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Federal Communications Commission
Office of Secretary

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the matter of	)	
	)	
Application of RaySat, Inc. for Authority to Operate 4,000 In-Motion Mobile Satellite Antennas in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands	)	File No. SES-LIC-20060629-01083
	)	

COMMENTS OF VIASAT, INC.

ViaSat, Inc. ("ViaSat") submits the following comments regarding the above-referenced application of RaySat, Inc. ("RaySat") for authority to operate 4,000 in-motion mobile satellite antennas in the 14.0-14.5 GHz and 11.7-12.2 GHz frequency bands.[1] ViaSat provides and develops Ku band services and equipment. Thus, ViaSat has an interest in licensing decisions impacting the development of new technologies that expand the capabilities of Ku band systems. RaySat's Application contains numerous technical deficiencies, and operation of RaySat's in-motion antennas as proposed in the Application could result in harmful interference to adjacent satellite networks. The Commission should not grant RaySat's requested authority unless RaySat cures such deficiencies and resolves the interference issues identified herein.

I. INTRODUCTION & BACKGROUND

In its Application, RaySat seeks blanket authority for a 2-way phase combined, low-profile antenna that will be mounted on vehicles and operated while in motion to provide

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1 *Application of RaySat, Inc. for Authority to Operate 4,000 In-Motion Mobile Satellite Antennas in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands*, File No. SES-LIC-20060629-01083, Public Notice, Report No. SES-00834 (rel. July 5, 2006) (the "Application").

users with high-speed data communications while traveling in vehicles.[2] The antenna will use a single channel per carrier ("SCPC") modem and will communicate with a number of satellites through several control points.[3]

As a general matter, ViaSat encourages the FCC to authorize new and innovative uses of the FCC Ku band spectrum, including land mobile satellite service ("LMSS"). However, ViaSat has identified numerous technical deficiencies in RaySat's Application regarding the proposed network and operations. RaySat's proposed LMSS system does not have a central network management system ("NMS"). This lack of central control significantly limits RaySat's ability to prevent interference into adjacent satellite networks and to track incidents of interference. More importantly, RaySat's use of a simple unspread modem in a system without a NMS cannot adequately protect adjacent satellites from interference. The pointing error in RaySat's proposed system, combined with the high power densities emitted by the SCPC modem, further raises the interference potential of the network. Additionally, the Commission should require RaySat to provide link budgets to demonstrate that it can feasibly provide service at the proposed power levels and without causing interference into adjacent operations. The Commission should require RaySat to address the technical deficiencies and the potential interference issues described in these comments before it grants the authorization RaySat requests in the Application.

II. THE USE OF AN UNSPREAD SIGNAL WITHOUT A NETWORK MANAGEMENT SYSTEM INCREASES THE INTERFERENCE POTENTIAL OF RAYSAT'S PROPOSED SYSTEM

RaySat's proposed system does not adequately protect adjacent satellites from interference due to the use of a simple unspread modem and a lack of central control in the

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2 Application at 5.

3 *Id.* at 2.

network.[4] RaySat's Application lists a number of control points, but does not identify one as the central control point.[5] The lack of central control gives each antenna terminal user the ability to control the bandwidth modulation and coding and places the onus on the user to manage compliance with the off-axis EIRP density ("OAED") mask set forth in Section 25.209 of the Commission's rules.[6] Typically, the price of bandwidth leased by satellite operators is based on the greater of the bandwidth utilization and the power utilization on the transponder. In RaySat's proposed network, the antennas will use more bandwidth than power;[7] thus, end users with less regulatory awareness may have the incentive to operate at higher power levels and less bandwidth to reduce transponder costs, and thereby could potentially increase the power spectral density to OAED levels that would violate the Section 25.209 mask. Without a central network control, RaySat would be unable to verify that the network operations conform to the specified license parameters. Instead, RaySat would need to rely on the satellite operator to inspect and verify the network link budgets to insure compliance.

Further, the lack of a central control point in RaySat's proposed network configuration severely limits the ability of adjacent satellite users to track incidents of interference. When an adjacent operator suspects a RaySat LMSS terminal of interference, the adjacent operator would need to contact several different control points, rather than one central

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4 *Id.*; Application, FCC Form 312 at 15.

5 Application at 2.

6 47 C.F.R. § 25.209.

7 Based on the technical data that RaySat provides in the Application, ViaSat estimates that a 128 kbit/s signal in RaySat's system will use 1.422% of the transponder bandwidth but only 0.121% of the transmitter power, assuming a 0 dB transponder input attenuation. *See* Link Budget Calculations, attached hereto as Exhibit A. ViaSat calculated the link budgets based on data in RaySat's Application and nominal values for satellite performance that reflect parameters generally accepted in the satellite industry for Ku band service, using standard link budget formulas presented in engineering texts such as "Satellite Communication System Engineering" by Wilbur Pritchard, *et al.*

control point to determine the source of interference. Moreover, RaySat does not indicate whether its individual control points have the ability to track the location of their terminals or operating parameters. The Commission should require RaySat to submit information regarding the tracking capabilities of individual control points including logging of terminal locations, into the record Application. In the Earth Station on Vessel ("ESV") context, the Commission has required Ku band ESV hub operators to have the capability to track and maintain certain data, including terminal locations, for potential review in the event interference issues arise.[8] Tracking capabilities would serve the same purpose in the LMSS context.[9]

III. THE POINTING ACCURACY OF THE SCPC SIGNAL IS INSUFFICIENT TO PREVENT INTERFERENCE INTO ADJACENT SATELLITES

Because an antenna using a SCPC modem transmits at relatively narrow bandwidths at high power densities compared to a spread modem, minor shifts in antenna pointing would significantly impact power density in a particular direction. Thus, a mispointed individual antenna likely would emit at power density levels that could cause interference into adjacent satellites. ViaSat does not support antenna pointing requirements for systems using spread spectrum modulation techniques in which individual antennas operate at extremely low

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8 *Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands*, Report and Order, 20 FCC Rcd 674, ¶ 112 (rel. Jan. 6, 2005).

9 Although ViaSat does not support a publicly accessible database containing tracked data or public disclosure of aircraft locations, ViaSat is in favor of a requirement to track terminal locations to enforce interference protections. *See* ViaSat, Inc. Comments, *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 22 (filed July 5, 2005) (ViaSat AMSS Comments"); ViaSat, Inc. Reply Comments, *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 19-21 (filed Aug. 3, 2005) ("ViaSat AMSS Reply Comments"). However, the Commission should not require carriers to track exact antenna pointing angles. *Id.*

power densities, and where aggregate power density is controlled by a NMS.[10] In such systems, antenna pointing requirements are unnecessary because a single mispointed antenna operates using a wide bandwidth at power density levels that are undetectable to adjacent satellites. Further, using central power control to manage the aggregate power density ensures that the power density of the network does not exceed the OAED mask, thereby protecting adjacent users. However, RaySat's proposed system uses an unspread modem, which by definition does not employ these technologies, and thus, pointing errors could result in harmful interference.

Furthermore, RaySat's asserted pointing accuracy is inconsistent with the characteristics and performance levels of a viable service. When the "antenna mechanically mispoints by more than 0.5 degrees, the antenna system will mute the transmit carrier."[11] However, the antenna has a pointing error standard deviation of 0.35 degrees.[12] Therefore, approximately 15 percent of the time, the terminal will not be operational and will only be able to transmit a signal 85 percent of the time.[13] Thus, the antenna's pointing accuracy does not appear to support viable service in real-world conditions.

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10 *See* ViaSat AMSS Comments at 17-18; ViaSat AMSS Reply Comments at 11. In such cases, ViaSat believes that the mask and the exceedance table are sufficient to protect adjacent users from interference resulting from mispointed antennas. In the event interference cannot be controlled using spread spectrum and/or power control technology, ViaSat supports reasonable pointing accuracy limits.

11 Application at 6.

12 Letter from Ram Manohar, Department Manager, Intelsat GSC to Federal Communications Commission, at 1, Attached to Application (Feb. 14, 2006) ("The azimuth tracking for these antennas is +/- 0.35 degrees nominal and +/- 0.5 degrees maximum.").

13 A zero mean error with 0.35° standard deviation results in a pointing error greater than 0.5° 15.33 percent of the time. *See* Distribution for Pointing Deviation, attached as Exhibit B hereto. ViaSat used commercially available Monte Carlo simulation software to generate a simulation based on a zero mean error and a 0.35° standard deviation run on 5,000 trials.

IV. RAYSAT SHOULD SUBMIT LINK BUDGETS TO SUPPLEMENT ITS APPLICATION

While the proposed input power densities in the Application conform to the FCC's rules, it is unclear whether the antennas using a SCPC modem can close the satellite link while operating at these power levels. Based on ViaSat's calculation of RaySat's system link budget, the power density level at which RaySat proposes to operate do not appear to be sufficient to close the link from the remote terminal to the hub antenna even under ideal operating conditions.[14] Therefore, the Commission should require RaySat to demonstrate that it can provide service without causing interference into adjacent satellite operations.

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14 In its Application, RaySat states that it will use BPSK and R1/3 FEC and thereby occupy 2070 kHz of bandwidth for a 512 kbit/s circuit or 512 kHz for a 128 kbit/s circuit. Thus, when using a 2 watt power amplifier (3 dBW), the input power spectral density to the antenna flange is:

3 dBW - 10 * log (2070 kHz/4 kHz) = -24.1 dBW/4 kHz, or

3 dBW - 10 * log (512 kHz/4 kHz) = -18.1 dBW/4 kHz,

which is consistent with the power density levels specified in the Application. Even under ideal operating conditions, 2 or 3 watts is insufficient to close a 128 kbit/s data link from the remote antenna to the hub. Assuming a 0 dB transponder input attenuation and a 0 dB rain margin, results in a margin of -0.436 dB. However, these assumptions do not reflect realistic operating conditions. A system using an SPCP modem typically operates at a transponder input attenuation of 6 dB or greater and must employ a constant rain margin. Thus, under these assumptions the link margin is even lower. *See* Exhibit A, Link Budget Calculations.

V. CONCLUSION

For the foregoing reasons, the Commission should require RaySat to cure the technical deficiencies in RaySat's proposed operations and to address the potential interference issues identified herein. Until RaySat resolves these issues, the Commission should not grant RaySat's requested authority.

Respectfully submitted,

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Filed: August 4, 2006

EXHIBIT A

LINK BUDGET CALCULATIONS

128 kbit/s RaySat to Hub Link Budget with 0 dB Transponder Input Attenuation

Satellite Name	AMC-6	Data Rate	128000 bit/s
Satellite Location	72 Deg W	Bit Error Rate	1x10E-7
Satellite Center Beam EIRP	52.97 dBW	Eb/No Required	3.1 dB
Satellite EIRP in direction of DL ES	49.72 dBW	C/No Required	54.172 dB-Hz
Satellite SFD in direction of UL ES	-97.9 dBW/m^2	Availability Required	99.7% 1577.8464 Outage Min/Year
Satellite G/T in direction of UL ES	4.87 dB/K	ITU Uplink Rain Zone	E
Satellite Input Back Off	7 dB	ITU Downlink Rain Zone	E
Satellite Output Back Off	4 dB	Modulation Type	BPSK
Transponder BW	36 MHz	FEC Factor	Rate 1/3
		Spread Factor : Bandwidth (Normally	1
		Carrier Spacing (1.4 Nominal)	1.3
		Signal Bandwidth	512.0
Uplink Name	RaySat Remote	Downlink Name	Hub
Uplink Location Latitude	40 Deg N	Downlink Location Latitude	40 Deg N
Uplink Location Longitude	95 Deg W	Downlink Location Longitude	95 Deg W
Uplink Frequency	14250 MHz	Downlink Frequency	11950 MHz
Effective Uplink Antenna Size	0.178 m	Downlink Antenna Size	4.5 m
Uplink Antenna Efficiency	0.8	Downlink Antenna Efficiency	0.67
Uplink Antenna Gain	27.516 dBi	Downlink Antenna Gain	53.273 dBi
Uplink EIRP	30.5 dBW	Downlink Antenna LNA Temp	110 K
Uplink Output Circuit Loss	1 dB	Downlink Antenna Noise Temp	35 K
Uplink PA Output Power	2.503 Watts	Downlink Rain Noise	0 K
Uplink PA Output Power	3.984 dBW	Downlink Earth Station G/T	31.459 dB/K
Uplink Rain Attenuation	0.741 dB	Downlink Rain Attenuation	0 dB
Uplink Misc Losses	1.25 dB	Downlink Misc Losses	0.5 dB
Uplink Elevation Look Angle	38.016 Deg	Downlink Elevation Look Angle	38.016 Deg
Uplink Azimuth Look Angle	146.561 Deg	Downlink Azimuth Look Angle	146.561 Deg
Uplink Slant Range	37947.137 km	Downlink Slant Range	37947.137 km
Uplink m^2 Antenna Gain	44.526 dBi	Downlink m^2 Antenna Gain	42.997 dBi
Uplink Spreading Loss	162.576 dB(m^2)	Downlink Spreading Loss	162.576 dB(m^2)
Uplink Path Loss	207.102 dB	Downlink Path Loss	205.573 dB
Satellite Input level	-134.067 dBW/m^2	Satellite Input level	-178.593 dBW
Satellite Input Back Off	36.167 dB	Uplink C/No	54.877 dB-Hz
Satellite Output Back Off	33.167 dB	Uplink C/Io	63.776 dB-Hz
Satellite Downlink EIRP	16.553 dBW	Uplink C/(No+Io)	54.351 dB-Hz
		Uplink Margin	0.179 dB
Interference Calculations		Satellite Downlink EIRP	16.553 dBW
Adjacent Satellite Uplink	67.233 dB-Hz	Downlink C/No	70.539 dB-Hz
Adjacent Satellite Downlink	82.906 dB-Hz	Downlink C/Io	63.278 dB-Hz
Cross-Polarization Uplink	70.033 dB-Hz	Downlink C/(No+Io)	62.531 dB-Hz
Cross-Polarization Downlink	71.033 dB-Hz	Downlink Margin	8.359 dB
E.S. HPA Intermodulation	68.833 dB-Hz	Total Link C/(No+Io)	53.736 dB-Hz
Transponder Intermodulation	64.133 dB-Hz	Margin	-0.436 dB
Number of active carriers	1 N		
C/Io Uplink	63.776 dB-Hz	Antenna Flange Power Density	-18.088 dBW/4 kHz
C/Io Downlink	63.278 dB-Hz	Uplink Off-Axis EIRP Power Density	13.386 dBW/40 kHz
		Downlink EIRP Power Density	-1.269 dBW/4 kHz
Transponder Bandwidth Utilization	1.422 %	Installed HPA Size	3 Watts
Transponder Bandwidth Utilization	512 kHz	Installed HPA Size	4.771 dBW
Transponder Power Utilization	0.121 %	Required HPA Power	3.984 dBW
Transponder Power Equiv. Bandwidth	43.611 kHz	Operating HPA Single Carrier OBO	0.787 dB
Number of like carriers supported	70.313		
Actual transponder Utilization for N	1.422 %		

128 kbit/s RaySat to Hub Link Budget with 6 dB Transponder Input Attenuation

Satellite Name	AMC-6	Data Rate	128000 bit/s
Satellite Location	72 Deg W	Bit Error Rate	1x10E-7
Satellite Center Beam EIRP	52.97 dBW	Eb/No Required	3.1 dB
Satellite EIRP in direction of DL ES	49.72 dBW	C/No Required	54.172 dB-Hz
Satellite SFD in direction of UL ES	-91.9 dBW/m^2	Availability Required	99.7% 1577.8464 Outage Min/Year
Satellite G/T in direction of UL ES	4.87 dB/K	ITU Uplink Rain Zone	E
Satellite Input Back Off	7 dB	ITU Downlink Rain Zone	E
Satellite Output Back Off	4 dB	Modulation Type	BPSK
Transponder BW	36 MHz	FEC Factor	Rate 1/3
		Spread Factor : Bandwidth (Normally	1
		Carrier Spacing (1.4 Nominal)	1.3
		Signal Bandwidth	512.00

Uplink Name	RaySat Remote	Downlink Name	Hub
Uplink Location Latitude	40 Deg N	Downlink Location Latitude	40 Deg N
Uplink Location Longitude	95 Deg W	Downlink Location Longitude	95 Deg W
Uplink Frequency	14250 MHz	Downlink Frequency	11950 MHz
Effective Uplink Antenna Size	0.178 m	Downlink Antenna Size	4.5 m
Uplink Antenna Efficiency	0.8	Downlink Antenna Efficiency	0.67
Uplink Antenna Gain	27.516 dBi	Downlink Antenna Gain	53.273 dBi
Uplink EIRP	30.5 dBW	Downlink Antenna LNA Temp	110 K
Uplink Output Circuit Loss	1 dB	Downlink Antenna Noise Temp	35 K
Uplink PA Output Power	2.503 Watts	Downlink Rain Noise	0 K
Uplink PA Output Power	3.984 dBW	Downlink Earth Station G/T	31.459 dB/K
Uplink Rain Attenuation	0.741 dB	Downlink Rain Attenuation	0 dB
Uplink Misc Losses	1.25 dB	Downlink Misc Losses	0.5 dB
Uplink Elevation Look Angle	38.016 Deg	Downlink Elevation Look Angle	38.016 Deg
Uplink Azimuth Look Angle	146.561 Deg	Downlink Azimuth Look Angle	146.561 Deg
Uplink Slant Range	37947.137 km	Downlink Slant Range	37947.137 km
Uplink m^2 Antenna Gain	44.526 dBi	Downlink m^2 Antenna Gain	42.997 dBi
Uplink Spreading Loss	162.576 dB(m^2)	Downlink Spreading Loss	162.576 dB(m^2)
Uplink Path Loss	207.102 dB	Downlink Path Loss	205.573 dB

Satellite Input level	-134.067 dBW/m^2	Satellite Input level	-178.593 dBW
Satellite Input Back Off	42.167 dB	Uplink C/No	54.877 dB-Hz
Satellite Output Back Off	39.167 dB	Uplink C/Io	57.776 dB-Hz
Satellite Downlink EIRP	10.553 dBW	Uplink C/(No+Io)	53.079 dB-Hz
		Uplink Margin	-1.093 dB
Interference Calculations		Satellite Downlink EIRP	10.553 dBW
Adjacent Satellite Uplink	61.233 dB-Hz	Downlink C/No	64.539 dB-Hz
Adjacent Satellite Downlink	76.906 dB-Hz	Downlink C/Io	57.278 dB-Hz
Cross-Polarization Uplink	64.033 dB-Hz	Downlink C/(No+Io)	56.531 dB-Hz
Cross-Polarization Downlink	65.033 dB-Hz	Downlink Margin	2.359 dB
E.S. HPA Intermodulation	62.833 dB-Hz	Total Link C/(No+Io)	51.460 dB-Hz
Transponder Intermodulation	58.133 dB-Hz	Margin	-2.712 dB
Number of active carriers	1 N		
C/Io Uplink	57.776 dB-Hz	Antenna Flange Power Density	-18.088 dBW/4 kHz
C/Io Downlink	57.278 dB-Hz	Uplink Off-Axis EIRP Power Density	13.386 dBW/40 kHz
		Downlink EIRP Power Density	-7.269 dBW/4 kHz
Transponder Bandwidth Utilization	1.422 %	Installed HPA Size	3 Watts
Transponder Bandwidth Utilization	512 kHz	Installed HPA Size	4.771 dBW
Transponder Power Utilization	0.030 %	Required HPA Power	3.984 dBW
Transponder Power Equiv. Bandwidth	10.955 kHz	Operating HPA Single Carrier OBO	0.787 dB
Number of like carriers supported	70.313		
Actual transponder Utilization for N	1.422 %		

512 kbit/s RaySat to Hub Link Budget with 0 dB Transponder Input Attenuation

Satellite Name	AMC-6	Data Rate	512000 bit/s
Satellite Location	72 Deg W	Bit Error Rate	1x10E-7
Satellite Center Beam EIRP	52.97 dBW	Eb/No Required	3.1 dB
Satellite EIRP in direction of DL ES	49.72 dBW	C/No Required	60.193 dB-Hz
Satellite SFD in direction of UL ES	-97.9 dBW/m^2	Availability Required	99.7% 1577.8464 Outage Min/Year
Satellite G/T in direction of UL ES	4.87 dB/K	ITU Uplink Rain Zone	E
Satellite Input Back Off	7 dB	ITU Downlink Rain Zone	E
Satellite Output Back Off	4 dB	Modulation Type	BPSK
Transponder BW	36 MHz	FEC Factor	Rate 1/3
		Spread Factor : Bandwidth (Normally	1
		Carrier Spacing (1.4 Nominal)	1.314
		Signal Bandwidth	2070.053

Uplink Name	RaySat Remote	Downlink Name	Hub
Uplink Location Latitude	40 Deg N	Downlink Location Latitude	40 Deg N
Uplink Location Longitude	95 Deg W	Downlink Location Longitude	95 Deg W
Uplink Frequency	14250 MHz	Downlink Frequency	11950 MHz
Effective Uplink Antenna Size	0.178 m	Downlink Antenna Size	4.5 m
Uplink Antenna Efficiency	0.8	Downlink Antenna Efficiency	0.67
Uplink Antenna Gain	27.516 dBi	Downlink Antenna Gain	53.273 dBi
Uplink EIRP	30.5 dBW	Downlink Antenna LNA Temp	110 K
Uplink Output Circuit Loss	1 dB	Downlink Antenna Noise Temp	35 K
Uplink PA Output Power	2.503 Watts	Downlink Rain Noise	0 K
Uplink PA Output Power	3.984 dBW	Downlink Earth Station G/T	31.459 dB/K
Uplink Rain Attenuation	0.741 dB	Downlink Rain Attenuation	0 dB
Uplink Misc Losses	1.25 dB	Downlink Misc Losses	0.5 dB
Uplink Elevation Look Angle	38.016 Deg	Downlink Elevation Look Angle	38.016 Deg
Uplink Azimuth Look Angle	146.561 Deg	Downlink Azimuth Look Angle	146.561 Deg
Uplink Slant Range	37947.137 km	Downlink Slant Range	37947.137 km
Uplink m^2 Antenna Gain	44.526 dBi	Downlink m^2 Antenna Gain	42.997 dBi
Uplink Spreading Loss	162.576 dB(m^2)	Downlink Spreading Loss	162.576 dB(m^2)
Uplink Path Loss	207.102 dB	Downlink Path Loss	205.573 dB

Satellite Input level	-134.067 dBW/m^2	Satellite Input level	-178.593 dBW
Satellite Input Back Off	36.167 dB	Uplink C/No	54.877 dB-Hz
Satellite Output Back Off	33.167 dB	Uplink C/Io	63.776 dB-Hz
Satellite Downlink EIRP	16.553 dBW	Uplink C/(No+Io)	54.351 dB-Hz
		Uplink Margin	-5.842 dB
Interference Calculations		Satellite Downlink EIRP	16.553 dBW
Adjacent Satellite Uplink	67.233 dB-Hz	Downlink C/No	70.539 dB-Hz
Adjacent Satellite Downlink	82.906 dB-Hz	Downlink C/Io	63.278 dB-Hz
Cross-Polarization Uplink	70.033 dB-Hz	Downlink C/(No+Io)	62.531 dB-Hz
Cross-Polarization Downlink	71.033 dB-Hz	Downlink Margin	2.338 dB
E.S. HPA Intermodulation	68.833 dB-Hz	Total Link C/(No+Io)	53.736 dB-Hz
Transponder Intermodulation	64.133 dB-Hz	Margin	-6.457 dB
Number of active carriers	1 N		

C/Io Uplink	63.776 dB-Hz	Antenna Flange Power Density	-24.155 dBW/4 kHz
C/Io Downlink	63.278 dB-Hz	Uplink Off-Axis EIRP Power Density	7.319 dBW/40 kHz
		Downlink EIRP Power Density	-7.336 dBW/4 kHz

Transponder Bandwidth Utilization	5.750 %	Installed HPA Size	3 Watts
Transponder Bandwidth Utilization	2070.5 kHz	Installed HPA Size	4.771 dBW
Transponder Power Utilization	0.121 %	Required HPA Power	3.984 dBW
Transponder Power Equiv. Bandwidtł	43.611 kHz	Operating HPA Single Carrier OBO	0.787 dB
Number of like carriers supported	17.387		
Actual transponder Utilization for N	5.751 %		

512 kbit/s RaySat to Hub Link Budget with 6 dB Transponder Input Attenuation

Satellite Name	AMC-6	Data Rate	512000 bit/s
Satellite Location	72 Deg W	Bit Error Rate	1x10E-7
Satellite Center Beam EIRP	52.97 dBW	Eb/No Required	3.1 dB
Satellite EIRP in direction of DL ES	49.72 dBW	C/No Required	60.193 dB-Hz
Satellite SFD in direction of UL ES	-91.9 dBW/m^2	Availability Required	99.7% 1577.8464 Outage Min/Year
Satellite G/T in direction of UL ES	4.87 dB/K	ITU Uplink Rain Zone	E
Satellite Input Back Off	7 dB	ITU Downlink Rain Zone	E
Satellite Output Back Off	4 dB	Modulation Type	BPSK
Transponder BW	36 MHz	FEC Factor	Rate 1/3
		Spread Factor : Bandwidth (Normally	1
		Carrier Spacing (1.4 Nominal)	1.314
		Signal Bandwidth	2070.053
Uplink Name	Remote	Downlink Name	Hub
Uplink Location Latitude	40 Deg N	Downlink Location Latitude	40 Deg N
Uplink Location Longitude	95 Deg W	Downlink Location Longitude	95 Deg W
Uplink Frequency	14250 MHz	Downlink Frequency	11950 MHz
Effective Uplink Antenna Size	0.178 m	Downlink Antenna Size	4.5 m
Uplink Antenna Efficiency	0.7975	Downlink Antenna Efficiency	0.67
Uplink Antenna Gain	27.503 dBi	Downlink Antenna Gain	53.273 dBi
Uplink EIRP	30.5 dBW	Downlink Antenna LNA Temp	110 K
Uplink Output Circuit Loss	1 dB	Downlink Antenna Noise Temp	35 K
Uplink PA Output Power	2.510 Watts	Downlink Rain Noise	0 K
Uplink PA Output Power	3.997 dBW	Downlink Earth Station G/T	31.459 dB/K
Uplink Rain Attenuation	0.741 dB	Downlink Rain Attenuation	0 dB
Uplink Misc Losses	1.25 dB	Downlink Misc Losses	0.5 dB
Uplink Elevation Look Angle	38.016 Deg	Downlink Elevation Look Angle	38.016 Deg
Uplink Azimuth Look Angle	146.561 Deg	Downlink Azimuth Look Angle	146.561 Deg
Uplink Slant Range	37947.137 km	Downlink Slant Range	37947.137 km
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Uplink Spreading Loss	162.576 dB(m^2)	Downlink Spreading Loss	162.576 dB(m^2)
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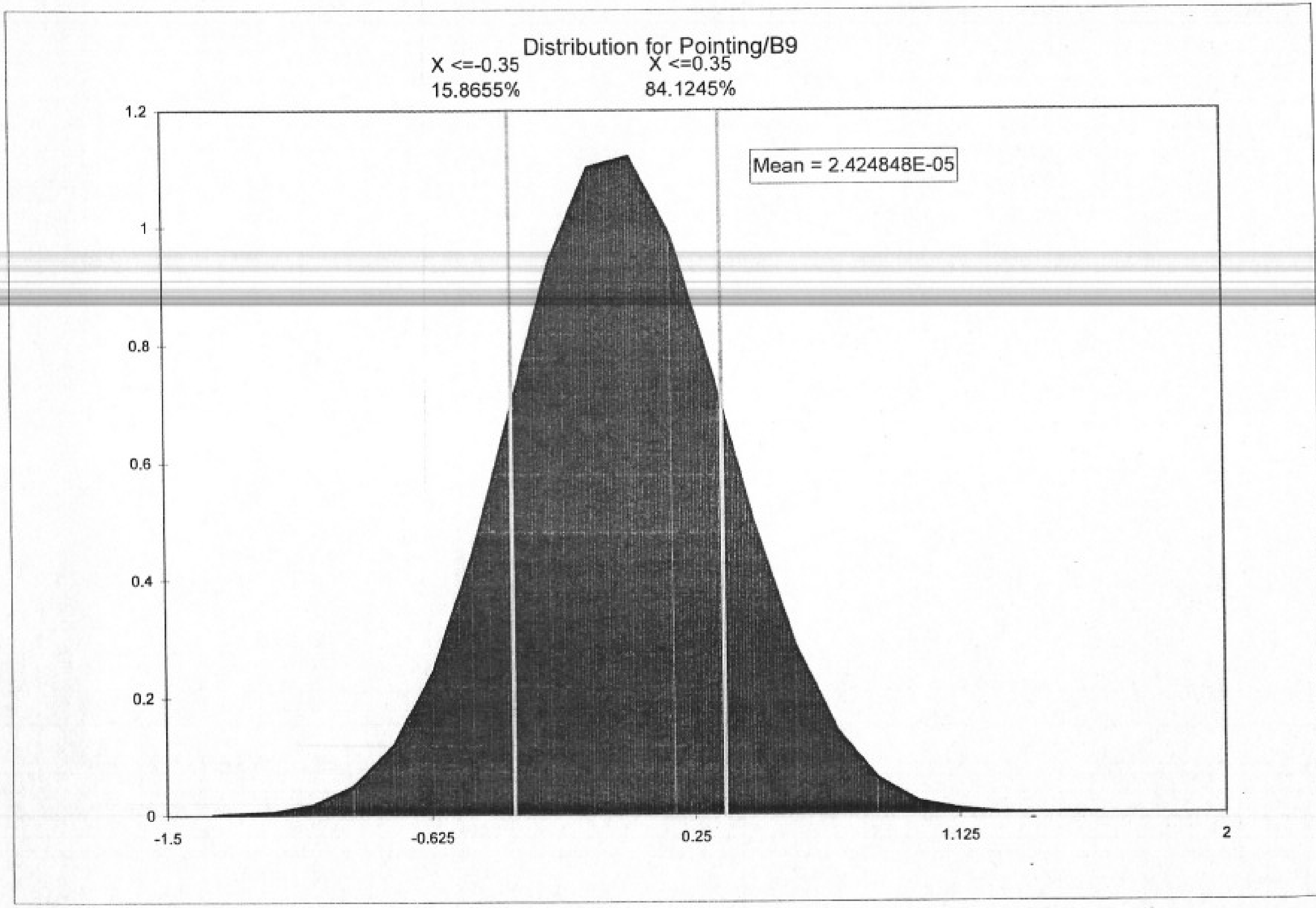
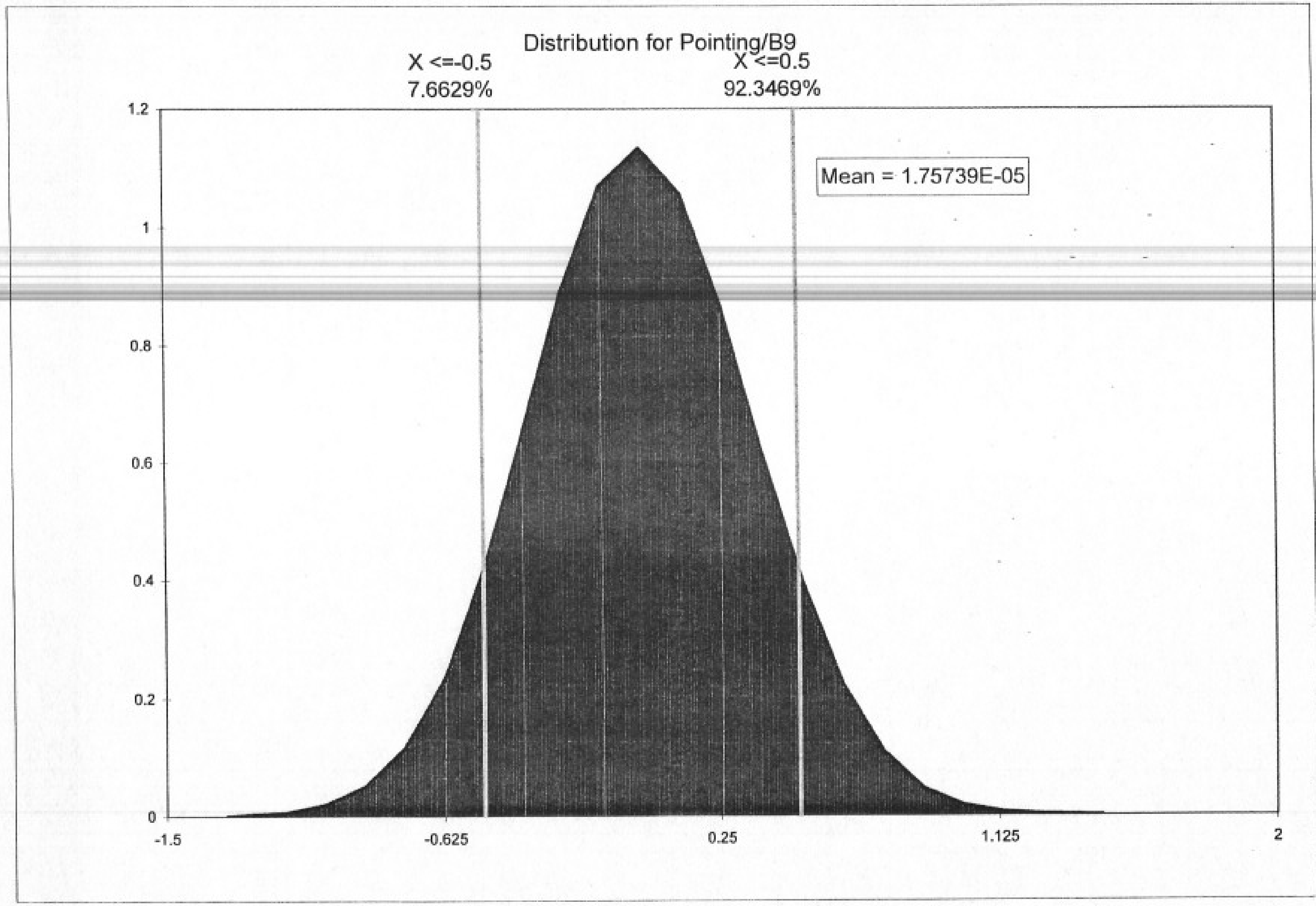
Satellite Input Back Off	42.167 dB	Uplink C/No	54.877 dB-Hz
Satellite Output Back Off	39.167 dB	Uplink C/Io	57.776 dB-Hz
Satellite Downlink EIRP	10.553 dBW	Uplink C/(No+Io)	53.079 dB-Hz
		Uplink Margin	-7.114 dB
Interference Calculations		Satellite Downlink EIRP	10.553 dBW
Adjacent Satellite Uplink	61.233 dB-Hz	Downlink C/No	64.539 dB-Hz
Adjacent Satellite Downlink	76.906 dB-Hz	Downlink C/Io	57.278 dB-Hz
Cross-Polarization Uplink	64.033 dB-Hz	Downlink C/(No+Io)	56.531 dB-Hz
Cross-Polarization Downlink	65.033 dB-Hz	Downlink Margin	-3.662 dB
E.S. HPA Intermodulation	62.833 dB-Hz	Total Link C/(No+Io)	51.460 dB-Hz
Transponder Intermodulation	58.133 dB-Hz	Margin	-8.733 dB
Number of active carriers	1 N		
C/Io Uplink	57.776 dB-Hz	Antenna Flange Power Density	-24.142 dBW/4 kHz
C/Io Downlink	57.278 dB-Hz	Uplink Off-Axis EIRP Power Density	7.332 dBW/40 kHz
		Downlink EIRP Power Density	-13.336 dBW/4 kHz
Transponder Bandwidth Utilization	5.750 %	Installed HPA Size	3 Watts
Transponder Bandwidth Utilization	2070.5 kHz	Installed HPA Size	4.771 dBW
Transponder Power Utilization	0.030 %	Required HPA Power	3.997 dBW
Transponder Power Equiv. Bandwidtl	10.955 kHz	Operating HPA Single Carrier OBO	0.774 dB
Number of like carriers supported	17.387		
Actual transponder Utilization for N	5.751 %		

EXHIBIT B

DISTRIBUTION FOR POINTING DEVIATION


Distribution for Pointing/B9
X <=-0.35
15.8655%
X <=0.35
84.1245%
Mean = 2.424848E-05
1.2
1
0.8
0.6
0.4
0.2
0
-1.5
-0.625
0.25
1.125
2


Distribution for Pointing/B9
X <=-0.5
7.6629%
X <=0.5
92.3469%
Mean = 1.75739E-05
1.2
1
0.8
0.6
0.4
0.2
0
-1.5
-0.625
0.25
1.125
2

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. 06-30-2008
ELECTRICAL
STATE OF CALIFORNIA

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

Dated: August 4, 2006

CERTIFICATE OF SERVICE

I, Elizabeth R. Park, hereby certify that on this 4th day of August, 2006, served a true copy of the foregoing Comments of ViaSat, Inc. by first class mail, postage pre-paid upon the following:

Bruce A. Henoch
Shulman Rogers Gandal Pordy & Ecker
11921 Rockville Pike
Suite 300
Rockville, MD 20854

Elizabeth R. Park