O3b Networks
Application for Experimental License

Narrative Statement

(1) Name, address, phone number (also e-mail address and facsimile number, if available) of the applicant.

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(2) Description of why an STA is needed.

O3b Limited ("O3b") is a satellite operator with a unique non-geostationary orbit ("NGSO") satellite system[1] that operates in a medium earth orbit 8,062 km above the earth. O3b is a wholly-owned subsidiary of SES S.A. ("SES"). SES operates a fleet of over 50 geostationary orbit ("GSO") commercial satellites.

O3b Limited (O3b) is seeking an experimental special temporary authority to test and demonstrate the capabilities of a new class of satellite antenna, the GetSat Microsat terminal, which will eventually support communications on mobile platforms, including aeronautical services. The GetSat Microsat terminal has the potential to deliver high-throughput, low-latency satellite capacity to mobile platforms and is being developed to help enable critical applications for the U.S. Government.

O3b is requesting special temporary authority to conduct **on-the-ground** tests of the GetSat Microsat for fixed and short-range mobile operations at a potential customer testing facility in Hunt Valley, MD. The new terminal will communicate with O3b's Ka-band NGSO satellite constellation.

The Office of Engineering and Technology has previously authorized this terminal for testing at an SES facility in Manassas, VA.[2] The successful testing and demonstration of the terminal at that location has accelerated the demand for the GetSat Microsat from the U.S. government and a number of other customers.

(3) Time and Date of Proposed Operation

O3b requests temporary authority for 1 month, from November 18, 2019 through December 18, 2019.

O3b will operate the terminals at a customer's testing facility in Hunt Valley, MD in both fixed and mobile mode. All mobile operations will be conducted within a 1-mile radius of the designated

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[1] The FCC has granted market access to the current O3b 20 satellite constellation and authorized the expansion of the constellation to up to 42 satellites. *See* O3b Limited, Call Sign S2935, File No. SAT-AMD-20171109-00154 (granted June 4, 2018) ("O3b Market Access Grant).

[2] Call Sign: WN9XBH; File No: 1076-EX-ST-2018.

coordinates (39° 28' 0.6024" N, 76° 38' 30.354" W). O3b seeks to operate one GetSat terminal at the facility which will communicate with O3b's NGSO system.

O3b will notify any U.S. authorized co-channel Ka-band satellite operators at least one week prior to any transmit testing, and provide emergency contact information. For the Commission's reference O3b has included an analysis in Annex B that demonstrates that the use of the GetSat terminal in Manassas, VA met the EPFD levels in Table 22-2 of Article 22, Section II, and Resolution 76 of the ITU Radio Regulations. Although operations will only take place in NGSO-primary bands, O3b certifies that its operations in Hunt Valley will similarly meet the EPFD levels in Table 22-2 of Article 22, Section II, and Resolution 76 of the ITU Radio Regulations.

O3b certifies that its proposed operations will comply with all existing or future coordination agreements between O3b and other satellite operators and will abide by all the terms and conditions of the O3b Market Access Grant.

(4) Class(es) of station (fixed, mobile, fixed and mobile) and call sign of station (if applicable).

The transmitting stations will operate in fixed and mobile.

(5) Description of the location(s) and, if applicable, geographical coordinates of the proposed operation.

O3b will operate the terminals at a potential customer testing facility in Manassas, VA, within a 1-mile radius of the designated coordinates on the application listed below:

39° 28' 0.6024" N, 76° 38' 30.354" W

(6) Maximum effective radiated power (ERP) or equivalent isotropically radiated power (EIRP).

The maximum transmitted ERP will be 45.6 dBW.

(7) Emission Designator see §2.201 of this chapter) or describe emission (bandwidth, modulation, etc.)

50M0G7D

6M00G7D

(8) Overall height of antenna of antenna structure above the ground (if greater than 6 meters above the ground or an existing structure, see part 17 of this Chapter concerning notification to the FAA).

The overall height of the antenna above ground level is 2 meters.

O3b Networks
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I. Is a directional antenna (other than radar) used? Yes

a. If yes, provide the following information

i. Width of the beam in degrees at the half power point: Az=1.3 degrees and El= 2.2 degrees

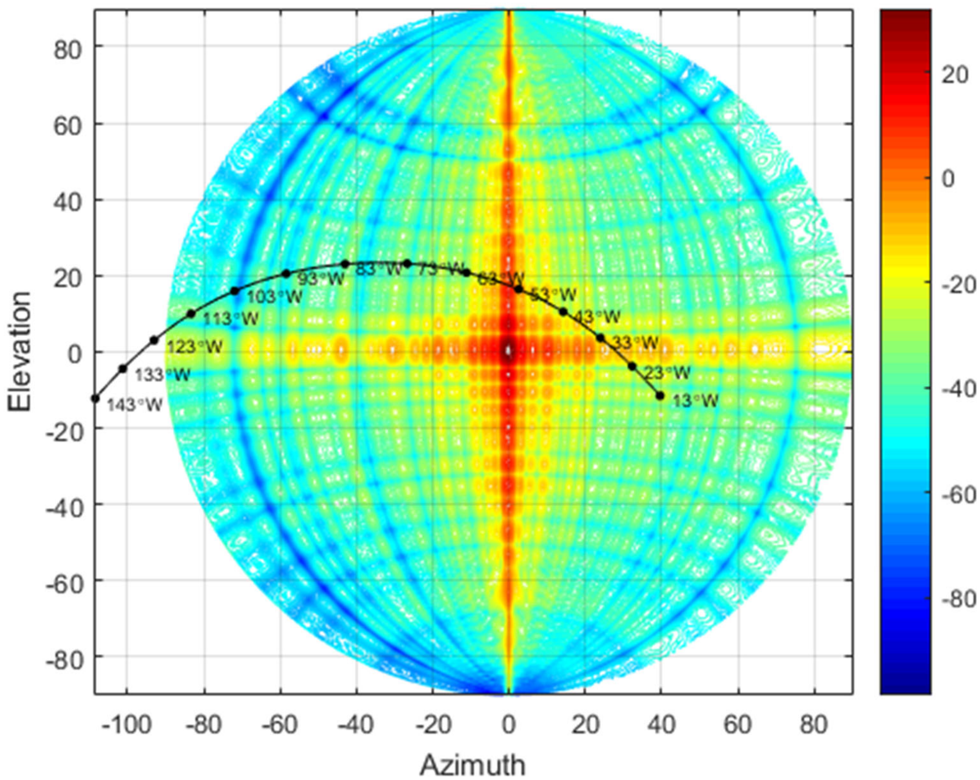
ii. Orientation in horizontal plane (degrees): Azimuth from 130° to 230°

iii. Orientation in vertical plane (degrees): Elevation from 14°to 33° across the pass

Application for Experimental License Annex B

Getsat compliance with EPFD ↑ limits at Manassas, VA Location

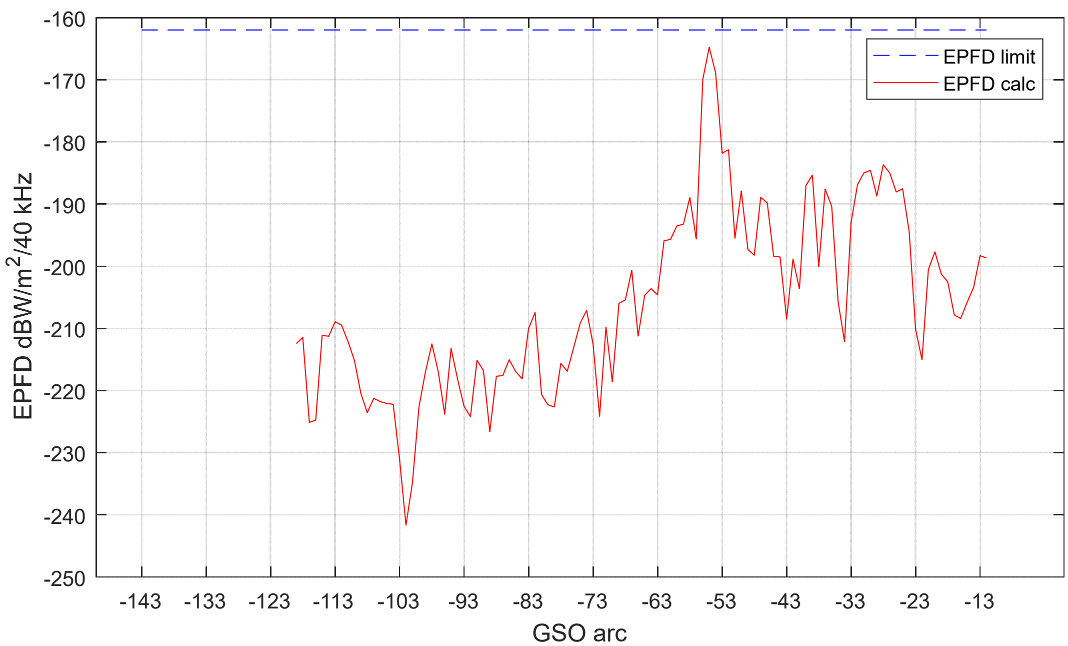
The following graphic illustrates the GETSAT antenna pattern in azimuth and elevation with the GSO arc superimposed in az/el coordinates when the antenna boresight is pointing toward an O3b satellite located at 55°W (for example). The colormap shows the antenna gain (units in dBi) as a function of azimuth 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 ↑ limit is −162 dBW/m²/40 kHz. The spreading loss determined by the equation

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

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↑ can be determined. The following graphic illustrates the EPFD↑ produced at the GSO arc from the GETSAT antenna.



As seen by the plot above, the GETSAT operations are compliant with the EPFD↑ limits in Article 22 of the ITU Radio Regulations.[3] This graphic is for when the antenna boresight is pointing toward an O3b satellite located at 55°W.

Since this is a moving antenna tracking an O3b satellite, the EPFD↑ limits are confirmed in the same way as demonstrated above for all pointing directions along the O3b orbit.

Calculation of Getsat Microsat compliance with EPFD ↑ limits at Manassas, VA Location

The formula for calculating EPFD is defined in 22.5C.1 in the Radio Regulations and repeated here:

$$epfd = 10\log_{10}\left[\sum_{i=1}^{N_a} 10^{\frac{P_i}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\varphi_i)}{G_{r,max}}\right]$$

The EPFD limit in the requested frequencies is -162 dBW/m^2/40 kHz. In this example, we assume the GETSAT antenna is located at the testing facility around 37.8N, 77.5W and pointing to an O3b satellite at 55W. The O3b satellites move, so this static case is for illustrative purposes. Each point along the O3b arc, the GETSAT antenna is performing an EPFD calculation to ensure the uplink EPFD limit is met.

Following the equation above, we assume an input power spectral density of -58 dBW/Hz or -12 dBW/40 kHz. The GETSAT antenna varies in the direction of the GSO arc but the maximum gain in the direction of the GSO arc is 9.7 dBi. The spreading loss (4*pi*d^2), in the log scale, in the direction of the GSO arc at the peak off-axis gain of the GETSAT antenna is 162.5 dB. Lastly, we assume the GSO satellite

[3] 47 C.F.R. 25.289. If the applicable EPFD$_{up}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference.

victim antenna peak gain is located at the testing facility site so that there is no discrimination advantage at the GSO satellite receiver. With this assumption, the last term of the EPFD calculation becomes one since G_r(phi_i) = G_r, max. With this, we have all parameters defined.

Therefore, the EPFD uplink (in log scale) is:

epfd = -12 dBW/40 kHz + 9.7 dBi – 162.5 dB = -164.8 dBW/m^2/40 kHz

which compared to the limit of -162 dBW/m^2/40 kHz is 2.8 dB below the limit.

When considering the specific emissions identified, 50MG7D and 6M00G7D, SES could operate the 50 MHz carrier at full power, 20 W, and only achieve -18 dBW/40 kHz input power spectral density. This will have approximately 8.8 dB of margin below the EPFD limit. For the 6 MHz carrier, SES could not operate at full power, 20 W and will operate with some amount of output backoff. Because of the narrower width of this carrier, a full power input would not be necessary. SES will, at the least, operate minimum with the minimum output backoff required to be compliant with EPFD uplink limits which is approximately 1 dB.