Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority to operate the Intelsat 10 satellite (S2382), at the 177.8° E.L. orbital location. The characteristics of the satellite, as well as its compliance with the various provisions of Part 25 of the Federal Communications Commission's ("FCC" or "Commission") rules[1] are provided in this Engineering Statement and the accompanying Schedule S. In all other respects, the characteristics of Intelsat 10 remain unchanged from those described in SAT-MOD-20191008-00109 and are incorporated by reference.

2 Spacecraft Overview

Intelsat 10 is capable of operating in the following C- and Ku-band frequencies:

Direction	Frequency
Uplink	5925-6425 MHz
	14000-14500 MHz
Downlink	3700-4200 MHz
	11450-11700 MHz
	12250-12500 MHz
	12500-12750 MHz

[1] Unless otherwise stated, all references to rule sections in this document refer to sections in Title 47 of the Code of Federal Regulations.

The spacecraft provides the following coverage at 177.8° E.L.:

Beam Name	Coverage Area	Frequency Band
North Pacific	Northeast Asia, Alaska, and Canada	Steerable Ku-band
Northeast Pacific	Northeast Asia, Western United States, and Canada	Steerable Ku-band
Central Pacific	Central Pacific (including Hawaii)	Steerable Ku-band
West Pacific	Oceania and Northeast Asia	Steerable Ku-band
Northwest Pacific	Northeast Asia	Steerable Ku-band
Global	Global	Steerable C-band

2.1 Spacecraft Characteristics

Intelsat 10 is a Boeing BS-601HP three-axis stabilized spacecraft with a rectangular outer-body structure. Intelsat 10 utilizes two deployable solar array wings and four mechanically adjustable reflectors (East, West, North, and South).

The Intelsat 10 spacecraft is composed of the following subsystems:

- Thermal;
- Power;
- Attitude Control;
- Propulsion;
- Telemetry, Tracking, and Command ("TT&C");
- Uplink Power Control ("ULPC"); and
- 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 subsystems in order to avoid single-point failures.

The structural design of Intelsat 10 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.

2.2 Communication Subsystem

The C- and Ku-band frequencies, polarization, and channel plan as well as the coverage contours and performance characteristics are provided in Schedule S. Exhibits 1 and 2 provide the beam parameters for the C- and Ku-band uplink and downlink beams, respectively, and Exhibit 3 provides the Schedule S beam designations.

2.3 TT&C Subsystem

The TT&C 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 satellite's command and telemetry channel frequencies and performance are provided 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 visible Earth. Therefore, pursuant to 25.114(c)(4)(vi)(A), contours for these beams are not required to be provided and the associated .gxt files are not included in Schedule S.

2.4 ULPC Subsystem

Intelsat 10 utilizes two Ku-band channels for ULPC, antenna tracking, and ranging. The coverage patterns of the ULPC 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 25.114(c)(4)(vi)(A), contours for these beams are not required to be provided and the associated .gxt files have not been included with the Schedule S. Intelsat 10's ULPC frequencies and subsystem performance are summarized in Exhibit 3.

2.5 Satellite Station-Keeping

The satellite will be maintained within 0.05° of its nominal longitudinal position in the east-west direction in compliance with 25.210(j).

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 10 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 10 can provide a range of communications services, including compressed digital video, high speed digital data, and digital single carrier per channel data channels.

4 Power Flux Density

The power flux density limits for space stations operating in the C-, Ku-bands specified in 25.208. As provided in Schedule S, the Intelsat 10 transmissions do not exceed these limits.

5 Emission Compliance

25.202(e) requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Intelsat 10 is designed to be compliant with this rule.

Intelsat 10 will comply with the provisions of 25.202(f) with regard to its emissions.

6 Orbital Location

Intelsat requests that Intelsat 10 be assigned the 177.8° E.L. orbital location. The 177.8° E.L. location satisfies Intelsat 10 requirements for optimizing coverage, elevation angles, and service availability. Although 177.8° E.L. was entered into Schedule S, the Schedule S software rounded it to 178.0° E.L.

7 International Telecommunication Union Filings

Intelsat 10 operations in the 3700-4200 MHz, 5925-6425 MHz, 11450-11700 MHz, 12250-12500 MHz, 12500-12750 MHz, and 14000-14500 MHz frequency bands will use ODYSSEY POR filing under the Administration of Federal Republic of Germany ("Germany").

Intelsat respectfully requests that the United States Administration state its non-objection to the Administration of Germany's use of Intelsat 10 for purposes of maintaining the ODYSSEY POR filing.

8 Coordination with Co-frequency Space Stations

The downlink equivalent isotropically radiated power ("EIRP") density of the satellite's transmissions in the conventional C-band will not exceed 3 dBW/4 kHz for digital transmissions or 8 dBW/4 kHz for analog transmissions. The associated uplink transmissions will not exceed applicable EIRP density envelopes in 25.218 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 177.8°E.L.

The downlink EIRP density of the satellite's transmissions in the conventional or extended Ku-bands will not exceed 14 dBW/4 kHz for digital transmissions or 17 dBW/4 kHz for analog transmissions, and associated uplink transmissions will not exceed applicable EIRP density envelopes in 25.218 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 177.8° E.L.

9 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.

9.1 Spacecraft Hardware Design

Intelsat 10 is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and small debris. In order to limit the effects of such unlikely collisions critical satellite components are located inside the protective body of the satellite and are properly shielded. The satellite does not use any subsystems for end-of-life disposal that are not used for normal operations.

9.2 Minimizing Accidental Explosions

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The satellite 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 satellite, 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.

9.3 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 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-10. Intelsat is also not aware of any system with an overlapping station-keeping volume with the satellite that is the subject of an International Telecommunication Union filing and that is either in orbit or progressing towards launch.

9.4 Post Mission Disposal

At the end of the mission, Intelsat will dispose of the spacecraft by moving it to an altitude of at least 175 kilometers above the geostationary arc. Intelsat has reserved 30.1 kilograms of bi-propellant for that purpose.

In its *Second Report and Order* in IB Docket 02-54, Mitigation of Orbital Debris,[2] the FCC declared that satellites launched prior to March 18, 2002, such as the Intelsat 10 satellite, would be designated as grandfathered satellites not subject to a specific disposal altitude. Therefore, the planned disposal orbit for Intelsat 10 complies with the FCC's rules.

The reserved propellant figure is an estimate. This figure is 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.

10 TT&C Control Earth Stations

Intelsat will conduct TT&C operations through one or more of the following earth stations: Kumsan, Korea; Regency Park, Mingenew, Australia; Paumalu, Hawaii and Filmore, California. Additionally, Intelsat is capable of remotely controlling Intelsat 10 from its facilities in McLean, Virginia and or in Long Beach, California.

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

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/ Giselle Creeser	March 10, 2023
Giselle Creeser Intelsat US LLC Director, Spectrum Policy and Engineering	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-band Global	C-band Global	West Pacific	West Pacific	Northeast Pacific	North Pacific	Northwest Pacific
Schedule S Beam ID	GCVU	GCHU	WPHU	WPVU	MEVU	NPHU	AKVU
Frequency Band (MHz)	5925-6425	5925-6425	14250-14500	14250-14500	14000-14250	14000-14250	14250-14500
Polarization	Vertical	Horizontal	Horizontal	Vertical	Vertical	Horizontal	Vertical
G/T (dB/K)	-0.4	0.4	2.1	2.3	4.8	6.4	4.4
Minimum SFD-- (dBW/m^2)	-103.6	-104.4	-97.1	-97.3	-99.8	-101.4	-99.4
Maximum SFD-- (dBW/m^2)	-78.6	-79.4	-72.1	-72.3	-74.8	-76.4	-74.4

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-band Global	C-band Global	Northeast Pacific	West Pacific	West Pacific	Northwest Pacific	North Pacific	Central Pacific
Schedule S Beam ID	GCHD	GCVD	NEVD	WPHD	WPVD	NWVD	NPHD	CPHD
Frequency Band (MHz)	3700-4200	3700-4200	12500-12750	12500-12750	12500-12750	11450-11700	11450-11700	12250-12500
Polarization	Horizontal	Vertical	Vertical	Horizontal	Vertical	Vertical	Horizontal	Horizontal
Maximum Beam Peak EIRP Density (dBW/Hz)	-32.9	-32.5	-26.6	-28.2	-28.0	-26.3	-26.5	-23.6
Maximum Beam Peak EIRP (dBW)	41.4	41.8	49	47.4	47.6	49.3	49.1	52
Maximum Beam Peak EIRP Density (dBW/4kHz)	3.1	3.5	9.5	7.9	8.1	9.8	9.6	12.5

EXHIBIT 3

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Global	Command Bicone	Command Global
Schedule S Beam ID	CMDG	CMDB	CMDH
Frequencies (MHz)	14000.5	14499.5	14499.5
Polarization	RHCP	Horizontal	Horizontal
Peak Flux Density at Command Threshold (dBW/m^2)	-90	-90	-90

Beam Name	Telemetry Global	Telemetry Global	Telemetry Pipe	Telemetry Pipe	Telemetry Bicone	Telemetry Bicone	ULPC	ULPC
Schedule S Beam ID	TLMG	TLMB	TLMP	TLMQ	TLM1	TLM2	ULP1	ULP2
Frequencies (MHz)	12747.5	12748.5	12747.5	12748.5	12747.5	12748.5	11699.0	12749.5
Polarization	Horizontal	Horizontal	RHCP	RHCP	Horizontal	Horizontal	Vertical	Horizontal
Maximum Channel EIRP (dBW)	8	8	8	8	8	8	13	13
Maximum Beam Peak EIRP Density (dBW/4kHz)	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-6.4	-6.4
Maximum Beam Peak EIRP Density (dBW/Hz)	-47.4	-47.4	-47.4	-47.4	-47.4	-47.4	-42.4	-42.4

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

EXHIBIT 4
Beam Polarizations and GXT File Names

	Schedule S Beam 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								
Global Beam	GCHU	GCVU	GCHD	GCVD	----	----	----	----
Ku-Band Beams								
North West Pacific	----	NWVU	----	NWVD	----	----	----	----
West Pacific	WPHU	WPVU	WPHD	WPVD	----	----	----	----
North Pacific	NPHU	----	NPHD	----	----	----	----	----
Northwest Pacific	----	NWVU	----	NWVD	----	----	----	----
Central Pacific	----	----	CPHD	----	----	----	----	----
Telemetry Global	TLMG* TLMB*	----	----	----	----	----	----	----
Telemetry Bicone	TLM1* TLM2*	----	----	----	----	----	----	----
Telemetry Pipe	----	----	----	----	----	----	----	TLMP* TLMQ*
Command Global	CMDH*	----	----	----	----	CMDG*	----	----
Command Bicone	CMDB*	----	----	----	----	----	----	----
Ku-band ULPC	ULP2*	ULP1*	----	----	----	----	----	----

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