Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to launch and operate a new satellite designated as Intelsat 37e. This spacecraft will operate from 18.0° W.L. and will replace the Intelsat 901 spacecraft currently operating at that location.

The characteristics of the Intelsat 37e spacecraft, as well as its compliance with the various provisions of Part 25 of the Federal Communication Commission's ("FCC" or "Commission") rules, are provided in the remainder of this Engineering Statement.

2 Spacecraft Overview

Intelsat 37e is a Boeing model 702MP spacecraft that is capable of operating in C-band, Ku-band, and Ka-band frequencies listed in the table below.

C-band:	Uplink:	5850 – 6650 MHz
	Downlink:	3400 – 4200 MHz
Ku-band:	Uplink:	13000 – 13250 MHz
		13750 – 14500 MHz
	Downlink:	10700 – 11700 MHz
		11700 – 11950 MHz
		12500 – 12750 MHz
Ka-band:	Uplink:	28350 – 28850 MHz
		29250 – 30000 MHz
	Downlink:	18300 – 18800 MHz
		19700 – 20200 MHz

The spacecraft provides the following coverage:

C-band:	Wide Beams:	Africa/Europe, Central Africa, and Latin America
	4 Spot Beams:	Europe, North America, South America, Falkland Islands
	Global Beam:	Global Coverage

Ku-band:	55 Spot beams:	Africa, Europe, Middle East, South America, North America, and Asia
	Wide Beam:	Europe, Middle East, and Asia
	Shaped Beam:	Algeria
	Steerable Spot Beam	
Ka-band:	Steerable Spot Beam	

2.1 Spacecraft Characteristics

Intelsat 37e is a three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 37e utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 37e spacecraft is composed of the following subsystems:

1) Thermal
2) Power
3) Attitude Control
4) Propulsion
5) Telemetry, Command and Ranging ("TC&R")
6) Uplink Power Control ("ULPC")
7) Communications

These subsystems maintain the correct position and attitude of the spacecraft, ensure that all internal units are maintained within the required temperature range, and ensure that the spacecraft can be commanded and controlled with a high level of reliability from launch to the end of its useful life. The spacecraft design incorporates redundancy in each of the various subsystems in order to avoid single point failures.

The structural design of Intelsat 37e provides mechanical support for all subsystems. The structure supports the communication antennas, solar arrays, and thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

A summary of the basic spacecraft characteristics is provided in Exhibit 1.

2.2 Communication Subsystem

Intelsat 37e provides active communication channels at C-band, Ku-band, and Ka-band frequencies. Since channel bandwidth in each frequency band can be varied via on-board processing, only the range of frequencies over which each beam can operate and the polarization plan is specified in Schedule S.

Intelsat 37e utilizes a multiple spot-beam architecture in Ku-band in which each spot beam has an identical design, and each Ku-band gateway beam also has an identical design. Therefore, the coverage contours and performance characteristics for only a single representative spot beam and a single representative gateway beam are provided in Schedule S. The latitude and longitude of each Ku-band spot beam's maximum gain point on the Earth and of each Ku-band gateway beam's maximum gain point on the Earth are provided in Exhibits 2 and 3 respectively in conformance with Section 25.114(c)(4)(vii)(B) of the Commission's rules.

The performance characteristics of all Intelsat 37e beams are provided in Schedule S. The coverage contours of all Intelsat 37e beams except for those with their -8.0 dB contour extending beyond the edge of the Earth are provided with Schedule S. Exhibits 4 and 5 provide the beam parameters for the Intelsat 37e uplink and downlink beams, respectively.

Additionally, Intelsat has included the Schedule S beam designation for all beams in Exhibit 7.

Intelsat 37e is equipped with two steerable spot beams, one in Ku-band and one in Ka-band. Gain contours for both beams are provided in Schedule S. Each steerable beam may be pointed toward any location on the earth that is visible from 18.0° W.L., and the coverage contours will remain identical in gain and roll-off regardless of pointing. Intelsat will ensure that transmissions in these beams are consistent with the Commission's rules and the ITU Radio Regulations as they pertain to the Fixed Satellite Service.

The level of cross-polarization isolation of all Intelsat 37e beams is equal to or greater than 22 dB. This level was the best that the satellite manufacturer could achieve without causing excessive degradation in the performance of the beam and/or in the size of the beams' coverage area. Intelsat has taken this level of isolation into account in its planned operations.

Due to the extensive number of C-, Ku-, and Ka-band channel and beam combinations, the uplink channels and downlink channels have been listed separately in the Schedule S S10 "Space Station Transponders" table.[1] Customer requirements will dictate the final interconnections. Some typical configurations will use uplink and downlink channels within one beam using the same band; others will have uplink and downlink channels in separate beams on any band to provide communications links between or within regions.

The Ka-, Ku- and C-band communication subsystems are all inter-connected, allowing any frequency combination for the uplink and downlink connectivity at sub-beam

[1] Two Ka-band channels are not switchable and their connections are shown in the Transponder Table.

level. Additionally, a beam can have multiple connections to several other beams by splitting the beam into sub-beams with variable sizes.

2.3 Telemetry, Command and Ranging Subsystem

The telemetry, command and ranging ("TC&R") subsystem provides the following functions:

1) Acquisition, processing and transmission of spacecraft telemetry data;

2) Reception and retransmission of ground station generated ranging signals; and

3) Reception, processing and distribution of telecommands.

Intelsat 37e can be commanded through the use of two command channels that can have center frequencies in the ranges 5850.5 - 5853.0 MHz and 6422.0 - 6424.5 MHz, selectable via ground command in 100 kHz steps, The coverage patterns of the on-station command and telemetry beams as well as the wide-angle beams used for orbital maneuvers and on-station emergencies have 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 FCC's rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Intelsat 37e command and telemetry subsystem performance is summarized in Exhibit 6.

2.4 Uplink Power Control Subsystem

Intelsat 37e utilizes one C-band, three Ku-band, and one Ka-band carriers for uplink power control ("ULPC"), antenna tracking, and ranging. The coverage patterns of the C-band, Ku-band, and Ka-band beams have 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 FCC's rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Intelsat 37e ULPC subsystem performance is summarized in Exhibit 6.

2.5 Satellite Station-Keeping

The spacecraft will be maintained within 0.05° of its nominal longitudinal position in the east-west direction. Accordingly, it is in compliance with Section 25.210(j) of the Commission's rules.

The attitude of the spacecraft will be maintained with accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (i.e., attitude perturbations, thermal distortions, misalignments, orbital tolerances and thruster perturbations, etc.).

3 Services and Emission Designators

Intelsat 37e will be a general purpose communications satellite and has been designed to support various services offered within the Intelsat's satellite system. Depending upon the needs of the users, the transponders on Intelsat 37e can accommodate television, radio, voice, and data communications. Typical communication services include:

a) Compressed digital video

b) High speed digital data

c) Digital single channel per carrier ("SCPC") data channels

Emission designators and allocated bandwidths for representative communication carriers are provided in Schedule S.

4 Power Flux Density ("PFD")

The power flux density ("PFD") limits for space station transmissions in certain bands are contained in Section 25.208 of the Commission's rules. The limits in certain other bands not covered by Section 25.208 are specified in No. 21.16 of the ITU Radio Regulations. The applicable rules for the Intelsat 37e transmit bands are indicated in the following table:

Applicable Power Flux Density Rules

From (MHz)	To (MHz)	FCC 25.208	ITU RR 21.16
3400	3650		X
3650	4200	X	
10700	10950		X
10950	11200	X	
11200	11450		X
11450	11700	X	
11700	11950	No applicable rule	
12200	12750		X
18300	19700	X	
19700	20200	No applicable rule	

Neither the Commission's rules nor the ITU Radio Regulations specify any PFD limits for the 11700 – 11950 MHz or the 19700-20200 MHz bands applicable to geostationary satellites operating in the Fixed Satellite Service.

The maximum PFD levels for the Intelsat 37e transmissions were calculated for the bands indicated in the table. The PFD levels were also calculated for the Intelsat 37e telemetry and ULPC carriers. The results are provided in Schedule S and show that the downlink power flux density levels of the Intelsat 37e carriers do not exceed the limits specified in Section 25.208 of the Commission's rules or the limits specified in No. 21.16 of the ITU Radio Regulations.

5 Emission Compliance

Section 25.202(e) of the FCC's rules requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Intelsat 37e is designed to be compliant with the provisions of this rule.

Intelsat will comply with the provisions of Section 25.202(f) of the Commission's rules with regard to Intelsat 37e emissions.

6 Orbital Location

Intelsat requests that it be assigned the 18.0° W.L. orbital location for Intelsat 37e. The 18.0° W.L. location satisfies Intelsat 37e requirements for optimizing coverage, elevation angles, and service availability. Additionally, the location also ensures that the maximum operational, economic, and public interest benefits will be derived.

7 Coordination Statement and Certifications

The downlink EIRP density of Intelsat 37e transmissions in the conventional or extended C-bands will not exceed 3 dBW/4kHz for digital transmissions or 8 dBW/4kHz for analog transmissions, and associated uplink transmissions will not exceed applicable EIRP density envelopes in Sections 25.218 or 25.221(a)(1) 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 Intelsat 37e at 18.0° W.L.

The downlink EIRP density of Intelsat 37e transmissions in the conventional or extended Ku-bands will not exceed 14 dBW/4kHz for digital transmissions or 17 dBW/4kHz for analog transmissions, and associated uplink transmissions will not exceed applicable EIRP density envelopes in Sections 25.218, 25.222(a)(1), 25.226(a)(1), or 25.227(a)(1) 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 Intelsat 37e at 18.0° W.L.

Intelsat 37e downlink transmissions in the conventional Ka-band will not generate power flux-density at the Earth's surface in excess of -118 dBW/m^2/MHz 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 Intelsat 37e at 18.0° W.L.

Intelsat 37e operations in the 13000 – 13250 MHz, 10700 – 10950 MHz, and 11200 – 114500 MHz bands will take into account the applicable requirements of Appendix 30B of the ITU's Radio Regulations. There are no United States Appendix 30B ITU filings within 6° of 18.0° W.L., and therefore there are no compatibility issues with Intelsat 37e operations under Appendix 30B with respect to United States ITU Appendix 30B filings.

Intelsat 37e will also operate in three bands addressed by Section 25.140(a)(3)(v): the 3400 - 3600 MHz, 12500 - 12750 MHz, and 28600 - 28850 MHz bands. The operations of Intelsat 37e in the bands 3400 - 3600 MHz and 12500 - 12750 MHz have been coordinated with the operators of the previously authorized co-frequency space stations at locations two degrees away. Since the operations of Intelsat 37e in the 28600 - 28850 MHz band have not been coordinated, the impact of those operations on hypothetical satellites having the same operating characteristics as Intelsat 37e located at 16.0° W.L. and 20.0º W.L. was analyzed. The satellite at 20.0° W.L. was assumed to have two adjacent satellites separated by 2°: Intelsat 37e at 18.0° W.L. and a hypothetical satellite having the same operating characteristics as Intelsat 37e located at 22.0º W.L. The satellite at 16.0° W.L. was assumed to have two adjacent satellites separated by 2°:

Intelsat 37e at 18.0° W.L. and a hypothetical satellite having the same operating characteristics as Intelsat 37e located at 14.0º W.L.[2]

It was also assumed for the analysis that in the plane of the geostationary satellite orbit, all 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. All other assumptions and the results of the analysis are documented in Exhibit 8.

8 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.

8.1 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.

8.2 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 all propellant tanks, venting all pressurized systems and by leaving the batteries in a permanent discharge state.

[2] Other satellites in the vicinity of 18.0° W.L. were not included in the interference analysis because they are not licensed by the United States nor do they have U.S. market access. Intelsat is coordinating the use of the overlapping frequencies pursuant to ITU rules.

8.3 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. With the exception of Intelsat 901 during the transition of traffic, Intelsat 37e 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.

During the transition of traffic from Intelsat 901, Intelsat will take all the necessary steps, to minimize the risk of collision between Intelsat 901 and Intelsat 37e. With the exception of Intelsat 901, 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 Intelsat 37e. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 37e that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

8.4 Post-Mission Disposal

At the end of the mission, Intelsat intends to dispose of the spacecraft by moving it to an altitude of at least 286.6 kilometers above the geostationary arc. Intelsat has reserved 7.0 kilograms of fuel for this purpose.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.[3] The effective area to mass ratio (Cr*A/M) of the Intelsat 37e spacecraft is 0.047 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 286.6 kilometers above the geostationary arc. Accordingly, the Intelsat 37e planned disposal orbit complies with the FCC's rules.

The reserved fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. This figure was calculated 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.

9 ITU Filings

On Intelsat 37e, the frequencies 3400-4200 MHz, 5850-6650 MHz, 13.75-14.5 GHz, 10.95-11.2 GHz, 11.45-11.95 GHz, and 12.5-12.75 GHz will be operated using the United Kingdom filing UKNETSAT-18W in addition to the notified filings of the Administration of the United States.

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[3] *Mitigation of Orbital Debris*, Second Report and Order, IB Docket No. 02-54, FCC 04-130 (rel. June 21, 2004).

The frequencies 28.35-28.85 GHz, 29.25-30 GHz, 18.3-18.8 GHz and 19.7-20.2 GHz also will be operated under United Kingdom filing UKNETSAT-18W.

The frequencies 10.7-10.95 GHz, 11.2-11.45 GHz and 13.0-13.25 GHz will be operated under United Kingdom filings UKFSS-18W and UKFSS-18W-A.

Intelsat requests that the United States state its non-objection to the use of the United Kingdom's filings UKNETSAT-18W, UKFSS-18W, and UKFSS-18W-A for operation of the Intelsat 37e satellite, in accordance with ITU Circular Letter CR/333 (May 2, 2012).

Intelsat is also submitting herewith United States filings:

- USASAT-101E, that includes the 10.7-10.95 GHz, 11.2-11.45 GHz, and 13.0-13.25 GHz bands.
- USASAT-71P, that includes all Intelsat-37e bands except for those included in USASAT-101E.

These two new USASAT filings contain all the frequencies to be used by Intelsat 37e.

10 TC&R Control Earth Stations

Intelsat will conduct TC&R operations through one or more of the following earth stations: Fuchsstadt, Germany; Mountainside, MD; Hartebeesthoek, South Africa; or Fucino, Italy. Additionally, Intelsat is capable of remotely controlling Intelsat 37e from its facilities in McLean, VA or in Long Beach, CA.

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/ Dick Evans	September 15, 2016
Dick Evans Intelsat Senior Principal Regulatory Engineer	Date

EXHIBIT 1

SUMMARY OF SPACECRAFT CHARACTERISTICS

General Spacecraft Characteristics	
Spacecraft Name	Intelsat 37e
Orbital Location	18.0° W.L.
Spacecraft Manufacturer	Boeing
Spacecraft Model	702MP
Spacecraft Type	3-axis stabilized
Spacecraft Expected Lifetime	15 years
Eclipse Capability	100%
Station-keeping	
North-South	±0.05°
East-West	±0.05°
Propulsion Type	Arcjet

EXHIBIT 2

Ku-band SPOT BEAM LOCATIONS

Beam Designation	Longitude (°E)	Latitude (°N)	Beam Designation	Longitude (°E)	Latitude (°N)
Ku-Band User Beams			**Ku-Band User Beams**		
Ku Spot 1	-1.04	56.57	Ku29	42.51	-1.64
Ku Spot 2	22.24	58.95	Ku30	15.99	-10.04
Ku Spot 3	-12.03	41.51	Ku31	29.8	-10.18
Ku Spot 4	0.8	42.13	Ku32	15.01	-18.67
Ku Spot 5	15.97	43.31	Ku33	29.22	-19.06
Ku Spot 6	40.47	45.87	Ku34	20.05	-29.69
Ku Spot 7	-7.42	31.03	Ku35	29.05	-28.27
Ku Spot 8	3.86	31.56	Ku36	-82.98	36.88
Ku Spot 9	17.01	32.43	Ku37	-85.64	26.42
Ku Spot 10	35.71	33.98	Ku38	-94.02	15.64
Ku Spot 11	-13.04	21.8	Ku39	-67.15	16.05
Ku Spot 12	-3.24	22.1	Ku40	-68.32	7.18
Ku Spot 13	7.4	22.56	Ku41	-53.79	4.23
Ku Spot 14	19.94	23.24	Ku42	-73.55	-2.52
Ku Spot 15	37.77	24.39	Ku43	-57.64	-3.61
Ku Spot 16	-16.35	13.62	Ku44	-46.02	-4.75
Ku Spot 17	-7.41	13.38	Ku45	-36.16	-7.57
Ku Spot 18	2.2	13.66	Ku46	-68	-11.3
Ku Spot 19	12.9	14.05	Ku47	-53.56	-12.76
Ku Spot 20	26.01	14.59	Ku48	-42.98	-15
Ku Spot 21	47.78	15.59	Ku49	-68.32	-21.5
Ku Spot 22	-12.39	5.30	Ku50	-53.33	-23.09
Ku Spot 23	-2.98	5.65	Ku51	-41.77	-24.02
Ku Spot 24	6.75	5.88	Ku52	-71.29	-32.96
Ku Spot 25	17.87	6.15	Ku53	-52.64	-33.15
Ku Spot 26	32.32	6.52	Ku54	-77.26	-45.72
Ku Spot 27	30.1	39.8	Ku55	-84.24	-59.12
Ku Spot 28	24.28	-1.73	Ku56	-26.51	5.68

EXHIBIT 3

GATEWAY BEAM LOCATIONS

Beam Designation	Longitude (°E)	Latitude (°N)
Ku-Band Gateway Beams		
G1	-1.04	56.57
G2	22.24	58.95
G8	3.86	31.56
G9	17.01	32.43
G23	-2.98	5.65
G24	6.75	5.88
G27	30.1	39.8
G28	24.28	-1.73
G30	15.99	-10.04
G35	29.05	-28.27
G36	-82.98	36.88
G40	-68.32	7.18
G51	-41.77	-24.02

EXHIBIT 4

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	Africa-Europe	Africa-Europe	Central Africa	Central Africa
Schedule S Beam ID	CELU	CERU	CALU	CARU
Frequency Band (MHz)	6090-6325	6090-6325	5860-6090	5860-6090
Polarization	LHCP	RHCP	LHCP	RHCP
G/T (dB/K)	-0.9	-1.0	2.9	2.9
Minimum SFD-- (dBW/m^2)	-108.0	-106.0	-106.1	-106.1
Maximum SFD-- (dBW/m^2)	-80.0	-78.0	-78.1	-78.1

Beam Name	Latin America	Latin America	Europe	Europe
Schedule S Beam ID	CMLU	CMRU	C1LU	C1RU
Frequency Band (MHz)	5860-6090	5860-6090	5860-6090	5860-6090
Polarization	LHCP	RHCP	LHCP	RHCP
G/T (dB/K)	0.7	0.7	12.9	12.9
Minimum SFD-- (dBW/m^2)	-104.3	-104.3	-110	-110
Maximum SFD-- (dBW/m^2)	-76.3	-76.3	-82	-82

Beam Name	North America	North America	South America	South America
Schedule S Beam ID	C2LU	C2RU	C3LU	C3RU
Frequency Band (MHz)	6090-6330	6090-6330	6090-6330	6090-6330
Polarization	LHCP	RHCP	LHCP	RHCP
G/T (dB/K)	13.1	13.1	11.6	11.6
Minimum SFD-- (dBW/m^2)	-110	-110	-110.1	-110.1
Maximum SFD-- (dBW/m^2)	-82	-82	-82.1	-82.1

Beam Name	Falkland Islands	C-band Global	C-band Global	Ku User K56
Schedule S Beam ID	C4RU	CGLU	CGRU	K56U
Frequency Band (MHz)	6090-6330	6330-6450	6330-6450	14125-14250
Polarization	RHCP	LHCP	RHCP	Horizontal
G/T (dB/K)	12.3	-5.9	-5.9	10.2
Minimum SFD-- (dBW/m^2)	-109.3	-106.8	-106.8	-113.9
Maximum SFD-- (dBW/m^2)	-81.3	-78.8	-78.8	-85.9

Beam Name	Ku User	Ku User	Algeria	Gateway
Schedule S Beam ID	KUHU	KUVU	KZVU	KGHU
Frequency Band (MHz)	14000-14500	14000-14500	14000-14175	13000-13250 13750-14000
Polarization	Horizontal	Vertical	Vertical	Horizontal
G/T (dB/K)	14.4	14.4	11.7	13.7
Minimum SFD-- (dBW/m^2)	-114.0	-114.0	-116.3	-113.8
Maximum SFD-- (dBW/m^2)	-86	-86	-88.3	-85.8

Beam Name	Gateway	Ku Steerable	Ku Steerable	Ka Steerable
Schedule S Beam ID	KGVU	KSHU	KSVU	ASLU
Frequency Band (MHz)	13000-13250 13750-14000	14000-14500	14000-14500	28350-28850 29500-3000
Polarization	Vertical	Horizontal	Vertical	LHCP
G/T (dB/K)	13.7	12	12	11.3
Minimum SFD-- (dBW/m^2)	-113.8	-113.2	-113.2	-96.8
Maximum SFD-- (dBW/m^2)	-85.8	-85.2	-85.2	-75.8

Beam Name	Ka Steerable
Schedule S Beam ID	ASRU
Frequency Band (MHz)	28350-28850 29500-3000
Polarization	RHCP
G/T (dB/K)	11.3
Minimum SFD-- (dBW/m^2)	-96.8
Maximum SFD-- (dBW/m^2)	-75.8

EXHIBIT 5

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	Africa-Europe	Africa-Europe	Central Africa	Central Africa
Schedule S Beam ID	CELD	CERD	CALD	CARD
Frequency Band (MHz)	3864-4102	3864-4102	3625-3864	3625-3864
Polarization	LHCP	RHCP	LHCP	RHCP
Maximum Beam Peak EIRP (dBW)	43.3	43.3	47.9	47.9
Maximum Beam Peak EIRP Density (dBW/4kHz)	-3.1	-3.1	1.6	1.6

Beam Name	Latin America	Latin America	Europe	Europe
Schedule S Beam ID	CMLD	CMRD	C1LD	C1RD
Frequency Band (MHz)	3625-3864	3704-3864	3400-3864	3400-3864
Polarization	LHCP	RHCP	LHCP	RHCP
Maximum Beam Peak EIRP (dBW)	46.5	46.5	52.1	52.1
Maximum Beam Peak EIRP Density (dBW/4kHz)	0.2	0.2	2.9	2.9

Beam Name	North America	South America	South America	South America
Schedule S Beam ID	C2LD	C2RD	C3LD	C3RD
Frequency Band (MHz)	3870-4100	3870-4100	3870-4100	3870-4100
Polarization	LHCP	RHCP	LHCP	RHCP
Maximum Beam Peak EIRP (dBW)	52.1	52.1	51.8	51.8
Maximum Beam Peak EIRP Density (dBW/4kHz)	5.8	5.8	5.5	5.5

Beam Name	Falkland Islands	C-band Global	C-band Global	Ku User K56
Schedule S Beam ID	C4RD	CGLD	CGRD	K56D
Frequency Band (MHz)	3870-4100	4102-4194	4102-4194	10950-11075
Polarization	RHCP	LHCP	RHCP	Horizontal
Maximum Beam Peak EIRP (dBW)	51.4	38	38	50.3
Maximum Beam Peak EIRP Density (dBW/4kHz)	5.1	-3.9	-3.9	6.9

Beam Name	Ku User	Ku User	Algeria	Gateway
Schedule S Beam ID	KDHD	KDVD	KZHD	KGHD
Frequency Band (MHz)	10950-11200, 11450-11950, 12500-12750	10950-11200, 11450-11950, 12500-12750	10950-11125	10700-10950, 11200-11450
Polarization	Horizontal	Vertical	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	51.0	51.0	51.5	50.8
Maximum Beam Peak EIRP Density (dBW/4kHz)	10.6	10.6	6.3	7.4

Beam Name	Gateway	Ku Steerable	Ku Steerable	Ka Steerable
Schedule S Beam ID	KGVD	KSVD	ASLD	ASRD
Frequency Band (MHz)	10700-10950, 11200-11450	10950-11075, 11450-11700	18300-18800, 19700-20200	18300-18800, 19700-20200
Polarization	Vertical	Vertical	LHCP	RHCP
Maximum Beam Peak EIRP (dBW)	50.8	56.0	58.0	58.0
Maximum Beam Peak EIRP Density (dBW/4kHz)	7.4	7.8	10.6	10.6

EXHIBIT 6

TC&R and ULPC SUBSYSTEM CHARACTERISTICS

Beam Name	Command – Global	Command – Pipe	Command-Hemi
Schedule S Beam ID	CGVU	CPLU	CHLU
Frequencies (MHz)	6423.25	6423.25	5851.75
Bandwidth (MHz)	3.7	3.7	3.7
Polarization	Vertical	LHCP	LHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-75.0	-60	-60.0

Beam Name	Telemetry – Global	Telemetry – Pipe	Telemetry – Hemi
Schedule S Beam ID	TGHD	TPRD	THRD
Frequencies (MHz)	4197.75, 4199.25, 4198.25, 4198.75	4197.75, 4199.25, 4198.25, 4198.75	4197.75, 4199.25, 4198.25, 4198.75
Polarization	Horizontal	RHCP	RHCP
Maximum Channel EIRP (dBW)	7.9	6.4	7.9
Maximum Beam Peak EIRP Density (dBW/4kHz)	-12.1	-13.6	-21.6

Beam Name	ULPC	ULPC	ULPC
Schedule S Beam ID	CLVD	KLRD	ALVD
Frequencies (MHz)	4199.75	11199.0, 11451.5, &12501.0	20199.5
Polarization	Vertical	RHCP	Vertical
Maximum Channel EIRP (dBW)	11.0	13.0	21.0
Maximum Beam Peak EIRP Density (dBW/4kHz)	3.0	5.0	13.0

Note: *RHCP: Right Hand Circular Polarization, LHCP: Left Hand Circular Polarization*

EXHIBIT 7

Beam Polarizations and GXT File Names

	Schedule S Beam GXT File Names							
	Linear Polarization				Circular Polarization			
Beam Designation	**Uplink (H-Pol.)**	**Uplink (V-Pol.)**	**Downlink (H-Pol.)**	**Downlink (V-Pol.)**	**Uplink (LHCP)**	**Uplink (RHCP)**	**Downlink (LHCP)**	**Downlink (RHCP)**
C-Band Beams								
Africa & Europe	----	----	----	----	CELU	CERU	CELD	CERD
Central Africa	----	----	----	----	CALU	CARU	CALD	CARD
Latin America	----	----	----	----	CMLU	CMRU	CMLD	CMRD
Europe	----	----	----	----	C1LU	C1RU	C1LD	C1RD
North America	----	----	----	----	C2LU	C2RU	C2LD	C2RD
South America	----	----	----	----	C3LU	C3RU	C3LD	C3RD
Falkland Islands	----	----	----	----	----	C4RU	C4LD	----
Global	----	----	----	----	CGLU*	CGRU*	CGLD*	CGRD*
ULPC Global	----	----	----	CLVD*	----	----	----	----
Telemetry Global	----	----	TGHD*	----	----	----	----	----
Command Global	----	CGVU*	----	----	----	----	----	----
Telemetry Pipe	----	----	----	----	----	----	----	TPRD*
Telemetry Hemi	----	----	----	----	----	----	----	THRD*
Command Pipe	----	----	----	----	CPLU*	----	----	----
Command Hemi	----	----	----	----	CHLU*	----	----	----
Ku-Band Beams								
User Beams	KUHU	KUVU	KUHD	KUVD	----	----	----	----
Elliptical User	K56U	----	----	K56D	----	----	----	----
Algeria	----	KZVU	KZHD	----	----	----	----	----
Gateway	KGHU	KGVU	KGHD	KGVD	----	----	----	----
Steerable	KSHU	KSVU	KSHD	KSVD	----	----		----
ULPC Global	----	----	----	----	----	----	----	KLRD*
Ka-Band Beam								
Steerable Spot	----	----	----	----	ASLU	ASRU	ASLD	ASRD
ULPC Global	----	ALVD*	----	----	----	----	----	----

** GXT files are not provided for the indicated beams because their -8 dB gain contours extend beyond the edge of the Earth.*

EXHIBIT 8

HYPOTHETICAL 20.0°W.L. SATELLITE INTERFERENCE ANALYSIS

Uplink Beam Name	**ASLU & ASRU**	**ASLU & ASRU**	**ASLU & ASRU**	**ASLU & ASRU**
Uplink Frequency (MHz)	**28600 - 28850**	**28600 - 28850**	**28600 - 28850**	**28600 - 28850**
Uplink Beam Polarization	**LHCP & RHCP**	**LHCP & RHCP**	**LHCP & RHCP**	**LHCP & RHCP**
Uplink Beam Peak G/T (dB/K)	**11.3**	**11.3**	**11.3**	**11.3**
Uplink Beam Peak SFD (dBW/m2)	**-75.8**	**-75.8**	**-75.8**	**-75.8**
Uplink Relative Contour Level (dB)	**-6.3**	**-6.3**	**-6.3**	**-6.3**
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	**ASRD & ASLD**	**ASRD & ASLD**	**ASRD & ASLD**	**ASRD & ASLD**
Downlink Frequency (MHz)	**18300 - 18800**	**18300 - 18800**	**18300 - 18800**	**18300 - 18800**
Downlink Beam Polarization	**RHCP & LHCP**	**RHCP & LHCP**	**RHCP & LHCP**	**RHCP & LHCP**
Downlink Beam Peak EIRP (dBW)	**58.0**	**58.0**	**58.0**	**58.0**
Downlink Relative Contour Level (dB)	**-6.0**	**-6.0**	**-6.0**	**-6.0**
ADJACENT SATELLITE 1				
Satellite Name	**Intelsat 37e**			
Orbital Location	**18° W.L.**	**18° W.L.**	**18° W.L.**	**18° W.L.**
Uplink Power Density (dBW/Hz)	**-45.0**	**-45.0**	**-45.0**	**-45.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-20.0**	**-20.0**	**-20.0**	**-20.0**
ADJACENT SATELLITE 2				
Satellite Name	**Hypothetical 22° W.L.**			
Orbital Location	**22° W.L.**	**22° W.L.**	**22° W.L.**	**22° W.L.**
Uplink Power Density (dBW/Hz)	**-45**	**-45**	**-45.0**	**-45.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-20.0**	**-20.0**	**-20.0**	**-20.0**
CARRIER INFORMATION				
Carrier ID	**36M0G7W**	**10M3G7W**	**1M45G7W**	**400KG7W**
Carrier Modulation	**QPSK**	**QPSK**	**BPSK**	**BPSK**
Information Rate(kbps)	**21600**	**6000**	**512**	**128**
Code Rate	**1/2x188/204**	**1/2x188/204**	**R1/2**	**R1/2**
Occupied Bandwidth(kHz)	**24376**	**6771**	**1229**	**307**
Allocated Bandwidth(kHz)	**36000**	**10300**	**1450**	**400**
Minimum C/N, Rain (dB)	**7.3**	**4.3**	**3.4**	**3.4**
UPLINK EARTH STATION				
Earth Station Diameter (meters)	**3.5**	**3.5**	**3.0**	**2.8**
Earth Station Gain (dBi)	**58.9**	**58.9**	**57.5**	**56.9**
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	**2.7**	**2.7**	**2.8**	**3.0**
Earth Station Gain (dBi)	**53.2**	**53.2**	**53.4**	**54.1**
Earth Station G/T (dB/K)	**30.8**	**30.8**	**31.0**	**31.7**
COMPOSITE LINK PERFORMANCE				
C/N Thermal Uplink (dB)	**22.2**	**22.2**	**21.1**	**20.5**
Uplink Interference C/I (dB)	**13.7**	**9.7**	**6.5**	**4.9**
Uplink Adjacent Satellite C/I (dB)	**16.0**	**16.0**	**16.0**	**16.0**
Intermodulation C/IM (dB)	**25.5**	**25.4**	**24.3**	**23.8**
Downlink Thermal C/N (dB)	**22.4**	**18.3**	**15.1**	**13.6**
Downlink Interference C/I (dB)	**25.5**	**25.4**	**24.3**	**23.8**
Downlink Adjacent Satellite C/I (dB)	**22.4**	**18.3**	**15.1**	**13.6**
Subtotal C/N (dB)	**10.6**	**7.6**	**4.9**	**3.4**
Antenna Mispointing and Other Losses (dB)	**1.5**	**1.5**	**1.5**	**1.5**
Total C/N (dB)	**9.1**	**6.1**	**3.4**	**1.9**
Minimum Required C/N (dB)	**7.3**	**4.3**	**3.4**	**3.4**

HYPOTHETICAL 16.0°W.L. SATELLITE INTERFERENCE ANALYSIS

Uplink Beam Name	**ASLU & ASRU**	**ASLU & ASRU**	**ASLU & ASRU**	**ASLU & ASRU**
Uplink Frequency (MHz)	**28600 - 28850**	**28600 - 28850**	**28600 - 28850**	**28600 - 28850**
Uplink Beam Polarization	**LHCP & RHCP**	**LHCP & RHCP**	**LHCP & RHCP**	**LHCP & RHCP**
Uplink Beam Peak G/T (dB/K)	**11.3**	**11.3**	**11.3**	**11.3**
Uplink Beam Peak SFD (dBW/m2)	**-75.8**	**-75.8**	**-75.8**	**-75.8**
Uplink Relative Contour Level (dB)	**-6.3**	**-6.3**	**-6.3**	**-6.3**
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	**ASRD & ASLD**	**ASRD & ASLD**	**ASRD & ASLD**	**ASRD & ASLD**
Downlink Frequency (MHz)	**18300 - 18800**	**18300 - 18800**	**18300 - 18800**	**18300 - 18800**
Downlink Beam Polarization	**RHCP & LHCP**	**RHCP & LHCP**	**RHCP & LHCP**	**RHCP & LHCP**
Downlink Beam Peak EIRP (dBW)	**58.0**	**58.0**	**58.0**	**58.0**
Downlink Relative Contour Level (dB)	**-6.0**	**-6.0**	**-6.0**	**-6.0**
ADJACENT SATELLITE 1				
Satellite Name	**Intelsat 37e**			
Orbital Location	**18° W.L.**	**18° W.L.**	**18° W.L.**	**18° W.L.**
Uplink Power Density (dBW/Hz)	**-45.0**	**-45.0**	**-45.0**	**-45.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-20.0**	**-20.0**	**-20.0**	**-20.0**
ADJACENT SATELLITE 2				
Satellite Name	**Hypothetical 14° W.L.**			
Orbital Location	**14° W.L.**	**14° W.L.**	**14° W.L.**	**14° W.L.**
Uplink Power Density (dBW/Hz)	**-45**	**-45**	**-45.0**	**-45.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-20.0**	**-20.0**	**-20.0**	**-20.0**
CARRIER INFORMATION				
Carrier ID	**36M0G7W**	**10M3G7W**	**1M45G7W**	**400KG7W**
Carrier Modulation	**QPSK**	**QPSK**	**BPSK**	**BPSK**
Information Rate(kbps)	**21600**	**6000**	**512**	**128**
Code Rate	**1/2x188/204**	**1/2x188/204**	**R1/2**	**R1/2**
Occupied Bandwidth(kHz)	**24376**	**6771**	**1229**	**307**
Allocated Bandwidth(kHz)	**36000**	**10300**	**1450**	**400**
Minimum C/N, Rain (dB)	**7.3**	**4.3**	**3.4**	**3.4**
UPLINK EARTH STATION				
Earth Station Diameter (meters)	**3.5**	**3.5**	**3.0**	**2.8**
Earth Station Gain (dBi)	**58.9**	**58.9**	**57.5**	**56.9**
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	**2.7**	**2.7**	**2.8**	**3.0**
Earth Station Gain (dBi)	**53.2**	**53.2**	**53.4**	**54.1**
Earth Station G/T (dB/K)	**30.8**	**30.8**	**31.0**	**31.7**
COMPOSITE LINK PERFORMANCE				
C/N Thermal Uplink (dB)	**22.2**	**22.2**	**21.1**	**20.5**
Uplink Interference C/I (dB)	**13.7**	**9.7**	**6.5**	**4.9**
Uplink Adjacent Satellite C/I (dB)	**16.0**	**16.0**	**16.0**	**16.0**
Intermodulation C/IM (dB)	**25.5**	**25.4**	**24.3**	**23.8**
Downlink Thermal C/N (dB)	**22.4**	**18.3**	**15.1**	**13.6**
Downlink Interference C/I (dB)	**25.5**	**25.4**	**24.3**	**23.8**
Downlink Adjacent Satellite C/I (dB)	**22.4**	**18.3**	**15.1**	**13.6**
Subtotal C/N (dB)	**10.6**	**7.6**	**4.9**	**3.4**
Antenna Mispointing and Other Losses (dB)	**1.5**	**1.5**	**1.5**	**1.5**
Total C/N (dB)	**9.1**	**6.1**	**3.4**	**1.9**
Minimum Required C/N (dB)	**7.3**	**4.3**	**3.4**	**3.4**