Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate the satellite designated as Intelsat 903 at 31.5° W.L.

The characteristics of the Intelsat 903 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 the remainder of this Engineering Statement, which updates the beam gain contours. In all other respects, the characteristics of Intelsat 903 are the same as those described in SAT-MOD-20011221-00139.

2 Spacecraft Overview

Intelsat 903 is capable of operating in the C-band and Ku-band frequencies listed below.

Direction	Frequency
Uplink	5850 – 6425 MHz
	14000 – 14500 MHz
Downlink	3625 – 4200 MHz
	10950 – 11200 MHz
	11450 – 11700 MHz

The spacecraft provides the following coverage:

Beam	Coverage
Central West	South America
West Hemi	North and South America
East Hemi	Africa and Europe
Northwest	Northern United States
Southwest	Southern South America
Middle West	Central America and Caribbean
Southeast	Sub-Saharan Africa
Northeast	Europe and Greenland
Global	Global
Steerable Spot Beams	Global

2.1 Spacecraft Characteristics

Intelsat 903 is a Space Systems Loral FS-1300HL three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 903 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 903 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 903 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 903 provides active communication channels at C-band frequencies, each having a bandwidth of 36 MHz or 72 MHz, and Ku-band frequencies each having a bandwidth of 36 MHz, 72 MHz, or 77 MHz. The Intelsat 903 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 Schedule S operating bands table includes the frequency band 10950-11700 MHz, which encompasses two bands on Intelsat 903: 10950-11200 MHz and 11450-11700 MHz. Although the 10950-11700 MHz band also includes 11200-11450 MHz, which is not used by Intelsat 903, the larger band is identified in Schedule S to eliminate the need to create duplicate, identical beams to include both sub-bands.

The coverage contours and performance characteristics of all Intelsat 903 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 903 uplink and downlink beams, respectively.

Intelsat 903 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 31.5° W.L., and the coverage contours will remain identical in gain and roll-off regardless of pointing. Intelsat will ensure that transmissions in these beams are consistent with the Commission's rules and the ITU Radio Regulations as they pertain to the Fixed Satellite Service.

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 903 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 903 command and telemetry subsystem performance is summarized in Exhibit 3.

2.4 Uplink Power Control Subsystem

Intelsat 903 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 903 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 be in compliance 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 903 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 903 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

Emission designators and allocated 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 903 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 903 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 903 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 903 emissions.

6 Orbital Location

Intelsat requests that it be assigned the 31.5° W.L. orbital location for Intelsat 903. The 31.5° W.L. location satisfies Intelsat 903 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 with Co-frequency Space Stations

Intelsat 903 will operate under existing filings of the United States Administration. Intelsat 903 operations in the 3700 – 4200 MHz and 5925 – 6425 MHz bands have been coordinated under the Administration of the United States' ITU filings INTELSAT8 328.5E and INTELSAT9 328.5E.

The downlink EIRP density of Intelsat 903 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 903 at 31.5°W.L.

The downlink EIRP density of Intelsat 903 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 903 at 31.5° W.L.

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 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.

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 903 will be drifted to 31.5°W.L. and will be operated co-located with Intelsat 25.

During the relocation of Intelsat 903, Intelsat will take all the necessary steps to coordinate the move internally to minimize the risk of collision or interference between Intelsat 903 and Intelsat 25. 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 903. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 903 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 283.3 kilometers above the geostationary arc. Intelsat has reserved 47.7 kilograms of fuel for this purpose.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.[1] The effective area to mass ratio (Cr*A/M) of the Intelsat 903 spacecraft is 0.044 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 283.3 kilometers above the geostationary arc. Accordingly, the Intelsat 903 planned disposal orbit 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 one or more of the following earth stations: Fuchsstadt, Germany; Hartebeesthoek, South Africa; Mountainside, Maryland; or Fucino, Italy. Additionally, Intelsat is capable of remotely controlling Intelsat 903 from its facilities in McLean, VA or in Long Beach, CA.

[1] *Mitigation of Orbital Debris*, Second Report and Order, IB Docket No. 02-54, FCC 04-130 (rel. June 21, 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	January 30, 2017
Alexander Gerdenitsch Intelsat Manager, Spectrum Policy, Americas	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-Band Global	C-Band Global	West Hemi	East Hemi	Northwest
Schedule S Beam ID	CGRU	CGLU	WHLU	EHLU	NWRU
Frequency Band (MHz)	6300 - 6425	6300 - 6425	5850 - 6300	5850 - 6300	5850 - 6300
Polarization	RHCP	LHCP	LHCP	LHCP	RHCP
G/T (dB/K)	-6.7	-6.7	-2.2	-2.5	5.8
Minimum SFD-- (dBW/m^2)	-91.2	-92.6	-89.5	-89.7	-90.2
Maximum SFD-- (dBW/m^2)	-69.2	-70.6	-67.5	-67.7	-68.2

Beam Name	Southwest	Middle West	Southeast	Northeast	Central West
Schedule S Beam ID	SWRU	MWRU	SERU	NERU	CWRU
Frequency Band (MHz)	5850 - 6300	5850 - 6300	5850 - 6300	5850 - 6300	5850 - 6300
Polarization	RHCP	RHCP	RHCP	RHCP	RHCP
G/T (dB/K)	1.5	2.7	-0.8	4.2	-1.9
Minimum SFD-- (dBW/m^2)	-89.9	-91.2	-91.5	-92.0	-86.6
Maximum SFD-- (dBW/m^2)	-67.9	-69.2	-69.5	-70.0	-64.6

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	8.9
Minimum SFD-- (dBW/m^2)	-92.3	-91.8
Maximum SFD-- (dBW/m2)	-74.3	-73.8

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-Band Global	C-Band Global	West Hemi	East Hemi	Northwest
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 Density (dBW/Hz)	-40.1	-39.8	-35.2	-34.6	-32.8
Maximum Beam Peak EIRP (dBW)	35.5	35.8	40.4	41.0	42.8
Maximum Beam Peak EIRP Density (dBW/4kHz)	-4.1	-3.8	0.8	1.4	3.2

Beam Name	Southwest	Middle West	Southeast	Northeast	Central West
Schedule S Beam ID	SWLD	MWLD	SELD	NELD	CWLD
Frequency Band (MHz)	3625 - 4075	3625 - 4075	3625 - 4075	3625 - 4075	3625 - 4075
Polarization	LHCP	LHCP	LHCP	LHCP	LHCP
Maximum Beam Peak EIRP Density (dBW/Hz)	-31.6	-28.0	-34.5	-29.7	-32.5
Maximum Beam Peak EIRP (dBW)	44.0	47.6	41.1	45.9	43.1
Maximum Beam Peak EIRP Density (dBW/4kHz)	4.4	8.0	1.5	6.3	3.5

Beam Name	Ku-Band Spot	Ku-Band Spot
Schedule S Beam ID	SIVD	S2HD
Frequency Band (MHz)	10950 – 11200 11450 - 11700	10950 – 11200 11450 - 11700
Polarization	Vertical	Horizontal
Maximum Beam Peak EIRP Density (dBW/Hz)	**-22.0**	**-21.8**
Maximum Beam Peak EIRP (dBW)	**53.6**	**53.8**
Maximum Beam Peak EIRP Density (dBW/4kHz)	**14.0**	**14.2**

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
Schedule S Beam ID	TLMG	TLMB	UPKC	UPCV
Frequencies (MHz)	3947.5 & 3952.0	3948.0 & 3952.5	11198.0 & 11452.0	3950.0
Polarization	RHCP	RHCP	RHCP	Vertical
Maximum Channel EIRP (dBW)	8.0	8.0	11.0	8.0
Maximum Beam Peak EIRP Density (dBW/4kHz)	-6.0	-6.0	-3.0	0.0
Maximum Beam Peak EIRP Density (dBW/Hz)	-42	-42	-39	-36

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	----	----	----	----	----	MWRU	MWLD	----
Southeast	----	----	----	----	----	SERU	SELD	----
Northeast	----	----	----	----	----	NERU	NELD	----
East	----	----	----	----	----	CWRU	CWLD	----
Telemetry Global	----	----	----	----	----	----	----	TLMG*
Telemetry Bicone	----	----	----	----	----	----	----	TLMB*
Command Global	----	----	----	----	CMDG*	----	----	----
Command Bicone	----	----	----	----	CMDB*	----	----	----
C-band ULPC	----	----	----	UPCV*	----	----	----	----
Ku-Band Beams								
Sri Lanka	S1HU	----	S1VD	----	----	----	----	----
Central Europe	----	S2VU	----	S2HD	----	----	----	----
Ku-band ULPC	----	----	----	----	----	----	----	UPKC*

** 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)
SKU1	S2VU	Vertical	14042.5	SKD1	S2HD	Horizontal	10992.5	77
SKU2	S2VU	Vertical	14125	SKD2	S2HD	Horizontal	11075	72
SKU3	S2VU	Vertical	14205	SKD3	S2HD	Horizontal	11155	72
SKU4	S2VU	Vertical	14295	SKD4	S2HD	Horizontal	11495	72
SKU5	S2VU	Vertical	14355	SKD5	S2HD	Horizontal	11555	36
SKU6	S2VU	Vertical	14395	SKD6	S2HD	Horizontal	11595	36
SKU7	S2VU	Vertical	14435	SKD7	S2HD	Horizontal	11635	36
SKU8	S2VU	Vertical	14475	SKD8	S2HD	Horizontal	11675	36
SKU1	S1HU	Horizontal	14042.5	SKD1	S1VD	Vertical	10992.5	77
SKU2	S1HU	Horizontal	14125	SKD2	S1VD	Vertical	11075	72
SKU3	S1HU	Horizontal	14205	SKD3	S1VD	Vertical	11155	72
SKU4	S1HU	Horizontal	14295	SKD4	S1VD	Vertical	11495	72
SKU5	S1HU	Horizontal	14355	SKD5	S1VD	Vertical	11555	36
SKU6	S1HU	Horizontal	14395	SKD6	S1VD	Vertical	11595	36
SKU7	S1HU	Horizontal	14435	SKD7	S1VD	Vertical	11635	36
SKU8	S1HU	Horizontal	14475	SKD8	S1VD	Vertical	11675	36
CU1	NWRU,	RHCP	5890	CD1	NWLD,	LHCP	3665	72
CU2	SWRU,		5970	CD2	SWLD,		3745	72
CU3	MERU,		6050	CD3	MELD,		3825	72
CU4	SERU,		6130	CD4	SELD,		3905	72
CU5	NERU,		6220	CD5	NELD,		3995	72
CU6	& CERU		6280	CD6	& CELD		4055	36
CGU1	CGRU	RHCP	6320	CGD1	CGLD	LHCP	4095	36
CGU2	CGRU	RHCP	6360	CGD2	CGLD	LHCP	4135	36
CGU3	CGRU	RHCP	6402.5	CGD3	CGLD	LHCP	4177.5	36
CGU1	CGLU	LHCP	6320	CGD1	CGRD	RHCP	4095	36
CGU2	CGLU	LHCP	6360	CGD2	CGRD	RHCP	4135	36
CGU3	CGLU	LHCP	6402.5	CGD3	CGRD	RHCP	4177.5	36
CU1	WHLU & EHLU	LHCP	5890	CD1	WHRD & EHRD	RHCP	3665	72
CU2		LHCP	5970	CD2		RHCP	3745	72
CU3		LHCP	6050	CD3		RHCP	3825	72
CU4		LHCP	6130	CD4		RHCP	3905	72
CU5		LHCP	6220	CD5		RHCP	3995	72
CU6		LHCP	6280	CD6		RHCP	4055	36