Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to redeploy the satellite designated as Intelsat 904 (Call Sign S2408) to, and operate at, 29.5° W.L. (330. 5°E.L).

The characteristics of the Intelsat 904 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 also updates the beam gain contours. In all other respects, the characteristics of Intelsat 904 are the same as those described in SAT-MOD-20160805-00079.

2 Spacecraft Overview

Intelsat 904 is a Space Systems Loral FS1300 spacecraft that is capable of operating in the C-band and Ku-band frequencies listed below:

Direction	Frequency
Uplink	5850-5925 MHz
	5925-6425 MHz
	14000-14500 MHz
Downlink	3625-3700 MHz
	3700-4200 MHz
	10950-11200 MHz
	11450-11700 MHz

The spacecraft will provide the following coverage:

Beam	Coverage
Spot 1	South East Asia, Sri Lanka
Spot 2	Europe
West Hemi	Africa and Europe
East Hemi	India, Thailand, China
Northwest	Western Europe
Southwest	Southern Africa
Middle East	Middle East
Southeast	Malaysia, South East Asia
Northeast	India, South East Asia, China
Combined East	Malaysia, India, Thailand, Sumatra
Global	Global

2.1 Spacecraft Characteristics

Intelsat 904 is a Space Systems Loral FS-1300 three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 904 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 904 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 904 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 904 provides active communication channels in C-band and Ku-band. In C-band, active communication channels have a bandwidth of either 36 MHz, 41 MHz, or 72 MHz. In Ku-band, active communication channels have a bandwidth of either 36 MHz, 72 MHz, or 77 MHz. The Intelsat 904 frequencies, polarization, and channel plan are provided in the Schedule S.

The coverage contours and performance characteristics of all Intelsat 904 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 are not included in Schedule S. Exhibits 1 and 2 provide the beam parameters for the Intelsat 904 uplink and downlink beams, respectively.

Intelsat 904 is equipped with two steerable Ku-band spot beams. Gain contours for both beams are provided in Schedule S. Each steerable beam may be pointed toward any location on the earth that is visible from 29.5° W.L. Regardless of pointing, the coverage contours remain identical in gain and roll-off. Intelsat will ensure that transmissions in these beams are consistent with the relevant Commission rules and International Telecommunication Union ("ITU") Radio Regulations.

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 904 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 904 command and telemetry subsystem performance is summarized in Exhibit 3.

2.4 Uplink Power Control Subsystem

Intelsat 904 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 are not included in Schedule S. The Intelsat 904 ULPC frequencies and subsystem performance are summarized in Exhibit 3.

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 904 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 904 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

Bandwidths for representative communication carriers are provided in Schedule S.

4 Power Flux Density

The power flux density ("PFD") limits for space stations operating in the 3650-4200 MHz, 10950-11200 MHz, and 11450-11700 MHz bands are specified in Section 25.208 of the Commission's rules. The power flux density ("PFD") limits for space stations operating in the 3625-3650 MHz are specified in No. 21.16 of the ITU Radio Regulations.

The maximum PFD levels for the Intelsat 904 transmissions were calculated for the 3625-4200 MHz, 10950-11200 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 904 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 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 904 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 904 emissions.

6 Orbital Location

Intelsat requests that it be assigned the 330.5° E.L./29.5° W.L. orbital location for Intelsat 904. The 29.5° W.L. location satisfies Intelsat 904 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. Although 29.5° W.L. was entered into Schedule S, the Schedule S software has rounded it to 30.0°W.L.

7 ITU Filling

Intelsat 904 operations in the 3700-4200 MHz, 5925-6425 MHz, 10950-11200 MHz, 11450-11700 MHz, and 14000-14500 MHz frequency bands have been notified and coordinated under the Administration of the United States' ITU filings INTELSAT9 330.5E.

For the operation of Intelsat 904 at 29. 5° W.L in the frequency bands 3625-3700 MHz and 5850-5925 MHz Intelsat will be submitting as part of this application the corresponding Appendix 4 information and requests the FCC forward this information to the ITU as soon as possible.

8 Coordination with Co-frequency Space Stations

Intelsat 904 will operate under ITU filings of the United States Administration. The downlink EIRP density of Intelsat 904 transmissions in the conventional or extended 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 904 at 29.5° W.L.

The downlink EIRP density of Intelsat 904 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 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 904 at 29.5° W.L.

Given the above, the uplink frequency bands 5850-5925 MHz, 5925-6425 MHz, and 14000-14500 MHz; and the downlink frequency bands 3625-3700 MHz, 3700-4200 MHz, 10950-11200 MHz, and 11450-11700 MHz do not require any interference analysis or 2-degree analysis under Section 25.140 of the Commission's rules.

In all cases, Intelsat will comply with all executed operator-to-operator agreements for 29.5° 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 904 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 spacecraft components are located inside the protective body of the spacecraft and are properly shielded. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

9.2 Minimizing Accidental Explosions

The manufacturer, Space Systems Loral, 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 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.

During the relocation of Intelsat 904, Intelsat will take all the necessary steps to coordinate the move internally to minimize the risk of collision or interference between Intelsat 904 and any other 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 904. Intelsat is also not aware of any system with an overlapping station-

keeping volume with Intelsat 904 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 52.8 kilograms of fuel for this purpose. In its *Second Report and Order* in IB Docket 02-54, Mitigation of Orbital Debris,[1] the FCC declared that satellites launched prior to March 18, 2002, such as the Intelsat 904 satellite, would be designated as grandfathered satellites not subject to a specific disposal altitude. Therefore, the planned disposal orbit for Intelsat 904, 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: Fuchsstadt, Germany; Hartebeeshoek, South Africa; Mountainside, Maryland; Atlanta, Georgia; or Fucino, Italy. Additionally, Intelsat is capable of remotely controlling Intelsat 904 from its facilities in McLean, VA or in Long Beach, CA.

[1] 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	April 22, 2019
	Date

Intelsat
Director Spectrum Policy,
Engineering

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-Band Global	C-Band Global	C-Band Hemi	C-Band Hemi	C-Band Spot
Schedule S Beam ID	CGLU	CGRU	WHLU	EHLU	NWRU
Frequency Band (MHz)	6300 - 6425	6300 - 6425	5850 - 6300	5850 - 6300	5850 - 6300
Polarization	LHCP	RHCP	LHCP	LHCP	RHCP
G/T (dB/K)	-6.3	-5.6	-2.6	1.6	5.4
Minimum SFD-- (dBW/m^2)	-91.5	-92.0	-92.4	-93.4	-92.0
Maximum SFD-- (dBW/m^2)	-69.5	-70.0	-70.4	-71.4	-70.0

Beam Name	C-Band Spot	C-Band Spot	C-Band Spot	C-Band Spot	C-Band Spot
Schedule S Beam ID	SWRU	MERU	SERU	NERU	CERU
Frequency Band (MHz)	5850 - 6300	5850 - 6300	5850 - 6300	5850 - 6300	5850 - 6300
Polarization	RHCP	RHCP	RHCP	RHCP	RHCP
G/T (dB/K)	-0.9	1.9	3.3	3.7	0.2
Minimum SFD-- (dBW/m^2)	-92.7	-92.8	-92.8	-93.2	-92.7
Maximum SFD-- (dBW/m^2)	-70.7	-70.8	-70.8	-71.2	-70.7

Beam Name	Ku-Band Spot	Ku-Band Spot
Schedule S Beam ID	S1HU	S2VU
Frequency Band (MHz)	14000 - 14500	14000 - 14500
Polarization	Horizontal	Vertical
G/T (dB/K)	8.7	8.7
Minimum SFD-- (dBW/m^2)	-92.0	-92.6
Maximum SFD-- (dBW/m2)	-74.0	-74.6

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-Band Global	C-Band Global	C-Band Hemi	C-Band Hemi	C-Band Spot
Schedule S Beam ID	CGLD	CGRD	WHRD	EHRD	NWLD
Frequency Band (MHz)	4075 - 4200	4075 - 4200	3625 - 4075	3625 - 4075	3625 - 4075
Polarization	LHCP	RHCP	RHCP	RHCP	LHCP
Maximum Beam Peak EIRP (dBW)	35.7	35.3	41.0	45.3	41.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	-3.8	-4.2	-1.6	2.7	-1.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-39.9	-40.3	-37.6	-33.3	-37.0

Beam Name	C-Band Spot	C-Band Spot	C-Band Spot	C-Band Spot	C-Band Spot
Schedule S Beam ID	SWLD	MELD	SELD	NELD	CELD
Frequency Band (MHz)	3625 - 4075	3625 - 4075	3625 - 4075	3625 - 4075	3625 - 4075
Polarization	LHCP	LHCP	LHCP	LHCP	LHCP
Maximum Beam Peak EIRP (dBW)	42.2	43.8	43.6	47.7	44.8
Maximum Beam Peak EIRP Density (dBW/4kHz)	-0.4	1.2	1.0	5.1	2.2
Maximum Beam Peak EIRP Density (dBW/Hz)	-36.4	-34.8	-35.0	-30.9	-33.8

Beam Name	Ku-Band Spot1	Ku-Band Spot1	Ku-Band Spot2	Ku-Band Spot2
Schedule S Beam ID	SIVD	SIVE	S2HD	S2HE
Frequency Band (MHz)	10950 - 11200	11450 - 11700	10950 - 11200	11450 - 11700
Polarization	Vertical	Vertical	Horizontal	Horizontal
Maximum Beam Peak EIRP (dBW)	53.1	53.1	53.8	53.8
Maximum Beam Peak EIRP Density (dBW/4kHz)	10.5	13.6	11.2	14.3
Maximum Beam Peak EIRP Density (dBW/Hz)	-25.5	-22.5	-24.8	-21.8

EXHIBIT 3

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Global	Command Bicone
Schedule S Beam ID	CMDG	CMDB
Frequencies (MHz)	6173.7	6176.3
Polarization	LHCP	LHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-90	-90

Beam Name	Telemetry Global	Telemetry Bicone	ULPC	ULPC	ULPC
Schedule S Beam ID	TLMG	TLMB	UPKC	UPKD	UPCV
Frequencies (MHz)	3947.5 & 3952.0	3948.0 & 3952.5	11198.0	11452.0	3950.0
Polarization	RHCP	RHCP	RHCP	RHCP	Vertical
Maximum Channel EIRP (dBW)	8.0	8.0	11.0	11.0	8.0
Maximum Beam Peak EIRP Density (dBW/4kHz)	-13.0	-13.0	3.0	3.0	0.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-49.0	-49.0	-33.0	-33.0	-35.0

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	----	----	----	----	CGLU*	CGRU*	CGLD*	CGRD*
West Hemi	----	----	----	----	WHLU	----	WHRD	----
East Hemi	----	----	----	----	EHLU	----	EHRD	----
Northwest	----	----	----	----	----	NWRU	NWLD	----
Southwest	----	----	----	----	----	SWRU	SWLD	----
Middle East	----	----	----	----	----	MERU	MELD	----
Southeast	----	----	----	----	----	SERU	SELD	----
Northeast	----	----	----	----	----	NERU	NELD	----
East	----	----	----	----	----	CERU	CELD	----
Telemetry Global	----	----	----	----	----	----	----	TLMG*
Telemetry Bicone	----	----	----	----	----	----	----	TLMB*
Command Global	----	----	----	----	CMDG*	----	----	----
Command Bicone	----	----	----	----	CMDB*	----	----	----
C-band ULPC	----	----	----	UPCV*	----	----	----	----
Ku-Band Beams								
South East Asia, Sri Lanka	S1HU	----	----	S1VD S1VE	----	----	----	----
Europe	----	S2VU	S2HD S2HE	----	----	----	----	----
Ku-band ULPC	----	----	----	----	----	----	----	UPKC* UPKD*

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