FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Raysat Antenna Systems, LLC	)	File No.
	)	
Authority to Operate Up to 10 Technically Identical Vehicle Mounted Earth Stations in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands	)))))	Call Sign: E060101

REQUEST FOR SPECIAL TEMPORARY AUTHORIZATION

Raysat Antenna Systems, LLC ("RAS"), pursuant to Section 25.120(b)(4) of the Commission's rules, 47 C.F.R. § 25.120(b)(3), hereby seeks a 30-day special temporary authority ("STA") to operate its "E-7000" land mobile-satellite service ("LMSS") earth station antennas on a commercial basis. Such operations would be consistent with RAS's existing LMSS blanket license authority, which will soon be the subject of modification applications to confirm full conformance to the Commission's vehicle-mounted earth station ("VMES") rules. Grant of such authority will also facilitate the limited introduction of this new, low-cost mobile broadband solution to commercial and government customers alike.

I. INTRODUCTION

The Commission recently authorized RAS to operate a total of 10 units of the E-7000 LMSS antenna for experimental testing and demonstration purposes.[1] This testing has been successful and recent inquires by potential clients in the commercial and government sectors have prompted RAS to file the instant request. RAS seeks an STA to operate up to ten (10)

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[1] *Experimental Special Temporary Authorization*, File No. 0583-EX-ST-2011, Call Sign WF9XEG, (Oct. 5, 2011).

E-7000 to extend the E-7000's capabilities to the commercial sector during the pendency of formal VMES applications that will soon be filed with the Commission.[2]

Grant of the commercial STA would strongly serve the public interest by supporting limited commercial and government use of the E-7000 in real-world conditions and enabling RAS to respond quickly to market demand for this cutting-edge mobile satellite communications solution. An STA authorizing short-term commercial operation of the E-7000 will result in expanded equipment options for U.S. Government and commercial users, and will promote continued U.S. leadership in satellite communications technology and enhanced competition in an important sector of the mobile broadband telecommunications market in the United States.

II. THE E-7000 ANTENNA

The E-7000 antenna is a single panel Ku-band array antenna developed in response to customer requests for higher transmit and receive performance. As with all RAS antennas, the E-7000 antenna uses a full motion tracking system that allows the user to have broadband data access while on the move. The antenna is designed for military and commercial users and will provide mobile access to the many information-rich applications these users require.

The E-7000 antenna technology builds upon RAS's proven antenna technology for mobile applications.[3] The major enhancement is in the antenna panel. The element

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[2] Consistent with the Commission's determination in its existing blanket license authority, RAS has filed three separate STA requests to reflect the potential use of the E-7000 with three separate hub earth stations. However, RAS seeks authority to operate no more than ten (10) terminals across all three networks.

[3] RAS current holds six LMSS earth station authorization that will soon be the subject of modification applications to add the E-7000 and other terminals, as well as to establish full conformance with the Commission's VMES rules. *See Raysat Antenna Systems Application for Authority to Operate 400 Land Mobile Satellite Service ("LMSS") Earth Stations in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands,* IBFS File Nos. SES-LIC-20060629-01083; SES-LIC-20060629-02248; SES-LIC-20060629-02249; SES-LIC-20060629-02250; SES-LIC-20060629-02251; SES-LIC-20060629-02252; SES-AMD-20070620-00839; Call

technology has been changed from a printed circuit design to a waveguide design, which results in higher performance. The panel is capable of both transmit (at 14.0-14.5 GHz) and receive (at 11.7-12.2 GHz) operation. The antenna allows tracking in three axes: azimuth, elevation and polarization.

The E-7000 antenna consists of a single 44 inch-by-8.3 inch panel array that is mounted on a rotatable platform, which rotates in azimuth to orient the panel towards the satellite. The panel array tilts to set the panel's elevation angle. In addition, the E-7000 antenna has a polarization control mechanism that sets the correct polarization angle for both transmit and receive.

A. Antenna Operation and Pointing Control

As with all RAS antennas, the E-7000 antenna maintains active control of the azimuth, elevation and polarization angles. The antenna scans mechanically in both azimuth and elevation. For satellite acquisition, the E-7000 antenna uses a built-in GPS receiver to determine its position on the earth. It uses the geographical position and the longitudinal position of the satellite to determine the appropriate elevation angle. Once the elevation angle is set, the antenna rotates in azimuth.

During the scanning process, the antenna monitors the received power level within a specified frequency band with the RSSI. When a power threshold is reached, the scanning is stopped and the antenna tracks on the signal. The ACU then queries the modem to see if there is a valid Eb/No. If there is a valid Eb/No verifying that the target satellite has been acquired, the antenna will continue to track on the signal. Conversely, if there is not a valid Eb/No, the antenna will resume scanning.

Signs: E060101; E060447; E060448; E060449; E060450; E060451; Order and Authorization, DA 08-401 (IB OET rel. Feb 15, 2008).

Once the satellite is acquired, the antenna dithers mechanically in both azimuth and elevation to maintain peaking on the signal and maintain accurate pointing to the satellite. The maximum scan angles are ±0.3° in azimuth and 0.9° in elevation. The antenna also uses internal 3-axis gyroscopes and 2-axis inclinometers to help with tracking while the antenna is in motion. The antenna will also use the information from the gyros to determine when the maximum pointing offset of 0.5º has been reached and will cease transmissions within 100 milliseconds when this occurs.[4] The E-7000 will not resume transmissions until pointing accuracy is within 0.35°.[5]

A simplified block diagram of the major components in the tracking and acquisition system is shown below in Figure 1.

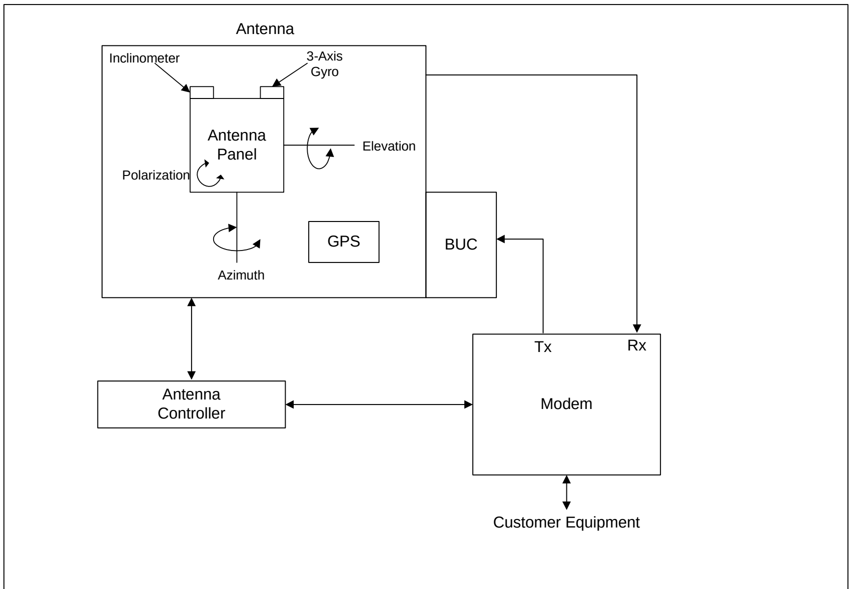

Figure 1
Typical Antenna Equipment Set-up

[4] *See* 47 CFR § 25.226(b)(1)(iv)(B). Although the antenna dithers in azimuth by ±0.3º and RAS expects pointing accuracy to typically remain at that value, RAS is implementing a declared pointing accuracy of 0.5° – the offset at which antenna transmissions automatically terminate – to set maximum transmit power levels. *See id.* at §§ 25.226(a)(1)(ii)(B), (b)(1).

[5] *Id.* Although the VMES rules permit the resumption of transmissions at the declared maximum pointing error (*i.e.*, 0.5º), RAS will not resume transmissions until the pointing accuracy is within 0.35º.

The following individual is the RAS point-of-contact with the ability and authority to cease all emissions from the terminals:

Kevin Bruestle
703-462-5004
1750 Old Meadow Road
McLean, VA 22180
Email: Kevin@sigs-raysat.com

B. Points of Communication and Hub

Under its current experimental STA, RAS operates the E-7000 antenna on the Galaxy 16 satellite located at 99˚ W.L.[6] To facilitate flexibility and serve the needs of its government and commercial customers, RAS also proposes to operate the E-7000 with two additional satellite points of contact: AMC-5 at 80.9˚ W.L and SES-1 at 101˚ W.L. Table 1 below lists the skew angles for various locations in CONUS to these satellites.

Table 1: Skew Angles (Various Locations in CONUS) to Galaxy 16 and SES 1

Site Name	Site Lat (deg. N)	Site Long (deg. W)	Galaxy 16 Skew Angle	SES 1 Skew Angle	AMC 5 Skew Angle
Seattle, WA	47.5	122.3	-19.2˚	-18.4˚	-31.2˚
San Diego, CA	32.4	117.2	-26.2˚	-23.7˚	-43.0˚
Bangor, ME	44.8	68.8	26.9˚	28.2˚	11.9˚
Miami, FL	25.8	80.2	33.7˚	36.3˚	1.5˚

The maximum skew angle associated with operation in CONUS with the Galaxy 16 and SES-1 satellites is 36.3˚, and with the AMC-5 satellites is 43˚. As a conservative measure, RAS will incorporate skew angle restrictions of 37.5˚ and 50˚ to limit the maximum transmit power to each of these satellites to ensure that the terminals comply with the VMES off-axis EIRP mask (i.e., two-degree spacing requirements) at all possible transmit locations.

[6] A coordination letter is being sought from Intelsat, which operates the Galaxy 16 satellite, and will be submitted as an attachment to the instant application as soon as it is available.

The gateway through which operations of the E-7000 will be control is the Spacenet gateway earth station in McLean, Virginia (Call Sign E860326).

C. Antenna Patterns and Transmit Power Levels

The transmit gain pattern shown below in Figure 2 exceeds the Commission's routine licensing guidelines (37.5˚ skew shown), but by limiting the input power spectral density ("PSD") to -18.1 dBW/4kHz for the Galaxy 18 and SES-1 satellites and -20.15 dBW/4kHz for the AMC-5 satellite, the off axis EIRP density remains under the off-axis PSD mask *even with maximum skew and a 0.5° degree pointing error in the GSO plane*, as further shown below in Figures 3 and 4. The impact of skew is also confirmed in Figure 5, where 0° skew is shown for the -20.15 dBW/4kHz power level.

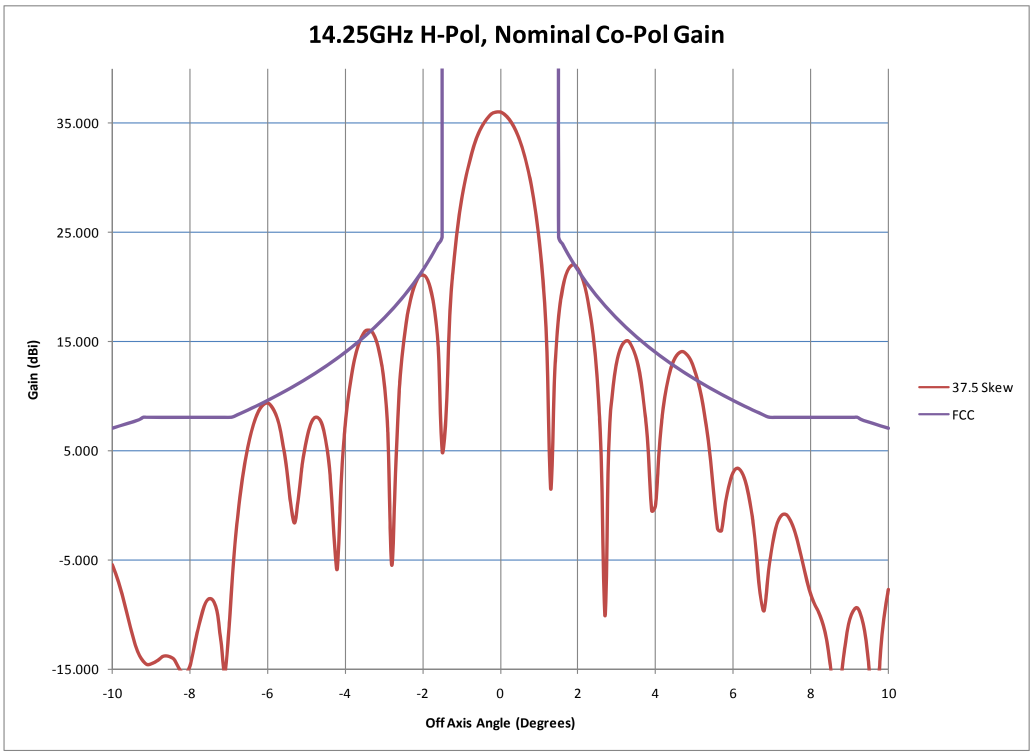

Figure 2
Close-In Gain Pattern 37.5˚ Skew Angle

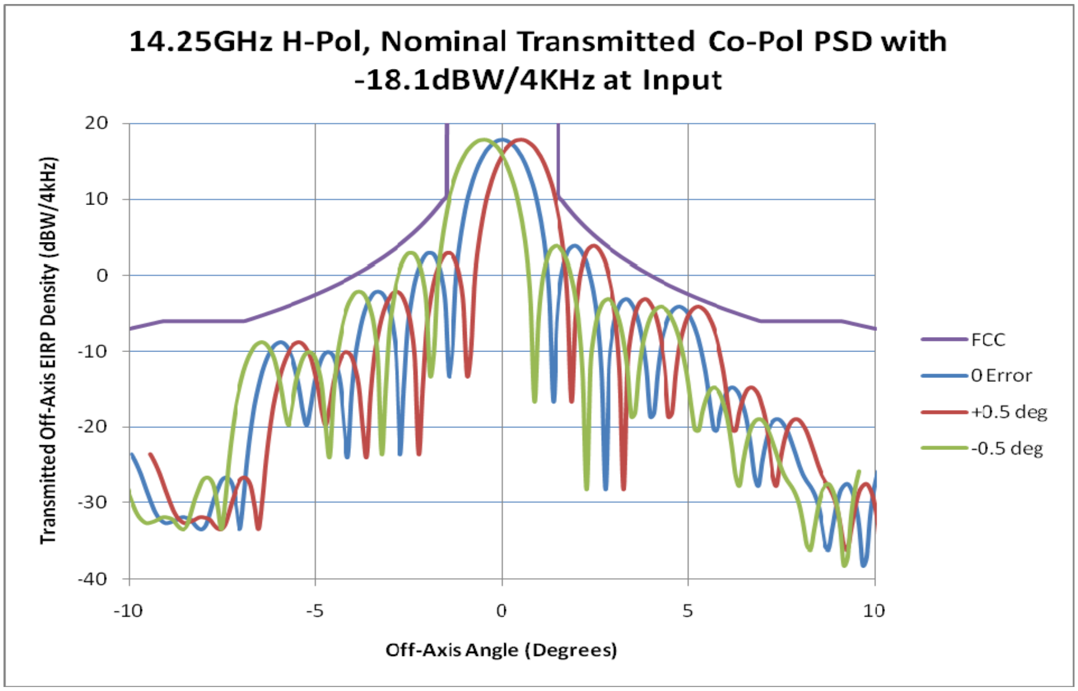

Figure 3 - 37.5 Degree Skew Angle Off-Axis PSD Pattern

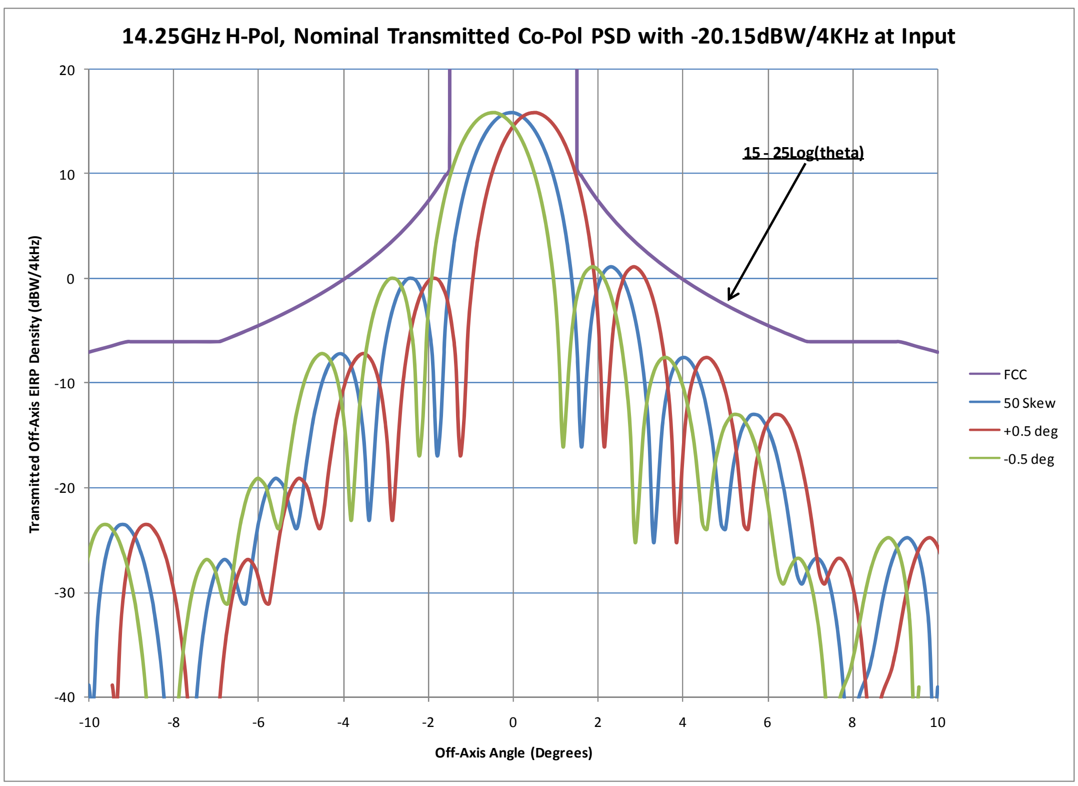

Figure 4 - 50 Degree Skew Angle Off-Axis PSD Pattern

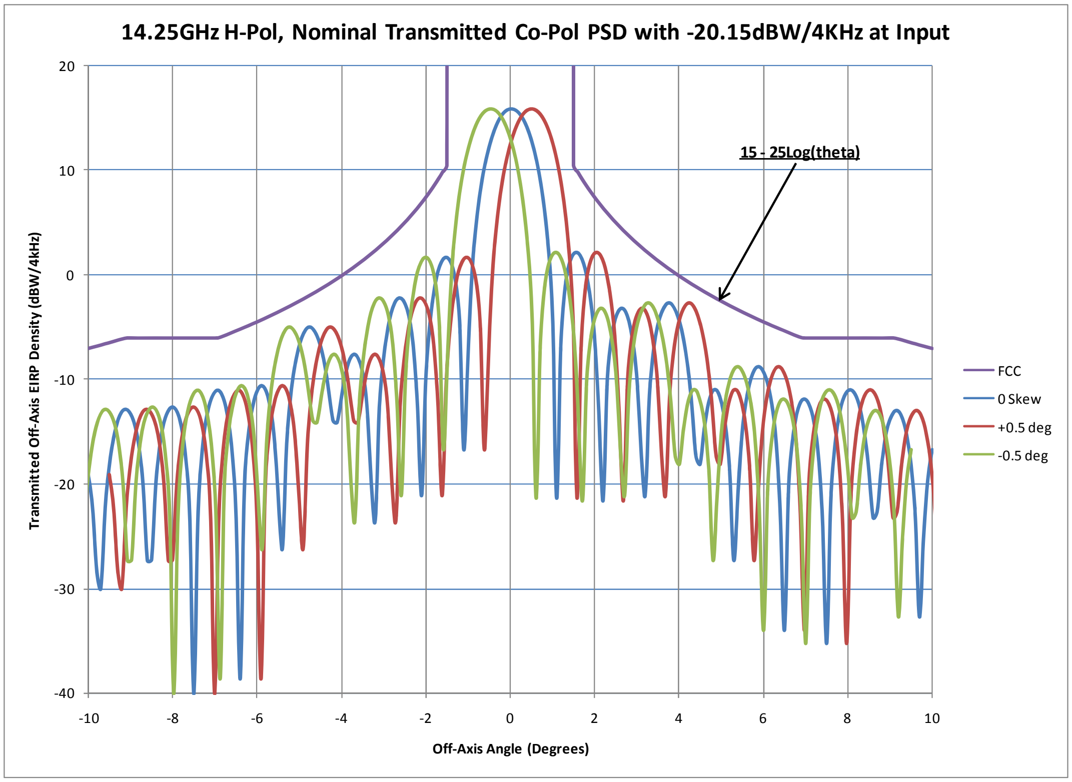

Figure 4 - 0 Degree Skew Angle Off-Axis PSD Pattern

The foregoing figures confirm that at all times transmissions from the E-7000 antenna are fully compliant with the Commission's two-degree spacing levels with each proposed satellite point of communications.

The maximum level of off-pointing is set to 0.5° in the plane of the GSO arc after which the transmissions are commanded to turn off. In addition, reduced input PSD into the antenna ensures compliance with off-axis EIRP levels associated with two-degree spacing and the coordinated parameters of the serving satellite. Relevant transmission parameters are set forth below.

SATELLITE	EIRP	EMISSION DESIGNATORS	ERP	INPUT POWER AT FLANGE
Galaxy 16 and SES-1	46.65dBW (46,238W)	7M75G7W, 9M45G7W	48.8dBW (75,858W)	-18.1 dBW/4kHz
AMC-5	44.75dBW (29,854W)	7M75G7W, 9M45G7W	46.9dBW (48,978W)	-20.15 dBW/4kHz

Link budgets for the E-7000 antenna are included as Attachment A. A Radiation Hazard Analysis is also included as Attachment B. Finally, RAS's experimental STA, which includes condition that RAS fully acknowledges and accepts, is included as Attachment C.

III. Grant of Special Temporary Authority Will Serve the Public Interest

RAS is seeking an STA to permit commercial operations of its E-7000 antenna during the pendency of the planned VMES application proceeding. RAS will follow this request with a companion STA and commercial application filing. This approach will enable RAS to meet immediate government and commercial market demand for the capabilities provided by the proven E-7000 design, which has operated without interference since the commencement of experimental trials last year.

This, in turn, will enhance competition in the mobile telecommunications market in the United States. Grant of the requested STA will also ensure that the increase in consumer demand high-bandwidth satellite communications services will be met with affordable and reliable VMES systems while strengthening U.S. leadership in these advanced communications services.

IV. CONCLUSION

In view of the foregoing, and in the absence of any objection or public interest harm and the significant public benefits associated with the requested relief, RAS respectfully requests that the Commission grant RAS a 30-day STA to permit commercial operation of the E-7000 antennas.

Sincerely,

RAYSAT ANTENNA SYSTEMS, LLC

***/s/* Carlos M. Nalda**

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Squire, Sanders & Dempsey (US) LLP
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Suite 300
Washington, D.C. 20036

February 8, 2012

ATTACHMENT A
LINK BUDGET

Galaxy 16 Link Budget - Example 1

Data Parameters

Data Rate	5280.9	kbps
FEC	21/44	Turbo
Modulation	qpsk	BPSK / QPSK
Threshold Eb/No	2.80	dB
Occ BW	1.40	
Spread Spectrum	n	(Y / N)
Chip Rate	5.53	Mchips/s
Total # of spread Links	1	
Beta Factor	1.00	

Satellite Parameters

Sat Name	G16	
Sat Long.	99	deg
Sat Rx, G/T	2.8	dB/K
Sat Tx, EIRP	51.3	dBW
SFD	-94	dBW/m^2
IP / OP ratio	4	dB
U/L Freq	14.25	GHz
D/L Freq.	11.95	GHz

Rx Site Parameters

Rx Site Name	NY Hub	
Rx Lat	40.5	deg
Rx Long	74	deg
Rx G/T	37.4	dB/K
Ant Gain	59.2	dBi
System Temp	150	K

Tx Site Parameters

Tx Site Name	Rem	
Tx Lat	39	deg
Tx Long	77	deg
Tx Ant Gain	36	dBi
Tx Loss	1	dB
Radome loss	0.25	dB
Pointing Loss	1	dB
Tx HPA	40.00	W

Interference Parameters

ASI U/L EIRP in our direction	4.2	dBW/4KHz
DL interferemce, dBW/4KHz	-20	dBW/4KHz

DownLink Fade	0.0	dB

Threshold C/N	2.60	dB
C/Io Uplink WRT Saturation	62.1	dB/Hz
C/Io Downlink WRT Saturation	107.3	dB/Hz
Tx Slant Range	37937218.3	m
Tx FSL	207.1	dB
Uplink EIRP	49.8	dBW
Uplink C/No	73.4	dB-HZ
U/L C/N	5.9	dB
G(1m^2) Tx	44.5	dBi
U/L flux density @ satellite	-113.5	dBW/m^2
IPBO	19.5	dB
C/I up	14.1	dB
C/I dn	24.4	dB
Clear Sky C/(N + I)	**5.25**	**dB**
CS Eb/No	**5.46**	**dB**
Clear Sky (CS)Margin	**2.66**	**dB**
D/L Faded C/(N+I)	**5.25**	**dB**
D/L faded Eb/No	**5.46**	**dB**
D/L Faded Margin	**2.66**	**dB**
PSD @ ant Flange	-18.1	dBW / 4KHz
Occupied BW	7745.3	KHz
D/L PSD/4KHz	2.9	dBW/4KHz

Rx Slant Range	38159620.9	m
Rx FSL	205.6	dB
OPBO	15.5	dB
D/L EIRP	35.8	dBW
D/L C/No	95.7	dB/Hz
D/L C/N	28.2	dB

NOTES & CALCULATIONS

Set CDMA margin to 0 to get correct UL pwr

COPBO	4	dB	
Transponder BW	36	MHz	
%PWR	7.07	%	
PEB	2.55	MHz	
Occupied BW	7.75	MHz	
Percentage BW	21.51	%	
Hub Dia/effec.	9		0.65
Rx Gain / G/T	59.16		37.40
Tx Gain	60.69		
Spread Factor	1		

	Tx Site	Rx Site	
Az Angle	212.70	215.68	deg
El Angle	39.39	36.59	deg
Pol Angle	24.83	26.33	deg

Galaxy 16 Link Budget - Example 2

Data Parameters

Data Rate	7000.0	kbps
FEC	1/2	LDPC
Modulation	qpsk	BPSK / QPSK
Threshold Eb/No	1.70	dB
Occ BW	1.35	
Spread Spectrum	n	(Y / N)
Chip Rate	7.00	Mchips/s
Total # of spread Links	1	
Beta Factor	1.00	

Satellite Parameters

Sat Name	G16	
Sat Long.	99	deg
Sat Rx, G/T	2.8	dB/K
Sat Tx, EIRP	51.3	dBW
SFD	-94	dBW/m^2
IP / OP ratio	4	dB
U/L Freq	14.25	GHz
D/L Freq.	11.95	GHz

Rx Site Parameters

Rx Site Name	NY Hub	
Rx Lat	40.5	deg
Rx Long	74	deg
Rx G/T	37.4	dB/K
Ant Gain	59.2	dBi
System Temp	150	K

Tx Site Parameters

Tx Site Name	Rem	
Tx Lat	39	deg
Tx Long	77	deg
Tx Ant Gain	36	dBi
Tx Loss	1	dB
Radome loss	0.25	dB
Pointing Loss	1	dB
Tx HPA	40.00	W

Interference Parameters

ASI U/L EIRP in our direction	4.2	dBW/4KHz
DL interferemce, dBW/4KHz	-20	dBW/4KHz

DownLink Fade	0.0	dB

Threshold C/N	1.70	dB
C/Io Uplink WRT Saturation	62.1	dB/Hz
C/Io Downlink WRT Saturation	107.3	dB/Hz
Tx Slant Range	37937218.3	m
Tx FSL	207.1	dB
Uplink EIRP	49.8	dBW
Uplink C/No	73.4	dB-HZ
U/L C/N	4.9	dB
G(1m^2) Tx	44.5	dBi
U/L flux density @ satellite	-113.5	dBW/m^2
IPBO	19.5	dB
C/I up	13.1	dB
C/I dn	23.3	dB
Clear Sky C/(N + I)	**4.23**	**dB**
CS Eb/No	**4.23**	**dB**
Clear Sky (CS)Margin	**2.53**	**dB**
D/L Faded C/(N+I)	**4.23**	**dB**
D/L faded Eb/No	**4.23**	**dB**
D/L Faded Margin	**2.53**	**dB**
PSD @ ant Flange	-19.0	dBW / 4KHz
Occupied BW	9450.0	KHz
D/L PSD/4KHz	2.1	dBW/4KHz

Rx Slant Range	38159620.9	m
Rx FSL	205.6	dB
OPBO	15.5	dB
D/L EIRP	35.8	dBW
D/L C/No	95.7	dB/Hz
D/L C/N	27.2	dB

NOTES & CALCULATIONS

Set CDMA margin to 0 to get correct UL pwr

COPBO	4	dB
Transponder BW	36	MHz
%PWR	7.07	%
PEB	2.55	MHz
Occupied BW	9.45	MHz
Percentage BW	26.25	%
Hub Dia/effec.	9	0.65
Rx Gain / G/T	59.16	37.40
Tx Gain	60.69	
Spread Factor	1	

	Tx Site	Rx Site	
Az Angle	212.70	215.68	deg
El Angle	39.39	36.59	deg
Pol Angle	24.83	26.33	deg

SES 1 – Link Budget

Data Parameters

Data Rate	4096.0 kbps
FEC	1/2 Turbo
Modulation	bpsk BPSK / QPSK
Threshold Eb/No	3.50 dB
Occ BW	1.40
Spread Spectrum	n (Y / N)
Chip Rate	8.19 Mchips/s
Total # of spread Links	1
Beta Factor	1.00

Satellite Parameters

Sat Name	SES-1
Sat Long.	101 deg
Sat Rx, G/T	4 dB/K
Sat Tx, EIRP	51 dBW
SFD	-87 dBW/m^2
IP / OP ratio	3 dB
U/L Freq	14.25 GHz
D/L Freq.	11.95 GHz

Rx Site Parameters

Rx Site Name	Atlanta Hub
Rx Lat	32.5 deg
Rx Long	84 deg
Rx G/T	34.2 dB/K
Ant Gain	55.9 dBi
System Temp	150 K

Tx Site Parameters

Tx Site Name	SanFrancisco
Tx Lat	37.75 deg
Tx Long	122.7 deg
Tx Ant Gain	36 dBi
Tx Loss	0 dB
Radome loss	0.5 dB
Pointing Loss	0.5 dB
Tx HPA	23.81 W

Interference Parameters

ASI U/L EIRP in our direction	5.2 dBW/4KHz
DL interferemce, dBW/4KHz	-20 dBW/4KHz

DownLink Fade	0.0 dB

Threshold C/N	0.49 dB
C/Io Uplink WRT Saturation	52.1 dB/Hz
C/Io Downlink WRT Saturation	107.0 dB/Hz

Tx Slant Range	37836921.8 m
Tx FSL	207.1 dB
Uplink EIRP	48.8 dBW
Uplink C/No	73.6 dB-HZ
U/L C/N	4.5 dB
G(1m^2) Tx	44.5 dBi
U/L flux density @ satellite	-114.5 dBW/m^2
IPBO	27.5 dB

Rx Slant Range	37321342.2 m
Rx FSL	205.4 dB
OPBO	24.5 dB
D/L EIRP	26.5 dBW
D/L C/No	83.4 dB/Hz
D/L C/N	14.3 dB

C/I up	10.4 dB
C/I dn	13.4 dB

Clear Sky C/(N + I)	**2.74 dB**
CS Eb/No	**5.75 dB**
Clear Sky (CS)Margin	**2.25 dB**

D/L Faded C/(N+I)	**2.74 dB**
D/L faded Eb/No	**5.75 dB**
D/L Faded Margin	**2.25 dB**

PSD @ ant Flange	-21.3 dBW / 4KHz
Occupied BW	11468.8 KHz
D/L PSD/4KHz	-8.1 dBW/4KHz

	Tx Site	Rx Site	
Az Angle	146.98	209.64	deg
El Angle	40.70	47.95	deg
Pol Angle	-25.53	24.65	deg

AMC 5 Link Budget

Data Parameters

Data Rate	4096.0 kbps
FEC	1/2 Turbo
Modulation	qpsk BPSK / QPSK
Threshold Eb/No	3.50 dB
Occ BW	1.40
Spread Spectrum	n (Y / N)
Chip Rate	4.10 Mchips/s
Total # of spread Links	1
Beta Factor	1.00

Satellite Parameters

Sat Name	AMC-5
Sat Long.	80.9 deg
Sat Rx, G/T	5 dB/K
Sat Tx, EIRP	47 dBW
SFD	-91 dBW/m^2
IP / OP ratio	6 dB
U/L Freq	14.25 GHz
D/L Freq.	11.95 GHz

Rx Site Parameters

Rx Site Name	MCL Hub
Rx Lat	39 deg
Rx Long	77 deg
Rx G/T	33.3 dB/K
Ant Gain	55.1 dBi
System Temp	150 K

Tx Site Parameters

Tx Site Name	SanFrancisco
Tx Lat	37.75 deg
Tx Long	122.7 deg
Tx Ant Gain	36 dBi
Tx Loss	0 dB
Radome loss	0.5 dB
Pointing Loss	0.5 dB
Tx HPA	15.54 W

Interference Parameters

ASI U/L EIRP in our direction	-1.7 dBW/4KHz
DL interferemce, dBW/4KHz	-23 dBW/4KHz

DownLink Fade	0.0 dB

Threshold C/N	3.50 dB
C/lo Uplink WRT Saturation	59.0 dB/Hz
C/lo Downlink WRT Saturation	106.0 dB/Hz

Tx Slant Range	38857601.6 m	Rx Slant Range	37545940.1 m
Tx FSL	207.3 dB	Rx FSL	205.5 dB
Uplink EIRP	46.9 dBW	OPBO	19.6 dB
Uplink C/No	72.5 dB-HZ	D/L EIRP	27.4 dBW
U/L C/N	6.4 dB	D/L C/No	83.4 dB/Hz
G(1m^2) Tx	44.5 dBi	D/L C/N	17.2 dB
U/L flux density @ satellite	-116.6 dBW/m^2		
IPBO	25.6 dB		

C/I up	18.5 dB
C/I dn	20.3 dB

Clear Sky C/(N + I)	**5.65 dB**
CS Eb/No	**5.65 dB**
Clear Sky (CS)Margin	**2.15 dB**

D/L Faded C/(N+I)	**5.65 dB**
D/L faded Eb/No	**5.65 dB**
D/L Faded Margin	**2.15 dB**

PSD @ ant Flange	-20.2 dBW / 4KHz
Occupied BW	5734.4 KHz
D/L PSD/4KHz	-4.1 dBW/4KHz

	Tx Site	Rx Site	
Az Angle	124.40	186.18	deg
El Angle	28.48	44.67	deg
Pol Angle	-40.72	4.80	deg

ATTACHMENT B
RADIATION HAZARD ANALYSIS

Radiation Hazard Analysis

E-7000

This analysis predicts the radiation levels around a proposed earth station complex, comprised of a single panel type antenna. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01, pp 26-30. The maximum level of non-ionizing radiation to which employees may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment. Note that the worse-case radiation hazards exist along the beam axis. Under normal circumstances, it is highly unlikely that the antenna axis will be aligned with any occupied area since that would represent a blockage to the desired signals, thus rendering the link unusable.

Earth Station Technical Parameter Table

Antenna Aperture Size	1.2m x 0.212m
Antenna Effective Diameter	0.569 meters
Antenna Surface Area	0.254 sq. meters
Antenna Isotropic Gain	36.0 dBi
Number of Identical Adjacent Antennas	1
Nominal Antenna Efficiency (ε)	55%
Nominal Frequency	14.25 GHz
Nominal Wavelength (λ)	0.0211 meters
Maximum Transmit Power / Carrier	40.0 Watts
Number of Carriers	1
Total Transmit Power	40.0 Watts
W/G Loss from Transmitter to Feed	1.0 dB
Total Feed Input Power	31.8 Watts
Radome Losses	0.25 dB
Effective RF Power at radome	30.0 Watts
Near Field Limit	$R_{nf} = D^2/4\lambda$ = 3.85 meters
Far Field Limit	$R_{ff} = 0.6\ D^2/\lambda$ = 9.23 meters
Transition Region	R_{nf} to R_{ff} = 3.85 meters to 9.23 meters

In the following sections, the power density in the above regions, as well as other critically important areas will be calculated and evaluated. The calculations are done in the order discussed in OET Bulletin 65.

1.0 At the Antenna Surface

The power density at the reflector surface can be calculated from the expression:

$PD_{as} = 4P/A =$ **49.96** mW/cm^2 (1)

Where: P = total power at feed, milliwatts

A = Total area of reflector, sq. cm

In the normal range of transmit powers for satellite antennas, the power densities at or around the reflector surface is expected to exceed safe levels. This area will not be accessible to the general public.

This antenna will incorporate a radome which has 0.25 dB of loss. The worst case power density at the surface of the radome is shown below:

$PD_{radome}=4P_{rad}/A$ = **47.16** mW/cm² (2)
Where: Prad = total power at feed less radome losses, milliwatts
A = Total area of reflector, sq. cm (this would represent worst case)

Operators and technicians should receive training specifying this area as a high exposure area. Procedures must be established that will assure that all transmitters are rerouted or turned off before access by maintenance personnel to this area is possible.

2.0 On-Axis Near Field Region

The geometrical limits of the radiated power in the near field approximate a cylindrical volume with a diameter equal to that of the antenna. In the near field, the power density is neither uniform nor does its value vary uniformly with distance from the antenna. For the purpose of considering radiation hazard it is assumed that the on-axis flux density is at its maximum value throughout the length of this region. The length of this region, i.e., the distance from the antenna to the end of the near field, is computed as Rnf above.

The maximum power density in the near field is given by:

$PD_{nf} = (16\varepsilon P)/(\pi D^2)$ = **26.03** mW/cm² (3)
from 0 to 3.85 meters

Evaluation
Uncontrolled Environment: **Does Not Meet Controlled Limits**
Controlled Environment: **Does Not Meet Uncontrolled Limits**

3.0 On-Axis Transition Region

The transition region is located between the near and far field regions. As stated in Bulletin 65, the power density begins to vary inversely with distance in the transition region. The maximum power density in the transition region will not exceed that calculated for the near field region, and the transition region begins at that value. The maximum value for a given distance within the transition region may be computed for the point of interest according to:

$PD_{tr} = (PD_{nf})(R_{nf})/R$ = dependent on R (4)
where: PD_{nf} = near field power density
R_{nf} = near field distance
R = distance to point of interest
PD_{tr} = **26.03** mW/cm²
For: 3.85 < R < 9.23 meters

We use Eq (4) to determine the safe on-axis distances required for the two occupancy conditions:

Evaluation

Uncontrolled Environment Safe Operating Distance, (meters), R_{safeu}: 100.1
Controlled Environment Safe Operating Distance, (meters), R_{safec}: 20.03

4.0 On-Axis Far-Field Region

The on- axis power density in the far field region (PD_{ff}) varies inversely with the square of the distance as follows:

$PD_{ff} = PG/(4\pi R^2)$ = dependent on R (5)
where: P = total power at feed
G = Numeric Antenna gain in the direction of interest relative to isotropic radiator
R = distance to the point of interest
For: $R > R_{ff} =$ 9.23 meters
$PD_{ff} =$ **11.15** mW/cm² at R_{ff}

We use Eq (5) to determine the safe on-axis distances required for the two occupancy conditions:

Evaluation

Uncontrolled Environment Safe Operating Distance,(meters), R_{safeu} : See Section 3
Controlled Environment Safe Operating Distance,(meters), R_{safec} : See Section 3

5.0 Off-Axis Levels at the Far Field Limit and Beyond

In the far field region, the power is distributed in a pattern of maxima and minima (sidelobes) as a function of the off-axis angle between the antenna center line and the point of interest. Off-axis power density in the far field can be estimated using the antenna radiation patterns prescribed for the antenna in use. Usually this will correspond to the antenna gain pattern envelope defined by the FCC or the ITU, which takes the form of:

$G_{off} = 32 - 25\log(\Theta)$
for Θ from 1 to 48 degrees; -10 dBi from 48 to 180 degrees
(Applicable for commonly used satellite transmit antennas)

Considering that satellite antenna beams are aimed skyward, power density in the far field will usually not be a problem except at low look angles. In these cases, the off axis gain reduction may be used to further reduce the power density levels.

For example: At two (2) degrees off axis At the far-field limit, we can calculate the power density as:

$G_{off} = 32 - 25\log(2) = 32 - 7.52$ dBi = 280.2 numeric

$PD_{2\ deg\ off\text{-}axis} = PD_{ff} \times 280.2/G =$ **0.78** mW/cm^2 **(6)**

6.0 Off-Axis power density in the Near Field and Transitional Regions

According to Bulletin 65, off-axis calculations in the near field may be performed as follows: assuming that the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point is at least a factor of 100 (20 dB) less than the value calculated for the equivalent on-axis power density in the main beam. Therefore, for regions at least D meters away from the center line of the dish, whether behind, below, or in front under of the antenna's main beam, the power density exposure is at least 20 dB below the main beam level as follows:

$PD_{nf(off\text{-}axis)} = PD_{nf} / 100 =$ **0.260** mW/cm^2 at D off axis (7)

See Section 7 for the calculation of the distance vs. elevation angle required to achieve this rule for a given object height.

7.0 Evaluation of Safe Occupancy Area in Front of Antenna

The distance (S) from a vertical axis passing through the dish center to a safe off axis location in front of the antenna can be determined based on the dish diameter rule (Item 6.0). Assuming a flat terrain in front of the antenna, the relationship is:

$S = (D/ \sin \alpha) + (2h - D - 2)/(2 \tan \alpha)$ (8)

Where: α = minimum elevation angle of antenna
D = dish diameter in meters
h = maximum height of object to be cleared, meters

For distances equal or greater than determined by equation (8), the radiation hazard will be below safe levels for all but the most powerful stations (> 4 kilowatts RF at the feed).

For	D =	0.569 meters
	h =	2.0 meters, delta between antenna and object >1 m
Then:		
	α	S
	10	1.7 meters
	15	1.1 meters
	20	0.9 meters
	25	0.7 meters
	30	0.6 meters

8.0 Summary of Results

The earth station site will be protected from uncontrolled access by virtue of the fact that it will be mounted on the roof of a vehicle. There will also be proper emission warning signs placed and all operating personnel will be aware of the human exposure levels at and around the earth station. The applicant agrees to abide by the conditions specified in Condition 18 provided below:

> *(18) - The Raysat Antenna Systems LLC shall take all reasonable and customary measures to ensure that the MET does not create potential for harmful non-ionizing radiation to persons who may be in the vicinty of the MET when it is in operation. At a minimum, permanent warning label(s) shall be affixed to the MET warning of the radiation hazard and including a diagram showing the regions around the MET where the radiation levels could exceed 1.0mW/cm2. The operator of the MET shall be responsible for assuring that individuals do not stray into the region around the MET where there is a potential for exceeding the maximum permissible exposure limits required by Section 1.1310 of the Commission's rules 47 C.F.R § 1.1310. This shall be accomplished by means of signs, caution tape, verbal warnings, placement of the MET so as to minimize access to the hazardous region and/or any other appropriate means*

The table below summarizes all of the above calculations.

Parameter	Abbr.		Units	Formula
Antenna Effective Diameter	Df	0.569	meters	
Antenna Centerline	h	2	meters	
Antenna Surface Area	Sa	0.254	$meter^2$	$(\pi*Df^2)/4$
Antenna Ground Elevation	GE	2	meters	
Frequency of Operation	f	14.25	GHz	
Wavelength	λ	0.0211	meters	
HPA Output Power	P_{HPA}	40	watts	
HPA to Antenna Loss	L_{Tx}	1	dB	
Radome Loss	L_{Rad}	0.25	dB	
Transmit Power at Flange	P	31.77	watts	$P/10Log^{-1}(L_{Tx}/10)$
Effective Power after Radome		30.00	watts	$P/10Log^{-1}$(Radome Loss/10)
Antenna Gain	G_{es}	36	dBi	does not include radome loss
Antenna Aperature Efficiency	η	55%	n/a	
1. Reflector Surface Region Calculations				
Antenna Surface Power Density	Pdas	499.6	W/m^2	$(16 * P)/(\pi * D^2)$
		49.96	mW/cm^2	
Power at Radome Surface	Pdrad	471.6	W/m^2	$(16 * P)/(\pi * D^2)$
(outside radome)		47.16	mW/cm^2	**Does not meet controlled limits** **Does not meet uncontrolled limits**
2. On Axis Near Field Calculations				
Extent of Near Field	Rn	3.846	meters	$D^2 / (4 * \lambda)$
		12.620	feet	
Near Field Power Density	PDnf	260.3	w/m^2	$(16 * \eta * P)/(\pi * D^2)$
		26.03	mW/cm^2	**Does not meet controlled limits** **Does not meet uncontrolled limits**
3. On Axis Transition Region Calculations				
Extent of Transition Region (min)	R_{Tr}	3.846	meters	$D^2 / (4 * \lambda)$
Extent of Transition Region (min)		12.620	feet	
Extent of Transition Region (max)	R_{Tr}	9.231	meters	$0.6 * D^2 / \lambda$
Extent of Transition Region (max)		30.287	feet	
Worst Case Transition Region Power Density	PD_{tr}	260.3	w/m^2	
		26.03	mW/cm^2	**Does not meet controlled limits** **Does not meet uncontrolled limits**
Uncontrolled enviorment safe operating distance	Rsu	100.1	meters	$(PD_{nf})/R_{nf})/Rsu$
Controlled enviorment safe operating distance	Rsc	20.0	meters	$(PD_{nf})/R_{nf})/Rsc$
4. On Axis Far Field Calculations				
Distance to Far Field Region	Rf	9.23	meters	$0.6 * D^2 / \lambda$
		30.29	feet	
On Axis Power Density in the Far Field	PD_{ff}	111.5	W/m^2	$(G_{es} * P) / (4 * \pi * Rf^2)$
		11.15	mW/cm^2	**Does not meet controlled limits** **Does not meet uncontrolled limits**
5. Off-axis Power Density in the Far Field Limit and Beyond				
Antenna Surface Power Density	PDs	7.8	W/m^2	$(G_{es} * P) / (4 * \pi * Rf^2) * (Goa/Ges)$
Goa/Ges at a sample angle of θ=2 degrees		0.070		$Goa = 32 - 25*\log(\theta)$
		0.78	mW/cm^2	
6. Off Axis Power Density in the Near Field and Transitional Region Calculations				
Power Density of Wn/100 for 1 diameter	PDs	2.60	W/m^2	$[(16 * \eta * P)/(\pi * D^2)] / 100$
removed		0.260	mW/cm^2	**Meets controlled limits** **Meets Uncontrolled limits**
7.0 Off-axis Safe Distances from Earth Station				
minimum elevation angle of antenna	α	10	degree	
hieght of object to be cleared	h	2	meter	
Groun elevation delta antenna-obstacle elevation ang	**GD**	**S**		
	10	1.7	meter	$S=(D/\sin\alpha) + (2h - D- 2) / (2\tan\alpha)$
	15	1.1	meter	
	20	0.9	meter	
	25	0.7	meter	
	30	0.6	meter	

Note: Maximum FCC power density limits for 6GHz is 1mW/cm2 for general population exposure as per FCC OS&T

ATTACHMENT C
GRANT OF EXPERIMENTAL STA

Ilan Kaplan, 8460-D Tyco Road, Vienna, VA 22102,

United States of America
FEDERAL COMMUNICATIONS COMMISSION
EXPERIMENTAL
SPECIAL TEMPORARY AUTHORIZATION

EXPERIMENTAL
(Nature of Service)

WF9XEG
(Call Sign)

XD MO
(Class of Station)

0583-EX-ST-2011
(File Number)

NAME Raysat Antenna Systems, LLC

This Special Temporary Authorization is granted upon the express condition that it may be terminated by the Commission at any time without advance notice or hearing if in its discretion the need for such action arises. Nothing contained herein shall be construed as a finding by the Commission that the authority herein granted is or will be in the public interest beyond the express terms hereof.

This Special Temporary Authorization shall not vest in the grantee any right to operate the station nor any right in the use of the frequencies designated in the authorization beyond the term hereof, nor in any other manner than authorized herein. Neither the authorization nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934. This authorization is subject to the right of use of control the Government of the United States conferred by Section 706 of the Communications Act of 1934.

Special Temporary Authority is hereby granted to operate the apparatus described below:

Purpose Of Operation:
Testing

Station Locations
(1) MOBILE: CONUS

Frequency Information

MOBILE: CONUS

Frequency	Station Class	Emission Designator	Authorized Power	Frequency Tolerance (+/-)
14-14.5 GHz	MO		58210 W (ERP)	
		7M75G7W		
		9M45G7W		

Special Conditions:
(1) In lieu of frequency tolerance, the occupied bandwidth of the emission shall not extend beyond the band limits set forth above.
(2) Licensee shall comply with the FCC CFR 47 Part 25.222 rules.

This authorization effective October 05, 2011 and will expire 3:00 A.M. EST April 03, 2012

FEDERAL COMMUNICATIONS COMMISSION

Special Conditions:

(3) National Science Foundation (NSF) requests that licensee:

1) Coordinate operation at the Taunton, MA site with the National Radio Astronomy Observatory's VLBA site at Hancock, NH. (POC Mr. Dan Mertely at Socorro, NM, Phone: 505- 835-7027 and e-mail: dmertely@nrao.edu).

2) Coordinate operation at the Fredericksburg, VA site with Wes Sizemore at Green Bank. (Phone: 304-456-2107, e-mail:wsizemor@nrao.edu).

(4) Off-axis EIRP spectral density for cross-polarized signals emitted from the earth station shall not exceed the calculations given in 47CFR25.222(a)(4).

(5) In accordance with Article 4.4 of the ITU Radio Regulations, the operations authorized herein shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the ITU Constitution, the ITU Convention, and the ITU Radio Regulations.

(6) Note that if, during the term of this authorization, NASA seeks to provide protection to a future TDRSS site that has been coordinated through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC) Frequency Assignment Subcommittee process, NTIA will notify the Commission that the site is nearing operational status. Upon notice from the Commission, licensee must cease operations in the 14.0-14.2 GHz band within 125 km of the new TDRSS site until Lockheed Martin Corp. has coordinated with the new site. After coordination, operations will then again be permitted in the 14.0-14.2 GHz band within 125 km of the new TDRSS site, subject to any operational constraints developed in the coordination process.

(7) No transmissions are permitted between 14.0 GHz and 14.2 GHz within 125 km of White Sands, NM (latitude: 32° 20' 59" N, longitude 106° 36' 31" W and latitude: 32° 32' 40" N, longitude 106° 36' 48" W).

(8) Licensee shall comply with the Minimum Angle of Antenna Elevation criteria set forth in Part 25.205 of the FCC's rules.

(9) No transmissions are permitted between 14.0 GHz and 14.2 GHz within 125 km of Blossom Point, MD (latitude: 38° 25' 44" N, longitude 77° 05' 20" W).

(10) POINT OF COMMUNICATION: Galaxy 16

(11) The power out of the transmitter should be 40 watts.