Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate the satellite designated as Intelsat 1R (Call Sign S2368) from 157.1° E.L.[1]

The characteristics of the Intelsat 1R 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 updates the beam gain contours. In all other respects, the characteristics of Intelsat 1R are the same as those described in SAT-MOD-20160219-00019.

2 Spacecraft Overview

Intelsat 1R is a Boeing 702MP spacecraft that is capable of operating in the C-band and Ku-band frequencies listed below.

Direction	Frequency
Uplink	5925 – 6425 MHz
	13750 – 14500 MHz
Downlink	3700 – 4200 MHz
	10950 – 11200 MHz
	11450 – 11950 MHz

The spacecraft provides the following coverage:

Band	Beam
C-band	Asia-Australia
	East Pacific
	Global
Ku-band	Asia
	Australia
	East Pacific
	Combined Uplink Asia and East Pacific

[1] Intelsat 1R currently is operating at 157.1° E.L. pursuant to STA. *See Policy Branch Information; Actions Taken*, Public Notice, Report No. SAT-01263, IBFS File No. SAT-STA-20170822-00120 (Aug. 25, 2017).

2.1 Spacecraft Characteristics

Intelsat 1R is a three-axis stabilized type spacecraft that has a rectangular outer body structure. Intelsat 1R utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Intelsat 1R 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 1R 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 1R provides active communication channels at C-band and Ku-band frequencies, each having a bandwidth of 36 MHz. The Intelsat 1R frequencies, polarization, and channel plan are provided in Schedule S.

The performance characteristics of all Intelsat 1R beams are provided in Schedule S. The coverage contours of all Intelsat 1R beams, except for those with their -8.0 dB contour extending beyond the edge of the Earth, are provided with Schedule S.

Exhibit 1 provides the Schedule S beam designation for all beams. Exhibits 2 and 3 provide the beam parameters for the Intelsat 1R uplink and downlink beams, respectively.

All of the bandwidth in each communication beam can be connected in loopback, wherein uplink channels in each uplink beam are connected to downlink channels in the downlink beam serving the same geographic area. Additionally, some C- or Ku-band channels in each beam can be interconnected with some C- or Ku-band channels in each of the other beams.

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 1R command and telemetry channel frequencies and performance are shown in Exhibit 4. The coverage patterns of the on-station command and telemetry beams are provided in the Schedule S. The coverage patterns of the bi-conical emergency 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.

2.4 Uplink Power Control Subsystem

Intelsat 1R utilizes one C-band channel and one Ku-band channel 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 Commission'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 1R ULPC frequencies and subsystem performance are summarized in Exhibit 4.

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 1R 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 1R 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 3700–4200 MHz, 10950–11200 MHz, and 11450-11700 MHz bands are contained in Section 25.208 of the Commission's rules. Neither the Commission's rules nor the ITU Radio Regulations specify any PFD limits for the 11700 – 11950 MHz band applicable to geostationary satellites operating in the Fixed Satellite Service.

The maximum PFD levels for the Intelsat 1R transmissions were calculated for the 3700–4200 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 1R carriers do not exceed the limits specified in Sections 25.208 of the Commission's rules.

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 1R 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 1R emissions.

6 Orbital Location

Intelsat requests that it be assigned the 157.1° E.L. orbital location for Intelsat 1R. The 157.1° E.L. location satisfies Intelsat 1R 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 1R's operations in the 3700-4200 MHz, 5925-6425 MHz, 10950-11200 MHz, 11450-11950 MHz, and 14000-14500 MHz frequency bands have been notified under the

Administration of the United States' International Telecommunication Union ("ITU") filing INTELSAT7 157E.

Intelsat 1R's operations in the 13750-14000 MHz frequency band are being notified under the Administration of Papua New Guinea's ITU filing NEW DAWN 47.

Intelsat respectfully requests that the United States Administration state its non-objection to Papua New Guinea's use of Intelsat 1R for purposes of bringing into use and maintaining the NEW DAWN 47 filing.

8 Coordination Statement and Certifications

The downlink EIRP density of Intelsat 1R'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 1R at 157.1° E.L.

The downlink EIRP density of Intelsat 1R's transmissions in the conventional and extended Ku-band 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 1R at 157.1° E.L.

Further, Intelsat will operate Intelsat 1R in compliance with all existing or future coordination agreements for 157.1° E.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

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.

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 that all active units are turned off. However, due to the design of Intelsat 1R, Intelsat will not be able to vent all pressurized systems. Intelsat previously received waiver of Section 25.283(c) of the Commission's rules, 47 C.F.R. § 25.283.[2]

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. At 157.1°E.L., Intelsat 1R will not be located at an orbital location that has an overlapping station-keeping volume with another 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 1R. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 1R 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 297.4 kilometers above the geostationary arc. Intelsat has reserved 30.035 kilograms of xenon for that purpose.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.[3] The effective area to mass ratio (Cr*A/M) of the Intelsat 1R spacecraft is 0.0625 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 297.4 kilometers above the geostationary arc. Accordingly, the Intelsat 1R 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

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[2] *See PanAmSat Licensee Corp. Application to Modify License for Intelsat 1R,* IBFS File No. SAT-MOD-20090720-00073, ¶ 8 (stamp grant issued by Steve Duall on Aug. 5, 2010).

[3] *Mitigation of Orbital Debris,* Second Report and Order, 19 FCC Rcd. 11567 (2004).

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: Kumsan, South Korea; Mingenew, Australia; and Paumalu, Hawaii. Additionally, Intelsat is capable of remotely controlling Intelsat 1R from its facilities in McLean, VA.

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 3, 2018
Alexander Gerdenitsch Intelsat Manager, Spectrum Policy, Americas	Date

EXHIBIT 1

Beam Polarizations and GXT File Names

	Schedule S Beam GXT File Names							
	Linear Polarization				Circular Polarization			
Beam Description	**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	GCHU*	----	----	GCVD*	----	----	----	----
Asia-Australia	ACHU	ACVU	ACHD	ACVD	----	----	----	----
East Pacific	----	ECVU	ECHD	----	----	----	----	----
ULPC (Global)	----	----		----	----	----	----	UPCR*
Ku-Band Beams								
Asia	NKHU	NKVU	NKHD NKHE	NKVD	----	----	----	----
Australia	SKHU	SKVU	SKHD	S1VD	----	----	----	----
Australia	----	----	----	S2VD	----	----	----	----
East Pacific	EKHU	EKVU	EKHD	EKVD EKVE	----	----	----	----
Asia & E. Pacific	----	CKVU	----	----	----	----	----	----
Telemetry	----	----	TLMB*	TLMC*	----	----	TLMP*	----
Command	CMDC*	CMDB*	----	----	CMDP*	----	----	----
ULPC (Global)	----	----	----	----	----	----	UPCL*	----

** 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	Asia & Australia		East Pacific	Global
Schedule S Beam ID	ACHU	ACVU	ECVU	GCHU
Frequency Band (MHz)	**5925 – 6425**	**5925 – 6425**	**5925 – 6425**	**5925 – 6425**
Polarization	Horizontal	Vertical	Vertical	Horizontal
G/T (dB/K)	1.4	1.3	1.2	-8.2
Minimum SFD-- (dBW/m^2)	-99.3	-98.4	-94.9	-88.8
Maximum SFD-- (dBW/m^2)	-69.3	-68.4	-64.9	-58.8

Beam	Asia		Australia	
Schedule S Beam ID	NKHU	NKVU	SKVU	SKHU
Frequency Band (MHz)	**13750 – 14500**	**13750 - 14500**	**13750 - 14500**	**13750 - 14500**
Polarization	Horizontal	Vertical	Vertical	Horizontal
G/T (dB/K)	6.8	6.8	6.5	6.1
Minimum SFD-- (dBW/m^2)	-104.8	-104.2	-104.6	-104.1
Maximum SFD-- (dBW/m^2)	-74.8	-74.2	-74.6	-74.1

Beam	East Pacific		Asia & East Pacific
Schedule S Beam ID	EKHU	EKVU	CKVU
Frequency Band (MHz)	**13750 - 14500**	**13750 - 14500**	**13750 - 14500**
Polarization	Horizontal	Vertical	Vertical
G/T (dB/K)	6.6	4.8	6.5
Minimum SFD-- (dBW/m^2)	-104.9	-102.9	-104.3
Maximum SFD-- (dBW/m^2)	-74.9	-72.9	-74.3

EXHIBIT 3

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam	Asia & Australia		East Pacific	Global
Schedule S Beam ID	ACHD	ACVD	ECHD	GCVD
Frequency Band (MHz)	3700 - 4200	3700 - 4200	3700 - 4200	3700 - 4200
Polarization	Horizontal	Vertical	Horizontal	Vertical
Maximum Beam Peak EIRP (dBW)	43.7	43.4	41.9	34.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	4.6	4.3	2.8	-4.5
Maximum Beam Peak EIRP Density (dBW/Hz)	-31.4	-31.7	-33.2	-40.5

Beam	Asia			Australia
Schedule S Beam ID	NKHD	NKHE	NKVD	SKHD
Frequency Band (MHz)	10950 – 11200	11450 – 11700	10950 – 11200	11700 - 11950
Polarization	Horizontal	Horizontal	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	50.9	50.9	50.3	52.9
Maximum Beam Peak EIRP Density (dBW/4kHz)	11.8	11.8	11.2	13.8
Maximum Beam Peak EIRP Density (dBW/Hz)	-24.2	-24.2	-24.8	-22.2

Beam	Australia	Australia	East Pacific
Schedule S Beam ID	S1VD	S2VD	EKHD
Frequency Band (MHz)	11700 - 11950	11450 - 11700	11450 - 11700
Polarization	Vertical	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	53.0	52.1	52.3
Maximum Beam Peak EIRP Density (dBW/4kHz)	13.9	13	13.2
Maximum Beam Peak EIRP Density (dBW/Hz)	-22.1	-23	-22.8

Beam	East Pacific	
Schedule S Beam ID	EKVD	EKVE
Frequency Band (MHz)	10950 – 11200	11450 – 11700
Polarization	Vertical	Vertical
Maximum Beam Peak EIRP (dBW)	50.3	50.3
Maximum Beam Peak EIRP Density (dBW/4kHz)	11.2	11.2
Maximum Beam Peak EIRP Density (dBW/Hz)	-24.8	-24.8

EXHIBIT 4

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command East Asia	Command Bicone	Command Pipe
Schedule S Beam ID	CMDC	CMDB	CMDP
Center Frequencies (MHz)	13995.0	13995.0	14498.5
Command Carrier Bandwidth (MHz)	1.0	1.0	1.0
Polarization	Horizontal	Vertical	LHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-122.9	-100.1	-103.0

Beam Name	Telemetry East Asia	Telemetry Bicone	Telemetry Pipe	ULPC	ULPC
Schedule S Beam ID	TLMC	TLMB	TLMP	UPCR	UPCL
Frequencies (MHz)	11696.0 & 11697.0	11696.0 & 11697.0	11696.0 & 11697.0	11699.0	11699.0
Polarization	Vertical	Horizontal	LHCP	RHCP	LHCP
Maximum Channel EIRP (dBW)	15.0	11.8	10.7	11.2	11.2
Channel Bandwidth (MHz)	0.5	0.5	0.5	.025	.025
Maximum Beam Peak EIRP Density (dBW/4kHz)	-6	-9.2	-10.3	3.2	3.2
Maximum Beam Peak EIRP Density (dBW/Hz)	-42	-45.2	-46.3	-32.8	-32.8

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