

Engineering Statement

1 Introduction

Together with the accompanying Schedule S and GXT files, Intelsat License LLC (“Intelsat”) herein demonstrates that it is technically qualified to hold the authority sought in this application to launch and operate Galaxy 37, a replacement C-band satellite with new frequencies at 127.0° W.L. Galaxy 37 is the C-band payload on the Galaxy 37/Horizons-4 spacecraft. The spacecraft’s Ku-band payload will be Japan-licensed and known as Horizons-4. While Horizons-4 Satellite LLC will separately seek U.S. market access for the Ku-band payload, for administrative ease the characteristics of the Galaxy 37/Horizons-4 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.

2 Spacecraft Overview

While Intelsat is only seeking authority to operate in C-band at 127.0° W.L., Galaxy 37/Horizons-4 has the capability to operate in the frequencies listed in the table below:

Direction	Frequency
Uplink	5925-6425 MHz
	14000-14500 MHz
Downlink	3700-4200 MHz ¹
	11700-12200 MHz

¹ Following completion of the C-band transition, the Galaxy 37/Horizons-4 satellite will not downlink in the 3700-4000 MHz band to fixed earth stations in the contiguous United States, except as allowed at two consolidated TT&C/Gateway locations in Brewster, Washington and Andover, Maine. *See Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343, ¶ 134 (2020).

The spacecraft provides the following coverage:

Frequency Band	Beam	Coverage
C-band	Wide Beam Steerable	North America including Alaska and Hawaii; Central America; and the Caribbean
Ku-band	Steerable CONUS	Contiguous United States
Ku-band	Steerable North Pacific	North Pacific area
Ku-band	Steerable East Pacific	East Pacific area
Ku-band	Steerable South Pacific	South Pacific area

2.1 Spacecraft Characteristics

Galaxy 37/Horizons-4 is a Maxar FS 1300-140 three-axis stabilized type spacecraft that has a rectangular outer body structure. Galaxy 37/Horizons-4 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The satellite is composed of the following subsystems:

- Thermal;
- Power;
- Attitude Control;
- Propulsion;
- Telemetry, Tracking, and Commanding (“TT&C”);
- Uplink Power Control (“ULPC”); 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 for all the various subsystems in order to avoid single-point failures.

The structural design of Galaxy 37/Horizon-4 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

Galaxy 37/Horizon-4's C- and Ku-band frequencies, polarization, and channel plan as well as the coverage contours and performance characteristics are provided in Schedule S. Exhibits 1 and 2 provide the beam parameters for the C- and Ku-band uplink and downlink beams, respectively, and Exhibit 4 provides the Schedule S beam designations.

2.3 TT&C Subsystem

The TT&C 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 Galaxy 37/Horizon-4 TT&C frequencies are tunable and selectable via ground command in 100 kHz steps. The satellite's command and telemetry channel frequencies and performance 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), contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S.

2.4 ULPC

Galaxy 37/Horizons-4 utilizes one C- and one Ku-band channel for 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), contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. Galaxy 37/Horizons-4's ULPC frequencies and subsystem performance are summarized in Exhibit 3.

2.5 Satellite Station-Keeping

The satellite will be maintained within 0.05° of its nominal longitudinal position in the east-west direction in compliance with Section 25.210(j).

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

Galaxy 37/ Horizons-4 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 Galaxy 37/Horizons-4 can provide a range of communications services, including compressed digital video, high speed digital data, and digital single channel per carrier data channels.

4 Power Flux Density

The power flux density limits for space stations operating in the C- and Ku-band is specified in Section 25.208. As provided in Schedule S, the Galaxy 37/Horizons-4 transmissions do not exceed these limits.

5 Emission Compliance

Section 25.202(e) requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Galaxy 37/Horizons-4 is designed to be compliant with the provisions of this rule.

Galaxy 37/Horizons-4 will comply with the provisions of Section 25.202(f) with regard to its emissions.

6 Orbital Location

Intelsat requests that Galaxy 37/Horizons-4 be assigned the 127.0° W.L. orbital location as a replacement satellite for Galaxy 13/Horizon 1, which is currently licensed and operating at 127.0°W.L.

7 Coordination Statement and Certifications

The downlink effective isotropic radiated power (“EIRP”) density of the satellite’s transmissions in the conventional C-band will not exceed 3 dBW/4 kHz for digital transmissions or 8 dBW/4 kHz for analog transmissions, and in the conventional and extended Ku-band the downlink EIRP

density will not exceed 14 dBW/4 kHz for digital transmissions or 17 dBW/4 kHz for analog transmissions.

The associated uplink transmissions will not exceed the applicable EIRP density envelope in Section 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 Galaxy 37/Horizons-4 at 127.0° 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

Galaxy 37/Horizons-4 is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and small 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.

As calculated using the NASA Debris Assessment Software, the Galaxy 37/Horizons 4 satellite's probability of a collision with large objects is less than 0.01 and based on satellite manufacturer analysis the probability of collision with small objects is less than 0.01.

8.2 Minimizing Accidental Explosions

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The satellite 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.

Galaxy 37/Horizons-4 will replace Galaxy 13/Horizon 1 at 127° W.L. The satellites may be nominally collocated during transfer of traffic and for a short period thereafter. Intelsat will

ensure that sufficient spatial separation is achieved between these two satellites through the use of orbit eccentricity and inclination offsets and thus will minimize the risk of collision.

Intelsat is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, having an overlapping station-keeping volume with Galaxy 37/Horizons-4. Intelsat is also not aware of any system with an overlapping station-keeping volume with the satellite that is the subject of an International Telecommunication Union filing and that is either in orbit or progressing towards launch.

8.4 Post Mission Disposal

At the end of the mission, Intelsat will dispose of the spacecraft by moving it to an altitude of at least 270.4 kilometers above the geostationary arc. Intelsat has reserved 52.0 kilograms of bi-propellant for that purpose.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.² The effective area to mass ratio ($C_r \cdot A/M$) of the satellite is 0.030 m²/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 270.4 kilometers above the geostationary arc. Accordingly, Galaxy 37/Horizons-4's planned disposal orbit complies with the FCC's rules.

The reserved propellant figure is an estimate. This figure is calculated by taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit.

9 TT&C Control Earth Stations

Intelsat will conduct TT&C operations through earth stations at one or more of the following teleports: Napa, California; Hagerstown, Maryland; Fillmore, California; Nuevo, California; Castle Rock, Colorado; Brewster, Washington; Andover, Maine; Haleiwa, Hawaii; and Ellenwood, Georgia. Additionally, Intelsat is capable of remotely controlling Galaxy 37/Horizons-4 from its facilities in McLean, Virginia and Long Beach, California.

² See *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

Giselle Creeser
Intelsat US LLC
Director, Spectrum Policy and
Engineering

28 March 2023

Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-band Wide beam	C-band Wide beam	Ku-band North Pacific	Ku-band East Pacific
Schedule S Beam ID	CAHU	CAVU	NPVU	EPHU
Frequency Band (MHz)	5925-6425	5925-6425	14000-14500	14000-14500
Polarization	Horizontal	Vertical	Vertical	Horizontal
G/T (dB/K)	4.9	4.8	1.98	2.83
Minimum SFD-- (dBW/m ²)	-102	-102	-101	-101.8
Maximum SFD-- (dBW/m ²)	-77	-77	-76	-76.8

Beam Name	Ku-band CONUS	Ku-band CONUS	Ku-band South Pacific
Schedule S Beam ID	USHU	USVU	SPHU
Frequency Band (MHz)	14000-14500	14000-14500	14000-14500
Polarization	Horizontal	Vertical	Horizontal
G/T (dB/K)	6.52	5.28	1.72
Minimum SFD-- (dBW/m ²)	-102	-102	-100.7
Maximum SFD-- (dBW/m ²)	-77	-77	75.7

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-band Wide beam	C-band Wide beam	Ku-band North Pacific	Ku-band East Pacific
Schedule S Beam ID	CAHD	CAVD	NPHD	EPVD
Frequency Band (MHz)	3700-4200	3700-4200	11700-12200	11700-12200
Polarization	Horizontal	Vertical	Horizontal	Vertical
Maximum Beam Peak EIRP (dBW)	46.4	46.0	48.3	48.2
Maximum Beam Peak EIRP Density (dBW/4kHz)	6.9	6.5	8.8	8.7
Maximum Beam Peak EIRP Density (dBW/Hz)	-29.2	-29.6	-27.3	-27.4

Beam Name	Ku-band CONUS	Ku-band CONUS	Ku-band South Pacific
Schedule S Beam ID	USHD	USVD	SPVD
Frequency Band (MHz)	11700-12200	11700-12200	11700-12200
Polarization	Horizontal	Vertical	Vertical
Maximum Beam Peak EIRP (dBW)	52.3	52.4	47.1
Maximum Beam Peak EIRP Density (dBW/4kHz)	12.8	12.9	7.6
Maximum Beam Peak EIRP Density (dBW/Hz)	-23.3	-23.2	-28.5

EXHIBIT 3

TT&C SUBSYSTEM CHARACTERISTICS

Beam Name	Command 1 Global	Command 1 Omni	Command 2 Global	Command 2 Omni
Schedule S Beam ID	CMD1	CMD2	CMD3	CMD4
Frequencies (MHz) ³	14000.5	14000.5	14498.25	14498.25
Polarization	Horizontal	RHCP	Vertical	RHCP
Peak Flux Density at Command Threshold (dBW/m ² -Hz)	-100	-100	-100	-100

Beam Name	Telemetry 1 Omni	Telemetry 1 Global	Telemetry 2 Omni	Telemetry 2 Global
Schedule S Beam ID	TLMA	TLMB	TLMC	TLMD
Frequencies (MHz) ⁴	12197.5	12197.5	12199.5	12199.5
Polarization	LHCP	Vertical	LHCP	Vertical
Maximum Channel EIRP (dBW)	8.2	8.2	7.6	7.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	-12.8	-12.8	-13.4	-13.4
Maximum Beam Peak EIRP Density (dBW/Hz)	-48.8	-48.8	-49.4	-49.4

Beam Name	ULPC Dish	ULPC Dish
Schedule S Beam ID	UPC2	UPC1
Frequencies (MHz)	12199.95	4199.95
Polarization	RHCP	RHCP
Maximum Channel EIRP (dBW)	11.5	9.4
Maximum Beam Peak EIRP Density (dBW/4 kHz)	3.5	1.4
Maximum Beam Peak EIRP Density (dBW/Hz)	-32.5	-34.6

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

³ The center frequencies given are representative. See § 2.3.

⁴ *Id.*

EXHIBIT 4 **BEAM POLARIZATIONS AND GXT FILE NAMES**

Beam Designation	Schedule S Beam Names							
	Linear Polarization				Circular Polarization			
	Uplink	Uplink	Downlink	Downlink	Uplink	Uplink	Downlink	Downlink
	(H-Pol.)	(V-Pol.)	(H-Pol.)	(V-Pol.)	(LHCP)	(RHCP)	(LHCP)	(RHCP)
C-band Beams								
C-band	CAHU	CAVU	CAHD	CAVD	----	----	----	----
Telemetry 1	----	----	----	TLMA*	----	----	TLMB*	----
Telemetry 2	----	----	----	TLMC*	----	----	TLMD*	----
ULPC	----	----	----	----	----	----	----	UPC1*
Ku-band Beams								
Ku-band	USHU EPHU SPHU	USVU NPVU	USHD NPHD	USVD EPVD SPVD	----	----	----	----
Command 1	CMD1*	----	----	----	----	CMD2*	----	----
Command 2	----	CMD3*	----	----	----	CMD4*	----	----
ULPC	----	----	----	----	----	----	----	UPC2*

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