Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate the satellite designated as Intelsat 16 at 76.2° W.L.

The characteristics of the Intelsat 16 spacecraft, as well as its compliance with the various provisions of Part 25 of the Federal Communications Commission's ("FCC or "Commission") rules, are provided in the remainder of this Engineering Statement, which updates the gain contours and the operational frequency ranges and beams. In all other respects, the characteristics of Intelsat 16 are the same as those described in SAT-MOD-20150105-00003.

2 Spacecraft Overview

Intelsat 16 is an Orbital Star-2 spacecraft that is capable of operating in Ku-band frequencies listed below.

Direction	Frequency[1]
Uplink	13750 – 14500 MHz
	12750 – 13250 MHz
Downlink	10700 – 11450 MHz
	11700 – 12200 MHz

The spacecraft provides the following coverage from the 76.2° W.L orbital position:

Beam	Coverage
Mexico	Mexico, Central America, the Caribbean, Puerto Rico, U.S.
Mexico 2	Mexico, Central America
Global	Global

[1] Although Intelsat 16 includes the bands 10700 – 11450 MHz, 12750 – 13250 MHz, and 13750 – 14000 MHz, Intelsat is not seeking authority to operate in these bands in this request except for the 13997.5 MHz frequency used for uplink TT&C.

2.1 Spacecraft Characteristics

Intelsat 16 is a three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 16 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 16 spacecraft is composed of the following subsystems:

- Thermal
- Power
- Attitude Control
- Propulsion
- Telemetry, Command and Ranging
- Uplink Power Control
- 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 all of the various subsystems in order to avoid single-point failures.

The structural design of Intelsat 16 provides mechanical support for all subsystems. The structure supports the communication antennas, solar arrays, and the thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

2.2 Communication Subsystem

Intelsat 16 provides active communication channels at Ku-band frequencies. The Ku-band payload employs channels having a bandwidth of 36 MHz. The Intelsat 16 frequencies, polarization, and channel plan are provided in the Schedule S.

The coverage contours and performance characteristics of all Intelsat 16 beams are provided in the Schedule S. Exhibits 1 and 2 provide the beam parameters for the Intelsat 16 uplink and downlink beams, respectively.

All of the bandwidth in each communication beam can be connected in loopback, wherein uplink channels in each uplink beam are connected to downlink channels in the downlink beam serving the same geographic area.

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.

The Intelsat 16 command and telemetry channel frequencies are shown in Exhibit 3. The coverage patterns of the command and telemetry 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 16 command and telemetry subsystem performance is summarized in Exhibit 3.

2.4 Uplink Power Control Subsystem

Intelsat 16 utilizes two Ku-band channels for uplink power control ("ULPC"), antenna tracking, and ranging. The coverage patterns of the 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 FCC's rules, contours for this beam are not required to be provided and the associated GXT file has not been included in Schedule S. The Intelsat 16 ULPC frequencies and subsystem performance are summarized in Exhibit 3.

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 will be 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

Intelsat 16 is a general purpose communications satellite and has been designed to support various services offered within the Intelsat satellite system. Depending upon the needs of the users, the transponders on Intelsat 16 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

Neither the Commission's rules nor the International Telecommunication Union ("ITU") Radio Regulations specify any power flux density ("PFD") limits for the 11700 – 12200 MHz band applicable to geostationary satellites operating in the fixed satellite service.

Since the Intelsat 16 telemetry and ULPC carriers are in the 11700 – 12200 MHz band where no PFD limits specified, PFD levels for this band were not calculated.

5 Emission Compliance

Section 25.202(e) of the Commission's rules requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Intelsat 16 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 16 emissions.

6 Orbital Location

Intelsat requests that it be assigned the 76.2° W.L. orbital location for Intelsat 16. The 76.2° W.L. location satisfies Intelsat 16 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 with Co-frequency Space Stations

Intelsat 16's operations in the 14000 – 14500 MHz and 11700 – 12200 MHz bands have been notified under the Administration of the United Kingdom ITU filing UKSAT-KU-4.

The downlink EIRP density of Intelsat 16 transmissions in the conventional Ku-band 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 16 at 76.2° W.L.

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. Intelsat will ensure the removal of all stored energy on the spacecraft by depleting all propellant tanks, venting all pressurized systems, and turning off all active units.

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. Intelsat 16 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, that will have an overlapping station-keeping volume with Intelsat 16. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 16 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 expects to dispose of the spacecraft by moving it to a planned minimum altitude of 300 kilometers above the geostationary arc. This altitude exceeds the

minimum altitude required by the Inter-Agency Space Debris Coordination Committee Page 6 of 9 ("IADC") formula. Intelsat has reserved 26.9 kilograms of fuel for this purpose.[2]

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 16 spacecraft is 0.03 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 267.9 kilometers above the geostationary arc.[4] Accordingly, the Intelsat 16 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 TC&R Control Earth Stations

Intelsat will conduct TC&R operations through one or more of the following earth stations: Castle Rock, Colorado and Fillmore, California. Additionally, Intelsat is capable of remotely controlling Intelsat 16 from its facilities in McLean, Virginia.

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[2] In 2016, Intelsat inadvertently made an error in the Engineering Statement where it said Intelsat had reserved 6.8 kilograms of fuel for deorbit. The correct reserve, 26.9 kilograms, is reflected in the above text. *Policy Branch Information; Satellite Space Applications Accepted for Filing*, Report No. SAT-01138, File No. SAT-MOD-20160201-00009 (Feb. 26, 2016) (Public Notice).

[3] *Mitigation of Orbital Debris, Second Report and Order*, 19 FCC Rcd 11567 (2004).

[4] In 2016, Intelsat also inadvertently made an error in the Engineering Statement where it said that effective area to mass ratio was .04 m^2/kg. The correct ratio is .03 m^2/kg, which results in a minimum perigee disposal altitude of 267.9 kilometers. *Policy Branch Information; Satellite Space Applications Accepted for Filing*, Report No. SAT-01138, File No. SAT-MOD-20160201-00009 (Feb. 26, 2016) (Public Notice).

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/ Alexander Gerdenitsch	April 24, 2018
Alexander Gerdenitsch Intelsat Manager, Spectrum Policy, Americas	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam	Mexico	Mexico
Schedule S Beam ID	MHUL	MVUL
Frequency Band (MHz)	14000 – 14500	14000 – 14500
Polarization	Horizontal	Vertical
G/T (dB/K)	11.5	11.5
Minimum SFD-- (dBW/m^2)	-108.5	-108.5
Maximum SFD-- (dBW/m2)	-83.5	-83.5

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam	Mexico	Mexico	Mexico
Schedule S Beam ID	MHDL	MVDL	M2DL
Frequency Band (MHz)	11700 – 12200	11700 – 12200	11700 – 12200
Polarization	Horizontal	Vertical	Vertical
EIRP (dBW)	54.2	54.2	57.2
Maximum Beam Peak EIRP Density (dBW/4kHz)	19.1	19.1	22.1
Maximum Beam Peak EIRP Density (dBW/Hz)	-16.9	-16.9	-13.9

EXHIBIT 3

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Omni	Command Wide Coverage	Command Global	Command Global
Schedule S Beam ID	CMDO	CMDW	CMDH	CMDV
Center Frequencies (MHz)	13997.5	14499.5	13997.5	14499.5
Command Carrier Bandwidth (MHz)	0.96	0.96	0.96	0.96
Polarization	LHCP	LHCP	Horizontal	Vertical
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-90.8	-94.9	-112.0	-112.0

Beam Name	Command Wide Coverage	Command Omni
Schedule S Beam ID	CMDP	CMDU
Center Frequencies (MHz)	13997.5	14499.5
Command Carrier Bandwidth (MHz)	0.96	0.96
Polarization	LHCP	LHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-112.0	-112.0

Beam Name	Telemetry Omni	Telemetry Wide Coverage	Telemetry Global	ULPC	ULPC
Schedule S Beam ID	TLMO	TLMW	TLMH	UPCH	UPCV
Frequencies (MHz)	12198.25 & 12198.75	12198.25 & 12198.75	12198.25 & 12198.75	12119.75	11701.25
Polarization	RHCP	RHCP	Horizontal	Horizontal	Vertical
Maximum Channel EIRP (dBW)	6.4	13.4	13.1	15.6	15.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	-11.6	-4.6	-4.9	10.6	10.6
Maximum Beam Peak EIRP Density (dBW/Hz)	-47.6	-40.6	-40.9	-25.4	-25.4

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