Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to operate a satellite, designated as Telkom-2, currently operating at 118° E.L., at 157.0° E.L. Telkom-2 currently is licensed by the Administration of Indonesia, which will authorize the drift of the satellite to the 157.0° E.L. location.

The characteristics of the Telkom-2 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.

2 Spacecraft Overview

Telkom-2 is an Orbital Sciences GEOStar-2 spacecraft that is capable of operating in the C-band frequencies listed below and providing service to Southeast Asia and India.

Direction	Frequency
Uplink	5925 – 6425 MHz
Downlink	3700 – 4200 MHz

2.1 Spacecraft Characteristics

Telkom-2 is a three-axis stabilized type spacecraft that has a rectangular outer body structure. Telkom-2 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Telkom-2 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 Telkom-2 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

Telkom-2 provides active communication channels at C-band frequencies, each having a bandwidth of 36 MHz. The Telkom-2 frequencies, polarization, and channel plan are provided in 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 Telkom-2 communications beams are provided in Schedule S. Exhibits 1 and 2 provide the beam parameters for the Telkom-2 uplink and downlink communications 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 Telkom-2 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 Telkom-2 command and telemetry subsystem performance is summarized in Exhibit 3 and in Schedule S.

2.4 Satellite Station-Keeping

The spacecraft will be maintained within 0.05° of 157.0° E.L. 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

Telkom-2 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 Telkom-2 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 band are specified in Section 25.208 of the Commission's rules and in No. 21.16 of the International Telecommunication Union ("ITU") Radio Regulations. The maximum PFD levels for the Telkom-2 transmissions were calculated for the 3700 – 4200 MHz band. The results are provided in Schedule S and show that the downlink power flux density levels of the Telkom-2 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. Telkom-2 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 Telkom-2 emissions.

6 Orbital Location

Intelsat requests that it be assigned the 157.0° E.L. orbital location for Telkom-2. The 157.0° E.L. location satisfies Telkom-2 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

Telkom-2 will operate under existing filings of the United States Administration. Telkom-2 operations in the 3700 – 4200 MHz and 5925 – 6425 MHz bands have been coordinated under the Administration of the United States' ITU filings INTELSAT5A 157E, INTELSAT6 157E, INTELSAT7 157E, and INTELSAT8 157E.

The downlink EIRP density of Telkom-2 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 Telkom-2 at 157.0° E.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. The Telkom-2 design incorporates the following elements to limit the effects of collision with small debris: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) spacecraft subsystems have redundant components to minimize 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

The probability of accidental explosions during and after completion of mission operations has been assessed. Telkom-2 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, all stored energy on the spacecraft will be removed by depleting the propellant, venting all pressurized systems and leaving the batteries in a permanent discharge state.

8.3 Safe Flight Profiles

The probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations has been assessed and limited. Subject to receipt of FCC approval, Telkom-2 will be operated at 157.0° E.L., where it will be nominally co-located with Intelsat 5, currently operating at 157.0° E.L. Prior to the arrival of Telkom-2, and pursuant to Commission approval, Intelsat 5 will be moved to 156.9° E.L.

Except for Intelsat 5, Intelsat is not aware of any FCC-licensed system, or any other system applied for and under consideration by the FCC, that will have an overlapping station-keeping volume with Telkom-2 at 157.0° E.L. Intelsat is also not aware of any system with an overlapping station-keeping volume with Telkom-2 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, Telkom-2 will be disposed of by moving it to an altitude of at least 263.6 kilometers above the geostationary arc. For that purpose, 5.5 kilograms of fuel has been reserved.

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 Telkom-2 spacecraft is 0.026 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 263.6 kilometers above the geostationary arc. Accordingly, the Telkom-2 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

TC&R operations will be conducted through an earth station located in Klapanunggal, Bogor-West Java Indonesia.

[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 24, 2017
Alexander Gerdenitsch Intelsat Manager, Spectrum Policy, Americas	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam	C-Band	C-Band	C-Band
Schedule S Beam ID	ASHU	ASVU	AIVU
Frequency Band (MHz)	5925 - 6425	5925 - 6425	5925 - 6425
Polarization	Horizontal	Vertical	Vertical
G/T (dB/K)	3	3	3
Minimum SFD-- (dBW/m^2)	-102	-102	-102
Maximum SFD-- (dBW/m^2)	-87	-87	-87

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam	C-Band	C-Band	C-Band
Schedule S Beam ID	ASHD	ASVD	AIHD
Frequency Band (MHz)	3700 - 4200	3700 - 4200	3700 - 4200
Polarization	Horizontal	Vertical	Horizontal
Maximum Beam Peak EIRP (dBW)	43.5	43.5	43.5
Maximum Beam Peak EIRP Density (dBW/4kHz)	3.9	3.9	3.9

EXHIBIT 3

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Global	Command Pipe	Command Bicone
Schedule S Beam ID	CMD	CMPV	CMDB
Frequencies (MHz)	6423.5	6423.5	6423.5
Polarization	RHCP	V	RHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-111.9	-110.9	-98.7

Beam Name	Command Global	Command Pipe	Command Bicone
Schedule S Beam ID	CMD	CMPH	CMDB
Frequencies (MHz)	5926.5	5926.5	5926.5
Polarization	RHCP	H	RHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-110.7	-111.7	-97.5

Beam Name	Telemetry Global	Telemetry Pipe	Telemetry Bicone
Schedule S Beam ID	TLM	TMPV	TLMB
Frequencies (MHz)	3701.25	3701.25	3701.25
Polarization	LHCP	V	LHCP
Maximum Channel EIRP (dBW)	11.3	17.7	13.6
Maximum Beam Peak EIRP Density (dBW/4kHz)	-8.2	-1.7	-5.8

Beam Name	Telemetry Global	Telemetry Pipe	Telemetry Bicone
Schedule S Beam ID	TLM	TMPH	TLMB
Frequencies (MHz)	4199.61	4199.61	4199.61
Polarization	LHCP	H	LHCP
Maximum Channel EIRP (dBW)	12.8	16.5	12.4
Maximum Beam Peak EIRP Density (dBW/4kHz)	-6.6	-2.9	-7.0

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								
ASEAN-India*	----	AIVU	AIHD	----	----	----	----	----
ASEAN	ASHU	ASVU	ASHD	ASVD	----	----	----	----
Telemetry Global	----	----	----	----	----	----	TLM**	----
Telemetry Pipe	----	----	TMPH**	TMPV**	----	----	----	----
Telemetry Bicone	----	----	----	----	----	----	TLMB**	----
Command Global	----	----	----	----	----	CMD**	----	----
Command Pipe	CMPH**	CMPV**	----	----		----	----	
Command Bicone	----	----	----	----	----	CMDB**	----	----

** ASEAN refers to the territories of the Association of Southeast Asian Nations*

*** 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	AIVU	Vertical	5945	CD01	AIHD	Horizontal	3720	36
CU02	AIVU	Vertical	5985	CD02	AIHD	Horizontal	3760	36
CU03	AIVU	Vertical	6025	CD03	AIHD	Horizontal	3800	36
CU04	AIVU	Vertical	6065	CD04	AIHD	Horizontal	3840	36
CU05	ASVU	Vertical	6105	CD05	ASHD	Horizontal	3880	36
CU06	ASVU	Vertical	6145	CD06	ASHD	Horizontal	3920	36
CU07	ASVU	Vertical	6185	CD07	ASHD	Horizontal	3960	36
CU08	ASVU	Vertical	6225	CD08	ASHD	Horizontal	4000	36
CU09	ASVU	Vertical	6265	CD09	ASHD	Horizontal	4040	36
CU10	ASVU	Vertical	6305	CD10	ASHD	Horizontal	4080	36
CU11	ASVU	Vertical	6345	CD11	ASHD	Horizontal	4120	36
CU12	ASVU	Vertical	6385	CD12	ASHD	Horizontal	4160	36
CU13	ASHU	Horizontal	5965	CD13	ASVD	Vertical	3740	36
CU14	ASHU	Horizontal	6005	CD14	ASVD	Vertical	3780	36
CU15	ASHU	Horizontal	6045	CD15	ASVD	Vertical	3820	36
CU16	ASHU	Horizontal	6085	CD16	ASVD	Vertical	3860	36
CU17	ASHU	Horizontal	6125	CD17	ASVD	Vertical	3900	36
CU18	ASHU	Horizontal	6165	CD18	ASVD	Vertical	3940	36
CU19	ASHU	Horizontal	6205	CD19	ASVD	Vertical	3980	36
CU20	ASHU	Horizontal	6245	CD20	ASVD	Vertical	4020	36
CU21	ASHU	Horizontal	6285	CD21	ASVD	Vertical	4060	36
CU22	ASHU	Horizontal	6325	CD22	ASVD	Vertical	4100	36
CU23	ASHU	Horizontal	6365	CD23	ASVD	Vertical	4140	36
CU24	ASHU	Horizontal	6405	CD24	ASVD	Vertical	4180	36