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

In the Matter of	)	
	)	
Comprehensive Review of Licensing and Operating Rules for Satellite Services	)	IB Docket No. 12-267
	)	
	)	

COMMENTS OF VIASAT, INC.

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Summary

ViaSat, Inc. ("ViaSat") submits these comments targeting certain issues in the Commission's Further Notice of Proposed Rulemaking ("*Further Notice*") regarding satellite licensing procedures and practices in Part 25 of the Commission's rules. ViaSat's proposals would facilitate flexibility to deploy new and efficient networks without creating risks of harmful interference.

Modifications to Limits on Aggregate EIRP Density. ViaSat recommends that the Commission eliminate the 1 dB reduction in the off-axis EIRP density limits applicable to mobile antenna technologies using dynamic power control techniques under existing rules, and not extend this restriction to other rules, as proposed in the *Further Notice*. Given the demonstrated operational success of dynamic power control systems, there is no need to constrain earth station networks to back off their maximum power by 1 dB. To the contrary, a 1 dB back-off in the aggregate off-axis EIRP density limit translates into a significant decline in the usable capacity of the network, which can impact system performance, spectral efficiency, and the level of service provided to users. Moreover, to enable the deployment of the latest earth station technology, ViaSat requests that the Commission delete the "10log(N)" reference in the off-axis EIRP density limits in Sections 25.138 and 25.218 and instead allow operators to comply with an aggregate off-axis EIRP density limit. ViaSat also recommends that the Commission not adopt a proposed "clarification" to Section 25.138—a significant substantive change that (i) would effectively extend the current "per beam" uplink EIRP density limit to the satellite as a whole, and (ii) have the disastrous, and likely unintended, consequence of significantly reducing the allowable power into each antenna in the network and thereby severely

limiting the number of antennas that can operate on the same frequencies throughout the satellite's coverage area.

Blanket Licensing of Earth Stations Operating in the 20/30 GHz Bands. ViaSat requests that the proposed Section 25.115(e) be modified to make clear that the rule covers the 18.8-19.3 GHz and 28.6-29.1 GHz segments of the 18.3-20.2 GHz and 28.35-30.0 GHz bands and that applications for blanket licensed terminals may be filed for GSO and NGSO FSS blanket licensed terminals across the same parts of the Ka band in which the Commission has already issued blanket licenses.

Confidentiality of Satellite Technical Specifications. ViaSat requests that the Commission review its satellite licensing procedures to reduce informational requirements or otherwise modify its procedures to ensure that trade secrets related to satellite network designs can be adequately protected.

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EXHIBIT A

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ViaSat, Inc. ("ViaSat") submits these comments in response to the Commission's Further Notice of Proposed Rulemaking regarding the Commission's satellite licensing procedures and practices in the Part 25 of the Commission's rules.[1] ViaSat is a leading provider of satellite-based broadband services to consumer, enterprise and government users, and offers broadband satellite service throughout the United States. ViaSat operates a fleet of satellites and hundreds of thousands of earth stations, and has developed earth station technologies that operate across a wide range of frequencies. ViaSat submits these comments, which target certain issues in the *Further Notice* that are of particular importance to the services and equipment that ViaSat provides.

I. MODIFICATIONS TO LIMITS ON AGGREGATE EIRP DENSITY

In the *Further Notice*, the Commission seeks comment on proposed changes to two aspects of the aggregate EIRP density limits for routinely licensed earth stations: (i) the 1 dB reduction in the aggregate maximum EIRP density limit that applies to systems that dynamically

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[1] *Comprehensive Review of Licensing and Operating Rules for Satellite Services*, IB Docket No. 12-267, Further Notice of Proposed Rulemaking, FCC 14-142 (rel. Sept. 30, 2014) ("*Further Notice*").

control[2] the radiated power density of individual antennas, and (ii) the 10log(N) factor incorporated into the individual EIRP density limits for earth stations operating in a network of simultaneously transmitting terminals operating in the same frequencies.[3] The Commission proposes what are described as minor modifications that should eliminate ambiguities and ensure consistency within its rules, and to provide greater flexibility to earth station network operators. While ViaSat agrees those are laudable goals, ViaSat believes the proposed rule changes would have unintended consequence of unduly constraining network operations.

As an alternative, ViaSat proposes modifications to those rules that would provide greater flexibility to deploy spectrum-efficient technologies without increasing the potential for interference. Specifically, ViaSat recommends that the Commission eliminate the 1 dB reduction in the off-axis EIRP density limits applicable to mobile antenna technologies using dynamic power control techniques under existing rules, and not extend this restriction to other rules, as proposed in the *Further Notice*. Moreover, ViaSat requests that the Commission delete the "10log(N)" reference in the off-axis EIRP density limits in Sections 25.138 and 25.218 and instead allow operators to comply with an aggregate off-axis EIRP density limit. Among other things, doing so would facilitate the deployment of new technology, including earth stations that would share access to a given frequency channel, and operate at different power limits within a given service beam.

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[2] References in these comments to "dynamic power control" and "dynamically controlled" terminals, also includes variable and other selective power control techniques.

[3] *Further Notice* ¶¶ 66-72.

A. Background

As the *Further Notice* acknowledges, system operators long have employed techniques to dynamically control the power density of individual earth stations operating within a network.[4] The power density needed to close the link can vary based on the location of the antenna within the satellite receive beam or on atmospheric conditions that affect signal attenuation. In addition, earth station networks may be comprised of different-sized antennas that operate at varying power levels. These dynamic power control technologies initially were developed and deployed predominantly for mobile terminal applications of the Fixed Satellite Service ("FSS"). In a mobile FSS environment, dynamic power control implementations have demonstrated that it is possible to ensure compliance with aggregate maximum EIRP density limits even when the terminal is in motion.

In its evaluation of dynamic power systems in the context of mobile FSS applications, the Commission recognized that a 10log(N) factor (applicable in other contexts to EIRP density limits for individual terminals operating simultaneously on the same frequencies) would not adequately address the flexibility needed for these mobile applications, because this limit requires each antenna to operate at the same power density level.[5] Thus, in lieu of applying the rigid 10log(N) formula, the Commission provided flexibility to accommodate the operation of terminals operating at varying power density levels by allowing such networks to meet the maximum power density limits on an aggregate basis.[6] Because the Commission did not have experience at that time with these technologies and the dynamic nature of mobile applications of

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4 *Further Notice* ¶ 71.

5 *See, e.g., Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, Report and Order, 24 FCC Rcd 10414 ¶ 115 (2009) ("*VMES Order*").

6 *Further Notice* ¶ 71.

the FSS, the Commission required systems using that aggregate power density approach to reduce the otherwise-applicable maximum aggregate EIRP power density by 1 dB to provide margin to ensure that the overall limit toward adjacent satellites would be met, should the dynamic power control mechanism not work as intended.[7] Specifically, the Commission incorporated this 1 dB power "back-off" into rules promulgated to facilitate the licensing of mobile FSS terminals.[8] In stark contrast, the 1 dB power back-off does not apply to the Commission's off-axis EIRP density rules for fixed terminals in the Ka band (*e.g.*, Section 25.138), which rules have existed largely in their current form for almost twenty years. Nor does that power back-off requirement apply to the off-axis EIRP density rules for fixed terminals in the C or Ku bands, (*e.g.*, Section 25.218), which rules were derived from the long-standing Ka-band rule.

For over a decade, ViaSat and other network operators have successfully operated earth stations using dynamic power control techniques without any reported interference events. This long track record of success demonstrates that this technology can operate without exceeding the specified maximum aggregate limits and without risking interference. The dynamic power control systems—that thus far have been used predominantly in C- and Ku-band mobile networks—are in the process of being extended to mobile Ka-band networks and to fixed antenna networks in various frequency bands. ViaSat therefore believes that the prevalence of this now well-proven technology warrants modifications to certain aspects of the EIRP density limits throughout Part 25 to provide the regulatory flexibility needed to allow these spectrally-efficient technologies to be deployed more broadly.

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[7] *See, e.g., VMES Order* ¶ 116.

[8] *See* 47 C.F.R. §§ 25.221, 25.222, 25.226, 25.227.

B. 1 dB Reduction

Given the proven ability of dynamic power control technologies to operate in compliance within any specified maximum aggregate EIRP density limit, ViaSat proposes to eliminate the 1 dB limitation where it exists in the rules for C- and Ku-band terminals on mobile platforms (*i.e.*, Sections 25.221, 25.222, 25.226 and 25.227). Critically, a 1 dB back-off in the aggregate off-axis EIRP density limit translates into a significant decline in the usable capacity of the network, which can impact system performance, spectral efficiency, and the level of service provided to users. There is no need to constrain these networks in this manner, particularly in light of the decade of experience demonstrating the reliability and effectiveness of various power control techniques. Nor is there any reason to extend this 1 dB power back-off requirement to other Commission rules.

The *Further Notice* proposes to add the 1 dB power back-off to rule sections that define an off-axis EIRP density mask outside the context of dynamically controlled networks, *i.e.*, Section 25.138 for Ka-band terminals, and Section 25.218 for C- and Ku-band terminals.[9] As detailed above, the Commission adopted the 1 dB limitation for mobile FSS applications in part because of their nascent nature at the time. Regardless of the fact that those mobile FSS applications are now proven and mature (thus warranting removal of the 1 dB back-off in that context), the simple truth remains that those concerns never existed in the operating environment of fixed terminals. Stated another way, there is simply no record evidence that the maximum EIRP density limits currently specified in Sections 25.138 and 25.218 are inadequate. In fact, hundreds of thousands of Ka-band terminals are currently operating successfully in reliance on

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[9] *Further Notice* ¶ 72. The *Further Notice* also includes a proposal to clarify that the 1 dB power back-off is to the EIRP density from stations in a network toward any co-frequency satellite. While the proposed revision clarifies the intent of the rule, as discussed herein, ViaSat believes that the 1 dB power back-off rule is unnecessary.

the current terms of Section 25.138. Imposing a 1 dB power back-off requirement under those rules would (i) significantly impair the provision of existing services and the further deployment of existing earth station technology, as well as (ii) reduce the flexibility to expand use of these technologies in new and innovative ways. ViaSat therefore urges the Commission not to extend a 1 dB power back-off to Section 25.138 or Section 25.218.

C. 10log(N) Factor

Under Sections 25.138 and 25.218, the off-axis EIRP density levels for an individual antenna operating within a network of antennas that transmit simultaneously in the same frequencies is determined by subtracting 10log(N) from the overall limit. The 10log(N) factor assumes that each antenna in the network will operate at the same power density level. But this will not always be the case, particularly as dynamic power control systems begin to be deployed in fixed terminals in the C and Ku band, and in fixed and mobile terminals in the Ka band. The extension of those types of dynamic power control systems will enable greater spectral efficiency by, among other things, allowing antennas within the same satellite beam to operate at varying power levels depending on their relative size, or based on the operating conditions at the location of the individual antenna (*i.e.*, being at the edge or peak of the gain contour of the satellite beam, atmospheric attenuation, etc.), as discussed above. The existing 10log(N) factor was developed twenty years ago, before these types of dynamic power control systems were developed. Since then, the Commission has expressly acknowledged that the 10log(N) factor may be too restrictive for the deployment of dynamic power control systems and has adopted an alternative aggregate limit for such systems in the more recently-adopted rules for mobile earth station networks (*i.e.*, Sections 25.221, 25.222, 25.226, 25.227).

For these reasons, ViaSat recommends that the Commission eliminate the 10log(N) factor from the off-axis EIRP density limits in Sections 25.138 and 25.218.[10] Instead, the rules should specify an aggregate EIRP density limit for the emissions from all antennas within the network. Such an approach has proven to be effective under the rules for C- and Ku-band mobile antennas in Sections 25.221, 25.222, 25.226 and 25.227. And, as detailed above, the extension to Sections 25.138 and 25.218 of the aggregate power density level approach currently reflected in Sections 25.221, 25.222, 25.226 and 25.227 should be done without reference to the 1 dB power density back-off requirement that currently exists in those rules.

In any event, ViaSat respectfully suggests that the proposed "clarification" relating to the application of the 10log(N) factor in paragraph 67 of the *Further Notice* is both unwarranted and would be unduly restrictive. The *Further Notice* proposes to revise the definition of N, which currently is defined as "the likely maximum number of simultaneously transmitting co-frequency earth stations in the receive beam of the satellite."[11] The proposal is based on what is described in the *Further Notice* as a potential ambiguity in that definition: whether the relevant receive beam is on the satellite serving the earth station network or is on an adjacent satellite.

As a threshold matter, ViaSat does not believe that any such ambiguity exists. Section 25.138 was developed as a means of defining the aggregate EIRP density emitted by a terminal with reference to its target satellite. This rule was developed based on the understanding that satellites would employ spot beam technology. Power levels toward adjacent spacecraft are

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[10] The 10log(N) factor is also unnecessary in Sections 25.221, 25.222, 25.226 and 25.227, and ViaSat would support the elimination of the factor from those rules. Unlike Sections 25.138 and 25.218, however, those rules already provide flexibility for dynamic power control systems to meet the overall EIRP density limit on an aggregate basis.

[11] *See, e.g.*, 47 C.F.R. § 25.138(a).

constrained by the off-axis EIRP density mask, which was never viewed or applied with reference to any particular adjacent satellite.

More fundamentally, the proposed definitional change would prevent the continued deployment of earth station technology successfully operating at current power levels with spot beam satellites. The proposal would change the current reference to earth stations "in the receive beam of the satellite" and instead define N as "the number of earth stations that will transmit simultaneously in common frequencies *to the same target satellite*,"[12] without regard to the number of spot beams on that satellite that could be reusing those same frequencies in discrete areas and at different polarizations. Thus, by identifying N as the number of terminals that can operate in common frequencies with the "satellite" instead of within a "beam," the proposed clarification would effectively extend the current "per beam" uplink EIRP density limit to the satellite as a whole. Doing so would have the disastrous, and likely unintended, consequence of significantly reducing the allowable power into each antenna in the network and thereby severely limiting the number of antennas that can operate on the same frequencies throughout the satellite's coverage area. Such a limitation would preclude the efficient reuse of spectrum on the satellite through multiple beams, which is inconsistent with the Commission's requirements to employ "state-of-the-art full frequency reuse" in the design of certain satellites.[13] For example, the ViaSat-1 satellite has a large number of user and gateway spot beams reusing each of two frequency bands and two polarizations and thus, potentially a large number of co-frequency, co-polarization transmissions to the satellite at any given time. However, the proposed change in the language would require approximately a 15 dB reduction in uplink EIRP density for each co-frequency earth station on the satellite. Moreover, as evidenced by the discussion below,

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12 *See Further Notice* ¶ 67 (emphasis added).

13 *See* 47 C.F.R. § 25.210(f).

defining N with respect to the number of antennas operating within an adjacent satellite's receive beam does not adversely affect the interference environment.

The *Further Notice* also proposes to delete stipulations that N equals 1 in the off-axis EIRP density limits for earth stations using FDMA and TDMA network protocols in Sections 25.134, 25.138, 25.212, 25.218, 25.221, 25.222, 25.226 and 25.227, based on the presumption that simultaneous transmission using the same frequencies could occur in FDMA and TDMA networks that use multiple spot beams and would increase the aggregate amount of off-axis power radiated toward an adjacent network.[14] The Commission's premise appears to be based on apparent misconceptions about spot-beam technology and the inability of adjacent satellites to coexist with networks operating multiple FDMA or TDMA antennas. As demonstrated by the analysis in the attached Exhibit A, reuse of frequencies across multiple spot beams in FDMA and TDMA networks does not substantially increase the potential for interference into adjacent satellites using larger regional or CONUS wide beams. In addition, as discussed in Exhibit A, when the adjacent satellite also uses spot beams, the interference is further reduced, because spot beam patterns typically are orthogonal to some degree. Thus, deleting the N=1 stipulation would require significant reductions in power into individual terminals operating on spot-beam satellites for no good reason. Furthermore, satellite operators have coordinated and operated these types of networks without any problems, and none has raised any issue with the application of the off-axis power density envelope based on N equaling 1 for FDMA and TDMA systems.

For the same reasons why N equals one for FDMA and TDMA systems, the Commission's proposal to incorporate the 10log(N) factor into power density limits for individually licensed C- and Ku-band earth stations in Section 25.212, and for analog stations in

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[14] *See Further Notice* ¶ 69.

Section 25.218, also is unnecessary.[15] In any event, the aggregate power density approach that ViaSat proposes above for Sections 25.138 and 25.218 would also be preferable to a 10log(N) approach in the context of Section 25.212 and analog stations in Section 25.218. Thus, ViaSat requests that the Commission refrain from inserting 10log(N) into these rules as well.

II. BLANKET LICENSING OF EARTH STATIONS OPERATING IN THE 20/30 GHZ BANDS

ViaSat supports the Commission's proposal to modify Section 25.115(e) to make clear that applications for blanket licensed earth stations operating in the Ka band do not require the applicant to specify the locations of user terminals.[16] ViaSat also believes that the first sentence of the proposed Section 25.115(e) correctly covers the 18.3-20.2 GHz and 28.35-30.0 GHz frequencies.[17] However, language in the second sentence of the proposed rule, as drafted, could be read to preclude blanket licensing in the 18.8-19.3 GHz and 28.6-29.1 GHz segments of that frequency band, because the second sentence uses the defined term "20/30 GHz," and the *Further Notice* proposes to redefine "20/30 GHz band" to exclude those frequency segments. ViaSat requests that the proposed rule be modified to include a reference to blanket licensing in the 18.8-19.3 GHz and 28.6-29.1 GHz portions of the Ka band without specifying the location of user terminals. This approach would be consistent with the Commission's decision to license ViaSat, among others, to operate blanket licensed terminals in these segments of the Ka band.[18]

Moreover, consistent with the inclusion of the 18.8-19.3 GHz and 28.6-29.1 GHz segments in the first sentence of the proposed rule, ViaSat does not believe the second sentence

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15 *See id.* ¶ 70.

16 *See id.* ¶ 143.

17 *Further Notice*, Appendix A, proposed 47 C.F.R. § 25.115(e).

18 *See, e.g.*, IBFS File No. SES-LIC-20101217-01585, Call Sign E100143 (granted Oct. 20, 2011).

should be limited to "GSO" earth stations. ViaSat requests that the proposed rule be modified to make clear that it applies to applications for both GSO and NGSO FSS blanket licensed terminals, to recognize that NGSO FSS system users will seek authority for blanket licensed terminals, and to account for the operation of blanket-licensed GSO FSS terminals in the 18.8-19.3 GHz and 28.6-29.1 GHz segments as well.

Therefore, ViaSat proposes to revise the second sentence of the proposed Section 25.115(d) read as follows:

> An applicant may request authority for operation of ~~GSO~~ FSS earth stations in ~~the 20/30 GHz~~ **any portion of the 18.3-20.2 GHz and 28.35-30.0 GHz bands** without specifying the location of user terminals but must specify the number of terminals to be covered by the license, the geographic area(s) in which they will operate, and the location of hub and/or gateway stations.

III. CONFIDENTIALITY OF SATELLITE TECHNICAL SPECIFICATIONS

As a leader of cutting-edge satellite technologies, ViaSat has developed highly-proprietary satellite designs that are competitively sensitive and thus must be kept from public disclosure. In the Commission's satellite licensing process, several stages exist where such highly confidential information is required to be filed with the Commission, which threatens to compromise the confidentiality of such information. As an initial matter, ViaSat believes that such information is exempt from disclosure under the Trade Secrets Act, and it should never be disclosed to third parties, even under protective orders.[19] Although the Commission generally is of the view that protective orders are adequate to protect confidential information, the recent litigation involving programming providers seeking to prevent disclosure of programming agreements under a protective order demonstrates the concerns that many companies have about third parties obtaining access to sensitive information even when there is a protective order in

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[19] *See* 18 U.S.C. § 1905.

place.[20] In the context of highly sensitive satellite specifications, many of the confidentiality concerns can be addressed by modifying the type of information that is required to be provided to the Commission. Thus, ViaSat respectfully requests that the Commission review its satellite licensing procedures to streamline informational requirements or otherwise modify its procedures to ensure that proprietary technology can be adequately protected.

As an initial matter and while not specifically falling within the ambit of the concerns raised above, ViaSat supports the Commission's proposal in the *Further Notice* to allow satellite applicants to make an initial submission to the Commission containing the Advanced Publication of Information ("API") and the Coordination Request ("CR") for filing with the International Telecommunication Union ("ITU"), prior to submitting detailed technical information currently required in the Commission's space station application.[21] The proposal to facilitate the filing of API and CR information before a satellite operator's plans are made public recognizes that public disclosure of a space station application with detailed operational information before an API is filed with the ITU would make such U.S. applicants vulnerable to competitors who can submit conflicting filings at the ITU through other administrations in the period before the Commission files an API and CR.

With respect to confidentiality concerns, many of these can be alleviated by eliminating unnecessary informational requirements. ViaSat is in favor of eliminating the Commission staff's practice of routinely requiring the submission of critical design review ("CDR") document packages.[22] Submission of the extensive detail in CDR documents regarding highly-proprietary

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20 *See* Opening Brief of Petitioners, CBS Corp. v. FCC, No. 14-1242 (D.C. Cir. Dec. 15, 2014).

21 *See Further Notice* ¶ 13.

22 *See id.* ¶ 22.

satellite design specifications is wholly unnecessary for ensuring that a satellite licensee is proceeding with its plans to construct a satellite and needlessly puts highly confidential information at risk of inadvertent public disclosure. Notably, this requires merely a change in practices, not a rule change.

Similarly, sensitive satellite design information also is required in the submission of both satellite applications and satellite manufacturing contracts that must be submitted to demonstrate compliance with the contract milestone. Many of the competitively sensitive details required in satellite applications are wholly unnecessary for evaluating the interference profile of the proposed satellite. And, like the detail in CDR submissions, similar information contained in satellite manufacturing contracts is irrelevant to the determining compliance with the requirement to enter into a binding, non-contingent contract for the construction of the authorized satellite. Thus, ViaSat requests that the Commission consider in this proceeding ways it can balance the need to ensure compliance with its technical and milestone rules and to make determinations that a proposed network would be compatible with the interference environment, with a significant reduction in current informational requirements to avoid the unnecessary disclosure of proprietary satellite information.

IV. CONCLUSION

For the foregoing reasons, ViaSat respectfully requests that the Commission adopt these proposed modifications to the Part 25 rules. ViaSat's proposals would facilitate flexibility to deploy new and efficient networks without creating risks of harmful interference.

Respectfully submitted,

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EXHIBIT A

Limits on Aggregate EIRP Density

In paragraphs 66 through 70 of the FNPRM the Commission proposes to modify the definition of N as being equal 1 for TDMA or FDMA transmissions because simultaneous co-frequency transmissions could occur from earth station networks operating in a spot beam environment.

SIA believes no change is required for the definition of N in this case – particularly in the case of Ka band satellites where spot beam usage was considered in the establishment of the 25.138 off-axis EIRP density mask. At that time it was recognized that a satellite with a wide area regional or CONUS beam would be less sensitive to multiple co-frequency transmissions from neighboring satellites and that there was not a need for limits on aggregate EIRP density.

This analysis will determine the relative impact in delta T/T between two spot beam satellite networks with different size spot beams and demonstrate that no reduction in e.i.r.p. density is needed in the case of multiple beams from one satellite being visible within the beam of an adjacent victim satellite.

In performing the analysis the following information will be used or developed: the e.i.r.p. density of the earth stations, the beam size of each satellite, the G/T of each satellite receiving beam, the number of beams from one satellite visible within the victim beam of the other satellite.

- Each network will use the same 75 cm class earth stations operating at the 25.138 off-axis e.i.r.p. density limit of 18.5 – 25*log(θ) – 10*log(N) dBW/40 kHz, or effectively 10.974 dBW/40 kHz for θ = 2°.
- Satellite A will use 200 km diameter spot beams.
- Satellite B will use 800 km diameter spot beams.
- Satellite A uses a four color frequency reuse pattern as depicted in Figure 1 and 23 of satellite A's spots fall inside or partially inside a single satellite B spot.

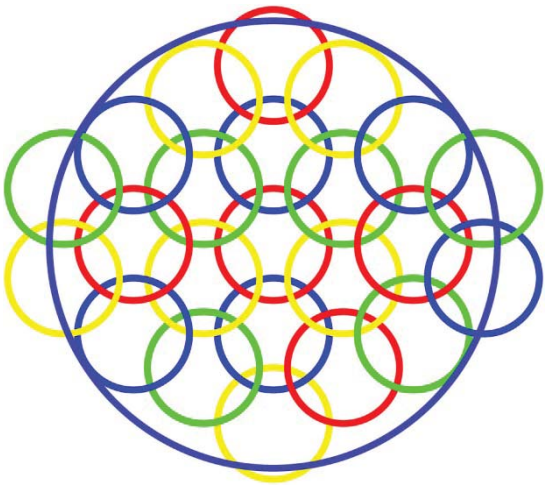

Figure 1 Satellite A and B Spot Beams

EXHIBIT A

For both networks, the analysis use the maximum allowable off-axis e.i.r.p. density from each network toward the other for N = 1 to find the interfering input level at each satellite. Then the G/T is determined for each satellite and the resulting delta T/T for N = 1. Next, the N value is determined for each satellite and the delta T/T values recalculated.

From above, the maximum allowable off-axis e.i.r.p. density at 2° is 10.974 dBW/40 kHz.

The input power density to the satellite is calculated as (e.i.r.p density* G)/L_{path}

L_{path} is calculated as $\left(\frac{4*\pi*r}{\lambda}\right)^2$, which for 29.75 GHz and 37513 km is 213.4 dB.

The gain G of the satellite will be derived by working backwards from the spot beam diameter. The gain of an antenna is proportional to its diameter, which in turn is proportional to its beamwidth and the beamwidth in turn is proportional to the spot beam size on the Earth.

The beamwidth can be calculated using the following formula:

$$BW = \tan^{-1}\frac{0.5*spot_{dia}}{\sqrt{{alt_{gso}}^2-(0.5*spot_{dia})^2}}*2$$

For the 200 km diameter spot beam of satellite A the beamwidth is 0.305° and for the 800 km diameter spot beam of satellite B the beamwidth is 1.222°. Having calculated the diameter, the gain can be determined using the rule of thumb formula: $\frac{70*\lambda}{\mathrm{BW}}$.

The antenna diameter of satellite A is then 2.309 m and satellite B is 0.577 m.

Gain is calculated using the formula: $\eta * \left(\pi * \frac{\mathrm{D}}{\lambda}\right)^2$ and using an efficiency η of 57% the gain for satellite A's antenna is 54.704 dBi and the gain of satellite B's antenna is 42.663 dBi. The G/Ts then are 23.565 dB/K and 11.524 dB/K respectively for satellite A and B.

For earth stations in satellite A's network, the interfering input power density I_o to satellite B is:

10.974 dBW/40 kHz + 42.664 dBi – 213.4 dB = -205.785 dBW/Hz

For earth stations in satellite B's network, the interfering input power density I_o to satellite A is:

10.974 dBW/40 kHz + 54.704 dBi – 213.4 dB = -193.743 dBW/Hz

The noise N_o at the satellite is calculated as $N_o = k * T_{sat}$ and from above, T_{sat} = 1300 K for each satellite, so N_o for each satellite is equal to: $10 * \log\left[1.38 * 10^{-23} * \frac{W}{Hz*K}\right] * 1300\ K$, or -197.46 dBW/Hz

Delta T/T is calculated by (I_o/N_o) * 100 or for I_o/N_o in dB form: $10^{\frac{\mathrm{Io}-\mathrm{No}}{10}} * 100$

EXHIBIT A

For N = 1 earth stations in satellite A's network transmitting in to satellite B's receive beam, the delta T/T is: $10^{\frac{-205.785\,\frac{\mathrm{dBW}}{\mathrm{Hz}} - -197.46\,\frac{\mathrm{dBW}}{Hz}}{10}}$ * 100 = 14.707%

For N = 1 earth stations in satellite B's network transmitting into satellite A's receive beam, the delta T/T is: $10^{\frac{-193.743*\frac{dBW}{Hz} - -197.46\frac{dBW}{Hz}}{10}} * 100$ = 235.315%

Examining the spot beams for satellite A, it can be seen that six blue spots fall inside or partially inside the larger blue spot of satellite B. The six blue spots of satellite A and the single blue spot of satellite B use the same frequency and polarization and thus in the case of satellite A, N = 6 because there are potentially six possible co-frequency and co-polarization transmissions that may fall inside satellite B's spot beam. The other color spots either use a different frequency or operate in the cross-pol and are not counted against N.

To determine the delta T/T impact to satellite B when N = 6 for satellite A, it would appear that 10*log(6) could simply be added to the I_o value for satellite A into satellite B. However, this would overstate the aggregate interference into satellite B. This is because several of the uplink spot beams of satellite A fall near the edge of satellite B's beam and therefore some gain roll-off must be factored in. Examining Figure 1, it can be seen that none of the beams from satellite A fall directly on the boresight of satellite B's beam and one of the beams from satellite A straddles the -3 dB contour of satellite B's beam. Therefore some weighting should be applied to the additional co-frequency transmissions.

For this example, the following estimations for weighting will be used: N_1 = - 0 dB, N_2 = -1 dB, N_3 = -1.5 dB, N_4 = -1.5 dB, N_5 = -2.0 dB, and N_6 = -2.5 dB. The six individual simultaneous transmissions are combined as follows:

$$I_{o_agg} = I_o + I_o * 10^{\frac{-1}{10}} + I_o * 10^{\frac{-1.5}{10}} + I_o * 10^{\frac{-1.5}{10}} + I_o * 10^{\frac{-2}{10}} + I_o * 10^{\frac{-2.5}{10}}$$

The result is an aggregate I_o of –199.347 dBW/Hz.

The resulting new delta T/T is 10^((-199.347 dBW/Hz – -197.46 dBW/Hz)/10) * 100 = 64.761%

So, even when N = 6 for satellite A's network, the resulting delta T/T impact to satellite B's network is less than 1/3 the impact from satellite B's earth stations into satellite A's network.

Bandwidth economics will likely drive newer satellites toward increasingly higher orders of frequency reuse through smaller spot beams rather than wider area, regional, or CONUS beams. It is worth considering what happens when two satellite using a large number of similar sized spot beams operate next to each other. In the extreme case, the frequency reuse pattern would exactly overlap and only

one earth station from each beam would be seen in the receive beam of the adjacent satellite. In the other case where the frequency reuse pattern is exactly orthogonal, no co-frequency transmissions would be observed in the receiving beam of the adjacent satellite. This is in fact exactly the case for WildBlue-1 and Anik-F2 which both operate in the same 111.1 W orbital location.

In practice for spot beam satellites practicing increasingly higher orders of frequency reuse the effective value for N will tend to be less than one for the two networks.

Industry designed current satellites to operate in the existing 25.138 off-axis e.i.r.p. density environment and is designing new satellites expecting levels of uplink e.i.r.p. density to continue from both 25.138 in the U.S. and ITU-R Rec 524-9 abroad. To implement the proposed change in the definition of N for TDMA and FDMA systems operating in a spot beam environment would have disastrous economic consequences for operators of existing and future satellites. Satellite operators coordinating operations under the current definition have not expressed any difficulty with the status quo and the existing definition of N should be left unchanged.

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 Senior Director, Regulatory Affairs of ViaSat, Inc.

2. I have reviewed the foregoing Comments of ViaSat, Inc., and the information contained therein is true and correct to the best of my knowledge, information and belief.

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Daryl T. Hunter, P.E.

Executed January 29, 2015