Attachment A – Regulatory Compliance Matrix

Reference	Reference Location	Topic / Reason for (n/a)
25.114(a)(1)	FCC Form 312, Schedule S, Attachment B	Overall context of filing
25.114(a)(2)	n/a	NGSO constellation
25.114(a)(3)	n/a	Application filed pursuant to two-step procedure
25.114(b)	n/a	Waiver required by 47 U.S.C 304
25.114(c)(1)	Schedule-S	Applicant info
25.114(c)(2)	Schedule-S	Info for correspondence person
25.114(c)(3)	Schedule-S	Type of authorization
25.114(c)(4)(i)	Schedule-S	Channel frequency, bandwdith and polarization
25.114(c)(4)(ii)	Schedule-S	Maximum EIRP and EIRP density of TX beams
25.114(c)(4)(v)	Schedule-S	RX beam: G/T, SFD
25.114(c)(4)(vi)(A)	Schedule-S	GSO: Antenna Gain Contours
25.114(c)(4)(vi)(B)	n/a	NGSO: Antenna Gain Contours
25.114(c)(4)(vi)(C)	n/a	Shapeable Beams: Antenna Gain Contours
25.114(c)(4)(vi)(D)	n/a	Steerable, non-shapeable beams
25.114(c)(4)(vii)(A-C)	n/a	GSO: Large number of spot beams
25.114(c)(5)(i-v)	Schedule-S	GSO: Orbital parameters
25.114(c)(6)(i-ix)	n/a	NGSO: Orbital parameters
25.114(c)(7)	Schedule-S	Frequency Bands, Types of Service and Coverage Areas
25.114(c)(8)	Schedule-S, See 25.208	TX Beams: PFD
25.114(c)(10)	Schedule-S	Operational Lifetime
25.114(c)(11)	Schedule-S	Common Carrier Status
25.114(c)(13)	n/a	17/24 GHz BSS polarization isolation
25.114(d)(1)	Narrative, Attachment B - Section 2	Overall description
25.114(d)(6)	Narrative	Public Interest
25.114(d)(7)	See 25.140(a)	Interference Analysis
25.114(d)(8)	n/a	L-Band MSS
25.114(d)(9)	n/a	MSS: Multiple Satellites
25.114(d)(10)	n/a	L/S-Band MSS
25.114(d)(11)	n/a	DBS
25.114(d)(12)	n/a	NGSO FSS
25.114(d)(13)(i-ii)	n/a	DBSS
25.114(d)(14)(i-v)	Attachment C - Orbital Debris	Orbital Debris
25.114(d)(15)(i-v)	n/a	17/24 GHZ BSS
25.114(d)(16)	n/a	17/24 GHZ BSS
25.114(d)(17)	n/a	17/24 GHZ BSS
25.114(d)(18)	n/a	17/24 GHZ BSS

Reference	Reference Location	Topic / Reason for (n/a)
25.140(a)(3)(i)	n/a	C-band limits
25.140(a)(3)(ii)	n/a	Ku-band limits
25.140(a)(3)(iii)	Attachment B - Section 14	Ka-band limits
25.140(a)(3)(iv)	n/a	AP30B limits
25.140(a)(3)(v)	Attachment B - Section 14	2-degree spacing interference analysis
25.202(e)	Attachment B - Section 7	Frequency Tolerance
25.202(f)(1-3)	Attachment B - Section 8	Out of band - emissions
25.208(a-g)	Attachment B - Section 12	PFD Analysis
25.210(f)	Attachment B - Section 9	Full Frequency Reuse
25.210(j)	Narrative	EW Station keeping tolerance
25.283(a-c)	Attachment C - Orbital Debris	End-of-life Disposal
25.207	Attachment B - Section 10	Cessation of Emissions

Attachment B - Engineering Statement

1. Scope

This Attachment contains additional information regarding the EUTELSAT 172B satellite required by Section 25.114 and other sections of the Part 25 rules that cannot be entered into the Schedule S online submission system. Note that this technical information includes frequency bands for which ES 172 LLC does not seek operational authority from the Federal Communication Commission ("Commission"). This additional information is included for the Commission's information and possible reference by a U.S. earth station applicant seeking the add EUTELSAT 172B as an authorized point of communication in bands not licensed by the Commission.

2. General Description (Section 25.114(d)(1))

The EUTELSAT 172B satellite will operate at the 172° E.L. orbital location and is intended as a replacement for the EUTELSAT 172A satellite that currently operates at 172° E.L. The EUTELSAT 172B satellite will provide a range of FSS services over the Pacific Ocean and to various countries within and bordering the Pacific Ocean using the C-band and Ku-band frequencies for service links and Ka-band frequencies for gateway links.

The satellite employs 14 C-band transponders and 40 Ku-band transponders using both linear polarizations thereby providing dual frequency re-use. The satellite has one C-band beam which provides coverage of the West coast of the United States and Canada and the Asia-Pacific region, including Australia, Japan, Indonesia, the Philippines and a portion of China. The satellite has five (5) regional Ku beams covering: North Pacific, South Pacific, South-West Pacific, South-East Pacific, and North-East Asia.

In addition to the beams described, which effectively reproduce the capabilities of the EUTELSAT 172A satellite, this satellite introduces a High-Throughput Satellite (HTS) Ku-band payload with eleven (11) spot beams covering the North Pacific. Also, unique to the EUTELSAT 172B satellite are several Ka-band gateway beams, including one within U.S. territory at Hawaii. The Ka-band gateway beams are intended mostly to serve the new HTS Ku-band beams but are also able to connect with any of the regional Ku-band beams.

3. Spacecraft Overview

EUTELSAT 172B was manufactured and supplied by Airbus Defense and Space based on the Airbus Eurostar 3000e bus platform. The satellite is 3-axis stabilized and uses electrical propulsion for initial orbit raising, on-station control, and end-of-life deorbit.

The EUTELSAT 172B satellite is a triple mission satellite with three distinct payloads:

- A C-band payload delivering increased power and broader coverage to enhance the service provided today to customers via EUTELSAT 172A and tap into new growth markets in the Asia-Pacific region;
- A traditional Ku-band payload which will double capacity at 172° East and connect five improved service areas: North Pacific, North East Asia, South East Pacific, South West Pacific and South Pacific;
- An innovative HTS Ku-band payload designed for in-flight and maritime broadband, with multiple user spots optimized to serve densely used Asian and trans-Pacific paths.

The spacecraft can operate in C-band, Ku-band, and Ka-band frequencies listed in the table below:

C-band	Uplink	5925 – 6425 MHz
	Downlink	3700 – 4200 MHz
Ku-band	Uplink	13.0 -13.25 GHz
		13.75 – 14.0 GHz
		14.0 – 14.5 GHz
	Downlink	10.95 – 11.20 GHz
		11.2 – 11.45 GHz
		11.45 – 11.7 GHz
		12.2 – 12.75 GHz
Ka-band	Uplink	27.5 – 29.15 GHz
	Downlink	18.4 – 19.2 GHz[1]

[1] The spacecraft will also include a Ka-band beacon at 19.202 GHz, the parameters of which are included in this application.

The spacecraft provides the following coverage. For the scope of this filing, the only pertinent coverage area is Oahu, HI.

C-band	POR	Western US, East Asia
Ku-band	North Pacific	East Asia, N Pacific Ocean, Western North America
	North-East Asia	China, Japan, Korea, Philippines
	South-West Pacific	SE Asia, Indonesia, Malaysia, Philippines
	South Pacific	Australia, New Zealand
	South-East Pacific	Hawaii, Fiji, American Samoa, Cook Islands, etc.
	High Throughput – North Pacific	11 beams covering aeronautical routes
Ka-band	Oahu, HI	Gateway Beam

4. Telemetry, Tracking and Control (TT&C)

The EUTELSAT 172B TT&C sub-system provides for communications during pre-launch, transfer orbit and on-station operations, as well as during spacecraft emergencies. Ku-band telecommand transmissions are received and Ku-band telemetry communications are transmitted by the spacecraft through a wide beam when on-station and they are transmitted and received through a near omni-directional antenna during both transfer orbit and emergency operations.

TT&C communication channels have been selected at the edge of the assigned Ku-band per Section 25.202(g).

TT&C operations will be conducted from Australia, Eutelsat does not seek Commission authorization for TT&C transmissions.

Contact details for the control stations are provided below:

E172B TT&C station 1:
Perth LES
620 Gnangara Road, Landsdale, Western Australia 6065

E172B TT&C station 2:
Speedcast Australia
12 Park Way
Mawson Lakes SA 5095
Australia

Satellite control center addresses and telephone numbers:

E172B Control Center
Address: Eutelsat
70 rue Balard
75015 Paris
France

E172B control responsible person: H. Schulze
Phone: fixed: / mobile: +33 1 5398 3466
24/7 hours number(s): +33 1 5398 3445

E172B Operations Coordinator: P. Turner
Phone: +33 1 5398 3177Phone: 01 (662) 2600289

5. Uplink Power Control (ULPC)

EUTELSAT 172B utilizes one Ka-band ULPC channel. The Ka-band ULPC channel center frequency is 19202 MHz.

The coverage patterns of the Ka-band ULPC beam has gain contours that vary by less than 8 dB across the surface of the Earth, and accordingly the gain at 8 dB below the peak falls beyond the edge of the Earth. Therefore, pursuant to Section 25.114(c)(4)(vi)(A) of the Rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S.

The Ka-band beacon has a bandwidth of 100 Hz. In the accompanying Schedule S, the bandwidth of the channels has been entered as 1000 Hz rather than 100 Hz due to a limitation of the precision of the channel bandwidth which does not accept values smaller than 1000 Hz. All other associated values, such as EIRP density, have been entered properly to reflect the 100 Hz emission bandwidth.

6. Ka-Band Frequency Plan

The following tables list the uplink and downlink Ka-band channel planned for E172B. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 1 Ka-Band Downlink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
G01D	54000	18493.75	R
G02D	54000	18681.25	R
G03D	54000	18868.75	R
G04D	54000	18976.75	R
G05D	54000	19101.75	R
G06D	54000	18556.25	R
G07D	54000	18743.75	R
G08D	54000	18431.25	R
G09D	54000	18618.75	R
G10D	54000	18806.25	R
G11D	54000	19039.25	R
GE1D	20000	19167	R
GN1D	20000	19189.5	R
GS1D	40000	18922.75	R
GW1D	20000	19144.5	R
GWBD	0.1	19202	R

Table 2 Ka-Band Uplink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
G01U	170000	28160	R
G02U	170000	28350	R
G03U	170000	27780	L
G04U	170000	27970	L
G05U	170000	28540	L
G06U	170000	27590	R
G07U	170000	28540	R
G08U	170000	27970	R
G09U	170000	27780	R
G10U	170000	27590	L
G11U	170000	28160	L
GE1U	54000	28806.25	R
GE2U	54000	28868.75	R
GH1U	36000	28931	R
GH2U	36000	28971	R
GN1U	54000	28681.25	R
GN2U	54000	28743.75	R
GS1U	54000	28291.25	L
GS2U	54000	28353.75	L
GW1U	54000	29056.25	R
GW2U	54000	29118.75	R

7. Frequency Tolerance

The frequency tolerance requirements of Section 25.202(e) that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency will be met.

8. Out of Band Emissions

The out-of-band emission limits of Section 25.202(f)(1), (2) and (3) will be met.

9. Frequency Reuse

EUTELSAT 172B employs full frequency reuse on the Ka-band gateway uplink by employing dual orthogonal circular polarization. The satellite employs one polarization for the gateway downlinks.

10. Cessation of Emissions

All downlink transmissions can be turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required by Section 25.207 of the FCC's rules.

11. ITU Filings

The EUTELSAT 172B Ka-band gateway links will operate under ITU filing F-SAT-N-172E filed via the French administration. This network has been notified to the ITU.

12. PFD Analysis

The power flux density ("PFD") limits for space stations operating in 18300–18800 MHz and 18800-19300 MHz bands are specified in Section 25.208 of the Commission's rules. Also, Sections 25.138(a)(6) and 25.140(a)(3)(iii) of the Commission's rules specify a PFD limit of -118 dBW/m2 /MHz for space stations operating in the 18300–18800 MHz band. The maximum PFD levels for the EUTELSAT 172B transmissions were calculated for the bands 18300–18800 MHz and 18800–19300 MHz. The results are provided in Schedule S and show that the downlink power flux density levels of the EUTELSAT 172B carriers do not exceed the limits specified in Sections 25.208, 25.138, and 25.140 of the Commission's rules.

13. Link Budgets

Link analysis for EUTELSAT 172B was conducted for a number of representative carriers in the HTS services. For each of these links it was assumed that the nearest satellite to EUTELSAT 172B was a hypothetical satellite operating at 170° E.L. and a hypothetical satellite operating at 174° E.L. Each of these hypothetical satellites were assumed to have the same operating parameters as EUTELSAT 172B.

The following assumptions were used in the link budget analysis:

- The link budgets are for clear sky operation.
- The clear sky link margins were chosen to provide sufficient link availability for the service(s).
- All transmitting and receiving earth stations have a cross-polarization isolation value of at least 27 dB within their main beam lobe.

The results of the analysis are shown in Exhibit 1.

14. Interference Analysis

In this section, the information specified in Section 25.140 (a) is presented (as required by Section 25.114(d)(7)). EUTELSAT 172B downlink transmissions in the conventional Ka-band will not generate power flux-density at the Earth's surface in excess of the levels provided in Section 25.140 (a)(3)(iii), and that associated uplink operation will not exceed applicable EIRP density envelopes in Section 25.138(a) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of EUTELSAT 172B at 172.0° E.L.

14.1 Adjacent Satellite Link Analysis (Section 25.140(a)(3)(v))

The EUTELSAT 172B satellite will operate in bands addressed by Section 25.140(a)(3)(v). Since there are no commercial satellites operating within 2° of EUTELSAT 172B, the impact of those operations on hypothetical satellites having the same operating characteristics as EUTELSAT 172B located at 170.0° E.L. and 174° E.L. was analyzed. The satellite at 170.0° E.L. was assumed to have two adjacent satellites separated by 2°: EUTELSAT 172B at 172° E.L. and a hypothetical satellite having the same operating characteristics as EUTELSAT 172B located at 168° E.L. The satellite at 174° E.L. was assumed to have two adjacent satellites separated by 2°: EUTELSAT 172B at 172° E.L. and a hypothetical satellite having the same operating characteristics as EUTELSAT 172B located at 176° E.L.

The link interference analysis demonstrating compatibility of EUTELSAT 172B with these hypothetical satellite systems was performed for representative carriers for Ka-band gateway links connected with HTS user links and for the Ka-band gateway ULPC beacon. Other assumptions used in the analysis were as follows:

- The transmitting and receiving earth station antennas have off-axis co-polar gains that are compliant with the limits specified in Section 25.209(a) of the FCC's rules.
- The Adjacent Satellite Interference (ASI) is computed based on EIRP densities.
- The uplink RF power density for each adjacent satellite is based on the maximum allowed in that frequency band (the provided analysis shows both cases where the interfering satellites operate at maximum power densities and when the interfering satellites are operating at the same power density as the signal of interest)
- The downlink EIRP density for each adjacent satellite is based on the maximum allowed in that frequency band (the provided analysis shows both cases where the interfering satellites operate at maximum EIRP densities and when the interfering satellites are operating at the same EIRP density as the signal of interest). [2]

The results of the Ka-band gateway link to HTS user link interference analysis and the Ka-band gateway ULPC beacon link interference analysis are shown in Exhibit 2 (for a hypothetical satellite at 170 E.L.) and Exhibit 3 (for a hypothetical satellite at 174 E.L.) and demonstrate that the operation of EUTELSAT 172B will permit the intended services for hypothetical satellites in slots 2° away while maintaining sufficient link margin.

15. Sharing with NGSO FSS in the 28.6-29.1 GHz and 18.8-19.2 GHz Band

Under the FCC's band plan, the 28.6-29.1 GHz band is allocated to NGSO FSS on a primary basis and to the GSO FSS on a secondary basis. Stations operating as a secondary service cannot

[2] The interference analyses for the Ka-band ULPC Beacon are only conducted for the case where the interfering satellites operate at the same EIRP density as the signal of interest. This is actually the worst-case scenario since the beacon has a bandwidth of only 100 Hz and therefore the PFD limit (which gets averaged over 1 MHz) allows for a much greater EIRP density.

cause harmful inference, nor seek interference protection from, co-frequency stations of a primary service. EUTELSAT 172B's operations in the United States in this band will be consistent with the obligations of a secondary user.

Under the FCC's band plan, the 18.8- 19.3 GHz band is available on a primary basis only to the NGSO FSS. A waiver is needed to allow the E172B satellite to operate in the 18.8 – 19.2 GHz band. Operations with EUTELSAT 172B will not cause harmful interference to, nor seek protection from, NGSO operations in this band. The analysis in this section demonstrates compatibility with NGSO FSS operations in these band segments.

The Commission has authorized WorldVu Satellite's OneWeb system (which has not yet been launched) and the O3b system (which is in orbit and operating) to serve the U.S. market in foregoing bands. With respect to OneWeb, Eutelsat has commenced discussions to coordinate the use of Ka-band frequencies between the OneWeb system and the entire Eutelsat satellite fleet, including EUTELSAT 172B. Eutelsat is confident that these discussions will result in a coordination agreement that includes EUTELSAT 172B access to the 18.8-19.2 GHz and 28.6-29.1 GHz bands.

With respect to O3b, the following analysis demonstrates compatibility with NGSO FSS operations in these band segments. The O3b constellation consists of 12 satellites in a medium earth orbit with an altitude of 8062 km and an inclination of zero degrees (an equatorial orbit). The satellites use steerable gateway spot beams which are oriented towards the gateways as the satellite traverses its orbit until the angle of arrival at the gateway falls below a minimum. An interference analysis is shown below that indicates that the EUTELSAT 172B and O3b networks can operate without causing harmful interference into each other.

To evaluate the impact of interference from EUTELSAT 172B into O3b and vice versa, it was necessary to compute the worst case angular separation (the smallest angle between the EUTELSAT 172B satellite and any of the satellites of the O3b constellation from the earth station location). A conservative assumption that simplifies that analysis was made that earth stations communicating with O3b and EUTELSAT 172B are collocated. For collocated earth stations on Oahu, HI, this analysis produced a minimum angular separation of 10.6° between EUTELSAT 172B and any O3b satellite. Other system parameters used in analysis are based on those in this Engineering Statement for EUTELSAT 172B and for the publicly available FCC filings from O3b.

The details of the calculations are shown in Table 3, which indicate that the operation of the EUTELSAT 172B system and corresponding HPT Gateway in the bands 28.6-29.1 GHz and 18.8-19.2 GHz will have a negligible impact on the O3b satellite network. Specifically, from Table 3 it can be seen that the calculated $\Delta T/T$ values are all well below 6%, with a maximum $\Delta T/T$ value of 0.4%. Furthermore, it should be noted that the uplink EIRP density reflects a rain margin of over 13 dB. The Ka-band uplink employs power control. Therefore, these uplink interference values would only be experienced a small fraction of time and in most cases, the interfering path would also experience significant rain fade. Finally, the uplink antenna sidelobe

performance exceeds the Section 25.209 specification by over 10 dB. Similarly, it can be seen that the impact of O3b on the operation of the EUTELSAT 172B network results in a maximum ΔT/T value of 4.9%.

Table 3 Interference Analysis between EUTELSAT 172B and O3B Hawaii Earth Stations.

Victim Network		O3b	172B
Interfering Network		172B	O3b
Victim ES Latitude	deg	21.7	21.7
Victim ES Longitude	deg	-158.0	-158.0
Uplink			
Frequency	GHz	28.7	28.7
Interfering ES Uplink Power Density	dB(W/Hz)	-64.4	-54.5
Worst Case Angular Separation	deg	10.6	10.6
Interfering ES off-axis TX Gain	dB	6.3	6.3
Slant Range (interfering path)	km	9457.8	37222.0
Free Space Loss (interfering path)	dB	201.1	213.0
Victim Satellite RX Peak Antenna Gain	dBi	34.0	48.5
Victim Satellite RX System Noise Temperature	K	1000.0	794.3
N_0	dB(W/Hz)	-198.6	-199.6
I_0	dB(W/Hz)	-225.2	-212.7
I_0/N_0	dB	-26.6	-13.1
$\Delta T/T$	%	0.2	4.9
Downlink			
Frequency	GHz	18.9	18.9
Interfering Satellite DL EIRP Density	dB(W/Hz)	-25.9	-26.3
Slant Range (interfering path)	km	37222.0	9457.8
Free Space Loss (interfering path)	dB	209.4	197.5
Worst Case Angular Separation	deg	10.6	10.6
Victim ES off-axis RX Gain	dBi	6.3	6.3
Victim ES RX System Noise Temperature	K	230	300
N_0	dB(W/Hz)	-205.0	-203.8
I_0	dB(W/Hz)	-229.0	-217.5
I_0/N_0	dB	-24.0	-13.6
$\Delta T/T$	%	0.4	4.3

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/

_____

David C Morse, Ph.D.

Avaliant, LLC

Bellevue, WA USA

(425) 246-3080

EXHIBIT 1: EUTELSAT 172B LINK BUDGETS

172B Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1			Hypothetical 170° E.L.		
Satellite 1 Orbital Location	deg	170	170	170	170
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2			Hypothetical 174° E.L.		
Satellite 2 Orbital Location	deg	174	174	174	174
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dBi	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	47.9	18.2	47.9	18.2
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	18.2	47.9	18.2	47.9
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.5	206.5	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 1	dB	6.8	25.9	14.4	25.9
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	26.0	14.4	26.0
C/(N+I) Composite	dB	1.1	0.2	6.6	6.4
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

172B Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAMINFORMATION						
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2	N/A
Uplink Frequency	GHz	28.2	14.2	28.2	14.2	N/A
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR	N/A
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2	N/A
DOWNLINK BEAMINFORMATION						
Downlink Beam Name		HDV4	OADR	HDV4	OADR	OABR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0	19.2
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3	20.0
ADJACENT SATELLITE 1		Hypothetical 170° E.L.				
Satellite 1 Orbital Location	deg	170	170	170	170	170
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
ADJACENT SATELLITE 2		Hypothetical 174° E.L.				
Satellite 2 Orbital Location	deg	174	174	174	174	174
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
CARRIER INFORMATION						
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN	BEACON
Information Rate	kbps	28816	4134	58161	7108	0.1
Modulation		QPSK	QPSK	8APSK	16APSK	BPSK
FEC Rate		0.48	0.69	0.65	0.59	1.00
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0	0.1
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7	10.0
UPLINK EARTH STATION						
Earth Station Diameter	meters	9.2	0.5	9.2	1.2	N/A
Earth Station Gain	dBi	64.1	35.6	64.1	43.2	N/A
Earth Station Latitude	deg	21.3	45.0	21.3	45.0	N/A
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0	N/A
Earth Station Elevation Angle	deg	47.9	18.2	47.9	18.2	N/A
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	0.5	9.2	1.2	9.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6	38.6
Earth Station Latitude	deg	45	21.32	45	21.32	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87	-157.87
Earth Station Elevation Angle	deg	18.2	47.9	18.2	47.9	47.9
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3	N/A
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5	N/A
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3	N/A
Satellite G/T	dB/K	13.2	12.2	13.2	12.2	N/A
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	N/A
Uplink C/N	dB	16.0	9.0	16.0	16.6	N/A
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7	20.0
Downlink Free Space Loss	dB	206.5	209.5	206.5	209.5	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	20.0
Downlink C/N	dB	5.8	24.7	13.4	24.7	56.7
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	16.0	9.0	16.0	16.6	N/A
C/N Downlink	dB	5.8	24.7	13.4	24.7	56.7
C/I Uplink	dB	25.7	12.4	25.7	12.4	N/A
C/I Downlink	dB	12.0	20.3	12.0	20.3	N/A
C/I Uplink Adjacent Satellite 1	dB	43.9	13.9	43.9	21.5	N/A
C/I Downlink Adjacent Satellite 1	dB	12.4	42.4	20.0	42.4	41.8
C/I Uplink Adjacent Satellite 2	dB	44.0	13.9	44.0	21.5	N/A
C/I Downlink Adjacent Satellite 2	dB	12.4	42.5	20.0	42.5	41.8
C/(N+I) Composite	dB	3.3	5.5	8.0	9.7	38.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7	10.0
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0	28.7

EXHIBIT 2: ADJACENT SATELLITE (170° E. L.) LINK BUDGETS

Hypothetical 170 East Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1		Hypothetical 168° E.L.			
Satellite 1 Orbital Location	deg	168	168	168	168
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2		Eutelsat 172B			
Satellite 2 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dBi	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	46.1	16.9	46.1	16.9
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	16.9	46.1	16.9	46.1
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	15.9	8.9	15.9	16.5
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.6	209.5	206.6	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.7	24.6	13.3	24.6
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	15.9	8.9	15.9	16.5
C/N Downlink	dB	5.7	24.6	13.3	24.6
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.8	4.2	24.8	11.8
C/I Downlink Adjacent Satellite 1	dB	6.7	25.9	14.3	25.9
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	25.9	14.4	25.9
C/(N+I) Composite	dB	1.0	0.2	6.6	6.4
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

Hypothetical 170 East Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAM INFORMATION						
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2	N/A
Uplink Frequency	GHz	28.2	14.2	28.2	14.2	N/A
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR	N/A
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2	N/A
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		HDV4	OADR	HDV4	OADR	OABR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0	19.2
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3	20.0
ADJACENT SATELLITE 1		Hypothetical 168° E.L.				
Satellite 1 Orbital Location	deg	168	168	168	168	168
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
ADJACENT SATELLITE 2		Eutelsat 172B				
Satellite 2 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
CARRIER INFORMATION						
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN	BEACON
Information Rate	kbps	28816	4134	58161	7108	0.1
Modulation		QPSK	QPSK	8APSK	16APSK	BPSK
FEC Rate		0.48	0.69	0.65	0.59	1.00
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0	0.1
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7	10.0
UPLINK EARTH STATION						
Earth Station Diameter	meters	9.2	0.5	9.2	1.2	N/A
Earth Station Gain	dBi	64.1	35.6	64.1	43.2	N/A
Earth Station Latitude	deg	21.3	45.0	21.3	45.0	N/A
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0	N/A
Earth Station Elevation Angle	deg	46.1	16.9	46.1	16.9	N/A
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	0.5	9.2	1.2	9.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6	38.6
Earth Station Latitude	deg	45	21.32	45	21.32	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87	-157.87
Earth Station Elevation Angle	deg	16.9	46.1	16.9	46.1	46.1
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3	N/A
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5	N/A
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3	N/A
Satellite G/T	dB/K	13.2	12.2	13.2	12.2	N/A
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	N/A
Uplink C/N	dB	15.9	8.9	15.9	16.5	N/A
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7	20.0
Downlink Free Space Loss	dB	206.6	209.5	206.6	209.5	209.6
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	20.0
Downlink C/N	dB	5.7	24.6	13.3	24.6	56.7
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	15.9	8.9	15.9	16.5	N/A
C/N Downlink	dB	5.7	24.6	13.3	24.6	56.7
C/I Uplink	dB	25.7	12.4	25.7	12.4	N/A
C/I Downlink	dB	12.0	20.3	12.0	20.3	N/A
C/I Uplink Adjacent Satellite 1	dB	43.9	13.8	43.9	21.4	N/A
C/I Downlink Adjacent Satellite 1	dB	12.3	42.4	19.9	42.4	41.7
C/I Uplink Adjacent Satellite 2	dB	43.9	13.9	43.9	21.5	N/A
C/I Downlink Adjacent Satellite 2	dB	12.4	42.4	20.0	42.4	41.8
C/(N+I) Composite	dB	3.2	5.5	8.0	9.7	38.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7	10.0
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0	28.7

EXHIBIT 3: ADJACENT SATELLITE (174° E. L.) LINK BUDGETS

Hypothetical 174 East Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1		Eutelsat 172B			
Satellite 1 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2		Hypothetical 176° E.L.			
Satellite 2 Orbital Location	deg	176	176	176	176
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dBi	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	49.6	19.4	49.6	19.4
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	19.4	49.6	19.4	49.6
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.8	207.5	212.8	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.4	206.5	209.4
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 1	dB	6.8	26.0	14.4	26.0
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	26.0	14.4	26.0
C/(N+I) Composite	dB	1.1	0.3	6.7	6.5
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

Hypothetical 170 East Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAM INFORMATION						
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2	N/A
Uplink Frequency	GHz	28.2	14.2	28.2	14.2	N/A
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR	N/A
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2	N/A
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		HDV4	OADR	HDV4	OADR	OABR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0	19.2
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3	20.0
ADJACENT SATELLITE 1		Eutelsat 172B				
Satellite 1 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
ADJACENT SATELLITE 2		Hypothetical 176° E.L.				
Satellite 2 Orbital Location	deg	176	176	176	176	176
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6	N/A
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1	0.0
CARRIER INFORMATION						
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN	BEACON
Information Rate	kbps	28816	4134	58161	7108	0.1
Modulation		QPSK	QPSK	8APSK	16APSK	BPSK
FEC Rate		0.48	0.69	0.65	0.59	1.00
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0	0.1
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7	10.0
UPLINK EARTH STATION						
Earth Station Diameter	meters	9.2	0.5	9.2	1.2	N/A
Earth Station Gain	dBi	64.1	35.6	64.1	43.2	N/A
Earth Station Latitude	deg	21.3	45.0	21.3	45.0	N/A
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0	N/A
Earth Station Elevation Angle	deg	49.6	19.4	49.6	19.4	N/A
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	0.5	9.2	1.2	9.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6	38.6
Earth Station Latitude	deg	45	21.32	45	21.32	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87	-157.87
Earth Station Elevation Angle	deg	19.4	49.6	19.4	49.6	49.6
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3	N/A
Uplink Free Space Loss	dB	212.8	207.5	212.8	207.5	N/A
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3	N/A
Satellite G/T	dB/K	13.2	12.2	13.2	12.2	N/A
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	N/A
Uplink C/N	dB	16.0	9.0	16.0	16.6	N/A
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7	20.0
Downlink Free Space Loss	dB	206.5	209.4	206.5	209.4	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8	20.0
Downlink C/N	dB	5.8	24.7	13.4	24.7	56.7
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	16.0	9.0	16.0	16.6	N/A
C/N Downlink	dB	5.8	24.7	13.4	24.7	56.7
C/I Uplink	dB	25.7	12.4	25.7	12.4	N/A
C/I Downlink	dB	12.0	20.3	12.0	20.3	N/A
C/I Uplink Adjacent Satellite 1	dB	44.0	13.9	44.0	21.5	N/A
C/I Downlink Adjacent Satellite 1	dB	12.4	42.5	20.0	42.5	41.8
C/I Uplink Adjacent Satellite 2	dB	44.0	14.0	44.0	21.6	N/A
C/I Downlink Adjacent Satellite 2	dB	12.4	42.5	20.0	42.5	41.8
C/(N+I) Composite	dB	3.3	5.6	8.0	9.7	38.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7	10.0
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0	28.7