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FILED ELECTRONICALLY

Marlene H. Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Room TW-A325
Washington, DC 20554

Re: O3b Limited
File No. SES-LIC-20130528-00455

Dear Ms. Dortch:

This filing supplements the response that O3b Limited ("O3b") provided on October 25, 2013, to questions from the International Bureau concerning O3b's application for authority to operate earth stations on maritime vessels.[1] On November 8, 2013, the International Bureau posed this follow-up question concerning O3b's response to Question 12:

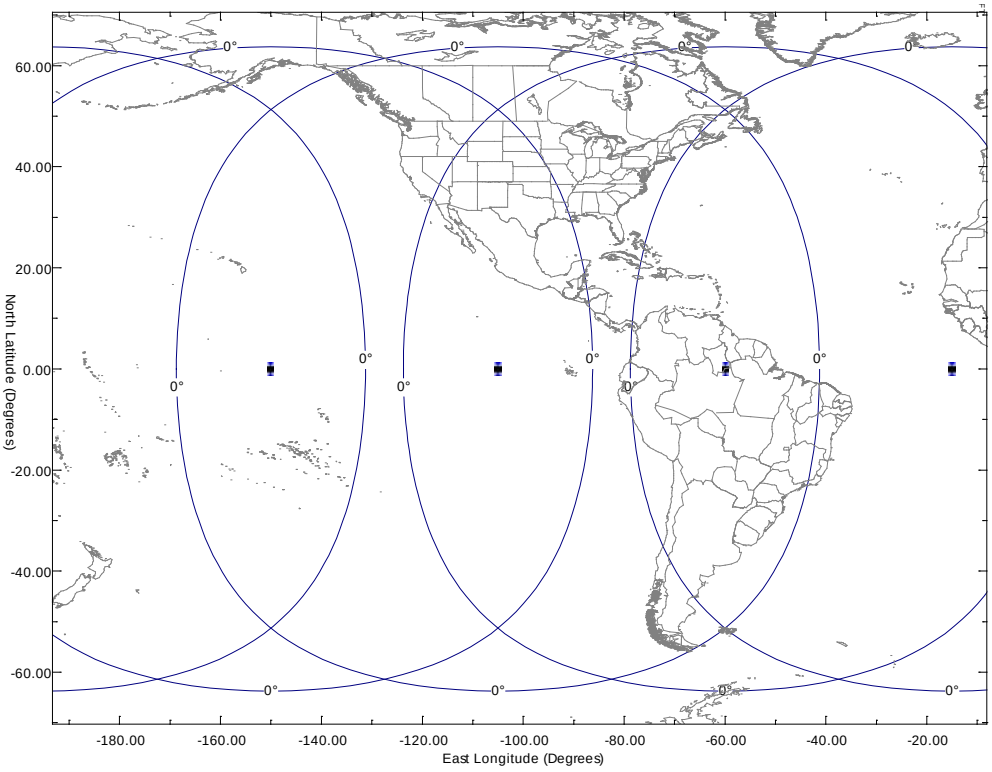
> *"In O3b's response to Question 12 contained in our letter of September 25, 2013, O3b limited its explanation to overlap from a single satellite in its system. While that information is useful, we are interested in the potential for O3b space-to-Earth co-frequency beam overlap at any single location within the United States from the O3b constellation as a whole and not a single satellite. Please describe the scenarios in which such beam overlap could occur, and please state the time duration of and time interval between such beam overlap events. If these parameters vary depending on geographic location, please state the longest beam overlap duration and the minimum interval between beam overlap events. If these parameters will change depending on the number of satellites in the O3b constellation, please describe how adding more satellites to the system will change the analysis."*

[1] *See* letter, dated September 25, 2013, from Jose Albuquerque, Chief, Satellite Division, FCC, to Joslyn Read, Vice President, Regulatory Affairs, O3b (FCC File No. SES-LIC-20130528-00455).

In O3b's original response Question #12, O3b explained that there is no aggregation of the downlink PFD on the surface of the Earth from the various beams of an individual O3b satellite.[2] The Bureau's follow-up question, which O3b is responding to in this supplement, requests information concerning the potential aggregation of downlink PFD from multiple O3b satellites.

O3b has sought FCC authorization to operate various earth stations in the United States with an 8-satellite constellation. O3b has also explained to the Commission that it is building an additional four satellites creating the potential to operate up to 12 satellites in its equatorial constellation at some time in the future. Therefore, the answer to this question will be initially focused on the 8-satellite constellation, but with additional references to the potential future situation with up to 12 satellites.

The following sample diagram shows the number of simultaneously visible O3b satellites in an 8-satellite constellation where the contours correspond to 0° elevation from each O3b satellite:



[2] Co-coverage operation using dual orthogonal polarizations is not considered to result in an aggregation of the PFD level when considering compliance with PFD limits. The PFD limits of the FCC rules and ITU Radio Regulations are applied per polarization.

It can be seen that there are periods of time when up to three satellites are simultaneously visible from all parts of CONUS, with the duration of such events being a function of latitude. For example, at 40°N latitude three O3b satellites are simultaneously visible for approximately half the time. Note, however, that three satellites are not visible all of the time from any latitude with an 8-satellite constellation. This means that O3b cannot provide continuous simultaneous service from more than two satellites at a time to the same location on the Earth with an 8-satellite constellation. The only time that three different O3b satellites could simultaneously point their beams to the same Earth location is therefore during handover from the setting to the rising O3b satellite, where the duration of the handover with an 8-satellite constellation will last for approximately 30 seconds every 45 minutes (*i.e.,* approximately 1% of the time) regardless of latitude. As O3b moves from an 8 satellite constellation to a 12 satellite constellation, the 30 seconds of handover time will remain the same, but the handovers will occur more often. Thus instead of 30 seconds every 45 minutes, the 30 second handover will occur every 30 minutes, upping the percentage of time to 1.67%.

From the above, we conclude that, apart from the short periods of handover, at most only two O3b satellites can simultaneously provide service to the same Earth location with an 8-satellite O3b constellation. If this were to happen, the simultaneous signals from the two O3b satellites would be coming from very different directions in the sky and this would have to be taken into account in determining how the two signals would aggregate in practice in terms of potential interference to the FS. Typically, when aggregating uncorrelated effects such as this it is normal to sum the contributions using a root sum square ("RSS") approach, rather than adding the contributions linearly. [3] Using this method, two signals with equal levels of maximum PFD would result in an increase in the aggregate of 1.5 dB relative to each one. Therefore, the effective aggregate PFD resulting from the simultaneous co-frequency co-coverage transmissions of two O3b satellites would be no more than 1.5 dB higher than the PFD of a single satellite.[4]

O3b's simple demonstration in its ESV application of compliance with the PFD limits in §25.208(e) for a single O3b satellite was overly conservative as it computed the high elevation PFD level and compared it to the low elevation PFD limit.[5] If the additional spreading loss for low elevation paths is taken into account, the resulting PFD level from an O3b satellite has more margin relative to the PFD limits as demonstrated below. Consider the most constraining case which is for an elevation of 5° where the PFD limit is -115 dBW/m^2/MHz. For the O3b orbit the additional spreading loss at 5° elevation is 3.8 dB compared to the spreading loss at 90° elevation.[6] The actual spreading loss at 5°

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[3] Aggregate interfering power is equal to the square root of the sums of the squares of the individual power contributions.

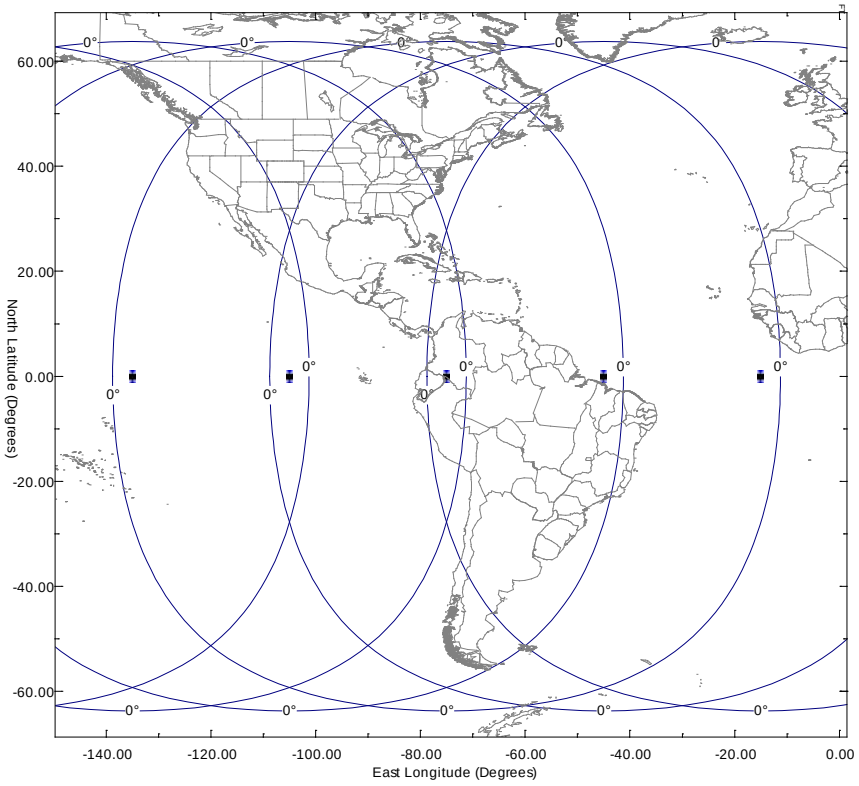
[4] In practice, the aggregate interference effect of two O3b satellites into an FS receiver would be less than 1.5 dB because only one of the O3b satellites would be at the worst-case minimum elevation angle considered for the PFD compliance test.

[5] See Section A.5 of Attachment A to the ESV earth station application.

[6] Note this increase in spreading loss at low elevations is significantly higher for the 8,062 km altitude orbit of O3b than it is for a geostationary satellite orbit.

elevation is 152.9 dB, resulting in a single satellite PFD level of -119.2 dBW/m^2/MHz when the assumed EIRP density is 33.7 dBW/MHz (the highest EIRP density at which O3b will operate). This PFD level has more than 4.2 dB of margin relative to the PFD limit in §25.208(e), which is more than sufficient to allow for PFD aggregation from two O3b satellites which, as shown above, could only increase the resultant PFD level by at most 1.5 dB. Therefore, with an 8-satellite constellation the aggregate PFD from multiple O3b satellites will be within the Commission's PFD limits.

If more satellites are added in the future to the O3b constellation, the theoretical potential increase in aggregate PFD from multiple O3b satellites will increase. For a 12-satellite constellation, the visibility contours are as shown in the following diagram:



In this case, it would be theoretically possible to provide continuous simultaneous service over CONUS using up to three O3b satellites and allowing for handover during the periods when four satellites are visible. Using the same RSS method as described above to calculate the aggregate effect of three satellites, the resulting increase relative to one satellite would be 2.4 dB. This is still significantly less than the 4.2 dB margin in the single satellite PFD level derived above. Therefore, even with a 12-satellite constellation, the aggregate PFD from multiple O3b satellites will be within the PFD limits.

In practice, moreover, the likelihood of O3b using more than one satellite at a time to provide service to the same Earth location is small. This means that, in the typical case, no more than two

co-frequency beams will be over a single location for a period of 30 seconds every 45 minutes (for an 8-satellite constellation), and as demonstrated the aggregate pfd from those two beams would still comply with the applicable pfd limits for the protection of terrestrial services.

In light of the above, O3b will satisfy the FCC's PFD limits in §25.208(e) even when the aggregation of the PFD from multiple satellites is considered. If the O3b constellation expands to more than twelve satellites and O3b needs to operate so many satellites simultaneously to the same Earth location in the USA that the aggregate PFD, calculated according to the method described above, could exceed the PFD limits, then O3b will take operational measures to ensure that the PFD limits are not exceeded in practice. The following are examples of these operational measures:

(a) O3b has the flexibility to select beams with different frequencies to serve the same geographic area, which would avoid any aggregation of the PFD;

(b) In practice the likely way that O3b would operate a constellation with more satellites is to provide higher elevation to its customer earth stations, rather than providing more beams from multiple satellites to the same number of earth stations;

(c) If multiple co-frequency co-polarized beams were required to be pointed to the same earth station this would likely be only to achieve very high capacity to that earth station. In that case, the O3b transponders would be operated in a more spectrally efficient manner where the available EIRP is spread across the transponder bandwidth. This would reduce the maximum downlink EIRP density by 7.3 dB compared to the value used to demonstrate PFD limit compliance.[7]

Respectfully submitted,

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cc: Andrea Kelly, FCC (via email)
Chip Fleming, FCC (via email)

[7] The demonstration of PFD limit compliance was made assuming the maximum O3b satellite EIRP was spread across only 40 MHz, rather than the full 216 MHz bandwidth of the O3b transponder. The ratio of these bandwidths is 7.3 dB.