

BLANKET EARTH STATION LICENSE MODIFICATION APPLICATION

O3b Limited (“O3b”) has been granted U.S. market access to operate its a U.K.-authorized, Ka-band non-geostationary orbit (“NGSO”) system in the Fixed-Satellite Service (“FSS”) and Mobile-Satellite Service (“MSS”) pursuant to Section 25.137 of the Commission’s rules.¹ The Commission previously granted O3b a blanket earth station license to communicate with the O3b NGSO satellite system.² In this application, O3b requests a modification of its blanket earth station license to add frequencies and antenna models and to expand the coverage area to all U.S. territories (the “Modification”).

Public Interest Showing

O3b will use the additional frequencies and antenna models to offer enhanced data services for mobile and fixed networks, including backhaul, resiliency and restoration, enterprise broadband, emergency response, and government data services. This application adds frequencies already authorized for O3b’s NGSO satellite system.³ The Modification will serve the public interest by facilitating additional high-speed, low-latency MEO connectivity throughout the U.S.

Frequency Plan

The current blanket license authorizes O3b to transmit using the 28.6-29.1 GHz band and receive using 18.8-19.3 GHz band. The Modification seeks to add the following frequencies to the current blanket license:

Transmit/uplink/Earth-to-space: 28.35-28.6 and 29.5-30 GHz bands

Receive/downlink/space-to-Earth: 17.8-18.6, 19.3-19.4 and 19.6-20.2 GHz bands

The Modification, if granted, would authorize current as well as new antenna models to operate in the full range of frequencies listed in section B7 of FCC Form 312 as well as the currently authorized frequencies.

¹ See *O3b Limited*, Order and Declaratory Ruling, 33 FCC Rcd 5508 (2018) (the “Market Access Grant”); 47 C.F.R. § 25.137.

² *O3b Limited*, Call Sign E130098, SES-LIC-20130528-00455 (granted June 8, 2015).

³ The O3b NGSO satellite communication system integrates terrestrial networks and ground-based infrastructure with high-throughput satellites (“HTS”) located in Medium Earth Orbit (“MEO”). The space segment design includes eleven new HTS to be launched in 2022-24, each of which will deliver capacity through more than 4,000 steerable beams that can be shifted and adjusted to cover specific locations and meet customer needs.

In the frequency bands listed above, which are shared with other services, O3b will operate the blanket-licensed earth stations in a manner consistent with the Commission's rules and policies. O3b addresses each of these shared bands below.

Earth Station Operations in Shared Bands

Uplink/Transmit/Earth-to-space frequencies

28.35-28.6 & 29.5-30 GHz – Sharing with primary GSO FSS operators

NGSO FSS systems are required to protect geostationary orbit ("GSO") FSS systems throughout the 28.35-28.6 GHz and 29.5-30 GHz bands. Both of these bands are allocated on a primary basis for GSO FSS systems and on a secondary basis for NGSO FSS systems.⁴

The Commission granted U.S. market access to the O3b NGSO satellite system in this portion of the Ka-band uplink spectrum based on O3b's demonstration that its NGSO operations are not likely to cause harmful interference to GSO networks⁵ and subject to conditions specifying that the O3b operations are not entitled to protection from interference caused by GSO systems.⁶ O3b's request to operate blanket-licensed earth stations in the 28.35-28.6 GHz and 29.5-30 GHz band segments is consistent with these provisions and other applicable Commission requirements.⁷

Pursuant to Sections 25.115(f)(1) and 25.146(a)(2) of the Commission's rules, O3b hereby certifies that the earth station operations proposed herein will comply with the applicable equivalent power flux-density ("EPFD") levels in Article 22, Section II, and Resolution 76 of the ITU Radio Regulations. The Commission has recognized that any NGSO system that complies with these international EPFD limits "is considered as having fulfilled its obligation . . . not to cause unacceptable interference to any GSO network."⁸ Moreover, O3b will not claim protection from interference from U.S.-licensed GSO FSS networks in the 28.35-28.6 GHz and 29.5-30 GHz bands. In Annex 1 below, O3b provides as a courtesy a sample EPFD analysis and the data used for that analysis for the AvL 1.2m antenna. Due to its smaller diameter, the 1.2m

⁴ See *Update to Parts 2 and 25 Concerning NonGeostationary, Fixed-Satellite Service Systems and Related Matters, Report and Order*, 32 FCC Rcd 7809 (2017) ("NGSO Order") at 7850, , Appendix B.

⁵ See, e.g., IBFS File No. SAT-AMD-20161115-00116 (the "O3b Amendment"), Technical Annex at 13-19.

⁶ See Market Access Grant, 33 FCC Rcd at 5514, ¶¶ 13-16, and 5525, ¶ 46.

⁷ See, e.g., 47 C.F.R. § 25.115(f)(2).

⁸ NGSO Order, 32 FCC Rcd at 7820, ¶ 32 (footnote omitted). See also 47 C.F.R. § 25.289.

antenna analysis serves as a useful demonstration of the EPFD calculations for the other earth station models included in the application for which O3b certifies compliance.

Downlink/receive/space-to-Earth frequencies

17.8-18.3 GHz – Sharing with primary fixed service (“FS”) operators

The 17.8-18.3 GHz band is allocated on a primary basis to FS and on a secondary basis to FSS.⁹ O3b seeks authority to receive NGSO FSS downlink signals in this portion of the Ka-band on a secondary basis and will accept any interference from primary FS networks and other services.

In the Market Access Grant, the Commission authorized O3b’s space stations to transmit in this band subject to compliance with ITU power flux density (“PFD”) limits at the earth’s surface, which are designed to protect terrestrial services in this band.¹⁰ The Commission also specified that O3b’s use of this spectrum is secondary with respect to the fixed service,¹¹ requiring O3b to accept interference from FS operations in the band.

Since O3b is operating on a secondary basis and not with “equal rights between terrestrial and space services,” operations in this band are not subject to the coordination requirements of Section § 25.203.¹²

18.3-18.6 GHz & 19.7-20.2 GHz – Sharing with primary GSO operators and other secondary NGSO operators

The 18.3-18.6 GHz and 19.7-20.2 GHz bands are allocated in the United States on a primary basis to GSO FSS and on a secondary basis to NGSO FSS. O3b requests authority for blanket licensed earth stations to receive in these bands.

⁹ NGSO Order, 32 FCC Rcd at 7812, ¶¶ 7-8, and 7850, Appendix B.

¹⁰ Market Access Grant, 33 FCC Rcd at 5525, ¶ 46(a).

¹¹ *Id.* at 5526, ¶ 46(g).

¹² 47 C.F.R. § 25.203(a)-(c). Subsections (a) and (b) make it clear that the requirements of this section apply where space and terrestrial services operate on an equal basis. Moreover, since the earth station is receiving only, transmissions in this band are covered by the space station authorization. *See also, e.g.,* O3b Limited, Call Sign E210037, SES-LIC-20210217-00350, granted Mar. 22, 2022, at 3, Condition 90696 (finding that O3b need not submit additional information regarding earth station transmissions to operate on a secondary basis in the 27.5-28.35 GHz band). In the current application, SES is proposing to receive on a secondary basis, which poses no additional interference issues.

In the Market Access Grant the Commission authorized O3b's space stations to transmit in these frequencies subject to compliance with "the applicable power flux-density and equivalent power-flux density limits contained in Section 25.208, 47 C.F.R. § 25.208, and Articles 21 and 22, as well as Resolution 76 of the ITU Radio Regulations."¹³ In addition, the Commission required O3b to "cooperate with other NGSO operators in order to ensure that all authorized operations, including MSS operations in the 19.7-20.2 GHz band, jointly comport with the applicable limits for aggregate EPFD in the space-to-Earth direction (EPFD_{down}) contained in Article 22 of the ITU Radio Regulations, and Resolution 76 of the ITU Radio Regulations."¹⁴ O3b recognizes that its MSS operations in the 19.7-20.2 GHz frequencies must not cause harmful interference to, and are not entitled to interference protection from, FSS operations in this band segment.¹⁵ O3b will also conform to the terms of its coordination agreements with U.S. Federal systems in the 17.7-20.2 GHz frequency bands under the requirements of the O3b market access grant.¹⁶

19.3-19.4 & 19.6-19.7 GHz – Sharing with co-primary NGSO MSS feeder links and GSO FSS stations

O3b requests authority for its blanket licensed earth stations to receive in the 19.3-19.4 & 19.6-19.7 GHz band on a secondary non-interference basis. The Iridium system does not operate in the 19.3-19.4 GHz and 19.6-19.7 GHz segments.¹⁷ Accordingly, granting O3b authority for these frequencies poses no coordination or interference issues.

Additional Antenna Models

O3b's current blanket earth station license includes 1000 units of four antenna models, including the General Dynamics 1.8 meter and 2.4 meter antennas and the Orbit 1.2 meter and 2.2 meter antennas. In the Modification, O3b requests the addition of up to 1000 units each of following antenna sizes and models:

Antenna Manufacturer and Size in Meters	Number of Units
AvL 2.4m	1000

¹³ Market Access Grant, 33 FCC Rcd at 5525, ¶ 46(a). See O3b Amendment, Technical Annex at 13-19 for a discussion of O3b's compliance with the operational limits in Article 22 of the ITU Radio Regulations.

¹⁴ Market Access Grant, 33 FCC Rcd at 5525, ¶ 46(b).

¹⁵ *Id.* at 5525, ¶ 46(d).

¹⁶ *Id.* at 5526, ¶ 46(h).

¹⁷ See Iridium Constellation LLC, Call Sign S2110 (granted 2016).

AvL 1.2m	1000
AvL 1m	1000
ViaSat 3.7m	1000
ViaSat 2.4m	1000
Intellian 1.2m	1000

Additional Geographic Coverage Area and Azimuth Angles

O3b's existing blanket earth station license authorizes O3b's earth stations to operate in the contiguous United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands. O3b requests to expand that geographic coverage to include all U.S. territories, including but not limited to Guam. O3b has expanded the eastern and western azimuth angle on Form 312 fields E56/E58 accordingly. However, in accordance with O3b's space station authorization for inclined orbits, O3b hereby requests the ability to use all azimuth angles between 0 and 360 degrees, which cannot be accommodated on Form 312

24/7 Point of Contact for Remote Control

SES Network Operations Center (NOC)

Phone: (+1) 703-330-3305

Email: NOC@ses.com

Address: 10432 Balls Ford Rd., Manassas, VA 20109

Additional Form 312 Notes

Fields E35-E37 and E39: O3b entered 0 as a stand-in for variable.

Fields E54/55: O3b entered 0 as a stand-in for "NGSO" as marked on its existing license.

Conclusion

For the reasons stated herein, the Commission should grant the Modification to O3b's blanket earth station license as described above.

Annex: AvL 1.2m compliance with EPFD $\uparrow$ limits

Figure 1 illustrates the 1.2-meter AvL antenna pattern in azimuth and elevation coordinates (left plot). The GSO arc and O3b arc are superimposed in az/el coordinates. The figure illustrates performance for the antenna assuming it is located at 38° N.L., 95° W.L., with a boresight pointing toward an O3b satellite located at 100° W.L. The colormap and associated scale shows the antenna gain (units in dBi) as a function of azimuth and elevation angles. The antenna gain data that intersects with the GSO arc is used to determine the gain in the direction of the GSO arc. The EPFD $\uparrow$ limit is $-162 \text{ dBW/m}^2/40 \text{ kHz}$. The spreading loss is determined by the equation:

$$\text{spreading loss (dB)} = 10\log_{10}(4\pi d^2)$$

where d is the distance to a point on the GSO arc from the location on the Earth of the transmitting earth station. With the spreading loss, input power spectral density, and antenna gain in the direction of the GSO arc, the EPFD $\uparrow$ can be determined. The plot of the right side of Figure 1 illustrates the EPFD $\uparrow$ produced at the GSO arc from the 1.2-meter AvL antenna.

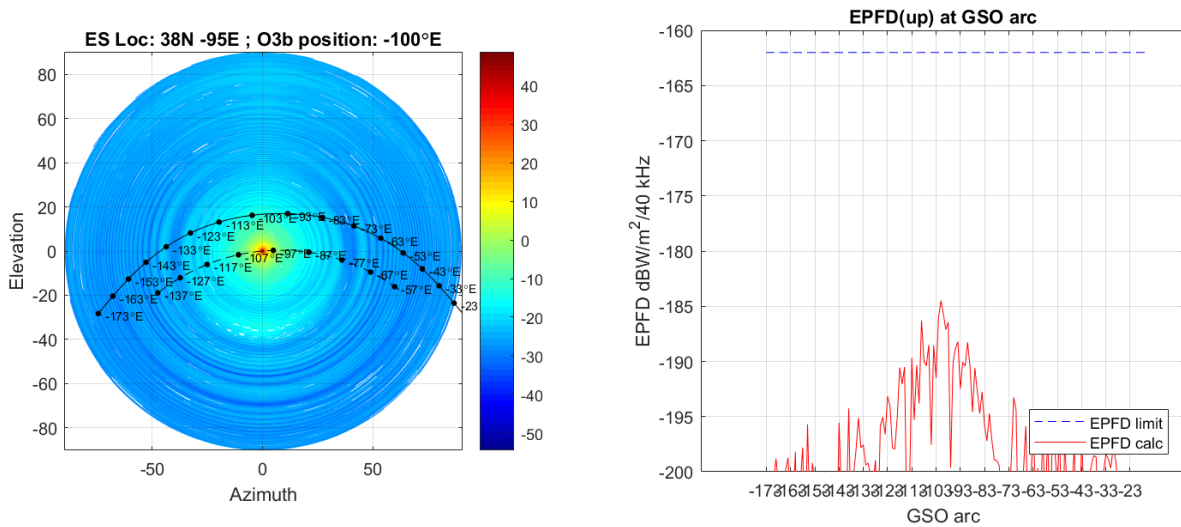


Figure 1. 1.2-meter AvL antenna gain and EPFD $\uparrow$ at the GSO arc

As seen in Figure 1, operations of the 1.2-meter AvL antenna comply with the EPFD $\uparrow$ limits with a margin of about 23 dB. Since this is a tracking antenna following an O3b satellite, the EPFD $\uparrow$ limits are confirmed in the same way as demonstrated above for all pointing directions of an eligible O3b satellite.

Extending the above analysis to a set of test points distributed over the United States produces the results shown in Figure 2. This plot illustrates a heatmap of the EPFD $\uparrow$ margin for the 1.2-meter AvL antenna operating from anywhere in the United States. The margin varies between

approximately 19 dB and slightly above 24 dB which confirms the antenna can be operated from anywhere in the United States and comply with the EPFD $\uparrow$ limits.

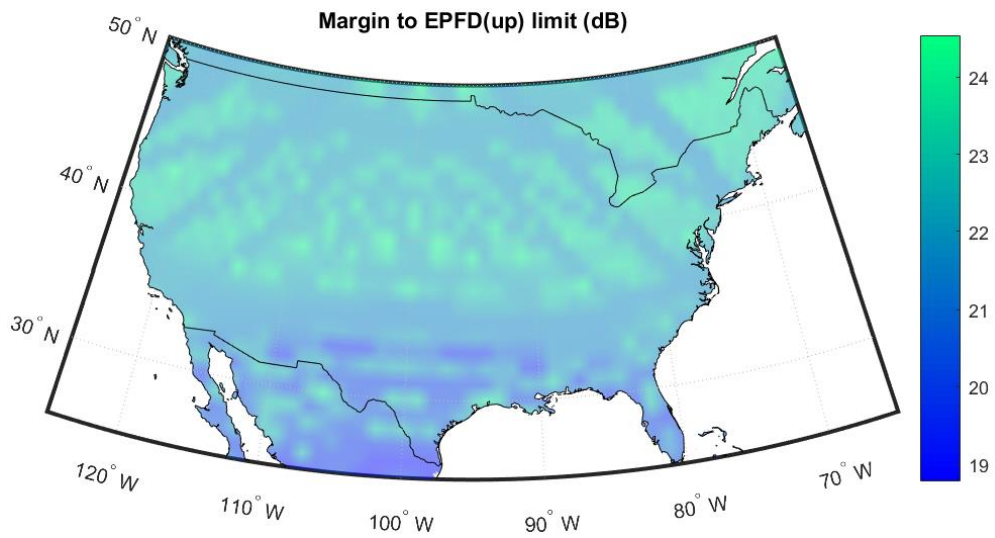


Figure 2. Margin to the EPFD $\uparrow$ limits for the 1.2-meter AvL antenna operating anywhere in the US

Data Used for EPFD Analysis

Data Type	At minimum Elevation		At center of pass	
	4 kHz	40 kHz	4 kHz	40 kHz
a maximum input power spectral density (dBW/40kHz and dBW/4kHz) for earth station,	-26.99	-16.99	-26.99	-16.99
the minimum separation angle between the O3b orbit and the GSO arc (degrees),	8.5	8.5	12.2	12.2
the off-axis gain (dBi) $(32-25\log(\theta))$ transmitting from earth station),	8.764526857	8.764526857	4.841004233	4.841004233
the off-axis EIRP density towards the GSO (dBW/40kHz and dBW/4kHz),	- 18.22547314	- 8.225473143	- 22.14899577	- 12.14899577
the minimum elevation angle from earth station FIXED site/location to the GSO orbit/satellite,	10	10	50	50
the spreading loss	163.1	163.1	162.2	162.2