Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Viasat, Inc.	)	IBFS File No. SES-LIC-20170401-00357
Application for Authority to Expand an Existing Earth Station Network	)	Call Sign E170088

PETITION FOR PARTIAL RECONSIDERATION OF VIASAT, INC.

Viasat, Inc. ("Viasat") respectfully requests partial reconsideration by the International Bureau of the authority granted to Viasat on November 9, 2017 in response to the above-captioned license application (the "Application"), which provided a blanket license to communicate with the Viasat-2 spacecraft over a number of earth stations across the Ka band (the "Licensed Operations"). Specifically, Viasat respectfully requests that the Bureau modify Condition 90447 to the grant of authority, which provides:

> [N]o later than sixty days before the scheduled initial launch of each NGSO FSS satellite system licensed or granted market access in the United States to operate in the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands, the licensee must either: (1) notify the Commission in writing when an agreement has been reached with the NGSO satellite system operator, or (2) seek and obtain the Commission's approval of a modification of this license including detailed technical demonstrations of how the licensee will protect the NGSO FSS satellite system. If neither condition is met, the licensee must cease earth station operations in the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands pursuant to this license until such time as compliance is demonstrated.

Notably, this new condition differs from the one previously imposed with respect to Viasat's use of the NGSO-primary band segments on Viasat-2, which specifies that Viasat-2 operations must

not cause harmful interference to, and must accept interference from, NGSO FSS systems operating in these band segments.[1]

Specifically, the new condition (90447) requires that, unless certain conditions otherwise are satisfied, Viasat cease operating its earth stations in the NGSO primary bands simply because of the upcoming scheduled launch of an NGSO satellite, and regardless whether harmful interference reasonably would be expected to occur from Viasat's operations after that NGSO satellite comes into service.

The basis for this new condition appears to be the submissions of O3b and SpaceX on the Application, including claims by SpaceX that uplink interference in the 28.6-29.1 GHz band segment could occur from the proposed GSO earth station operations into NGSO spacecraft in certain circumstances.[2] Viasat believes that it fully addressed these O3b and SpaceX submissions and demonstrated how Viasat's proposed operations would not reasonably cause harmful interference into NGSO operations in NGSO-primary band segments. Moreover, Viasat indicated that in the event of harmful interference into an NGSO system, it would cease uplink operations in the 28.6-29.1 GHz band segment, which correspondingly would result in a cessation of downlink transmissions in the 18.8-19.3 GHz band segment.[3]

In support of this Petition, and in an effort to obviate the need for the type of subsequent license modification applications contemplated by the new condition, Viasat provides the

---

[1] *See* Viasat, Inc., File No. SAT-MOD-20160527-00053, Call Sign S2902, Attachment to Grant ¶¶ 3, 8 (granted Jan. 12, 2017) (authorizing U.S. market access using Viasat-2 at 69.9º W.L.).

[2] Petition to Defer of O3b Limited, File No. SES-LIC-20170401-00357 (filed June 2, 2017); Reply of O3b Limited, File No. SES-LIC-20170401-00357 (filed June 27, 2017); Comments of Space Exploration Holdings, LLC, File No. SES-LIC-20170401-00357; Reply of Space Exploration Holdings, LLC, File No. SES-LIC-20170401-00357 (filed June 26, 2017).

[3] Opposition and Response of Viasat, Inc., File No. SES-LIC-20170401-00357 (filed June 15, 2017).

enclosed technical analysis that (i) discusses the results of a series of simulations, and (ii) demonstrates the absence of predicted harmful uplink interference from the Licensed Operations into any of the NGSO systems that filed in the Ka band processing round for access to the NGSO primary spectrum. As that analysis explains, even without maintaining any angular separation, harmful uplink interference would not reasonably be expected to occur. Moreover, if the level of unwanted emissions resulting from the absence of angular separation is deemed to be "harmful," the separation angles for each NGSO system identified in Table 1 of that analysis readily could be used as the trigger point for ceasing (and resuming) uplink transmissions with respect to any such NGSO system in the NGSO primary spectrum.

This demonstration obviates the need for Condition 90447, and shows that it would be more than sufficient to impose once again the same type of condition that the Commission previously has applied, which generally requires that Viasat-2 operations not cause harmful interference into authorized NGSO uses of the NGSO-primary bands.[4]

Respectfully submitted,

/s/

John P. Janka
Elizabeth R. Park
LATHAM & WATKINS LLP
555 Eleventh Street, N.W.
Suite 1000
Washington, DC 20004

Counsel for Viasat, Inc.

Christopher J. Murphy
Associate General Counsel, Regulatory Affairs
Daryl Hunter
Chief Technology Officer, Regulatory Affairs
VIASAT, INC.
6155 El Camino Real
Carlsbad, CA 92009

December 11, 2017

See Viasat, Inc., File No. SAT-MOD-20160527-00053, Call Sign S2902, Attachment to Grant ¶¶ 3, 8 (granted Jan. 12, 2017) (authorizing U.S. market access using Viasat-2 at 69.9º W.L.).

Exhibit 1

Viasat has conducted simulations using Visualyse software from Transfinite Systems, Ltd., on the filed characteristics of each of the various NGSO systems proposed or authorized in the NGSO application processing round covering the NGSO-primary portion of the Ka band, and the characteristics of the ViaSat-2 blanket license earth stations ("VS-2 Earth Stations") to determine the potential for causing harmful interference into those NGSO systems under various operating conditions. The simulation software produces, as one of its outputs, a Cumulative Distribution Function (CDF) with the I/N value given as a percentage of time. In the case of NGSO systems where links are not static and are constantly changing, I/N as a function of time is a more useful metric than a static snapshot of a single I/N value being exceeded or not. This analysis considers the resulting I/N when there is no angular separation between the ViaSat-2 network and the various NGSO systems. It also considers the results when different minimal angular separations are maintained. Consistent with the technical analyses provided during the application process, this analysis focuses on the uplink case.

O3b System

Currently, O3b operates an NGSO system with an equatorial orbit and has filed applications both to increase the number of satellites in the equatorial plane and to add two additional inclined planes with eight satellites each for a total of 60 operational satellites, and a subsequent amendment to reduce the total number of operational satellites to 42 – 32 satellites in a non-inclined orbital plane and 5 each in two 70 degree inclined orbital planes. Viasat evaluated both systems and found that the results were not markedly different for the two systems so only the results for the latest amendment are included here. To analyze the O3b system, the simulations were broken down into three scenarios. First, an examination of the

equatorial orbit only was performed. Second, an examination of the inclined orbits only, and finally, an examination considering both the equatorial and inclined orbits of the O3b system was performed.

In each of these cases, the scenarios were run assuming a 1% TDMA burst duty cycle representing a sustained heavy traffic upload condition for the VS-2 Earth Stations over the simulation period.

In the case of the equatorial only orbit, VS-2 Earth Station operations in CONUS and Puerto Rico will result in a minimum separation angle of approximately 10.4 degrees when an O3b satellite passes under the VS-2 satellite potentially communicating with an earth station located in Puerto Rico. The associated I/N was calculated as -30.9 dB by Visualyse, based on a scenario in which the VS-2 Earth Station is located in close proximity with an O3b gateway station such that the O3b satellite's beam center is pointed at the VS-2 Earth Station. As the VS-2 Earth Station and the O3b gateway are moved further north, the minimum separation angle between the O3b equatorial orbit satellite and VS-2 in GSO increases and the I/N continues to decrease. From this analysis, it is very clear that, just as in the case of ViaSat-1 earth stations authorized under Call Sign E100143, no reduction in EIRP density or inhibition of transmissions from VS-2 Earth Stations is needed to operate compatibly with the O3b equatorial orbit for any of the U.S. territories served by VS-2.

In the case of the O3b inclined orbital planes, several simulations were performed at various locations to determine the frequency and magnitude of in-line events. The simulation results produce a Cumulative Distribution Function (CDF) of I/N versus percentage of time. The worst-case alignment during the simulation period resulted in an I/N of 9 dB. Notably, the duration of the alignment that results in an I/N of 9 dB is very brief, only two seconds long, and

occurs only once during the 30 day simulation period. Lower I/N values occur more frequently according to the CDF but the aggregate time percentage for the aggregate of all in-line events within the 30 day simulation period when an I/N of -12.2 dB level is exceeded is very small—a total of only 22 seconds. In other words, for more than 99.999% of the time, the I/N would be less than -12.2 dB; conversely, the I/N would exceed -12.2 dB only 8.13×10^{-4}% of the time. These results are summarized in Table 1 below. Also shown in Table 1 below are values for when the separation angle from GSO is set to the value proposed by O3b in order to meet the Article 22 epfd limits. The difference between the two cases is 22 seconds per month.

SpaceX System

Due to the density of the SpaceX constellation and the larger number of identical inclined orbital planes, it was not necessary to propagate the orbits over a 30-day period to develop reliable statistics for I/N values, so a 24 hour period was used instead. Multiple tracking strategies were evaluated for the SpaceX simulation, including scenarios in which the SpaceX earth station is communicating with a satellite in the constellation that (i) is the nearest, (ii) has the highest elevation, (iii) has the longest hold time, and (iv) avoids the GSO arc by 22 degrees, which is what SpaceX proposes in its application in order to meet the Article 22 epfd limits in band segments where those limits apply. In no case was a -12.2 dB I/N exceeded in any of the scenarios. These results are summarized in Table 1 below.

SpaceX in their June 26, 2017 reply comment presented calculations for a 10 degree separation angle. However, in practice when implemented in the Visualyse simulation software, such an alignment does not occur during the simulation of the network's operation. At all times in Visualyse, each of the selected tracking strategies resulted in very large separations from GSO. In fact, this seems consistent with SpaceX's application and public statements regarding

user terminals which will employ flat-panel antennas “roughly the size of a laptop” and which will use phased-array technology to track the satellites. Optimal scanning angles for phased-array terminals would suggest that higher elevations well-removed from the GSO orbit in most cases would be used in order to minimize scan losses and maximize link performance. Notably, SpaceX did not include an actual orbital simulation showing that the smaller separation angle of 10 degrees actually would be used. Additionally as explained in Exhibit 1 of Viasat’s Opposition and Response filed on June 15, 2017, SpaceX used the operational EIRP densities of Viasat’s earth stations that would typically be employed only during faded conditions, not clear sky, thus SpaceX incorrectly uses unrealistically high power densities for the VS-2 Earth Stations in their calculations. Accordingly, the Visualyse results here represent a more realistic operating scenario.

Additional NGSO Systems and Combined Results

In addition to the O3b and SpaceX systems, Viasat also evaluated seven other NGSO systems in the Ka band NGSO processing round with plans to operate in the NGSO-primary spectrum. Because Audacy and Kepler have not proposed systems operating in the 28.6-29.1 GHz band, they were not evaluated. Also, results were not evaluated for OneWeb as coordination has already been completed between Viasat and OneWeb for that system.

Table 1 below shows the results of the simulations for each system. A reference I/N of -12.2 dB is used for illustrative purposes to demonstrate the level and frequency of unwanted energy emitted toward the NGSO satellite in the circumstances described. That reference I/N is not intended as a threshold for when harmful interference would occur.

Table 1: I/N Results for VS-2 Earth Stations into NGSO Systems

System	Operator Separation Angle (deg)	Simulation Separation Angle (deg)	Tracking Strategy	I/N Exceeded	% Time	% of time meeting -12.2 dB	Worst I/N (dB)	Total Exceeded (s) / month	Longest Event (s)
Audacy		N/A	No links in "NGSO" band						
Boeing	6	N/A	Nearest	No	0	100.000	-15.69	0	0
Karousel	20	N/A	Nearest	No	0	100.000	-44.34	0	0
Leosat		N/A	Nearest	Yes	0.013872	99.986	23.76	360	4
Leosat	7	7	Avoid GSO	Yes	0.000055	100.000	-11.79	2	1
O3b Equatorial Only		N/A	Nearest	No	0	100.000	-30.9	0	0
O3b		N/A	Nearest	Yes	0.000813	99.999	9.09	22	2
O3b	7.6	7.6	Avoid GSO	No	0	100.000	-27.67	0	0
OneWeb		N/A	Not examined due to coordination already completed						
SpaceX		N/A	Nearest	No	0	100.000	-16.21	0	0
SpaceX	22	22	Avoid GSO	No	0	100.000	-18.97	0	0
Space Norway		N/A	No links in "NGSO" band in VS-2 coverage area						
Telesat		N/A	Nearest	Yes	0.006164	99.994	20.64	160	3
Telesat	11.9	11.9	Avoid GSO	No	0.000000	100.000	-19.57	0	0
Theia Holdings		N/A	Nearest	Yes	0.002057	99.998	19.47	22	2
Theia Holdings	10	10	Avoid GSO	No	0	100.000	-14.43	0	0

The results in Table 1 are provided for each system for several different separation angles. For each system, the results are provided for using a tracking strategy with no GSO avoidance and a separation angle of 0 degrees input into the tracking strategy, as well as for other values for minimum separation angle from GSO if an exceedance of the -12.2 dB I/N value was observed for 0 degrees separation angle. For example, in the case of Leosat, in-line events could occur resulting in an I/N exceeding -12.2 dB for a brief period (i.e., up to 4 seconds). Increasing the separation angle to the 7 degrees, which is the angular separation at which Leosat proposes to operate in the bands where Article 22 epfd limits apply results in -12.2 dB I/N essentially all of the time. In the case of Boeing, Karousel, Telesat, and Theia Holdings, the same holds true, with operation at the GSO angular separation each operator proposes to employ for similar reasons resulting in the -12.2 dB I/N never being exceeded.

In the case of Boeing and Karousel, adding a separation angle in Visualyse over choosing a tracking strategy such as nearest or highest, or longest hold time, had no real effect in that the -12.2 dB I/N is met at all times for those systems.

The orbits of each of these NGSO systems are readily predicted using long-proven orbital propagation routines, and the orbital element data for the orbits available from sources such as Space Track, a U.S. government resource, or from the NGSO operators themselves. The orbital separation from the NGSO satellites and VS-2 can be easily determined. We do not believe that VS-2 Earth Station operations would result in harmful interference in NGSO-primary band segments under any circumstances, but the shut-off capabilities Viasat has previously described will in any event protect NGSO systems from harmful interference from VS-2 Earth Stations. Specifically, the VS-2 satellite has been designed with the capability to cease operations in the 28.6-29.1 GHz uplink band (and in the associated 18.8-19.3 GHz downlink band) on a beam by beam basis in any spot beams where the predicted physical alignment of either (i) an NGSO space station and an earth station communicating with the VS-2 satellite, or (ii) the VS-2 satellite and an earth station communicating with an NGSO space station, occurs, such that the angular separation between operational links of the two satellite networks would be equal to or less than a specified minimum line-of-sight separation angle. In addition, as all earth stations in the VS-2 network operate under control of a Network Management System (NMS) that coordinates the real-time operations of the TDMA scheduler for each beam on the satellite, cease transmission commands can be sent to individual earth stations for the duration of the brief period when the separation angle falls below the specified minimum as calculated by the NMS using data from Space Track or the NGSO operators.

DECLARATION

I hereby declare that I am the technically qualified person responsible for preparation of the engineering information contained in this Petition for Partial Reconsideration of Viasat, Inc. ("Petition"), that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted with this Petition, and that it is complete and accurate to the best of my knowledge, information and belief.

Daryl T. Hunter, P.E.
Chief Technology Officer, Regulatory Affairs
Viasat, Inc.
6155 El Camino Real
Carlsbad, CA 92009

December 11, 2017

CERTIFICATE OF SERVICE

I, Kayla Ernst, hereby certify that on this 11th day of December, 2017, I served a true copy of the foregoing Petition for Partial Reconsideration of Viasat, Inc. via first-class mail upon the following:

Suzanne Malloy
O3b Limited
900 17th Street, NW
Suite 300
Washington, DC 20006

Tim Hughes
Patricia Cooper
Space Exploration Technologies Corp.
1030 15th Street, NW
Suite 220E
Washington, DC 20005

William M. Wiltshire
Paul Caritj
Harris, Wiltshire & Grannis LLP
1919 M Street, NW
Suite 800
Washington, DC 20036

Counsel to SpaceX

/s/
Kayla K. Ernst