

EXHIBIT A

Application for Ka band Aeronautical Antenna

By this application, Viasat, Inc. (“Viasat”) requests blanket authority to operate two transmit/receive earth station antenna models mounted on aircraft to provide service in the United States using the ViaSat-2 satellite: (i) the Mantarray M40 antenna, which the Commission has already authorized to operate with Viasat’s other spacecraft,¹ and (ii) the Global Mantarray GM40 antenna, which is a variation of the Mantarray M40 that is optimized for the ViaSat-2 satellite architecture.

Grant of this application would promote the public interest by enabling the provision of expanded broadband service to passengers and crew on board commercial and private aircraft using the ViaSat-2 satellite, which is expected to commence commercial service during the first quarter of 2018. In granting access for satellite to additional spectrum in the Spectrum Frontiers proceeding, the Commission cited comments from major U.S. airlines that are Viasat customers “argu[ing] that as demand for in-flight broadband grows, airlines and their satellite broadband partners will need access to more spectrum to meet consumer demand.”²

1. Frequencies, Satellite Points of Communication and Geographic Area of Operation

The earth stations will operate using the 17.7-18.3 GHz, 18.3-18.8 GHz and 19.7-20.2 GHz portions of the Ka band for downlinks, and 28.35-28.6 GHz and 29.5-30 GHz for uplinks. The Commission’s Ka-band band plan designates the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30 GHz portions of the Ka band for GSO FSS on a primary basis. The 17.8-18.3 GHz band segment has been allocated on a secondary basis for FSS downlinks.³ The 17.7-17.8 GHz band segment is allocated on a co-primary basis to the terrestrial fixed service and BSS feeder links in the Earth-to-space direction.⁴ Thus,

¹ See Viasat, Inc., File No. SES-LIC-20120427-00404, Call Sign E120075 (granted July 17, 2013).

² *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Second Report and Order, FCC 17-152, at ¶ 188 (rel. Nov. 22, 2017); see also American Airlines *Ex Parte* Presentation, GN Docket No. 14-177, *et al.*, at 1 (Nov. 9, 2017); JetBlue Airways, *Ex Parte* Presentation, GN Docket No. 14-177, *et al.*, at 1 (Nov. 9, 2017).

³ See *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order, 32 FCC Rcd 7809, ¶ 7 (2017) (“NGSO Order”).

⁴ 47 C.F.R. § 2.106 n.US271.

consistent with the waiver already granted for market access for ViaSat-2,⁵ Viasat requests a waiver to receive satellite downlink communications in the 17.7-17.8 GHz band segment.

These earth stations will communicate with the ViaSat-2 satellite at the 69.9° W.L. orbital location. The Commission has granted U.S. market access for ViaSat-2, which is operated under the authority of the United Kingdom, to use these frequency bands.⁶

The earth stations will operate throughout the coverage area of the ViaSat-2 satellite and can be operated with each of the gateway earth stations for ViaSat-2.⁷

2. Operation on Mobile Platforms

The earth stations will be mounted on commercial and private aircraft and will be used to provide two-way, in-flight broadband communications, including Internet access, and will be operated while in flight and at fixed locations while on the ground. The Commission is considering the adoption of rules that would authorize earth stations in motion in Ka-band frequencies. In commencing that proceeding, the Commission acknowledges that it is now well-established in the industry and in the Commission's precedent that GSO FSS spectrum can be used for earth stations on mobile platforms without adversely changing the operating environment created by a traditional FSS earth station.⁸ Based on the Commission's tentative conclusion that FSS earth stations in motion ("ESIMs") would be no more interfering than operations in a fixed installation, the Commission proposes to adopt a footnote to the U.S. Table to recognize the operation of ESIMs as an application of the FSS with primary status.⁹

The earth stations proposed by this application would operate as an application of the FSS and would be no more interfering than a fixed terminal using the same antennas. ViaSat-2's authorized downlink operations in the 17.7-18.3 GHz, 18.3-18.8 GHz, and 19.7-20.2 GHz band segments are unaffected by the operation of the proposed earth stations. As demonstrated below and in the technical attachments to this application, the proposed operations would be compatible with the operations of other GSO systems in the 28.35-28.6 GHz and 29.5-30 GHz band segments, and also with NGSO systems. In accordance

⁵ Viasat, Inc., File No. SAT-MOD-20160527-00053, Att. To Grant at ¶ 11 (granted Jan. 12, 2017).

⁶ 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").

⁷ See 47 C.F.R. § 25.115(e).

⁸ See *Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service*, IB Docket No. 17-95, Notice of Proposed Rulemaking, FCC 17-56, ¶ 53 (rel. May 19, 2017).

⁹ *Id.*

with the requirements in Section 25.220 for the operation of earth stations at non-routine power levels, Viasat is in the process of coordinating exceedances in the off-axis EIRP density envelope in certain limited scenarios in the direction of the GSO arc with the one GSO satellite operator that potentially could be impacted by the operation of the proposed antennas at certain skew angles. Therefore, to the extent the Commission adopts the proposed ESIM rules that would treat such operations as an application of the FSS with primary status in the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30 GHz band segments, Viasat requests that the proposed earth stations be authorized on that basis. In the meantime, to the extent necessary and out of an abundance of caution, Viasat seeks a waiver of the U.S. Table, and the Commission's Ka-band band plan, to operate mobile earth stations in frequencies allocated for FSS. The Commission has granted such waivers to allow Viasat to operate aeronautical earth stations, including one of the models included here, with Viasat's other spacecraft,¹⁰ and has granted authority to other licensees to operate earth stations on mobile platforms in the Ka band.¹¹

3. Antenna Performance and Compatibility with GSO FSS Operations

The attached Technical Description in Attachment 1 describes the antenna specifications, network architecture, and antenna pointing mechanism for the GM40 and M40 antennas. The previously-authorized M40 antenna and the new GM40 antenna share the same antenna patterns, which are attached hereto as Exhibit B. The antenna patterns provided are in accordance with Section 25.115(g)(1), except that patterns were only able to be generated to +/- 80 degrees, rather than +/- 180 degrees for the co-polarized EIRP density in the plane tangent to the GSO arc in Section 25.115(g)(1)(i). The near-field range available for obtaining measurement data for the patterns was limited to 80 degrees. However, Viasat has developed simulated data for the antennas for off-axis angles out to +/- 180 degrees and found no exceedances beyond 80 degrees. Viasat thus requests a limited waiver to provide measured patterns to 80 degrees rather than 180 degrees.¹²

This application is consistent with the existing regulatory framework for the Ka band. The GM40 and M40 antennas comply with the PFD levels in Section 25.138(a)(6). As illustrated by the antenna patterns in Exhibit B, the GM40 and M40 antennas comply with the EIRP spectral density limits in Section 25.138(a) in the GSO plane, but exceed to a

¹⁰ See Viasat, Inc., File No. SES-MOD-20160108-00029, Call Sign E120075 (granted June 29, 2016).

¹¹ See, e.g., ISAT US Inc., File No. SES-LIC-20141030-00832, Call Sign E140114 (granted Aug. 11, 2015) (granting waiver for aeronautical earth stations at 19.7-20.2 GHz and 29.5-30 GHz); ISAT US Inc., File No. SES-LIC-20140224-00098, Call Sign E140029 (granted Sept. 29, 2015) (granting waiver for maritime earth stations at 19.7-20.2 GHz and 29.5-30 GHz); see also O3b Limited, File No. SES-MS-20151021-00760 (granted Jan. 29, 2016) (granting a waiver to provide service to 30 foreign-flagged ships using earth stations at 27.6-28.35 GHz).

¹² See, e.g., Viasat, Inc., File No. SES-MOD-20160108-00029, Call Sign E120075, Condition 90261 (granted June 29, 2016).

limited degree the Section 25.138(a)(2) limits in the elevation plane. Specifically, the antenna patterns show off-axis exceedances for the main lobe in the elevation plane. In order to avoid a scenario where the main-beam exceedances would impact the GSO arc, Viasat previously has accepted a condition for the M40 antenna that transmissions would cease if the antenna-to-GSO skew angle exceeds 60 degrees and the off-axis EIRP spectral density emissions risk harmful interference to a GSO space station.¹³ Viasat also agrees to inhibit transmissions from the M40 and GM40 antennas communicating with ViaSat-2 in any cases where the skew angles exceed 60 degrees and the off-axis EIRP spectral density emissions from operation at such angle risk harmful interference to a GSO space station.

The antenna patterns also show off-axis exceedances for four grating lobes along the elevation axis. Exhibit B includes plots of the off-axis EIRP spectral density at a 25-degree skew cut, which illustrates the location and magnitude of the exceedances of these grating lobes. As illustrated in Figure 2 of Attachment 1, the grating lobes are located well outside of the GSO arc and could only intersect the GSO arc when the earth station is skewed by approximately 25 degrees relative to the GSO arc. The supplemental table required by Section 25.115(g)(1)(viii) detailing the off-axis EIRP density levels that exceed the Section 25.138 envelope is included in a spreadsheet attached as Exhibit D.

Because the grating lobes occur well outside of the GSO arc, they would intersect the GSO arc only when the aircraft is traveling within certain geographic locations in which the GSO arc appears skewed with respect to the local horizon of the antenna, or when the aircraft is banking at certain angles while in flight. Due to the high speeds at which aircraft travel, any intersection of a grating lobe with the GSO arc likely would be fleeting. Moreover, due to the large off-axis angles from the main lobe where these grating lobes occur, the level of any actual impact to any GSO satellite is extremely low.

In accordance with Section 25.138(b), Viasat will comply with the coordination requirements in Section 25.220 with respect to the exceedances of the off-axis EIRP density envelope in Section 25.138(a) that potentially could impact other GSO networks. Section 25.220 requires coordination of non-conforming earth station operations “with all adjacent satellite networks . . . within 6° of orbital separation.” However, in the case of the proposed earth stations, the off-axis EIRP density toward the satellites +/- 6 degrees from ViaSat-2 will not be exceeded in any operating scenario. The only GSO satellites that could potentially be impacted are those located at off-axis angles where the grating lobes could radiate toward the GSO arc when the earth stations are operated in certain geographic locations and at certain skew angles. Moreover, the satellite networks at these off-axis locations potentially could be impacted only if they have overlapping coverage with ViaSat-2. As explained in Attachment 1, DirecTV’s satellites operating in the range of 99° W.L. to 103° W.L. are the only networks that are potentially impacted by the grating lobes. Viasat is coordinating the proposed operations with DirecTV.

¹³ See Viasat, Inc., File No. SES-LIC-20120427-00404, Call Sign E120075, Condition 90097 (granted July 17, 2013).

4. Compatibility with NGSO FSS Operations

In the 28.35-28.6 GHz and 29.5-30 GHz band segments, the Commission's band plan allows NGSO FSS operations on a secondary basis. GSO FSS operations are primary in this band, and as discussed above, the Commission is contemplating rules allowing ESIMs on a primary basis as an application of the FSS. However, to the extent necessary and out of an abundance of caution, Viasat has requested a waiver for the operation of ESIMs while the adoption of Ka-band ESIM rules is pending and, in connection with that request, provides a demonstration showing that the proposed ESIM operations are compatible with NGSO FSS operations in the 28.35-28.6 GHz and 29.5-30 GHz uplink band segments.

The Technical Description in Attachment 1 includes an analysis of the off-axis EIRP density in the plane perpendicular to the GSO with respect to the NGSO FSS systems in the Commission's Ka-band processing round. Based on simulations conducted using the technical characteristics of Viasat's proposed earth stations under typical operating conditions and the information in the NGSO FSS applications, the proposed operations are unlikely to cause harmful interference into NGSO systems.

5. Compatibility with Terrestrial Operations and BSS

Viasat requests authority for receive operations using the proposed earth stations from the ViaSat-2 satellite in the 17.7-18.3 GHz band segment. The U.S. Table allocates the 17.7-18.3 GHz band segment on a primary basis for fixed services. In the 17.8-18.3 GHz portion of this band segment, the Commission recently adopted a secondary FSS allocation.¹⁴ The 17.7-17.8 GHz portion of the band segment is allocated to FSS on a co-primary basis, but this FSS allocation is limited by footnote US271 to broadcasting-satellite service feeder links in the Earth-to-space direction.¹⁵

In seeking market access for ViaSat-2, Viasat demonstrated that its FSS downlinks in the 17.7-18.3 GHz band segment are compatible with primary fixed service operations and neighboring BSS operations.¹⁶ More specifically, Viasat demonstrated that downlink transmissions from ViaSat-2 will be within the power-flux density limits at the earth's surface set forth in Article 21 of the ITU Radio Regulations and¹⁷ would not cause harmful interference into primary fixed service operations throughout the 17.7-18.3 GHz band segment.

Because the 17.7-17.8 GHz band segment is not allocated for the FSS downlinks proposed in this application, Viasat requests a waiver with respect to this band segment.

¹⁴ See *NGSO Order* at ¶ 7.

¹⁵ 47 C.F.R. § 2.106 n.US271.

¹⁶ See *Viasat, Inc.*, File No. SAT-MOD-20160527-00053, Call Sign S2902, Technical Annex at 7-10 (filed May 27, 2016).

¹⁷ *ViaSat-2 Authorization*, File No. SAT-MOD-20160527-00053, Att. to Grant at ¶ 12 (granted Jan. 12, 2017).

The Commission granted a waiver of the U.S. Table to authorize ViaSat-2 for U.S. market access based on a showing that the ViaSat-2 downlinks at 17.7-17.8 GHz would not cause harmful interference into primary fixed service operations or neighboring BSS spacecraft. A corresponding waiver to allow the proposed earth stations to receive ViaSat-2 downlinks at 17.7-17.8 GHz would have no impact on the authorized RF environment. To the extent necessary, Viasat seeks a corresponding waiver to allow the proposed earth stations to receive signals from ViaSat-2 at 17.7-17.8 GHz. As a non-conforming user of this band segment, Viasat accepts the risk of interference from conforming spectrum uses.

In addition, to the extent necessary to authorize the operation of the proposed earth stations at 17.7-18.3 GHz without specifying their locations, Viasat seeks a waiver of Section 25.115(e) of the Commission's rules.¹⁸ Licensing multiple earth stations through a single authorization serves the public interest by reducing administrative costs and delays and by accelerating system deployment, and thereby facilitating the delivery of expanded services to end users. The Commission has previously issued licenses for GSO earth stations in segments of the Ka band other than those identified in Section 25.115(e) without specifying the locations of the earth stations in advance.¹⁹ Therefore, grant of this waiver request would be consistent with Commission precedent.

6. Control Point

The control point for all earth stations will be Viasat's network operations center (NOC) located at 349 Inverness Drive South, Englewood, Colorado 80112, and can be contacted 24/7 at (720) 493-7300. This single point of contact will have the capability of shutting down any of the earth stations operated within the network, which can occur through communications with the appropriate ViaSat-2 gateway.

7. Radiation Hazard Analysis

The radiation hazard analysis in Exhibit C covers both antenna models. As demonstrated by the results of the analysis, operation of the proposed terminals will not result in exceedance of the maximum permissible exposure limits (MPE) in an Occupational/Controlled Environment.

¹⁸ See 47 C.F.R. § 25.115(e).

¹⁹ See, e.g., Viasat, Inc., File No. SES-LIC-20170401-00357, Call Sign E170088 (granted Nov. 9, 2017) (authorizing large numbers of GSO earth stations at 17.7-18.3 GHz to communicate with ViaSat-2).