BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

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

To: Chief, Satellite Division
International Bureau

REPLY COMMENTS OF ROW 44, INC.

Row 44, Inc. ("Row 44"), by counsel and pursuant to Section 25.154 of the Commission's Rules (47 C.F.R. § 25.154), hereby replies to the ViaSat, Inc. ("ViaSat") response filed on January 24, 2013 concerning Row 44's initial comments in the above-captioned application proceeding.[1] Although ViaSat has submitted some additional technical and interference coordination documentation in response to Row 44's comments, its showing remains incomplete, failing to demonstrate that the requested authority would provide new service consistent with the public interest, without causing harmful interference. Rather than illuminating the issues in a manner that would facilitate the expedited action it requests, ViaSat's response obscures the real questions that remain concerning its novel proposal.

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[1] *See* Response of ViaSat, Inc., FCC File No. SES-LIC-20120427-00404 (filed January 24, 2013) ("ViaSat Response").

I. ViaSat's Coordination Showing Does Not Comply with Commission Rules and Established Practices.

ViaSat's principal responsive claim is that because it has now submitted a number of letters from satellite operators stating generally that ViaSat's operations "have been coordinated" with their own satellite networks, any interference concerns must be deemed resolved.[2] ViaSat asserts that the existence of these letters "obviates the need for the Commission to independently assess the risk of interference into those systems."[3] Submission of these letters, however, does not eliminate the need for the Commission to assess compliance with its rules and policies governing coordination showings, and the coordination letters that ViaSat has provided fall short of meeting the established standard.

It has been established both through past practice, as well as the specific requirements that the Commission has recently adopted for Ku-band Earth Stations Aboard Aircraft, that a proposed mobile earth station network must provide certifications from each target satellite operator "that the proposed non-conforming earth station operation is consistent with all existing coordination agreements with other satellite operators and that such operation will be addressed in future coordinations."[4] The documentation that ViaSat has provided in support of its application is voluminous, yet is largely non-responsive with respect to these specific requirements. Theoretically, ViaSat could have produced the required coordination certifications

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[2] *See* Letter from John P. Janka and Elizabeth R. Park, Counsel to ViaSat, to Marlene H. Dortch, ViaSat Response at 3-4.

[3] ViaSat Response at 3. *See also* ViaSat Response at 7.

[4] *Row 44, Inc.* 24 FCC Rcd 10223, 10231 (¶ 18) (IB/OET 2009); *Revisions of Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands*, FCC 12-161, *slip op.*, Appendix C, Final Rules, at 81 (New Rule 47 C.F.R. § 25.227(b)(2)) ("*ESAA R&O and NPRM*").

in its initial application and reasonably relied on certifications from just the target satellite operators, which include ViaSat itself, its WildBlue subsidiary, and Telesat.[5] Yet even now, after months of delay, it has still failed to produce coordination letters that squarely comply with the straightforward regulatory requirements. For example, the certification provided by Telesat consists mostly of a very general description of the proposed operation, and states only at the end that "ViaSat's operations have been coordinated with the Telesat satellite networks."[6] Notably, although the ANIK-F2 Ka-band satellite at 111.1 W.L. is one of the three points of communication requested by ViaSat, there are no representations by Telesat that the ViaSat operations would be consistent with all existing coordination agreements with all adjacent satellite systems within 6° of orbital separation or, more significantly, that it would include the power-density levels specified by ViaSat in all of its future coordination agreements. Accordingly, the certification is incomplete.

This omission is troubling because, as Row 44 has emphasized from the beginning of this proceeding, one of its principal concerns – given the relatively early stage of development of the Ka-band orbital arc, and particularly in the development of ancillary mobile-satellite services – is that ViaSat's operations could have a long-term detrimental impact upon the advancement and

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[5] Prior to its January 24th Supplement, ViaSat was inexplicably resistant to providing any operator certifications, some of which were clearly available to it as early as October 2012. *Compare* ViaSat Opposition to Petition to Deny of Row 44, Inc., FCC File No. SES-STA-20120815-00751, at 4-6 (filed September 14, 2012) and ViaSat January 24th Supplement, Exhibit 1 (Engineering Certification of DirecTV, dated October 12, 2012 and Engineering Certification from Intelsat, dated October 8, 2012). As Row 44 previously noted, early Ku-band mobile satellite applicants were required to submit counter-signed coordination letters evidencing the agreement of each of the affected operators. *See* Row 44 Comments at 7, *citing., e.g.*, *ViaSat, Inc.*, 22 FCC Rcd 19964, 19969 (¶ 15) & n.31 (IB/OET 2007).

[6] ViaSat January 24th Supplement, Exhibit 1, Letter from Elisabeth Neasmith, Manager ITU and Coordination, Office of CTO, Telesat, to International Bureau, FCC, dated December 18, 2012.

implementation of future space and earth station network proposals. Operators who might propose to operate geostationary or non-geostationary satellite systems or ground-based transmit/receive facilities using orbital and spectrum resources that are not currently assigned should not be ignored. The specific certification regarding future coordination is especially important in the context of Ka-band services, where significant swaths of orbital real estate have not yet been brought into use.[7] The core portion of the orbital arc placed at issue by ViaSat's Mantarray antenna extends from 85° W.L. to 71° W.L., but most of the Ka-band satellite operators providing supporting letters have satellites that lie outside of this portion of the arc.[8] There are within this range many unoccupied orbital locations that potentially would be adversely affected by the grating lobes exhibited by ViaSat's antenna.

II. ViaSat's Technical Response Omits Key Details and Understates the Potential Interference Impact of Its Antenna's Grating Lobes

ViaSat's response to Row 44's technical showing also does not address fully the legitimate concerns raised, and therefore fails to demonstrate conclusively that a system made up of up to 4,000 Mantarray antennas will not adversely impact the Ka-band interference environment. Instead of offering a definitive showing, ViaSat's answers are carefully qualified.

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[7] Although ViaSat has submitted coordination acknowledgements from many satellite network operators, its submissions do not constitute an exhaustive compendium of consents even from current industry participants that may have long term interest in developing new Ka-band capacity, let alone represent the interests of future technology developers. For example, Inmarsat plc is poised to launch three high capacity Ka-band satellites over the next two years under the Inmarsat Global Xpress banner. While these spacecraft are not expected to be operated at orbital locations within the coordination zone for the current ViaSat proposal, Inmarsat is a potential future applicant for untapped Ka-band resources that could be placed at risk by ViaSat's inefficient approach to spectrum use.

[8] Those satellites that fall within the affected range are AMC-16 at 85° W.L., the Bell Canada satellite at 82° W.L. and Hughes authorized satellite at 77.3° W.L.

For example, despite its statement that "the interference environment defined by the Ka-band rules protects all users of the band," it can only manage to avow that it would operate its antennas "largely within" this operating environment with "some small deviations."[9] It maintains that it is justified in making significant "tradeoffs in antenna performance" because these compromises allow a "low profile device that reduces drag and thus reduces aircraft fuel usage."[10] The paramount consideration in antenna design and production, however, should not be airline fuel economy, but the avoidance of harmful interference to other spectrum users. As Row 44 has demonstrated in its Comments, and as further amplified in the attached Technical Appendix, ViaSat has underestimated the impact that an antenna designed to produce grating lobes will have in this environment.

The Mantarray antenna's unique horn spacing is specifically intended to eliminate anomalous antenna lobes at zero degree antenna skew. The fact that grating lobes nonetheless occur when the Mantarray antenna is operating free of any skew casts substantial doubt on ViaSat's claims that the antenna design is sound, and that repeatability of performance can be achieved in large-scale manufacturing. The excessive grating lobes exhibited could be prevented by reducing the horns to a width of lambda-c, consistent with industry-standard antenna design practices. The ameliorative impact of this design correction would be even greater as higher levels of antenna skew.[11]

ViaSat also argues that the potential for mispointing occurs only when both azimuth and elevation error are outside of three-sigma limits, and that the variable impact of these errors is

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9 ViaSat Response at 1.

10 ViaSat Response at 3.

11 *See* Technical Appendix, attached hereto, at 1-2.

such that a substantial variance along one axis is unlikely to occur simultaneously with a substantial variation along the other axis. This assertion is an over-simplification. As shown in the attached Technical Appendix, the probability of both independent variables exceeding a 3-sigma variance is substantially higher than ViaSat's predictive methodology suggests, with the result that harmful-interference-causing events are much more likely to occur at higher skew angles than ViaSat admits in its technical demonstration.[12] ViaSat simply rejects Row 44's correction of its flawed assumption that calculations premised solely on azimuth or elevation error are sufficient to characterize the full impact of antenna mispointing. In fact, pointing errors that would exceed the 0.5 degree limit would occur for both azimuth and elevation pointing error values well below 3-sigma, and therefore would be present a far greater portion of the time than ViaSat's predictive methodology suggests. ViaSat's method of calculating and mitigating pointing error thus substantially understates the likelihood of harmful interference to adjacent satellite networks.

III. <u>Conclusion</u>

For all of the foregoing reasons, Row 44 respectfully urges the Bureau to consider the ViaSat Application carefully, particularly the potential impact of the ViaSat technical proposal upon the future development of Ka-band services. Before the Commission takes any further action on the application, ViaSat should be required to supplement its showing with additional

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[12] *See* Technical Appendix, attached hereto, at 3-6.

information sufficient to address the continuing deficiencies outlined herein and in Row 44's initial Comments.

Respectfully submitted,

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February 5, 2013

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Technical Appendix

ViaSat's Mantarray Antenna Does Not Reflect "State-of-the-Art" Design

In its response, ViaSat devotes considerable discussion to defending the Mantarray Antenna's design and manufacturing repeatability. However, the content of ViaSat's Application itself contradicts its claims.

Figure 1, below, extracted from ViaSat's Application, plots the EIRP Density for zero degree antenna skew. The plot shows the first-order grating lobes at approximately +/- 32 degrees from center. As Row 44 stated in its Comments, the Mantarray antenna's unique horn spacing is specifically established for the purposes of eliminating grating lobes in the 0 degree skew plot. The very existence of such lobes in the plot casts doubt upon ViaSat's claims as to the antenna's design and repeatability of performance in large-scale manufacturing. If the antenna possessed the integrity claimed by ViaSat, there would be no, or very low-level, grating lobes present. As it is, the plotted grating lobes are of a magnitude that violates the Section 25.138 EIRP mask. *See* 47 C.F.R. §25.138. Considering this extensive deviation between intended design and actual performance, no conclusion can be made that ViaSat's antenna will achieve the claimed satisfactory performance.

The Commission must also keep in mind that, as Row 44 has previously indicated, the excessive grating lobe-levels of the Mantarray antenna are preventable by reducing the horns to a width of lambda-c, vs. the Mantarray's value of 2*lambda-c. The inferior performance of the Mantarray Antenna is therefore neither a function of the laws of physics nor consistent with state-of-the-art design,

In addition, the impact of the grating lobes at zero degrees skew is substantially less than at higher skew values. The second plot below (Figure 2), also extracted from ViaSat's application, shows grating level exceedances at 25° skew, and also shows the substantial asymmetric nature (~15 dB) of the Mantarray antenna grating lobes. Also, grating lobe level variations of ~7 dB exist, for example, between ViaSat's LHCP EIRP spectral density plots at 28.35 GHZ and 30 GHz. These types of deficiencies originate from the limitations of the Mantarray Antenna design. For example, in practice, the power dividers in the antenna's feed network will introduce a (frequency-dependent) phase shift between the signals in two (or more) arms. These phase shifts are very sensitive to manufacturing tolerances and, indeed, cause the significant asymmetries observed between the left and right sections of the plots.

In summary, unavoidable fabrication tolerances will lead to variations in the antenna patterns of different production units. The grating lobe fluctuations with significant phase errors indicate that repeatability cannot be ensured and that the performance of the measured antenna will degrade over time due to environmental effects.

Figure 1:

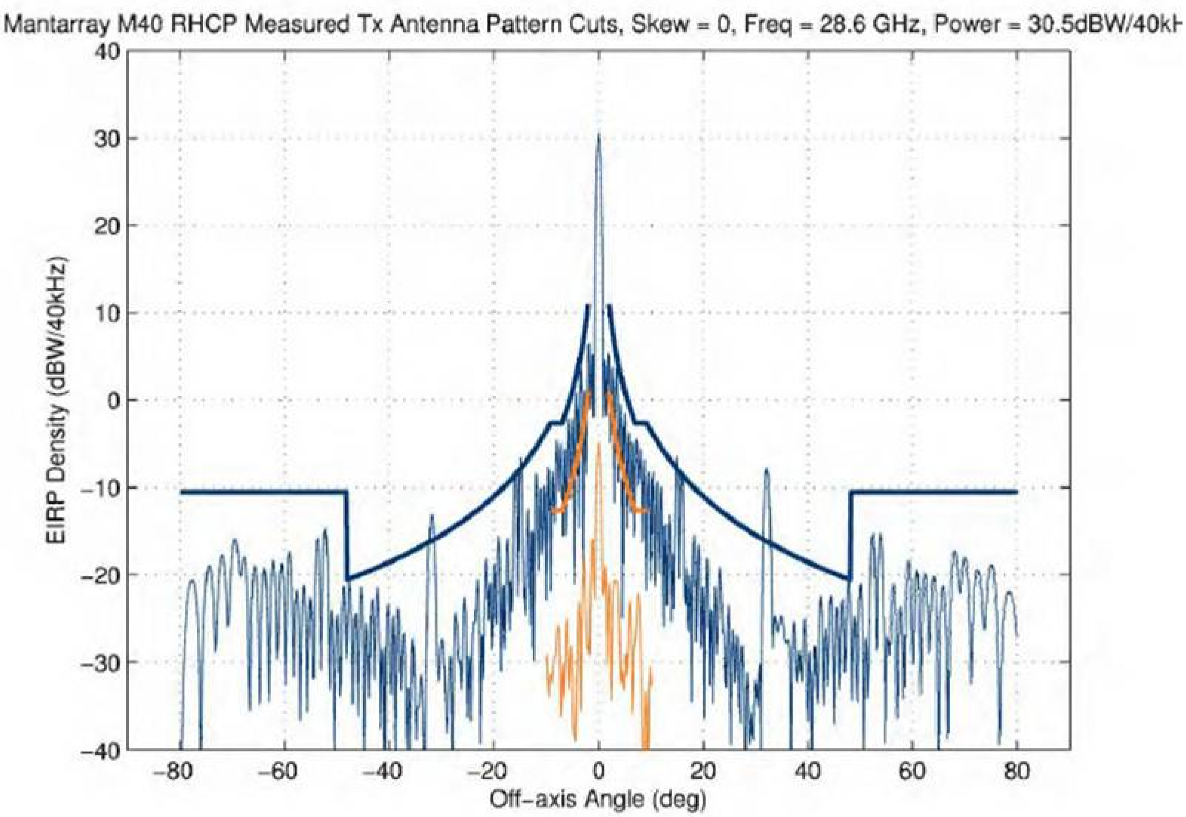
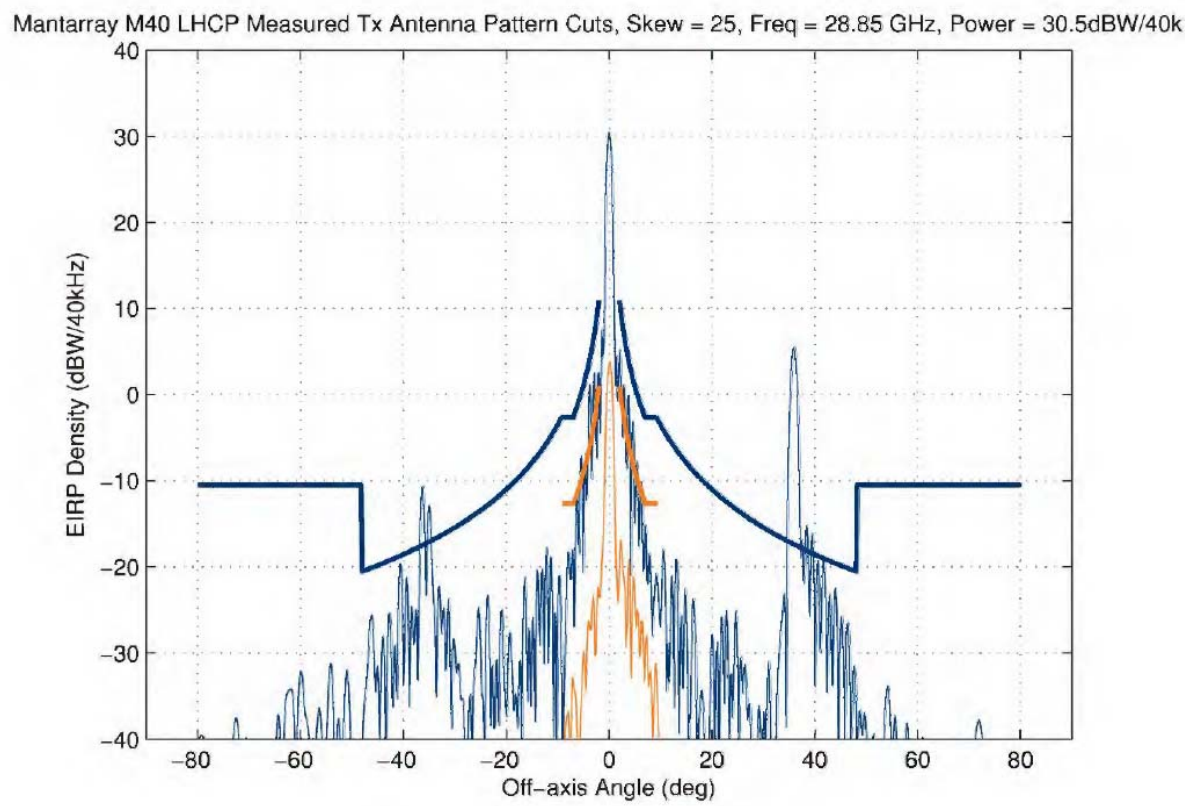


Figure 2:



<u>Pointing Error</u>

ViaSat misses the point of Row 44's argument relating to pointing error. ViaSat implies that the potential of mispointing occurs only when both the azimuth and elevation error are both outside of the three-sigma limit, and states that a value of 7.8 e-8 percent corresponds to the likelihood of such mispointing. To make matters worse, ViaSat's calculation is erroneous.

The probability of a Gaussian variable being within 3-sigma is a ratio of 0.9973. The probability of two such independent variables <u>exceeding</u> 3-sigma is (1-0.9973)*(1-0.9973), or a factor 7.3e-6, which, multiplied by 100, yields a probability of 7.3**e-4** percent, not the 7.3e-8 percent ViaSat claims.

ViaSat also does not accept the significance of Row 44's tabular listing of maximum GSO arc pointing error values, and ignores Row 44's correction of ViaSat's flawed assumption that calculations based only on azimuth or elevation errors are sufficient to characterize mispointing. If ViaSat employed the appropriate analysis, it would show that a violation of the 0.5 degree limit will occur for azimuth and elevation pointing error values well below 3-sigma.

Further, in an effort to deflect legitimate concern regarding its antenna's design, ViaSat engages in a qualitative discussion suggesting a variable, inter-dependent relationship between the Mantarray antenna's elevation and azimuth pointing errors, where substantial variances along one axis are less prone to occur simultaneously with substantial variances along the other axis. However, ViaSat includes no quantitative information defining the conditions and extent under which such trade-off effects would occur, nor any diagrams depicting the basis for its claims.

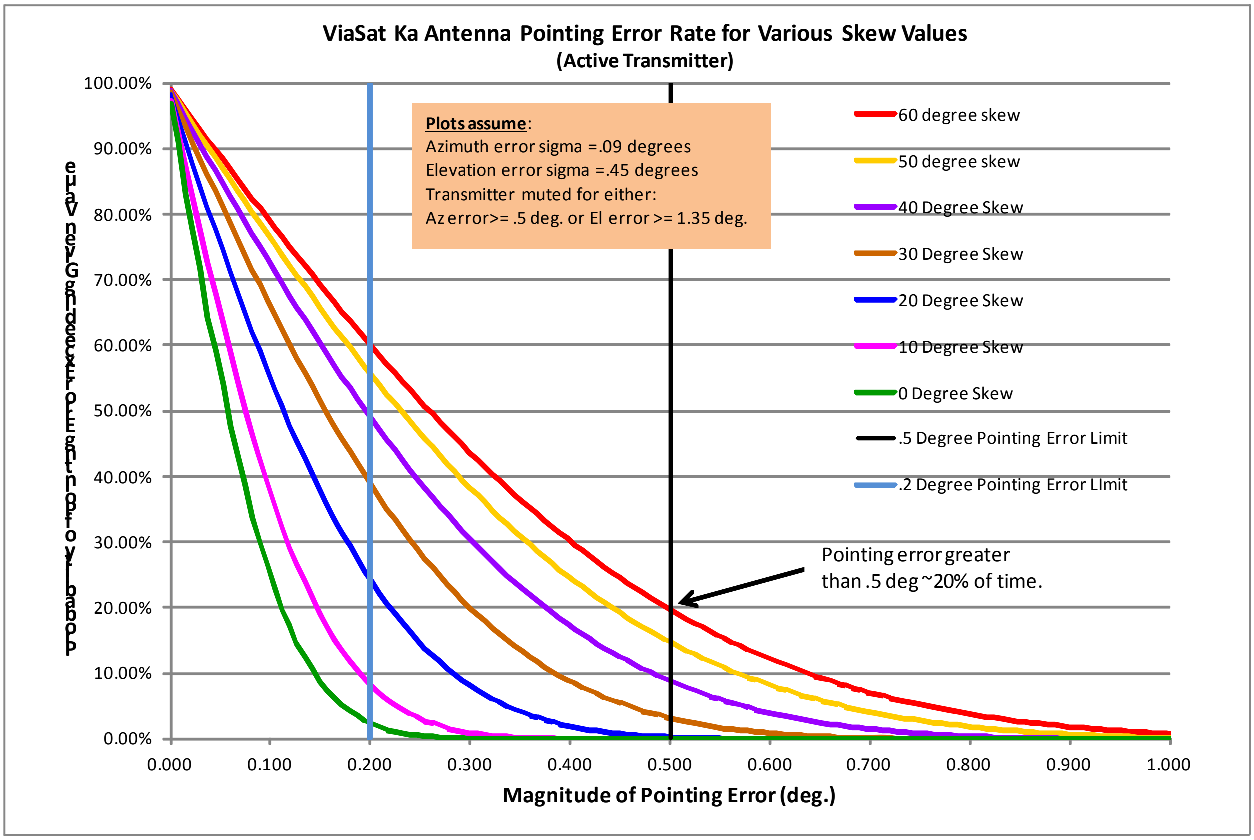
Row 44 has performed additional analysis clarifying the significance of the mispointing calculations provided in its initial Comments, and submits the plot below to demonstrate the likelihood that ViaSat's design and implementation will violate mispointing standards. The method of calculating pointing error must, in contrast to ViaSat's method, consider both azimuth and elevation pointing errors and skew angle. The equation is as follows:

PointErrorAlongGSO = AzPointError*Cos(SkewAngle) + ElPointError*Sin(SkewAngle)

Using this equation, Row 44 analyzed ViaSat's pointing error assuming Gaussian-distributed values of azimuth and elevation error, using ViaSat's stated sigma of .09 and .45 degrees, respectively. Row 44's analysis broke down the range of azimuth and elevation errors into two hundred (200) discrete values each, and calculated the statistical influence of each potential combination of azimuth and elevation error. Using this discrete approach, Row 44 removed the influence of instances where <u>either</u> the elevation error exceeded 1.35 degrees or the azimuth error exceeded 0.5 degrees. (That is, Row 44's total 'count' of the statistics of instances where the pointing error exceeds a given value did not include the 'count' of statistics of instances where the pointing error exceeded the same, but where ViaSat would disable its transmitter). Therefore, each trace in the plot below (Figure 3) represents the total time that the pointing error will exceed a given value while ViaSat's transmitter is active, compared to the total time that ViaSat's system is operating with either an active or inactive transmitter.

This analysis was performed for skew values between 0 and 60 degrees (i.e., the functional range claimed by ViaSat). The black vertical trace denotes the 0.5 degree pointing error limit. As another reference, the light-blue vertical trace denotes the 0.2 degree pointing error limit.

Figure 3:



The plots portray the troubling nature of ViaSat's approach, as the pointing error frequently exceeds 0.5 degrees. At 30 degrees skew, the brown trace indicates that the GSO arc pointing error will exceed 0.5 degrees ~3.5% of the time. For 40 degrees (purple), ~9% of the time. For 50 degrees (yellow), ~15% of the time. For 60 degrees skew (red), the .5 degree limit will be exceeded nearly ~20% of the time.

From another perspective, using Viasat's 0.09 azimuth pointing error and a 0.45 elevation pointing error values, the probability that 0.5^0 pointing error is exceeded can be computed from a normal distribution with zero mean and a standard deviation determined for a specified skew angle. The standard deviation is computed from

$$\sigma_{GSO}(\alpha) = \sqrt{\cos^2(\alpha)\sigma_{AZ}^2 + \sin^2(\alpha)\sigma_{EL}^2}$$

where σ_{GSO} = *pointing error standard deviation along the GSO*, α = *skew angle*,

σ_{AZ} = *azimuth standard deviation and* σ_{EL} *is the elevation standard deviation*

In the critical skew range between 30^0 and 40^0, Table 1 provides the probability in percent for this exceedance. These correspond to the graphical representation developed above.

Table 1:

Skew angle (degrees)	Probability of 0.5% exceedance (%)
30	3.6
35	6.2
40	9.3

In short, ViaSat's method of calculating and mitigating pointing error substantially understates the likelihood of harmful interference to adjacent satellite networks.

ViaSat asserts that the grating lobe exceedances are between 25^0 and 35^0 off axis, but the labeling of the off-axis EIRP plots themselves is contradictory. Exhibit 2 of the ViaSat January 24th Supplement labels the x axis as azimuth and the y axis as elevation, whereas the same plot in the ViaSat application (Attachment, Figure 3) labels the x-axis as **$-\theta\cos(\phi)$ and the y-axis as $\theta\sin(\phi)$,** leading to an ambiguous representation, and an interpretation of the results of uncertain validity. Also, as the plot is offered for only a single frequency, insufficient data is provided to permit a complete analysis for all transmit frequencies that could either corroborate or disprove conclusively ViaSat's assertions regarding grating lobe exceedances.

TECHNICAL CERTIFICATE

I, James B. Costello, hereby certify that I am the technically qualified person responsible for the preparation of the technical discussion contained in the foregoing "Reply Comments of Row 44, Inc." that I am familiar with Part 25 of the Commission's Rules (47 C.F.R., Part 25), and that I have either prepared or reviewed the technical information and supporting facts contained herein and found them to be complete and accurate to the best of my knowledge and belief.

February 5, 2013

By: James B. Costello

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Vice President - Engineering
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CERTIFICATE OF SERVICE

I, Sharon A. Krantzman, do hereby certify that on this 5th day of February 2013, I sent a copy of the foregoing "Reply Comments of Row 44, Inc" via first-class mail to:

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