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August 17, 2006

Marlene H. Dortch
Secretary
Federal Communications Commission
c/o Natek, Inc.
236 Massachusetts Avenue, N.E.
Suite 110
Washington, D.C. 20002

Re: 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

Dear Ms. Dortch:

Enclosed please find an original and four copies of the Reply Comments filed by RaySat, Inc. in the above-referenced proceeding.

Also enclosed please find an additional copy. Please date-stamp this copy and return it to the courier.

Please direct any questions concerning this filing to the undersigned at (301) 230-6569.

Respectfully submitted,

Bruce A. Henoch /RMB

Bruce A. Henoch
Counsel for RaySat, Inc.

Enclosure

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

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

REPLY OF RAYSAT, INC.

RaySat, Inc. ("RaySat"), the applicant in the above-referenced proceeding,[1] through its attorney, hereby submits its Reply to the comments filed by ViaSat, Inc.[2] RaySat filed its Application to authorize the use of its StealthRay in-motion satellite antenna system. ViaSat's Comments appear to have been filed for the purpose of forcing RaySat to use ViaSat's own modem products in lieu of others on the market. ViaSat is known in the industry as one of the original developers of spread spectrum modems, which are currently used with several other mobile communications systems. RaySat has no objection to using spread spectrum technology, but it also recognizes the value of qualifying its antenna with as broad a range of systems as possible, rather than restricting the user's choice, as would be ViaSat's preference. This would have the added benefit of maximizing the antenna's applications to include local, state, and federal emergency

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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 (filed June 26, 2006) ("Application").

[2] Comments of ViaSat, Inc., *In the Matter 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, filed August 4, 2006 ("Comments").

response units, transportation companies, Border Patrol, and others whose needs are better served with other networks.

The RaySat network will be managed using the customary VSAT industry practices of carefully deploying and monitoring all remote sites and coordinating any interference issues with adjacent satellite operators. In addition, RaySat has shown in its Application that the StealthRay meets the off-axis emission limits for either spread spectrum or non-spread carriers.

Real-world operations have demonstrated most of ViaSat's concerns to be unfounded. As the Commission is aware, RaySat has been conducting several market studies using the StealthRay system featuring numerous users under varying operating conditions since August 2005 pursuant to an experimental license. These studies have shown that RaySat's links are robust under real-world conditions, and no claims of adjacent satellite interference have been received. RaySat has done extensive testing during this period, and these studies have shown that the performance of the StealthRay is well within the parameters described in the Application.

Thus, there is no need for the Commission to give any weight to ViaSat's Comments, particularly because they contain a significant number of errors and incorrect assumptions and also display a fundamental misunderstanding of the way the RaySat system operates. As will be discussed in detail below, the ViaSat Comments do not present any issues of significance to the Commission, and they can and should be ignored.

RaySat will address each of ViaSat's contentions in turn:

I. Use of Unspread Signal Does Not Increase Interference Potential

ViaSat's initial claim is that the RaySat system does not adequately protect adjacent satellites from interference due to the use of a "simple unspread modem" (*i.e.*, a modem manufactured by other than ViaSat). This claim is incorrect for several reasons. First, the Application does not limit the RaySat system to SCPC carriers only. Indeed, RaySat is in the process of integrating the StealthRay antenna with multiple VSAT systems currently on the market that offer both spread and non-spread spectrum solutions. The VSAT vendors are aware of the coding and modulation requirements and are developing compatible products to support those requirements.[3] These VSAT systems provide a central control system with the full capability to monitor and control the bandwidth, frequency, and power levels of the StealthRay remotes.

Second and more importantly, ViaSat's Comments leaves the misimpression that the RaySat system utilizes a simple SCPC modem link with no central management. This is not true. As discussed below, users of the RaySat systems are all served through central hubs, which manage system parameters such as bandwidth, power, and modulation. These hubs are all staffed with highly trained personnel, who are knowledgeable about the setting up of power levels as well as the frequency and

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[3] Further, the use of SCPC carriers does not preclude a lack of a central control. On the contrary, SCPC modems are fully capable of integrating a full Network Management System ("NMS"), and numerous vendors offer such a capability. For example, the SCPC modem vendor Comtech offer a NMS called Vipersat. This system offers automatic control of the bandwidth frequency and power levels of each modem in the field. The command control and monitoring capabilities of this NMS are comparable with the abilities of most VSAT NMS systems.

bandwidth requirement necessary to meet FCC limits. These personnel also have the ability remotely to shut down any antenna suspected of causing interference.

The RaySat hub operators will be well-versed in the operational limitations of the StealthRay antenna. Specifically, the RaySat hub operators will enforce the PSD limitations required to meet Commission requirements. The hub operators will be able to identify any user operating FEC or modulation schemes that are incompatible with these requirements and will be able to shut down the service by refusing to bring up a carrier. This will be an operational requirement contained for all hub operators. Thus, even for systems without an NMS, the remote users will be affirmatively constrained to operations within the limitations established by the FCC. In addition, many satellite operators now require that each remote site be tested by the operator to verify compliance, or at a minimum a test report be provided to the operator, prior to any remote being allowed to access the network. These measures provide another layer of protection against potential interference.

II. There Is No "Lack of Central Control"

ViaSat also argues that the lack of "one" specific central control point leaves the system open for user abuse, such as the ability of the remote users to control bandwidth modulation and coding.[4] This is not accurate. First, although there is no *single* central control point governing the entire network of RaySat users, each and every user remote is controlled by *a* central hub facility, as discussed above.

In addition, ViaSat's statement that the link is bandwidth-limited only looks at the portion of the link from the remote to the hub and is therefore incorrect. In fact, in the

[4] Comments at 2-3.

overall system, the carrier from the hub to the remote (the forward link) uses more power than bandwidth. This is due to the larger size of the hub antenna, the small remote antenna size, the use of QPSK or higher order modulation, and high FEC rates. Additionally, the data rate requirements from the hub to the remote are much greater than the data rate from the remote to the hub. All of these factors make the overall power utilization for the forward link greater than the bandwidth utilization on the forward link. In fact the power utilization on the forward link will make the overall network space segment consumption power dominated. Thus, there is no economic benefit for a remote user to decrease the return link's bandwidth or increase its power.

Further, the RaySat hub operators have knowledge of the operating limitations of the modem and will enforce the modulation, FEC, power, and bandwidth limitations imposed upon remote users. As mentioned above, the RaySat hub operators will be able to recognize uses that are incompatible with FCC standards and will shut down the service in such cases by refusing to bring up a carrier

ViaSat further claims that the "lack of a central control point . . . severely limits the ability of adjacent satellite users to track incidents of interference," because, according to ViaSat, the adjacent operator would need to contact "several different control points" to determine the source of interference.[5] Again, this is not accurate. First, we must note that each and every adjacent satellite operator has thoroughly examined the RaySat application and has concluded that the RaySat system will not cause harmful interference.[6] If the satellite operators themselves – who obviously should

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[5] Comments at 3.

[6] *See* Application, Exhibit 1.

be the most concerned about protecting their users from interference – have approved the parameters of the system, it should be of little practical concern to ViaSat.

It must be remembered that the RaySat antenna will automatically mute transmission if the pointing error exceeds 0.5 degrees, thus making adjacent satellite interference exceedingly unlikely.[7] And in the unlikely event that an antenna causes harmful interference to a user of an adjacent satellite, simple procedures can be used to identify the party causing such interference, whether or not an NMS is in use. For example, the affected user will likely first contact its satellite operator with details about the satellite, the interfering frequency, bandwidth, polarization, and other relevant circumstances. The satellite owner can then contact the operators of the two adjacent satellites, who are able quickly to check their database to determine whether such a carrier is registered on their satellite, thus enabling the source of interference to be quickly identified and corrected. Even if there is no NMS, the hub operator can simply shut down the forward carrier (from the hub to the remote) which will automatically mute the remote transmit. In this scenario there is no advantage between operating with a NMS or operating without one.

RaySat would also note ViaSat's contradictory statements regarding positional tracking capabilities. ViaSat claims that it is not in favor of a publicly-accessible database containing tracking data but is still in favor of requiring RaySat to submit

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[7] As mentioned above, RaySat has been operating the system pursuant to an experimental license since August 2005, and no instances of interference have been reported.

information regarding "tracking capabilities," including "logging of terminal locations."[8] As RaySat noted in its Application, its system is designed primarily for government and military use as well as in significant commercial enterprise settings such as commuter rail lines. The commuter trains operate over short distances, usually less than 60 miles, on a specified rail line, making the use of tracking data unnecessary, and Government and military users are generally opposed to the use of tracking data for security reasons.

Further, the use of RaySat's system over the past year under an experimental license has yielded no examples of interference into other systems, and use of similar systems such as Ku-Band Earth Station aboard Vessel ("ESV") systems, VSAT networks, and Satellite-Newsgathering systems over the past several years has demonstrated a history of virtually interference-free operations vis-à-vis fixed satellite users. In light of these factors, RaySat views tracking capabilities as unnecessary and, in the case of most users, impractical.

III. THE POINTING ACCURACY OF THE RAYSAT ANTENNA IS SUFFICIENT TO PREVENT INTERFERENCE INTO ADJACENT SATELLITES

The StealthRay uses a combination of an energy detector, built in gyroscopes and azimuth scanning precisely to track the satellite. The offset from the satellite peak is determined from both the energy detector and the positional information from the gyroscopes. This system works even with rotational motion on the antenna, as all motion is taken into account by the gyroscopes. When the positional error reaches 0.5 degrees, the antenna initiates commands to mute the output.

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[8] Comments at 4 and n.9.

When there is no rotational motion imparted on the antenna, the azimuth scan is ±0.35 degrees. This is controlled by the information from the gyros. When there is rotational movement imparted on the antenna, the offset angle is detected by the gyros; however, due to mechanical factors such as drive torque limitations, tracking errors can be introduced. For this analysis we consider the nominal antenna scanning and the rotational rate of the antenna to be independent of each other.

The nominal azimuth scanning is driven by a sinusoidal function with a peak amplitude of 0.35 degrees. This gives a Root Mean Square (RMS) deviation from zero degrees of 0.25 degrees. The second factor is the random error caused by tracking at different speeds. If a worst-case rotational movement of 60 degrees/second is assumed, this results in a peak error of 0.4 degrees as measured in lab tests. Further, the high rotational rate occurs infrequently and is assumed to lay on the 3 sigma level. This gives a standard deviation of 0.13 degrees.

From the above results we can calculate the overall standard deviation, which can be obtained by:

Sigma = [(0.25)^2 + (0.13)^2]^0.5 . degrees

= 0.28 degrees

The specified error limit of 0.5 degrees is 1.78 sigma, which occurs 7.5% of the time while the vehicle is turning. Assuming that the vehicle is turning 5% of the time, then the outage, even under these severe conditions, is still less than 0.4% of the time, much lower than the figures cited by ViaSat.

IV. VIASAT'S LINK BUDGETS CALCULATIONS ARE INCORRECT

Link budgets are attached and show that all FCC off-axis emissions requirements can be met with SCPC type carriers while providing an adequate link margin of 1.7dB.

The suppositions provided by ViaSat are not accurate. First, ViaSat assumes a threshold Eb/No of 3.1dB. With advanced Forward Error Correcting Codes (FEC) used by modem manufactures, a typical modem utilized by RaySat will achieve a threshold Eb/No of 2.0dB. This alone improves by 1.1dB the link budget margins provided by ViaSat. In addition, there are other FEC techniques currently on the market that promise even better Eb/No performance, such as Low Density Parity Check (LDPC) codes.

Additionally, the interference levels assumed by ViaSat are pessimistic. Also, the narrow bandwidth of the carriers allows them to be located in areas that have minimal levels of interference.

In addition, as noted above, RaySat has been operating the StealthRay system under an experimental license since August 2005, and has been operating satisfactorily during this entire period, thus showing that ViaSat's theoretical assumptions are overly conservative.

The table below shows a sample RaySat link budget, at 128 kbps. This link budget shows that RaySat's antenna achieves a link margin of 1.7dB at this data rate.

Data Parameters

Data Rate	128.0	kbps
FEC	5/16	Turbo
Modulation	BPSK	BPSK / QPSK
Threshold Eb/No	2.00	dB
Occ BW	1.35	
Spread Spectrum	N	(Y / N)
Chip Rate	13.11	Mchips/s
Total # of spread Links	5	

Satellite Parameters

Sat Name	TestSat	
Sat Long.	79	Deg
Sat Rx, G/T	4.5	dB/K
Sat Tx, EIRP	48	dBW
SFD	-90	dBW/m^2
IP / OP ratio	5	dB
U/L Freq	14.25	GHz
D/L Freq.	11.95	GHz

Rx Site Parameters

Rx Site Name	Remote	
Rx Lat	39	deg
Rx Long	77	deg
Rx G/T	33	dB/K
Ant Gain	55	dBi
System Temp	150	K

Tx Site Parameters

Tx Site Name	Remote	
Tx Lat	39	Deg
Tx Long	77	Deg
Tx Ant Gain	27.5	dBi
Tx Loss	0.75	dB
Radome loss	0.5	dB
Pointing Loss	0.35	dB
Tx HPA	2.5	W

Interference Parameters

ASI U/L EIRP in our direction	-3.9	dBW/4KHz
DL interferemce, dBW/4KHz	-30.6	dBW/4KHz

DownLink Fade	5.3	dB

Threshold C/N	-3.05	dB
C/Io Uplink WRT Saturation	26.6	dB/Hz
C/Io Downlink WRT Saturation	114.6	dB/Hz

Tx Slant Range	37536418.2	m
Tx FSL	207.0	dB
Uplink EIRP	30.0	dBW
Uplink C/No	55.3	dB-HZ
U/L C/N	-0.8	dB
G(1m^2) Tx	44.5	dBi
U/L flux density @ satellite	-133.2	dBW/m^2
IPBO	43.2	dB
C/I up	13.7	dB
C/I dn	20.3	dB
Clear Sky C/(N + I)	**-1.35**	**dB**
CS Eb/No	**3.70**	**dB**
Clear Sky (CS)Margin	**1.70**	**dB**
D/L Faded C/(N+I)	**-3.00**	**dB**
D/L faded Eb/No	**2.05**	**dB**
D/L Faded Margin	**0.05**	**dB**
PSD @ ant Flange	-18.1	dBW / 4KHz
Occupied BW	553.0	KHz
D/L PSD/4KHz	-11.6	dBW/4KHz

Rx Slant Range	37536418.2	M
Rx FSL	205.5	dB
OPBO	38.2	dB
D/L EIRP	9.8	dBW
D/L C/No	65.4	dB/Hz
D/L C/N	9.3	dB

V. CONCLUSION

For the reasons discussed herein, the Commission should disregard the Comments filed by ViaSat, and RaySat's Application should be granted without condition.

Respectfully submitted,

RAYSAT, INC.

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Date: August 17, 2006

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION SUBMITTED IN THESE REPLY COMMENTS

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in these Reply Comments, that I am familiar with Part 25 of the Commission's Rules (47 CFR Part 25), that I have either prepared or reviewed the engineering information submitted in these Reply Comments, and that it is complete and accurate to the best of my knowledge.

By:_____

Kenneth G. Ryan, P.E.
Vice President
Skjei Telecom, Inc.

Date: August 17, 2006

Certificate of Service

The undersigned hereby certifies that a true and complete copy of the foregoing Reply Comments filed by RaySat, Inc. in file number SES-LIC-20060629-01083 were served on this date by U.S. Mail, postage prepaid, on the following:

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