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

In the matter of	)	
	)	
Amendment of Parts 2 and 25 of the	)	
Commission's Rules to Allocate Spectrum	)	
and Adopt Service Rules and Procedures to	)	IB Docket No. 07-101
Govern the Use of Vehicle-Mounted Earth	)	
Stations in Certain Frequency Bands	)	
Allocated to the Fixed-Satellite Service	)	
	)	

REPLY COMMENTS OF VIASAT, INC.

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Summary

ViaSat, Inc. ("ViaSat") is pleased that the parties commenting in this proceeding overwhelmingly support the Commission's proposal to license Vehicle-Mounted Earth Stations ("VMES") as an application of the fixed-satellite service in the conventional and extended Ku-band frequencies. However, the comments reflect differing positions regarding the form that VMES service rules should take. In weighing these positions, ViaSat urges the Commission to assess the degree to which corresponding VMES service rules: (i) are technology-neutral; and (ii) embrace a wide range of VMES technologies and applications.

As ViaSat demonstrated in its comments, small, low-profile VMES terminals using spread spectrum modulation and Code Division Multiple Access can operate well under the proposed off-axis EIRP density mask, thereby avoiding harmful interference into adjacent operations, while still providing viable service to the general public. ViaSat urges the Commission to adopt service rules that will facilitate the ability of VMES operators to provide service using these terminals, and to otherwise provide a full range of government, business, and consumer applications at price points appropriate to each of these groups.

In particular, the Commission should avoid adopting rules that would restrict routine licensing and primary status to VMES antennas employing "traditional" technology complying with the Commission's Earth Station on Vessel rules. The record establishes that as long as VMES transmitters comply with the proposed off-axis EIRP density mask, additional requirements – such as strict antenna pointing limits – are unnecessary to protect adjacent users from harmful interference. Thus, ViaSat urges the Commission to adopt service rules that afford system operators the flexibility to employ new and innovative technologies that are capable of cost-effective and efficient service, while protecting adjacent users from harmful interference. This approach would advance the public interest by allowing the marketplace to determine which system designs are most efficient and effective.

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REPLY COMMENTS OF VIASAT, INC.

I. INTRODUCTION

ViaSat, Inc. ("ViaSat") submits the following reply to the comments filed in connection with the above-captioned proceeding.[1] ViaSat is pleased that the parties commenting in this proceeding overwhelmingly support the Commission's proposal to license Vehicle-Mounted Earth Stations ("VMES") as an application of the fixed-satellite service ("FSS") in the conventional and extended Ku-band frequencies. While the comments vary with respect to certain aspects of licensing and the degree to which the VMES service rules should deviate from the Earth Station on Vessel ("ESV") service rules, ViaSat is optimistic that, based on the record in this proceeding, the Commission can adopt rules that will promote mobile broadband services and allow deployment of VMES on a commercially viable basis, without disrupting traditional Ku-band services. In weighing the various positions taken in the comments, the Commission should assess the degree to which corresponding VMES service rules: (i) are technology-neutral; and (ii) embrace a wide range of VMES technologies and applications.

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[1] *Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in*

ViaSat urges the Commission to adopt rules that prospectively account for the wide array of potential government and commercial VMES technologies and applications, and to avoid adopting rules that suit only traditional technology, as General Dynamics Corporation ("General Dynamics") proposes. General Dynamics' request to adopt rules that permit only "full performance" VMES terminals[2] – meaning VMES terminals that have the technical characteristics of General Dynamics' VMES terminals – is entirely self-serving and inconsistent with evidence in the record.

As ViaSat demonstrated in its comments, small, low-profile VMES terminals using spread spectrum modulation and Code Division Multiple Access ("CDMA") can operate well under the proposed off-axis EIRP density ("OAED") mask, thereby avoiding harmful interference into adjacent operations, while still providing viable service to the general public. For example, Qualcomm, Incorporated's OmniTRACS operations demonstrate that even without a precise antenna pointing mechanism, VMES systems are capable of providing commercially viable service without causing interference. Other commenters have also recognized that low-power operation using spread spectrum technology renders pointing accuracy requirements unnecessary to prevent adjacent satellite interference.[3]

Certain Frequency Bands Allocated to the Fixed-Satellite Service, Notice of Proposed Rulemaking, IB Docket No. 07-101, FCC 07-86 (May 9, 2007) ("*NPRM*").

2 Comments of General Dynamics Corporation, IB Docket No. 07-101, at 35 (Aug. 17, 2007) ("General Dynamics Comments")

3 *See, e.g.*, Comments of the Boeing Company, IB Docket No. 07-101, at 24-5 and n.25 (Aug. 17, 2007) ("Boeing Comments") (noting Boeing's plan to incorporate spread spectrum technologies into its VMES systems, and "arguing against the imposition of pointing error and transmission cessation requirements for VMES . . . ."); Comments of Raysat Antenna Systems, LLC, IB Docket No. 07-101, at 11 (Aug. 17, 2007) ("Raysat Comments") ("To address this issue, the Commission should apply the pointing accuracy requirement only to those VMES terminals that seek to operate at maximum permissible off-axis EIRP levels without taking mispointing into account.").

Critically, while ViaSat supports rules that provide flexibility to use spread spectrum and other innovative technologies to offer cost-effective VMES service, ViaSat does not condone low-quality VMES systems that are unable to operate within the proposed OAED mask. ViaSat believes that the Commission can adopt reasonable limits that promote consumer-friendly VMES solutions but that also effectively prevent harmful interference. ViaSat urges the Commission to take a broader view of VMES than General Dynamics proposes by adopting service rules that will maximize the potential for a full range of government, business, and consumer applications at price points appropriate to each of these groups, while still ensuring that adjacent users are protected from harmful interference.

Furthermore, although ViaSat supports timely action by the Commission to adopt rules in this proceeding, ViaSat does not support General Dynamics' approach of adopting rules on an expedited basis that would only afford primary status to a limited class of VMES antennas that use traditional antenna technology. Adopting VMES service rules in this limited fashion would undercut the public interest benefits that spread spectrum and other new technologies can offer. Therefore, the Commission should refrain from adopting a framework that suits a limited range of systems merely for the sake of adopting rules quickly.

II. THE RECORD REFLECTS STRONG SUPPORT FOR ADOPTING THE PROPOSED FOOTNOTES TO PERMIT VMES OPERATIONS AS AN APPLICATION OF FSS IN THE KU- AND EXTENDED KU-BANDS

Commenters in this proceeding have overwhelmingly supported the Commission's proposal to add new non-Federal footnotes to the U.S. Table of Allocations providing that VMES is an application of FSS, and may be authorized as such as on a primary

basis in the Ku-band and on a secondary basis in the extended Ku-band.[4] As ViaSat and others have noted, affording primary status to VMES in the Ku-band frequencies would facilitate viable VMES operations from both a technical and business perspective, promote the efficient use of this spectrum, and ensure regulatory consistency between VMES, ESV, and AMES mobile applications.

The few commenters that do not support the Commission's proposal to authorize VMES operations on a primary basis in the Ku-band express concern that such operations would cause harmful interference into existing Ku-band operations.[5] However, to the extent that a VMES terminal is no more interfering than a standard VSAT terminal, there is no reason that VMES operations in the Ku-band should not be permitted on a primary basis. The OAED limit proposed in the *NPRM* defines the limit below which a VMES terminal would be no more interfering than a VSAT terminal. This limit has been proven to be sufficient to prevent harmful interference, and should be adopted in this proceeding for VMES terminals.[6]

A. Routine Processing and Primary Status Should Be Available for VMES Terminals That Can Operate In a Manner Consistent with the Proposed OAED Limit and a Two-Degree Spacing Environment

To the extent that a VMES terminal operates within the proposed OAED limit, any application to provide service using that terminal should be routinely processed. Further,

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4 *See, e.g.,* Comments of Maritime Telecommunications Network, Inc., IB Docket No. 07-101, at 3-4 (Aug. 17, 2007) ("MTN Comments"); Raysat Comments at 4-6; Comments of the Satellite Industry Association, IB Docket No. 07-101, at 3-4 and 8-9 (Aug. 17, 2007 ("SIA Comments"); Comments of SES Americom, Inc. and Americom Government Services, IB Docket No. 07-101, at 2-4 (Aug. 20, 2007) ("SES Comments"); Comments of the National Spectrum Managers Association, IB Docket No. 07-101, at 2-3 (Aug. 17, 2007) ("NSMA Comments").

5 *See* Joint Comments of the Association of Public Television Stations and the Public Broadcasting Service, IB Docket No. 07-101, at 3 (Aug. 17, 2007) ("APTS/PBS Comments").

primary status should be afforded to all terminals that can operate in a manner consistent with a two-degree spacing environment. Any VMES terminal meeting these conditions is unlikely to cause harmful interference to any adjacent user, and should be subject to routine processing procedures.

The record contains strong support for this position. ViaSat, SES Americom, Inc. and Americom Government Services ("SES"), and the National Spectrum Managers Association ("NSMA") have all noted that antennas that are able to meet the proposed OAED mask, inclusive of pointing errors and other factors, should be entitled to operate on a primary basis.[7] Likewise, Raysat Antenna Systems, LLC ("Raysat") and the Satellite Industry Association ("SIA") agree that as long as VMES operators can demonstrate that an antenna will not cause harmful interference into adjacent satellites, that antenna should be entitled to primary status even if it does not comply with antenna pointing accuracy, cessation of emissions period, or other service rules that the Commission may adopt in this proceeding.[8]

In its comments, ViaSat proposed service rules that would relax or eliminate pointing accuracy requirements for certain antennas and systems.[9] Any VMES antenna or system subject to this relaxed treatment would be considered a conforming antenna or system, and would be treated as such. However, to the extent that a VMES antenna neither qualifies for this relaxed treatment nor complies with the service rules adopted in this proceeding, ViaSat agrees with SIA that a non-routine licensing process should be available for applicants that can

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6 *See, e.g.*, Boeing Comments at 21; Raysat Comments at 8; SIA Comments at 13-4.

7 Comments of ViaSat, Inc., IB Docket No. 07-101, at 8 (Aug. 17, 2007) ("ViaSat Comments"); SES Comments at 2-4 (terminals should be afforded primary status "based on whether they can operate successfully in a two-degree spacing environment.").

8 Raysat Comments at 6-7; SIA Comments at 15.

9 *See* ViaSat Comments at 7-15.

demonstrate that such VMES antenna will not cause harmful interference.[10] Such antennas should be afforded primary status to the extent the operations comply with the proposed OAED limit and the two-degree spacing rules, and on an unprotected basis outside of that envelope.[11]

ViaSat urges the Commission not to limit primary status to VMES terminals that comply with the ESV pointing accuracy and automatic shut down requirements, as General Dynamics and ARINC Incorporated propose.[12] As General Dynamics acknowledges, systems can be designed using spread spectrum technology in a manner that would avoid harmful interference to adjacent users.[13] In sum, the Commission should not adopt rules that afford primary status to only one particular technology or a single application of the technology for the sake of expediting rules. The Commission should instead carefully consider rules that will promote the goal of this proceeding as stated in the *NPRM* – namely to "promote innovative and flexible use of satellite technology while ensuring avoidance of interference and efficient use of the spectrum."[14]

B. VMES Operations in the Ku-Band Will Benefit from Efficiencies Not Yet Available in the Ka-Band

APTS/PBS proposes that VMES operations be relegated to the Ka-band instead of the Ku-band as proposed in this proceeding.[15] This proposal ignores an important benefit extending from VMES operations in the Ku-band – namely, the economies resulting from the use of existing Ku-band infrastructure. Although services in the Ka-band are beginning to

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10 SIA Comments at 4.

11 *Id.* at 16-17.

12 General Dynamics Comments at 20 and 35; Comments of ARINC Incorporated, IB Docket No. 07-101, at 4-5 (Aug. 17, 2007).

13 General Dynamics Comments at 35.

14 *NPRM* at ¶ 3.

develop and have the potential to be robust, the small number of Ka-band satellites currently deployed severely restricts the available bandwidth available for VMES operations in the band.[16] On the other hand, the ubiquity of Ku-band systems provides Ku-band service providers with multiple potential sources of transponder capacity, which balances the negotiating positions of satellite carriers and new system operators in the transponder lease market. Moreover, the hub terminals and other ground systems operating in the Ku-band are readily available to VMES operators, providing cost advantages over Ka-band operations in the near term. In short, the Ka-band is not a reasonable alternative to the Ku-band for VMES operations, and should not be treated as such.

C. Aeronautical Mobile Earth Stations in the Ku-band Should Be Afforded Primary Status and Treated Similarly To VMES

ViaSat supports the proposal of the Boeing Company ("Boeing") to treat aeronautical mobile earth stations ("AMES") as primary, consistent with the status of ESV operations and that proposed for VMES operations.[17] VMES and AMES are mobile platforms that will incorporate substantially similar earth station networks and systems. Thus, it makes sense for certain technical rules, such as power density limits, to be consistent between these platforms. The reasoning underlying the service rules and the need for primary status are no different for VMES and AMES.

Further, provided that the Commission decides to subject VMES and AMES to the proposed OAED mask alone, without adopting separate pointing accuracy or other service

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15 APTS/PBS Comments at 3.

16 Furthermore, many of the Ka-band satellites currently deployed or that are being planned operate using spot beam technology, which is not suitable for existing mobile FSS system designs.

17 Boeing Comments at 8-15.

requirements, ViaSat supports Boeing's proposal to adopt a single class of earth station encompassing VMES and AMES.[18] However, the Commission should recognize that ground vehicles and aircraft are vehicular platforms with differing characteristics, requiring differing performance levels. Therefore, ViaSat notes that if the Commission adopts pointing accuracy or other service requirements, it may be appropriate to adopt certain rules that are specific to each platform. ViaSat believes that this approach – in lieu of the use of licensing conditions as proposed by Boeing[19] – would provide the certainty necessary to successfully launch VMES and AMES service, while increasing the efficiency of the Commission's licensing procedures.

III. THE COMMISSION SHOULD ADOPT VMES SERVICE RULES THAT ARE TECHNOLOGY-NEUTRAL

Since the ESV rules were proposed and developed in 2002,[20] new antenna and signal modulation technologies have emerged, which have the potential to reduce VMES system costs, improve bandwidth efficiency, and reduce the interference potential of antennas smaller than one meter in diameter. While there is strong support in this proceeding for the Commission's proposal to use the ESV service rules as a basis for VMES rules, wholesale adoption of the ESV rules without adjustments would preclude the routine processing of applications to provide service using VMES antennas that incorporate newer technologies that have demonstrated the ability to operate successfully in the Ku-band. Several commenters have expressed the need to adopt VMES rules that differ from the ESV rules in a manner that enhances VMES operators' flexibility to employ spread spectrum modulation and aggregate

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18 *Id.* at 11.

19 *Id.* at 6.

20 *See Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in Bands Shared With Terrestrial Fixed Service*, Notice of Inquiry, 17 FCC Rcd 2646 (2002).

power control technology.[21] ViaSat agrees and urges the Commission to relax the 10*log(N) rule and to adopt a two-tiered approach to antenna pointing accuracy requirements, as discussed in ViaSat's comments.[22]

A. ViaSat Disagrees With Commenters Proposing Service Rules That Mandate a Particular Technology

1. System operators should be permitted to select a system design that they deem most efficient.

ViaSat urges the Commission to avoid adopting rules that mandate specific VMES antenna or modulation technologies. As the record demonstrates, restrictive VMES service rules are unnecessary to prevent harmful interference to adjacent users, and would serve only to increase the cost of VMES terminals and systems, undermining the viability of VMES operations.[23] Accordingly, ViaSat and others have asked the Commission to adopt flexible, technology-neutral service rules that permit a wide range of VMES solutions, including low-cost spread spectrum systems.

General Dynamics asks the Commission to adopt the strict pointing accuracy and shut-off timing requirements found in the ESV rules, claiming that VMES terminals must operate at high antenna gain levels to optimize bandwidth efficiency.[24] Contrary to General

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21 Boeing Comments at 19-27; Raysat Comments at 10 ("Modifying the unnecessarily restricting pointing accuracy requirement is essential to ensure that the VMES rules are technology neutral and facilitate the introduction of the most innovative VMES systems and services . . . ."); SIA Comments at 13 ("VMES operators should be permitted to demonstrate that they can comply with the off-axis E.I.R.P. density mask that was adopted in the ESV rules without concurrently meeting the ESV pointing accuracy requirements and transmission cessation requirements."); SES Comments at 3 ("[R]ules for VMES licensing should accord operators significant flexibility while ensuring protection of adjacent satellites."); NSMA Comments at 6.

22 ViaSat Comments at 7.

23 *See, e.g.,* ViaSat Comments at 7; RaySat Comments at 10-11.

24 General Dynamics Comments at 10-11.

Dynamics' assertions, not all systems require this design to provide efficient and robust service. In particular, technologies exist today that allow antennas to operate efficiently using wide bandwidths. These technologies can alleviate the transponder costs that General Dynamics cites as a basis for summarily rejecting high-bandwidth systems.[25] Qualcomm's OmniTRACS land mobile satellite system, Boeing's AMSS system, and ARINC's SKYLink system are three successful examples of low power density, wide-bandwidth systems that have proven to be operationally viable. The Commission should not ignore these cases when evaluating General Dynamics' proposal to adopt rules that limit primary status and routine processing for systems that meet its own subjective definition of efficiency.

ViaSat employs an A-PCMA carrier cancellation technique, in which the system return links operate on the same frequencies as the forward links. Using this technique, the system user only pays for the forward link transponder capacity because the return link uses the same transponders. Because the return link carriers use very little power, they can be placed on the same transponder with the forward link with only a slight reduction in forward link power. While General Dynamics appears to be aware of this carrier cancellation technology, General Dynamics disregards the potential for this technology to drastically improve system bandwidth efficiency in networks with far greater than two terminals.[26]

Furthermore, VMES antennas operating at high EIRP densities using expensive antenna-pointing equipment are not infallible. Despite General Dynamics' claims that its VMES system has never caused interference,[27] ViaSat is aware of incidents of adjacent satellite

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[25] *See id.* at 6.

[26] *See id.* at 36-7 (noting the availability of "uplink-cancellation" systems).

[27] *Id.* at 7 ("General Dynamics has operated its VMES system in the FSS for more than four years without causing any harmful interference . . . .").

interference resulting from malfunctioning high-gain antennas that could have been avoided if spread spectrum modulation had been used. Thus, high-gain VMES signals are no guarantee of efficient, interference-free operation.

ViaSat is in favor of rules that permit carriers to make trade-offs between power and bandwidth, and allow the market – and not individual competitors – to determine which technologies should succeed. VMES operators should be free to design their systems in the manner that they find most efficient, provided that they do not cause harmful interference to adjacent users. Likewise, VMES users should be free to choose from a wide range of available VMES solutions, and to choose the solution that best suits their communications requirements and business case. By contrast, General Dynamics' proposal to adopt rules on an expedited basis that would only accommodate old technologies myopically forecloses opportunities to promote new and innovative antenna technologies and systems.

While General Dynamics has made clear that it deems bandwidth efficiency the utmost of importance in system design, General Dynamics ignores the Commission's overriding statutory mandate: to serve the public interest, convenience, and necessity. As the Commission has long recognized, the blind pursuit of spectrum efficiency, without consideration of other factors such as competition and the timely availability of service for both government and commercial users, does little to advance the public interest.[28] This is particularly true where

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[28] *See, e.g,, An Inquiry Into the Use of the Bands 825-845 MHz and 870-890 MHz for Cellular Communications Systems; and Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems*, 89 FCC 2d 58, at ¶ 23 (1982).

there is no evidence that spectrum is so scarce that spectrum efficiency considerations must dictate the rules.[29]

2. Spread spectrum technologies have proven to be effective for mobile FSS operations.

ViaSat and others have submitted for the record evidence and examples demonstrating that spread spectrum technology can be used to operate a viable VMES service and to prevent interference into adjacent satellites.[30] As the record shows, if an individual VMES antenna operates well below the proposed OAED mask, that antenna will be virtually undetectable to adjacent systems and will not add interfering noise power to the operating environment of incumbent Ku-band FSS systems. Further, the record shows that in a well-managed system, the network aggregate power density can be actively controlled on a real-time basis to ensure that the system as a whole does not exceed the aggregate power density threshold; the network can adjust to account for variations in the power density produced by individual antennas due to angular pointing, or where higher power is necessary to close the link in degraded conditions. In contrast, there is no evidence in the record to substantiate claims that spread spectrum antennas that do not adhere to rigid antenna pointing requirements will result in harmful interference to adjacent systems, as claimed by the Association of Public Television

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[29] Notably, General Dynamics makes no attempt to demonstrate that restrictive technical rules will facilitate the widespread availability of VMES to the public, or robust competition for VMES services. To the contrary, General Dynamics claims that "[i]f the interference avoidance requirements applicable to VMES systems are at least as stringent as those applicable to ESVs, then the costs associated with purchasing and operating compliant VMES systems would alleviate most of the Commission's concerns [with respect to potential interference stemming from ubiquitous VMES operations]." General Dynamics Comments at 6. In other words, General Dynamics seeks to artificially inflate costs in order to control demand for VMES service. This result runs contrary to the public interest.

[30] *See, e.g.,* ViaSat Comments at 8-11 and Atts. 1 and 2; Raysat Comments at 1-2; SIA Comments at 15.

Stations and the Public Broadcasting Service ("APTS/PBS") and Maritime Telecommunications Network, Inc. ("MTN").[31]

Moreover, there is also no evidence that smaller terminals using spread spectrum modulation are necessarily more susceptible to interference, as some commenters claim.[32] ViaSat agrees that VMES antennas should only receive protection from adjacent systems to the extent that those antennas comply with Section 25.209(c) of the Commission's rules. However, spread spectrum technologies do not require greater protection than traditional VSATs and are not more susceptible to interference. In fact, a wide bandwidth spread spectrum signal inherently has anti-jam properties and is less susceptible to interference – a fact relied on by the U.S. Military for as long as spread spectrum modulation technologies have been available.[33]

As demonstrated by ViaSat's link budget calculations,[34] a VMES antenna using spread spectrum modulation can close the link just as effectively as a terminal using a single channel per carrier ("SCPC") modulation and can do so while operating within the OAED limits adopted for ESVs.[35] In any event, to the extent a smaller antenna may require higher downlink power, the higher power level antenna should be permitted to coordinate with adjacent satellites and operate on a non-interference basis.

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31 APTS/PBS Comments at 3; MTN Comments at 6.

32 APTS/PBS Comments at 2-3; Comments of the Fixed Wireless Communications Coalition, IB Docket No. 07-101, at 29 (Aug. 17, 2007).

33 *See gen.* ROBERT DIXON, SPREAD SPECTRUM SYSTEMS WITH COMMERCIAL Applications (3d Ed. 1994); SIMON, OMURA, SCHOLTZ, & LEVITT, SPREAD SPECTRUM COMMUNICATIONS HANDBOOK (Rev. Ed. 1994).

34 ViaSat Comments at Att. 2.

35 ViaSat submitted with its comments link budget calculations for antennas using both SCPC and spread spectrum modulations. *See* ViaSat Comments at Att. 2. The spread spectrum antennas can operate with a positive link margin over and above the up/downlink rain margin included in the calculations.

B. The Rules Should Not Dictate a Particular Antenna Pointing Technology or Modulation Technique

ViaSat has proposed in its comments a two-tiered approach to ensure that VMES antennas do not cause harmful interference to adjacent users as a result of antenna mispointing. Specifically, ViaSat has suggested that no pointing accuracy requirement should apply to individual VMES antennas that operate at a power density level sufficiently below the OAED mask, while a pointing accuracy limit may be appropriate for individual VMES antennas that operate at power density levels that are close to the OAED limit, provided that limit varies in accordance with the beamwidth and input power level of the antenna.[36] This approach would balance the need for a variable pointing accuracy requirement for certain high-gain antennas operating close to the OAED limit with the necessary flexibility for antennas that operate at extremely low power densities. Several commenters agree that pointing accuracy requirements are unnecessary for VMES antennas that can meet the proposed OAED mask inclusive of pointing errors.[37] NSMA, Boeing and Raysat also acknowledge that certain systems may need to employ pointing accuracy technologies in order to prevent harmful interference into adjacent systems, and that the need for such requirements may vary depending on the terminal and the system.[38]

ViaSat opposes rules that mandate a certain technology for antenna pointing or the use of certain modulations. For instance, ViaSat disagrees with MTN's proposal to mandate

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36 ViaSat Comments at 7.

37 SES Comments at 4, NSMA Comments at 6-7 ("NSMA believes that the 0.2 degree pointing accuracy requirement may not be necessary for VMES terminals that adequately take mispointing into account and operate at lower power levels.").

38 NSMA Comments at 7; Raysat Comments at 11; Boeing Comments at 24.

spread spectrum modulation for antennas smaller than one meter.[39] Such a rule would preclude innovative technologies that could employ small antennas using some other means to avoid interference into adjacent satellites.

ViaSat also opposes claims that the relaxation of the ESV pointing accuracy limits is unnecessary. General Dynamics argues that a stringent pointing requirement is justified by the fact that antenna pointing technology is available, and could be used to support high-power VMES operations.[40] Notwithstanding, General Dynamics fails to provide any justification for limiting the options available to VMES operators and users when there are a multitude of ways in which to ensure that VMES operations do not cause harmful interference into adjacent operations. Moreover, MTN's claim that suitable antenna pointing technology exists is unsupported. MTN claims that pointing accuracy limits should apply to all VMES antennas because antenna stabilizing technology exists that meets the ESV pointing criteria, and cites two existing antenna systems as examples.[41] While these antennas may meet the pointing accuracy specifications when mounted on an ocean vessel moving at fairly low acceleration rates, they do not appear to be able to meet the pointing accuracy requirements in Section 25.222 when moving at acceleration rates typically experienced by a vehicle driving on a paved road.[42]

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39 MTN Comments at 7.

40 *See* General Dynamics Comments at 9-11.

41 MTN Comments at 5 n.9.

42 Technical data for the Sea Tel antenna demonstrates only that the antenna is compliant with the 0.2 degree accuracy limit under conditions of tangential accelerations equal to or less than 0.5 G in 6 seconds. *See* http://www.seatel.com/pdfs/flyers/126930_A.pdf. This is a mild acceleration typical of that experienced on a large ship in seas that are not rough. The KNS Model no. Z6, *see gen.* http://kns-kr.com/eng/eng_324.htm, is designed for one-way receive only Internet applications; it does not support two-way. Further, the antenna is clearly designed to be used aboard ships, and not in the typical VMES operating environment.

Therefore, ViaSat requests that the Commission adopt rules that promote a wide range of technological choices, and to reject the endorsement by these commenters of a particular system design or technology.

C. The Level of Precision and Strict Application of Pointing Accuracy Requirements That Some Commenters Propose Is Entirely Unwarranted

ViaSat disagrees with comments that call for the strict application of precise antenna pointing requirements applicable to all VMES antennas. MTN and General Dynamics propose precise pointing accuracy requirements, and reject even momentary deviations from these requirements.[43] However, even under the ESV rules, which these commenters endorse, the Commission permits operators to exceed the 0.2 degree limit. As ViaSat noted in its comments, while the Commission's rules provide that ESV antennas should not be mispointed by more than 0.2 degrees, those rules also provide that ESV antennas need not cease transmission until they are mispointed by more than 0.5 degrees.[44] Thus, the Commission has already recognized that the strict antenna pointing limits proposed by MTN and General Dynamics may be unnecessary.

For similar reasons, APTS/PBS's proposal to require exhaustive testing of VMES antennas to demonstrate strict compliance with antenna pointing limits would unnecessarily complicate the VMES licensing requirements and procedures.[45] The proposed testing would require the Commission to clearly and completely specify the conditions under which the pointing accuracy requirements must be met and what the success criteria would be. These conditions and criteria would need to account for differences in the proposed operating environment; a VMES antenna that meets the performance criteria when installed in a

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43 MTN Comments at 5-7; General Dynamics Comments at 11, 29-34.

44 *See* 47 C.F.R. § 25.222(a)(7).

45 APTS/PBS Comments at 3-4.

recreational vehicle driving over a paved road would not necessarily meet those criteria when installed on a smaller vehicle traveling on an off-road environment. In contrast, a simple requirement that the VMES antenna meet the proposed OAED mask, inclusive of pointing error and other deviations and regardless of operating environment, would obviate the need to devise an elaborate testing regime.

IV. THE VMES SERVICE RULES SHOULD REFLECT REALISTIC CHARACTERISTICS OF VMES SERVICE

Several commenters describe the innovations in antenna technology that will make VMES a viable and robust service.[46] Interest in and demand for mobile FSS service is growing,[47] and appropriate service rules should provide a framework for development and investment in these services. The Commission should ensure that the service rules for VMES reflect the realities of VMES operations. ViaSat and others have cited the benefits of using existing FSS infrastructure for these new systems, and ensuring that service rules are consistent across different mobile applications and with other FSS applications.[48] For instance, VMES infrastructure can be used most efficiently if the OAED mask for VMES is consistent with that for VSATs.

Further, government and commercial VMES users are likely to demand small, low-profile antennas. These antennas will require flexibility to transmit at higher power density levels outside of the GSO plane. Finally, given the mobile nature of VMES, it will be difficult for Ku-band VMES operators to resolve incidents of interference from mobile terminals without a data logging requirement. While ViaSat supports the same type of data logging requirements

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46 ViaSat Comments at 3, 8-11; RaySat Comments at 1-2.

47 SES Comments at 3.

48 *See* ViaSat Comments at 4-5; RaySat Comments at 4-5; Boeing Comments at 5-6.

imposed on ESV operators, terrestrial vehicle motions are very different than those of ocean vessels, and thus, the requirements for VMES should be modified accordingly.

A. The OAED Limit for VMES Should Be Modified to Be Consistent With Any Changes Adopted for VSATs in That Proceeding

ViaSat agrees with SIA's proposal to adjust the proposed OAED mask for VMES operations to reflect adjustments to the VSAT OAED mask proposed in the Commission's pending proceeding relating to VSAT regulations in Part 25 – including the proposed 10 dB escalation between 85 degrees and 180 degrees and the proposed relaxation of the start angle of the mask from 1.25 degrees to 1.5 degrees.[49] A consistent OAED limit for VSATs and for Ku-band antennas on mobile platforms would allow efficient operation of networks that contain multiple antenna types.

B. Increasing the Allowable OAED Power Level Outside of the GSO Plane Would Promote the Use of Small and Low-Profile Antennas

In ViaSat's experience, both government and commercial customers prefer lower profile antennas for VMES operations. While circular antennas are suitable for ESV, wide deployment of VMES will depend in part on the ability to mount lower profile antennas onto vehicles in a less conspicuous manner.[50] Thus, the antennas that will be used for VMES applications will not likely be circularly symmetric, as SIA asserts.[51] Reducing the size of the antenna in the height axis will necessarily increase the beamwidth in the elevation plane. ViaSat does not propose that power density levels outside of the geostationary arc be uncontrolled. Rather, the limits should be relaxed to a degree that will promote innovative and cost-effective

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49 SIA Comments at 14.

50 *See* Raysat Comments at 15 ("Commercial success and widespread deployment of VMES services depend in part upon the ability to use small, low-profile antennas . . . .").

51 SIA Comments at 20.

antenna designs, such as those cited by Raysat,[52] while still ensuring that adjacent users are protected from harmful interference. Although Boeing proposes a three-degree start angle,[53] existing low-profile antennas today may require a larger start angle. Thus, ViaSat proposes a start angle of seven degrees.

C. The Data Logging Requirement Should Balance the Need to Trace the Paths of VMES Terminals With Practical System Capacity Limitations

As ViaSat discussed in its comments and as supported by Boeing and SIA, a data logging requirement is the most effective way to identify and resolve incidents of interference.[54] VMES terminals are mobile and their operations will be transient. Both of these characteristics make it difficult for existing interference locating systems to detect harmful interference and pinpoint its source. VMES systems will likely be equipped with GPS or another location determining technology to aid in antenna pointing and/or conformance with exclusion zones for the Tracking and Data Relay Satellite System ("TDRSS") and the Radio Astronomy Service ("RAS"). Therefore, these systems can easily send a periodic location log message to the network management control centers ("NCMCs") without suffering an unreasonable burden.

While Boeing's proposal to log data at 90-second intervals[55] will likely be feasible for most sophisticated system operators, this frequency may be unnecessary to track a ground vehicle. ViaSat proposes that a logging interval of 300 seconds (five minutes) may better balance system and storage capacity requirements with the desire to collect sufficient data to isolate the path of a VMES terminal. Even assuming a worst-case vehicle speed of 80 mph, a 300 second logging interval would update the location once every 6.6 miles. Interpolating

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52 Raysat Comments at 1-2.

53 Boeing Comments at 23.

54 ViaSat Comments at 22-3; Boeing Comments at 27-30; SIA Comments at 18-9.

between data points would yield a good representation of the vehicle track. Although each location logging message to the hub will be small, in a large system, the number of messages may be significant, and thus, shorter logging intervals may unnecessarily consume system and end-user capacity. With the exception of the data logging interval, ViaSat otherwise supports VMES data logging requirements that are consistent with ESV requirements, including a requirement to maintain data for at least one year and to make information available to appropriate entities within twenty-four hours of a request.[56]

V. THE COMMISSION SHOULD NOT IMPOSE RAS AND TDRSS COORDINATION REQUIREMENTS THAT ARE MORE BURDENSOME THAN NECESSARY

ViaSat fully understands the Commission's desire to prevent VMES operations from causing harmful interference into RAS and TDRSS facilities. At the same time, ViaSat believes that there is no need to restrict VMES operations to the degree proposed by the National Association of Sciences' Committee on Radio Frequencies ("CORF"). In particularly, ViaSat opposes any outright prohibition on transmissions or a requirement to disable transmissions in the vicinity of RAS and TDRSS facilities. There are several mechanisms by which the Commission can permit VMES operations in the vicinity of RAS and TRDRSS facilities while protecting those facilities from harmful interference. Therefore, the Commission should not, as CORF proposes, prohibit VMES uplink transmissions in the 14.47-14.50 GHz band.[57]

First, careful coordination between VMES operators and TDRSS and RAS facilities can minimize the likelihood of any interference. As ViaSat and others have maintained,

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55 *See* Boeing Comments at 29.

56 *NPRM* at ¶ 62.

57 Comments of the National Association of Sciences' Committee on Radio Frequencies, IB Docket No. 07-101, at 5 (Aug. 17, 2007).

coordination should be a post-licensing condition for all VMES operators.[58] There are several examples of mobile systems in the FSS that have coordinated with NASA and NSF, and these systems have demonstrated that they can successfully coordinate with TDRSS and RAS facilities and operate without causing interference.[59] ViaSat further supports SIA's suggestion that because coordination with NASA for TDRSS sites has been successful, a general coordination scheme could be developed to facilitate a more narrowly established contour around the TDRSS earth station site.[60]

Second, VMES transmitters can incorporate technology that ensures that transmissions cease whenever the transmitter is within a TDRSS or RAS geographic exclusion zone. As discussed in ViaSat's comments and above, ViaSat is in favor of some form of location determination to facilitate data logging for interference detection and tracking purposes. As long as GPS or other location determination system is already incorporated within the VMES system design, this technology can and should be used to ensure that the VMES transmit signal is terminated whenever the VMES transmitter is located in an area where transmissions may pose a risk to TDRSS or RAS facilities.

Third, the technical characteristics of VMES antennas and the signals they produce will serve to protect TDRSS and RAS facilities. The typical radio horizon for VMES antennas will be approximately 18 km, as these antennas will typically be less than 10 feet above ground level. Obstacles in the signal path and foliage will further attenuate the signal; notably,

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58 *See, e.g.,* ViaSat Comments at 5-6; SIA Comments at 9-12; General Dynamics Comments at 46; RaySat Comments at 5; Boeing Comments at 18-9.

59 *See, e.g.,* General Dynamics Comments at 50.

60 SIA Comments at 10.

the National Radio Astronomy Observatory ("NRAO") recognizes in its comments that local terrain shielding should be factored into RAS coordination.[61]

As such, the proposed TDRSS coordination zone of 125 km, and the proposed RAS coordination radii of up to 160 km, are unnecessarily large for VMES operations, and would impose unnecessary burdens on VMES operators.[62] Similarly, CORF's proposal to establish coordination zones for operations in the 14.44-14.47 GHz band to protect RAS observatories from VMES out-of-band emissions would impose burdens on VMES operators without any offsetting benefits. Coordination conducted by existing mobile systems illustrates that coordination agreements that require incorporation of proper hardware designs into networks are sufficient to prevent out-of-band emissions below 14.47 GHz.[63] Additionally, VSATs that are within these zones are not subject to the additional coordination requirements or the larger zones proposed in the *NPRM*.[64] As discussed above, VMES antennas are no more interfering than a traditional VSAT. Therefore, these additional coordination requirements are unnecessary, and any restrictions or requirements on VMES antennas should be no more stringent than those currently imposed on other FSS Ku-band services.[65]

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61 Comments of the National Radio Astronomy Observatory, IB Docket No. 07-101, at 1 (Aug. 17, 2007).

62 ViaSat also agrees with the Commission's suggestion that new TDRSS sites should be required to implement state-of-the-art filtering in the antenna/receiver front end to minimize the required 150 MHz guard band. *See NPRM* at ¶ 31; SIA Comments at 11.

63 Comments of the National Radio Astronomy Observatory, *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, at 2-3 (Apr. 7, 2005).

64 *See* General Dynamics Comments at 48 and 51.

65 General Dynamics at 51.

VI. OTHER ISSUES

A. Hub Stations

ViaSat agrees with comments that support a requirement for VMES operators to maintain a NCMC control point in the U.S.[66] However, provided that this condition is met, VMES operators should not also be required to maintain a hub station within the U.S. While it is unlikely that VMES terminals would operate in a mesh network without a hub, the Commission should not mandate the use of a hub, as APTS/PBS proposes.[67] A NCMC control point within the U.S. will be sufficient to resolve potential interference events. Further, the requirement to maintain an NCMC control point within the U.S. should apply to operators of individual VMES antennas, not just those to operators of multiple VMES antennas licensed on a blanket basis.[68]

B. Equipment Certification and Radiation Hazard

ViaSat agrees with comments that equipment certification requirements for VMES terminals should be the same as VSAT certification procedures, and should not in any way add to the certification requirements to which VSATs are currently subject.[69] VMES terminals will be mounted on vehicles and are not likely to be operated close to a person's body. Additionally, ViaSat and other commenters have established in this proceeding that VMES antennas will not pose any greater interference risk to satellites than a VSAT, and thus, the VSAT certification procedures should address any interference concerns. However, ViaSat

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66 *See* SIA Comments at 26.

67 APTS/PBS Comments at 3-4.

68 *See* ViaSat Comments at 21 (requesting that the Commission evaluate individual VMES antenna applications to assess the manner in which individual antennas may operate within a larger network of separately licensed terminals).

69 SIA Comments at 22.

supports a requirement that all VMES applications include a radiation hazard analysis detailing expected power levels in and around the VMES terminal.

ViaSat supports SIA's proposal to require qualified professional installation of VMES terminals in order to mitigate radiation hazards.[70] Due to the complexity of VMES systems, professional installation will likely be necessary from a technical perspective, and would also resolve radiation safety concerns. ViaSat also agrees with SIA that the Commission should require VMESs to cease transmissions upon loss of forward link connectivity, as it currently does VSATs.[71] As with VSATs, the Commission should not impose a time limit to cease transmissions upon the loss of a forward-link lock on the satellite as there are many potential factors, such as rain fade, to consider in setting the shutdown time.

Because of the high probability that parked vehicles will be in the vicinity of the general public, the hazards related to parked vehicles should be considered more carefully than in moving vehicles.[72] In addition to precautionary signage, flashing lights or other clearly visible warnings may be necessary to ensure strict compliance with the FCC OET Bulletin 65 general population limits for antennas operating at higher power levels and/or duty cycles. ViaSat does not agree with General Dynamics' proposal to except certain government vehicles from labeling

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70 SIA Comments at 21.

71 SIA Comments at 21-22.

72 The FCC OET Bulletin 65 limits for general population (uncontrolled) and occupational (controlled) access are time-averaged limits with averaging times of 30 and 6 minutes, respectively. OET Bulletin 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, at 10 (Aug. 1997). Therefore, the hazard to the general population will typically be low for a VMES antenna mounted on the roof of a moving vehicle because the antenna beam will both be pointed up and away from the public, and also will not remain very long on an individual exposed to the signal.

requirements due to security concerns.[73] In the U.S., the battlefield conditions that General Dynamics notes simply do not exist, and can in no way justify the increased risk of exposure to hazardous radiation that could result in the absence of labeling. If a government vehicle were deployed outside of the U.S., any labeling could easily be removed.

C. Parity Among Federal and Non-Federal Licensees

ViaSat agrees with the positions taken by SIA, Raysat and Boeing in the open proceeding regarding federal government use of non-federal government bands.[74] To the extent the Commission finds issues raised in that proceeding to be relevant in this VMES proceeding, ViaSat supports regulatory parity between federal government earth stations that are operating with non-government satellites, provided that such federal earth station licensees are subject to the same regulatory obligations as non-federal licensees, and that operations in these bands shared on a co-primary basis among federal and non-federal users are not subject to any additional approval process by NTIA, the Commission or any other government entity.

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[73] General Dynamics Comments at 57-8.

[74] SIA Comments at 26-7; Raysat Comments at 16-7; Boeing Comments at 41-2.

VII. CONCLUSION

For the foregoing reasons, ViaSat respectfully requests that the Commission adopt service rules and routine licensing procedures for VMES antennas consistent with the proposals in ViaSat's comments and in these reply comments.

Respectfully submitted,

VIASAT, INC.

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September 4, 2007

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.

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