Engineering Statement

1 Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to relocate a satellite designated as JCSAT-RA, currently operating at 128° E.L. to, and operate the satellite at, 169.0° E.L. JCSAT-RA currently is licensed by the Administration of Japan.

The characteristics of the JCSAT-RA 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.

2 Spacecraft Overview

JCSAT-RA is a Lockheed Martin model A2100AX spacecraft that is capable of operating in the C- and Ku-band frequencies listed below.

Direction	Frequency
Uplink	6225 – 6485 MHz
	13800 – 14500 MHz
Downlink	3940 – 4200 MHz
	12200 – 12750 MHz

The spacecraft provides the following coverage:

Band	Beams	Coverage
C-band	CRH, CRV, CTH, CTV	Asia and Hawaii
Ku-band	JRH, JRV, JTH, JTV	Japan
Ku-band	ARH, ARV, ATH, ATV	Asia
Ku-band	HHT, HHR, OVT, OHR	Global

2.1 Spacecraft Characteristics

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

The JCSAT-RA 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 JCSAT-RA provides mechanical support for all subsystems. The structure supports the communication antennas, solar arrays, and the thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

2.2 Communication Subsystem

JCSAT-RA provides active communication channels at C- and Ku-band frequencies.

The C-band payload employs channels having a bandwidth of 36 MHz. The Ku-band payload employs channels having bandwidths of 27 MHz and 36 MHz. The JCSAT-RA frequency and polarization plan and performance characteristics of all JCSAT-RA beams are provided in Schedule S. The coverage contours for the C-band and Ku-band beams are provided in the separately submitted GIMS container file.

Exhibits 1 and 2 provide the beam parameters for the JCSAT-RA uplink and downlink 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 JCSAT-RA command and telemetry channel frequencies are shown in Exhibit 3. The coverage patterns of the OVT, HHT, OHR and HHR command and telemetry beams have gain contours that vary by less than 8 dB across the surface of the Earth and, accordingly, the contour at 8 dB below peak falls entirely beyond the edge of the visible 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 the GIMS container file. The JCSAT-RA command and telemetry subsystem performance is summarized in Exhibit 3.

2.4 Uplink Power Control Subsystem

JCSAT-RA utilizes one C-band and two Ku-band channels for uplink power control ("ULPC"), antenna tracking, and ranging. The coverage contours of the ULPC beams for the C-band and Ku-band ULPC beams are provided in the separately submitted GIMS container file. The JCSAT-RA ULPC frequencies and subsystem performance are summarized in Exhibit 3.

2.5 Cross-polarization Isolation

The level of cross-polarization isolation of all JCSAT-RA Ku-band beams is equal to or greater than 30 dB. The level of cross-polarization isolation of all JCSAT-RA C-band beams is equal to or greater than 27 dB. This level was the best that the satellite manufacturer could achieve without causing excessive degradation in the performance of the beam and/or in the size of the beams' coverage area. Intelsat has taken this level of isolation into account in its planned operations.

2.6 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

JCSAT-RA 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 JCSAT-RA 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

There are no power flux density ("PFD") limits for space stations operating in the 12200 – 12750 MHz band in Section 25.208 of the Commission's rules. There are PFD limits applicable to geostationary satellites operating in the fixed satellite service specified for this band in No.21.6 of the ITU Radio Regulations. The PFD limits for the 3940 – 4200 MHz band are contained in Section 25.208 of the Commission's rules.

The maximum PFD levels for the JCSAT-RA transmissions were calculated for the 3940 – 4200 MHz and 12200 – 12750 MHz bands. The results are provided in Schedule S and show that the downlink power flux density levels of the JCSAT-RA carriers do not exceed the limits specified in Sections 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. JCSAT-RA 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 JCSAT-RA emissions.

6 Orbital Location

Intelsat requests that it be assigned the 169.0° E.L. orbital location for JCSAT-RA. Currently, Intelsat 8 and Intelsat 805 are providing service at the nominal 169° E.L. orbital location. Intelsat intends to launch Horizons 3e in the third quarter of 2018 to replace both Intelsat 8 and Intelsat 805 at the nominal 169° E.L. orbital location. To bridge any potential gap in station-kept service that might otherwise occur prior to the arrival of Horizons 3e, JCSAT-RA is to be relocated to 169.0° E.L. Additionally, the location also ensures that the maximum operational, economic, and public interest benefits will be derived.

7 ITU Filings and Coordination with Co-Frequency Space Stations

The impact of the JCSAT-RA emissions on adjacent satellites located at 167.0°E.L. and 171.0º E.L. was analyzed. The interference analysis was conducted for a number of representative carriers at C-band and Ku-band frequencies.

The adjacent satellite located at 167.0º E.L. was assumed to be a hypothetical satellite having the same operating characteristics as JCSAT-RA.[1] The adjacent satellite located at 171.0º E.L. was also assumed to be a hypothetical satellite having the same operating characteristics as JCSAT-RA.[2]

It was also assumed for the analysis that in the plane of the geostationary satellite orbit, all transmitting and receiving earth station antennas have off-axis co-polar gains that are compliant with the limits specified in section 25.209(a) of the FCC's rules.

All assumptions and the results of the analysis are documented in Exhibits 4 and 5. The JCSAT-RA transmissions will comply with the levels contained in Sections 25.212(c) and (d) and Section 25.138 of the Commission's rules, as applicable, unless higher levels are coordinated with affected adjacent satellite operators within ±6°.

JCSAT-RA will operate under existing filings of the United States Administration.

JCSAT-RA's transmissions will comply with the levels contained in Sections 25.212(c) and (d) and Section 25.140(a)(3)(i) and (ii) of the Commission's rules, as recently amended,[3] unless higher levels are coordinated with affected adjacent satellite operators within ±6°

8 Orbital Debris Mitigation Plan

Intelsat is proactive in ensuring safe operation and disposal of 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 JCSAT-RA design incorporates the following elements to limit the effects of collision with small

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[1] [1]At the time of submission of this application, Luch-5A is located at 167° E.L. Its frequency plan overlaps Intelsat 805 in the 12500 – 12750 MHz band. Luch-5A was not included in the interference analysis because it is not licensed by the United States nor does it have U.S. market access. Intelsat is coordinating the use of the overlapping frequencies pursuant to ITU rules.

[2] Other satellites in the vicinity of 167° E.L. and 171° E.L. were not included in the interference analysis because they are not licensed by the United States nor do they have U.S. market access. Intelsat is coordinating the use of the overlapping frequencies pursuant to ITU rules.

[3] Intelsat understands that the FCC will apply the new rules and procedures to pending applications as soon as these rules become effective. *See Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, IB Docket No. 12-267, FCC 15-167 at ¶ 333 (rel. Dec. 17, 2015).

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. JCSAT-RA 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

Intelsat has assessed and limited the probability of the JCSAT-RA space station becoming a source of debris as a result of collision with large debris or other operational space stations at 169.0° E.L. When the drift of JCSAT-RA is completed, Intelsat 8 will be operating at 168.9° E.L and Intelsat 805 will be operating at 169.0° E.L. JCSAT-RA and Intelsat 805 will operate co-located at 169.0° E.L until traffic transition is complete, at which time Intelsat 805 will be moved to 169.1° E.L., subject to receipt of FCC approval. Once launched, Horizons 3e will operate at 169.0° E.L. The plan for JCSAT-RA after the arrival of Horizons-3e has not yet been determined. While these satellites are nominally collocated with JCSAT-RA, Intelsat will ensure that sufficient spatial separation is achieved between these two satellites through the use of orbit eccentricity and inclination offsets and thus minimize the risk of collision.

With the exception of the collocation with Intelsat 805 and Horizons 3e for the purpose of traffic transition, JCSAT-RA will not be located at the same orbital location as another satellite or at an orbital location that has an overlapping station-keeping volume with another satellite. Further, 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 JCSAT-RA at 169.0° E.L. Finally, Intelsat is not aware of any system with an overlapping station-keeping volume with JCSAT-RA at 169.0° E.L. that is the subject of an ITU filing and that is either in orbit or progressing toward launch.

8.4 Post Mission Disposal

At the end of the mission, JCSAT-RA will be disposed by moving it to an altitude of 300 kilometers above the geostationary arc. For that purpose, 10.2 kilograms of hydrazine have been reserved. 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.

In calculating the disposal orbit, simplifying assumptions have been used as permitted under the Commission's Orbital Debris Report and Order.[4] For reference, the effective area to mass ratio (Cr*A/M) of the JCSAT-RA spacecraft is 0.037 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of at most 272 kilometers above the geostationary arc. Accordingly, the JCSAT-RA planned disposal orbit complies with the FCC's rules.

9 TC&R Control Earth Stations

TC&R operations will be conducted through the earth stations located in Yokohama, Japan and Ibaraki, Japan.

[4] *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/ Candice DeVane	April 6, 2016
Candice DeVane Intelsat Manager, Spectrum Policy	Date

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	Japan	Japan	Asia	Asia	Asia/Hawaii	Asia/Hawaii
Schedule S Beam ID	JRH	JRV	ARH	ARV	CRH	CRV
Frequency Band (MHz)	13800-14500	13800-14500	13800-14500	13800-14500	6225 - 6485	6225 - 6485
Polarization	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Beam Peak G/T (dB/K)	12.9	12.2	3.1	3.2	0.9	0.8
Minimum SFD at Beam Peak (dBW/m^2)	-100	-100	-93	-93	-97	-97
Maximum SFD at Beam Peak (dBW/m^2)	-86	-86	-79	-79	-84	-84

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	Japan	Japan	Asia	Asia	Asia/Hawaii	Asia/Hawaii
Schedule S Beam ID	JTH	JTV	ATH	ATV	CTH	CTV
Frequency Band (MHz)	12200-12750	12200-12750	12200-12750	12200-12750	3940 – 4200	3940 - 4200
Polarization	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Maximum Beam Peak EIRP (dBW)	57.8	58.0	49.0	49.0	41.0	40.9
Maximum Beam Peak EIRP Density (dBW/4kHz)	19.5	19.7	10.7	10.7	1.5	1.4

EXHIBIT 3
TC&R SUBSYSTEM CHARACTERISTICS
Telecommand Carriers

Beam Name	Japan	Omni	Horn
Schedule S Beam ID	JRV	OHR	HHR
Frequencies (MHz)	13993.5	14496.0	14496.0
Polarization	Vertical	Horizontal	Horizontal

Telemetry Carriers

Beam Name	Japan	Omni	Horn
Schedule S Beam ID	JTV	OVT	HHT
Frequencies (MHz)	12748.35 & 12749.75	12748.35 & 12749.75	12748.35 & 12749.75
Polarization	Vertical	Vertical	Horizontal
Maximum Channel EIRP (dBW)	24.6	3.5	6.9

Tracking Beacons

Beam Name	Asia	Asia	Asia & Hawaii
Schedule S Beam ID	ATH	ATV	CTV
Frequencies (MHz)	12248.5	12747.2	4199.55
Polarization	Horizontal	Vertical	Vertical
Maximum Channel EIRP (dBW)	14.2	14.2	23

EXHIBIT 4
HYPOTHETICAL C-BAND 2-DEGREE COMPATIBILITY ANALYSIS

VICTIM UPLINK BEAM INFORMATION				
Uplink Frequency (MHz)	**6225-6485**	**6225-6485**	**6225-6485**	**6225-6485**
Uplink Beam Peak G/T (dB/K)	**0.9**	**0.9**	**0.9**	**0.9**
INTERFERING DOWNLINK BEAM INFORMATION				
Downlink Beam Name	**CTH/CTV**	**CTH/CTV**	**CTH/CTV**	**CTH/CTV**
Downlink Frequency (MHz)	**3940-4200**	**3940-4200**	**3940-4200**	**3940-4200**
Beam Peak Downlink EIRP (dBW)	**41.0**	**41.0**	**41.0**	**41.0**
INTEREFRING CARRIER INFORMATION				
Emission Designation	**36M0G7W**	**36M0G7W**	**1M74G7W**	**1M74G7W**
Carrier Modulation	**QPSK**	**QPSK**	**QPSK**	**QPSK**
Uplink Power Density (dBW/Hz)	**-45.6**	**-45.6**	**-38.7**	**-38.7**
Uplink Max Aggregate Power (dBW/36MHz)	**30.0**	**30.0**	**33.0**	**33.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-34.6**	**-34.6**	**-32.0**	**-32.0**
Max Aggregate Beam Peak D/L EIRP (dBW/36MHz)	**41.0**	**41.0**	**41.0**	**41.0**
VICTIM CARRIER INFORMATION				
Emission Designation	**36M0G7W**	**1M74G7W**	**36M0G7W**	**1M74G7W**
Carrier Modulation	**QPSK**	**QPSK**	**QPSK**	**QPSK**
Allocated Bandwidth(kHz)	**36000**	**1733**	**36000**	**1733**
Minimum Uplink EIRP (dBW)	**79.0**	**69.2**	**79.0**	**69.2**
Minimum Downlink EIRP (dBW)	**38.0**	**27.4**	**38.0**	**27.4**
Minimum C/N Required (dB)	**6.4**	**6.4**	**6.4**	**6.4**
INTERFERING UPLINK EARTH STATION				
Earth Station Diameter (meters)	**3.7**	**3.7**	**3.7**	**3.7**
Earth Station Gain (dBi)	**45.9**	**45.9**	**45.9**	**45.9**
VICTIM DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	**5.0**	**5.0**	**5.0**	**5.0**
Earth Station Gain (dBi)	**44.8**	**44.8**	**44.8**	**44.8**
Earth Station G/T (dB/K)	**24.0**	**24.0**	**24.0**	**24.0**
COMPOSITE LINK PERFORMANCE				
Uplink Interference C/I (dB)	**27.4**	**30.8**	**24.4**	**23.9**
Downlink Interference C/I (dB)	**20.2**	**22.7**	**20.2**	**20.2**
Total C/I (dB)	**19.4**	**22.1**	**18.8**	**18.6**
C/I Required (dB)	**18.6**	**18.6**	**18.6**	**18.6**
Margin (dB)	**0.8**	**3.5**	**0.2**	**0.0**

EXHIBIT 5
HYPOTHETICAL KU-BAND 2-DEGREE COMPATIBILITY ANALYSIS

VICTIM UPLINK BEAM INFORMATION				
Uplink Frequency (MHz)	**13809-14494.5**	**13809-14494.5**	**13809-14494.5**	**13809-14494.5**
Uplink Beam Peak G/T (dB/K)	**12.9**	**3.2**	**12.9**	**3.2**
INTERFERING DOWNLINK BEAM INFORMATION				
Downlink Beam Name	**JTH/JTV**	**JTH/JTV**	**ATH/ATV**	**ATH/ATV**
Downlink Frequency (MHz)	**12200-12750**	**12200-12750**	**12200-12750**	**12200-12750**
Beam Peak Downlink EIRP (dBW)	**58.0**	**58.0**	**49.0**	**49.0**
INTEREFRING CARRIER INFORMATION				
Emission Designation	**27M0G7W**	**27M0G7W**	**27M0G7W**	**27M0G7W**
Carrier Modulation	**QPSK**	**QPSK**	**QPSK**	**QPSK**
Uplink Power Density (dBW/Hz)	**-45.0**	**-45.0**	**-45.0**	**-45.0**
Uplink Max Aggregate Power (dBW/27MHz)	**33.0**	**33.0**	**33.0**	**33.0**
Beam Peak Downlink EIRP Density (dBW/Hz)	**-18.0**	**-18.0**	**-25.3**	**-25.3**
Max Aggregate Beam Peak D/L EIRP (dBW/27MHz)	**56.3**	**56.3**	**49.0**	**49.0**
VICTIM CARRIER INFORMATION				
Emission Designation	**27M0G7W**	**27M0G7W**	**27M0G7W**	**27M0G7W**
Carrier Modulation	**QPSK**	**QPSK**	**QPSK**	**QPSK**
Allocated Bandwidth(kHz)	**27000**	**27000**	**27000**	**27000**
Minimum Uplink EIRP (dBW)	**72.9**	**78.6**	**72.9**	**78.6**
Minimum Downlink EIRP (dBW)	**55.0**	**46.0**	**55.0**	**46.0**
Minimum C/N Required (dB)	**6.6**	**6.6**	**6.6**	**6.6**
INTERFERING UPLINK EARTH STATION				
Earth Station Diameter (meters)	**1.5**	**1.5**	**3.5**	**3.5**
Earth Station Gain (dBi)	**45.0**	**45.0**	**52.3**	**52.3**
VICTIM DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	**1.8**	**3.5**	**1.8**	**3.5**
Earth Station Gain (dBi)	**45.6**	**51.3**	**45.6**	**51.3**
Earth Station G/T (dB/K)	**24.8**	**30.5**	**24.8**	**30.5**
COMPOSITE LINK PERFORMANCE				
Uplink Interference C/I (dB)	**22.0**	**27.8**	**22.0**	**27.8**
Downlink Interference C/I (dB)	**22.7**	**19.5**	**22.7**	**19.5**
Total C/I (dB)	**19.3**	**18.9**	**19.3**	**18.9**
C/I Required (dB)	**18.8**	**18.8**	**18.8**	**18.8**
Margin (dB)	**0.5**	**0.1**	**0.5**	**0.1**