Engineering Statement

1 Introduction

Together with the accompanying Schedule S and GXT files, Intelsat License LLC ("Intelsat") herein demonstrates that it is technically qualified to hold the authority sought in this application to launch and operate Intelsat 43, a software-defined satellite ("SDS") at 137.1°W. L.[1] 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,[2] are provided in the remainder of this Engineering Statement.

The software-defined design of Intelsat 43 will enable greater agility and flexibility than a traditional satellite design, which will allow Intelsat to better serve its broad customer base. Intelsat 43 design replaces traditional satellite hardware components with software defined components and utilizes array-fed reflector antennas with digital beam forming capability. The resulting software-defined design allows for shapeable and steerable beams, flexible power, bandwidth, and frequency allocation that delivers satellite capacity where and when it is needed.

2 Spacecraft Overview

Intelsat 43 has the capability to operate in the Ku-, Ka-, Q-, and V-band frequencies listed in the table below.[3]

Direction	Frequency
Uplink	13.0-13.25 GHz
	13.75-14.5 GHz
	14.5-14.8 GHz
	27.5-28.6 GHz[4]

[1] The Schedule S system does not allow for decimal inputs in the "Orbital Information For Geostationary Satellites" section. In this section, Intelsat 43's location is listed as 137.0° W.L.

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

[3] Intelsat refers to the downlink bands above 33 GHz as Q-band and the uplink bands in the same range as V-band.

[4] Intelsat is aware that the 27.5-28.35 GHz band is secondary for geostationary satellite orbit ("GSO") Fixed Satellite Services ("FSS") and is subject to Section 25.136. *See* 47 C.F.R. § 25.202(a)(1)(i).

	28.6-29.1 GHz[5]
	29.1-29.25 GHz
	29.25-30.0 GHz[6]
	30.0-30.5 GHz[7]
	47.2-50.2 GHz
	50.4-51.4 GHz
	51.4-52.4 GHz
Downlink	10.7-10.95 GHz
	10.95-11.7 GHz
	11.7-12.2 GHz
	12.2-12.5 GHz
	12.5-12.75 GHz
	17.3-17.7 GHz
	17.7-17.8 GHz
	17.8-18.8 GHz[8]
	18.8-19.3 GHz[9]
	19.3-19.4 GHz
	19.4-19.6 GHz[10]

[5] Intelsat is aware that GSO FSS is secondary to non-geostationary satellite ("NGSO") FSS in the 28.6-29.1 GHz frequency band. *See* 47 C.F.R. § 2.106, NG165.

[6] The band 29.25-29.30 GHz is allocated to the mobile satellite service ("MSS") feeder links and FSS on a co-primary basis. Earth station uplink operation in this band will require coordination with the incumbent MSS feeder link operators. *See* 47 C.F.R. § 2.106, NG535A.

[7] Although the Intelsat 43 satellite design includes this frequency band, Intelsat is not seeking authority to operate in this band.

[8] Intelsat is aware that the band 17.8-18.3 GHz is primary for fixed service and secondary for FSS. *See* 47 C.F.R. § 2.106, US334.

[9] Intelsat is aware that the 18.8-19.3 GHz frequencies are primary for NGSO FSS and secondary for GSO FSS. *See* 47 C.F.R. § 2.106, NG165.

[10] Although the Intelsat 43 satellite design includes this frequency band, Intelsat is not seeking authority to operate in this band.

	19.6-20.2 GHz
	20.2 -20.7 GHz[11]
	37.5- 40.5 GHz
	40.5- 42.5 GHz
	42.5- 43.5 GHz

The spacecraft will provide: Ku-, Ka, Q-, and V-band coverage within the field of view of the 137.1° W.L orbital location, that includes North, Central, and South America, the Pacific Ocean, the Gulf of Mexico, and the Caribbean.

Intelsat 43 Ku-band user beams are steerable and shapeable. The typical range of the user beams Intelsat expects to generate vary in diameter from 0.3°-1.5°;[12] the satellite is capable of generating user beams outside of this range. User beams can individually be dynamically assigned required spectrum and power to meet customer demands.

Intelsat 43 will also utilize two Ka-band steerable transmit and receive beams and two V-band steerable receive and Q-band transmit beams that will be utilized for Intelsat 43 gateway operations.

The satellite antenna gain contours for the user beams and gateway beams are provided in the GIMS database attached to the Form 312, Schedule S. For the transmit and receive Ku-band user beams the contours are shapeable and steerable, and the GXT files provide a beam pointed at nadir and at the edge of the coverage area. The Ka-band and Q/V-band gateway transmit and receive beams are steerable, and representative beams are provided in the GXT database. The satellite is capable of pointing the user beams and gateway beams anywhere in the coverage area of the satellite.

2.1 Spacecraft Characteristics

Intelsat 43 is an Airbus OneSat three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 43 utilizes two deployable solar array wings, parabolic gimbaled antennas for communication with gateways and a digital processor and array fed reflector antenna for communications with users.

The Intelsat 43 satellite is composed of the following subsystems:

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[11] Although the Intelsat 43 satellite design includes this frequency band, Intelsat is not seeking authority to operate in this band.

[12] GXT files for these representative beams are provided.

- thermal;
- power;
- attitude control;
- propulsion;
- telemetry, tracking, and control ("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's design incorporates redundancy for all the various subsystems in order to avoid single-point failures.

The structural design of Intelsat 43 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

Intelsat 43 can form Ku-band active channels with varying bandwidths, as narrow as 2 MHz and as wide as 250 MHz. The frequencies, polarizations, channel plans and coverage contours for the 0.3°, 0.5°, 0.7°, 1.0° and 1.5° Ku-band representative user beams, are provided in Schedule S.[13]

Exhibits 1 and 2 provide the general beam parameters for the Ku-band user links and Ka-, Q-, and V-band gateway links, 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.

Intelsat 43 is equipped with two tunable command receivers and four tunable telemetry transmitters. The center command and telemetry frequency on each receiver and transmitter is selectable via ground command in 100 kHz steps within the 13750-14800 MHz (space-to-Earth) and 10700-12750 MHz (Earth-to-space) frequency ranges.

The satellite's command and telemetry default channel frequencies and performance are shown in Exhibit 4. 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

[13] The gain of the different size beams does not vary by more than 1 dB

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 in Schedule S.

2.4 Uplink Power Control Subsystem

Intelsat 43 utilizes three Ku-band, one Ka-band, and one Q-band channel for ULPC, antenna tracking, and ranging and can be tuned in 100 kHz steps within their bands. The coverage patterns of the Ku-band 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 Section 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 in Schedule S. The Ka- and Q-band ULPC are the same as those provided for the gateway beams. The ULPC frequencies and subsystem performance are summarized in Exhibit 4.

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 Section 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, thruster perturbations, etc.).

3 Services

Intelsat 43 is a general-purpose communications satellite and has been designed to support various services offered within the Intelsat communications system. Depending upon the needs of the users, the channels on Intelsat 43 can provide a range of communications services, including compressed digital video, high speed digital data, and digital single channel per carrier data channels.

4 Power Flux Density

The power flux density limits for space stations operating in the Ku-, Ka-, and Q-band are specified in Section 25.208. As provided in Schedule S, the Intelsat 43 transmissions do not exceed these limits.

5 Emission Compliance

Section 25.202(e) requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Intelsat 43 is designed to be compliant with the provisions of this rule.

Intelsat 43 will comply with the provisions of Section 25.202(f) with regards to its emissions.

6 Orbital Location

Intelsat requests that Intelsat 43 be assigned the 137.1° W.L. orbital location.

7 International Telecommunication Union ("ITU") Filings

Intelsat 43's operations in the 10.95-11.2 GHz, 11.45-12.2 GHz, 12.2-12.75 GHz in Region 3, 13.75 -14.75 GHz, 17.7-20.2 GHz, 27.5-30.0 GHz, 37.5-42.5 GHz, 42.5-43.5 GHz, 47.2-50.2 GHz, 50.4-52.4 GHz frequency bands will use the USASAT-85A filing under the Administration of the United States.

Intelsat 43's operations in the 10.7-10.95 GHz, 11.2-11.45 GHz and 13.0-13.25 GHz frequency bands will use the USASAT-101G filings under the Administration of the United States.

Intelsat 43's operations in the 12.2-12.7 GHz and 17.3-17.7 in Region 2 frequency bands will use the USABSS-50 filing under the Administration of the United States.

Intelsat respectfully requests that the United States Administration state its non-objection to the Federal Republic of Germany's use of Intelsat 43 for purposes of notifying the ODYSSEY-137W and ODYSSEY-137W-1 filings.

8 Coordination Statement and Certifications

The downlink equivalent isotropically radiated power ("EIRP") density of the satellite's transmissions in the conventional and extended Ku-band will not exceed 14 dBW/4kHz for digital transmissions, and in conventional Ka-band 3.5 dBW/1 MHz for digital transmission. Associated uplink transmissions will not exceed the applicable EIRP density envelopes in Sections 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 Intelsat 43 at 137.1° W.L.

Associated uplink transmissions will not exceed the applicable EIRP density envelope in Section 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 Intelsat 43 at 137.1° W.L.

Operations in the 10.7-10.95 GHz (space-to-Earth) and 13.0-13.25 MHz (Earth-to-space) bands will be consistent with applicable Appendix 30B ITU Radio Regulations. Further, there are no other U.S. ITU filings under Appendix 30B within at least 10° of 137.1° W.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 43 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 spacecraft, Intelsat will ensure the removal of the spacecraft's stored energy by depleting the propellant tanks, venting the 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 43 will be assigned at 137.1 °W.L. Intelsat is not aware of any FCC-authorized system, or any other system applied for and under consideration by the FCC, having an overlapping station-keeping volume with Intelsat 43. Intelsat is also not aware of any system with an overlapping station-keeping volume with the satellite that is the subject of an ITU 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 306.9 kilometers above the geostationary arc. Intelsat has reserved 17.1 kilograms of Xenon bi-propellant for that purpose.[14]

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.[15] The effective area to mass ratio (Cr*A/M) of the satellite is 0.060 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 306.9 kilometers above the geostationary arc. Accordingly, Intelsat 43's planned disposal orbit complies with the FCC's rules.

10 TT&C Control Earth Stations

Intelsat will conduct TT&C operations through earth stations at one or more of the following teleports: Fillmore, California; Atlanta, Georgia; Napa, California; Riverside, California; Castle Rock, Colorado; Ellenwood, Georgia; Paumalu, Hawaii; Andover, Maine; Hagerstown, Maryland; and Brewster, Washington. Additionally, Intelsat is capable of remotely controlling Intelsat 43 from its facilities in Long Beach, California and McLean, Virginia.

[14] 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.

[15] *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*	June 9, 2023
Giselle Creeser Intelsat US LLC Director, Spectrum Policy and Engineering	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	Ku-band	Ku-band	Ku-band	Ku-band
Schedule S Beam ID	KUHU	KUVU	K1HU	K1VU
Frequency Band (MHz)	13000-13250	13000-13250	13750-14500	13750-14500
Polarization	Horizontal	Vertical	Horizontal	Vertical
G/T (dB/K)	13	13	13	13
Minimum SFD-- (dBW/m2)	-99.4	-99.4	-99.4	-99.4
Maximum SFD-- (dBW/m2)	-74.4	-74.4	-74.4	-74.4

Beam Name	Ku-band	Ku-band	Ka-band	Ka-band
Schedule S Beam ID	K2HU	K2VU	KARU	KALU
Frequency Band (MHz)	14500-14800	14500-14800	27500-30500	27500-30500
Polarization	Horizontal	Vertical	RHCP	LHCP
G/T (dB/K)	13	13	15.3	15.3
Minimum SFD-- (dBW/m^2)	-99.4	-99.4	-98.2	-98.2
Maximum SFD-- (dBW/m^2)	-74.4	-74.4	-73.2	-73.2

Beam Name	Ka-band	Ka-band	V-band	V-band
Schedule S Beam ID	KVRU	KVLU	V1RU	V1LU
Frequency Band (MHz)	27500-30000	27500-30000	47200-50200	47200-50200
Polarization	RHCP	LHCP	RHCP	LHCP
G/T (dB/K)	13.9	13.9	15.5	15.5
Minimum SFD-- (dBW/m^2)	-97	-97	-96.3	-96.3
Maximum SFD-- (dBW/m^2)	-72	-72	-71.3	-71.3

Beam Name	V-band	V-band
Schedule S Beam ID	V2RU	V2LU
Frequency Band (MHz)	50400-52400	50400-52400
Polarization	RHCP	LHCP
G/T (dB/K)	15.3	15.3
Minimum SFD-- (dBW/m^2)	-96.3	-96.3
Maximum SFD-- (dBW/m^2)	-71.3	-71.3

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	Ku-band	Ku-band	Ka-band	Ka-band
Schedule S Beam ID	KUHD	KUVD	KARD	KALD
Frequency Band (MHz)	10700-12750	10700-12750	17300-19400	17300-19400
Polarization	Horizontal	Vertical	RHCP	LHCP
Maximum Beam Peak EIRP (dBW)	78	78	61.4	61.4
Maximum Beam Peak EIRP Density (dBW/Hz)	-22.7	-22.7	-16	-16

Beam Name	Ka-band	Ka-band	Q-band	Q-band
Schedule S Beam ID	A2RD	A2LD	QBRD	QBLD
Frequency Band (MHz)	19600-20700	19600-20700	37500-40000	37500-40000
Polarization	RHCP	LHCP	RHCP	LHCP
Maximum Beam Peak EIRP (dBW)	61.4	61.4	61.9	61.9
Maximum Beam Peak EIRP Density (dBW/Hz)	-16	-16	-23.7	-23.7

Beam Name	Q-band	Q-band	Q-band	Q-band
Schedule S Beam ID	Q1RD	Q1LD	Q2RD	Q2LD
Frequency Band (MHz)	40000-40500	40000-40500	40500-43500	40500-43500
Polarization	RHCP	LHCP	RHCP	LHCP
Maximum Beam Peak EIRP (dBW)	61.9	61.9	61.9	61.9
Maximum Beam Peak EIRP Density (dBW/Hz)	-11.7	-11.7	-16.7	-16.7

EXHIBIT 3
Beam Polarizations and GXT File Names

	Schedule S Beam Names							
	Linear Polarization				Circular Polarization			
Beam Designation	Uplink	Uplink	Downlink	Downlink	Uplink	Uplink	Downlink	Downlink
	(H-Pol.)	(V-Pol.)	(H-Pol.)	(V-Pol.)	(LHCP)	(RHCP)	(LHCP)	(RHCP)
Ku-band Beams								
Ku band	KUHU K1HU K2HU	KUVU K1VU K2VU	KUHD	KUVD	----	----	----	----
Telemetry 1	----	----	----	----	----	----	TLMB*	TLMA*
Telemetry 2	----	----	----	----	----	----	TLMD*	TLMC*
Telemetry 3	----	----	----	----	----	----	TLMF*	TLME*
Telemetry 4	----	----	----	----	----	----	TLMH*	TLMG*
Command 1	----	----	----	----	CMD1*	CMD2*	----	----
Command 2	----	----	----	----	CMD3*	CMD4*	----	----
ULPC1	----	----	----	----	----	----	----	UPC1*
ULPC2	----	----	----	----	----	----	----	UPC2*
ULPC4	----	----	----	----	----	----	----	UPC3*
Ka-band Beams								
Ka-band	----	----	----	----	KALU KVLU	KARU KVRU	KALD A2LD	KARD A2RD
ULPC5	----	----	----	----	----	----	UPC4*	UPC5*
V-band Beams								
V-band	----	----	----	----	V2LU V1LU	V2RU V1RU	----	----
Q-band Beams								
Q-band	----	----	----	----	----	----	QBLD Q1LD Q2LD	QBRD Q1RD Q2RD
ULPC6	----	----	----	----	----	----	UPC6*	UPC7*

EXHIBIT 4

TT&C SUBSYSTEM CHARACTERISTICS

Beam Name	Command 1	Command 1	Command 2	Command 2
Schedule S Beam ID	CMD1	CMD2	CMD3	CMD4
Frequencies (MHz)[1]	14000.5	14000.5	14003.0	14003.0
Polarization	LHCP	RHCP	LHCP	RHCP
Peak Flux Density at Command Threshold (dBW/m2-Hz)	-84	-84	-84	-84

Beam Name	Telemetry 1	Telemetry 1	Telemetry 2	Telemetry 2	Telemetry 3	Telemetry 3
Schedule S Beam ID	TLMA	TLMB	TLMC	TLMD	TLME	TLMF
Frequencies (MHz)[2]	11450.7	11450.7	11451.9	11451.9	11453.2	11453.2
Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP
Maximum Channel EIRP (dBW)	7	7	7	7	7	7
Maximum Beam Peak EIRP Density (dBW/4kHz)	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-46.0	-46.0	-46.0	-46.0	-46.0	-46.0

Beam Name	Telemetry 4	Telemetry 4	ULPC 1	ULPC 2	ULPC 4
Schedule S Beam ID	TLMG	TLMH	UPC1	UPC2	UPC3
Frequencies (MHz)[3]	11454.4	11454.4	10950.1	11699.5	12199.5
Polarization	RHCP	LHCP	RHCP	RHCP	RHCP
Maximum Channel EIRP (dBW)	11	11	11	11	11
Maximum Beam Peak EIRP Density (dBW/4kHz)	-10.0	-10.0	3.0	3.0	3.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-46.0	-46.0	-33.0	-33.0	-33.0

1 The center frequencies given are representative. *See* § 2.3.

2 *Id.*

3 *Id.*

Beam Name	ULPC 5 (Ka-band)	ULPC 5 (Ka-band)	ULPC 6 (Q-band)	ULPC 6 (Q-band)
Schedule S Beam ID	UPC4	UPC5	UPC6	UPC7
Frequencies (MHz)[3]	20199.5	20199.5	37500.5	37500.5
Polarization	LHCP	RHCP	LHCP	RHCP
Maximum Channel EIRP (dBW)	16.5	16.5	22	22
Maximum Beam Peak EIRP Density (dBW/4kHz)	8.5	8.5	14.0	14.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-27.5	-27.5	-21.0	-21.0

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

[3] *Id.*