

## **Engineering Statement**

Intelsat License LLC (“Intelsat”) proposes to relocate Horizons 2 from its current orbital location of 74.05° W.L to 84.85° E.L. From this orbital location, Horizons 2 would operate in conjunction with Intelsat 15, which currently operates from 85.15° E.L. Additionally, with this application, Intelsat updates the performance of the Horizons 2 beams.

Horizons 2 is currently authorized to operate from 74.05° W.L. (see FCC File Nos.: SAT-MOD-20070628-00090 and SAT-AMD-20070731-00108). In order to meet new customer requirements, Intelsat proposes to operate Horizons 2 from 84.85° E.L.

To take the impact of this proposed change in orbital location into account, this engineering statement provides the following technical information: (1) frequency/polarization plan, (2) beam gain contours and updated beam performance, (3) link budget and interference analysis, and (4) Schedule S. In all other respects, the characteristics of Horizons 2 are the same as those specified in SAT-MOD-20070628-00090 and SAT-AMD-20070731-00108.

It should be noted that there are no power flux density (“pfd”) limits specified by the Commission or the International Telecommunications Union (“ITU”) in the space-to-Earth direction for geostationary satellites operating in the fixed satellite service in the 11700 – 12200 MHz band. Accordingly, no power flux density calculations are provided for this frequency band.

### **1.0) Frequency Plan**

The Horizons 2 frequency plan is provided in Exhibits 1A and 1B. It should be noted that Horizons 2 also has the additional capability to operate in the 14000 – 14500 MHz and 11700 – 12200 MHz band through another set of dedicated uplink and downlink beams; however, Intelsat does not intend to utilize this additional capability at the 84.85° E.L. Accordingly, the frequency/polarization plan for these additional beams has not been included in Exhibits 1A and 1B.

### **2.0) Gain Contours**

The coverage patterns for Horizons 2 operating from 84.85° E.L are contained in Exhibits 2A-1 to 2A-4, 2B-1 to 2B-6 and 2C-1 to 2C-2.

Updated beam peak performance for each of the communication beams is also provided in Exhibits 2A-1 to 2A-4.

With respect to the Horizons 2 command and telemetry beams associated with the omni and wide coverage antennas (shown in Exhibits 2B-2, 2B-3, 2B-5 and 2B-6), and the uplink power control beams (shown in Exhibits 2C-1 and 2C-2), the beam gain patterns could not be provided in the format specified in Section 25.114(d)(3) of the rules for the reasons given in SAT-MOD-20070628-00090. Accordingly, Intelsat requests that a waiver of the provisions of this section of the rules continue to be applied with respect to these beams at the 84.85° E.L. orbital location.

As previously indicated, Horizons 2 has the additional capability to operate in the 14000 – 14500 MHz and 11700 – 12200 MHz band through another set of dedicated uplink and downlink beams; however, Intelsat does not intend to utilize this additional capability at the 84.85° E.L. The beam performance and gain contours for these additional beams have not been included in Exhibit 2A.

### 3.0) Horizons 2 Link Budgets and Interference Analysis

Link analysis for Horizons 2 was conducted for a number of representative carriers. Excluding Intelsat 15, the nearest co-frequency satellites to Horizons 2 are Kazsat 2, located at 86.5° E.L., and Insat 4A, located at 83° E.L. Kazsat 2 and Insat 4A both utilize the 14000 – 14500 MHz band; however, neither spacecraft utilizes the 11700 – 12200 MHz band.<sup>1</sup>

For conservatism, it was assumed that the nearest co-frequency satellites to Horizons 2 were two hypothetical satellites – one located at 83° E.L and the other located at 86.5° E.L. The hypothetical satellites were assumed to have the same operational parameters as Horizons 2. It was further assumed that each of the hypothetical satellites utilized digital carriers having a maximum uplink power density -45 dBW/Hz. The maximum downlink EIRP density of the hypothetical satellites was assumed to be -20 dBW/Hz.

Other assumptions made for the link budget analysis were as follows:

- a) In the plane of the geostationary satellite orbit, all C- and Ku-band transmitting and receiving earth station antennas have off-axis co-

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<sup>1</sup> Intelsat 15 is licensed to Intelsat. Intelsat will internally coordinate the co-located operations of Intelsat 15 and Horizons 2.

- polar gains that are compliant with the limits specified in Section 25.209(a)(1) or (a)(2) of the FCC's rules, depending on the frequency band under consideration.
- b) All transmitting and receiving earth stations have a cross-polarization isolation value of at least 30 dB within their main beam.
  - c) At Ku-band frequencies, rain attenuation predictions are derived using Recommendation ITU-R 618-8.
  - d) At Ku-band frequencies, increase in noise temperature of the receiving earth station due to rain is taken into account.
  - e) For the cases where the transponder operates in a multi-carrier mode, the effects due to intermodulation interference are taken into account.

The impact of the TV/FM carriers from the adjacent satellites at 83° E.L and 86.5° E.L on the transmissions of Horizons 2 was not considered due to the fact that TV/FM carriers are known to be high-density carriers with most of the energy contained within the near vicinity of the carrier center frequency. Operation of sensitive narrow-band carriers is typically precluded within these high power density areas of the TV/FM carrier. Accordingly, placement and operation of TV/FM carriers are normally achieved through internal coordination and/or coordination discussions with the adjacent satellite operator, whichever may be the case, rather than through C/I calculations – since the results of such calculations would show that narrow-band carriers typically could not operate on a co-frequency basis with TV/FM carriers.

The results of the Ku-band analysis are shown in Exhibit 3 and demonstrate that operation of the Horizons 2 satellite from 84.85° E.L. would permit the intended services to achieve their respective performance objectives while maintaining sufficient link margin. Additionally, the power and EIRP density levels of the carriers listed in Exhibit 3 comply with the limits contained in Section 25.212(c) of the Commission's rules.

#### 4.0) Adjacent Satellite Link Analysis

At Ku-band, the impact of the proposed Horizons 2 emissions on the transmissions of hypothetical adjacent satellites located at 83° E.L and 86.5° E.L was analyzed. It was assumed that each of the hypothetical satellites had the same operating characteristics as Horizons 2.

For the satellite located at 83° E.L, it was assumed that the adjacent satellites were Horizons 2, located at 84.85° E.L, and a hypothetical satellite having the same operating characteristics as Horizons 2 located at 81° E.L. For the

satellite located at 86.5° E.L, it was assumed that the adjacent satellites were Horizons 2, located at 84.85° E.L, and a hypothetical satellite having the same operating characteristics as Horizons 2 located at 88° E.L.<sup>2</sup>

The impact of Horizons 2 emissions on the TV/FM carriers of the adjacent satellites at 83° E.L and 86.5° E.L was not considered for the reasons articulated in section 3.0 above. The assumptions made in section 3.0 pertaining to Earth station off-axis gain performance, Earth station cross-polarization performance and rain attenuation were also applied in the analysis.

The results of the analysis are given in Exhibits 4 and 5. The Horizons 2 transmissions will be limited to those levels contained in Section 25.212(c), as applicable, unless higher levels are coordinated with affected adjacent satellite operators. In any case, pursuant to the results in Exhibits 4 and 5, the uplink power density of the Horizons 2 digital carriers operating in the 14000 – 14500 MHz band will not exceed -45 dBW/Hz. Within the 11700 – 12200 MHz band the downlink EIRP density of the Horizons 2 digital carriers will not exceed -20 dBW/Hz.

It is noted that in the coverage area of Horizons 2 at 84.85° E.L. the band 11700-12200 MHz is allocated to the broadcasting satellite service (BSS). Operation in this band will be conducted in accordance with the satellite network USABSS-29 that has already been notified to the ITU.

#### 5.0) Schedule S Submission

Intelsat is providing a Schedule S with its application. The Schedule S contains only: (1) those Horizons 2 data items that have changed from those that were shown in the Schedule S for SAT-MOD-20070628-00090; and (2) data items whose inclusion was required in order for the software application to function properly.

Intelsat is providing with its application a Schedule S for the operations of Horizons 2 from 84.85° E.L. In column “g” of Section S13 of the Schedule S, a link budget file has been included for the first link (*i.e.*, the first row of data) contained in that section. This link budget file is applicable to all the links listed in Section S13 and should have been included with each row of data in that section of the Schedule S. However, given that the link budget

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<sup>2</sup> ST-1 and ST-2 operate from 88° E.L and are assumed to utilize the 14000 – 14500 MHz. As best as can be determined, neither of these spacecraft utilizes the 11700 – 12200 MHz.

file is rather large and its inclusion with each link (or data row) would lead to the Schedule S file having an unmanageable size, all other links (or rows of data) contain a small ASCII file that references the link budget file that is attached to the first link (*i.e.*, the link budget file attached to the first row of data).

## 6.0) Orbital Debris Mitigation Plan

Intelsat is proactive in ensuring safe operation and disposal of this and all spacecraft under its control. The four elements of debris mitigation are addressed below.

### 6.1) Spacecraft Hardware Design

The spacecraft is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other small debris (<1 cm diameter) and has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

### 6.2) Minimizing Accidental Explosions

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in a manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission, and upon disposal of the spacecraft, Intelsat will ensure the removal of all stored energy on the spacecraft by depleting the fuel tank, venting all pressurized systems and by leaving the batteries in a permanent discharge state.

As indicated in SAT-AMD-20070731-00108, Horizons 2 does not have the capability to deplete its oxidizer tank. In this regard, the Commission had granted a waiver of this requirement.

### 62.3) Safe Flight Profiles

Intelsat has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations. Horizons 2 will not be located at the same orbital location as another satellite or at an orbital location that has an overlapping station keeping volume with another satellite.

Intelsat is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, having an overlapping station-keeping volume with Horizons 2. Intelsat is also not aware of any system with an overlapping station-keeping volume with Horizons 2 that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

### 6.4) Post Mission Disposal

At the end of the mission, Intelsat will dispose of the spacecraft by moving it to a minimum altitude of 300 kilometers above the geostationary arc. This exceeds the minimum altitude established by the IADC formula. Intelsat has reserved 6.8 kilograms of fuel for this purpose. The reserved fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. To calculate this figure, the “rocket equation” was used, taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission’s Orbital Debris Report and Order. For reference, the effective area to mass ratio ( $C_r \cdot A/M$ ) of the Horizons 2 spacecraft is  $0.04 \text{ m}^2/\text{kg}$ , resulting in a minimum perigee disposal altitude under the IADC formula of at most 280.4 kilometers above the geostationary arc, which is lower than the 300 kilometer above geostationary disposal altitude specified by Intelsat in this filing. Accordingly, the Horizons 2 planned disposal orbit complies with the FCC’s rules.

## Certification Statement

I hereby certify that I am a technically qualified person and am familiar with Part 25 of the Commission's rules. The contents of this engineering statement were prepared by me or under my direct supervision and to the best of my knowledge are complete and accurate.

/s/ Jose Albuquerque

Jose Albuquerque

Intelsat

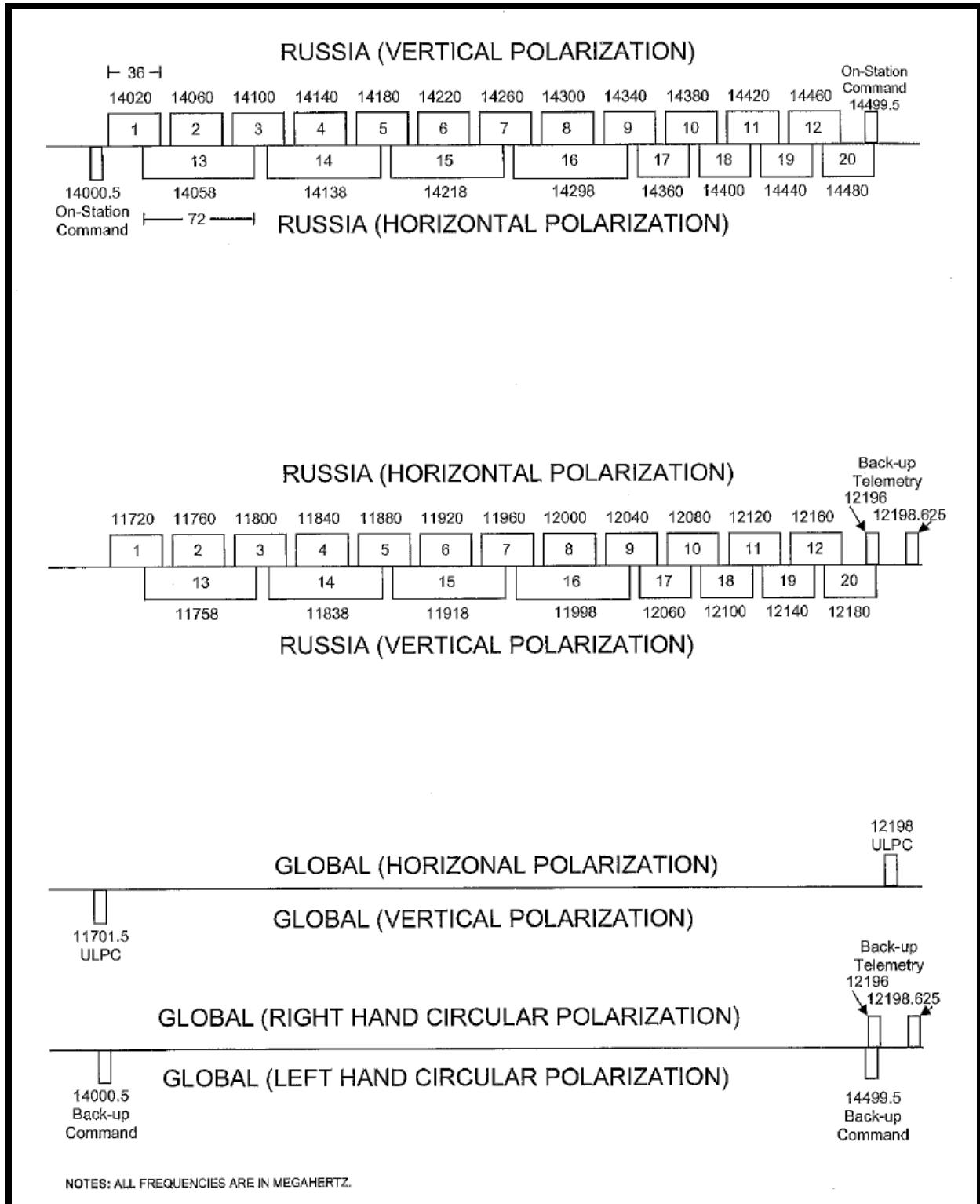
Senior Director

Spectrum Strategy

September 26, 2011

Date

# EXHIBIT 1A: FREQUENCY PLAN





## EXHIBIT 1B: FREQUENCY ASSIGNMENTS

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Channel Gain (dB)
1	RUSSIA	VERTICAL	14020	1	RUSSIA	HORIZONTAL	11720	36	130.1
2	RUSSIA	VERTICAL	14060	2	RUSSIA	HORIZONTAL	11760	36	130.1
3	RUSSIA	VERTICAL	14100	3	RUSSIA	HORIZONTAL	11800	36	130.1
4	RUSSIA	VERTICAL	14140	4	RUSSIA	HORIZONTAL	11840	36	130.1
5	RUSSIA	VERTICAL	14180	5	RUSSIA	HORIZONTAL	11880	36	130.1
6	RUSSIA	VERTICAL	14220	6	RUSSIA	HORIZONTAL	11920	36	130.1
7	RUSSIA	VERTICAL	14260	7	RUSSIA	HORIZONTAL	11960	36	130.1
8	RUSSIA	VERTICAL	14300	8	RUSSIA	HORIZONTAL	12000	36	130.1
9	RUSSIA	VERTICAL	14340	9	RUSSIA	HORIZONTAL	12040	36	130.1
10	RUSSIA	VERTICAL	14380	10	RUSSIA	HORIZONTAL	12080	36	130.1
11	RUSSIA	VERTICAL	14420	11	RUSSIA	HORIZONTAL	12120	36	130.1
12	RUSSIA	VERTICAL	14460	12	RUSSIA	HORIZONTAL	12160	36	130.1
13	RUSSIA	HORIZONTAL	14058	13	RUSSIA	VERTICAL	11758	72	132.6
14	RUSSIA	HORIZONTAL	14138	14	RUSSIA	VERTICAL	11838	72	132.6
15	RUSSIA	HORIZONTAL	14218	15	RUSSIA	VERTICAL	11918	72	132.6
16	RUSSIA	HORIZONTAL	14298	16	RUSSIA	VERTICAL	11998	72	132.6
17	RUSSIA	HORIZONTAL	14360	17	RUSSIA	VERTICAL	12060	36	130.0
18	RUSSIA	HORIZONTAL	14400	18	RUSSIA	VERTICAL	12100	36	130.0
19	RUSSIA	HORIZONTAL	14440	19	RUSSIA	VERTICAL	12140	36	130.0
20	RUSSIA	HORIZONTAL	14480	20	RUSSIA	VERTICAL	12180	36	130.0
				ULPC 1	GLOBAL	VERTICAL	11701.5	0.008	
				UPLC 2	GLOBAL	HORIZONTAL	12198	0.008	
Command 1	RUSSIA	HORIZONTAL	14000.5					1.000	
Command 2	RUSSIA	VERTICAL	14499.5					1.000	
Command 3	GLOBAL	LEFT HAND CIRCULAR	14000.5					1.000	
Command 4	GLOBAL	LEFT HAND CIRCULAR	14499.5					1.000	
				TELEMETRY 1	RUSSIA	HORIZONTAL	12196	0.500	
				TELEMETRY 2	RUSSIA	HORIZONTAL	12198.625	0.500	
				TELEMETRY 3	GLOBAL	RIGHT HAND CIRCULAR	12196	0.500	
				TELEMETRY 4	GLOBAL	RIGHT HAND CIRCULAR	12198.625	0.500	

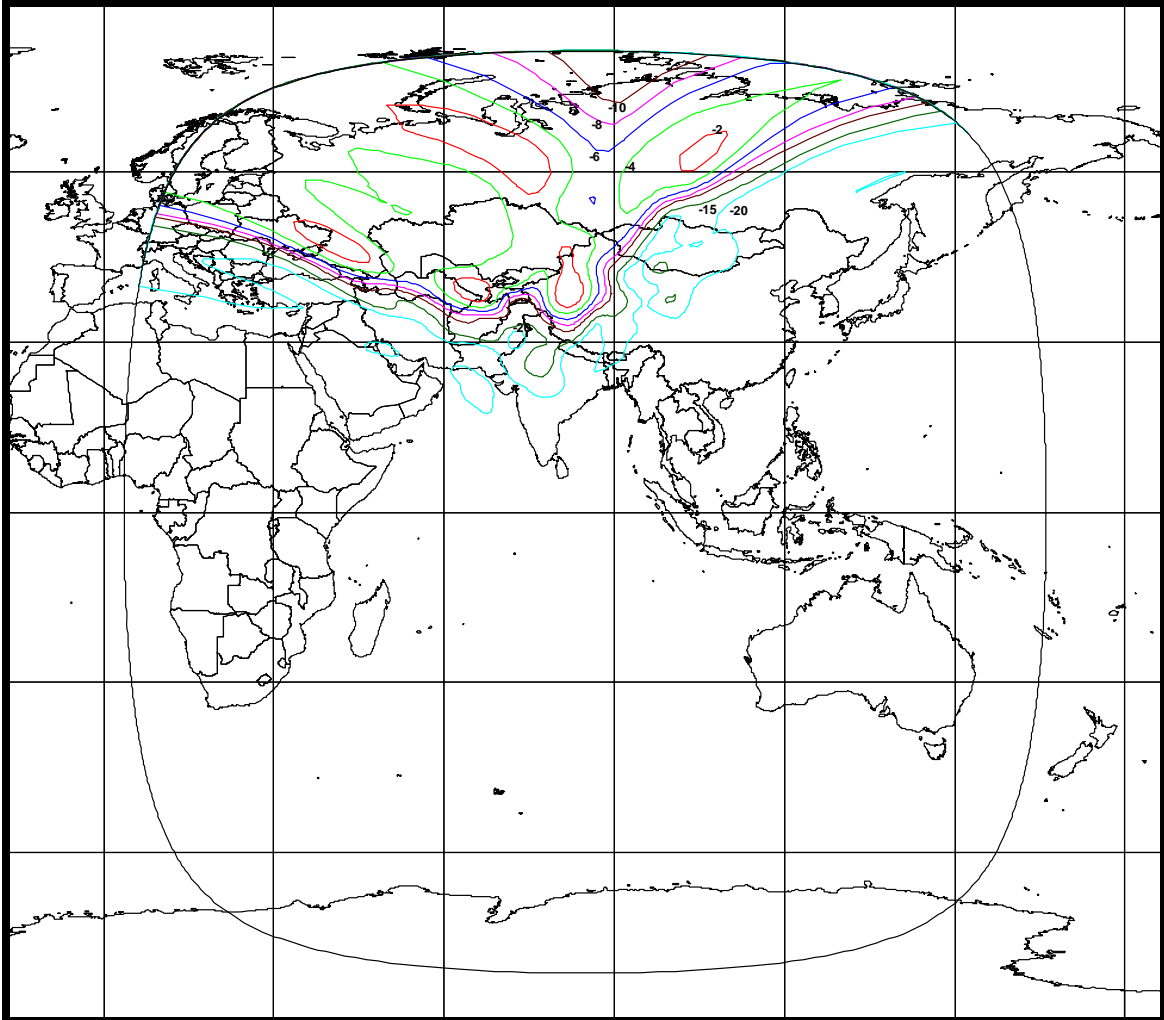
**EXHIBIT 2A-1: RUSSIA RECEIVE BEAM**  
**(Schedule S Beam ID: RHUP)**

Beam Polarization: Horizontal

Peak Beam Gain: 36.2 dBi

Peak Beam G/T: 8.1 dB/K

Saturated Flux Density @ Peak Beam G/T: -105.1 to -80.1 dBW/m<sup>2</sup>



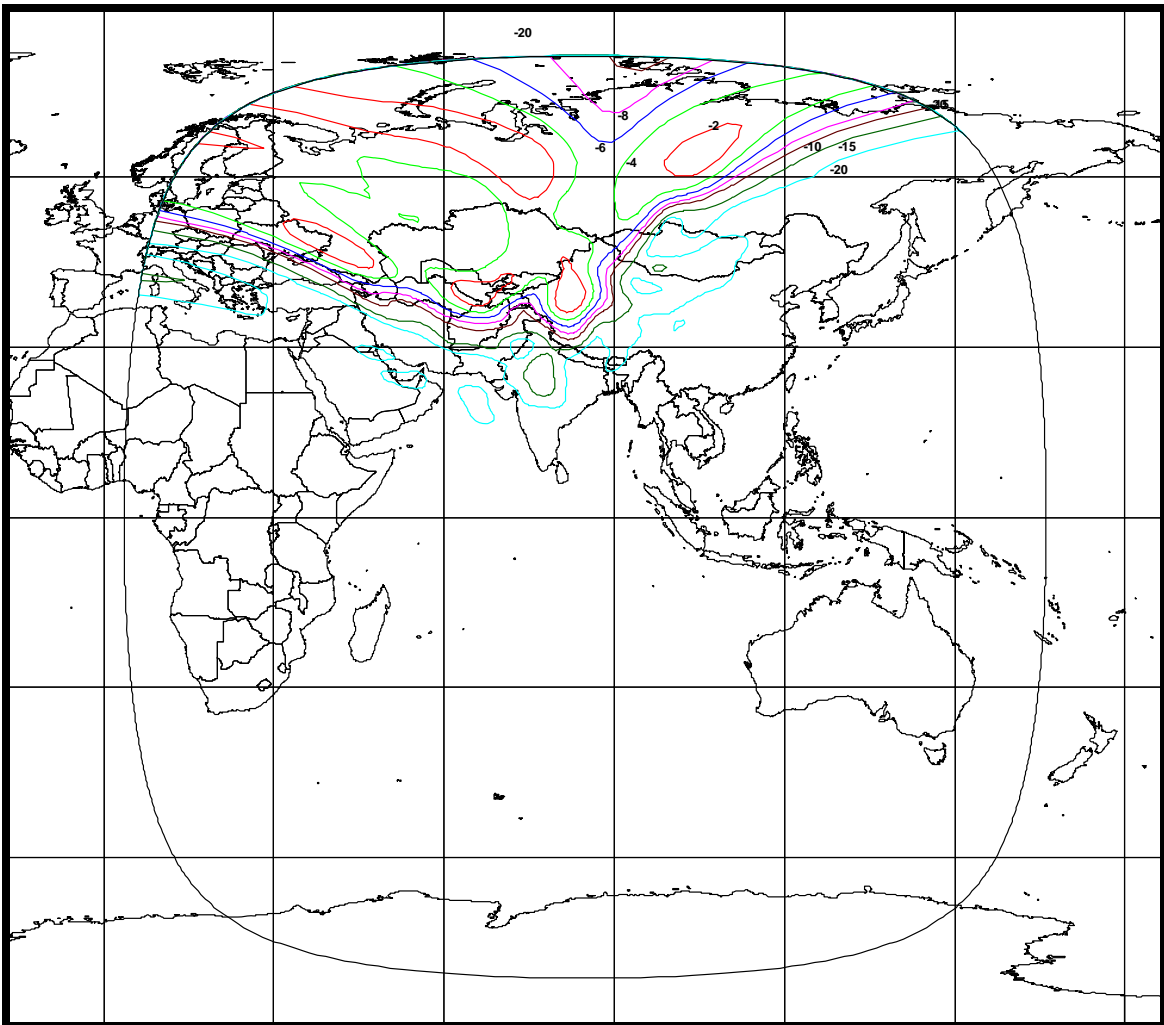
**EXHIBIT 2A-2: RUSSIA RECEIVE BEAM**  
**(Schedule S Beam ID: RVUP)**

Beam Polarization: Vertical

Peak Beam Gain: 35.9 dBi

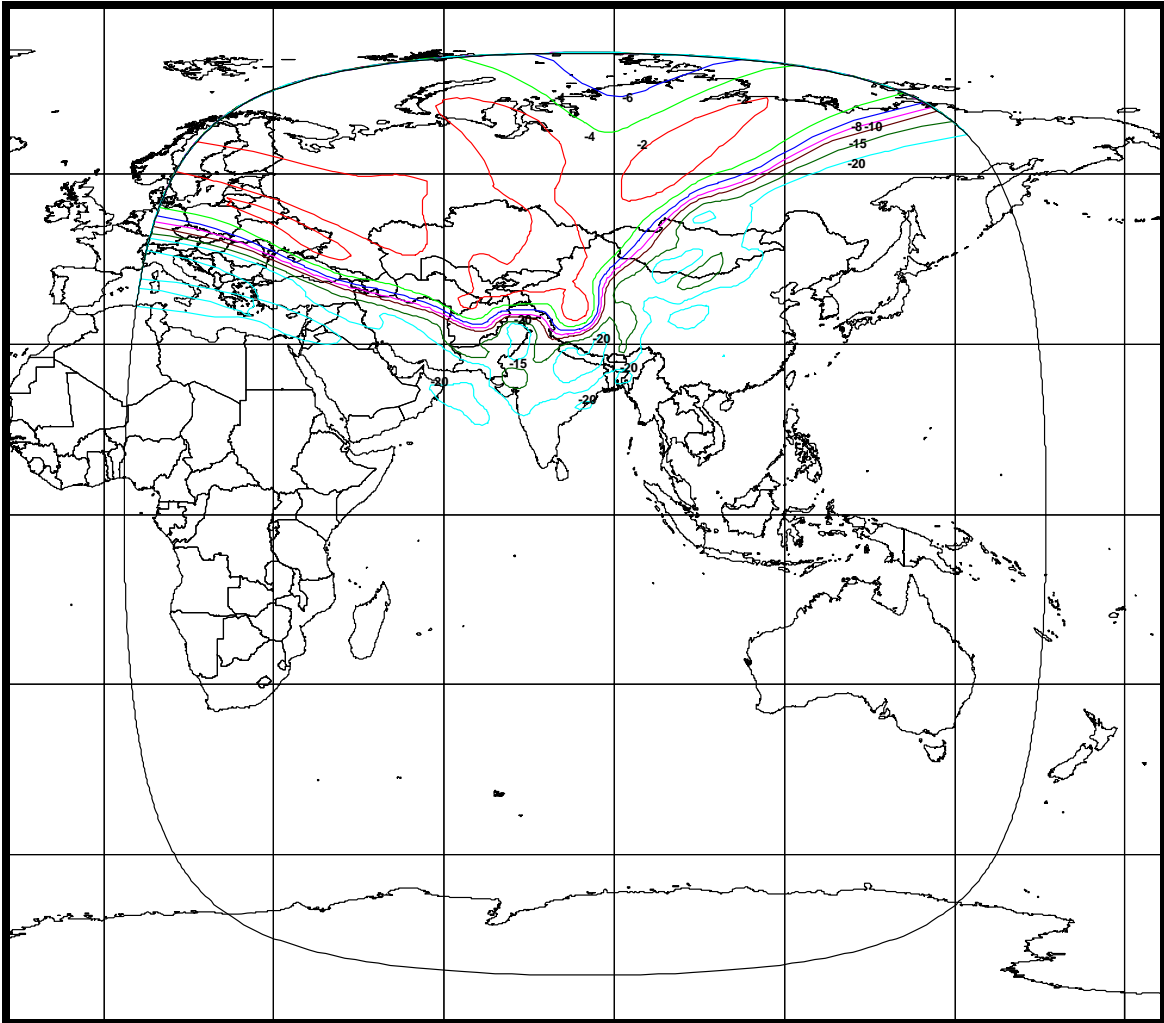
Peak Beam G/T: 8.1 dB/K

Saturated Flux Density @ Peak Beam G/T: -105.1 to -80.1 dBW/m<sup>2</sup>



**EXHIBIT 2A-3: RUSSIA TRANSMIT BEAM**  
**(Schedule S Beam ID: RHDN)**

Beam Polarization: Horizontal  
Peak Beam Gain: 34.4 dBi  
Peak Beam EIRP: 50.8 dBW



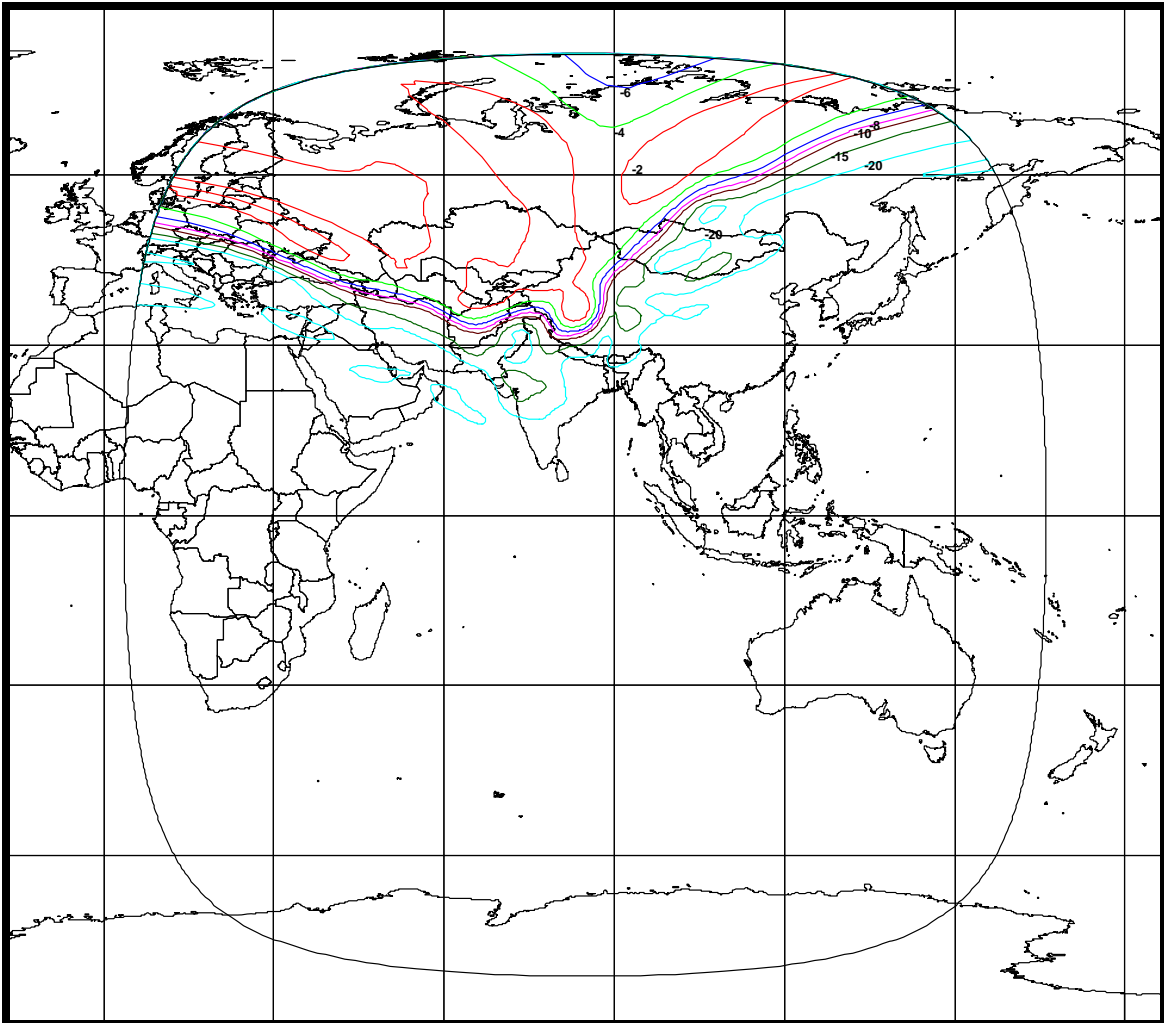
**EXHIBIT 2A-5: RUSSIA TRANSMIT BEAM**  
**(Schedule S Beam ID: RVDN)**

Beam Polarization: Vertical

Peak Beam Gain: 34.4 dBi

Peak Beam EIRP: 51.0 dBW (for 36 MHz wide channels)

Peak Beam EIRP: 53.6 dBW (for 72 MHz wide channels)



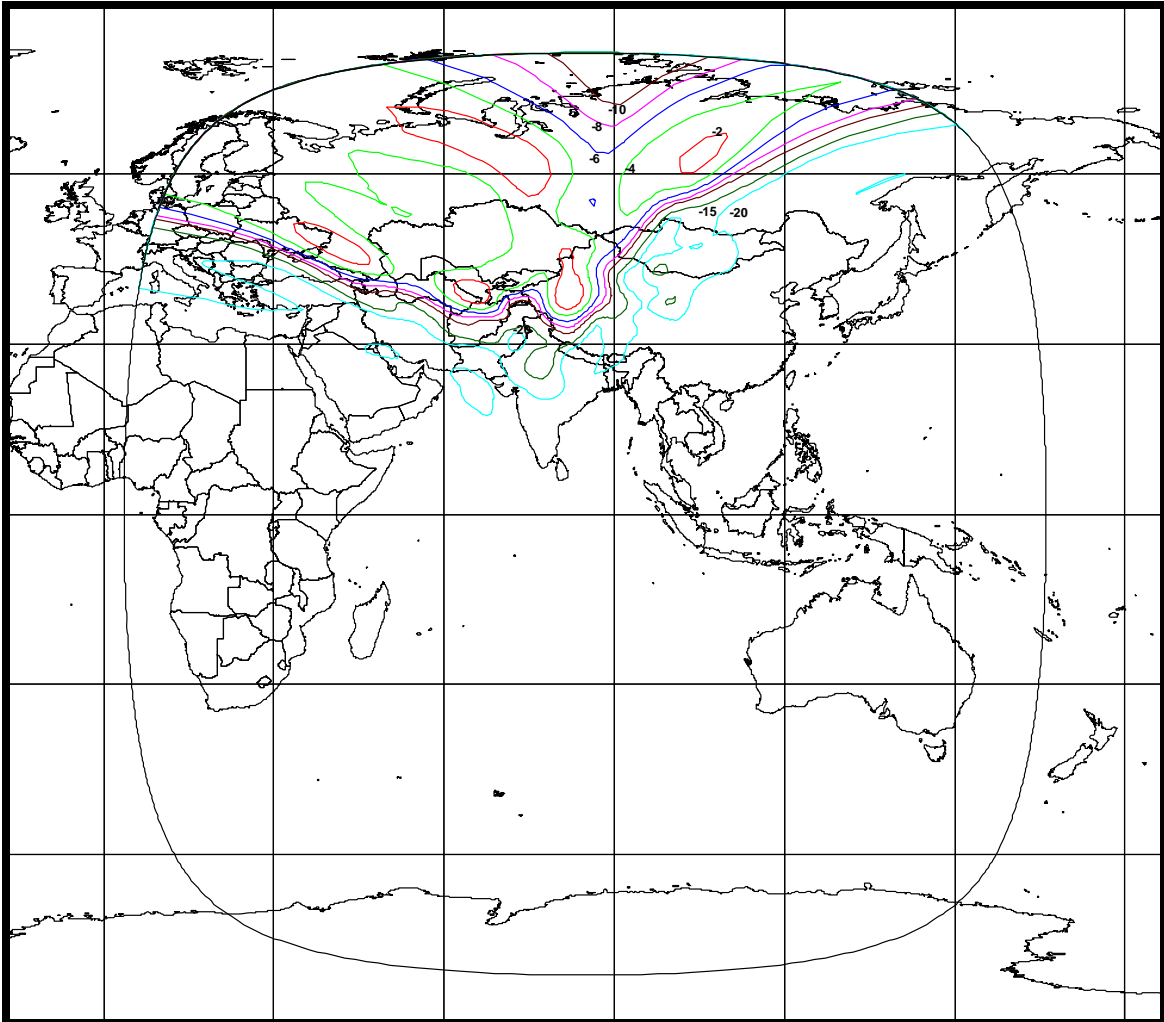
**EXHIBIT 2B-1: COMMAND RECEIVE BEAM**  
**(Schedule S Beam ID: CMDH)**

Beam Polarization: Horizontal

Peak Beam Gain: 36.2 dBi

Peak Beam G/T: -5.3 dB/K

Command Threshold Flux Density @ Peak Beam G/T: -119.6 dBW/m<sup>2</sup>



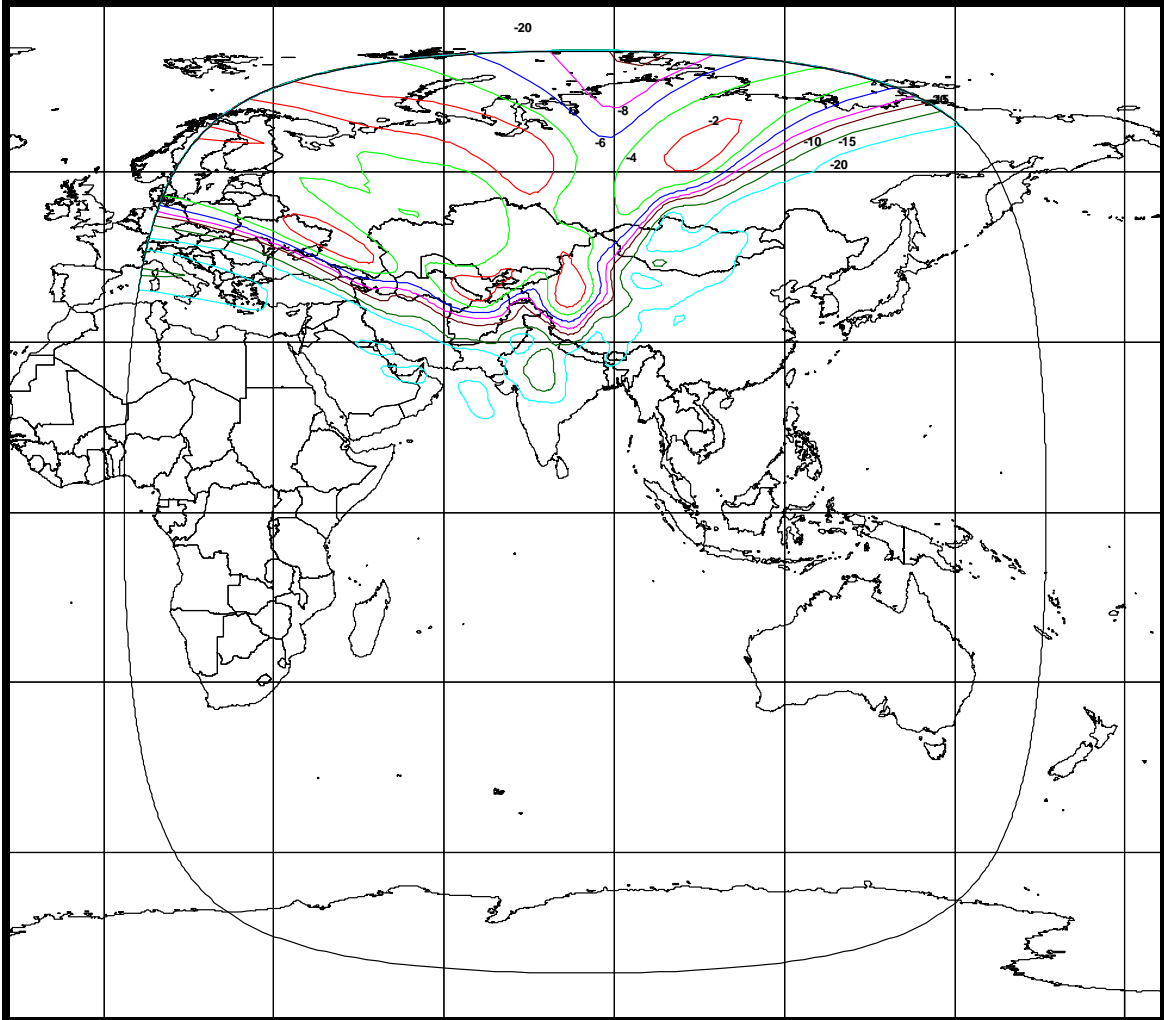
**EXHIBIT 2B-2: COMMAND RECEIVE BEAM**  
**(Schedule S Beam ID: CMDV)**

Beam Polarization: Vertical

Peak Beam Gain: 35.9 dBi

Peak Beam G/T: -5.3 dB/K

Command Threshold Flux Density @ Peak Beam G/T: -119.6 dBW/m<sup>2</sup>



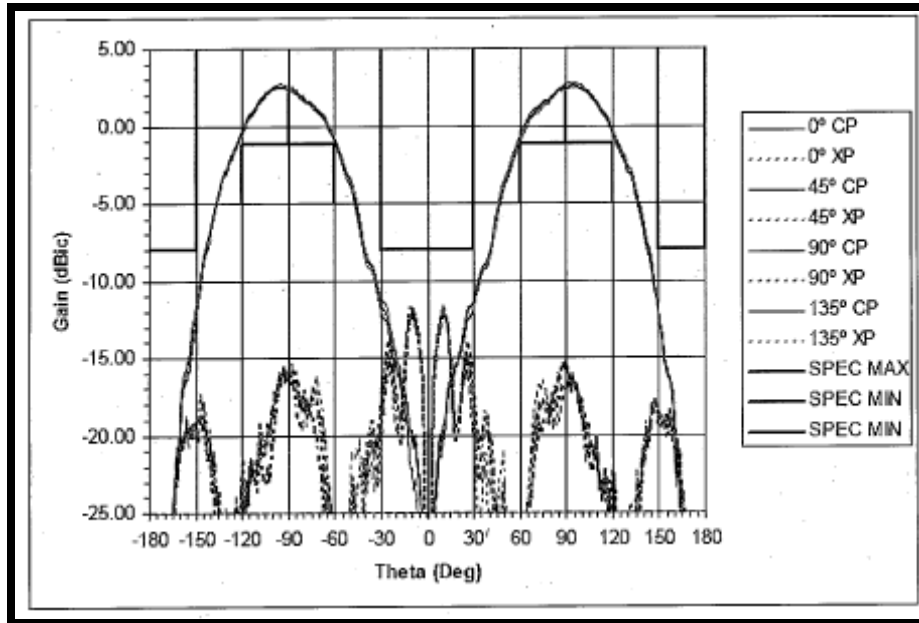
**EXHIBIT 2B-2: COMMAND RECEIVE BEAM (Omni Antenna)**  
**(Schedule S Beam ID: CMDO)**

Beam Polarization: Left Hand Circular

Peak Beam Gain: 2.8 dBi

Peak Beam G/T: -33.4 dB/K

Command Threshold Flux Density @ Peak Beam G/T: -91.5 dBW/m<sup>2</sup>





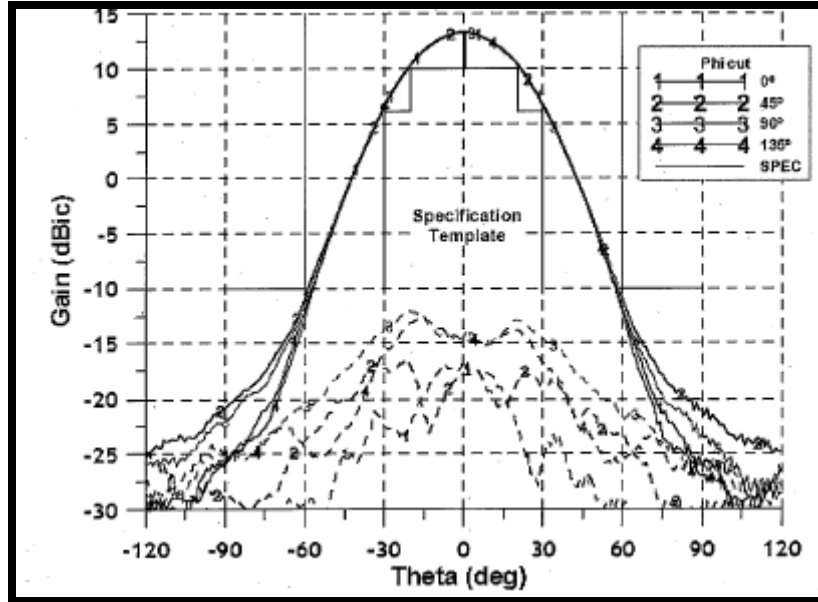
**EXHIBIT 2B-3: COMMAND RECEIVE BEAM (Wide Coverage Antenna)**  
**(Schedule S Beam ID: CMDW)**

Beam Polarization: Left Hand Circular

Peak Beam Gain: 13.2 dBi

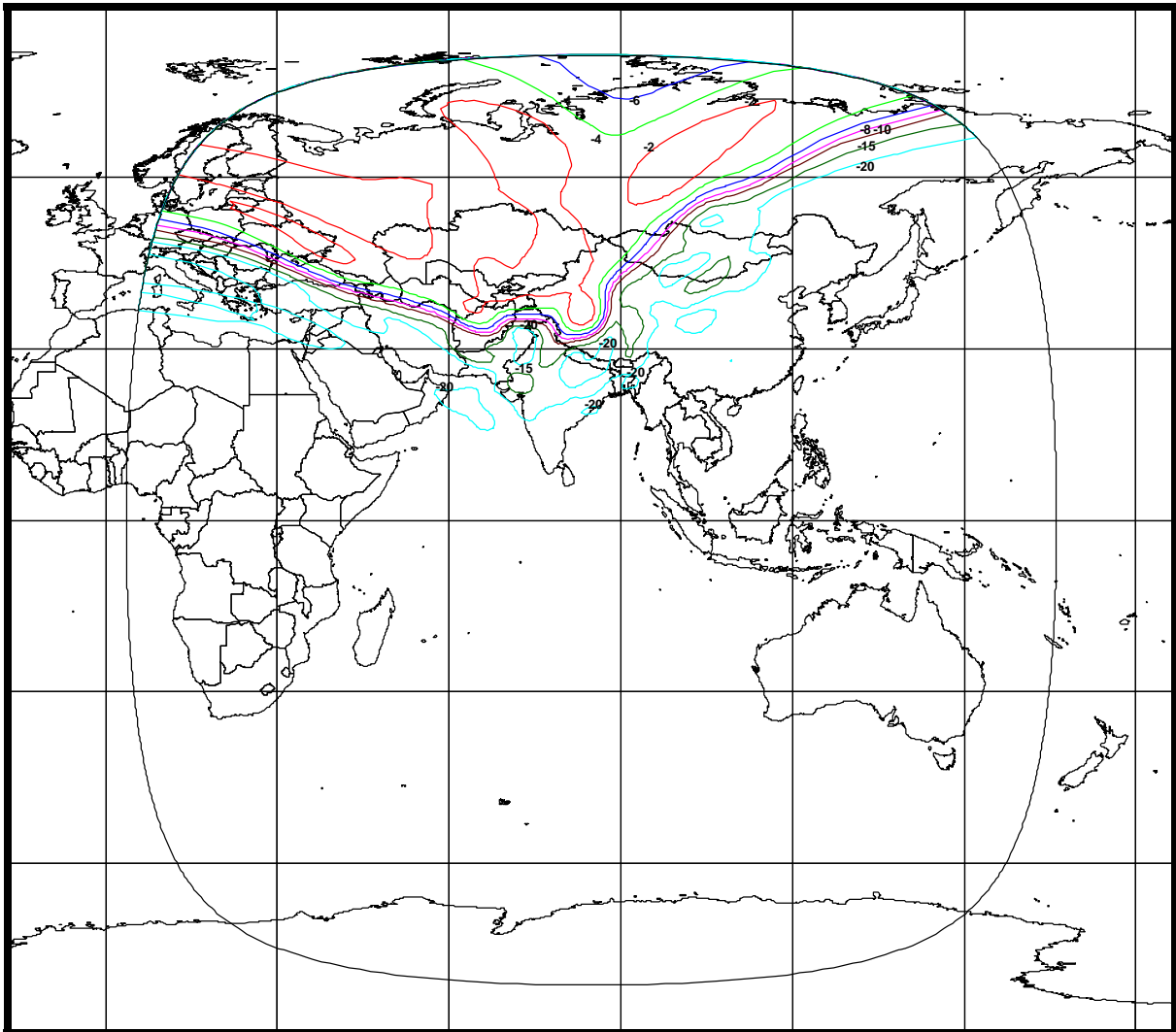
Peak Beam G/T: -28.9 dB/K

Command Threshold Flux Density @ Peak Beam G/T: -96.1 dBW/m<sup>2</sup>



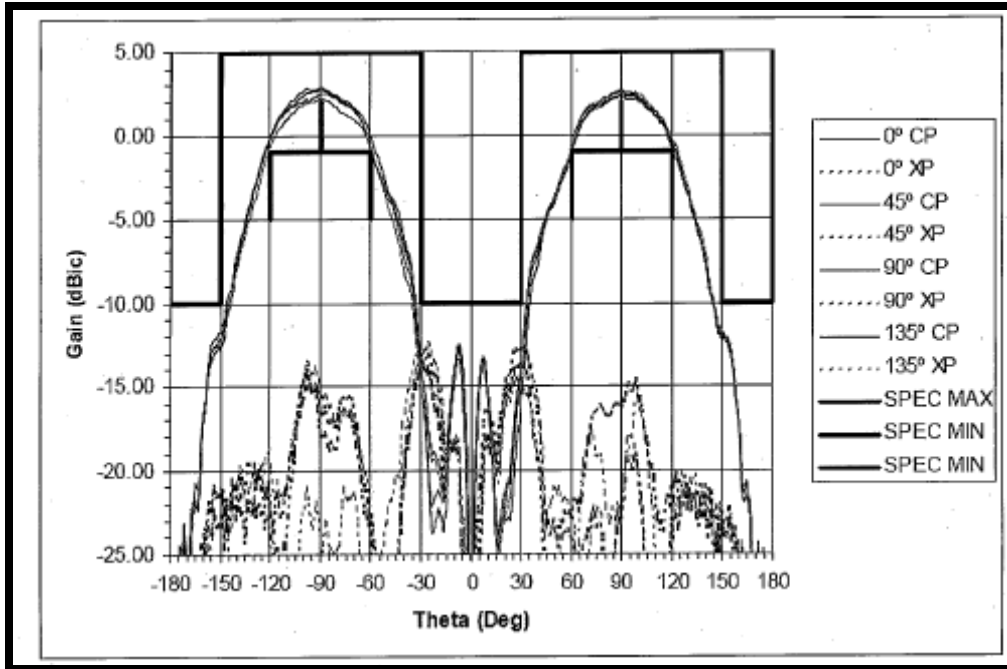
**EXHIBIT 2B-4: TELEMETRY TRANSMIT BEAM**  
**(Schedule S Beam ID: TLMH)**

Beam Polarization: Horizontal  
Peak Beam Gain: 34.4 dBi  
Peak Beam EIRP: 23.0 dBW



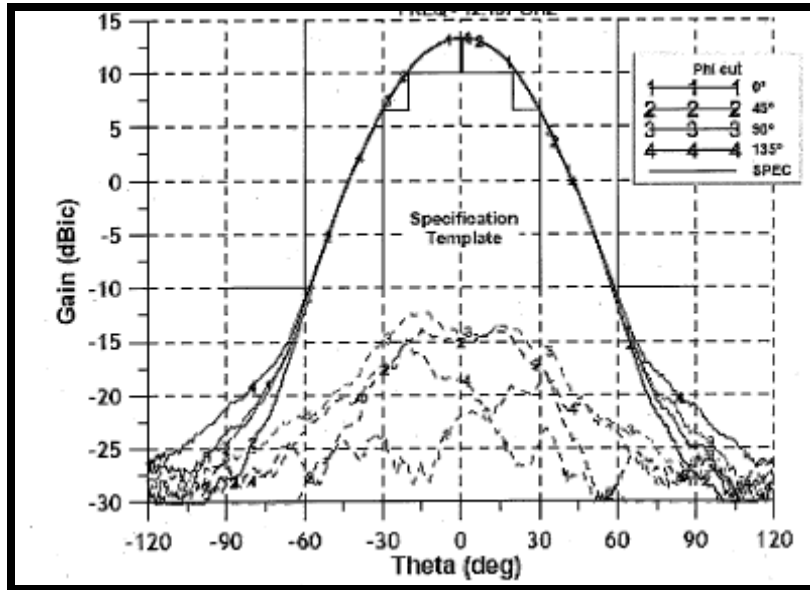
**EXHIBIT 2B-5: TELEMETRY TRANSMIT BEAM (Omni Antenna)**  
**(Schedule S Beam ID: TLMO)**

Beam Polarization: Right Hand Circular  
Peak Beam Gain: 2.9 dBi  
Peak Beam EIRP: 7.0 dBW



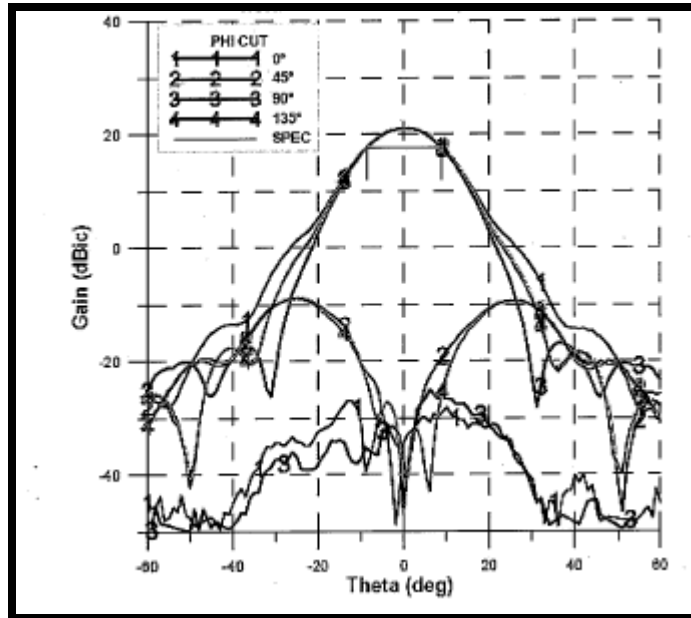
**EXHIBIT 2B-6: TELEMETRY TRANSMIT BEAM (Wide Coverage Antenna)**  
**(Schedule S Beam ID: TLMW)**

Beam Polarization: Right Hand Circular  
Peak Beam Gain: 13.3 dBi  
Peak Beam EIRP: 15.0 dBW



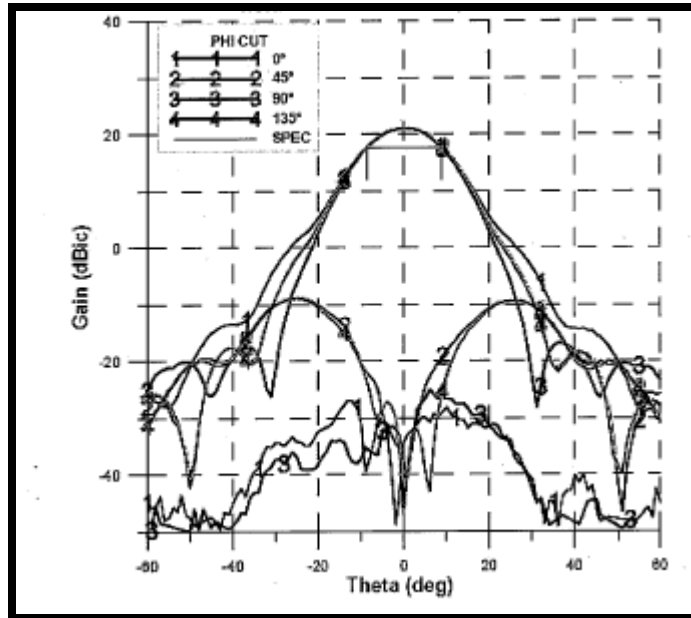
**EXHIBIT 2C-1: C-BAND ULPC TRANSMIT BEAM**  
**(Schedule S Beam ID: UPKH)**

Beam Polarization: Horizontal  
Peak Beam Gain: 21.0 dBi  
Peak Beam EIRP: 16.2 dBW



**EXHIBIT 2C-2: Ku-BAND ULPC TRANSMIT BEAM**  
**(Schedule S Beam ID: UPKV)**

Beam Polarization: Vertical  
Peak Beam Gain: 21.0 dBi  
Peak Beam EIRP: 16.2 dBW



## EXHIBIT 3: HORIZONS 2 LINK BUDGETS

<b>UPLINK BEAM INFORMATION</b>						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-82.1	-77.1	-88.1	-88.1	-88.1	-88.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>DOWNLINK BEAM INFORMATION</b>						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	44.8	44.8	44.8	44.8	44.8	44.8
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>ADJACENT SATELLITE 1</b>						
Satellite 1 Orbital Location	83.0E	83.0E	83.0E	83.0E	83.0E	83.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>ADJACENT SATELLITE 2</b>						
Satellite 1 Orbital Location	86.5E	86.5E	86.5E	86.5E	86.5E	86.5E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>CARRIER INFORMATION</b>						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
<b>UPLINK EARTH STATION</b>						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
<b>DOWNLINK EARTH STATION</b>						
Earth Station Diameter (meters)	2.4	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	47.5	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
<b>LINK FADE TYPE</b>	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
<b>UPLINK PERFORMANCE</b>						
Uplink Earth Station EIRP (dBW)	80.8	80.5	62.5	42.2	54.3	45.0
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	28.9	17.4	16.7	16.6	13.3
<b>DOWNLINK PERFORMANCE</b>						
Downlink EIRP per Carrier (dBW)	44.8	42.8	35.7	15.5	27.5	18.2
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.4	12.5	11.8	11.1	11.0	18.6
<b>COMPOSITE LINK PERFORMANCE</b>						
C/N Uplink (dB)	28.5	28.9	17.4	16.7	16.6	13.3
C/N Downlink (dB)	16.4	12.5	11.8	11.1	11.0	18.6
C/I Intermodulation (dB)	N/A	N/A	24.2	23.4	23.3	20.1
C/I Uplink Co-Channel (dB)*	27.0	27.0	28.1	28.0	28.4	24.7
C/I Downlink Co-Channel (dB)*	27.0	27.0	28.1	28.0	28.4	24.7
C/I Uplink Adjacent Satellite 1 (dB)	25.3	25.8	14.3	13.6	13.5	10.2
C/I Downlink Adjacent Satellite 1 (dB)	21.1	17.5	16.9	16.1	16.0	22.7
C/I Uplink Adjacent Satellite 2 (dB)	24.0	24.5	13.0	12.3	12.2	8.9
C/I Downlink Adjacent Satellite 2 (dB)	18.1	13.8	13.2	12.4	12.3	20.7
C/(N+I) Composite (dB)	12.3	8.9	6.1	5.4	5.3	5.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.3	7.9	5.1	4.4	4.3	4.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.3	4.6	1.2	1.4	.9	.6
Number of Carriers	1	1.0	2.7	285.0	17.9	90.0
<b>CARRIER DENSITY LEVELS</b>						
Uplink Power Density (dBW/Hz)	-42.1	-51.2	-62.7	-63.4	-63.5	-56.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.2	-26.0	-26.6	-27.3	-27.4	-30.7

## EXHIBIT 3: HORIZONS 2 LINK BUDGETS (continued)

<b>UPLINK BEAM INFORMATION</b>						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-82.1	-77.1	-88.1	-88.1	-88.1	-88.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>DOWNLINK BEAM INFORMATION</b>						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	45.0	45.0	45.0	45.0	45.0	45.0
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>ADJACENT SATELLITE 1</b>						
Satellite 1 Orbital Location	83.0E	83.0E	83.0E	83.0E	83.0E	83.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>ADJACENT SATELLITE 2</b>						
Satellite 1 Orbital Location	86.5E	86.5E	86.5E	86.5E	86.5E	86.5E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>CARRIER INFORMATION</b>						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
<b>UPLINK EARTH STATION</b>						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
<b>DOWNLINK EARTH STATION</b>						
Earth Station Diameter (meters)	2.4	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	47.5	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
<b>LINK FADE TYPE</b>	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
<b>UPLINK PERFORMANCE</b>						
Uplink Earth Station EIRP (dBW)	80.8	80.2	62.5	42.2	54.2	45.1
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	28.6	17.4	16.7	16.6	13.5
<b>DOWNLINK PERFORMANCE</b>						
Downlink EIRP per Carrier (dBW)	45.0	42.8	35.9	15.6	27.6	18.5
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	12.4	12.0	11.3	11.2	18.9
<b>COMPOSITE LINK PERFORMANCE</b>						
C/N Uplink (dB)	28.5	28.6	17.4	16.7	16.6	13.5
C/N Downlink (dB)	16.6	12.4	12.0	11.3	11.2	18.9
C/I Intermodulation (dB)	N/A	N/A	24.1	23.4	23.3	20.2
C/I Uplink Co-Channel (dB)*	27.0	27.0	28.1	28.0	28.4	24.8
C/I Downlink Co-Channel (dB)*	27.0	27.0	28.1	28.0	28.4	24.8
C/I Uplink Adjacent Satellite 1 (dB)	25.3	25.5	14.3	13.6	13.5	10.3
C/I Downlink Adjacent Satellite 1 (dB)	21.3	17.4	17.0	16.3	16.2	23.1
C/I Uplink Adjacent Satellite 2 (dB)	24.0	24.2	13.0	12.2	12.1	9.0
C/I Downlink Adjacent Satellite 2 (dB)	18.3	13.7	13.3	12.6	12.5	21.1
C/(N+I) Composite (dB)	12.5	8.9	6.2	5.4	5.3	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.5	7.9	5.2	4.4	4.3	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.5	4.5	1.3	1.5	.9	.8
Number of Carriers	1	1.0	2.7	286.7	18.0	90.0
<b>CARRIER DENSITY LEVELS</b>						
Uplink Power Density (dBW/Hz)	-42.1	-51.5	-62.7	-63.4	-63.6	-56.2
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.0	-26.0	-26.4	-27.1	-27.3	-30.4



## EXHIBIT 3: HORIZONS 2 LINK BUDGETS (continued)

<b>UPLINK BEAM INFORMATION</b>						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-79.1	-77.1	-85.1	-85.1	-85.1	-85.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>DOWNLINK BEAM INFORMATION</b>						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	47.6	47.6	47.6	47.6	47.6	47.6
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	42.0
<b>ADJACENT SATELLITE 1</b>						
Satellite 1 Orbital Location	83.0E	83.0E	83.0E	83.0E	83.0E	83.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>ADJACENT SATELLITE 2</b>						
Satellite 1 Orbital Location	86.5E	86.5E	86.5E	86.5E	86.5E	86.5E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>CARRIER INFORMATION</b>						
Carrier ID	36M0F3F	72M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	49150	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	60266	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	72000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
<b>UPLINK EARTH STATION</b>						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
<b>DOWNLINK EARTH STATION</b>						
Earth Station Diameter (meters)	3.0	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	49.2	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	26.7	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
<b>LINK FADE TYPE</b>						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
<b>UPLINK PERFORMANCE</b>						
Uplink Earth Station EIRP (dBW)	80.8	80.7	62.7	42.5	54.5	45.7
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	26.1	17.7	16.9	16.8	14.1
<b>DOWNLINK PERFORMANCE</b>						
Downlink EIRP per Carrier (dBW)	43.3	45.8	35.7	15.5	27.5	18.0
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	26.7	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	12.4	11.9	11.1	11.0	18.4
<b>COMPOSITE LINK PERFORMANCE</b>						
C/N Uplink (dB)	28.5	26.1	17.7	16.9	16.8	14.1
C/N Downlink (dB)	16.6	12.4	11.9	11.1	11.0	18.4
C/I Intermodulation (dB)	N/A	N/A	24.4	23.7	23.6	14.4
C/I Uplink Co-Channel (dB)*	27.0	27.0	28.4	28.2	28.6	23.5
C/I Downlink Co-Channel (dB)*	27.0	27.0	28.4	28.2	28.6	23.5
C/I Uplink Adjacent Satellite 1 (dB)	25.3	23.0	14.5	13.8	13.7	11.0
C/I Downlink Adjacent Satellite 1 (dB)	21.2	17.5	16.9	16.1	16.0	21.9
C/I Uplink Adjacent Satellite 2 (dB)	24.0	21.7	13.2	12.5	12.4	9.6
C/I Downlink Adjacent Satellite 2 (dB)	18.5	13.8	13.2	12.5	12.4	21.4
C/(N+I) Composite (dB)	12.5	8.7	6.2	5.5	5.4	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.5	7.7	5.2	4.5	4.4	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.5	4.3	1.3	1.5	1.0	.8
Number of Carriers	2	1.0	5.1	542.6	34.1	180.0
<b>CARRIER DENSITY LEVELS</b>						
Uplink Power Density (dBW/Hz)	-42.1	-54.0	-62.5	-63.2	-63.3	-55.6
Downlink EIRP Density At Beam Peak (dBW/Hz)	-16.7	-26.0	-26.6	-27.3	-27.4	-30.8

## EXHIBIT 4: ADJACENT SATELLITE (83° E.L) LINK BUDGETS

UPLINK BEAM INFORMATION						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m <sup>2</sup> )	-82.1	-77.1	-85.1	-85.1	-85.1	-85.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	44.8	44.8	44.8	44.8	44.8	44.8
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	81.0E	81.0E	81.0E	81.0E	81.0E	81.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
CARRIER INFORMATION						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.2
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	42.9
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	2.4	1.2	1.8	1.2	1.2	6.1
Earth Station Gain (dBi)	47.5	41.3	44.8	41.3	41.3	55.5
Earth Station G/T (dB/K)	25.0	18.8	22.3	18.8	18.8	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	80.8	80.5	64.7	47.3	59.3	45.9
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	28.9	19.6	21.8	21.6	14.2
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	44.8	42.8	34.2	16.8	28.8	15.4
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	18.8	22.3	18.8	18.8	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.4	9.0	10.3	9.0	8.9	15.8
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	28.5	28.9	19.6	21.8	21.6	14.2
C/N Downlink (dB)	16.4	9.0	10.3	9.0	8.9	15.8
C/I Intermodulation (dB)	N/A	N/A	16.9	19.1	19.0	11.6
C/I Uplink Co-Channel (dB)*	27.0	27.0	25.3	28.1	28.5	20.6
C/I Downlink Co-Channel (dB)*	27.0	27.0	25.3	28.1	28.5	20.6
C/I Uplink Adjacent Satellite 1 (dB)	26.2	26.7	17.4	19.5	19.4	12.0
C/I Downlink Adjacent Satellite 1 (dB)	20.4	11.9	14.1	11.9	11.8	20.2
C/I Uplink Adjacent Satellite 2 (dB)	25.3	25.8	16.5	18.6	18.5	11.1
C/I Downlink Adjacent Satellite 2 (dB)	21.1	14.5	15.3	14.5	14.4	19.9
C/(N+I) Composite (dB)	13.0	6.2	6.2	5.6	5.5	5.1
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	12.0	5.2	5.2	4.6	4.5	4.1
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	2.0	1.9	1.3	1.6	1.1	.7
Number of Carriers	1	1.0	3.5	281.3	17.7	90.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-42.1	-51.2	-60.5	-58.4	-58.5	-51.9
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.2	-26.0	-28.1	-26.0	-26.1	-33.5

# EXHIBIT 4: ADJACENT SATELLITE (83° E.L) LINK BUDGETS (continued)

UPLINK BEAM INFORMATION						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-82.1	-77.1	-84.1	-84.1	-84.1	-84.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	45.0	45.0	45.0	45.0	45.0	45.0
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	81.0E	81.0E	81.0E	81.0E	81.0E	81.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
CARRIER INFORMATION						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.2
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	42.9
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	2.4	1.2	1.8	1.2	1.2	6.1
Earth Station Gain (dBi)	47.5	41.3	44.8	41.3	41.3	55.5
Earth Station G/T (dB/K)	25.0	18.8	22.3	18.8	18.8	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	80.8	80.2	65.4	48.1	60.1	46.4
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	28.6	20.3	22.6	22.4	14.8
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	45.0	42.8	34.1	16.8	28.8	15.1
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	18.8	22.3	18.8	18.8	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	8.9	10.3	9.0	8.8	15.5
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	28.5	28.6	20.3	22.6	22.4	14.8
C/N Downlink (dB)	16.6	8.9	10.3	9.0	8.8	15.5
C/I Intermodulation (dB)	N/A	N/A	16.7	18.9	18.8	11.1
C/I Uplink Co-Channel (dB)*	27.0	27.0	25.1	27.9	28.3	20.2
C/I Downlink Co-Channel (dB)*	27.0	27.0	25.1	27.9	28.3	20.2
C/I Uplink Adjacent Satellite 1 (dB)	26.2	26.4	18.1	20.3	20.2	12.6
C/I Downlink Adjacent Satellite 1 (dB)	20.6	11.8	14.0	11.9	11.7	19.9
C/I Uplink Adjacent Satellite 2 (dB)	25.3	25.5	17.2	19.4	19.3	11.7
C/I Downlink Adjacent Satellite 2 (dB)	21.3	14.4	15.3	14.5	14.4	19.7
C/(N+I) Composite (dB)	13.1	6.2	6.3	5.7	5.6	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	12.1	5.2	5.3	4.7	4.6	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	2.1	1.8	1.4	1.7	1.2	.8
Number of Carriers	1	1.0	3.5	295.0	18.6	90.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-42.1	-51.5	-59.8	-57.6	-57.7	-51.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.0	-26.0	-28.2	-26.0	-26.1	-33.7

## EXHIBIT 4: ADJACENT SATELLITE (83° E.L) LINK BUDGETS

UPLINK BEAM INFORMATION						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-79.1	-77.1	-81.1	-81.1	-81.1	-81.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	47.6	47.6	47.6	47.6	47.6	47.6
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	81.0E	81.0E	81.0E	81.0E	81.0E	81.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
CARRIER INFORMATION						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	49150	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	60266	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	72000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.2
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	42.9
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	3.0	1.2	1.8	1.2	1.2	6.1
Earth Station Gain (dBi)	49.2	41.3	44.8	41.3	41.3	55.5
Earth Station G/T (dB/K)	26.7	18.8	22.3	18.8	18.8	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	80.8	80.7	65.8	48.4	60.5	46.5
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	26.1	20.7	22.9	22.8	14.9
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	43.3	45.8	34.1	16.7	28.8	14.8
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	26.7	18.8	22.3	18.8	18.8	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	8.9	10.2	8.9	8.8	15.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	28.5	26.1	20.7	22.9	22.8	14.9
C/N Downlink (dB)	16.6	8.9	10.2	8.9	8.8	15.2
C/I Intermodulation (dB)	N/A	N/A	17.0	19.2	19.1	11.2
C/I Uplink Co-Channel (dB)*	27.0	27.0	25.4	28.2	28.6	20.3
C/I Downlink Co-Channel (dB)*	27.0	27.0	25.4	28.2	28.6	20.3
C/I Uplink Adjacent Satellite 1 (dB)	26.2	23.9	18.5	20.7	20.6	12.6
C/I Downlink Adjacent Satellite 1 (dB)	20.8	11.8	14.0	11.8	11.7	19.6
C/I Uplink Adjacent Satellite 2 (dB)	25.3	23.0	17.6	19.8	19.7	11.7
C/I Downlink Adjacent Satellite 2 (dB)	21.2	14.5	15.2	14.4	14.3	19.4
C/(N+I) Composite (dB)	13.1	6.1	6.3	5.7	5.6	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	12.1	5.1	5.3	4.7	4.6	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	2.1	1.8	1.5	1.7	1.2	.8
Number of Carriers	2	1.0	7.0	543.3	34.2	180.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-42.1	-54.0	-59.4	-57.2	-57.3	-51.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-16.7	-26.0	-28.2	-26.0	-26.1	-34.1

## EXHIBIT 5: ADJACENT SATELLITE (86.5° E.L) LINK BUDGETS

<b>UPLINK BEAM INFORMATION</b>						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-80.1	-77.1	-88.1	-88.1	-88.1	-88.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>DOWNLINK BEAM INFORMATION</b>						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	44.8	44.8	44.8	44.8	44.8	44.8
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
<b>ADJACENT SATELLITE 1</b>						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>ADJACENT SATELLITE 2</b>						
Satellite 1 Orbital Location	88.0E	88.0E	88.0E	88.0E	88.0E	88.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
<b>CARRIER INFORMATION</b>						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
<b>UPLINK EARTH STATION</b>						
Earth Station Diameter (meters)	9.0	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	60.2	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
<b>DOWNLINK EARTH STATION</b>						
Earth Station Diameter (meters)	2.4	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	47.5	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
<b>LINK FADE TYPE</b>	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
<b>UPLINK PERFORMANCE</b>						
Uplink Earth Station EIRP (dBW)	82.8	80.5	63.7	43.4	55.5	46.3
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	30.5	28.9	18.6	17.9	17.8	14.7
<b>DOWNLINK PERFORMANCE</b>						
Downlink EIRP per Carrier (dBW)	44.8	42.8	36.2	15.9	28.0	18.8
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.4	12.5	12.3	11.6	11.5	19.2
<b>COMPOSITE LINK PERFORMANCE</b>						
C/N Uplink (dB)	30.5	28.9	18.6	17.9	17.8	14.7
C/N Downlink (dB)	16.4	12.5	12.3	11.6	11.5	19.2
C/I Intermodulation (dB)	N/A	N/A	18.9	18.2	18.1	15.0
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.3	27.2	27.6	24.1
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.3	27.2	27.6	24.1
C/I Uplink Adjacent Satellite 1 (dB)	26.0	24.5	14.2	13.5	13.4	10.3
C/I Downlink Adjacent Satellite 1 (dB)	18.1	13.8	13.6	12.9	12.8	21.4
C/I Uplink Adjacent Satellite 2 (dB)	24.9	23.4	13.0	12.4	12.2	9.2
C/I Downlink Adjacent Satellite 2 (dB)	18.9	15.3	15.2	14.5	14.4	21.1
C/(N+I) Composite (dB)	12.1	8.5	6.0	5.3	5.2	5.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.1	7.5	5.0	4.3	4.2	4.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.1	4.2	1.1	1.3	.8	.6
Number of Carriers	1	1.0	3.3	343.2	21.6	90.0
<b>CARRIER DENSITY LEVELS</b>						
Uplink Power Density (dBW/Hz)	-43.4	-51.2	-61.5	-62.2	-62.3	-54.9
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.2	-26.0	-26.1	-26.8	-26.9	-30.0

# EXHIBIT 5: ADJACENT SATELLITE (86.5° E.L) LINK BUDGETS (continued)

UPLINK BEAM INFORMATION						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-82.1	-77.1	-88.1	-88.1	-88.1	-88.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	45.0	45.0	45.0	45.0	45.0	45.0
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	88.0E	88.0E	88.0E	88.0E	88.0E	88.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
CARRIER INFORMATION						
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	36000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	2.4	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	47.5	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	80.8	80.2	63.6	43.4	55.4	46.5
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.5	28.6	18.6	17.9	17.8	14.8
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	45.0	42.8	36.3	16.1	28.1	19.2
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	25.0	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	12.4	12.5	11.8	11.7	19.6
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	28.5	28.6	18.6	17.9	17.8	14.8
C/N Downlink (dB)	16.6	12.4	12.5	11.8	11.7	19.6
C/I Intermodulation (dB)	N/A	N/A	18.9	18.2	18.1	15.2
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.3	27.2	27.6	24.2
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.3	27.2	27.6	24.2
C/I Uplink Adjacent Satellite 1 (dB)	24.0	24.2	14.1	13.5	13.3	10.4
C/I Downlink Adjacent Satellite 1 (dB)	18.3	13.7	13.8	13.1	13.0	21.7
C/I Uplink Adjacent Satellite 2 (dB)	22.9	23.1	13.0	12.4	12.2	9.3
C/I Downlink Adjacent Satellite 2 (dB)	19.1	15.3	15.3	14.7	14.6	21.4
C/(N+I) Composite (dB)	12.0	8.4	6.1	5.4	5.3	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.0	7.4	5.1	4.4	4.3	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.0	4.1	1.2	1.4	.9	.8
Number of Carriers	1	1.0	3.3	343.6	21.6	90.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-42.1	-51.5	-61.6	-62.2	-62.4	-54.8
Downlink EIRP Density At Beam Peak (dBW/Hz)	-15.0	-26.0	-26.0	-26.6	-26.7	-29.7

# EXHIBIT 5: ADJACENT SATELLITE (86.5° E.L) LINK BUDGETS (continued)

UPLINK BEAM INFORMATION						
Uplink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Uplink SFD (dBW/m2)	-77.1	-77.1	-85.1	-85.1	-85.1	-85.1
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA	RUSSIA
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	47.6	47.6	47.6	47.6	47.6	47.6
Rain Rate (mm/hr)	22.0	22.0	22.0	22.0	22.0	22.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	84.85E	84.85E	84.85E	84.85E	84.85E	84.85E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	88.0E	88.0E	88.0E	88.0E	88.0E	88.0E
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0	0	0	0	0	0
Downlink EIRP Density (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0
Downlink Polarization Advantage (dB)	0	0	0	0	0	0
CARRIER INFORMATION						
Carrier ID	36M0F3F	72M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	49150	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	R1/2	R1/2
Occupied Bandwidth(kHz)	36000	60266	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	72000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	9.0	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	60.2	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	3.0	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	49.2	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	26.7	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE						
	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	82.8	80.7	63.9	43.7	55.7	46.5
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.1	2.1	2.1	2.1	2.1	2.1
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	30.5	26.1	18.8	18.1	18.0	14.9
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	43.3	45.8	36.2	16.0	28.0	18.8
Antenna Pointing Error (dB)	-5	-5	-5	-5	-5	-5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	26.7	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	16.6	12.4	12.3	11.6	11.5	19.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	30.5	26.1	18.8	18.1	18.0	14.9
C/N Downlink (dB)	16.6	12.4	12.3	11.6	11.5	19.2
C/I Intermodulation (dB)	N/A	N/A	19.2	18.5	18.4	15.2
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.6	27.4	27.8	24.3
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.6	27.4	27.8	24.3
C/I Uplink Adjacent Satellite 1 (dB)	26.0	21.7	14.4	13.7	13.6	10.4
C/I Downlink Adjacent Satellite 1 (dB)	18.5	13.8	13.7	13.0	12.9	21.4
C/I Uplink Adjacent Satellite 2 (dB)	24.9	20.6	13.3	12.6	12.5	9.3
C/I Downlink Adjacent Satellite 2 (dB)	18.9	15.3	15.2	14.5	14.4	21.0
C/(N+I) Composite (dB)	12.2	8.2	6.1	5.4	5.3	5.2
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	11.2	7.2	5.1	4.4	4.3	4.2
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	1.2	3.9	1.3	1.4	.9	.8
Number of Carriers	2	1.0	6.1	651.5	41.0	180.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-43.4	-54.0	-61.3	-62.0	-62.1	-54.8
Downlink EIRP Density At Beam Peak (dBW/Hz)	-16.7	-26.0	-26.1	-26.8	-26.9	-30.1