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

In the Matter of	)	
	)	
Service Rules and Procedures to Govern the	)	
Use of Aeronautical Mobile Satellite Service	)	IB Docket No. 05-20
Earth Stations in Frequency Bands Allocated	)	
to the Fixed Satellite Service	)	
	)	

REPLY COMMENTS OF VIASAT, INC.

John P. Janka
Teresa D. Baer
Elizabeth R. Park
LATHAM & WATKINS LLP
555 Eleventh St., N.W., Suite 1000
Washington, D.C. 20004
202-637-2200

Counsel for ViaSat, Inc.

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ViaSat, Inc. ("ViaSat") replies to the comments filed in response to the Notice of Proposed Rulemaking ("NPRM") regarding the implementation of service rules and licensing procedures for the aeronautical mobile satellite service ("AMSS") in the Fixed Satellite Service ("FSS") bands.[1]

I. INTRODUCTION AND SUMMARY

ViaSat and other AMSS system operators commenting in this proceeding have developed and implemented new technology that allows broadband services to be provided on board aircraft using the frequency bands currently used for FSS. AMSS technology promises to facilitate a number of important public policy goals articulated in the Commission's recently-released Strategic Plan: (i) providing more competitive choices for U.S. consumers, (ii) facilitating the ubiquitous deployment of broadband services, (iii) using spectrum more

[1] *See* Comments of ViaSat, Inc., *Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, IB Docket No. 05-20 (filed July 5, 2005) ("ViaSat Comments").

efficiently and effectively, and (iv) fostering investment and innovation in broadband technologies and services.[2]

ViaSat's AMSS system couples spread spectrum technology with dynamic power management over the entire AMSS network in order to direct system capacity where and when it is needed to serve user demands, and to reduce the potential for interference into other systems. The full benefits of this technology can be achieved, however, only if the Commission adopts a regulatory regime that is flexible enough to allow greater shared use of the FSS frequency bands. As several commenters have shown, adopting rules based on existing FSS rules, which were designed for now decades-old technologies, would constrain the development of the technology implemented in AMSS systems.[3] Without citing a single incident of interference from AMSS in FSS bands, certain parties in this proceeding urge the Commission to impose on AMSS the same rules that constrain VSAT development in the FSS today.[4] Fortunately, the Commission has recently rejected a number of those arguments in its Earth Station Licensing Sixth Report and Order.[5]

More fundamentally, the Commission has recently recognized, as ViaSat has urged, that more efficient uses of spectrum can be facilitated by "enlightened" regulatory approaches that do not specify the use of certain system designs or technologies. In the context of allowing mobile satellite service ("MSS") providers to implement an ancillary terrestrial

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[2] *See* Public Notice, *Public Invited to Review Draft Strategic Plan* (rel. Jul. 5, 2005).

[3] *See* ARINC Comments at 11; Boeing Comments at 27; SES Americom Comment at 2-3.

[4] PanAmSat Comments at 3; Intelsat Comments at 3.

[5] *2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, IB Docket No. 00-248, Sixth Report and Order and Third Further Notice of Proposed Rulemaking, FCC 05-62 at ¶ 119 (rel. Mar. 15, 2005) ("Earth Station Licensing Sixth Report and Order").

component ("ATC"), the Commission established appropriate aggregate interference limits, but provided the ATC operator great latitude to choose the operational parameters and technology necessary to comply with those limits.[6] The comments in this proceeding amply support such an "enlightened" approach to regulation of AMSS.

ViaSat and the other AMSS interests commenting in this proceeding set forth very similar proposals regarding the service rules and licensing of AMSS. All agree that the Commission should afford aeronautical earth station ("AES") terminals in an AMSS network the same regulatory status and treatment as VSAT terminals in an FSS network.[7] AMSS operators are able to control the power density of aeronautical terminals on an aggregate basis and thus, can limit off-axis power density into adjacent satellites to levels that are comparable to that of VSATs. From the perspective of adjacent satellites, AES terminals do not present any greater interference potential than a typical VSAT network. Existing AMSS systems have proven that AMSS operations can successfully operate in FSS bands without causing harmful interference. Therefore, there is no need for the Commission to limit AMSS technology in the manner that PanAmSat and Intelsat advocate.[8] To the contrary, their proposals would constrain the spectrum efficiency and the scope of broadband service that AMSS use of FSS bands promises.

Finally, the Department of Justice, including the Federal Bureau of Investigation, and the Department of Homeland Security (collectively, the "Departments") raise issues that

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[6] *See Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2/4 GHz Bands*, IB Docket No. 01-185, Memorandum Opinion and Order and Second Order on Reconsideration, FCC 05-30 at ¶¶ 47, 50 (rel. Feb. 25, 2005) ("ATC Second Order on Reconsideration").

[7] ARINC Comments at 5, 24; Boeing Comments at 15.

[8] PanAmSat Comments at 3; Intelsat Comments at 3.

warrant careful review by the Commission. Given the complexity of the issues and the need for a full record, the Commission should commence a separate proceeding to address these issues.

II. AMSS SPECTRUM ALLOCATION

A. AMSS Should Be Treated as Co-Primary With FSS

AMSS uplinks and downlinks in the Ku-band should be treated as co-primary with FSS, consistent with the Commission's proposed footnote in the NPRM. The comments submitted in this proceeding support ViaSat's arguments that AMSS systems are no more interfering, and no more susceptible to interference than, an FSS system due to the spread spectrum multiple access and dynamic power control technologies employed by AMSS systems. Therefore, the Commission should adopt the co-primary AMSS footnote, but should revise its proposed language, as indicated below, to recognize that the technology AMSS systems employ may be different than that used in traditional VSATs.

Boeing supports ViaSat's position that AMSS systems can operate such that they are no more interfering than an FSS system.[9] ViaSat appreciates the need to protect FSS; ViaSat itself operates FSS VSAT networks, and would not support proposals for AMSS systems that do not protect FSS. However, existing AMSS systems have already demonstrated that operators can control the total level of aggregate power in the network such that the power density towards adjacent satellites is within the prescribed limits. Boeing and SES Americom have experienced first hand the ability of AMSS networks to operate without causing harmful interference into adjacent satellites.[10] Since 2001, Boeing has successfully managed network power in its Connexion AMSS system, demonstrating that AMSS systems and FSS operations can coexist in

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[9] Boeing Comments at 7, 9.

[10] *Id.* at 10; SES Comments at 2.

the Ku-band without incidents of harmful interference into FSS operations. SES Americom, which provides capacity to both FSS and AES system operators, indicates that AES terminals can be deployed without creating harmful interference into other FSS applications.[11]

Boeing's experience operating AMSS networks demonstrates that Telesat Canada and PanAmSat's doubts regarding the ability of systems to control aggregate EIRP are unfounded.[12] AMSS networks, such as ViaSat's system, clearly can manage off-axis EIRP density on an aggregate basis to prevent harmful interference into adjacent satellites. ViaSat has worked with FSS satellite operators, including SES Americom, to test the aggregate power control of its AMSS system, with successful results. Without citing a single incident of interference by AMSS networks, PanAmSat asserts that the mobile nature of AMSS creates a higher potential for creating interference and is more susceptible to receiving interference.[13] As discussed in more detail below, the antenna pointing variability associated with mobile antennas does not significantly increase the interference potential because each antenna in an AMSS network using spread spectrum emits at extremely low power density levels.

In its comments, Boeing has changed its position on priority for Ku-band AMSS downlinks and now agrees with ViaSat that the Commission should afford protection to AMSS downlink operations.[14] As a policy matter, co-primary treatment of AMSS is necessary to create an environment where broadband services on aircraft may proliferate. Co-primary status would provide the level of certainty required to encourage investors and the market to promote AMSS technology. Just like earth stations on vessels ("ESVs"), which have co-primary status with FSS,

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[11] SES Comments at 2.

[12] Boeing Comments at 10.

[13] PanAmSat Comments at 2.

[14] Boeing Comments at 7.

AES terminals would use existing FSS infrastructure to provide broadband service. AMSS is essentially another application of FSS, and thus, should be treated as co-primary with FSS. Therefore, Section 25.209(c) should apply equally to AMSS, such that an AES terminal is protected from interference to the extent the terminal is no more susceptible to harmful interference than a conforming earth station antenna.

ViaSat endorses Boeing's request that the Commission adopt its proposal in the NPRM to add a non-Federal government footnote to the U.S. Table of Frequency Allocations affording AMSS protection as a co-primary service in the Ku-band uplink and downlink frequencies.[15] However, the Commission should revise its proposed footnote to reflect the fact that AES terminals may use different technologies than traditional VSATs, and thus, may not necessarily operate under the "same parameters" as VSATs. The language of the footnote should be as follows:

> **NGyy** In the bands 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space), aircraft earth stations in the aeronautical mobile-satellite service are an application of the Fixed Satellite Service (FSS). The provision of the ITU Radio Regulations Nos. 5.29, 5.30 and 5.31 apply, except that reception from geostationary space stations in the fixed-satellite service in the 11.7-12.2 GHz shall be protected on a primary basis, **to the extent** ~~provided~~ that aircraft earth stations **are no more susceptible to interference than** ~~operate under the same parameters as~~ earth stations in the fixed-satellite service.

B. ViaSat Supports AMSS Operations in the Extended Ku-Band On The Same Basis As FSS

In their respective comments, ARINC and Boeing both urge the Commission to permit AMSS operations in the 10.95-11.2 and 11.45-11.7 GHz bands.[16] ViaSat agrees that the Commission should afford AMSS the same regulatory status as FSS in the Ku-band, as well as in

[15] *See NPRM* at ¶ 31.

[16] ARINC Comments at 25; Boeing Comments at 8.

the extended Ku-band.[17] The U.S. Table of Frequency Allocations currently includes a footnote that allows FSS downlinks in the extended Ku-bands on a co-primary basis with fixed services ("FS") only when the FSS uplink originates outside the U.S.[18] The Commission adopted this allocation to limit the number of FSS networks with which FS providers would need to coordinate. However, the Commission has granted waivers to applicants requesting use of the extended Ku-band for domestic FSS on an unprotected, non-interference basis.[19] In those cases, the Commission determined that such use on an unprotected, non-interference basis would not require FS providers to coordinate with domestic FSS and thus, would not undermine the purpose of the rule.

AMSS should be treated as an application of the FSS, as the Commission proposes in the NPRM. As such, the Commission should allow AES terminals to operate in the extended Ku-bands on a co-primary basis with the FS where the uplink originates outside of the U.S., and on a non-interference basis vis-à-vis the FS where the uplink originates domestically. ViaSat agrees with Boeing and ARINC that permitting AMSS operations in these bands would allow seamless broadband service to passengers on U.S. registered aircraft flying over international territories.[20] Due to the international nature of many aeronautical routes, the Commission should afford AMSS operators the flexibility to operate throughout internationally allocated Ku-band FSS spectrum.[21]

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[17] Boeing Comments at 9.

[18] 47 C.F.R. § 2.106 n. NG104.

[19] *See, e.g., EchoStar KuX Corporation Application for Authority to Construct, Launch and Operate a Geostationary Satellite Using the Extended Ku-band Frequencies in the Fixed-Satellite Service at the 121 W.L.*, Orbital Location, Order and Authorization, DA 04-3164 at ¶ 13 (rel. Sept. 30, 2004).

[20] Boeing Comments at 8; ARINC Comments at 25.

[21] ARINC Comments at 25.

C. Coordination With RAS and TDRSS Should Be Required Only In The Bands In Which Those Services Operate

The National Radio Astronomy Observatory ("NRAO") asserts in its comments that imposing coordination requirements below 14.47 GHz is unnecessary to protect Radio Astronomy Services ("RAS") in the 14.47-14.5 GHz band.[22] NRAO cites as evidence the memoranda of understanding between National Science Foundation, and ARINC and Boeing, respectively, which include a requirement to incorporate "'proper' hardware design" into their networks, as provided in ITU-R M. 1643, Part C.[23] ViaSat agrees that the incorporation of this ITU regulation as a license condition is appropriate, and NRAO's comments confirm that compliance with this regulation is sufficient to prevent AMSS operations below 14.47 GHz from interfering with RAS in the 14.47-14.5 GHz band.

Adopting this ITU regulation as a license condition would make moot National Academy of Sciences' ("NAS") proposal that the Commission require AMSS to coordinate with RAS in the entire 14.0-14.5 GHz band in order to afford NAS "optimal" protection.[24] NAS indicates in its comments that limiting coordination to the 14.47-14.5 GHz band would be "acceptable" if systems comply with ITU-R M. 1643. Thus, the Commission should make clear that as long as the requirements of ITU-R M. 1643 are met, coordination requirements with research facilities are limited to the narrow bands used by those facilities.

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[22] National Radio Astronomy Observatory Comments at 2.

[23] *Id.* at 3.

[24] National Academy of Sciences' Committee on Radio Frequencies Comments at 6.

III. AMSS SERVICE RULES

A. AMSS Service Rules Should Be Consistent With VSAT Service Rules But Should Accommodate AMSS Technology

In its comments, Boeing notes that "certain elements of the Commission's proposed approach do not appear to be consistent with . . . recent Commission actions adopting analogous ESV rules and addressing other station licensing reforms."[25] ViaSat agrees that the Commission should adopt service rules and licensing procedures for AMSS that are comparable to the requirements for VSATs in FSS as currently proposed in the Earth Station Licensing Sixth Report and Order.[26] As discussed above, AMSS should be treated as an application of FSS, and thus, should be subject to the same regulatory approaches.

In the pending Earth Station Licensing Sixth Report and Order, the Commission proposes to adopt an off-axis power density limit to allow VSAT operators to employ a "power-pattern" trade off, and thereby use smaller antennas that do not meet the Section 25.209 antenna mask. This approach recognizes that small antennas can operate without causing harmful interference into adjacent satellites by reducing transmit power levels to compensate for the amount by which the antenna gain pattern exceeds the Section 25.209 requirements.[27]

Developing regulations for all Ku-band services based on a power-pattern trade off would accommodate a broad range of antenna technologies that do not comply with the Section 25.209 antenna mask. For instance, the dynamic power control technology employed by AMSS systems expands the potential of networks using FSS satellites by increasing spectrum use efficiency. As the Commission recognized in the case of VSATs, network operators can

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[25] Boeing Comments at 15.

[26] *See*, *generally*, Earth Station Licensing Sixth Report and Order.

[27] *Id.* at ¶ 74.

reduce the overall power into a VSAT to compensate for a non-compliant pattern. In AMSS networks, network operators can adjust the power of hundreds or thousands of antennas simultaneously operating on a co-channel basis, using spread spectrum techniques, such that the aggregate power density transmitted by all antennas in the network remains below a threshold level that the Commission deems acceptable to protect adjacent satellites from harmful interference. This technology, which enables aeronautical terminals to use the Ku-band, readily could be extended to "traditional" VSAT terminals to allow VSATs to use spectrum capacity more efficiently. The innovations in spectrum-sharing technology employed by AMSS networks make possible the use of smaller antennas. The Commission recognizes the need to afford flexibility to VSATs to use small antennas and should allow AMSS the same flexibility to accommodate such technologies.

Therefore, the off-axis power density limits, contention table and coordination requirements for higher power operations should be the same for AMSS as for FSS, as proposed by many of the commenters in this proceeding.[28] Further, the Commission should reject proposals to adopt an antenna pointing accuracy requirement for AMSS, as it did for VSATs.[29] SES Americom supports consistent regulatory treatment of AMSS and FSS in its comments, cautioning the Commission that additional requirements should be imposed only where they are necessary to prevent harmful interference.[30] Consistent regulatory treatment of AMSS and FSS is critical to the development of AMSS into a commercially viable, widely-available service.

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[28] *See, e.g.,* Boeing Comments at 15; ARINC Comments at 2, 24; Intelsat Comments at 3-4 (supporting the consistent off-axis power density limits); SES Americom Comments at 4 (supporting consistent treatment of coordination of higher power operations).

[29] Earth Station Licensing Sixth Report and Order at ¶ 23.

[30] SES Americom Comments at 2.

B. Antenna Pointing Errors Do Not Cause Harmful Interference Into Adjacent Satellites

ViaSat, Boeing and ARINC agree that an antenna pointing accuracy requirement is unnecessary because the off-axis EIRP density limit already accounts for pointing errors.[31] The off-axis power density envelope is intended to define a level of power density for non-compliant antenna patterns that is deemed to be "pre-coordinated" with adjacent satellites. By adopting a "power-pattern trade off" approach, the Commission recognizes that the antenna gain pattern of the antenna does not matter as long as the antenna does not exceed the pre-coordinated power density levels into adjacent satellites. AMSS networks can be controlled such that the aggregate power density of the antennas in the network does not exceed the pre-coordinated power density levels. Because AMSS operators can control the aggregate network power density into adjacent satellites, any variations in individual antenna performance, including mispointing, can be alleviated by reducing the aggregate power level of all antennas in the network.

ViaSat agrees with ARINC's argument that a specific pointing accuracy requirement could limit advancement in antenna technology.[32] ARINC cites as an example an omni-directional antenna, which has no main lobe, and thus, is not compliant with the Section 25.209 antenna gain pattern.[33] The Commission purpose in adopting the "power pattern tradeoff" is to allow various antenna technologies that do not conform with Section 25.209. Although it would not comply with Section 25.209, an omni-directional antenna could instead comply with the off-axis EIRP density envelope to prevent harmful interference into adjacent satellites. However, an antenna pointing accuracy requirement for an antenna with no mainbeam

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[31] Boeing Comments at 27; ARINC Comments at 12.

[32] ARINC Comments at 11.

[33] *Id.* at 12.

is meaningless because the beam radiates in all directions. ViaSat agrees with ARINC that pointing accuracy must be a function of antenna power and beamwidth, which is more effectively addressed through the aggregate off-axis EIRP.

Likewise, AES terminals using spread spectrum technology have non-compliant antenna patterns and wide beamwidths. Pointing errors by these terminals, however, do not significantly increase interference into adjacent satellites. In AMSS networks that employ spread spectrum multiple access techniques, individual AES terminals are characterized by wide beamwidths with extremely low power density. Because the power density level of any given antenna in such an aeronautical network is so low, any individual antenna that is "mispointed" is unlikely to be noticeable to an adjacent satellite. Indeed, because the main lobe of the antenna is so wide, even when the antenna is accurately pointed, some portion of the mainbeam will spill over in the direction of an adjacent satellite.[34]

Even assuming the deployment of a large number of AES terminals, the likelihood of a number of AES terminals all mispointing into the same satellite is miniscule due to the random nature of antenna pointing errors.[35] ViaSat has prepared a Technical Summary of Pointing Error Effects, attached hereto as Exhibit A, which describes the simulated effect of AES terminal pointing errors. The simulation assumes a network of 100 AES terminals, using spread spectrum multiple access techniques, in which off-axis power density is controlled on an

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[34] The Satellite Industry Association ("SIA") recently filed a Petition for Reconsideration in the Earth Station Licensing Sixth Report and Order arguing that smaller earth station antennas are prone to larger pointing errors than those of larger antennas. While this might be the case for VSATs, it is not relevant to AES terminals. AES terminals operate in a dynamic environment, and antenna orientation is continually adjusted to point accurately at the antenna's point of communication. Therefore, these terminals do not face the same factors that cause VSAT antennas to be mispointed in a static environment, such as installation errors, wind and other environmental factors.

[35] The random nature of mispointing also means that an antenna may be as likely pointed away from an adjacent satellite as towards it, thereby balancing the aggregate power into that satellite at any given time.

aggregate basis. This analysis demonstrates that, even assuming mispointing angles of 5° to 10°, the network aggregate off-axis antenna gain profile would exceed the Section 25.209 mask by relatively small amounts. For instance, assuming that the AES terminals are mispointed by less than 10° 99.7% of the time, the network aggregate EIRP would need to be reduced by 1.35 dB in order to comply with the mask. Due to the ability of currently existing AMSS networks to control aggregate power density at any given time, the AMSS operator can reduce the aggregate power density to account for any increases in off-axis power density resulting from mispointed antennas.

C. The Contention Table Would Account For Multiple Factors That Cause AMSS Networks to Exceed Off-Axis EIRP Density Limits

ViaSat, Boeing and ARINC each propose that the Commission adopt for AMSS the exceedance table proposed for VSATs in the Earth Station Licensing Sixth Report and Order.[36] All agree that while AMSS systems are designed to adjust aggregate power levels to take into account statistical variations in the off-axis EIRP density, the Commission should make its rules clear that such variations are anticipated and permitted.[37] The off-axis EIRP density emitted by AES terminals will vary over time from the perspective of an adjacent satellite due to the short bursts of power resulting from the use of contention protocols, as the Commission recognized in the context of VSATs. However, variations in off-axis EIRP density from AES terminals can also result from pointing factors and adjustments in the aggregate power of the network. Therefore, in AMSS networks, the contention table would provide added flexibility to trade off all of these factors.

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[36] Boeing Comments at 18; ARINC Comments at 24.

[37] Boeing Comments at 19.

ViaSat agrees with Boeing's argument that the contention exceedance table would appropriately provide AMSS operators a margin for error to account for mispointing.[38] While the Commission proposed the table in the VSAT context only to deal with multiple access techniques, the contention table would also allow flexibility for AMSS networks to exceed the limits for short periods as a result of other factors, such as antenna pointing and lags in dynamic power control. Just like increases in the network aggregate power density due to the use of contention protocols, increases in off-axis power toward an adjacent satellite due to antenna mispointing are likely to last only for very short periods. Because AES terminals are in motion and because the dynamic power control mechanism constantly adjusts the power into individual antennas, any exceedance of the off-axis EIRP density limits would not last long and could be adequately captured by the exceedance allowances in the contention table.

D. AMSS Operators Have Proven That An Aggregate Network Power Density Limit Is Feasible

The comments in the record support the ability of AMSS networks to meet the off-axis EIRP density limits on an aggregate basis.[39] An aggregate limit would provide AMSS operators the most flexibility to use any technology that is capable of meeting the off-axis power density mask, thereby promoting new technologies and encouraging the deployment of new broadband services. ViaSat urges the Commission to recognize, as it did in the context of ATCs in MSS bands, that an aggregate limit would facilitate more efficient uses of spectrum.[40] In order to promote new and improved services and greater spectrum efficiency, the Commission authorized terrestrial use of the MSS spectrum in the L-band, on a secondary basis. In that

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[38] *Id.* at 19.

[39] ARINC Comments at 2; SES Americom Comments at 4.

[40] ATC Second Order on Reconsideration at ¶ 47.

proceeding, the Commission adopted an aggregate limit on the amount of interference that a network of ATC terminals is permitted to generate, on a co-frequency basis, into MSS operations.

Significantly, the Commission did not require ATC operators to use any specific technology to meet these limits, and instead allowed operators to meet the limits in accordance with their own designs and business plans. The Commission applied this "enlightened" regulatory approach to afford network operators broad discretion to design ATC systems in any manner that would not exceed the aggregate noise level, and thus, did not require specific technology or constraints. In that case, the Commission determined that an aggregate limit was appropriate even though, at the time, there were no ATC technologies that were proven to operate at such limits and without causing interference to MSS operations.

The Commission should adopt the same enlightened regulatory approach for AMSS as it did for ATCs. Indeed, there is no reason to adopt a different approach for AMSS. Adoption of an aggregate off-axis EIRP density limit for AMSS should be even less controversial than in the ATC context because AMSS providers have demonstrated that AMSS systems can operate within prescribed limits and in a manner that avoids harmful interference to incumbent services. Dynamic power control technology is proven technology that allows AMSS networks to comply with the same off-axis EIRP density limits as VSATs. As discussed above, ViaSat, Boeing and SES Americom have experience with the actual operation of such networks, demonstrating that the technology works. Thus, the doubts that Telesat Canada and PanAmSat express regarding AMSS operators' ability to control aggregate network power and to ensure protection of adjacent satellites are unsubstantiated.[41]

Further, PanAmSat's proposals to adopt an antenna pointing accuracy requirement run counter to the approach that the Commission has taken in the ATC proceeding.[42] Such a requirement would impose design limitations on AMSS antenna technology. As discussed above, an antenna pointing requirement is unnecessary to protect adjacent satellites from harmful interference and would only serve to hinder the development of AMSS technology.

E. The Commission Should Allow Coordination With Satellite Operators For Higher Power Operations

ViaSat supports proposals to permit AMSS networks to operate at a higher power density than the off-axis EIRP density limits, subject to coordination with adjacent satellite operators. Like VSAT operators, AMSS operators should have the flexibility to coordinate with adjacent satellite operators any transmissions in excess of the off-axis EIRP density limits set forth in the Commission's rules.[43] VSAT operators and satellite operators routinely coordinate such higher power operations. Coordination among AMSS operators and satellite operators would proceed in the same manner. Intelsat and SES Americom both support this approach. As Intelsat notes, operator-to-operator coordination agreements are the "norm" and thus, certification by satellite operators and AES licensees should satisfy the Commission in licensing such AMSS networks.[44]

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[41] Telesat Canada Comments at 3; PanAmSat Comments at 2.

[42] PanAmSat Comments at 3.

[43] Boeing Comments at 23.

[44] Intelsat Comments at 5; *see also*, SES Americom Comments at 4.

Coordinating operations at levels higher than off-axis power density limits is particularly important for AMSS networks because foreign systems often operate at higher routine power levels than U.S. systems.[45] AES terminals are likely to communicate with non-U.S. networks during international flights. Thus, U.S. AMSS operators should be permitted to operate with satellites outside of U.S. airspace so that they may compete effectively with foreign operators. Imposing a strict requirement that AMSS networks operate within the off-axis EIRP density limits, even where adjacent satellite operators agree that they would not be harmed, could severely limit the ability of AMSS licensees to operate in foreign jurisdictions, thereby constraining development of AMSS by U.S. operators. By allowing coordination of higher power AMSS operations in the Ku-band, the Commission can "preserve operational flexibility for AMSS licensees while fully protecting the interests of potentially affected parties."[46]

IV. THE COMMISSION SHOULD ADDRESS THE ISSUES RAISED BY LAW ENFORCEMENT AGENCIES IN A SEPARATE PROCEEDING

The Departments propose that AMSS systems meet certain design requirements and technical capabilities to address the public safety and national security concerns.[47] ViaSat agrees that law enforcement must have the tools it needs to protect our country, and ViaSat is prepared to do its part to assist in that important effort. In the NPRM, the Commission notes that AMSS operators may be subject to any rules adopted in the Commission's currently pending proceeding on the applicability of CALEA requirements to broadband services, including

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[45] Boeing Comments at 24.

[46] *Id.* at 24.

[47] *See* Comments of the Department of Justice, Including the Federal Bureau of Investigation, and the Department of Homeland Security ("DOJ Comments").

services provided via satellite.[48] Therefore, to the extent that the Departments' comments address issues relating to CALEA, those concerns are addressed in that proceeding.

The Departments' comments also address the need for AMSS operational capabilities that go beyond the scope of CALEA. Some of the capabilities that the Departments propose, however, have not yet been developed, and others may be technologically infeasible or prohibitively expensive. The Commission should review these proposals carefully to identify the capabilities that should be implemented and to determine a reasonable transition period for AMSS operators to implement those the Commission decides are appropriate. Given the complexity of the Departments' proposals, and the difficult policy questions some of the proposals raise, the Commission should ensure that it reviews those proposals on a fully developed record.

The Departments submitted comments with substantially similar proposals in the Commission's proceeding to implement rules that would allow the use of cellular telephone and wireless devices on board aircraft.[49] This proceeding currently is open, with reply comments due in August 2005. While the "pico cell" technology for cellular communications on board aircraft employs different technology than aeronautical satellite antennas, the concerns of the law enforcement agencies with respect to these services appear to be similar to those relating to AMSS. Any policies that the Commission adopts for law enforcement access to aeronautical

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[48] *See* NPRM at n. 7; *Communications Assistance for Law Enforcement Act and Broadband Access and Services*, ET Docket No. 04-295, RM-10865, Notice of Proposed Rulemaking and Declaratory Ruling, FCC 04-187 at ¶ 37 (rel. Aug. 9, 2004).

[49] *See Amendment of the Commission's Rules to Facilitate the Use of Cellular Telephones and Other Wireless Devices Aboard Aircraft*, Notice of Proposed Rulemaking, WT Docket No. 04-435, FCC 04-288 (rel. Feb. 15, 2005) ("Pico Cell Proceeding"); DOJ Pico Cell Proceeding Comments (filed May 26, 2005).

communications systems should be consistent for all such systems, to the extent technically feasible and appropriate.

Therefore, the Commission should institute a separate proceeding to focus on law enforcement issues relating to aeronautical communications systems. The purpose of the AMSS NPRM proceeding is to address technical issues relating to radio frequency interference and to develop service rules and licensing procedures for AMSS, and thus, law enforcement issues relating generally to aeronautical communications systems would more appropriately be addressed separately from the issues in this NPRM.

V. THE COMMISSION SHOULD NOT REQUIRE OPERATORS TO SUBMIT TRACKING DATA INTO A PUBLICLY ACCESSIBLE DATABASE

Although ViaSat agrees with other commenters that AMSS operators should be required to maintain tracking data, neither the Commission nor a third party needs to maintain a database of such data, as some suggest. In the FSS arena, earth station licensees and satellite operators cooperate with one another to identify and resolve instances of interference. There is no third-party tracking database interference database for FSS or for ESVs. In the context of ESVs, the Commission determined that making real-time location information available to third parties was unnecessary and that "the risk associated with ubiquitous distribution of such tracking information outweighs the benefit it may provide in preventing interference to other operations."[50] The Commission determined that the point of contact requirement and the requirement that operators maintain tracking data for one year are sufficient to resolve interference issues.[51]

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[50] ESV Order at ¶ 112.

[51] *Id.*

Boeing and ARINC support this approach in their respective comments.[52] Satellite operator, Telesat Canada, also notes that "[a]s in other cases of interference, the best recourse is contact between satellite operators."[53] As ARINC points out, satellite operators have an excellent track record in cooperating with each other to locate and eliminate interference.[54] AMSS operators are able to coordinate with satellite operators through the same procedures. ViaSat agrees that AMSS operators should maintain their own tracking data and make available any information that is relevant to resolving specific instances of interference through a point of contact in the U.S. However, for purposes of determining the source of interference, such information should be provided without any information that might identify the particular aircraft or its owners or passengers.[55]

The databases proposed by PanAmSat and the Satellite Users Interference Reduction Group ("SUIRG") would jeopardize the security of confidential data.[56] Additionally, the administrative burdens of maintaining a database that can be accessed by FSS operators are unnecessary and unjustifiable. The expense and resources that a third-party database would require would add to the cost of providing AMSS services, which could hinder deployment of the service, without any added benefit. As noted by ViaSat, Boeing and ARINC, making real-time AES tracking data raises security and privacy concerns, especially to business jets used by individuals or corporations.[57] AMSS services would be significantly less attractive to customers due to the risk of security breaches that could result if satellite operators and other private

[52] Boeing Comments at 36; ARINC Comments at 17.

[53] Telesat Canada Comments at ¶ 14.

[54] ARINC Comments at 16.

[55] *Id.* at 17.

[56] SUIRG Comments at 2; PanAmSat at 5.

[57] Boeing Comments at 37; ARINC Comments at 17; ViaSat Comments at 22.

citizens were able to access information that could be used to monitor a person's location and travel destinations.

VI. LICENSING ISSUES

A. Technical Showings

Telesat Canada supports a requirement for a technical showing from AMSS applicants that the proposed system will not exceed the off-axis EIRP density limits.[58] ViaSat agrees that AMSS applicants should provide technical information in applications, including non-proprietary system design information, to demonstrate that the system performance would conform with the rules. The Commission should examine carefully any proposals to impose informational requirements on AMSS operators to ensure that the required showings are not burdensome and would not defeat the purpose of adopting streamlined licensing procedures.

Boeing proposes a specific requirement to submit a report regarding performance verification testing of new AMSS systems prior to commencement of commercial operations.[59] Boeing argues that such a requirement would not be overly burdensome given that AMSS operators are likely to conduct such tests in any event. However, a requirement to submit a report would not be meaningful and is more than is necessary to ensure that systems comply with off-axis power density limits. The Commission's rules already provide that earth station licensees are required to certify within one year of the date of grant of a license that licensed facilities have been constructed and are operating in accordance with the licensed parameters.[60] This certification requirement is all that is necessary for AMSS systems. Requiring AMSS operators to provide a report or further information on performance tests would impose

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[58] Telesat Canada Comments at 3.

[59] Boeing Comments at 29.

[60] 47 C.F.R. § 25.133.

administrative burdens on the AMSS operator and is unlikely to provide any additional benefit to the Commission or other service providers in the Ku-band.

B. ALSAT Designation

The comments submitted in this proceeding reinforce ViaSat's support for allowing ALSAT authority for AES terminals.[61] In addition to the comments of AMSS operators, Telesat Canada also supports ALSAT designations for AES antennas.[62] However, Telesat Canada proposes to limit ALSAT authority to AES terminals that are 2-degree compliant. The off-axis EIRP density limits and the contention exceedance table are intended to represent the level of interference that satellites in a 2-degree spacing environment are able to tolerate. Thus, the Commission should instead make clear that ALSAT authority is available for antennas that comply with the off-axis power density limits, as adjusted by the contention exceedance table.[63]

As the Commission determined in the context of ESVs, allowing ALSAT designations to Ku-band AMSS operators would afford flexibility to negotiate with multiple satellite service providers for satellite capacity.[64] Requiring AMSS operators to file modifications each time they wish to change satellite providers, or in instances where traffic is migrated to a different satellite in the satellite operator's fleet, would impose unnecessary burdens on AMSS applicants and on the Commission.

AES terminals are no different than VSATs from an interference perspective; *i.e.*, an AES terminal that complies with the same off-axis EIRP density limits as VSAT terminals

[61] Boeing Comments at 35; ARINC Comments at 23.

[62] Telesat Canada Comments at 4.

[63] ARINC at 23.

[64] *Id.*

would not cause any more interference into adjacent satellites. Therefore, there is no reason not to afford AES licensees the ability to modify their points of communication without prior FCC authority, as long as the satellite is U.S.-licensed or is a non-US-licensed satellite with an ALSAT designation.

VII. CONCLUSION

For the foregoing reasons, ViaSat respectfully requests that the Commission adopt service rules and streamlined licensing procedures for AMSS consistent with the proposals in ViaSat's comments and in these reply comments. Further, ViaSat requests that the Commission consider the issues raised by the Departments in a separate proceeding.

Respectfully submitted,

VIASAT, INC.

By: *\/s/ John P. Janka*

John P. Janka
Teresa D. Baer
Elizabeth R. Park
LATHAM & WATKINS LLP
555 Eleventh St., N.W., Suite 1000
Washington, D.C. 20004
202-637-2200

Counsel for ViaSat, Inc.

Filed: August 3, 2005

Exhibit A

Technical Summary of Pointing Error Effects

Introduction

This document describes the effects of antenna pointing errors of aeronautical earth stations (AES) terminals in a network using direct sequence spread spectrum and CDMA. Analysis of the components that induce pointing error, and simulation of a population of such AES terminals with random error, show that pointing errors of individual AES terminals do not cause harmful interference to adjacent satellite systems – even at pointing errors an order of magnitude greater than the 0.2° pointing accuracy requirement proposed by the FCC in the Notice of Proposed Rulemaking (NPRM).

Additionally, the simulation shows that AMSS networks employing dynamic power control and congestion control[1] can model and account for pointing error of individual terminals on an aggregate basis, such that the overall network off-axis EIRP density is maintained within the FCC's proposed mask.

Elements of Pointing Error

A number of factors can cause AES antennas to become mispointed. These errors can be described as either static or dynamic and may be nonrandom or random in nature.

An example of static error would be the case where upon installation, the antenna base plate was improperly aligned in the azimuth plane by some fixed amount. In practice however, the installation process includes a calibration routine where any alignment errors are detected and corrected. Therefore, this analysis does not include this type of error as a factor.

An example of a dynamic error would be a case where during turbulence the airframe flexes to a degree where some mis-alignment between the nose and tail is present. This momentary mispointing would return to normal after the aircraft transits the air pocket. The direction and magnitude of error induced would be random. This simulation assumes dynamic, random errors.

The ViaSat tail mounted antenna subsystem (TMASS) used by ARINC in their AMSS network uses an open loop pointing algorithm. The algorithm takes in to account:

- Ephemeris data stored in the AES to determine the satellite location and polarization

[1] Congestion control reduces the number of simultaneously transmitting AES terminals when network aggregate EIRP density levels reach defined thresholds.

- Stored constants to determine the antenna orientation relative to the airframe (part of commissioning calibration test procedure)
- Latitude, longitude, and altitude data from the aircraft inertial navigation system (INS) to determine the aircraft location
- Heading, pitch, roll, and yaw data from the aircraft INS to determine the aircraft orientation
- Speed, pitch, roll, and yaw rate of change data from the aircraft INS to predict changes in aircraft location and orientation.

Once the AES terminal is assigned to a particular point of communication, the antenna control unit (ACU) continuously updates the pointing of the antenna based on new data from the INS. New data is provided from the INS every 0.02 seconds with a resolution of 0.05º. The ACU computes the desired steering inputs for the antenna's azimuth, elevation, and polarization motors once every millisecond. The antenna mechanical resolution is 0.09º and the motors accelerate at up to $40^{\circ}/s^2$ and drive each axis at a nominal 30º/s. The calculated root mean squared (RMS) pointing error for the system typically is less than 0.1º during normal flight operations.

If the AES detects an ACU or TMASS error or loses receive lock on the downlink signal from the satellite, the transmitter is inhibited within 250 ms.

The Simulation

The simulation has several inputs: a reference antenna gain pattern for individual AES terminals, the number of iterations to run, and the standard deviation for the pointing error.

Reference Antenna Pattern

The simulations in this summary represent a simplified 0.2921 m reference antenna pattern that is symmetric about both the elevation and azimuth planes. The reference pattern was generated based on the mean magnitude of off-axis gain at each 0.2° angle increment off the main beam in any direction. The purpose of this approach is to simplify the look-up of off-axis gain in any direction, especially at off-axis angles greater than 5º, where the sidelobe patterns for azimuth and elevation planes are significantly different.

Standard Deviation for Pointing Error

The simulation generates a random error in degrees for both the elevation and azimuth planes with a normal, or Gaussian, probability distribution. The initial simulation run in this analysis is based on the FCC's proposal in the NPRM that pointing accuracy be maintained with 0.2º. While the FCC does not provide an allowance for exceeding such a limit, the standard deviation values used in the simulation were selected based on reasonable "real-world" assumptions common in the satellite industry. The simulation assumes that AES pointing accuracy is maintained within 0.2°, 99.73% of the time, or three standard deviations (3σ). Accuracy at a 99.73% level is consistent with the common satellite industry standard for link availability, and thus, is a reasonable assumption for this simulation. In addition to the 0.2º pointing error simulation, other simulations were run at increasingly higher 3σ values of 0.5º, 1º, 5º, and 10º. ViaSat does not propose these higher values as alternative antenna pointing accuracy requirements. Instead, ViaSat includes the results of such simulations in this analysis to illustrate that aggregate off-axis EIRP density increases are relatively small, even when random pointing errors are 20 times greater than the FCC's proposed pointing accuracy requirement. AMSS operators can adequately manage the effects of any such errors through dynamic power control / congestion control of the network.

The standard deviation (1σ) values selected for the simulation runs were 0.0666º, 0.1666º, 0.3333º, 1.6666º, and 3.3333º. These values correspond to the 3σ values of 0.2º, 0.5º, 1.0º, 5º, and 10º, respectively. Figure 1 shows the familiar normal curve for the 1.6666º standard deviation (3σ = 5.0°) case.

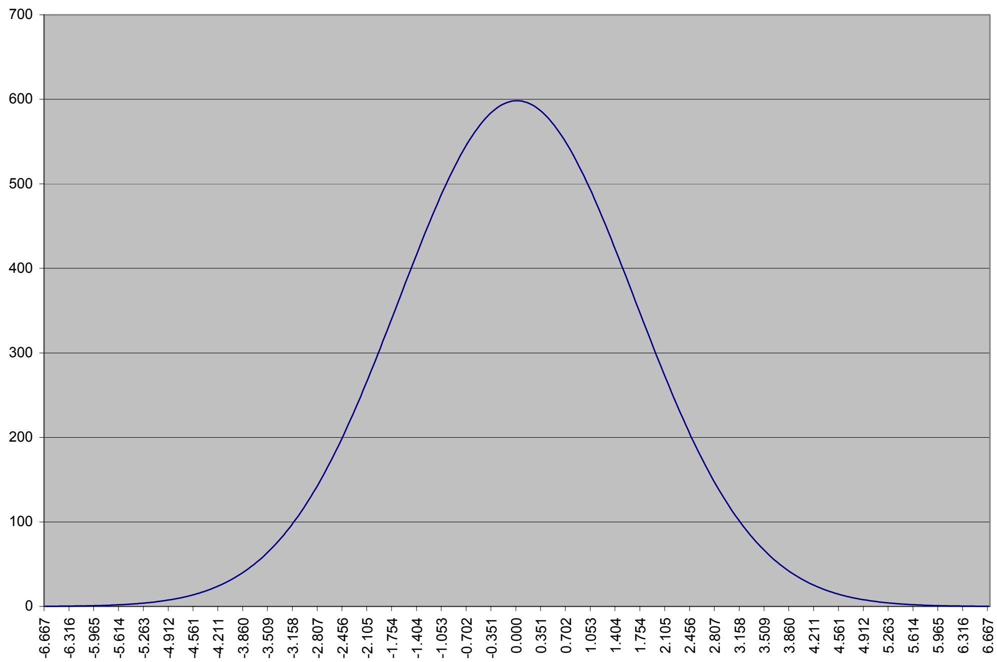

Figure 1 - Sample Frequency Distribution of Pointing Error (1σ = 1.6666 deg, 3σ = 5.0)

Table 1 shows the percentage of time that pointing error would be less than a given value. The 1σ and 3σ values are highlighted.

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For example, a 3σ value of 0.2º means that 99.7% of the time the error in either the azimuth or elevation axis will be less than 0.2º and that 68.3% of the time it will be less than 0.0666º.

The percentage of time under the normal curve must always add up to 100%. So for example in the 0.2º case, 20% of the time the error will be 0.0169º or less and 80% of the time it will be greater than 0.0169. Similarly if 80% of the time, pointing error is less than 0.0854º, and 20% of the time it is greater than 0.0169º then 60% of the time it must be between 0.0854º and 0.0169º.

σ	Percentage of time	0.2º (3σ)	0.5º (3σ)	1.0º (3σ)	5.0º (3σ)	10.0º (3σ)
0.2534	20.00%	0.0169º	0.0422º	0.0845º	0.4223º	0.8447º
0.3854	30.00%	0.0257º	0.0642º	0.1285º	0.6423º	1.2847º
0.5245	40.00%	0.0350º	0.0874º	0.1748º	0.8742º	1.7483º
0.6745	50.00%	0.0450º	0.1124º	0.2248º	1.1242º	2.2483º
0.8417	60.00%	0.0561º	0.1403º	0.2806º	1.4028º	2.8057º
1.0000	**68.27%**	**0.0667º**	**0.1667º**	**0.3333º**	**1.6667º**	**3.3333º**
1.0365	70.00%	0.0691º	0.1728º	0.3455º	1.7275º	3.4550º
1.2816	80.00%	0.0854º	0.2136º	0.4272º	2.1360º	4.2720º
1.6450	90.00%	0.1097º	0.2742º	0.5483º	2.7417º	5.4833º
1.9600	95.00%	0.1307º	0.3267º	0.6533º	3.2667º	6.5333º
2.2420	97.50%	0.1495º	0.3737º	0.7473º	3.7367º	7.4733º
2.5760	99.00%	0.1717º	0.4293º	0.8587º	4.2933º	8.5867º
2.8100	99.50%	0.1873º	0.4683º	0.9367º	4.6833º	9.3667º
3.0000	**99.73%**	**0.2000º**	**0.5000º**	**1.0000º**	**5.0000º**	**10.0000º**
3.3000	99.90%	0.2200º	0.5500º	1.1000º	5.5000º	11.0000º
3.9000	99.99%	0.2600º	0.6500º	1.3000º	6.5000º	13.0000º

Table 1 – Degrees of Pointing Error vs. Percentage of Time

The magnitude of error calculations in Table 1 above take into account the direction of the error – either azimuth or elevation. Thus, the magnitude of the combined error vector is:

$$Total\_Error = \sqrt{Az\_Error^2 + El\_Error^2}$$

See Figure 2.

i.e., if the error in the azimuth axis is 0.2º at the same time it is 0.2º in the elevation axis the total error would be 0.28º.

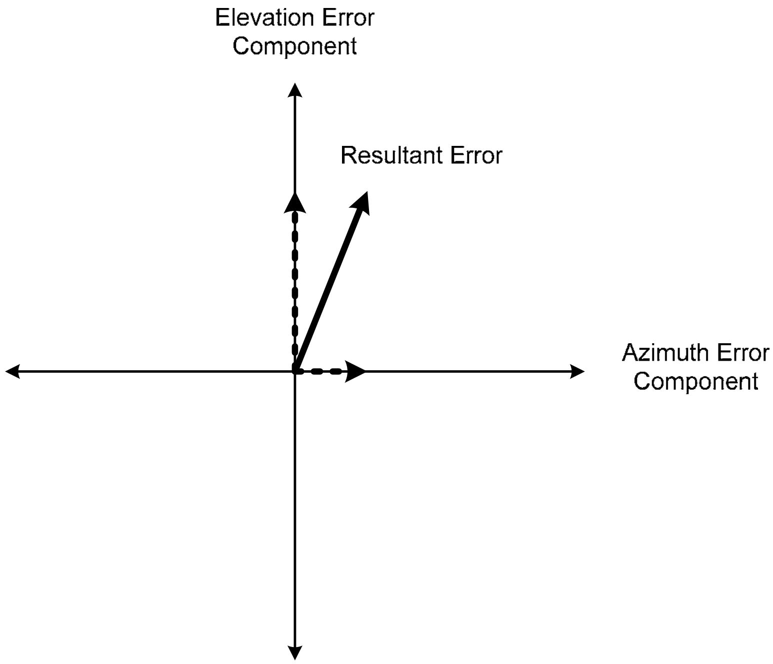

Figure 2 – Resultant Pointing Error

AES Terminal Locations

The simulation uses a ±10º range across the geostationary arc and includes satellite locations from 85º West longitude to 105º West longitude. The analysis described in this document assumes random AES locations in order to simulate mobile AES terminals. The simulator generates for each iteration a random latitude and longitude within the geographic boundaries of CONUS for the AES location.

How The Simulation Works

During a simulation run, the simulator calculates for each iteration the look angle from the new AES location to each 0.2° increment, or "location of interest" along the geosynchronous arc from 85º WL to 105º WL. The simulator creates a "data bin" for each location of interest, into which the off-axis gain measurements for such location of interest are collected.

Next, the program generates a random pointing error value for azimuth and elevation based on the standard deviation assumption input. The azimuth and elevation error components are added together to determine the total error offset angle and magnitude. For each location of interest along the orbital arc, the resultant change in off-axis gain over a properly pointed antenna is calculated and added to the data bin for that location of interest.

The simulator calculates multiple iterations of this process until the desired number of iterations has been reached. The simulations in this summary are based on 1 million iterations.[2] At the conclusion of the simulation run, each data bin contains the sum of all the off-axis gain from each AES terminal in the direction of that particular location of interest. The simulator compiles the output for each data bin in a file available for review.

Geocentric angle versus Topocentric angle

The spacing of satellites along the geostationary arc is nominally every 2º along the equator. That is, the angle between two satellites as seen from the center of the earth, or geocentric, is 2º. The angle between two satellites from the perspective of the AES terminal operating on or above the surface of the earth is the topocentric angle. The topocentric angle between two satellites from the perspective of an AES terminal will always be greater than the geocentric angle. The actual angle as observed by the AES depends upon the location of the AES terminal. When AES terminals are allowed to move about within the simulation, each terminal will have a slightly different topocentric angle to the geostationary arc depending upon its location.

The simulation results in the charts below are based on the topocentric angle. Therefore, the data points are plotted over +/- 12.1 degrees, which represents the average topocentric angle across the U.S. for +/- 10 degrees of geocentric angle.

Results of Pointing Error Simulation

The charts in Figures 3 and 4 below illustrate the baseline off-axis EIRP density of the AES terminals used for the simulation. Figure 3 shows the reference antenna pattern from a single centrally located antenna, as plotted across the geographic arc versus the current 25.209 mask. This is to establish a baseline off-axis EIRP density profile across the geographic arc from 85º WL to 105º WL. The antenna off-axis gain in this case does not meet the requirements of 25.209; thus, the antenna input power density is reduced to meet the intent of 25.209 and 25.134 and the proposed FCC off-axis EIRP density mask. A second plot on the chart shows the antenna pattern amplitude reduced by lowering the input power density via direct sequence spread spectrum (DSSS) to just meet the mask. This pattern represents the input power density reduction required by a single transmitter to meet the mask limits.

Because the ViaSat AMSS network uses CDMA, the input power density of individual AES antennas is further reduced so that the aggregate off-axis EIRP density of all AES terminals in the network complies with the mask. The greater the number of simultaneously active terminals in the network, the further each terminal's input power

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[2] The simulation results for iterations greater than 100 converge quickly, and thus, the difference between the network aggregate patterns plotted for a simulation based on 100 iterations and a simulation based on 1 million iterations is small.

density must be reduced. A third plot in Figure 3 shows the gain plot reduced an additional 20 dB, simulating in this case that the AES is one terminal out of a network of 100 technically identical CDMA terminals.

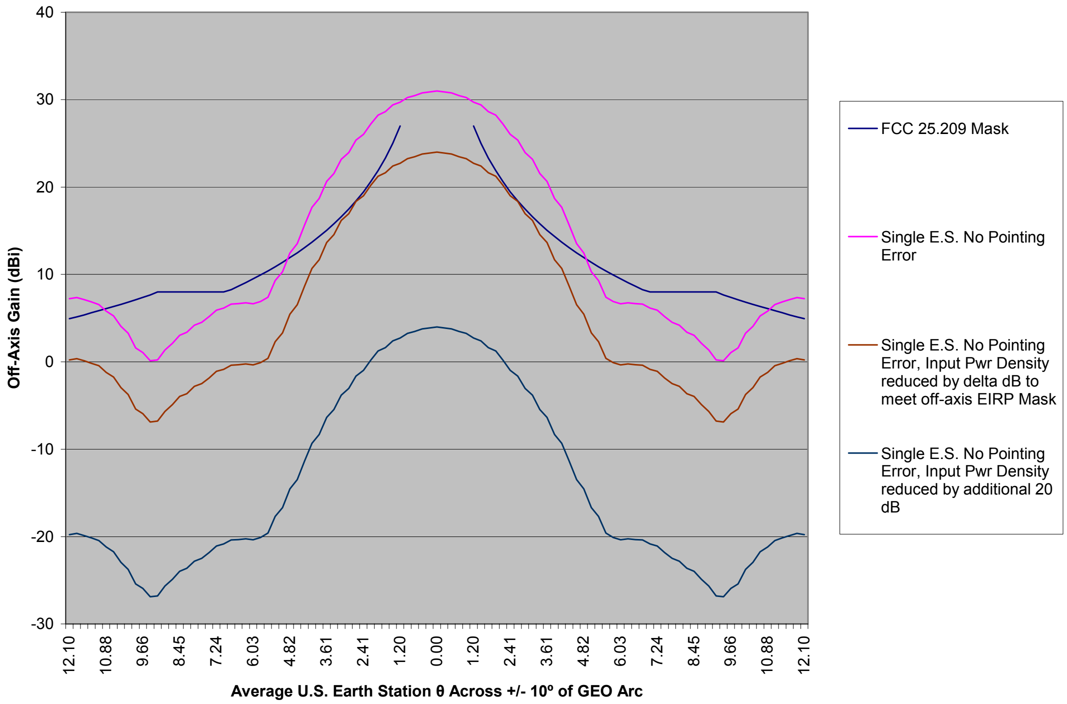

Figure 3 - Representative Antenna Pattern (no pointing error)

Figure 4 illustrates a baseline plot of network aggregate off-axis gain for a large population of perfectly pointed AES terminals transmitting from random locations. The patterns in Figure 4 appear smoother than those in Figure 3 due to the averaging of the varying topocentric angles across the satellite arc for different terminal locations. The patterns in Figure 4 serve as the baseline off-axis gain pattern reference to which the results of the pointing error simulation should be compared.

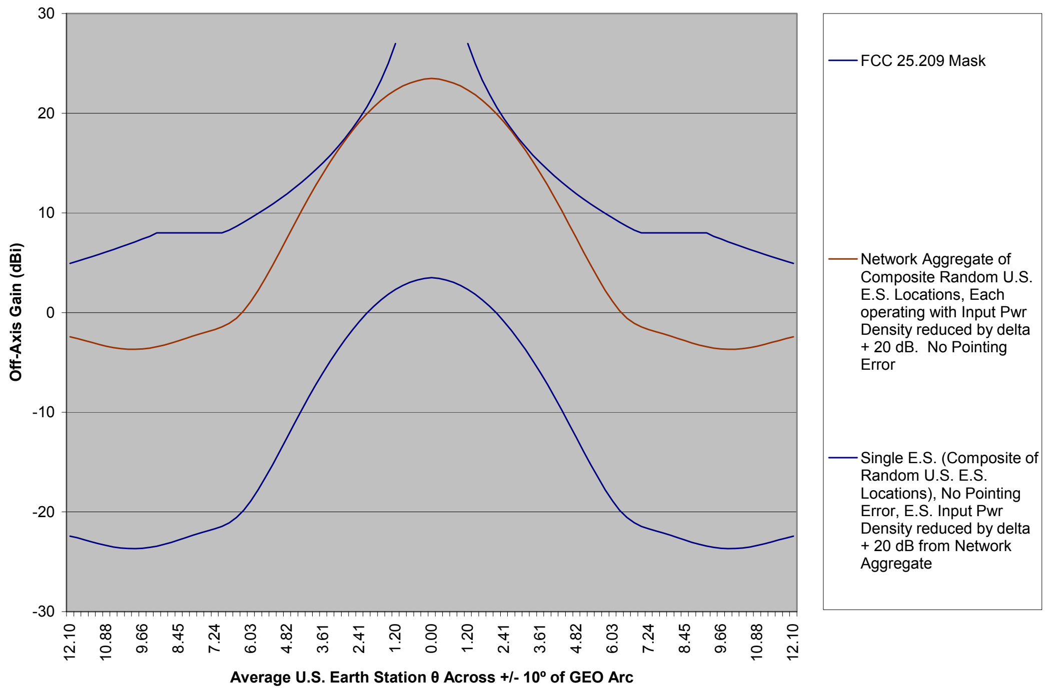

Figure 4 - Reference Antenna Pattern for Composite Locations

As illustrated in Figure 4, the effect of a single AES terminal in the 100 node CDMA network described above with its antenna mispointed by 0.2º, 0.5º, 1.0º, 5.0º, or even 10º would be minimal. As seen from the pattern of the individual antenna, even when shifting the antenna pattern fully to the right or left side of the plot, the level of interference generated by this single terminal is well below the mask and too low to cause harmful interference into adjacent satellites.

In a CDMA system, the larger the number of AES terminals transmitting simultaneously co-frequency, the smaller the individual contribution of each AES will be to the network aggregate power density. This reduction of power into individual antennas further lowers the likelihood that any given terminal on its own can cause interference into an adjacent system. Conversely, a conventional VSAT terminal not using CDMA, and operating at the limits of the mask, could easily exceed the mask and cause interference by a small shift of the antenna pattern to the right or left. In this case, much tighter pointing accuracy would be required to prevent harmful interference into adjacent satellites.

Figure 5 shows several AES terminals at random locations with random antenna mispointing. The simulation generating these results assumes a 1.666° standard deviation (3σ = 5.0º) input for the pointing error. Figure 5 also includes the baseline reference network aggregate plot, plus the composite off-axis plot resulting from one million iterations (each iteration simulates a single AES terminal at a random location with random error). As illustrated in this chart, the pointing error across the network of terminals increases the composite off-axis EIRP density at 3.61º by only 0.5 dB.

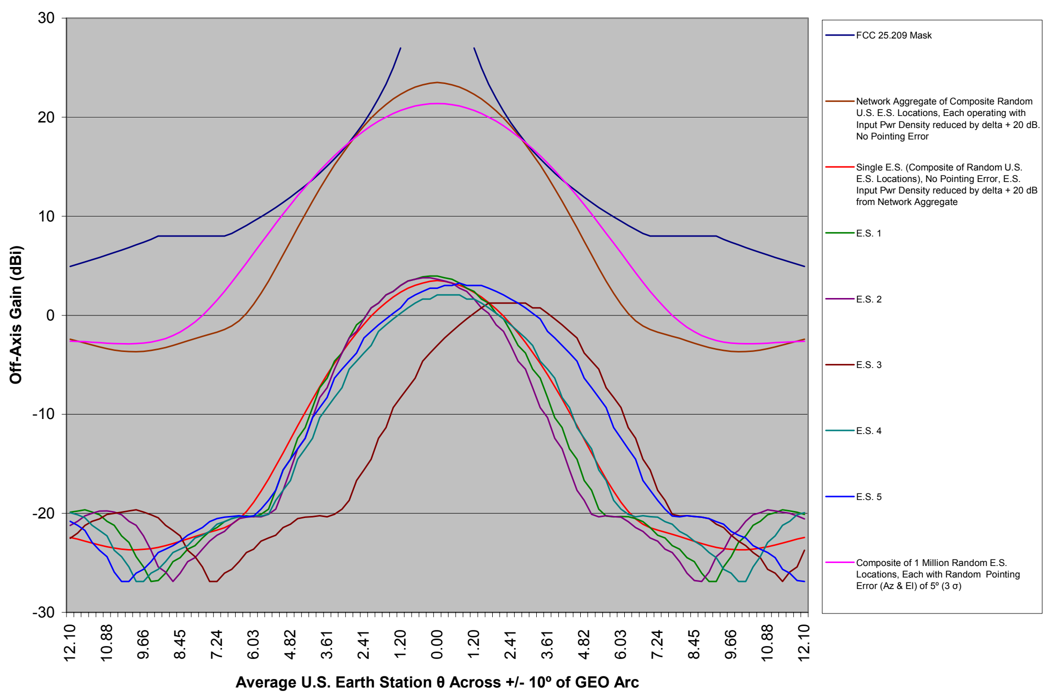

Figure 5 – Results for 5º (3σ)

Figures 6 - 10 show the baseline reference plot compared to the composite off-axis gain profiles for one million iterations (randomly located AES terminals with random antenna mispointing) at 3σ values of 0.2º, 0.5º, 1.0º, 5º, and 10º. As shown in Figures 6-8, for pointing accuracy assumptions up to 1.0º there is no appreciable change in the network aggregate off-axis gain profile seen by the observers along the geostationary arc – the reference plot and the pointing error plot are virtually indistinguishable. For pointing accuracy assumptions of 5º and 10º, the network aggregate off-axis gain profile only exceeds the mask by 0.5 to 1.35 dB, and is only slightly higher than the baseline off-axis profile.

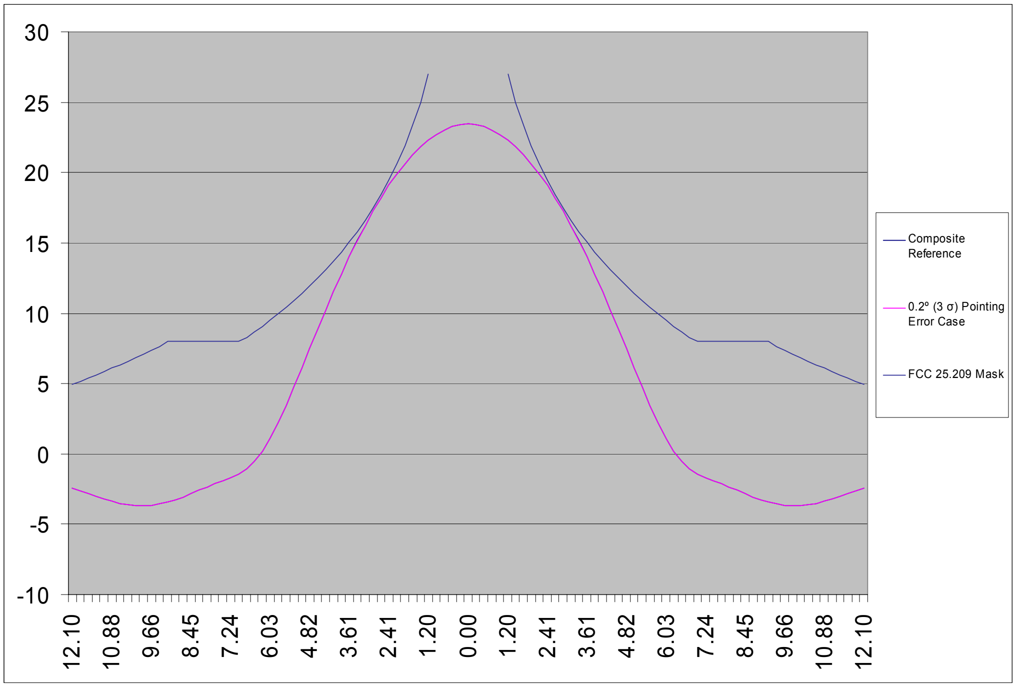

Figure 6 - Results for 0.2º (3σ)

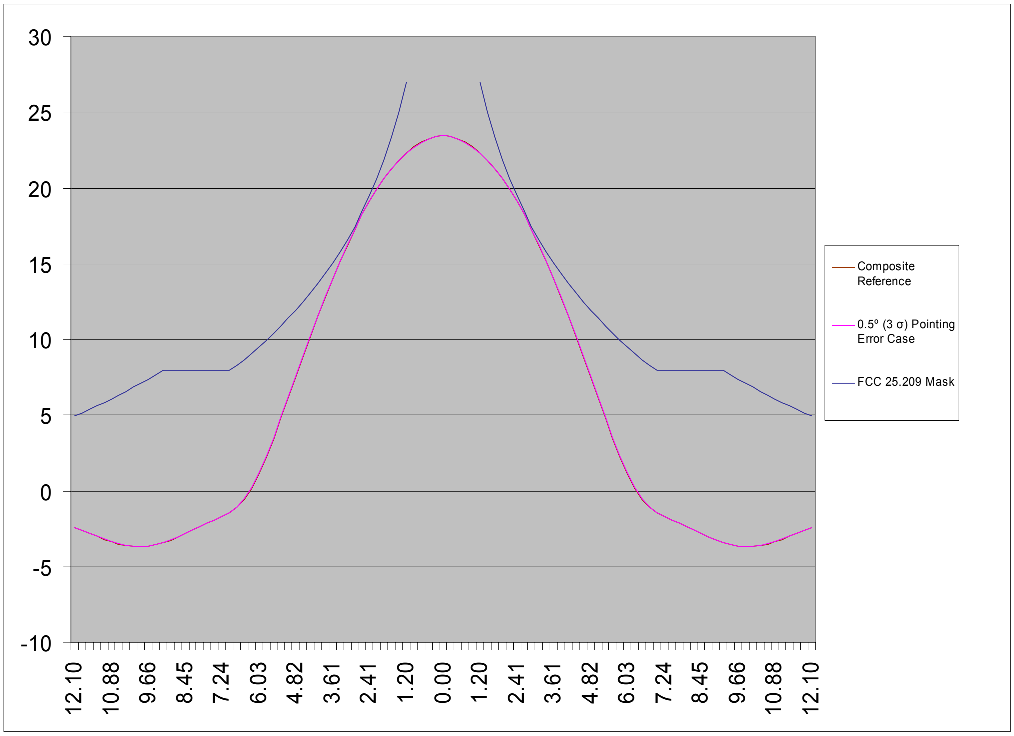

Figure 7 - Results for 0.5º (3σ)

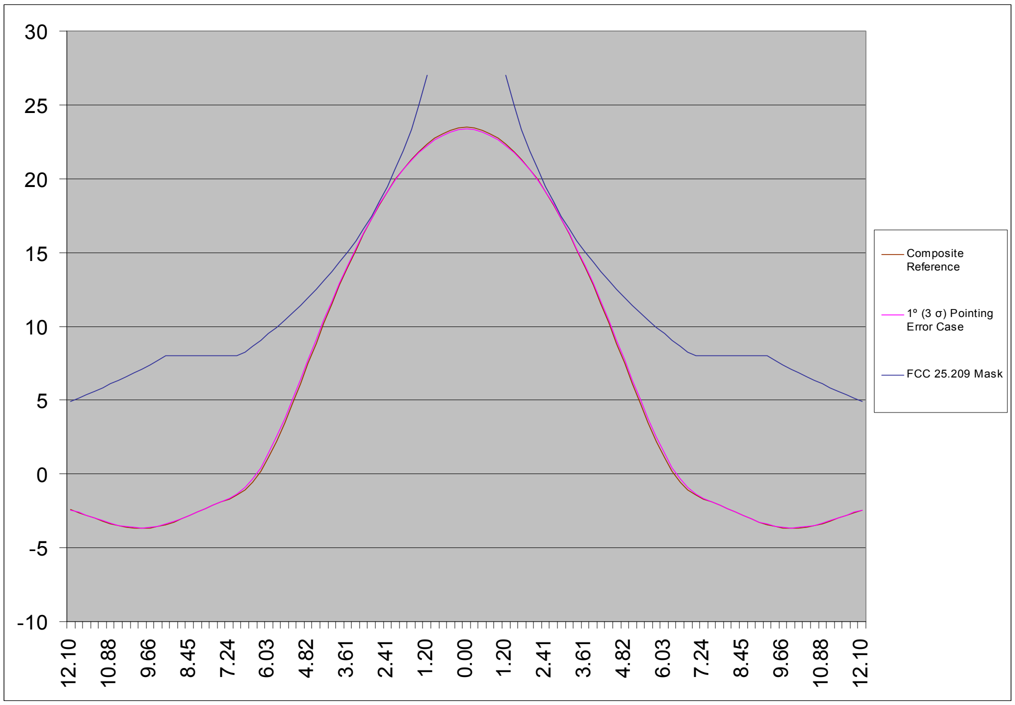

Figure 8 - Results for 1.0º (3σ)

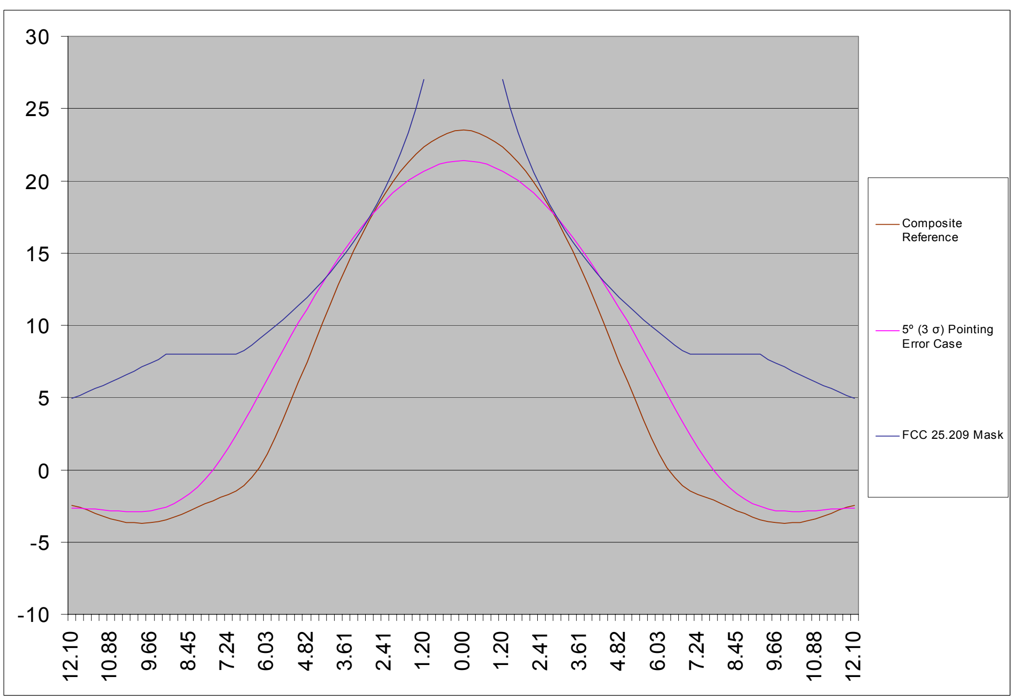

Figure 9 - Result for 5.0º (3σ)

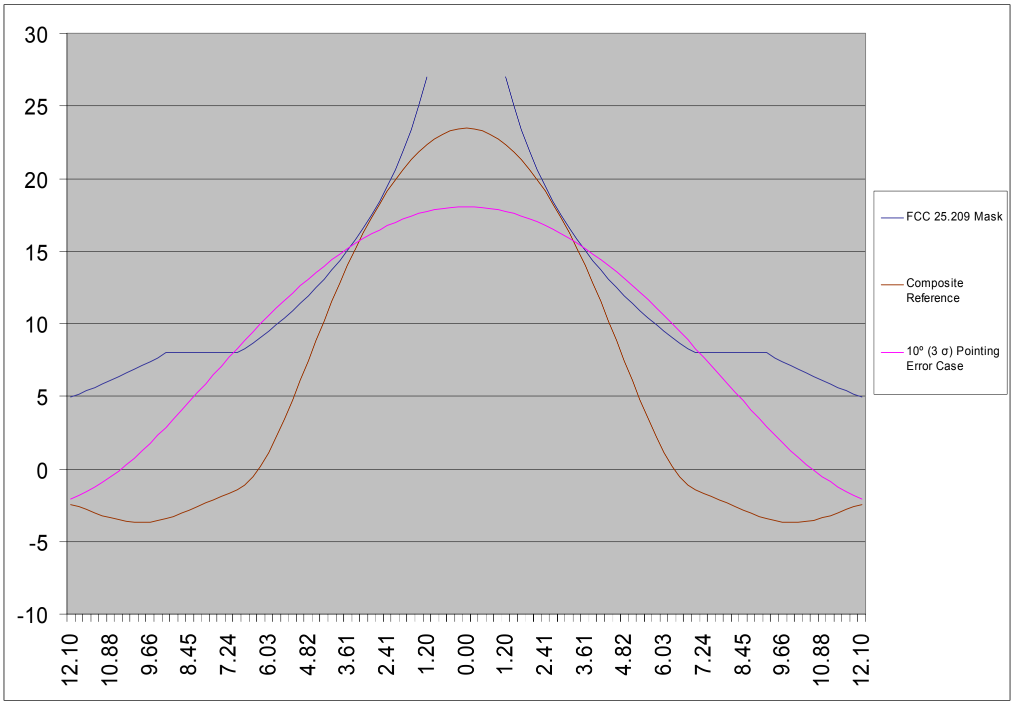

Figure 10 - Result for 10.0º (3σ)

Conclusion

The simulation shows that because the pointing error in these examples is random and dynamic in nature, and because the network is comprised of a large number of terminals using CDMA, the network aggregate off-axis EIRP density is only slightly increased even when significant pointing errors are present on individual AES terminals. The transient nature of these errors are such that violation of the mask would only occur for very short periods – even in a system not employing dynamic power control / congestion control.

The allowances in the proposed contention exceedance table would capture such momentary increases in aggregate off-axis EIRP density resulting from pointing errors. AMSS network operators using dynamic power control / congestion control are able to reduce network aggregate off-axis EIRP density to levels that comply with the off-axis EIRP density limits, as adjusted by the allowances in the contention table. Therefore, a separate pointing error limit for these systems is unnecessary.

ENGINEERING INFORMATION CERTIFICATION

I hereby certify that I am the technically qualified person responsible for reviewing the engineering information contained in the foregoing submission, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

REGISTERED PROFESSIONAL ENGINEER
DARYL T. HUNTER
E 16610
EXP. 06-30-2006
ELECTRICAL
STATE OF CALIFORNIA

Daryl T. Hunter, P.E.
ViaSat, Inc.
6155 El Camino Real
Carlsbad, CA 92009-1699

Dated: August 3, 2005