comments of SES Americom, Inc. and O3b Limited, IB Docket No. 17-95, at 2 (filed Apr. 8, 2019); Reply of SES Americom, Inc., O3b Limited, and Intelsat License LLC, IB Docket No. 17-95 at 2 (filed May 8, 2019).

Respectfully submitted,

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September 5, 2019

Viasat, Inc.

## Attachment 1

### Supplemental Technical Description

With this supplemental technical description, Viasat provides a further demonstration that the operation of the G-12 antenna is compatible with O3b in the 28.6-29.1 GHz band.

**Network**

As discussed in the E190201 application, the G-12 ESIM antennas operate in the same WildBlue-1, ANIK-F2, ViaSat-1 and ViaSat-2 Ka-band networks, using the same frequencies and access method, as Viasat's residential customers using the fixed VSAT equipment authorized under call signs E170088 and E100143. The transmitted bursts from the ESIMs may use the same return link channels as used by the residential terminals and represent just another burst out of many on any given return channel frequency.

Because the ESIM typically operate above, or navigate around, weather, the ESIM mainly operate in clear sky conditions at higher symbol rates at less than maximum output power, and as a result at the lowest power density. Further, as noted, these ESIM operate using MF-TDMA, bursting only a part of the time. Because these terminals operate at very high symbol rates in clear sky conditions, they correspondingly only operate at fairly low duty cycles, typically less than 1% on ViaSat-2.

**NGSO Sharing Analysis**

To address the comments filed by O3b, Viasat supplements the previously provided analysis with more detailed discussion and additional simulation results performed specifically for the G12 antenna and the O3b System as amended in SAT-AMD-20171109-00154 to include satellites at 70-degree inclined orbits in addition to existing and future satellites in equatorial orbits.[1]

In the software simulation, an ESIM was placed at the center of the NGSO's receiving beam next to a presumed gateway earth station of the NGSO system. The orbit of the NGSO was propagated over a 30-day period while the ESIM transmitted using a typical duty cycle, as required to support commercial aircraft services in order to generate I/N statistics over time.

Conservatively, this supplemental analysis assumes the ESIM remains overhead an O3b gateway with the O3b satellite beam pointed at the gateway. This ensures that the ESIM is always in the maximum beam center gain of the O3b receiving beam and therefore the simulation performed to develop very conservative I/N interference statistics. In actual practice the ESIM would be in motion and spending little time in the beam center.

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[1] Viasat also reviewed O3b ITU filings O3B-A, O3B-B, and O3B-C for additional technical information to be used in the analysis. O3B-A and O3B-B filings contain the equatorial orbits and O3B-C contains the 70-degree inclined orbits.

The threshold criteria used in the Visualyse simulations was the 6% ΔT/T coordination trigger which is equivalent to an I/N of -12.2 dB and represents an increase in the noise floor of the receiver of just 0.25 dB.

Unlike the case of GSO networks, where energy from the ESIM would generally be of a long-term nature, in the case of the NGSO, any energy from in-line or near in-line events is short term and infrequent in nature. Thus, these small percentage of time, brief noise floor increases are generally considered short-term interference, which are typically acceptable.

To provide O3b with additional detail sufficient to replicate Viasat's analysis, Table 1 shows the input values used in the simulation as well as output values taken from the Visualyse simulation at a single snapshot of the point for a near in-line event during the simulation run. In this exemplary case, the ESIM is located in South Florida at a longitude of 24.7 degrees North. To ensure that all potential in-line events were captured, the simulation was run using a step interval of 1 second and 100% duty cycle. As noted above, the typical operating duty cycle for ESIMs operating on ViaSat-2 is less than 1%, which was factored into the simulation as well.

Lastly, the simulation was configured to use a tracking strategy with no separation or exclusion angle between O3b satellites and the GSO orbital arc. The closest separation angle observed over a 30-day simulation period for this location was 0.17 degrees and the maximum I/N was 0.82 dB. Over the course of the 30-day simulation the -12.2 dB I/N criteria was exceeded during 29 brief events over the month for a total of 0.12% of the time using a 100% duty cycle. Therefore, taking into account duty cycle, the -12.2 dB I/N criteria was met more than 99.999% of the time even using these overly conservative, worst-case assumptions.

Figure 1 – I/N vs percentage of time

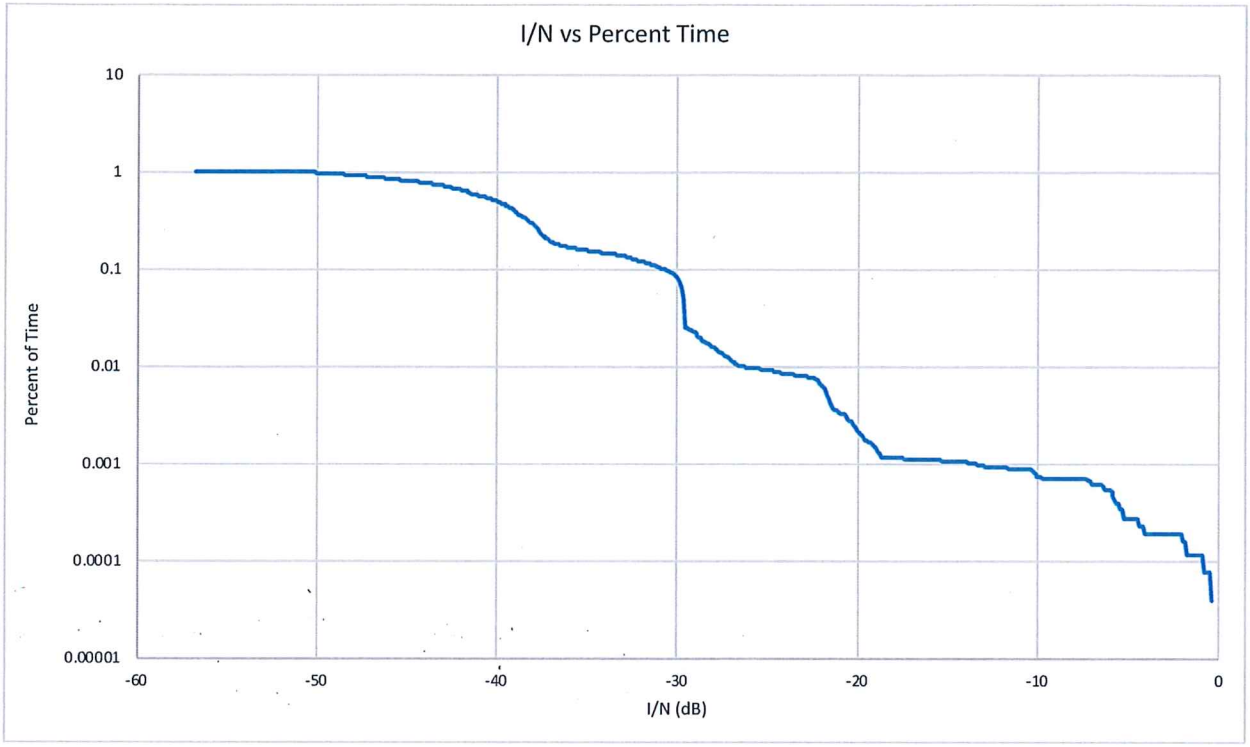



**Table 1: Visualyse simulation snapshot results**

| Aero ESIM | | |
|---|---|---|
| Antenna Input power | 20.0 | W |
| Modulated bandwidth | 80.0 | MHz |
| Input power density | 13 | dBW/80 MHz |
| Antenna on-axis gain | 35.8 | dBi |
| Antenna relative gain toward O3b | -0.06 | dB |
| Antenna off-axis gain toward O3b | 35.8 | dBi |
| EIRP density toward O3b | 48.8 | dBW/80 MHz |
| Path and atm loss toward O3b | 200.3 | dB |
| O3b Antenna peak gain | 35.0 | dBi |
| O3b Antenna relative gain | -0.01 | dB |
| O3b Antenna gain toward ESIM | 35 | dBi |
| ESIM power received at O3B | -116.6 | dBW/80 MHz |
| O3b receive system noise | -117.4 | dBW/220 MHz |
| I/N | 0.82 | dB |

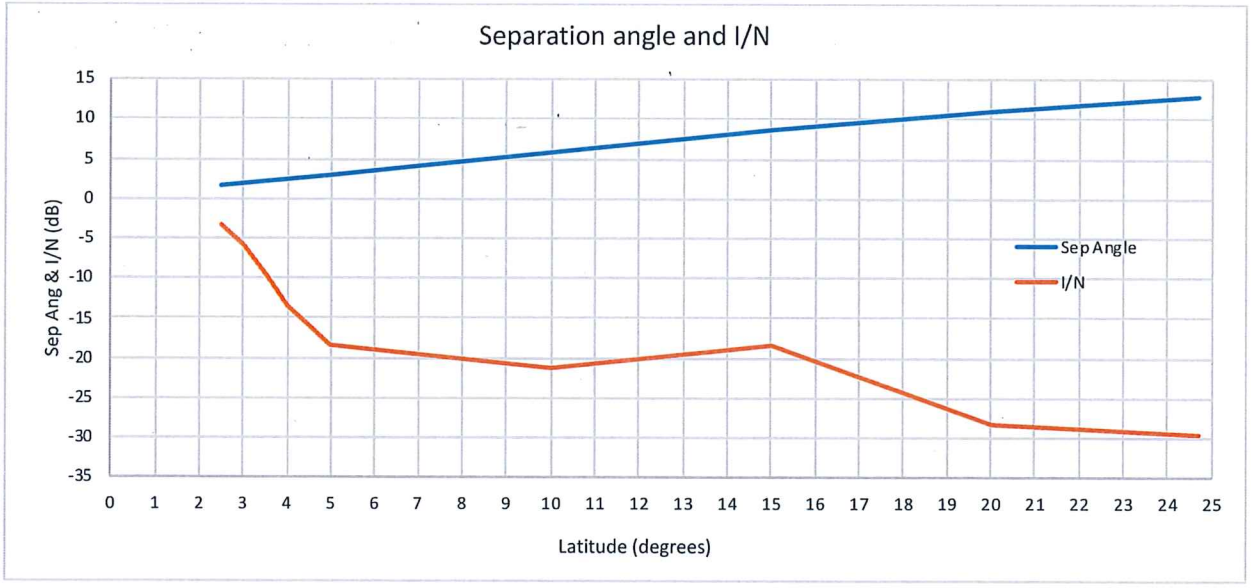
It was observed that the in-line or near in-line events occur occasionally when a satellite from one of the 70-degree inclined orbit planes passes in the path between the ESIM and the

GSO satellite. To determine the magnitude and frequency of these events, a number of additional simulations were run varying the latitude of the ESIM between 10 degrees and 45 degrees North latitude.

The separation angle, number of events, and percentage of time where the I/N exceeds -12.2 dB vary by latitude. At 40 degrees North latitude the number of in-line events drops to 8 over the 30-day simulation period, and at 41.5 degrees North latitude the closest separation angle increases 2.59 degrees and maximum I/N drops to -19.3 dB. Above 41.5 degrees the -12.2 dB I/N criterion is never exceeded during the 30-day run. Accordingly, at any latitude above 41.5 degrees both the equatorial and 70-degree inclined orbits of O3b will be unaffected by any ESIM operating in this region.

As O3b has not yet launched any satellites into the 70-degree orbital inclination plane, Viasat also performed analysis of interference to the equatorial only orbit satellites. Figure 2 shows the separation angle and I/N into the O3b equatorial orbit as a function of latitude.

Figure 2 – Separation angle and I/N for equatorial orbit




The analysis shows that for any latitude greater than 4 degrees from the equator the I/N is less than -12.2 dB into the O3b equatorial orbit satellites.

**Conclusion**

This supplemental interference analysis provides additional detail and confirms Viasat's original demonstration that the G-12 earth station in this application can operate compatibly with the O3b's system, both as that system currently exists and reflecting its planned deployment. The earth station will not cause unacceptable interference into the currently operating O3b equatorial orbiting MEO satellites. The analysis also shows that when O3b launches satellites

into the 70-degree inclined orbital planes, while occasional in-line events occur, these are infrequent and of short duration and a -12.2 dB I/N is met more than 99.999% of the time.

## DECLARATION

I hereby declare that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing Supplemental Technical Description, which is attached as Attachment 1 to the Opposition of Viasat to O3b Petition to Defer ("Opposition"), that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted with the Opposition, and that it is complete and accurate to the best of my knowledge, information and belief.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September 5, 2019

## CERTIFICATE OF SERVICE

I, Kayla K. Ernst, hereby certify that on this 5th day of September 2019, I served a true copy of the foregoing Opposition of Viasat to O3b Petition to Defer via first-class mail upon the following:

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/s/
Kayla K. Ernst