Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate Intelsat 9 (Call Sign S2380), at 50.0° W.L. (310.0° E.L.). The characteristics of the satellite, as well as its compliance with the various provisions of the Federal Communications Commission's ("FCC" or "Commission") rules, are provided in this Engineering Statement. Intelsat also provides new beam gain contours in this Engineering Statement. In all other respects, the characteristics of Intelsat 9 are the same as those described in SAT-MOD-20180305-00019.

2 Spacecraft Overview

Intelsat 9 is capable of operating in the C- and Ku-band frequencies listed below:

Direction	Frequency
Uplink	5925-6425 MHz
	14000-14500 MHz
Downlink	3700-4200 MHz
	11450-11700 MHz
	11700-12200 MHz

The spacecraft provides the following coverage:

Beam Name	Coverage Area	Frequency Band
Americas, Europe (East Reflector)	North America, South America, and West Europe	C-band
Americas, Europe (North reflector fixed)	North America, South America, and West Europe	Ku-band
Brazil (South reflector fixed)	Brazil	Ku-band
Caribbean (West Reflector)	Caribbean countries	Ku-band

2.1 Spacecraft Characteristics

Intelsat 9 is a Boeing model BS601HP three-axis stabilized spacecraft with a rectangular outer-body structure. Intelsat 9 utilizes two deployable solar array wings with two fixed reflectors (north and south) and two mechanically adjustable reflectors (east and west).

The Intelsat 9 spacecraft is composed of the following subsystems:

- Thermal;
- Power;
- Attitude Control;
- Propulsion;
- Telemetry, Command, and Ranging ("TC&R");
- Uplink Power Control; 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 of the various subsystems in order to avoid single-point failures.

The structural design of the satellite 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 9 provides active communication channels at C- and Ku-band frequencies, each having a bandwidth of 36 MHz. The satellite's frequencies, polarization, and channel plan are provided in the Schedule S.

The coverage contours and performance characteristics of all Intelsat 9 beams are provided in the Schedule S. Intelsat has included the Schedule S beam designation for all beams in Exhibit 1. Exhibits 2 and 3 provide the beam parameters for the Intelsat 9 uplink and downlink beams, respectively.

Intelsat 9 has two mechanically adjustable reflectors (East and West, respectively) providing flexibility to point the boresight of the beam to different locations to meet current customer needs and those that will arise in the future. Intelsat requests authority to fully utilize the Intelsat 9 capability to steer these two reflectors within the satellite service area, shown by the red contour, in the figure below. This will allow Intelsat to meet on-going and future customer requirements in an expeditious manner without the need to modify the Intelsat 9 license each time a new requirement is identified. Intelsat specifies that the peak equivalent isotropically radiated power ("EIRP") in the service area for the East and West reflectors will not exceed 54.2 dBW. The EIRP at the edge of the service area will not exceed 51.0 dBW

2.3 Telemetry, Command, and Ranging Subsystem

The TC&R subsystem provides the following functions:

- Acquisition, processing, and transmission of spacecraft telemetry data;
- Reception and retransmission of ground station generated ranging signals; and
- Reception, processing and distribution of telecommands.

The Intelsat 9 command and telemetry channel frequencies 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 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 9 command and telemetry subsystem performance is summarized in Exhibit 4.

2.4 Uplink Power Control Subsystem

Intelsat 9 utilizes two Ku-band channels for uplink power control ("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 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 9 ULPC frequencies and subsystem performance are summarized in Exhibit 4.

2.5 Satellite Station-Keeping

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

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 9 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 9 can accommodate television, radio, voice, and data communications. Typical communication services include:

- Compressed digital video;
- High speed digital data; and
- Digital single channel per carrier ("SCPC") data channels.

4 Power Flux Density

The power flux density ("PFD") limits for space stations operating in the 3700-4200 MHz and 11450-11700 MHz bands are specified in Section 25.208 of the Commission's rules. The PFD limits for space stations operating in the 11700-12200 MHz band are specified in No. 21.16 of the International Telecommunication Union ("ITU") Radio Regulations. The maximum PFD levels for the Intelsat 9 transmissions were calculated for the 3700-4200 MHz and 11450-11700 MHz bands. As shown in the Schedule S, the downlink PFD levels of the Intelsat 9 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 Commission's rules requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Intelsat 9 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 9's emissions.

6 Orbital Location

Intelsat requests that it be assigned the 50° W.L. orbital location for Intelsat 9. The 50° W.L. location satisfies Intelsat 9 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 ITU Filings

Intelsat 9's operations in the 3700-4200 MHz, 5925-6425 MHz, 11450-11950 MHz, and 14000-14500 MHz frequency bands will operate under the notified ITU filings INTELSAT7 310E, INTELSAT9 310E, and INTELSAT10 310E of the Administration of the United States. Operations in the 11950-12200 MHz frequency band will operate under the notified NEW DAWN 35 ITU filing of the Administration of the Papua New Guinea. Intelsat 9's operations will also use the more recently filed USASAT-80A and USASAT-55O-1ITU filings of the Administration of the United States to cover frequency gaps in the USA legacy filings.

8 Coordination Statement and Certifications

The downlink EIRP density of the satellite's transmissions in the conventional C-band 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 9 at 50° W.L.

The downlink EIRP density of the satellite's 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 9 at 50° 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 9 is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other 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 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 active units are turned off. Due to the design of Intelsat 9, Intelsat will not be able to vent two helium tanks on Intelsat 9.[1] Upon disposal Intelsat will vent the fuel and Oxidizer tanks; the Xenon propellant on Intelsat 9 has already been completely vented.

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. Subject to receipt of FCC approval, Intelsat 9 will be drifted to 50° W.L.

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[1] *See* Legal Narrative at n.3.

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 9 at 50° W.L. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 9 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 intends to dispose of the spacecraft by moving it to an altitude of at least 150 kilometers above the geostationary arc. Intelsat has reserved 24.1 kilograms of fuel for this 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 9 satellite, would be designated as grandfathered satellites not subject to a specific disposal altitude. Therefore, the planned disposal orbit for Intelsat 9, as revised, 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.

10 TC&R Control Earth Stations

Intelsat will conduct TC&R operations through one or more of the following earth stations: Ellenwood, GA and Hagerstown, MD. Additionally, Intelsat is capable of remotely controlling Intelsat 9 from its facilities in McLean, VA or Long Beach, CA.

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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	February 26, 2020
Giselle Creeser Intelsat US LLC Director, Spectrum Policy and Engineering	Date

EXHIBIT 1
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)**
C-Band Beams								
Americas, Europe	AMHU	AMVU	AMHD	AMVD	----	----	----	----
Ku-Band Beams								
N. America & Europe	----	AEVU	AEHD	----	----	----	----	----
Brazil	BRHU	----	----	BRVD	----	----	----	----
Caribbean	MXHU	MXVU	MXHD	MXVD	----	----	----	----
Telemetry Global	----	----	----	TLM*	----	----	----	----
Telemetry Pipe	----	----	----	----	----	----	----	TLMP*
Telemetry Bicone	----	----	TLMB*	----	----	----	----	----
Command Global	----	----	----	CMD*	----	----	----	----
Command Pipe	----	----	----	----		----	----	CMDP*
Command Bicone	----	----	----	CMDB*	----	----	----	----
ULPC	----	----	UPCH*	UPCV*	----	----	----	----

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

EXHIBIT 2
COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-Band Americas		Ku-Band Brazil	Ku-Band Americas/Europe
Schedule S Beam ID	AMHU	AMVU	BRHU	AEVU
Frequency Band (MHz)	5925 - 6425	5925 - 6425	14000 - 14260	14000 - 14240
Polarization	Horizontal	Vertical	Horizontal	Vertical
G/T (dB/K)	-0.2	-0.8	3.3	0.0
Minimum SFD--(dBW/m^2)	-94.8	-93.3	-96.8	-93.1
Maximum SFD--(dBW/m^2)	-78.8	-77.3	-80.8	-77.1

Beam Name	Ku-Band Caribbean	
Schedule S Beam ID	MXVU	MXHU
Frequency Band (MHz)	14240 - 14500	14260 - 14500
Polarization	Vertical	Horizontal
G/T (dB/K)	8.6	8.4
Minimum SFD--(dBW/m^2)	-102.2	-101.6
Maximum SFD--(dBW/m^2)	-86.2	-85.6

EXHIBIT 3
COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-Band Americas		Ku-Band Brazil	Ku-Band Americas/Europe
Schedule S Beam ID	AMHD	AMVD	BRVD	AEHD
Frequency Band (MHz)	3700 - 4200	3700 - 4200	11700- 11960	11450 - 11700
Polarization	Horizontal	Vertical	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	42.7	42.8	48.1	49.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	4.4	4.5	9.8	11.3

Beam Name	Ku-Band Caribbean	
Schedule S Beam ID	MXVD	MXHD
Frequency Band (MHz)	11900 - 12200	11900 - 12200
Polarization	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	54.2	54.2
Maximum Beam Peak EIRP Density (dBW/4kHz)	15.9	15.9

EXHIBIT 4
TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Global	Command Pipe	Command Bicone
Schedule S Beam ID	CMD	CMDP	CMDB
Frequencies (MHz)	14494.5	14000.5	14494.5
Polarization	Vertical	RHCP	Vertical
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-103.0	-102.2	-90

Beam Name	Telemetry Global	Telemetry Pipe	Telemetry Bicone	ULPC1	ULPC2
Schedule S Beam ID	TLM	TLMP	TLMB	UPCH	UPCV
Frequencies (MHz)	11700.5 & 11702	11700.5 & 11702	11700.5 & 11702	11699.0	11703.0
Polarization	Vertical	RHCP	Horizontal	Horizontal	Vertical
Maximum Channel EIRP (dBW)	9.2	14.8	10.7	13.2	12.3
Maximum Beam Peak EIRP Density (dBW/4kHz)	-11.8	-6.7	-10.3	5.2	4.3

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