Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
ViaSat, Inc.	)	
	)	
Application for Authority to Operate Up to 4,000 Transmit/Receive Earth Stations Mounted on Aircraft in the Ka band	)	File No. SES-LIC-20120427-00404 Call Sign E120075
	)	
	)	

RESPONSE OF VIASAT, INC.

ViaSat, Inc. ("ViaSat") responds to the comments of Row 44, Inc. ("Row 44")[1] filed in in the above-captioned request of ViaSat for authority to operate Ka-band earth stations mounted on aircraft (the "Application").

I. INTRODUCTION AND SUMMARY

ViaSat seeks authority to operate 4,000 aeronautical earth stations ("AES") operating in the 18.3-19.3 GHz, 19.7-20.2 GHz, 28.35-29.1 GHz and 29.5-30.0 GHz portions of the Ka-band. The AES terminals will enable in-flight broadband Internet access at speeds of up to 12/3 Mbps to passengers and crew on aircraft of all sorts, including commercial jets. The first planned deployments of this service will be on JetBlue and United aircraft soon, after the Commission grants ViaSat's Application.

ViaSat proposes to operate these terminals largely within the operating environment that the Commission has established for the Ka-band, and coordinated some small deviations from that operating environment with potentially affected satellite networks. Because no designation for aeronautical mobile use of the Ka-band currently exists in the Commission's rules, ViaSat has requested any waivers of Commission rules that may be needed to use these terminals to extend broadband service to aircraft, starting early this year, and also has proposed

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[1] Comments of Row 44, Inc., File No. SES-LIC-20120427-00404, Call Sign E120075 (filed Jan. 11, 2013) ("Row 44 Comments").

to operate this network on a non-interference basis, consistent with longstanding Commission practice in similar circumstances.[2]

In its Comments, Row 44 argues that ViaSat's Application does not comply with the Commission's rules and that the Ka-band operating framework somehow does not apply to ViaSat's proposed operations.[3] Row 44 also makes a number of technical arguments about ViaSat's proposed operations and antenna design.

Significantly, ViaSat has coordinated its proposed AES network with all potentially affected satellite networks – including those GSO systems located across the entire range of the orbital arc that could potentially be affected. As the Commission found in granting Row 44 AES authority in a similar context, the consent of potentially affected satellite networks "resolves concerns regarding interference to existing satellite operators."[4] Moreover, ViaSat's proposed operations are consistent with the longstanding Ka-band operating environment that has served as the basis for the billions of dollars that Ka-band satellite operators have invested in dozens of satellite networks in operation in reliance on the interference environment established by Section 25.138 of the Commission's rules and by inter-system coordination.

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[2] *See* ViaSat, Inc. Application, File No. SES-LIC-20120427-00404, Exhibit A at 4 ("ViaSat Application"); ViaSat, Inc., Submission of *Ex Parte* Presentation; IBFS File Nos. SES-LIC-20120427-00404; SES-STA-20120815-00751, Call Sign E120075 (filed Dec. 10, 2012).

[3] Row 44's Comments repeat the same arguments that it has already made in the context of ViaSat's request for special temporary authority ("STA") to operate a small number of the proposed terminals in preliminary market trials—arguments that ViaSat firmly rebutted in that context. *See* Row 44 Petition to Deny, ViaSat, Inc., File No. SES-STA-20120815-00751, Call Sign E120075 (filed Sept. 5, 2012). Row 44 has also made (and ViaSat has firmly rebutted) these same arguments in an entirely unrelated proceeding involving an experimental license modification application filed by ViaSat. *See* Row 44 Petition to Deny or Dismiss, ViaSat, Inc. Application for Modification of Experimental License, Call Sign WF2XOQ, File No. 0197-EX-ML-2012 (filed Nov. 27, 2012).

ViaSat incorporates by reference its prior rebuttals to these arguments. *See* ViaSat, Inc., File No. SES-STA-20120815-00751; ViaSat Opposition to Row 44 Petition to Deny, File No. SES-STA-20120815-00751 (filed Sept. 14, 2012); ViaSat Response to Row 44 November 9, 2012 Submission, File No. SES-STA-20120815-00751 (filed Nov. 30, 2012).

[4] *Row 44, Inc.*, 24 FCC Rcd 10223 ¶ 25 (2009) ("*Row 44 AMSS Order*").

For these reasons, the coordination that ViaSat has effectuated will adequately protect all reasonable expectations regarding use of the Ka-band. ViaSat's state-of-the-art antenna design embodies the Commission's Ka-band policy of allowing tradeoffs in antenna performance to enable the deployment of new technologies while maintaining the interference environment on which all Ka-band networks rely. Moreover, that antenna design enables the deployment of broadband service to commercial aircraft at speeds of up to 12/3 Mbps, using a compact, low-profile device that reduces drag and thus reduces aircraft fuel usage. For these reasons, ViaSat urges the Commission to grant ViaSat's Application in an expeditious manner.

II. COORDINATION RESOLVES ANY INTERFERENCE CONCERNS

ViaSat successfully has coordinated the operation of its proposed AES network with all potentially affected satellite networks: O3b's NGSO Ka-band network, and the Ka-band GSO networks of Hughes Network Systems, SES, DIRECTV, Intelsat, EchoStar, Dish, Telesat, and Bell Canada. More specifically, ViaSat has coordinated its proposed operations with all Ka-band satellite networks that operate (or are expected within the next few years to operate) on a co-frequency and co-coverage basis with ViaSat's satellite points of communication (*i.e.,* ViaSat-1 at 115.1º W.L.; WildBlue-1 and Anik-F2 at 111.1º W.L.), and are located within +/-30º of those points of communication. The fact of successful coordination is evidenced by the letters that ViaSat has just placed into the record.[5]

Commission policy in this respect is crystal clear: coordination with potentially affected satellite networks obviates the need for the Commission to independently assess the risk of interference into those systems.[6] Indeed, the Commission's longstanding policy is to rely on the satellite network coordination process to facilitate efficient use of the limited spectrum resource, recognizing that satellite operators are sophisticated, understand the relevant

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[5] ViaSat, Inc., *Ex Parte* Submission of Supplemental Information, File No. SES-LIC-20120427-00404; SES-STA-20120815-00751, Call Sign E120075 (filed Jan. 24, 2013).

[6] *Row 44 AMSS Order* at ¶ 25 (Consent of potentially affected satellite networks "resolves concerns regarding interference to existing satellite operators.").

technology,[7] and understand any tradeoffs made in the course of coordination.[8] In fact, the satellite operators with which ViaSat has coordinated are the largest operators in the industry, and, in the aggregate, have invested many billions of dollars into hundreds of commercial satellites. Moreover, and as contemplated by Section 25.138, ViaSat will coordinate with any future satellite networks that could be affected by its AES network.[9]

Against this background, Row 44's arguments about theoretical interference concerns ring particularly hollow. First, Row 44 does not operate a Ka-band satellite network, does not operate a Ka-band earth station network, and has no clear plans to do either. And even if Row 44 were to operate a Ka-band earth station network,[10] Row 44 would be bound by the terms of the coordination agreement to which its satellite capacity provider had agreed.[11] In sum, particularly because all affected satellite networks have consented to the proposed AES operations, ViaSat has no legal obligation, as Row 44 mistakenly suggests, to prove a negative: that ViaSat "will not cause harmful interference to other spectrum users."[12]

III. THE INTERFERENCE ENVIRONMENT DEFINED BY THE KA-BAND RULES PROTECTS ALL USERS OF THE BAND

Section 25.138 of the Commission's rules defines the "default" operating parameters under which GSO FSS Ka-band satellite networks are deemed to be

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[7] *Id*. at ¶ 24 (finding that "potentially affected satellite operators are . . . capable of assessing the potential interference impact of proposed Ku-band AES operations" despite arguments that those operators "do not have sufficient knowledge and expertise to assess the technical issues involving new AES equipment").

[8] *See*, *e.g.*, *Satellite Network Earth Stations*, 20 FCC Rcd 5666 ¶ 51 (2005); *Fixed-Satellite Service (Recon. of 1988 Orbital Assignment Plan)*, 5 FCC Rcd 179 ¶ 32 (1990); *Orion Satellite*, 5 FCC Rcd 4937 ¶ 14 (1990); *GE American Communications*, 3 FCC Rcd 6871 ¶ 2 (1988); *see also SkyTerra Subsidiary*, 25 FCC Rcd 3043 ¶ 29-30 (2010) ("Reliance on satellite-operator coordination agreements is an important aspect of a longstanding Commission policy of reliance on marketplace mechanisms to develop solutions to interference concerns. . .").

[9] *See* 47 C.F.R. § 25.138(c).

[10] *See* Row 44 Comments at 2.

[11] *See*, *e.g.*, *Comsat Mobile Communications*, 16 FCC Rcd 21661 ¶ 115 (2001) (requiring earth station licensees to operate subject to the constraints of satellite network coordination).

[12] *See* Row 44 Comments at 4.

"precoordinated," and provides a coordination procedure for operations at levels that could exceed these default parameters.[13] Ka-band licensees operating at levels exceeding the default parameters bear the burden of coordinating with other affected Ka-band satellite networks—those in existence, and those that may be deployed in the future.[14] As detailed above, ViaSat has coordinated its proposed AES operations with all potentially affected Ka-band satellite networks, and has confirmed its willingness to coordinate with future satellite networks. The interference environment established by this legal framework has guided the development of the Ka-band in the United States for nearly 15 years,[15] including the launch of about 18 Ka-band satellites to serve the United States. Moreover, this legal framework is the basis on which each of the FSS satellite networks with which ViaSat has coordinated, and that is authorized to serve the United States, has been authorized by the Commission.

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[13] 47 C.F.R. § 25.138; *see also Redesignation of the 17.7-19.7 GHz Frequency Band*, First Report and Order, 15 FCC Rcd 13430 (2000) ("*18 GHz First Report and Order*").

In fact, the power-pattern tradeoff reflected in Section 25.138 provided the framework for a similar licensing approach that the Commission adopted for the Ku-band over *a decade after* the Ka-band framework was first conceived. *2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules*, Eighth Report and Order, 23 FCC Rcd 15099, 15108 (2008) ("[A]n off-axis EIRP approach for conventional C-band and Ku-band FSS earth stations would be consistent with our treatment of Ka-band FSS earth stations.") ("*Licensing Reform Eighth Report and Order*").

[14] 47 C.F.R. 25.138(c).

[15] *See, e.g., Redesignation of the 17.7-19.7 GHz Frequency Band*, Second Order on Reconsideration, 17 FCC Rcd 24248 ¶ 24 (2002) (Section 25.138 "will permit nearly ubiquitous deployment of services [in the Ka-band] without compromising the interference protection that other users in the band are entitled to receive."); *Redesignation of the 17.7-19.7 GHz Frequency Band*, NPRM, 13 FCC Rcd 19923, 19945-6 (1998) (Off-axis EIRP density threshold "ensure[s] that conforming satellite systems will not emit power at off-axis angles at levels high enough to cause unacceptable interference to adjacent satellites spaced at 2-degree intervals.") ("*18 GHz NPRM*"); *see also 18 GHz First Report and Order* at 13471 (adopting the recommendations of the Ka-band industry group, which included coordination procedures for operations exceeding the off-axis EIRP density thresholds); *Second Report of the GSO FSS Ka-band Blanket Licensing Industry Working Group*, IB Docket No. 98-172 (filed Sept. 27, 1999); *Report of the GSO Ka-Band Blanket Licensing Industry Working Group*, IB Docket No. 98-172, at 9 (filed Nov. 19, 1998) (noting the group's goal was to identify uplink off-axis EIRP spectral density limits that ensure "maximum design flexibility in areas that [would] not affect adjacent GSO satellite interference," thereby "accommodat[ing] various Ka-band system designs").

Despite the long history and established precedent, Row 44 argues that Section 25.138 and the coordination agreements ViaSat has reached are not relevant because the Ka-band is "at a relatively early stage of development,"[16] and because Section 25.138 applies only to the FSS, and not the MSS.[17] Row 44's claim about the technological stage of development of the Ka-band does not pass the "red face" test. With respect to the definition of "FSS" versus "MSS," it bears emphasis that each of the satellite networks at issue in this case, the networks that would provide capacity for ViaSat's AES network, as well as each of the satellites with which ViaSat has effectuated coordination, is authorized by the Commission to provide FSS. Moreover, for purposes of assessing the expected effect of ViaSat's AES network on other FSS networks, the only relevant factor is the level of energy generated in the direction of those networks—not whether it is generated by a fixed, transportable, or mobile terminal. And, again, the level of that energy is understood and accepted by all relevant Ka-band FSS satellite networks through coordination agreements.[18] Finally, in granting Row 44's AES authority, the Commission determined that no less weight should be placed on coordination when dealing with an "emerging" technology in the Ku-band.[19]

Moreover, the absence of a regulatory framework at the ITU for Ka-band AES systems has no bearing on this Application.[20] When the Commission began authorizing Ku-band

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[16] Row 44 Comments at 8 (arguing that coordination is insufficient to protect future satellite networks that may be launched into the "many potentially usable orbital locations" in the Ka-band).

[17] *Id.* at 4.

[18] ViaSat Application, Exhibit A at 6 ("While there are no rules for mobile operations in the Ka band, operating the proposed terminals consistent with the technical parameters of Section 25.138 would ensure compatibility with satellite systems operating in the Ka band.").

[19] *Row 44 AMSS Order* at ¶ 24.

[20] *See* Row 44 Comments at 4, 8. The CEPT has finalized its work to develop a licensing framework for earth stations on mobile platforms, including AES terminals, to operate on Ka-band FSS networks as an application of the FSS. ECC Decision (13)01 is expected to be formally approved in March 2013.

AES terminals, no relevant ITU framework existed.[21] Likewise, no Commission service rules for Ku-band AES terminals existed when the Commission authorized thousands of Ku-band AES terminals to at least five licensees, including Row 44 itself.[22]

IV. VIASAT'S ANTENNA DESIGN AND PROPOSED OPERATIONS ARE CONSISTENT WITH THE COMMISSION'S RULES AND POLICIES

As detailed above, because ViaSat has coordinated with all potentially affected satellite networks, Commission precedent is clear that "[t]his resolves concerns regarding interference to existing satellite operators."[23] That coordination obviates the need to address Row 44's technical arguments about the potential off-axis EIRP density levels from, and the potential for mispointing of, ViaSat's AES terminals.[24] Nevertheless, ViaSat provides the technical response included as Attachment 1 ("ViaSat Technical Response"), to correct the record with respect to certain inaccurate technical statements in Row 44's Comments.

In discussing the extent to which the AES operations could (in certain cases) exceed the default Section 25.138 off-axis EIRP density levels, Row 44 conflates the instances in which an AES antenna would appear skewed in relation to the GSO arc, with the geographic areas in which the operations of an AES theoretically could affect a particular GSO satellite.[25] In doing so, Row 44 grossly overstates the geographic area where AES operations are even theoretically relevant to any GSO satellite. Notably, a GSO spacecraft will only be impacted if a "grating lobe" from an individual AES "lands" on the spacecraft because of a specific amount of

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[21] *See The Boeing Company*, 16 FCC Rcd 22645 ¶ 10 (2001) (granting authority to operate aeronautical earth stations in the FSS Ku-band before the secondary AMSS allocation in that band ultimately was added in the ITU 2003 World Radiocommunication Conference ("WRC-03")) ("*Boeing AMSS Order*"); *see also Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations*, 20 FCC Rcd 2906 ¶ 2 (2005).

[22] *See Panasonic Avionics*, 26 FCC Rcd 12557 (2011); *Row 44 AMSS Order*; *ViaSat*, 22 FCC Rcd 19964 (2007); *ARINC*, 20 FCC Rcd 7553 (2005); *Boeing AMSS Order*.

[23] *Row 44 AMSS Order* at ¶ 25.

[24] *Id.* at ¶¶ 19, 22 (declining to address arguments concerning antenna mispointing, because coordination was achieved with operators); *see also id.* at ¶¶ 24, 25 (declining to address arguments concerning the level of off-axis EIRP into adjacent spacecraft because potentially affected satellite operators had consented). *Cf.* Row 44 Comments at 9.

[25] Row 44 Comments at 9, Technical Appendix at 4.

skew (caused by the geographic location of the AES and/or aircraft banking). Because the locations of these grating lobes are known with certainty, only a finite and limited number of orbital locations exist at which the grating lobes could fall. Moreover, for any such orbital location, the AES must be located within very limited geographic areas where that "intersection" with that particular GSO satellite can occur. In any event, ViaSat's quantitative analysis of the thermal noise impact, even under the worst-case conditions, for any such satellites showed that the impact would be negligible and served as the basis for successful coordination.

Row 44's claim that ViaSat's AES design is "fundamentally inconsistent with typical engineering practice"[26] is factually baseless.[27] ViaSat has a long history and extensive experience developing reliable antenna technology for mobile applications, including aeronautical applications. Row 44's argument also ignores longstanding Commission policy to allow earth station licensees the flexibility to make tradeoffs in antenna performance necessary to enable the deployment of new technologies.[28] The highly innovative design of the ViaSat AES antenna reflects these very tradeoffs, and the antenna control unit in fact is based on the same proven technology used in ViaSat's Ku-band mobile systems. The arrangement of the feed horns in the antenna array incorporates state-of-the-art antenna engineering and allows efficient spectrum use in a compact, low-profile antenna construction, which reduces drag, thereby reducing aircraft fuel costs.

Moreover, Row 44 speculates that ViaSat will be unable to replicate a mass-produced antenna that complies with the terms of ViaSat's Commission authorization for this AES network. As an initial matter, as a longstanding Commission licensee, ViaSat takes its licensing obligations seriously and will ensure that its operation of AES antennas will comply with the relevant terms of its license. In addition, as a well-regarded manufacturer and operator

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[26] Row 44 Comments at 8, Technical Appendix at 8, 11.

[27] As detailed in the attached ViaSat Technical Response, at 2-3, Row 44's pointing error "projections" are based on faulty statistical analyses.

[28] *See, e.g.*, *18 GHz NPRM* at 19946 (off-axis EIRP envelope affords earth station operators system design flexibility).

of blanket licensed earth stations, ViaSat has demonstrated its ability to control the quality and uniformity of such mass-produced terminals.

In any event, the performance of the radiating aperture of ViaSat's proposed antenna (including the grating lobes) is dictated by a single grid plate containing each of the individual waveguide openings and a single horn plate, each of which are precision machined. The simplicity of this two-piece construction ensures the uniform placement of the horns on each antenna and ensures that neither vibrations in flight nor aging of the antenna will change the location and arrangement of the horns. Further, ViaSat conducts RF testing of all completed antenna assemblies.[29] The manufacturing process for the proposed aeronautical antenna will be as rigorous as it has been for the other mass-produced Ka-band terminals that ViaSat has produced. In short, ViaSat's stringent quality control mechanisms have ensured, and will continue to ensure, the consistency of the proposed antennas.

Finally, ViaSat has certified in its Application that it will comply with the -118 dBW/m2/MHz downlink power flux density ("pfd") levels specified in the authorizations of the satellite points of communication,[30] and ViaSat is not aware of any proposal before the Commission to modify the authorizations for those satellite points of communication to increase the permissible level of downlink pfd. Still, Row 44 suggests that ViaSat's downlink operations will not comply with the -118 dBW/m2/MHz pfd level.[31] Again, ViaSat has no obligation to prove a negative—that it will not exceed the maximum downlink pfd level authorized to be emitted by the satellites whose capacity it would utilize. In any event, Row 44's arguments do not bear scrutiny: the attenuation of the satellite downlink signal from the aircraft fuselage could

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[29] Additional details regarding the design and construction of ViaSat's AES antenna are provided in the ViaSat Technical Response at 3.

[30] ViaSat Application, Exhibit A at 4. The FCC Form 312 includes a certification that all statements made in the application, including in attached exhibits are "true, complete and correct to the best of [the signatory's] knowledge and belief, and are made in good faith." *See* ViaSat Application, FCC Form 312 at 10.

[31] Row 44 Comments at 11.

not possibly magnify or increase the level of the satellite downlink in any way.[32] Moreover, the satellite downlinks will operate in the same manner regardless of whether the receiving terminals are fixed or mobile.

V. CONCLUSION

ViaSat has coordinated its proposed AES operations with all potentially affected satellite systems, which resolves all interference concerns raised by Row 44. Furthermore, ViaSat's proposed operations are consistent with the interference environment established by the Ka-band framework established in the Commission's rules, ensuring that other satellite operations will be adequately protected. Row 44's technical arguments, which in any event are obviated by coordination, are based on inaccurate assumptions about the construction of ViaSat's antennas and erroneous statistical claims. ViaSat's antenna design entirely is consistent with the Commission's rules and policies, and ViaSat's proposed AES operations will fully comply with the terms of its AES license. For the foregoing reasons, ViaSat respectfully requests that the Commission expeditiously grant ViaSat's Application in order to facilitate the deployment of high-speed mobile broadband services on aircraft to meet growing consumer demand for ubiquitous connectivity.

Respectfully submitted,

/s/

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January 24, 2013

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[32] *Cf.* Row 44 Comments, Technical Appendix at 11.

ATTACHMENT 1
ViaSat, Inc. Technical Response to Row 44 Technical Appendix

The range over which grating lobes could potentially impact a satellite network is limited.

The grating lobes of ViaSat's Mantarray aeronautical earth station ("AES") antenna and their potential impact on other satellite networks are much more limited than Row 44 describes, and in any event, have been fully coordinated with all potentially impacted satellite operators.

Row 44 in Figure 3 of its Technical Appendix depicts the geographic areas in which it believes the operation of aircraft with ViaSat AESs can generate interference into other Ka band GSO satellite networks. Row 44's assumption that any exceedance of the 25.138 mask at any off-axis angle will result in interference is not correct.

The lobes exceeding the Section 25.138 off-axis EIRP spectral density limits are discrete and would intersect the GSO arc only when the aircraft is skewed with respect to the GSO at specific angles as a result of geographic location or aircraft attitude, or a combination of the two. In the vast majority of the orbital locations along the GSO arc, the grating lobes would never intersect with that location under any conditions. For the few locations at which a grating lobe under certain conditions could radiate toward another satellite, ViaSat calculated the ΔT/T assuming the worst-case power density levels of the grating lobes and the worst-case antenna pointing and geographic skew conditions.

The plot shown in Figure 1 of Row 44's Technical Appendix represents the highest on-axis EIRP density level (*i.e.*, highest power, lowest symbol rate operations) at which the Mantarray antenna will operate. As seen from this plot (generated using measured antenna pattern cuts), the EIRP density of the grating lobes is 30 dB lower than the main lobe. While the magnitude and position of the grating lobes do vary with frequency, across the entire 28.35 – 30 GHz frequency range the worst case grating lobe is 26 dB down from the main lobe. Therefore, Row 44's assertion that the grating lobes ". . . may even rival the level of the antenna's main lobe itself" is incorrect. *See* Row 44 Technical Appendix at 8.

Despite ViaSat's having provided this information about the nominal level of the grating lobes, Row 44 provides no quantitative analysis to back up its claim that the EIRP density of the grating lobes could rival the antenna's main lobe.

Moreover, Row 44 provides no quantitative analysis of what it believes to be the ΔT/T impact to the various satellites located over the range depicted in Figure 3 of Row 44's Technical Appendix for the given AES locations. In fact, Row 44 vastly overstates the potential impact.

ViaSat has had direct discussions with the satellite operators and provided each with a detailed interference analysis based on actual satellite receiver performance. This ΔT/T analysis assumed the maximum possible operational EIRP density of the worst-case grating lobe that potentially could land directly on the satellite in question. In all cases, the resulting ΔT/T impact was negligible.

In addition, as the AES must be operating at specific locations in order for energy from the sidelobes and grating lobes to fall in the vicinity of a victim satellite, ViaSat developed a detailed geospatial model that considers among other things, the actual antenna pattern, the AES location, the target satellite, and the victim satellite. The output of this model was shared with satellite operators during discussions and depicts the areas in which an AES must operate to cause a given rise over thermal noise ($\Delta T/T$) level. In many cases the aircraft must be operating outside the service coverage area in order to produce a meaningful increase in noise. However, as that theoretically could occur only outside the coverage area of the service satellite, no potential for interference actually exists because the transmitter would be disabled in those instances.

Row 44's pointing error projections rely on incorrect statistical analyses.

ViaSat actively monitors both azimuth and elevation pointing errors and will inhibit transmissions when the declared pointing error limit is exceeded on either axis independently of the other. ViaSat has a long history of making antennas for dynamic antenna pointing applications, including mobile platforms. The antenna control unit ("ACU") that ViaSat will use in this case is based on the same technology used in ViaSat's existing Ku band mobile systems and will ensure compliance with the antenna pointing accuracy limits stated in ViaSat's application.

Row 44 presents what purports to be a formula to project the pointing error along the GSO. Row 44 uses this formula to produce the table on page 6 of its Technical Appendix and claims that the results in the table represent the 1-sigma or 3-sigma likelihood of the maximum pointing angle for the indicated skew angle. Row 44's application of the formula and presentation of the data in the table are wrong in two ways.

First, the joint probability of two 1-sigma or two 3-sigma events is not itself a 1-sigma or 3-sigma event.

The joint probability of two independent 3-sigma events is given as follows:

$$P(az = 3\text{-sigma} \cap el = 3\text{-sigma}) = (1 - 99.73) \times (1 - 99.73)$$

$$0.0027 \times 0.0027 = 7.29 \times 10^{-6} \approx 4.5 \text{ sigma, or } 7.3 \times 10^{-8}\%$$

Thus the azimuth error and the elevation error both reach a 3-sigma value simultaneously only 0.000000073% of the time – if they are independent events. However, they are not completely independent.

In the case of the Mantarray antenna, the azimuth and elevation errors are actually inversely correlated to a degree in that the worst case azimuth and elevation error each actually occur when the other axis is least likely to experience significant error. This inverse correlation is a function of the elevation angles at which the peak velocities for azimuth and elevation occur. Specifically, azimuth pointing errors have the greatest chance of occurring when the AES is pointing at high elevation angles (*e.g.*, near the equator), and elevation pointing errors have the greatest chance of occurring when the AES is pointing at low elevation angles (*e.g.*, operating at higher latitudes). This reduces the actual likelihood of a simultaneous dual axis 3-sigma event even more.

Second, while Row 44 includes the ± sign for the azimuth and elevation error in its table, Row 44 only includes the results for cases where both axes have the same error sign, *i.e.* both positive, or, both negative values. This characterization of the error scenario for the maximum pointing error across GSO as a 1 or 3-sigma event is wrong. In fact, because half of the time the azimuth or elevation error will have a negative sign, the probability of dual axis 3-sigma events along the GSO would more correctly be:

$$(0.5 \times 0.0027) \times (0.5 \times 0.0027) = 1.28 \times 10^{-6} \approx 4.9 \text{ sigma or } 1.28 \times 10^{-8}\%$$

That is, only 0.0000000128% of the time would both antenna axis experience simultaneous 3-sigma error events where the error direction is additive.

In any case, the pointing error performance of the Mantarray has been disclosed and coordinated with other potentially affected satellite networks.

Row 44 mischaracterizes ViaSat's antenna design and manufacturing process.

In describing alleged deficiencies in ViaSat's antenna construction, Row 44 makes incorrect assumptions about the Mantarray antenna's design and assembly. Row 44 claims that manufacturing tolerances will not be precise enough to produce horn spacings that are uniform or repeatable, and thus, the grating lobe pattern will vary among units. Row 44 also claims that the effects of aging and varying environmental conditions could change the antenna performance.

The Mantarray antenna design is composed of three parts: 1) a thin uniform fiber reinforced dielectric window or aperture closeout for environmental protection, 2) a single grid plate with a number of waveguide openings or apertures that is a multiple of the number of horns, and 3) a single horn plate with a number of individual waveguide openings or apertures. Items 2 and 3 control the grating lobe characteristics by careful layout and choice of the interleaving of horn and grid openings.

The grid plate and horn plate are precision milled from single pieces of aircraft grade (6061-T6) aluminum stock to very high tolerances in a temperature controlled environment. Finished parts are 100% dimensionally inspected using a state-of-the-art computer controlled coordinate measuring machine. Locating pin features are used to insure proper mating between the grid and horn plates and the two components are bonded into a single assembly in a temperature controlled environment using the precise machine locating features. Finally, each unit is 100% RF tested in a state-of-the-art antenna measurement facility during production prior to integration with the positioner, and no antenna will be deployed that does not meet its performance requirements regarding grating lobes.

These manufacturing and testing processes ensure the uniformity and repeatability of antenna construction. In addition, the performance of the Mantarray antenna is not expected to change over time or due to environmental effects, because of the precision openings in a single element that form the antenna horns and because of the simplicity of the assembly.

DECLARATION

I, Daryl T. Hunter, hereby make the following declarations under penalty of perjury. I understand that this Declaration will be submitted to the Federal Communications Commission.

1. I am Director, Regulatory Affairs of ViaSat, Inc.

2. I have reviewed the forgoing Response of ViaSat, Inc.

3. I certify that the facts set forth in the foregoing Response of ViaSat, Inc. are true and correct to the best of my knowledge.

Daryl T Hunter

Daryl T. Hunter

Executed January 24, 2013

CERTIFICATE OF SERVICE

I, Amanda E. Potter, hereby certify that on this 24th day of January, 2013, I served a true copy of the foregoing Response of ViaSat, Inc. via first-class mail upon the following:

David S. Keir
Lerman Senter PLLC
2000 K Street, NW, Suite 600
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/s/
Amanda E. Potter