Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate the satellite designated as Intelsat 9 at 29.5° W.L. The characteristics of the Intelsat 9 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 this Engineering Statement, which also updates the beam gain contours. In all other respects, the characteristics of Intelsat 9 are the same as those described in SAT-MOD-20120703-00110.

2 Spacecraft Overview

Intelsat 9 is a SSL FS-1300 spacecraft that is capable of operating in the C-band and Ku-band frequencies listed below and that provides service to North and South America and Europe.

Direction	Frequency
Uplink	5925 – 6425 MHz
	14000 – 14500 MHz
Downlink	3700 – 4200 MHz
	11450 – 11700 MHz
	11700 – 12200 MHz[1]

2.1 Spacecraft Characteristics

Intelsat 9 is a SSL FS-1300 three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 9 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 9 spacecraft is composed of the following subsystems:

- Thermal
- Power
- Attitude Control
- Propulsion

[1] Intelsat 9 will use the 11.7-12.2 GHz to serve Region 2 only. Accordingly, Intelsat's operations in this band will be consistent with the International Table of Frequency Allocations included in 47 C.F.R. § 2.106.

- 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 9 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-band frequencies, each having a bandwidth of 36 MHz, and Ku-band frequencies each having a bandwidth of 36 MHz. The Intelsat 9 frequencies, polarization, and channel plan are provided in the Schedule S. An explanation of how uplink frequency bands are connected to downlink frequency bands is provided in Exhibit 5.

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

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 9 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 9 command and telemetry subsystem performance is summarized in Exhibit 3.

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 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 comply 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 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:

a) Compressed digital video

b) High speed digital data

c) 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. There are no PFD limits specified for the 11700 – 12200 MHz band in either Section 25.208 of the Commission's rules or 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. The results are provided in Schedule S and show that the downlink power flux density 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 emissions.

6 Orbital Location

Intelsat requests that it be assigned the 29.5° W.L. orbital location for Intelsat 9. The 29.5° 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 Coordination Statement and Certifications

The downlink EIRP density of Intelsat 9 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 29.5° W.L.

The downlink EIRP density of Intelsat 9 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 29.5° W.L.

Currently, there is no U.S. ITU filing for a satellite network that specifies operation in the frequency band 11950 – 12200 MHz at the nominal orbital location of 29.5° W.L. Intelsat will submit to the Commission Appendix 4 information for a new satellite network that utilizes these frequency bands at the nominal orbital longitude of 29.5° W.L., to be forwarded to the ITU.

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 active units are turned off. Due to the design of Intelsat 9, Intelsat will not be able to vent all pressurized systems. Upon disposal Intelsat will vent the fuel and Oxidizer tanks; the Xenon propellant on Intelsat 9 has already been completely vented. However, because of the spacecraft design, Intelsat will not be able to vent two helium tanks on Intelsat 9. Intelsat notes that the Satellite Industry Association's pending request for blanket waiver of Section 25.283(c) includes the Intelsat 9 satellite. *See* Satellite Industry Association, Request for Blanket Waiver of Section 25.283(c) of the Commission's Rules, IB Docket No. 02-54 (Oct. 1, 2010).

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. Subject to receipt of FCC approval, Intelsat 9 will be drifted to 29.5° W.L. Intelsat 701 currently operates at 29.5° W.L. To the extent Intelsat 9 and Intelsat 701 both operate at the 29.5° W.L. orbital location prior to the de-orbit of Intelsat 701, Intelsat will take all the necessary steps to minimize the risk of collision between Intelsat 9 and Intelsat 701.

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 29.5° 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.

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 150 kilometers above the geostationary arc. Intelsat has reserved 42.4 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.

9 TC&R Control Earth Stations

Intelsat will conduct TC&R operations through earth stations near Atlanta, GA and Hagerstown. MD. Additionally, Intelsat is capable of remotely controlling Intelsat 9 from the company's facilities in McLean, VA and Long Beach, CA.

[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/ Alexander Gerdenitsch	November 10, 2016
Alexander Gerdenitsch Intelsat Manager, Spectrum Policy, Americas	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-Band Americas	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 - 14250	14000 - 14250
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 Mexico	Ku-Band Mexico
Schedule S Beam ID	MXVU	MXHU
Frequency Band (MHz)	14250 - 14500	14250 - 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 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-Band Americas	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 Mexico	Ku-Band Mexico
Schedule S Beam ID	MXVD	MXHD
Frequency Band (MHz)	11700 - 12200	11700 - 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 3

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 & 11702.5	11700.5 & 11702.5	11700.5 & 11702.5	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*

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								
Americas, Europe	AMHU	AMVU	AMHD	AMVD	----	----	----	----
Ku-Band Beams								
N. America & Europe	----	AEVU	AEHD	----	----	----	----	----
Brazil	BRHU	----	----	BRVD	----	----	----	----
Mexico	MXHU	MXVU	MXHD	MXVD	----	----	----	----
Southeast	----	----	----	----	----	----	----	----
	----	----	----	----	----	----	----	----
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 5
Uplink Band to Downlink Band Connections

Uplink Channel Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Channel Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)
CU01	Americas	Horizontal	5945	CD01	Americas	Vertical	3720	36
CU03	Americas	Horizontal	5985	CD03	Americas	Vertical	3760	36
CU05	Americas	Horizontal	6025	CD05	Americas	Vertical	3800	36
CU07	Americas	Horizontal	6065	CD07	Americas	Vertical	3840	36
CU09	Americas	Horizontal	6105	CD09	Americas	Vertical	3880	36
CU11	Americas	Horizontal	6145	CD11	Americas	Vertical	3920	36
CU13	Americas	Horizontal	6185	CD13	Americas	Vertical	3960	36
CU15	Americas	Horizontal	6225	CD15	Americas	Vertical	4000	36
CU17	Americas	Horizontal	6265	CD17	Americas	Vertical	4040	36
CU19	Americas	Horizontal	6305	CD19	Americas	Vertical	4080	36
CU21	Americas	Horizontal	6345	CD21	Americas	Vertical	4120	36
CU23	Americas	Horizontal	6385	CD23	Americas	Vertical	4160	36
CU02	Americas	Vertical	5945	CD02	Americas	Horizontal	3720	36
CU04	Americas	Vertical	5985	CD04	Americas	Horizontal	3760	36
CU06	Americas	Vertical	6025	CD06	Americas	Horizontal	3800	36
CU08	Americas	Vertical	6065	CD08	Americas	Horizontal	3840	36
CU10	Americas	Vertical	6105	CD10	Americas	Horizontal	3880	36
CU12	Americas	Vertical	6145	CD12	Americas	Horizontal	3920	36
CU14	Americas	Vertical	6185	CD14	Americas	Horizontal	3960	36
CU16	Americas	Vertical	6225	CD16	Americas	Horizontal	4000	36
CU18	Americas	Vertical	6265	CD18	Americas	Horizontal	4040	36
CU20	Americas	Vertical	6305	CD20	Americas	Horizontal	4080	36
CU22	Americas	Vertical	6345	CD22	Americas	Horizontal	4120	36
CU24	Americas	Vertical	6385	CD24	Americas	Horizontal	4160	36
KU01	Americas / Europe	Vertical	14020	KD01	Americas / Europe	Horizontal	11477	36
KU03	Americas / Europe	Vertical	14060	KD03	Americas / Europe	Horizontal	11517	36
KU05	Americas / Europe	Vertical	14100	KD05	Americas / Europe	Horizontal	11557	36
KU07	Americas / Europe	Vertical	14140	KD07	Americas / Europe	Horizontal	11597	36
KU09	Americas / Europe	Vertical	14180	KD09	Americas / Europe	Horizontal	11637	36
KU11	Americas / Europe	Vertical	14220	KD11	Americas / Europe	Horizontal	11677	36
KU07	Americas / Europe	Vertical	14140	KD07	Brazil	Vertical	11597	36
KU09	Americas / Europe	Vertical	14180	KD09	Brazil	Vertical	11637	36
KU11	Americas / Europe	Vertical	14220	KD11	Brazil	Vertical	11677	36
KU13	Mexico	Vertical	14260	KD13	Mexico	Horizontal	11960	36
KU15	Mexico	Vertical	14300	KD15	Mexico	Horizontal	12000	36
KU17	Mexico	Vertical	14340	KD17	Mexico	Horizontal	12040	36
KU19	Mexico	Vertical	14380	KD19	Mexico	Horizontal	12080	36
KU21	Mexico	Vertical	14420	KD21	Mexico	Horizontal	12120	36
KU23	Mexico	Vertical	14460	KD23	Mexico	Horizontal	12160	36
KU02	Brazil	Horizontal	14040	KD02	Brazil	Vertical	11740	36
KU04	Brazil	Horizontal	14080	KD04	Brazil	Vertical	11780	36
KU06	Brazil	Horizontal	14120	KD06	Brazil	Vertical	11820	36
KU08	Brazil	Horizontal	14160	KD08	Brazil	Vertical	11860	36
KU10	Brazil	Horizontal	14200	KD10	Brazil	Vertical	11900	36
KU12	Brazil	Horizontal	14240	KD12	Brazil	Vertical	11940	36
KU14	Mexico	Horizontal	14280	KD14	Mexico	Vertical	11980	36
KU16	Mexico	Horizontal	14320	KD16	Mexico	Vertical	12020	36
KU18	Mexico	Horizontal	14360	KD18	Mexico	Vertical	12060	36
KU20	Mexico	Horizontal	14400	KD20	Mexico	Vertical	12100	36
KU22	Mexico	Horizontal	14440	KD22	Mexico	Vertical	12140	36
KU24	Mexico	Horizontal	14480	KD24	Mexico	Vertical	12180	36