Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	Call Sign ____________
Application of Intelsat License LLC for a Ku-band Earth Stations Aboard Aircraft ("ESAA") Blanket License	)	
	)	File No. _____________
	)	

ESAA BLANKET LICENSE APPLICATION

By this application, Intelsat License LLC ("Intelsat") respectfully seeks an earth stations aboard aircraft ("ESAA") blanket license to operate up to 1000 of each of two Ku-band ESAA terminal types pursuant to Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227, in order to provide advanced mobile broadband services to aircraft using Intelsat's global fleet of fixed-satellite service ("FSS") satellites and associated gateway earth stations. Intelsat seeks certain waivers, consistent with Commission precedent, to operate these ESAA terminals (*e.g.*, in frequencies not identified in Section 25.227) in a manner consistent with the Commission's ESAA rules and applicable international requirements. Grant of the requested authority would be consistent with Commission rules and precedent, would serve the public interest by enhancing competition in the in-flight connectivity market, and would further enhance U.S. leadership in satellite-based, mobile broadband services.

I. DISCUSSION

Intelsat is a worldwide leader in providing innovative broadband satellite services and currently holds numerous FCC licenses to operate geostationary satellite orbit ("GSO") FSS satellites and earth station facilities. The IntelsatOne® Flex network aggregates Intelsat's global wide beam and Intelsat Epic^NG® high throughput satellite ("HTS") fleet and the IntelsatOne® terrestrial network into a simplified ecosystem that enables Intelsat and its distribution partners to easily and cost efficiently scale service delivery capability to meet customer demand. Intelsat's proposed ESAA network is an integral part of its global IntelsatOne® Flex offering.

Intelsat's legal and technical qualifications to hold authorizations like that requested in this application are a matter of record before the Commission. Furthermore, its proposed ESAA operations are consistent with the coordinated parameters of the satellites in the network and the Commission's rules and policies governing Ku-band ESAAs.[1] Accordingly, as described herein, grant of the proposed application would serve the public interest.

A. Network Description

The Intelsat ESAA network will consist of three segments: (i) ESAA Segment, (ii) Space Segment, and (iii) Ground Segment. The ESAA Segment consists of ESAA terminals mounted on private, commercial, and government aircraft. The Space Segment consists of a portion of the fleet of commercial Ku-band traditional and HTS satellites, as identified individually in this Application.[2] The Ground Segment consists of Intelsat owned or leased teleport antennas, which provide uplink and downlink connectivity to iDirect hubs. The iDirect hubs consist of an iDirect Network Management System ("NMS"), DVB-S2 modulator cards for the forward link, and iDirect demodulator cards for the return link. In the following sections, Intelsat describes its proposed ESAA system in detail.

1. ESAA Segment

Intelsat is proposing to operate two (2) ESAA terminal types as part of the ESAA Segment: the 18-inch Rantec Airborne SATCOM terminal and the TECOM KuStream® 1500

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1 *See* 47 C.F.R. § 25.227; *see also Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands; Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service,* IB Docket Nos. 12-376 & 05-20, Notice of Proposed Rulemaking and Report and Order, FCC 12- 161 (rel. Dec. 28, 2012) ("*ESAA Order*").

2 In addition, Intelsat requests authority in this Application for the ESAA terminals to communicate with other Permitted List satellites not specifically identified in Table 1, below.

terminal. Intelsat will operate these ESAA terminals in accordance with the requirements of Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227. The Commission has previously licensed each terminal as part of previous applications. Below, Intelsat provides a summary description of its proposed ESAA terminal operations.

a. The Rantec Terminal

Intelsat seeks authorization of the 18-inch Rantec terminal under the provisions of Section 25.227(a)(1) of the Commission's rules, 47 C.F.R. § 25.227(a)(1), applicable to ESAA terminals that use transmitters with off-axis EIRP spectral densities lower than or equal to the levels in paragraph (a)(1)(i) of that section.[3] The Rantec terminal incorporates a circular parabolic antenna mounted inside a radome on the fuselage or the upper tail stabilizer of the aircraft. It has been installed on various government aircraft, including on over 100 Gulfstream jets, the U.S. Army King Air 350, and multiple other aircraft supporting U.S. military operations. The Rantec terminal, which is flight-qualified and certified for aviation safety, can support streaming of highly reliable high-definition video, as well as full Internet connectivity and live video conferencing.

(1) Section 25.227(a)(1) Compliance

The Rantec terminal complies with the requirements set forth in Section 25.227(a)(1) of the Commission's rules, 47 C.F.R. § 25.227(a)(1), designed to facilitate Ku-band ESAA operations in a two-degree spacing environment.[4] Specifically, with respect to Section 25.227(a)(1)(i), the Rantec terminal will operate at off-axis EIRP spectral density ("ESD") levels

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[3] The Rantec terminal has been previously authorized by the Commission for various experimental operations, including some conducted by Intelsat. *See, e.g.*, Intelsat License LLC, File No. 0359-EX-ST-2012 (Call Sign WF9XRY); The Boeing Company, File No. 0326-EX-RR-2016 (Call Sign WH2XJL); Tachyon Networks Inc., File No. SES-STA-20110427-00518 (Call Sign E070139).

[4] *See* Technical Appendix, IV.A.

well below the off-axis ESD masks set forth in that section, and thus will protect co-frequency operations from harmful interference.[5] In addition, the Rantec terminal fully meets the pointing accuracy requirements of Section 25.227(a)(1)(ii)(A) with a pointing accuracy of less than or equal to 0.2º between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna. In accordance with Section 25.227(a)(1)(iii)(A), the Rantec terminal is designed to ensure that all emissions from the ESAA automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds 0.5°, and transmission will not resume until such angle is less than or equal to 0.2°. Below, Intelsat provides the additional information required by Section 25.227(b)(1) of the Commission's rules.

(2) Section 25.227(b)(1) Compliance

§ 25.227(b)(1) Specification of off-axis EIRP density calculated in accord with Section 25.115(g)(1): In the Technical Appendix § IV, Intelsat provides the off-axis ESD plots pursuant to Section 25.115(g)(1) of the Commission's rules, 47 C.F.R. § 25.115(g)(1).[6] The Rantec terminal uses a circular parabolic antenna with no skew angle issues. The charts show that the ESD remains below permitted limits in all cases.

§ 25.227(b)(1)(iii)(A-B) Tracking Error and Cessation of Operations: The Rantec terminal has a pointing accuracy of 0.2º, will automatically cease transmissions if point offset is

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[5] Intelsat's ESAA terminals will be monitored by the Intelsat Secure Operating Center ("ISOC") and, because they use the iDirect modem and network management functionality that assigns individual time slots for each terminal's transmissions, there is no potential for aggregation of transmissions resulting in an exceedance of the levels set forth in the applicable mask.

[6] In Section III.C, *infra*, Intelsat requests a partial waiver of the Section 25.115(g)(1)(i) requirement to provide off-axis ESD plots for the range from minus 90° to plus 90° because those are the only data available from the manufacturer.

0.5º or greater and automatically cease transmissions within 100 milliseconds if they generate an ESD that exceeds the specifications provided to the target satellite operator. Off-axis ESD will be controlled to permissible two-degree spacing levels or the coordinated limits for the satellite, whichever is greater, and control will be achieved by limiting maximum ESD, as applicable.

As set forth in the Technical Appendix and Form 312 Schedule B, Intelsat provides additional exhibits documenting the operational characteristics of the Rantec terminal, and demonstrating that it will otherwise operate in compliance with the Commission's ESAA rules and policies. The Rantec terminal has operated in the United States pursuant to Commission authority on an experimental basis and pursuant to special temporary authority, *see, supra,* n.2, without any reported interference and in compliance with the ESAA rules embodied in Section 25.227. Thus, operation of the Rantec terminal as part of the Intelsat ESAA network will not increase the potential for interference to other lawfully operating spectrum users.

b. TECOM KuStream® 1500 Terminal

Intelsat also seeks authorization of the TECOM terminal under Section 25.227(a)(2) of the Commission's rules, 47 C.F.R. § 25.227(a)(2). The TECOM terminal is a low profile, aerodynamic antenna system designed to support high transmit and receive data rates, and has previously been authorized by the Commission for commercial[7] and experimental[8] ESAA operations. The TECOM terminal is an advanced version of the TECOM KuStream® 1000 terminal, and is mounted on the top of the aircraft body and enclosed in a radome with associated support electronics installed inside the aircraft fuselage.

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7 *See* The Boeing Company, File No. SES-MFS-20160816-00729, Call Sign E140097; Row 44 Inc., File No. SES-MFS-20150928-00635, Call Sign E080100.

8 *See* Intelsat License LLC, File No. 0359-EX-ST-2012 (Call Sign WF9XRY).

Although the TECOM terminal conforms in most respects with the Section 25.227(a)(1) requirements, Intelsat seeks licensing of this terminal under Section 25.227(a)(2). Like many ESAA terminals, the TECOM terminal utilizes a low-profile antenna that is narrower in the elevation plane than in the azimuth plane and, as a result, the TECOM antenna exceeds off-axis ESD limits specified in Section 25.227(a)(1)(i)(B) in the plane perpendicular to the GSO arc at certain power levels and skew angles.[9]

Nonetheless, the TECOM terminal operates at off-axis ESD levels well below the off-axis ESD masks set forth in Sections 25.227(a)(1)(i)(A) and (a)(1)(i)(C) to prevent adjacent satellite interference and facilitate Ku-band ESAA operations in a two-degree spacing environment.[10] In accord with Section 25.227(a)(1)(ii)(A), the TECOM terminal uses a mechanically steered aperture and aircraft attitude data (*i.e.*, yaw, roll, pitch, yaw rate, roll rate, pitch rate, and heading vector), together with location of the terminal (latitude, longitude, and altitude), to reliably maintains 0.2º pointing accuracy through all anticipated flight maneuvers. In accord with Section 25.227(a)(1)(iii)(A), if for any reason the pointing offset between the angle of the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna were to exceed 0.5º, the terminal would automatically mute transmissions within 100 milliseconds and would delay resumption of transmissions until pointing accuracy were again within 0.2º.

(1) Section 25.227(a)(2) Compliance

As required by Section 25.227(a)(2)(i), Intelsat submits the certifications required under Section 25.227(b)(2), after providing the off-axis ESD specifications shown in the Technical Appendix to the target satellite operators. As required by Section 25.227(a)(2)(ii), and as stated

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9 Elsewhere in this application, in the alternative, Intelsat has also requested a waiver of 25.227(a)(1)(i)(B) of the Commission's rules.

10 *See* Technical Appendix, V.A.

above, the TECOM terminal is self-monitoring and capable of shutting itself off, and would cease emissions within 100 milliseconds after generating off-axis EIRP-density in excess of the specifications supplied to the target satellite operator (*i.e.,* the 0.5º specification shown in Section 1.1 of the Technical Appendix and supplied to the target satellite operator).

(2) Section 25.227(b)(2) Compliance

In this Application, Intelsat provides the information required under Section 25.227(b)(2) of the Commission's rules. In addition to the information provided in the Technical Appendix, Intelsat states as follows:

§ 25.227(b)(2)(i) Off-axis EIRP Density: In the Technical Appendix, § V, Intelsat provides off-axis ESD plots for the TECOM terminal at various skew angles, pursuant to Section 25.227(b)(2)(ii) of the Commission's rules.[11] Although Intelsat is applying under Section 25.227(a)(2) of the Commission's rules, which permits ESAA operations with off-axis ESD levels in excess of the levels specified in Section 25.227(a)(1), the ESAA terminals off-axis ESD will remain well below the off-axis limits for all off-axis ranges in the plane tangent to the GSO arc.

§ 25.227(b)(2)(ii) Certifications required under 25.220(d): The TECOM terminal will operate in a manner consistent with Intelsat's coordination agreements with each satellite operator, so that they will not result in unacceptable interference to other satellites within +/- 6º of the subject satellite point of communication. As part of this Application, Intelsat certifies that the proposed operations are consistent with coordination agreements with operators of all adjacent satellite networks within 6º of orbital separation from the target satellites with which the TECOM terminal will communicate.[12] If the Commission were to authorize new non-

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11 *See* Technical Appendix, V.A.; *see also* 47 C.F.R. § 25.115(g)(1).

12 *See* Technical Appendix, III.

geostationary satellite constellations to operate in the ESAA bands in the future, Intelsat would work to reach an appropriate agreement to coordinate its operation of its TECOM terminals.

§ 25.227(b)(2)(iii) Cessation of Operations: Off-axis ESD will be controlled to permissible two-degree spacing levels or the coordinated limits for the satellite, whichever is greater, and control will be achieved by limiting maximum ESD and skew angle, as applicable. Moreover, as noted, the TECOM terminal has a pointing accuracy of 0.2º, will automatically cease transmissions if point offset is 0.5º or greater, and will automatically cease transmissions within 100 milliseconds if it generates an EIRP density that exceeds the specifications provided to the target satellite operator.

§ 25.227(b)(2)(iv) Simultaneously transmitting ESAAs: Intelsat's ESAA terminals will be monitored by its Intelsat Secure Operating Center ("ISOC") and, because they use the iDirect modem and network management functionality, which assigns individual time slots for each terminal's transmissions, there is no potential for aggregation of transmissions resulting in an exceedance of the off-axis ESD levels coordinated with the target satellite operator. As discussed, the TECOM terminal is self-monitoring and will automatically cease transmissions within 100 milliseconds if it generates an EIRP density that exceeds the specifications provided to the target satellite operator. Intelsat's proposed operations of its ESAA terminals will not increase the potential for interference to other co-frequency operations in the United States.

As set forth in the Technical Appendix, with the exception of its limited exceedance of the off-axis ESD levels away from the GSO arc, the TECOM terminal will otherwise operate in compliance with the Commission's ESAA rules and policies. The TECOM terminal has operated in the United States pursuant to Commission authority without any reported interference and in compliance with the ESAA rules embodied in Section 25.227. Thus, operation of the TECOM terminal as part of the Intelsat ESAA network will not increase the potential for interference to other lawfully operating spectrum users. In the attached Technical Appendix and Form 312 Schedule B, Intelsat provides exhibits demonstrating the characteristics of the TECOM terminal, including information regarding the operational parameters with each proposed satellite point of communication.

c. Waveform Description

The Intelsat ESAA network uses well established industry standard waveforms, DVB-S2 and iDirect D-TDMA, which are also utilized by the Rantec terminal and TECOM terminal. The iDirect forward link (hub-to-mobile terminal) will consist of a single DVB-S2 carrier that may occupy up to a full transponder and operate in saturation but in most cases will be operated in a partial transponder. DVB-S2 is a widely adopted standard for digital data and video broadcasting over satellite. Data may be multiplexed on this carrier for multiple terminals. The DVB-S2 standard supports Adaptive Coding and Modulation (ACM) with QPSK, 8PSK, and 16APSK modulations and Low Density Parity Check Coding rates between 0.25 and 0.9.

The return link uses iDirect's Deterministic TDMA ("D-TDMA"), which supports multi-frequency ("MF") TDMA. The iDirect network management system manages the frequency and timeslot assignments and ensures that no assignments are duplicated among the terminals. Timeslots and carriers are uniquely assigned, ensuring that only a single terminal can transmit in an assigned timeslot at a time (*i.e.,* there is no aggregation). Terminals will transmit a single carrier in each assigned time slots, and the network management system will adjust the return link timeslot assignments as user demand varies over time. Finally, any event that results in the loss of modem lock to the DVB-S2 downlink will cause the modem to cease all transmission. Thus, operation of the TECOM and Rantec terminals will not increase the potential for interference from ESAAs communicating with the Intelsat network.

2. Space Segment

The Space Segment will consist of capacity on the U.S.-licensed satellites specified in Table 1, below. Uplinks from the ESAA terminals will occur in permissible portions of the 14.0-14.5 GHz band and downlinks will occur in permissible portions of the 10.95-11.2 and 11.45-12.2 GHz band for operations within the United States. Intelsat also requests authority to utilize FSS satellite capacity available on these satellites in the 12.2-12.75 GHz band for ESAA receive operations on an unprotected, non-harmful interference basis outside the United States (principally in Regions 1 and 3), subject to any necessary authorizations from foreign administrations.[13]

The Intelsat ESAA network may use whole or partial transponders and operate with single saturated carriers (forward link to the ESAA only) in a transponder or with multiple carriers. Forward and return links may be operated in the same or different transponders. The following table provides an overview of the basic parameters of ESAA operations with each individual satellite point of communication that will comprise Intelsat's ESAA network.[14]

Table 1. Proposed ESAA System Satellites

Satellite	FCC Call Sign	Orbital Location	Downlink Freq. (GHz)	ITU Region	Service To U.S.[15]
Galaxy-19	S2647	97° W	11.7-12.2	2	Yes

[13] The 12.5-12.75 GHz band is allocated for FSS downlinks in Region 1 and the 12.2-12.75 GHz band is allocated for FSS downlinks in Region 3.

[14] The Rantec and TECOM terminals will operate in the uplink direction within the 14.0-14.5 GHz band consistent with satellite operator coordination agreements, the Commission's rules and applicable international requirements.

[15] "Yes" indicates that the relevant satellite may be used for Intelsat's ESAA System operations in U.S. territory, in accordance with any conditions imposed by the underlying Commission license. "No" indicates that Intelsat's operations will be conducted outside U.S. territory, even if the satellite may have some coverage of the United States. Operations in the 12.2-12.75 GHz band will be consistent with the Table of Frequency Allocations, individual satellite license conditions, and the waivers sought in this Application.

Satellite	FCC Call Sign	Orbital Location	Downlink Freq. (GHz)	ITU Region	Service To U.S.[15]
Horizons-1	S2475	127° W	11.7-12.2	2, 3	Yes
Horizons-3e	S2947	169° E	10.95-11.2; 11.45-11.7; 12.2-12.25; 12.25-12.75	2, 3	Yes
IS-14	S2785	45° W	11.45-11.95	1, 2	Yes
IS-17	S2814	66° E	10.95-11.2; 11.45-11.7; 12.5-12.75	1, 3	No
IS-18	S2817	180° E	10.95-11.2; 11.45-11.7; 12.25-12.75	2, 3	Yes (except in 12.25-12.75 GHz)
IS-19	S2850	166° E	12.25-12.75	2, 3	Yes
IS-20	S2847	68.5° E	10.95-11.2; 11.45-11.7; 12.5-12.75	1, 3	No
IS-21[16]	S2863	58° W	11.45 - 11.7	1, 2	Yes
IS-22	S2846	72.1° E	11.45-11.7; 12.25-12.75	1, 3	No
IS-23	S2831	53° W	11.45-11.7; 11.7-12.2	2	Yes
IS-29e	S2913	50° W	10.95-11.2; 11.45-11.7; 11.7-12.2	1, 2	Yes
IS-32e (Sky B-1)[17]	S2922	43.15° W	11.7-12.2	1, 2	Yes
IS-33e	S2939	60° E	10.95-11.2; 11.45-11.7; 11.7-12.2	1, 3	No
IS-34[18]	S2915	55.5° W	11.45-11.7	1, 2	Yes

[16] IS-21 uplink operations are limited to the 14.0-14.25 GHz band.

[17] This satellite is licensed to DIRECTV Enterprises, LLC. Pursuant to a contract dated October 12, 2015 with DTVLA B.V., Intelsat holds transponder capacity for the payload with which the ESAA terminals will communicate. *See* Letter from Jennifer Hindin, Counsel for DIRECTV Enterprises, LLC, Application for Authority to Launch and Operate a Ku-Band Satellite at 43.1° W.L.; File No. SAT-AMD-20150806-00054, Call Sign S2922 (filed Nov. 3, 2015) (Request for Confidential Treatment and contract submitted therewith).

[18] IS-34 uplink operations are limited to the 14.0-14.25 GHz band.

Satellite	FCC Call Sign	Orbital Location	Downlink Freq. (GHz)	ITU Region	Service To U.S.[15]
IS-35e	S2959	34.5° W	10.95-11.2; 11.45-11.7	1, 2	Yes
IS-37e	S2972[19]	18° W	10.95-11.2; 11.45-11.7; 11.7-11.95; 12.50-12.75	1, 2, 3	Yes (except in 12.5-12.75 GHz)

In addition to the specific satellite points of communication indicated above, pursuant to Section 25.227(a)(12) of the Commission's rules, 47 C.F.R. § 25.227(a)(12), Intelsat is also requesting authority to operate its ESAA terminals with all U.S.-licensed satellites and non-U.S.licensed satellites on the Commission's Permitted Space Station List.[20] Permitted List authority is appropriate here because Intelsat will operate its ESAA terminals at all times within the relevant off-axis ESD limits in the plane tangent to the GSO arc (i.e., consistent with two-degree spacing levels).[21] Accordingly, there is no potential for interference into adjacent GSO FSS satellite operations. Intelsat will operate the ESAA terminals with these satellites in permissible portions of the Ku-band at power levels compliant with the Commission's rules, and otherwise in accordance with operational conditions imposed by the Commission. This authority

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[19] Intelsat's application to launch and operate IS-37e remains pending before the Commission. *See* File No. SAT-LOA-20160915-00089, Call Sign S2972.

[20] *See* Approved Space Station List, http://transition.fcc.gov/ib/sd/se/ssal.xlsx(last updated on May 5, 2017), available at: https://www.fcc.gov/approved-space-station-list.

[21] Section 25.227(a)(12) permits an ESAA system that complies with the off-axis EIRP spectral density ("ESD") limits in Section 25.227(a)(1)(i) to request Permitted List authority. The ESAA terminals fully comply with the off-axis ESD masks for GSO operations in Sections 25.227(a)(i)(A) and 25.227(a)(i)(C). Still, elsewhere in this Application, Intelsat requests a waiver of Section 25.227(a)(i)(B) with respect to the TECOM terminal because it incorporates a low-profile antenna and thus exceeds the ESD mask in the plane perpendicular to the GSO arc. Although Intelsat is seeking authority for the TECOM terminal under Section 25.227(a)(2), it seeks this waiver to the extent required to permit TECOM terminal operations with Permitted List satellites.

will provide Intelsat with operational flexibility to help facilitate the reliability and performance of its proposed ESAA operations.

3. Ground Segment

The Ground Segment consists of equipment located at Intelast and commercial teleport facilities (*i.e.*, gateway earth stations), which facilitate network control and connection to the terrestrial telecommunications network. iDirect DVB-S2 modulator cards for the forward link, iDirect demodulator cards for the return link, and the iDirect network management sytem are installed at each gateway earth station location. This equipment is operated remotely from Intelsat's centralized operations center. Each gateway location (listed in Table 2, below) has redundant terrestrial connectivity to the Intelsat operations center. In addition, Intelsat's ESAAs will be connected to the terrestrial telecommunications network via these gatways to provide communications connectivity to equipped aircraft. The Intelsat ESAA network will provide access to the Internet and other terrestrial connections at the iDirect hubs.

Table 2. Intelsat Network Gateway Earth Stations

Satellite	Gateway Operator	Gateway Earth Station Location	Country	FCC Call Sign
Galaxy-19	Intelsat	Hagerstown, MD	U.S.	E040141
Horizons-1	Intelsat	Atlanta, GA	U.S.	E990092
Horizons-3e	TBD	TBD	TBD	TBD
IS-14	Intelsat	Atlanta, GA	U.S.	E090093
IS-17	Intelsat	Fuchsstadt	Germany	N/A
IS-18	Telstra	Oxford Falls	Australia	N/A
IS-19	Intelsat	Napa, CA	U.S.	E980460
IS-20	Intelsat	Fuchsstadt	Germany	N/A
IS-21	Intelsat	Hagerstown, MD	U.S.	E120051

Satellite	Gateway Operator	Gateway Earth Station Location	Country	FCC Call Sign
IS-22	Intelsat	Fuchsstadt	Germany	N/A
IS-22	KTSat	Kumsan	Korea	N/A
IS-23	Intelsat	Nuevo, CA	U.S.	E020191
IS-29e	Intelsat Intelsat Speedcast	Hagerstown, MD Hagerstown, MD Macae	U.S. U.S. Brazil	E150002 E140121 N/A
IS-32e	Intelsat	Hagerstown, MD	U.S.	TBD
IS-33e	Intelsat KTSat Neotel/Liquid Telecom	Fuchsstadt Kumsan Johannesburg	Germany Korea South Africa	N/A N/A N/A
IS-34	Intelsat	Hagerstown, MD	U.S.	E070139
IS-35e	Intelsat Intelsat	Hagerstown, MD Fuchsstadt	U.S. Germany	TBD N/A
IS-37e	Intelsat Intelsat	Hagerstown, MD Fuchsstadt	U.S. Germany	TBD N/A

Control and monitoring of the Intelsat ESAA network (ESAA, Space and Ground segments) will be provided by the ISOC in Ellenwood, Georgia, United States on a 24/7 basis. The ISOC utilizes the iDirect Network Management System ("NMS") to provide complete control and visibility to all components of the Intelsat ESAA network. The NMS system has the capability of shutting down any component in the system that is malfunctioning. The ISOC can be reached at:

ISOC – Intelsat Secure Operating Center
Phone: +1 (404) 381-2727 / Email: ISOC@intelsatgeneral.com

Primary Point of Contact:
Angela Wheeler, Manager, Network Operations
Phone: +1 (404) 381-2727, Email:Angela.Wheeler@IntelsatGeneral.com

B. Protection of Co-Frequency Spectrum Users

1. Protection of GSO FSS Systems

The ESAA terminals comply with the requirements set forth in Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227, designed to facilitate Ku-band ESAA operations in a two-degree spacing environment.[22] Specifically, the ESAA terminals will operate at off-axis ESD levels well below the off-axis ESD masks in Sections 25.227(a)(1)(i)(A) and 25.227(a)(1)(i)(C) of the Commission's rules designed to protect adjacent GSO FSS satellite operations from harmful interference. Additionally, Intelsat has provided a certification letter confirming that its ESAA network operations will not result in unacceptable interference to other GSO FSS satellites within +/- 6º of a given satellite point of communication. Thus, operation of the ESAA terminals will not increase the potential for interference to other GSO FSS systems in the United States or elsewhere.

2. Protection of NGSO FSS Systems

In the plane perpendicular to the GSO arc, the TECOM terminal will exceed the off-axis ESD values set forth in the Commission's rules, 47 C.F.R § 25.227(a)(1)(i)(B), which is principally intended to protect non-geostationary satellite orbit ("NGSO") FSS systems.[23] In Section III.B., below, Intelsat respectfully requests a waiver of the off-axis ESD limits set forth in Section 25.227(a)(1)(i)(B) to the extent required in the absence of an operational Ku-band NGSO FSS system.

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22 *See* Technical Appendix, IV.A & V.A.

23 *See Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands*, IB Docket No. 12-376, Notice of Proposed Rulemaking and Report and Order, FCC 12-161, 27 FCC Rcd 16510 (2012), at ¶¶ 54-55.

3. NASA and NSF Coordination

The proposed Intelsat ESAA operations are subject to coordination with the National Aeronautics and Space Administration ("NASA") through the NTIA Interdepartment Radio Advisory Committee ("IRAC") and the National Science Foundation ("NSF"), in accordance with Sections 25.227(c) and (d) of the Commission's rules.[24] Pending completion of coordination with NASA and NSF, Intelsat confirms that it will not operate its ESAAs in the 14.0-14.2 GHz band within line-of-site of NASA TDRSS facilities or in the 14.47-14.5 GHz band within the radio line-of-sight of radio astronomy service ("RAS") observatories operating in the band. Intelsat will submit any executed coordination agreements to the Commission when available, and will comply with the requirements for ESAA operations within the coordination zones and with respect to any new TDRSS and RAS sites.[25]

II. WAIVER REQUESTS

A. Waiver of Section 2.106 and 25.227(a) to Use 12.2-12.75 GHz Outside the United States

Intelsat respectfully seeks a waiver of Sections 2.106 and 25.227(a) of the Commission's rules, 47 C.F.R. §§ 2.106 and 25.227(a), to operate these ESAA terminals in the 12.2-12.75 GHz downlink band while on U.S. aircraft located outside of the United States. The Commission may waive its rules for "good cause shown."[26] Good cause exists here because the requested waiver would serve the public interest by enabling use of this downlink (ESAA receive) spectrum for essential in-flight broadband connectivity offerings in Ku-band spectrum, in regions where the ITU Table of Frequency Allocations permits FSS use of this spectrum. A waiver of Section

[24] 47 CFR § 25.227(c) and (d).

[25] 47 C.F.R. §§ 25.227(c)(2), 25.227(d)(3).

[26] *See* 47 C.F.R. § 1.3; *WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969).

2.106 is necessary because the U.S. Table of Frequency Allocations does not contain an FSS downlink allocation in this band, while a waiver of Section 25.227(a) is necessary because that section does not authorize ESAA operations in this band.

The FCC's Table of Allocations permits use of the 10.95-11.2 GHz and 11.45-11.7 GHz bands (on an unprotected basis) and the 11.7-12.2 GHz and 14.0-14.5 GHz bands (on a primary basis) for ESAA operations.[27] Intelsat seeks to conduct ESAA receive operations in the 12.2-12.75 GHz band on an unprotected, non-harmful interference basis outside the United States (principally in Regions 1 and 3) where the Table of Frequency Allocations in the ITU Radio Regulations permits FSS downlink use of this spectrum.[28]

Grant of this waiver presents a negligible risk of interference to other spectrum users. The space-to-Earth transmissions and permissible power levels in FSS satellite downlink beams are identical regardless of whether an ESAA or FSS earth station is receiving the signal. ESAAs are designed to operate with essentially the same interference characteristics and antenna discrimination as traditional Ku-band earth stations. Additionally, because ESAA terminals operate on aircraft flying at great speeds and substantial altitude, there is no need to protect the receive operations from any co-frequency systems and services. Thus, authorizing ESAA receive operations will have no adverse impact on other spectrum users.

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[27] *See* 47 C.F.R. § 2.106 and n. NG52 and NG55; 47 C.F.R. § 25.227. To the extent the FCC's Table of Allocations and associated rules may not be considered effective outside U.S. territory and out of an abundance of caution, Intelsat also seeks a waiver of Section 2.106 to permit ESAA receive operations (which have been considered a mobile-satellite service or "MSS") in FSS downlink spectrum.

[28] The 12.5-12.75 GHz band is allocated for FSS downlinks in Region 1 and the 12.2-12.75 GHz band is allocated for FSS downlinks in Region 3. Although the Commission classifies ESAA operations as FSS, as noted above, Intelsat seeks to use these bands on an unprotected, non-harmful interference basis because ESAA receive operations onboard aircraft in flight have been considered non-conforming MSS operations.

The Commission previously waived Section 2.106 with respect to operation of other ESAA in-flight connectivity providers in this additional Ku-band downlink spectrum.[29] Accordingly, grant of this waiver is consistent with Commission precedent and would afford Intelsat the same operational flexibility as other ESAA providers.

B. Waiver of Section 25.227(a)(1)(i)(B) to Exceed ESD Limits in the Plane Perpendicular to the GSO Arc

Intelsat seeks a limited waiver of Section 25.227(a)(1)(i)(B) of the Commission's rules, 47 C.F.R. § 25.227(a)(1)(i)(B), to permit operation of the TECOM terminal at off-axis ESD limits in the plane perpendicular to the GSO arc in excess of those set forth in Section 25.227(a)(1)(i)(B).

That rule is is principally intended to protect non-geostationary satellite orbit ("NGSO") FSS systems.[30] Currently, there are no Ku-band NGSO FSS systems operating or licensed by the Commission, although there is an active Ku-band NGSO FSS satellite application processing round involving proposed U.S. and foreign-licensed systems.[31] Although Intelsat seeks authority to operate pursuant to satellite operator agreements and there are currently no NGSO FSS systems operating or licensed by the Commission in the Ku-band, it seeks this waiver to the extent required to ensure its TECOM terminal operations are consistent with Commission rules and policies, and in connection with the request for Permitted List authority, above.

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[29] *See*, *e.g.*, Panasonic Avionics Corporation, SES-MFS-20150609-00349, Call Sign E100089.

[30] *See Revisions to Parts 2 and 25 of the Commission's Rules to Govern the Use of Earth Stations Aboard Aircraft Communicating with Fixed-Satellite Service Geostationary-Orbit Space Stations Operating in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz and 14.0-14.5 GHz Frequency Bands*, IB Docket No. 12-376, Notice of Proposed Rulemaking and Report and Order, FCC 12-161, 27 FCC Rcd 16510 (2012), at ¶¶ 54-55.

[31] *See* Public Notice, OneWeb Petition Accepted for Filing, IBFS File No. Sat-LOI-20160428-00041, Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations In the 10.7-12.7 GHz, 14.0-14.5 GHz, 17.8-18.6 GHz, 18.8-19.3 GHz, 27.5-28.35 GHz, 28.35-29.1 GHz, and 29.5-30.0 GHz Bands, DA 16-804 (July 15, 2016).

As discussed, the TECOM terminal utilizes a low-profile antenna that is narrower in the elevation plane than in the azimuth plane and, as a result, that terminal exceeds off-axis ESD limits specified in Section 25.227(a)(1)(i)(B) in the plane perpendicular to the GSO arc at certain power levels and skew angles. This is an issue with all low-profile ESAA terminals.

Although no Ku-band NGSO FSS systems are currently liensed or operating, in the event a future NGSO network is deployed, Intelsat will coordinate with the new network as required in order to facilitate co-frequency operations, and will modify its ESAA operations as necessary to reflect any coordination agreement reached.

Grant of this waiver is consistent with a substantial body of Commission precedent involving similar ESAA terminal operations that exceed the off-axis ESD mask away from the GSO plane.[32] In this case, good cause exists because it will allow Intelsat to operate the TECOM terminal as effectively as possible and facilitate flexible ESAA operations. The Commission should therefore grant this waiver in connection with Intelsat's proposed ESAA operations.

C. Waiver of Section 25.115(g)(1)(i) to Provide Available ESD Plots

Intelsat hereby requests a partial waiver of the Section 25.115(g)(1)(i) requirement to provide "[a] plot of maximum co-polarized EIRP density in the plane tangent to the GSO arc at

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[32] *See, e.g.,* Row 44 Inc., File No. SES-MFS-20150928-00635, Call Sign E080100 (granting a waiver for TECOM KuStream® 1000 terminal operations); The Boeing Company, File No. SES-LIC-20140922-00748, Call Sign E140097 (same for TECOM KuStream® 1500); Panasonic Avionics Corporation, File No. SES-MFS-20120913-00818, Call Sign E100089 (granting a waiver for Panasonic Phase Array terminal operations); Gogo LLC, File No. SES-MFS-20151022-00735, Call Sign E120106 (granting a waiver for Astronics AeroSat HR6400 terminal operations).

The Commisison has also routinely granted similar waivers in connection with authorizations for Vehicle Mounted Earth Stations, *see, e.g.,* ThinKom Solutions Inc., File No. SES-LIC-20120822-00768, Call Sign E120174, Application, Technical Annex at 19 (granted March 8, 2013); RaySat Antenna Systems, LLC (now Gilat North America, LLC), File No. SES-MFS-20120517-00446, Application, Narrative at 23, and License, Call Sign E060448, at Condition 6582 (granted April 1, 2013).

off-axis angles from minus 180° to plus 180°" for the Rantec terminal. The Technical Appendix contains the required plot only for the range from minus 90° to plus 90° for the Rantec terminal because those are the only data available from Rantec.

In approving operation of this terminal previously, *see supra*, n.3, the Commission has accepted data covering this range as sufficient. *See, e.g.*, Tachyon Networks Inc., File No. SES-STA-20110427-00518 (Call Sign E070139), at Exhibit A. The performance characteristics of the Rantec parabolic antenna are well-understood and its actual operation without interference incidents confirm that the off-axis ESD data submitted with this application is sufficient to grant Intelsat operating authority for this ESAA terminal, and the policies underlying the rule will not be undermined by grant of the limited waiver requested herein. Accordingly, consistent with its licensing precedent for the Rantec terminal, Intelsat respectfully requests acceptance of the antenna performance data currently available and previously accepted for licensing this terminal.

III. PUBLIC INTEREST STATEMENT

Grant of this Intelsat ESAA blanket license application will serve the public interest by promoting competition in the market for in-flight connectivity services to the benefit of travelers in the United States and internationally. In particular, users of the Intelsat ESAA network will enjoy increased productivity, operational efficiencies, and other benefits from expanded access to in-flight broadband connectivity. This, in turn, will enhance competition in the air transportation market by enabling aircraft equipped with the Intelsat ESAAs to compete with aircraft operators and air carriers offering terrestrial and satellite-based connectivity to passengers.

Intelsat has provided the technical and operational information necessary for the Commission to grant an ESAA blanket license pursuant to Section 25.227 of the Commission's rules. Intelsat has established that its ESAA terminals can operate with the proposed satellite points of communication consistent with applicable coordination agreements and that its proposed operations are compatible with other co-frequency services, or otherwise requested a waiver. Thus, grant of the requested ESAA blanket license would be consistent with Commission rules, policies and precedent facilitating Ku-band ESAA operations and would serve the public interest.

IV. CONCLUSION

For the foregoing reasons, Intelsat requests that the Commission grant this blanket license application and authorize operation of the Intelsat ESAA network, including the ESAA terminal types, satellite points of communications and other network elements described herein, pursuant to Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227.

<u>TECHNICAL APPENDIX</u>

Intelsat License LLC
ESAA Blanket License Application

I. Technical Description

II. Coverage Map

III. Satellite Operator Certification Letter

IV. Rantec Airborne SATCOM ESAA Terminal
   A. *Off-Axis EIRP Spectral Density Plots*
   B. *Radiation Hazard Analysis*
   C. *Representative Link Budget*

V. TECOM KuStream® 1500 ESAA Terminal
   A. *Off-Axis EIRP Spectral Density Plots*
   B. *Radiation Hazard Analysis*
   C. *Representative Link Budget*

VI. FCC Section 25.227 Certifications

VII. FCC Section 25.227 Compliance Matrix

VIII. Technical Certification

I. Technical Description

This Technical Description provides a detailed overview of the operational characteristics of Intelsat's proposed Ku-band earth stations onboard aircraft ("ESAA") network. The Intelsat ESAA network will consist of three segments: (i) ESAA Segment, (ii) Space Segment, and (iii) Ground Segment. The ESAA Segment consists of ESAA terminals mounted on private, commercial, and government aircraft. The Space Segment consists of a portion of the IntelsatOne® Flex network fleet of commercial Ku-band traditional and HTS satellites, as identified individually in this Application. The Ground Segment consists of Intelsat owned or leased teleport antennas which provide uplink and downlink connectivity to iDirect hubs. The iDirect hubs consist of an iDirect Network Management System (NMS), DVB-S2 modulator cards for the forward link, and iDirect demodulator cards for the return link.

Technical and operational information regarding each of the ESAA network segments demonstrating compliance with the Commission's rules (except to the extent waivers have been requested) is provided below and in associated attachments. In addition, the attached Regulatory Compliance Matrix indicates which application section(s) address individual rule provisions.

1. ESAA Segment

The ESAA Segment will consist of the TECOM KuStream® 1500 ("TECOM") and Rantec Airborne SATCOM ("Rantec") ESAA terminals and a terminal controller. Both ESAA terminals have been previously authorized by the Commission and were specifically designed for the aeronautical environment. Intelsat will operate the ESAA terminals consistent with the requirements set forth in Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227. Subject aircraft will be installed with either the Rantec terminal or TECOM terminal for operations in U.S. and international airspace.

The terminal controller contains the modem and control functionality of the ESAA terminals. The modem will include a DVB-S2 demodulator and iDirect D-TDMA modulator. The controller includes the ability to inhibit transmissions as a function of location and skew angle, control transmit power and select the serving satellite as a function of location. Skew angle control will be enforced regardless of whether the skew angle results from the location of the aircraft with respect to the satellite or the attitude of the aircraft.[1] The controller also will select the serving satellite based on preloaded maps and network management control, this includes commands to switch satellite beams as the aircraft moves through geographic regions. The map-based technology also allows Intelsat to inhibit ESAA transmissions based on location if required to protect other services operating in the Ku-band (*e.g.*, space research and radio astronomy) or accommodate other regulatory limitations.

[1] Because the Rantec terminal includes a circular parabolic antenna, there are no skew angle control issues.

1.1. TECOM KuStream® 1500

The TECOM terminal is a variant of the KuStream® 1000 terminal, which has been previously authorized by the Commission for similar commercial ESAA operations.[2] Intelsat will operate the TECOM terminal consistent with ESAA requirements, including:

(i) 0.2º pointing accuracy;
(ii) automatic muting within 100ms if pointing offset exceeds 0.5º and transmissions do not resume until pointing accuracy is within 0.2º; and
(iii) compliance with Section 25.227's off-axis EIRP spectral density ("ESD") limits in the plane tangent to the GSO arc for all off-axis ranges.[3]

The TECOM terminal complies with the Commission's two-degree spacing policies and rules designed to protect co-frequency adjacent satellite operations from harmful interference. The TECOM terminal transmits and receives using a single horn array aperture that is mechanically steered to track and secure the desired satellite through aircraft flight maneuvers and over a large geographic range. The polarization angle is electronically rotated to match the polarization of the satellite. The horn array aperture is mounted on the top of the aircraft body and enclosed in a radome. Associated support electronics are installed inside the aircraft. The TECOM fuselage-mounted aperture is shown in Figure 1 and its basic characteristics are summarized in Table 1 below.

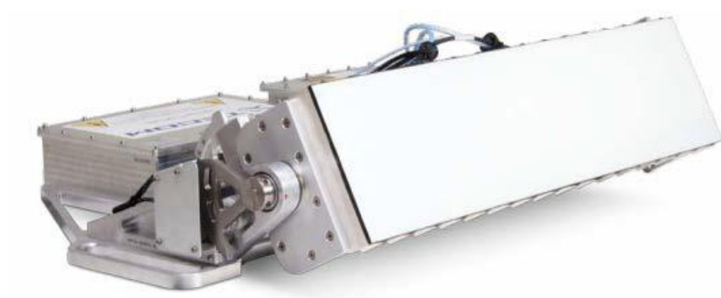

Figure 1. TECOM KuStream® 1500 ESAA Terminal

2 *See* The Boeing Company, File No. SES-MFS-20160816-00729, Call Sign E140097; Row 44 Inc., File No. SES-MFS-20150928-00635, Call Sign E080100; Intelsat License LLC, File No. 0359-EX-ST-2012, Call Sign WF9XRY).

3 Elsewhere in this Application, Intelsat seeks a limited waiver of Section 25.227(a)(1)(i) of the Commission's rules because the TECOM exceeds specified off-axis ESD limits in directions perpendicular to the GSO arc at certain power levels and skew angles.

Table 1. Summary of TECOM 1500 Technical Parameters

Aperture Dimensions	65.0 x 17.0 cm
Transmit Band	14.0-14.5 GHz
Receive Band	10.95-12.75 GHz
Transmit Gain	34 dBi @ 14.5 GHz
Receive Gain	32.5 dBi @ 12.0 GHz
EIRP	42.5 dBW[4]
Receive G/T	11.9 dB/k
Pointing Error	< 0.2 degrees

Uplink transmissions from the TECOM terminal will occur in permissible portions of the 14.0-14.5 GHz band and downlink receive operations will occur in permissible portions of the 10.95-11.2 and 11.45-12.2 GHz band for operations within the United States. Intelsat also seeks to conduct ESAA receive operations in the 12.20-12.75 GHz band on an unprotected, non-harmful interference basis outside the United States (principally in ITU Regions 1 and 3).[5]

The TECOM terminal employs a mechanically steered aperture and uses aircraft attitude data (*i.e.*, yaw, roll, pitch, yaw rate, roll rate, pitch rate, and heading vector), together with location information (latitude, longitude, and altitude) to calculate the command vectors. The attitude and position data is provided to the antenna by an inertial reference unit ("IRU") and is used in conjunction with the satellite coordinates to yield continuously updated steering commands for the antenna elevation, azimuth, and polarization. The IRU location and design allows for a high-rate position and attitude sensing, and eliminates errors caused by airframe deformation and data latency. The TECOM terminal is capable of reliably maintaining 0.2^o pointing accuracy through all anticipated flight maneuvers and, if pointing offset exceeds 0.5^o, the terminal will automatically mute transmissions within 100 milliseconds and delay resumption of transmissions until pointing accuracy is within 0.2^o.

1.2. Rantec Airborne SATCOM

The Rantec terminal is configured to install on the fuselage or tail of an aircraft and has been previously licensed by the Commission in the experimental context.[6] Intelsat will operate the terminal pursuant to the requirements set forth in Section 25.227 of the Commission's rules, 47 C.F.R. § 25.227, designed to facilitate Ku-band ESAA operations in a two-degree spacing

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4 Although the maximum EIRP of this terminal is 44.0 dBW, the highest power proposed in this Application is 42.5 dBW.

5 The 12.5-12.75 GHz band is allocated for FSS downlinks in Region 1 and the 12.2-12.75 is allocated for FSS downlinks in Region 3.

6 *See, e.g.*, Intelsat License LLC, File No. 0359-EX-ST-2012 (Call Sign WF9XRY); The Boeing Company, File No. 0326-EX-RR-2016 (Call Sign WH2XJL); Tachyon Networks Inc., File No. SES-STA-20110427-00518 (Call Sign E070139).

environment.[7] The Rantec terminal will operate at off-axis ESD levels well below the off-axis ESD masks in Section 25.227(a)(1)(i) of the Commission's rules designed to protect co-frequency operations from harmful interference, as well as all other applicable ESAA requirements.

The Rantec terminal comprises an antenna assembly, antenna control unit ("ACU") and sensors in the antenna assembly that are used to establish reference positions for each of the three axes (elevation, azimuth and polarization). Algorithms in the ACU direct the feed/reflector system to rotate in polarization (to match the polarization of the satellite and the antenna) and to move in elevation and azimuth (to compensate for aircraft motion). In addition to allowing for both vertical and horizontal receive polarization, the ACU corrects for the polarization errors generated by the relative positions of the satellite and Rantec antenna.

Figure 2. Rantec Airborne SATCOM ESAA Terminal

Table 2. Summary of Rantec Technical Parameters

Antenna Dimensions	.46m
Transmit Band	14.0-14.5 GHz
Receive Band	10.95-12.75 GHz
Transmit Gain	34 dBi @ 14.5 GHz
Receive Gain	32.2 dBi @ 11.3 GHz
EIRP	43.4 dBW[8]
Receive G/T	11 dBi/K
Pointing Error	< 0.2 degrees

7 *See* Technical Appendix, IV.A.

8 Although the maximum EIRP of this terminal is 44.0 dBW, the highest power proposed in this Application is 43.4 dBW.

Accurate pointing of the Rantec terminal is achieved under direction of the ACU. The ACU receives aircraft position, heading, orientation and rate of change information from the dedicated IRU and determines the desired antenna azimuth and elevation by executing an open loop pointing process using data such as:

(i) ephemeris data stored in the modem to determine satellite location and polarization;
(ii) latitude, longitude, and altitude data from the IRU to determine aircraft location; and
(iii) heading, yaw, pitch, and roll data from the IRU to determine aircraft orientation.

Once the satellite is acquired, the ACU corrects for aircraft attitude changes based upon the IRU data, without waiting for degradation of the received signal strength. The IRU data is provided every 0.02 seconds, with a data resolution of 0.05°. The ACU computes the desired antenna azimuth, elevation and polarization 1024 times every second (approximately once every millisecond) and the antenna mechanical resolution is 0.09°. The antenna can slew in azimuth and elevation at more than 15° per second, which is sufficient to track aircraft motion within a normal flight envelope. The total root mean square pointing error for the antenna is calculated to be less than 0.1°, which is sufficient to satisfy the requirements for minimizing off-axis emissions, while maintaining the necessary gain for proper system operation.

The terminal receive polarization choices are selectable as linear horizontal, linear vertical, right-circular or left-circular. Transmit polarization is linear and aligned to be orthogonal to the selected receive polarization. For polarization setting, the antenna reflector and its fixed feed can be rotated 210° with a resolution of 0.25°. The ACU executes an open loop algorithm using the same inputs that it uses for antenna pointing to control the polarization.

1.3. Waveforms

The Intelsat ESAA network will use well established, standard iDirect waveforms: DVB-S2 and D-TDMA. The iDirect forward link (hub-to-mobile terminal) will consist of a single DVB-S2 carrier that may occupy up to a full transponder and operate in saturation but in most cases, will be operated in a partial transponder. DVB-S2 is a widely adopted standard for digital data and video broadcasting over satellite. Data may be multiplexed on this carrier for multiple terminals. The DVB-S2 standard supports Adaptive Coding and Modulation ("ACM") with QPSK, 8PSK, and 16APSK modulations and Low Density Parity Check Coding rates between 0.25 and 0.9.

The return link uses iDirect's Deterministic TDMA ("D-TDMA"), which supports multi-frequency ("MF") TDMA. The iDirect hub manages the frequency and timeslot assignments and ensures that no assignments are duplicated among the terminals. Timeslots and carriers are uniquely assigned, ensuring that only a single terminal can transmit in an assigned return link timeslot at a time (*i.e.*, there is no aggregation). Terminals will transmit a single carrier in each assigned return link time slot and the hub will adjust the timeslot assignments as user demand varies. Finally, any event that results in the loss of modem lock to the DVB-S2 downlink will cause the modem to cease transmissions. Thus, operation of the TECOM and Rantec terminals will not increase the potential for interference from ESAAs in the Intelsat ESAA network.

The ESAA terminals also will comply with the out-of-band emissions limitations and other relevant requirements in 47 C.F.R. §25.202.

1.4. Automatic Cessation of Emissions

The ESAA terminals cease transmission in the event of the following fault conditions:

(i) loss of ARINC-429 data from the IRU;
(ii) invalid status message from the IRU;
(iii) corruption of the 10 MHz reference;
(iv) antenna out of position (if pointing accuracy exceeds 0.5°, transmissions cease within 100 ms and will not resume until the pointing accuracy is better than 0.2°); or
(v) any critical fault detected by the terminal.

Furthermore, any event that results in the loss of modem lock to the DVB-S2 downlink will cause the modem to cease all transmission.

The additional technical data included in this application further demonstrate compliance with the Commission's ESAA rules and that Intelsat's proposed operation of the previously licensed ESAA terminals will not result in unacceptable interference to GSO FSS operations or other systems and services.

2. Space Segment

As discussed in the Narrative, the Space Segment will consist of capacity on the U.S.-licensed satellites specified in Table 1 of the ESAA Narrative submitted as part of this Application using frequencies authorized for ESAA operations in Section 25.227 of the Commission's rules. In addition, in the ESAA narrative, Intelsat seeks a waiver to permit it to use portions of the 12.2-12.75 GHz band for ESAA receive operations on an unprotected, non-harmful interference basis outside the United States (principally in Regions 1 and 3), subject to any necessary authorizations from foreign administrations.[9]. The Intelsat ESAA network may use whole or partial transponders and operated with single saturated carriers (forward link only) in a transponder or with multiple carriers. Forward and return links may be operated in the same or different transponders.[10]

Intelsat's proposed ESAA operations are consistent with the coordination agreements it has reached with adjacent satellites located within +/- 6 degrees of each serving satellite.[11] At all

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[9] The 12.5-12.75 GHz band is allocated for FSS downlinks in Region 1 and the 12.2-12.75 GHz band is allocated for FSS downlinks in Region 3.

[10] In addition, in order to afford Intelsat operational flexibility, the ESAA Narrative seeks authority for these ESAA terminals to communicate with other satellites appearing on the FCC's Permitted List.

[11] *See* Technical Appendix, III.

times, Intelsat will operate its ESAA terminals pursuant to the relevant coordination agreements and otherwise consistent with the Commission's rules governing ESAAs.

3. Ground Segment

The Ground Segment consists of hub controllers operated by Intelsat and located at Intelsat and commercial teleport facilities (aka Gateways). The entire Ground Segment is designed and deployed to be operated remotely from a centralized operations center.

3.1. Gateway Earth Stations

The gateway earth stations associated with ESAA terminal operations are listed in Table 2 of the ESAA Narrative. Teleport earth stations are licensed by the teleport operator and are not part of this application. iDirect DVB-S2 modulator cards for the forward link, iDirect demodulator cards for the return link, and the iDirect network management system are installed at each teleport location.

3.2. Network Operations Center

Control and monitoring of the Intelsat ESAA network (ESAA, Space and Ground segments) will be provided by the Intelsat Secure Operating Center ("ISOC") in Ellenwood, Georgia, United States on a 24/7 basis. The ISOC utilizes the iDirect Network Management System ("NMS") to provide complete control and visibility to all components of the Intelsat ESAA network. The NMS system has the capability of shutting down any component in the system that is malfunctioning. The ISOC can be reached at:

ISOC – Intelsat Secure Operating Center
Phone: +1 (404) 381-2727 / Email: ISOC@intelsatgeneral.com

Primary Point of Contact:
Angela Wheeler, Manager, Network Operations
Phone: +1 (404) 381-2727, Email: Angela.Wheeler@IntelsatGeneral.com

4. Protection of Co-Frequency Operations

Intelsat will protect GSO and NGSO FSS systems and space research and radio astronomy service operations in the 14.0-14.5 GHz band. As discussed in the associated application narrative, Intelsat seeks a limited waiver of Section 25.227(a)(1)(i)(B) of the Commission's rules because at certain power levels and skew angles the TECOM terminal exceeds the off-axis ESD levels in the plane perpendicular to the GSO arc, which is principally intended to protect NGSO FSS systems.[12]

[12] Currently, there are no NGSO systems operating in the United States or licensed by the Commission in the Ku-band.

4.1. GSO FSS Systems

The Intelsat ESAA network protects GSO FSS uplink (satellite receive) operations by controlling the off-axis ESD generated by an ESAA terminal to the levels established for Ku-band ESAAs or the levels that have been accepted by the adjacent satellites in coordination. The off-axis ESD limits for ESAAs are defined by 47 C.F.R. § 25.227 as:

15–25log10 (Θ)	dBW/4 kHz	For	1.5° ≤ Θ ≤ 7°
−6	dBW/4 kHz	For	7° < Θ ≤ 9.2°
18–25log10(Θ)	dBW/4 kHz	For	9.2° < Θ ≤ 19.1°
−14	dBW/4 kHz	For	19.1° < Θ ≤ 180°

Off-axis ESD is managed on an individual terminal basis. Only one ESAA terminal transmits at a given time and in a given bandwidth. The off-axis ESD of an individual ESAA terminal is a function of its transmit signal bandwidth, input power to the antenna, the projection of the antenna gain pattern of the antenna along the geostationary arc, and antenna pointing error. Input power to an ESAA terminal is controlled by limiting the output power of the modem. The input power limitations are specified on a satellite beam-by-satellite beam basis.

The contribution of pointing error to off-axis ESD is minimized by inhibiting pointing errors greater than 0.5° and not resuming transmission until the pointing error is less than 0.2°. Both ESAA terminal types have been proven to operate on an interference-free basis within these pointing parameters in both commercial and test operations and there have been no reported interference cases associated with these terminal operations.

Off-axis EIRP of the ESAA terminals at various skew angles is shown in the attached Technical Appendix.[13] The ESD values are based on the specific link parameters for two-degree compliant operations in the United States. As demonstrated, both terminals off-axis ESD remains well below the 47 C.F.R. § 25.227 off-axis ESD limit for all off-axis ranges in the planet tangent to the GSO arc. Even with the pointing error of the terminal is included in the off-axis ESD, it remains below the off-axis ESD limit for a conforming and perfectly pointed terminal.

Intelsat has provided a range of ESAA terminal off-axis ESD data for the Commission's consideration. Operations generally will have the same off-axis characteristics and vary only by power level to ensure compliance with levels coordinated with adjacent satellite operators within +/- 6 degrees of the serving satellite. Off-axis EIRP will be controlled to permissible two-degree spacing levels or the coordinated limits for the satellite, whichever is greater. Control will be achieved by limiting maximum EIRP spectral density and skew angle.

[13] *See* Technical Appendix, IV.A & V.A. As noted, because the Rantec terminal use a circular parabolic antenna, it's beam is not susceptible to skew effects.

4.2. NGSO FSS Systems

The Rantec terminal complies with all ESD limits in Section 25.227(a)(1)(i) of the Commission's Rules, including those designed to protect co-frequency NGSO FSS systems. The TECOM terminal, however, will exceed the co-polarized signal ESD limits put forth in 47 C.F.R. § 25.227(a)(1)(i)(B) in the plane perpendicular to the GSO arc at certain power levels and skew angles. Although there are currently no NGSO FSS systems license by the Commission, if a Ku-band NGSO FSS system is launched in the future Intelsat would enter into coordination with the NGSO FSS system operator to establish operating parameters that permit successful co-frequency sharing, and would modify its operations as necessary to effect any coordination agreement.

4.3. Terrestrial Services

Intelsat's proposed ESAA System operations will be performed pursuant to its primary status in the 14.0-14.5 GHz band. In areas outside the United States, Intelsat will follow ITU and other international requirements to protect FS operations. Specifically, Intelsat will limit power flux density ("PFD") to the levels stated in Recommendation ITU-R M.1643 Part B in areas where protection is required.

4.4. NASA TDRSS

The Intelsat network inhibits ESAA terminal transmission by location (based on maps preloaded onto the terminal controller and by Network Management control) to protect space research operations. Intelsat has initiated but not yet completed discussions regarding a coordination agreement with NASA to protect space research activities in the 14.0-14.2 GHz band.

NASA operates downlinks for the Tracking and Data Relay Satellite System (TDRSS) links at various sites identified in the Commission's rules that are reverse-banded to the commercial Ku-Band uplink spectrum. As a result, they are potentially vulnerable to interference from ESAA uplink transmission. To protect these sites, Intelsat will cease ESAA transmissions within line of site of all TDRSS sites until coordination with NASA is completed. When Intelsat enters into a coordination agreement with NASA, it will submit the agreement to the Commission and comply with all terms and conditions set forth therein.

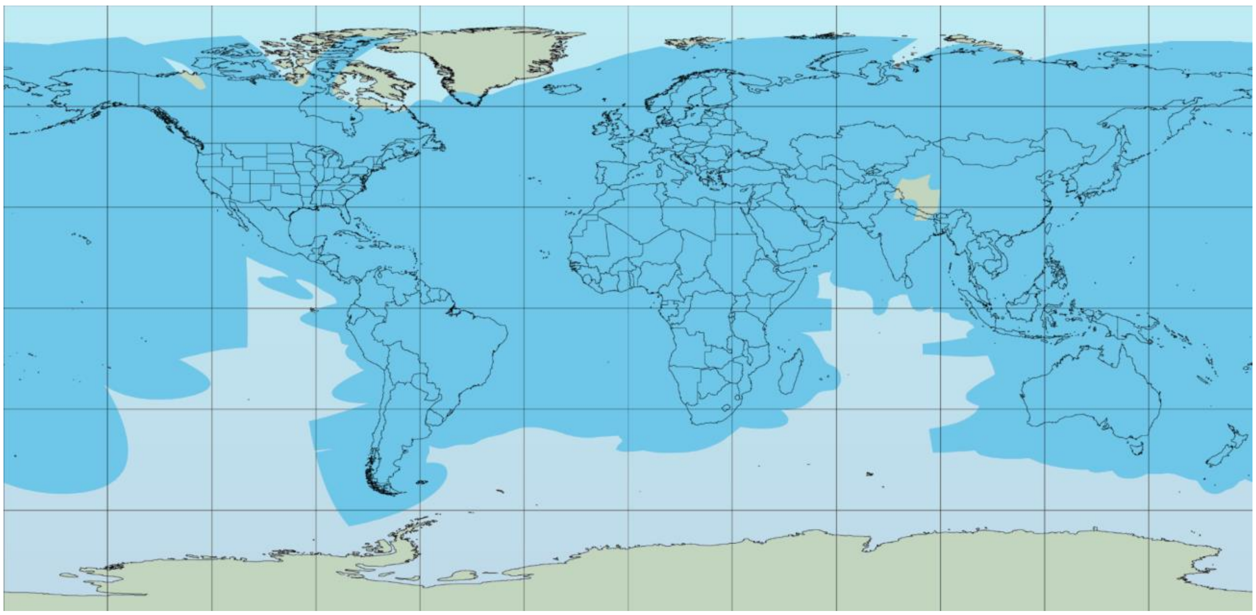
4.5. Radio Astronomy Service

Intelsat also inhibits ESAA terminal transmission by location (based on maps preloaded onto the terminal controller and by Network Management control) to protect space research operations. Intelsat has initiated but not yet completed discussions regarding a coordination agreement with the National Science Foundation ("NSF") to protect the radio astronomy operations in the 14.47-14.50 GHz band.

Radio astronomy observations are conducted at various times at locations identified in the Commission's rules. To protect these sites, the Intelsat will cease ESAA transmissions within line of site of all radio astronomy sites during observations until coordination with NSF is completed. When Intelsat enters into a coordination agreement with NSF, it will submit the agreement to the Commission and comply with all terms and conditions set forth therein.

II. Coverage Map

The geographic coverage of the Intelsat ESAA network is depicted below.



III. <u>Satellite Operator Certification Letter</u>

June 26, 2017

Federal Communications Commission
International Bureau
445 12th Street, SW
Washington, D.C. 20554

Re: Statement of Intelsat in Support of ESAA Application

To Whom It May Concern:

This letter supports Intelsat's application for a blanket earth stations aboard aircraft ("ESAA") license from the Federal Communications Commission ("FCC") to operate two aircraft-mounted satellite earth station terminals, the TECOM KuStream® 1500 terminal and the Rantec Airborne SATCOM terminal. The aircraft-mounted satellite earth station terminals are planned to be operated with a total of 17 satellites under the requested blanket license, as specified below in Table 1. Intelsat is filing this application pursuant to the FCC's rules governing ESAA operations, including Section 25.227.

Table 1: List of Satellites

Satellite	Orbital location
IS-23	53°EL
IS-17	66°EL
IS-20	68.5°EL
IS-22	72.1°EL
IS-19	166°EL
H-3e	169°EL
IS-18	180°EL
IS-37e	18°WL
IS-35e	34.5°WL
IS-14	45°WL
IS-29e	50°WL
IS-34	55.5°WL
IS-21	58°WL
IS-33e	60°WL
H-1	127°WL
G-19	97°WL
Sky-B1	43.15°WL

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Intelsat confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements between Intelsat and the operators of satellites within +/- 6 degrees of the above-listed satellites' orbit locations, and that the proposed operation of the aircraft-mounted satellite earth station terminals have the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

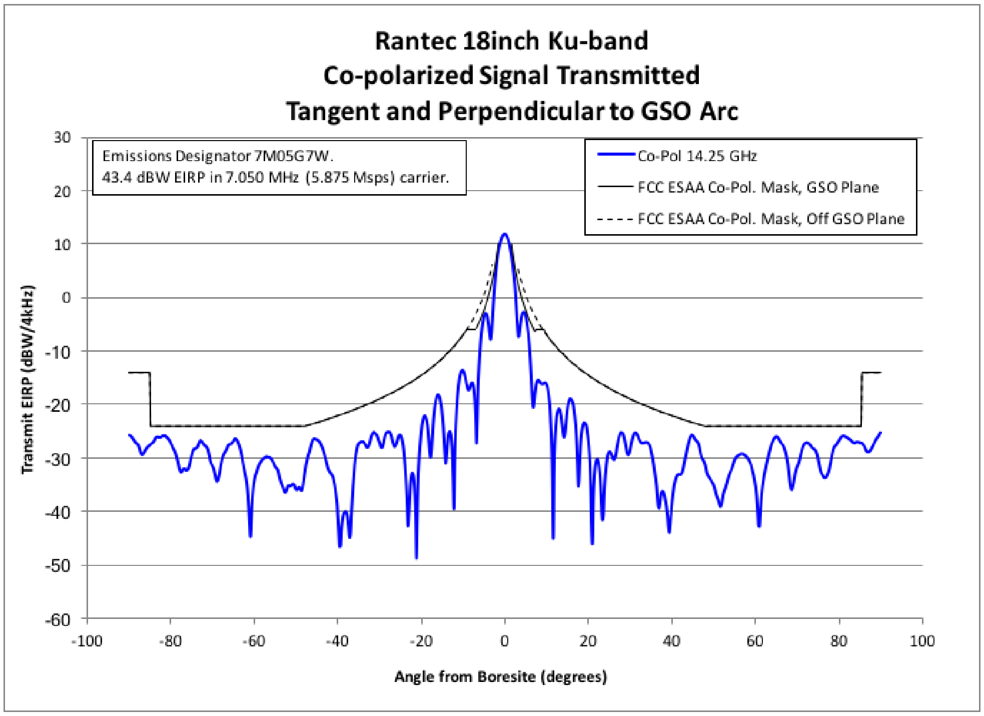
If the FCC authorizes the operations as proposed, Intelsat will include the power density levels in all future satellite network coordination agreements with operators of future satellites that are adjacent (within +/- 6 degrees) to the satellites addressed by this statement.

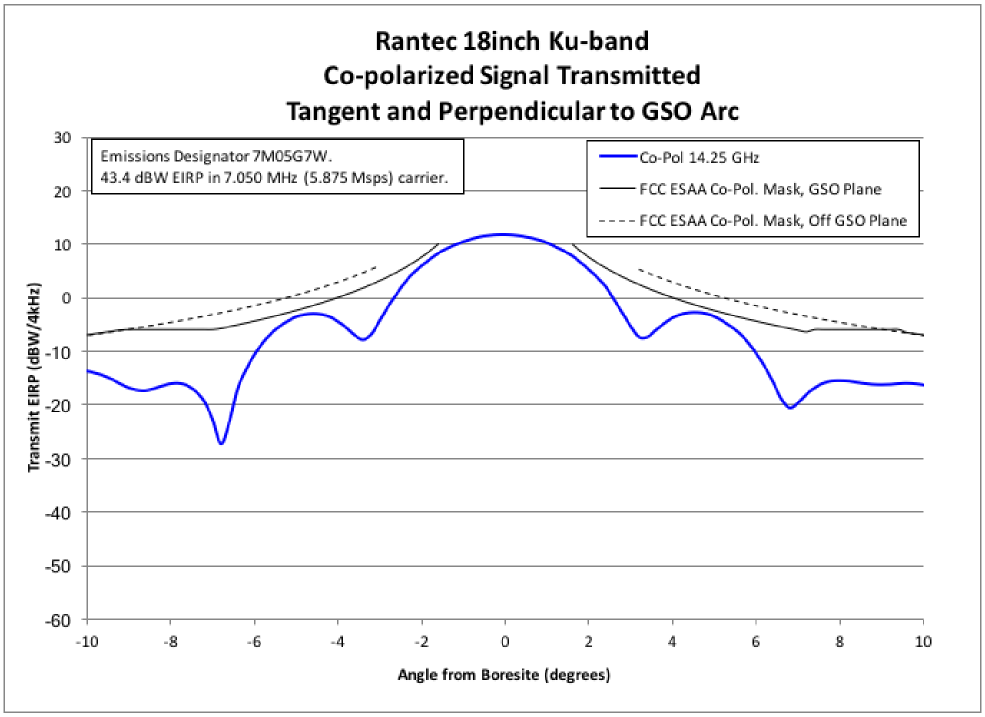
Sincerely,

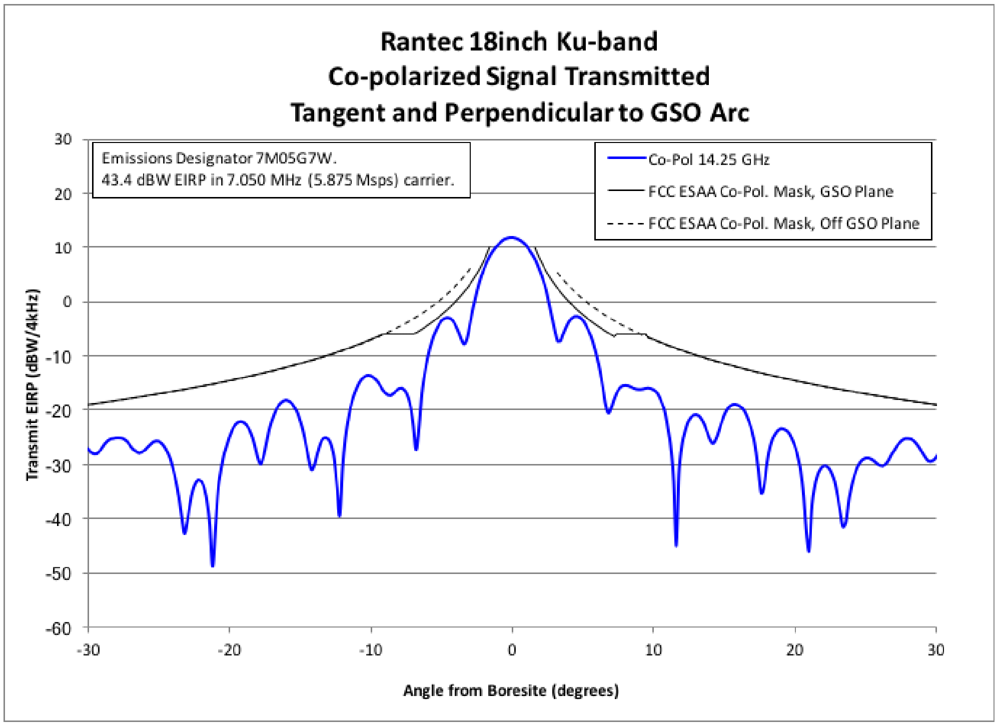
__/s/ *Alexander Gerdenitsch*______ June 26, 2017
Alexander Gerdenitsch Date
Manager, Spectrum Policy, Americas
Intelsat General Corporation

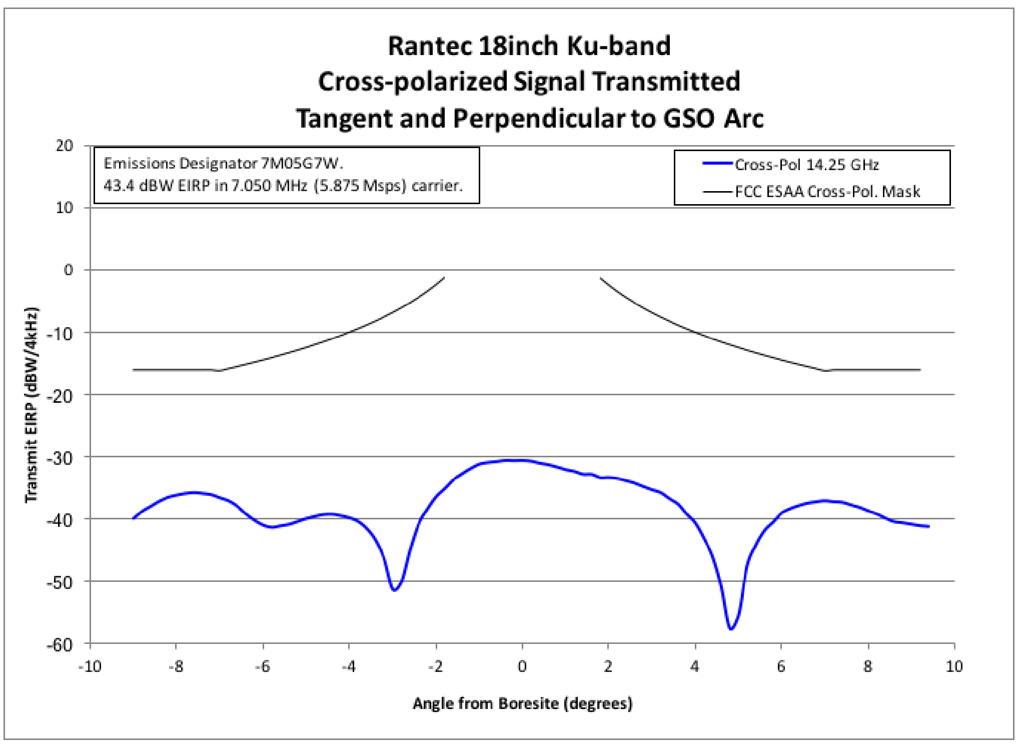
IV. Rantec Airborne SATCOM 18”

A. Off-Axis EIRP Spectral Density Plots






Rantec 18inch Ku-band
Co-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 7M05G7W.
43.4 dBW EIRP in 7.050 MHz (5.875 Msps) carrier.
Co-Pol 14.25 GHz
FCC ESAA Co-Pol. Mask, GSO Plane
FCC ESAA Co-Pol. Mask, Off GSO Plane
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)


Rantec 18inch Ku-band
Cross-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 7M05G7W.
43.4 dBW EIRP in 7.050 MHz (5.875 Msps) carrier.
Cross-Pol 14.25 GHz
FCC ESAA Cross-Pol. Mask
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)

B. Radiation Hazard Analysis for Rantec Airborne SATCOM

This report analyzes the non-ionizing radiation levels for the Rantec Airborne SATCOM ("Rantec") earth stations onboard aircraft ("ESAA") terminal.[14] This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/ Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. Because the antenna is mounted on top of an aircraft fuselage, this area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area is accessed by operators, maintenance or other authorized personnel.

Near Field Exposure

For this calculation, it was assumed that all 10 watts are uniformly distributed across the surface area of the panel.

The extent of the near field region is defined by the following equation:

$R_{nf} = D^2 /(4\lambda)$

2.53 m

Where D is the width of the panel (0.46 meters).

The maximum power density in the Near Field can be determined by the following equation:

$S_{nf} = P_{SSPA} / A$

31.34 mW/cm^2

[14] This radiation hazard analysis is conducted at maximum transmit power, without losses or back-off, to provide the most conservative assessment possible.

Where A is the surface area of the panel and P is the power available from the SSPA.

In normal operation, this antenna is mounted on the fuselage of an aircraft or rooftop with the main beam pointed toward the sky at a minimum elevation angle of 5 degrees such that human exposure in the near field is not possible. Additionally, in normal operation, any blockage in the near field will cause the transmitter to be disabled within seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation. Strict operational procedures and access to the antenna area on the top of equipped aircraft by trained personnel only will ensure that individuals are not exposed to excess levels of RF radiation.

Far Field Exposure (in main beam)

$$R_{ff} = 0.60D^2 / \lambda$$

6.06 m

$$S_{ff} = P_{EIRP} /(4\lambda R^2{}_{ff})$$

5.44 mW/ cm^2

At a distance of 6.06 meters (far-field boundary), the power density of the antenna is 5.44 mW/cm^2 and there is no RF hazard to personnel in the far field of the antenna (6.06 m) because safe radius distance will be observed at all times. The limit of 1 mW/cm^2 and 5 mW/cm^2 thresholds for the General Population/Uncontrolled Exposure in the main beam of the antenna is described below.

Transition Region Exposure (in main beam)

At a distance of 3.5m from the antenna, maximum exposure in the main beam is 16.32 mW/cm^2. This assumes that PFD decreases linearly from 31.34 mW/cm^2 to 5.44 mW/cm^2 in this region between the near field and far field (2.53 m to 6.06 m from the antenna). At a distance of 5 m from the antenna, maximum exposure in the main beam is approximately 8.0 mW/cm^2.

Exposure to personnel located below antenna height

The antenna will be mounted at a height above personnel/public locations. In this case, the worst case exposure is due to the first elevation sidelobe at a level of -12 dB. For the Rantec terminal, the far field distance in the elevation plane is approximately 6.06 m. The 5 mW/cm^2 threshold is reached at a distance of 6.32 m and the 1 mW/cm^2 threshold is reached at a distance of 14.14 m. Observing the safe radius distance noted above during transmit operations will ensure that the threshold will not be exceeded.

Table 1: Parameters Used for Determining PFD (Rantec)

Antenna Width	.46	m
Antenna Height	.46	m
Antenna Surface Area	0.657	m^2
Frequency	14500	MHz
Wavelength	.021	m
Transmit Power	10	W
Antenna Gain	34	dBi
EIRP	44	dBW
Far Field Boundary (Azimuth)	6.06	m
Power Density at far field boundary (Azimuth)	5.44	mW/cm^2
Near Field Distance (Azimuth)	2.53	m
Near Field Power Density (Azimuth)	31.34	mW/cm^2
Elevation sidelobe level	-12	dB
Far Field Boundary (Elevation)	6.06	m
Power Density at far field boundary (Elevation)	.34	mW/cm^2
Safe Far Field Distance (Elevation)	14.14	m
Power Density	1.00	mW/cm^2
Safe Far Field Distance (Elevation)	6.32	m
Power Density	5.00	mW/cm^2

Conclusions

The worse-case radiation hazards exist along the main beam axis. In the case of being aligned with the antenna axis, General Population / Uncontrolled Exposure limits are satisfied at 6.3 meters. For the proposed operations, it is highly unlikely that the antenna axis will be aligned with any uncontrolled area. The antenna will be mounted on the top of an aircraft fuselage and will transmit only when (a) it has a clear field of view towards the serving satellite (i.e., has successfully received from the satellite) and (b) it's elevation angle (relative to the aircraft) is above the antenna's mechanical limit of 5 degrees. The general public does not have access to this area. For general population / uncontrolled access below the antenna (i.e., when approaching the aircraft), the maximum power density at the antenna's first side lobe, at the minimum far field distance of 6.1 m, is 0.34 mW/cm^2, well below the 1.0 mW/cm^2 limit.

In addition, commissioning of the Rantec terminal will only be conducted by trained personnel in a controlled environment. By maintaining an adequate safety radius during transmit operations, it can be guaranteed that the General Population/Uncontrolled Exposure limits will not be exceeded under any conditions. As required by Special Condition 90053, Intelsat will utilize appropriate labeling warning about the radiation hazard, including a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2.

C. Representative Link Budget

Customer Support Engineering & Capacity Management

Link Budget Report for:

Opportunity-ID / SSR-ID
Done by: vivanh   Date: 08 May 2017

Application: STRIP7 v6.2   Presumptive

Satellite and Role: IS-29e @ 310.00°E
Connectivity: K04V1 / K601V2
Platform bias: 0.00°E; 0.00°N
Sat. TWT Power [Watts]: 150.0
Sat. D/L EIRP at be/bp [dBW]: 54.3 / 59.4
SFD at be/bp [dBW/m²]: N/A / N/A
Band Up/Dw [MHz]: (14159 - 14177) / (11210 - 11440)
Polarization Up/Dw: V / V

Total lease resource [MHz]:
Total D/L EIRP Avail. at be/bp [dBW]:
Total D/L EIRP Used at be/bp [dBW]: 20.8 / 25.9
Total BW Used [MHz]: 2.1
Xp Operational Mode: Multi-Carrier
Nominal OBO= -3.5 dB

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Antennas	Diameter [m]	Gtx [dBi]	G/T [dB/K]	Latitude [°N]	Longitude [°E]	Xpol [dB]	Location (Nearest City and Country)
MTN-K77	13.0	63.7	40.4	39.93	282.2417	36.5	MTN-K77 - UNITED STATES
R18-K04	0.45	34.0	10.8	36.60	278.00	26.0	-

Tx E/S	Rx E/S	Carrier Type #, Type, [I.R, OH, FEC, RS, modulation]	Noise BW [MHz]	Space Factor (Roll-off)	Alloc. BW [MHz]	PEB [MHz]	b.e. D/L EIRP [dBW]	C/N thresh. [dB]	CS C/N after ASI [dB]	Eb/No thresh. [dB]	CS Eb/No after ASI [dB]	Link Availab. [%/yr]	U/L EIRP [dBW]
			Per Carrier Link Parameters and Results										
R18-K04	MTN-K77	DIG (2.333 Mbps, OH=0.0%, 2/3 FEC, QPSK)	1.750	1.20	2.100	0.226	20.8	5.3	6.4	4.1	5.2	99.90	38.1
	TOTAL:	1 Carrier			2.100	0.226	20.8						

ISCO comments:

Antenna pattern comments:

Notes: Clear Sky C/N includes 0.3 dB additional margin for terrestrial interference. Uplink antenna mis-pointing & HPA instability and downlink antenna mis-pointing are accounted for in the uplink and the downlink respectively (0.5 dB).
* Analysis results include presumed levels of interference to overcome fluctuations in operational interferences due to other carriers in the system.

Customer Support Engineering & Capacity Management

Link Budget Report for:

Opportunity-ID / SSR-ID
Done by: vivanh   Date: 08 May 2017

Application: STRIP7 v6.2   Presumptive

Satellite and Role: IS-29e @ 310.00°E
Connectivity: K601H1 / K04H1
Platform bias: 0.00°E; 0.00°N
Sat. TWT Power [Watts]: 150.0
Sat. D/L EIRP at be/bp [dBW]: 57.1 / 63.9
SFD at be/bp [dBW/m²]: N/A / N/A
Band Up/Dw [MHz]: (13156 - 13174) / (12080 - 12195)
Polarization Up/Dw: H / H

Total lease resource [MHz]:
Total D/L EIRP Avail. at be/bp [dBW]:
Total D/L EIRP Used at be/bp [dBW]: 42.8 / 49.6
Total BW Used [MHz]: 17.9
Xp Operational Mode: Multi-Carrier
Nominal OBO= -3.5 dB

INTELSAT

Antennas	Diameter [m]	Gtx [dBi]	G/T [dB/K]	Latitude [°N]	Longitude [°E]	Xpol [dB]	Location (Nearest City and Country)
MTN-K77	13.0	63.7	40.4	39.93	282.2417	36.5	MTN-K77 - UNITED STATES
R18-K04	0.45	34.0	10.8	36.60	278.00	26.0	-

Tx E/S	Rx E/S	Carrier Type #, Type, [I.R, OH, FEC, RS, modulation]	Noise BW [MHz]	Space Factor (Roll-off)	Alloc. BW [MHz]	PEB [MHz]	b.e. D/L EIRP [dBW]	C/N thresh. [dB]	CS C/N after ASI [dB]	Eb/No thresh. [dB]	CS Eb/No after ASI [dB]	Link Availab. [%/yr]	U/L EIRP [dBW]
			Per Carrier Link Parameters and Results										
MTN-K77	R18-K04	DIG (12.300 Mbps, OH=0.0%, 0.4134 FEC, QPSK)	14.877	1.20	17.852	9.272	42.8	1.7	4.1	2.5	5.0	99.91	63.3
	TOTAL:	1 Carrier			17.852	9.272	42.8						

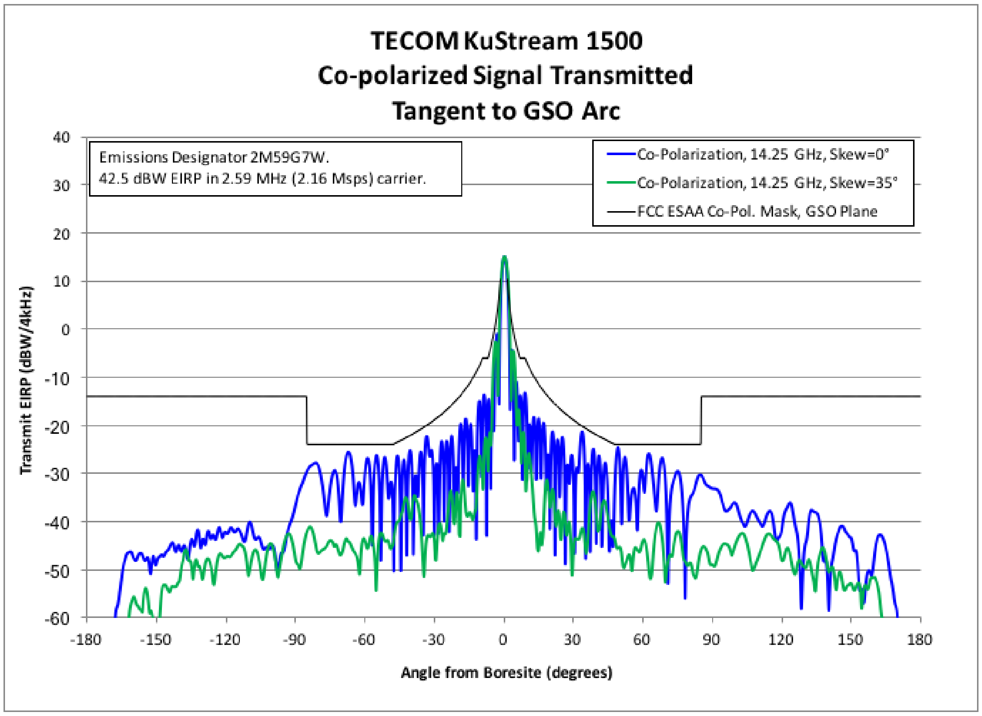
ISCO comments:

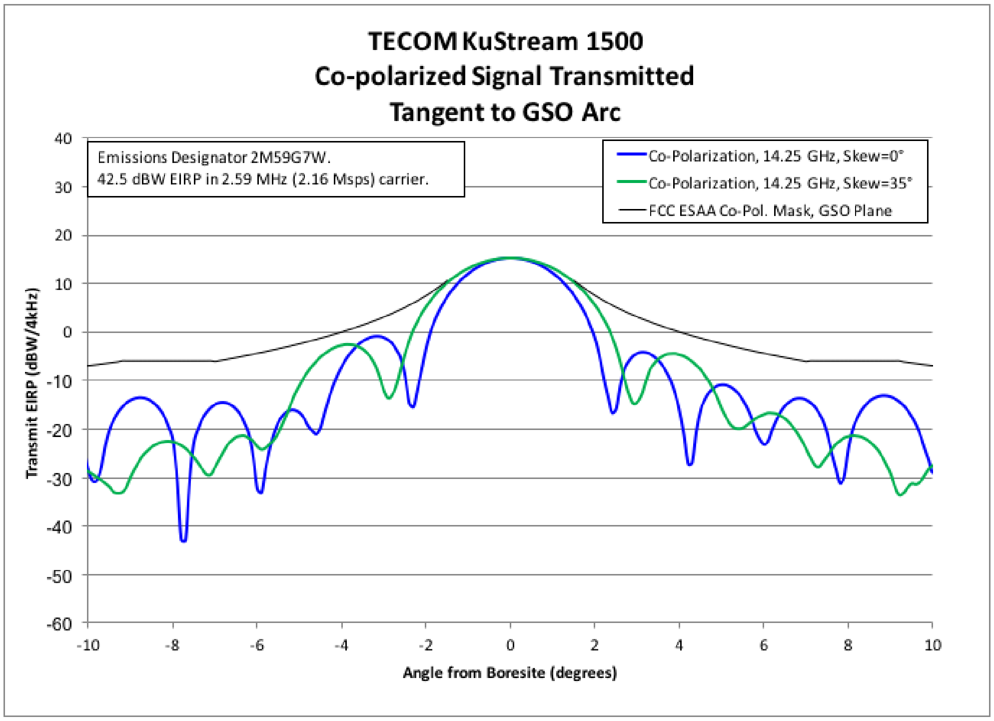
Antenna pattern comments:

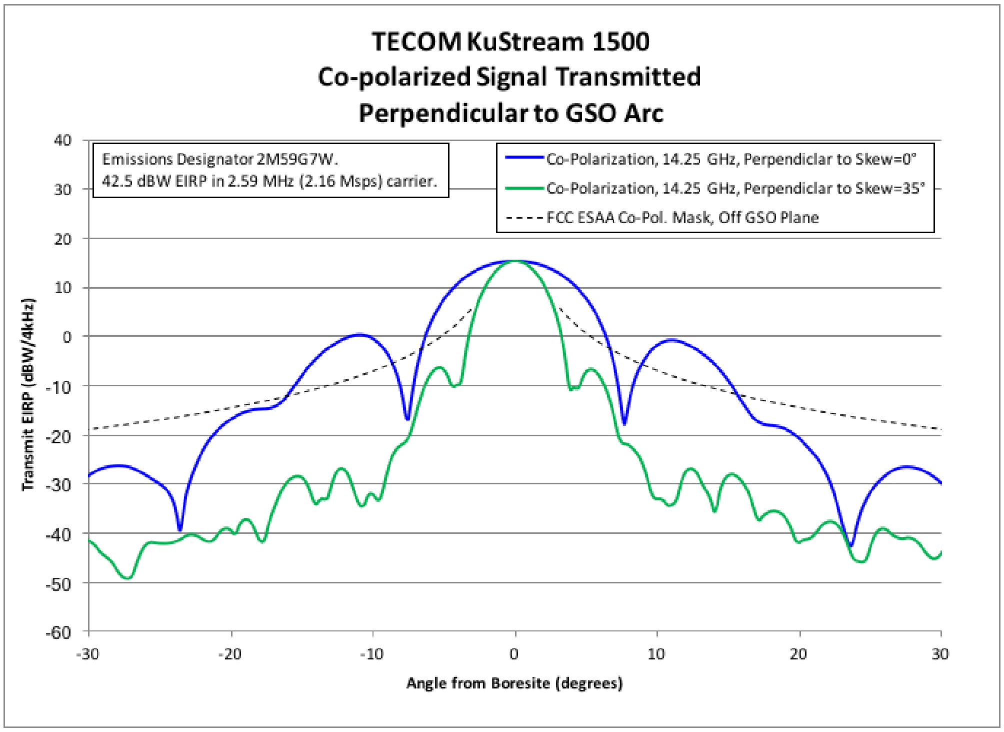
Notes: Clear Sky C/N includes 0.3 dB additional margin for terrestrial interference. Uplink antenna mis-pointing & HPA instability and downlink antenna mis-pointing are accounted for in the uplink and the downlink respectively (0.5 dB).
* Analysis results include presumed levels of interference to overcome fluctuations in operational interferences due to other carriers in the system.

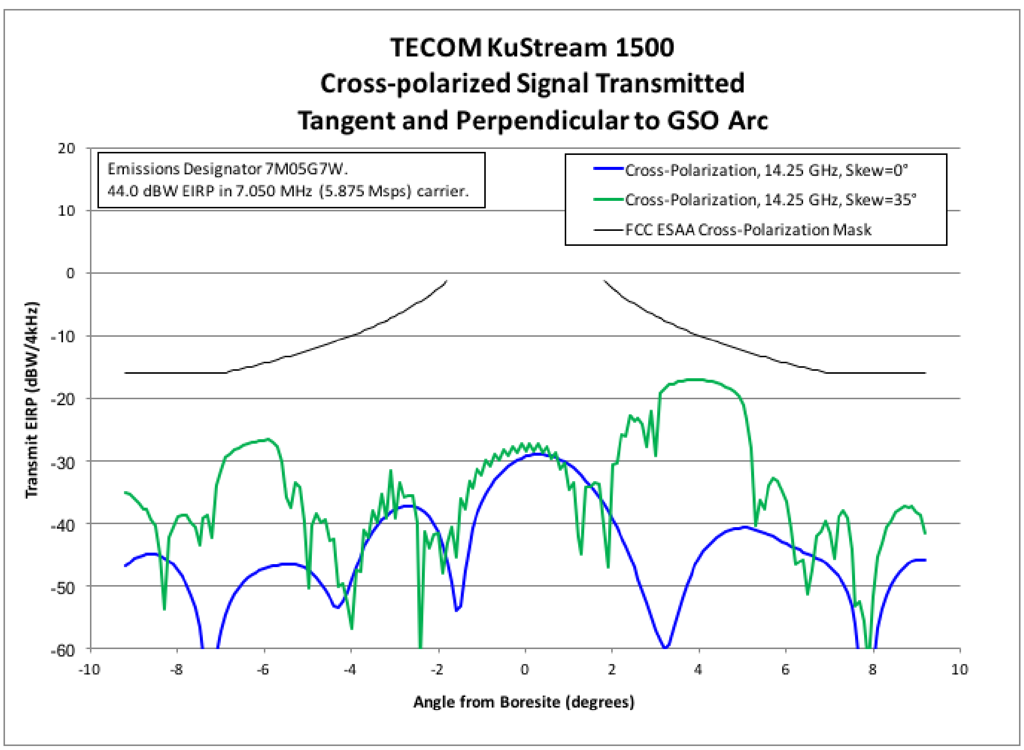
V. TECOM KuStream® 1500

A. Off-Axis EIRP Spectral Density Plots






TECOM KuStream 1500
Co-polarized Signal Transmitted
Perpendicular to GSO Arc
Emissions Designator 2M59G7W.
42.5 dBW EIRP in 2.59 MHz (2.16 Msps) carrier.
Co-Polarization, 14.25 GHz, Perpendiclar to Skew=0°
Co-Polarization, 14.25 GHz, Perpendiclar to Skew=35°
FCC ESAA Co-Pol. Mask, Off GSO Plane
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)


TECOM KuStream 1500
Cross-polarized Signal Transmitted
Tangent and Perpendicular to GSO Arc
Emissions Designator 7M05G7W.
44.0 dBW EIRP in 7.050 MHz (5.875 Msps) carrier.
Cross-Polarization, 14.25 GHz, Skew=0°
Cross-Polarization, 14.25 GHz, Skew=35°
FCC ESAA Cross-Polarization Mask
Transmit EIRP (dBW/4kHz)
Angle from Boresite (degrees)

TECOM KuStream® 1500
Supplemental Off-Axis EIRP Density Table

47 C.F.R. § 25.115(g)(1)(viii)

Co-Polarized Signal Perpendicular to the GSO Arc from
minus 15° to plus 15°

Angle	**Off-Axis EIRP Density (dBW/4KHz)**
-15.00	-7.91
-14.80	-7.14
-14.60	-6.41
-14.40	-5.72
-14.20	-5.08
-14.00	-4.47
-13.80	-3.92
-13.60	-3.40
-13.40	-2.92
-13.20	-2.48
-13.00	-2.07
-12.80	-1.68
-12.60	-1.33
-12.40	-1.00
-12.20	-0.70
-12.00	-0.42
-11.80	-0.18
-11.60	0.02
-11.40	0.19
-11.20	0.30
-11.00	0.35
-10.80	0.34
-10.60	0.26
-10.40	0.11
-10.20	-0.12
-10.00	-0.44
-9.90	-0.63
-9.80	-0.85
-9.70	-1.08
-9.60	-1.35
-9.50	-1.63
-9.40	-1.95
-9.30	-2.28
-9.20	-2.66
-9.10	-3.05
-9.00	-3.49
-8.90	-3.94
-8.80	-4.46
-8.70	-5.01
-8.60	-5.62
-8.50	-6.28
-8.40	-7.04
-8.30	-7.86
-8.20	-8.83

-8.10	-9.91
-8.00	-11.22
-7.90	-12.69
-7.80	-14.52
-7.70	-16.05
-7.60	-16.87
-7.50	-16.87
-7.40	-14.88
-7.30	-12.94
-7.20	-11.03
-7.10	-9.23
-7.00	-7.68
-6.90	-6.21
-6.80	-4.94
-6.70	-3.73
-6.60	-2.67
-6.50	-1.66
-6.40	-0.75
-6.30	0.12
-6.20	0.90
-6.10	1.66
-6.00	2.35
-5.90	3.02
-5.80	3.63
-5.70	4.23
-5.60	4.78
-5.50	5.31
-5.40	5.80
-5.30	6.28
-5.20	6.73
-5.10	7.17
-5.00	7.58
-4.90	7.97
-4.80	8.35
-4.70	8.71
-4.60	9.05
-4.50	9.39
-4.40	9.70
-4.30	10.01
-4.20	10.30
-4.10	10.58
-4.00	10.85
-3.90	11.11
-3.80	11.36
-3.70	11.60
-3.60	11.83
-3.50	12.05
-3.40	12.26
-3.30	12.46
-3.20	12.65
-3.10	12.84
-3.00	13.01

-2.90	13.18
-2.80	13.34
-2.70	13.50
-2.60	13.64
-2.50	13.78
-2.40	13.91
-2.30	14.04
-2.20	14.15
-2.10	14.27
-2.00	14.37
-1.90	14.47
-1.80	14.56
-1.70	14.65
-1.60	14.73
-1.50	14.81
-1.40	14.88
-1.30	14.95
-1.20	15.01
-1.10	15.07
-1.00	15.12
-0.90	15.17
-0.80	15.21
-0.70	15.25
-0.60	15.28
-0.50	15.31
-0.40	15.33
-0.30	15.35
-0.20	15.36
-0.10	15.37
0.00	15.37
0.10	15.37
0.20	15.36
0.30	15.35
0.40	15.33
0.50	15.31
0.60	15.28
0.70	15.24
0.80	15.20
0.90	15.16
1.00	15.11
1.10	15.06
1.20	15.00
1.30	14.94
1.40	14.87
1.50	14.79
1.60	14.71
1.70	14.63
1.80	14.54
1.90	14.45
2.00	14.35
2.10	14.24
2.20	14.13

2.30	14.01
2.40	13.89
2.50	13.76
2.60	13.62
2.70	13.48
2.80	13.33
2.90	13.17
3.00	13.01
3.10	12.83
3.20	12.65
3.30	12.46
3.40	12.26
3.50	12.06
3.60	11.84
3.70	11.62
3.80	11.39
3.90	11.15
4.00	10.89
4.10	10.63
4.20	10.35
4.30	10.07
4.40	9.77
4.50	9.47
4.60	9.14
4.70	8.81
4.80	8.46
4.90	8.10
5.00	7.72
5.10	7.33
5.20	6.92
5.30	6.49
5.40	6.03
5.50	5.56
5.60	5.06
5.70	4.54
5.80	3.99
5.90	3.41
6.00	2.79
6.10	2.15
6.20	1.46
6.30	0.73
6.40	-0.06
6.50	-0.88
6.60	-1.79
6.70	-2.74
6.80	-3.80
6.90	-4.92
7.00	-6.19
7.10	-7.54
7.20	-9.11
7.30	-10.81
7.40	-12.83

7.50	-14.84
7.60	-16.79
7.70	-17.79
7.80	-16.46
7.90	-15.09
8.00	-13.59
8.10	-12.19
8.20	-11.03
8.30	-9.94
8.40	-9.04
8.50	-8.19
8.60	-7.47
8.70	-6.79
8.80	-6.20
8.90	-5.63
9.00	-5.13
9.10	-4.65
9.20	-4.22
9.30	-3.81
9.40	-3.44
9.50	-3.09
9.60	-2.77
9.70	-2.47
9.80	-2.21
9.90	-1.96
10.00	-1.74
10.20	-1.37
10.40	-1.09
10.60	-0.89
10.80	-0.77
11.00	-0.73
11.20	-0.76
11.40	-0.85
11.60	-1.00
11.80	-1.20
12.00	-1.44
12.20	-1.72
12.40	-2.03
12.60	-2.36
12.80	-2.72
13.00	-3.11
13.20	-3.52
13.40	-3.96
13.60	-4.43
13.80	-4.94
14.00	-5.50
14.20	-6.09

14.40	-6.73
14.60	-7.43
14.80	-8.17
15.00	-8.96

B. Radiation Hazard Analysis for TECOM KuStream® 1500

This report analyzes the non-ionizing radiation levels for the TECOM KuStream® 1500 ("TECOM 1500") earth stations onboard aircraft ("ESAA") terminal.[15] This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/ Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. Because the antenna is mounted on top of an aircraft fuselage, this area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area is accessed by operators, maintenance or other authorized personnel.

Near Field Exposure

For this calculation, it was assumed that all 10 watts are uniformly distributed across the surface area of the panel.

The extent of the near field region is defined by the following equation:

$$R_{nf} = D^2 /(4\lambda)$$

4.72 m (where D is the width of the panel, 0.65 meters).

The maximum power density in the Near Field can be determined by the following equation:

$$S_{nf} = P_{SSPA} / A$$

[15] This radiation hazard analysis is conducted at maximum transmit power, without losses or back-off, to provide the most conservative assessment possible.

8.96 mW/ cm^2 (where A is the surface area of the panel and P is the power available from the SSPA).

In normal operation, this antenna is mounted on the fuselage of an aircraft or rooftop with the main beam pointed toward the sky at a minimum elevation angle of 5 degrees such that human exposure in the near field is not possible. Additionally, in normal operation, any blockage in the near field will cause the transmitter to be disabled within seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation. Strict operational procedures and access to the antenna area on the top of equipped aircraft by trained personnel only will ensure that individuals are not exposed to excess levels of RF radiation.

Far Field Exposure (in main beam)

$R_{ff} = 0.60D^2 / \lambda$

11.34 m

$S_{ff} = P_{EIRP} /(4\lambda R^2_{ff})$

1.56 mW/ cm^2

At a distance of 11.34 meters (far-field boundary), the power density of the antenna is 1.56 mW/cm^2 and there is no RF hazard to personnel in the far field of the antenna (11.34 m) because safe radius distance will be observed at all times. The limit of 1 mW/cm^2 and 5 mW/cm^2 thresholds for the General Population/Uncontrolled Exposure in the main beam of the antenna is described below.

Transition Region Exposure (in main beam)

At a distance of 10 m from the antenna, maximum exposure in the main beam is 2.0 mW/cm^2. This assumes that PFD decreases linearly from 8.96 mW/cm^2 to 1.56 mW/cm^2 in this region between the near field and far field (4.72 m to 11.34 m from the antenna). At a distance of 15 m from the antenna, maximum exposure in the main beam is approximately .89 mW/cm^2.

Exposure to personnel located below antenna height

The antenna will be mounted at a height above personnel/public locations. In this case, the worst case exposure is due to the first elevation sidelobe at a level of -12 dB. For the TECOM 1500 terminal, the far field distance in the elevation plane is approximately 11.34 m. The 5 mW/cm^2 threshold is reached at a distance of 10.12 m and the 1 mW/cm^2 threshold is reached at a distance of 14.14 m. Observing the safe radius distance noted above during transmit operations will ensure that the threshold will not be exceeded.

Table 1: Parameters Used for Determining PFD (TECOM 1500)

Antenna Width	.65	m
Antenna Height	.17	m
Antenna Surface Area	0.111	m^2
Frequency	14500	MHz
Wavelength	.021	m
Transmit Power	33.1	W
Antenna Gain	28.8	dBi
EIRP	44	dBW
Far Field Boundary (Azimuth)	11.34	m
Power Density at far field boundary (Azimuth)	1.56	mW/cm^2
Near Field Distance (Azimuth)	4.72	m
Near Field Power Density (Azimuth)	8.86	mW/cm^2
Elevation sidelobe level	-12	dB
Far Field Boundary (Elevation)	11.34	m
Power Density at far field boundary (Elevation)	.10	mW/cm^2
Safe Far Field Distance (Elevation)	14.14	m
Power Density	1.00	mW/cm^2
Safe Far Field Distance (Elevation)	10.12	m
Power Density	5.00	mW/cm^2

Conclusions

The worse-case radiation hazards exist along the main beam axis. In the case of being aligned with the antenna axis, General Population / Uncontrolled Exposure limits are satisfied at 6.3 meters. For the proposed operations, it is highly unlikely that the antenna axis will be aligned with any uncontrolled area. The antenna will be mounted on the top of an aircraft fuselage and will transmit only when (a) it has a clear field of view towards the serving satellite (i.e., has successfully received from the satellite) and (b) it's elevation angle (relative to the aircraft) is above the antenna's mechanical limit of 5 degrees. The general public does not have access to this area. For general population / uncontrolled access below the antenna (i.e., when approaching the aircraft), the maximum power density at the antenna's first side lobe at the minimum far field distance of 6.1m, is 0.34 mW/cm^2, well below the 1.0 mW/cm^2 limit.

In addition, commissioning of the TECOM 1500 will only be conducted by trained personnel in a controlled environment. By maintaining an adequate safety radius during transmit operations, it can be guaranteed that the General Population/Uncontrolled Exposure limits will not be exceeded under any conditions. As required by Special Condition 90053, Intelsat will utilize appropriate labeling warning about the radiation hazard, including a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2.

C. Representative Link Budget

Customer Support Engineering & Capacity Management

Link Budget Report for:

Opportunity-ID / SSR-ID
Done by: vivanh   Date: 10 May 2017

Application: STRIP7 v6.2   Presumptive

Satellite and Role: IS-29e @ 310.00°E
Connectivity: K04V1 / K601V2
Platform bias: 0.00°E; 0.00°N
Sat. TWT Power [Watts]: 150.0
Sat. D/L EIRP at be/bp [dBW]: 54.3 / 59.4
SFD at be/bp [dBW/m²]: N/A / N/A
Band Up/Dw [MHz]: (14159 - 14177) / (11210 - 11440)
Polarization Up/Dw: V / V

Total lease resource [MHz]:
Total D/L EIRP Avail. at be/bp [dBW]:
Total D/L EIRP Used at be/bp [dBW]: 20.8 / 25.9
Total BW Used [MHz]: 2.1
Xp Operational Mode: Multi-Carrier

Nominal OBO= -3.5 dB

Antennas	Diameter [m]	Gtx [dBi]	G/T [dB/K]	Latitude [°N]	Longitude [°E]	Xpol [dB]	Location (Nearest City and Country)
MTN-K77	13.0	63.7	40.4	39.93	282.2417	36.5	MTN-K77 - UNITED STATES
TEC-K04	0.45	28.8	11.6	36.60	278.00	26.0	-

Tx E/S	Rx E/S	Carrier Type #, Type, [I.R, OH, FEC, RS, modulation]	Noise BW [MHz]	Space Factor (Roll-off)	Alloc. BW [MHz]	PEB [MHz]	b.e. D/L EIRP [dBW]	C/N thresh. [dB]	CS C/N after ASI [dB]	Eb/No thresh. [dB]	CS Eb/No after ASI [dB]	Link Availab. [%/yr]	U/L EIRP [dBW]
			Per Carrier Link Parameters and Results										
TEC-K04	MTN-K77	DIG (2.333 Mbps, OH=0.0%, 2/3 FEC, QPSK)	1.750	1.20	2.100	0.226	20.8	5.3	6.4	4.1	5.2	99.90	38.1
	TOTAL:	**1 Carrier**			**2.100**	**0.226**	**20.8**						

ISCO comments:

Antenna pattern comments:

Notes: Clear Sky C/N includes 0.3 dB additional margin for terrestrial interference. Uplink antenna mis-pointing & HPA instability and downlink antenna mis-pointing are accounted for in the uplink and the downlink respectively (0.5 dB).
* Analysis results include presumed levels of interference to overcome fluctuations in operational interferences due to other carriers in the system.

Customer Support Engineering & Capacity Management

Link Budget Report for:

Opportunity-ID / SSR-ID
Done by: vivanh   Date: 10 May 2017

Application: STRIP7 v6.2   Presumptive

Satellite and Role: IS-29e @ 310.00°E
Connectivity: K601H1 / K04H1
Platform bias: 0.00°E; 0.00°N
Sat. TWT Power [Watts]: 150.0
Sat. D/L EIRP at be/bp [dBW]: 57.1 / 63.9
SFD at be/bp [dBW/m²]: N/A / N/A
Band Up/Dw [MHz]: (13156 - 13174) / (12080 - 12195)
Polarization Up/Dw: H / H

Total lease resource [MHz]:
Total D/L EIRP Avail. at be/bp [dBW]:
Total D/L EIRP Used at be/bp [dBW]: 42.8 / 49.6
Total BW Used [MHz]: 17.9
Xp Operational Mode: Multi-Carrier

Nominal OBO= -3.5 dB

Antennas	Diameter [m]	Gtx [dBi]	G/T [dB/K]	Latitude [°N]	Longitude [°E]	Xpol [dB]	Location (Nearest City and Country)
MTN-K77	13.0	63.7	40.4	39.93	282.2417	36.5	MTN-K77 - UNITED STATES
TEC-K04	0.45	28.8	11.6	36.60	278.00	26.0	-

Tx E/S	Rx E/S	Carrier Type #, Type, [I.R, OH, FEC, RS, modulation]	Noise BW [MHz]	Space Factor (Roll-off)	Alloc. BW [MHz]	PEB [MHz]	b.e. D/L EIRP [dBW]	C/N thresh. [dB]	CS C/N after ASI [dB]	Eb/No thresh. [dB]	CS Eb/No after ASI [dB]	Link Availab. [%/yr]	U/L EIRP [dBW]
			Per Carrier Link Parameters and Results										
MTN-K77	TEC-K04	DIG (12.300 Mbps, OH=0.0%, 0.4134 FEC, QPSK)	14.877	1.20	17.852	9.272	42.8	1.7	2.1	2.5	2.9	99.64	63.3
	TOTAL:	**1 Carrier**			**17.852**	**9.272**	**42.8**						

ISCO comments:

Antenna pattern comments:

Notes: Clear Sky C/N includes 0.3 dB additional margin for terrestrial interference. Uplink antenna mis-pointing & HPA instability and downlink antenna mis-pointing are accounted for in the uplink and the downlink respectively (0.5 dB).
* Analysis results include presumed levels of interference to overcome fluctuations in operational interferences due to other carriers in the system.

VI. <u>Section 25.227 Certifications</u>

Intelsat License LLC ("Intelsat"), pursuant to Section 25.227 of the FCC's Rules, hereby certifies the following:

1. In accordance with Section 25.227(a)(15), as the operator of an ESAA system operating over international waters, Intelsat has confirmed with its target space station operators that its existing and proposed operations are within coordinated parameters for adjacent satellites up to six degrees away (+/- 6°) on the geostationary arc.

2. In accordance with Section 25.227(b)(7), Intelsat certifies that its proposed operations comply with the following requirements of Section 25.227:

   - Per Section 25.227(a)(6), for each ESAA transmitter, Intelsat will time annotate and maintain a record for a period of not less than one year of the vehicle location (i.e., latitude/longitude/altitude), transmit frequency, channel bandwidth and satellite used. Records will be recorded at time intervals no greater than one (1) minute while the ESAA is transmitting. Intelsat will make this data available in the requisite format within 24 hours of a request from the Commission, NTIA, or a frequency coordinator for purposes of resolving harmful interference events.
   - Per Section 25.227(a)(9), each ESAA terminal will automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal or when it detects that unintended satellite tracking has happened or is about to happen.
   - Per Section 25.227(a)(10), each ESAA terminal will be subject to the monitoring and control by an NCMC or equivalent facility. Each terminal will be able to receive "enable transmission" and "disable transmission" commands from the NCMC and must automatically cease transmissions immediately on receiving any "parameter change command", which may cause harmful interference during the change, until it receives an "enable transmission" command from its NCMC. In addition, the NCMC will be able to monitor the operation of an ESAA terminal to determine if it is malfunctioning.
   - Per Section 25.227(a)(11), each ESAA terminal shall be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the terminal will automatically cease transmissions.

By: __/s/ *Susan Crandall*____________

Susan Crandall
Associate General Counsel
Intelsat

June 26, 2017

VII. Section 25.227 Compliance Matrix

Rule	Text	Application Citation
§ 25.227	**§25.227 Blanket licensing provisions for ESAAs operating with GSO FSS space stations in the 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.2 GHz, and 14.0-14.5 GHz bands.**	
§ 25.227(a)	(a) The following ongoing requirements govern all ESAA licensees and operations in the 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space) frequency bands receiving from and transmitting to geostationary orbit satellites in the Fixed-Satellite Service. ESAA licensees shall comply with the requirements in either paragraph (a)(1), (a)(2) or (a)(3) of this section and all of the requirements set forth in paragraphs (a)(4) through (a)(16) and paragraphs (c), (d), and (e) of this section. Paragraph (b) of this section identifies items that shall be included in the application for ESAA operations to demonstrate that these ongoing requirements will be met.	
§ 25.227(a)(1)	(1) The following requirements shall apply to an ESAA that uses transmitters with off-axis EIRP spectral-densities lower than or equal to the levels in paragraph (a)(1)(i) of this section. ESAA licensees operating under this section shall provide a detailed demonstration as described in paragraph (b)(1) of this section. The ESAA transmitter also shall comply with the antenna pointing and cessation of emission requirements in paragraphs (a)(1)(ii) and (iii) of this section.	Intelsat complies for all ESAA terminal operations in two-degree spacing environments.
§ 25.227(a)(1)(i)(A)	(A) EIRP spectral density emitted in the plane tangent to the GSO arc, as defined in §25.103, must not exceed the following values: 15 - 25 log10(θ) dBW/4 kHz For 1.5° ≤ θ ≤ 7° -6 dBW/4 kHz For 7° < θ ≤ 9.2° 18 - 25 log10(θ) dBW/4 kHz For 9.2° < θ ≤ 19.1° -14 dBW/4 kHz For 19.1° < θ ≤ 180° Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite. The EIRP density levels specified for θ > 7° may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.	*See* Technical Appendix, IV.A & V.A.

§ 25.227(a)(1)(i)(B)	(B) The EIRP spectral density of co-polarized signals must not exceed the following values in the plane perpendicular to the GSO arc, as defined in §25.103: 18 - 25 log(θ) dBW/4 kHz For 3° ≤ θ ≤ 19.1° -14 dBW/4 kHz For 19.1° < θ ≤ 180° Where θ is as defined in paragraph (a)(1)(i)(A) of this section. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.	*Id*. Intelsat seeks a waiver of §25.227(a)(1)(i)(B) for TECOM terminal operations (*see* Legal Narrative, II.B).
§ 25.227(a)(1)(i)(C)	(C) The off-axis EIRP spectral-density of cross-polarized signals must not exceed the following values in the plane tangent to the GSO arc or in the plane perpendicular to the GSO arc 5 - 25 log10(θ) dBW/4 kHz For 1.8° ≤ θ ≤ 7° Where θ is as defined in paragraph (a)(1)(i)(A) of this section.	*See* Technical Appendix, IV.A & V.A.
§ 25.227(a)(1)(ii)	(ii) Each ESAA transmitter shall meet one of the following antenna pointing requirements: (A) Each ESAA transmitter shall maintain a pointing error of less than or equal to 0.2° between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna; or (B) Each ESAA transmitter shall declare a maximum antenna pointing error that may be greater than 0.2° provided that the ESAA does not exceed the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section, taking into account the antenna pointing error.	*See* Technical Appendix, I; Legal Narrative, I.A.1.a (Rantec terminal).
§ 25.227(a)(1)(iii)	(iii) Each ESAA transmitter shall meet one of the following cessation of emission requirements: (A) For ESAAs operating under paragraph (a)(1)(ii)(A) of this section, all emissions from the ESAA shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds 0.5°, and transmission shall not resume until such angle is less than or equal to 0.2°, or (B) For ESAA transmitters operating under paragraph (a)(1)(ii)(B) of this section, all emissions from the ESAA shall automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds the declared maximum antenna pointing error and shall not resume transmissions until such angle is less than or equal to the declared maximum antenna pointing error.	*See* Technical Appendix, I; Legal Narrative, I.A.1.a (Rantec terminal).

25.227(a)(2)	(2) The following requirements apply to ESAA systems that operate with off-axis EIRP spectral-densities in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section under licenses granted based on certifications filed pursuant to paragraph (b)(2) of this section. (i) An ESAA or ESAA system licensed based on certifications filed pursuant to paragraph (b)(2) of this section must operate in accordance with the off-axis EIRP density specifications provided to the target satellite operator in order to obtain the certifications. (ii) Any ESAA transmitter operating under a license granted based on certifications filed pursuant to paragraph (b)(2) of this section must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP-density in excess of the specifications supplied to the target satellite operator. (iii) A system with variable power control of individual ESAA transmitters must monitor the aggregate off-axis EIRP density from simultaneously transmitting ESAA transmitters at the system's network control and monitoring center. If simultaneous operation of two or more ESAA transmitters causes aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications, and the transmitters must comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I & III; Legal Narrative, I.A.1.b (TECOM terminal).
§ 25.227(a)(3)	(3) The following requirements apply to an ESAA system that uses variable power-density control of individual ESAA earth stations transmitting simultaneously in the same frequencies to the same target satellite, unless the system operates pursuant to paragraph (a)(2) of this section. (i) Aggregate EIRP density from co-frequency earth stations in each target satellite receiving beam, not resulting from colliding data bursts transmitted pursuant to a contention protocol, will not exceed the limits specified in paragraph (a)(1)(i) of this section. (ii) Each ESAA transmitter must be self-monitoring and capable of shutting itself off and must cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density in excess of the limit in paragraph (a)(3)(i) of this section. (iii) A system with variable power control of individual ESAA transmitters must monitor aggregate power density from simultaneously transmitting ESAA transmitters at the network control and monitoring center. If simultaneous operation of two or more transmitters causes aggregate off-axis EIRP density to exceed the off-axis EIRP density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center must command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below	N/A

	that limit, and those transmitters must comply within 100 milliseconds of receiving the command.	
§ 25.227(a)(4)	(4) An applicant filing to operate an ESAA terminal or system and planning to use a contention protocol shall certify that its contention protocol use will be reasonable.	N/A
§ 25.227(a)(5)	(5) There shall be a point of contact in the United States, with phone number and address, available 24 hours a day, seven days a week, with authority and ability to cease all emissions from the ESAA.	*See* Technical Appendix, I; Legal Narrative, I.A.3.
§ 25.227(a)(6)	(6) For each ESAA transmitter, a record of the vehicle location (i.e., latitude/longitude/altitude), transmit frequency, channel bandwidth and satellite used shall be time annotated and maintained for a period of not less than one year. Records shall be recorded at time intervals no greater than one (1) minute while the ESAA is transmitting. The ESAA operator shall make this data available, in the form of a comma delimited electronic spreadsheet, within 24 hours of a request from the Commission, NTIA, or a frequency coordinator for purposes of resolving harmful interference events. A description of the units (i.e., degrees, minutes, MHz ….) in which the records values are recorded will be supplied along with the records.	*See* Technical Appendix, VI.
§ 25.227(a)(7)	(7) In the 10.95-11.2 GHz (space-to-Earth) and 11.45-11.7 GHz (space-to-Earth) frequency bands ESAAs shall not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.227(a)(8)	(8) An ESAA terminal receiving in the 11.7-12.2 GHz (space-to-Earth) bands shall receive protection from interference caused by space stations other than the target space station only to the degree to which harmful interference would not be expected to be caused to an earth station employing an antenna conforming to the referenced patterns defined in paragraphs (a) and (b) of section 25.209 and stationary at the location at which any interference occurred.	Applicable regulatory status and protection provision. Intelsat complies.
§ 25.227(a)(9)	(9) Each ESAA terminal shall automatically cease transmitting within 100 milliseconds upon loss of reception of the satellite downlink signal or when it detects that unintended satellite tracking has happened or is about to happen.	*See* Technical Appendix, VI.
§ 25.227(a)(10)	(10) Each ESAA terminal should be subject to the monitoring and control by an NCMC or equivalent facility. Each terminal must be able to receive at least "enable transmission" and "disable transmission" commands from the NCMC and must automatically cease transmissions immediately on receiving any "parameter change command", which may cause harmful interference during the change, until it receives an "enable transmission"	*Id.*

§ 25.227(a)(11)	(11) Each ESAA terminal shall be self-monitoring and, should a fault which can cause harmful interference to FSS networks be detected, the terminal must automatically cease transmissions.	*Id.*
§ 25.227(a)(12)	(12) Unless otherwise stated all ESAA system that comply with the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section may request Permitted List authority.	Applicable regulatory status and protection provision.
§ 25.227(a)(13)	(13) ESAA providers operating in the international airspace within line-of-sight of the territory of a foreign administration where fixed service networks have primary allocation in this band, the maximum power flux density (pfd) produced at the surface of the Earth by emissions from a single aircraft carrying an ESAA terminal should not exceed the following values unless the foreign Administration has imposed other conditions for protecting its fixed service stations: $-132+0.5 \cdot \theta$ dB(W/(m2 · MHz)) For $\theta \leq 40°$ -112 dB(W/(m2 · MHz)) For $40° < \theta \leq 90°$ Where: θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal) and the aforementioned limits relate to the pfd and angles of arrival would be obtained under free-space propagation conditions.	Applicable regulatory status and protection provision.
§ 25.227(a)(14)	(14) All ESAA terminals operated in U.S. airspace, whether on U.S.-registered civil aircraft or non-U.S.-registered civil aircraft, must be licensed by the Commission. All ESAA terminals on U.S.-registered civil aircraft operating outside of U.S. airspace must be licensed by the Commission, except as provided by Section 303(t) of the Communications Act.	Applicable regulatory status and protection provision.
§ 25.227(a)(15)	(15) For ESAA systems operating over international waters, ESAA operators will certify that their target space station operators have confirmed that proposed ESAA operations are within coordinated parameters for adjacent satellites up to 6 degrees away on the geostationary arc.	*See* Technical Appendix, III.
§ 25.227(a)(16)	(16) Prior to operations within the foreign nation's airspace, the ESAA operator will ascertain whether the relevant administration has operations that could be affected by ESAA terminals, and will determine whether that administration has adopted specific requirements concerning ESAA operations. When the aircraft enters foreign airspace, the ESAA terminal would be required to operate under the Commission's rules, or those of the foreign administration, whichever is more constraining. To the extent that all relevant administrations have identified geographic areas from which ESAA operations would not affect their radio operations, ESAA operators would be free to operate within those identified areas without further action. To the extent that the foreign administration has not adopted requirements regarding ESAA operations, ESAA operators would be required to coordinate their operations with any potentially affected operations.	Intelsat complies (no specific certification required).
§ 25.227(b)	(b) Applications for ESAA operation in the 14.0-14.5 GHz (Earth-to-space) band to GSO satellites in the FSS shall include, in addition to the particulars of operation identified on FCC Form 312, and associated Schedule B, the applicable technical demonstrations in paragraphs (b)(1), (b)(2), or (b)(3), and the documentation identified in paragraphs (b)(4) through (b)(8) of this section.	
§ 25.227(b)(1)	(1) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1) of this section must	

	provide the information required by §25.115(g)(1). An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section must also provide the certifications identified in paragraph (b)(1)(iii) of this section. An applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section must also provide the demonstrations identified in paragraph (b)(1)(iv) of this section. (i)-(ii) [Reserved] (iii) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(A) of this section shall: (A) Demonstrate that the total tracking error budget of their antenna is within 0.2° or less between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna. As part of the engineering analysis, the ESAA applicant must show that the antenna pointing error is within three sigma () from the mean value, *i.e.*, that there is a 0.997 probability the antenna maintains a pointing error within 0.2°; and (B) Demonstrate that the antenna tracking system is capable of ceasing emissions within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds 0.5°. (iv) An ESAA applicant proposing to implement a transmitter under paragraph (a)(1)(ii)(B) of this section shall: (A) Declare, in its application, a maximum antenna pointing error and demonstrate that the maximum antenna pointing error can be achieved without exceeding the off-axis EIRP spectral-density limits in paragraph (a)(1)(i) of this section; and (B) Demonstrate that the ESAA transmitter can detect if the transmitter exceeds the declared maximum antenna pointing error and can cease transmission within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna exceeds the declared maximum antenna pointing error, and will not resume transmissions until the angle between the orbital location of the target satellite and the axis of the main lobe of the ESAA antenna is less than or equal to the declared maximum antenna pointing error.	*See* Technical Appendix, I & IV.A (Rantec terminal); Legal Narrative, I.A.1.a.

§ 25.227(b)(2)	(2) An ESAA applicant proposing to operate with off-axis EIRP density in excess of the levels in paragraph (a)(1)(i) or (a)(3)(i) of this section must provide the following in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) The certifications required by §25.220(d); and (iii) A detailed showing that each ESAA transmitter in the system will automatically cease or reduce emissions within 100 milliseconds after generating EIRP density exceeding specifications provided to the target satellite operator; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting ESAA transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more ESAA transmitters causes the aggregate off-axis EIRP density to exceed the off-axis EIRP density specifications supplied to the target satellite operator, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below those specifications; and that those transmitters will comply within 100 milliseconds of receiving the command.	*See* Technical Appendix, I & V.A (TECOM terminal); Legal Narrative, I.A.1.b; Technical Appendix, III (operator certification letter).
§ 25.227(b)(3)	(3) An applicant proposing to implement an ESAA system subject to paragraph (a)(3) of this section must provide the following information in exhibits to its earth station application: (i) Off-axis EIRP density data pursuant to §25.115(g)(1); (ii) A detailed showing of the measures that will be employed to maintain aggregate EIRP density at or below the limit in paragraph (a)(3)(i) of this section; (iii) A detailed showing that each ESAA terminal will automatically cease or reduce emissions within 100 milliseconds after generating off-axis EIRP density exceeding the limit in paragraph (a)(3)(i) of this section; and (iv) A detailed showing that the aggregate power density from simultaneously transmitting ESAA transmitters will be monitored at the system's network control and monitoring center; that if simultaneous operation of two or more transmitters in the ESAA network causes aggregate off-axis EIRP density to exceed the off-axis density limit in paragraph (a)(3)(i) of this section, the network control and monitoring center will command those transmitters to cease emissions or reduce the aggregate EIRP density to a level at or below that limit; and that those transmitters will comply within 100 milliseconds of receiving the command.	N/A

§ 25.227(b)(4)	(4) There shall be an exhibit included with the application describing the geographic area(s) in which the ESAA will operate.	*See* Technical Appendix, II.
§ 25.227(b)(5)	(5) Any ESAA applicant filing for an ESAA terminal or system and planning to use a contention protocol shall include in its application a certification that will comply with the requirements of paragraph (a)(4) of this section.	N/A
§ 25.227(b)(6)	(6) The point of contact referred to in paragraph (a)(5) of this section shall be included in the application.	*See* Technical Appendix, I; Legal Narrative, I.A.3.
§ 25.227(b)(7)	(7) Any ESAA applicant filing for an ESAA terminal or system shall include in its application a certification that will comply with the requirements of paragraph (a)(6), (a)(9), (a)(10), (a)(11) of this section.	*See* Technical Appendix, VI.
§ 25.227(b)(8)	(8) All ESAA applicants shall submit a radio frequency hazard analysis determining via calculation, simulation, or field measurement whether ESAA terminals, or classes of terminals, will produce power densities that will exceed the Commission's radio frequency exposure criteria. ESAA applicants with ESAA terminals that will exceed the guidelines in Section 1.1310 for radio frequency radiation exposure shall provide, with their environmental assessment, a plan for mitigation of radiation exposure to the extent required to meet those guidelines. All ESAA licensees shall ensure installation of ESAA terminals on aircraft by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating the vehicle and equipment. An ESAA terminal exhibiting radiation exposure levels exceeding 1.0 mW/cm^2 in accessible areas, such as at the exterior surface of the radome, shall have a label attached to the surface of the terminal warning about the radiation hazard and shall include thereon a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2.	*See* Technical Appendix, IV.B & V.B.

§ 25.227(c)	(c)(1) Operations of ESAAs in the 14.0-14.2 GHz (Earth-to-space) frequency band in the radio line-of- sight of the NASA TDRSS facilities on Guam (latitude 13° 36' 55" N, longitude 144° 51' 22" E) or White Sands, New Mexico (latitude 32° 20' 59" N, longitude 106° 36' 31" W and latitude 32° 32' 40" N, longitude 106° 36' 48" W) are subject to coordination with the National Aeronautics and Space Administration (NASA) through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC). Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) When NTIA seeks to provide similar protection to future TDRSS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band ESAA licensees shall cease operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site until the licensees complete coordination with NTIA/IRAC for the new TDRSS facility. Licensees shall notify the International Bureau once they have completed coordination for the new TDRSS site. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The ESAA licensee then will be permitted to commence operations in the 14.0-14.2 GHz band within radio line-of-sight of the new TDRSS site, subject to any operational constraints developed in the coordination process.	In progress. Intelsat will update the record of this proceeding upon completion of coordination.
§ 25.227(d)	(d)(1) Operations of ESAA in the 14.47-14.5 GHz (Earth-to-space) frequency band in the radio line-of- sight of radio astronomy service (RAS) observatories observing in the 14.47-14.5 GHz band are subject to coordination with the National Science Foundation (NSF). The appropriate NSF contact point to initiate coordination is Electromagnetic Spectrum Manager, NSF, 4201 Wilson Blvd., Suite 1045, Arlington VA 22203, fax 703-292-9034, email esm@nsf.gov. Licensees shall notify the International Bureau once they have completed coordination. Upon receipt of the coordination agreement from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. (2) A list of applicable RAS sites and their locations can be found in 25.226(d)(2) Table 1. (3) When NTIA seeks to provide similar protection to future RAS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA will notify the Commission's International Bureau that the site is nearing operational status. Upon public notice from the International Bureau, all Ku-band ESAA licensees shall cease operations in the 14.47-14.5 GHz band within the relevant geographic zone of the new RAS site until the licensees complete coordination for the new RAS facility. Licensees shall notify the International Bureau once they have completed coordination for the new RAS site and shall submit the coordination agreement to the Commission. Upon receipt of such notification from a licensee, the International Bureau will issue a public notice stating that the licensee may commence operations within the coordination zone in 30 days if no party has opposed the operations. The ESAA licensee then will be permitted to commence operations in the 14.47-14.5 GHz band within the relevant coordination distance around the new RAS site, subject to any operational constraints developed in the coordination process.	In progress. Intelsat will update the record of this proceeding upon completion of coordination.

VIII. Technical Certification

I, Christopher M. Hudson, hereby certify that I am the technically qualified person responsible for the preparation of the technical information contained in the Intelsat License LLC blanket license application for ESAA operating authority and the accompanying Technical Appendix, that I am familiar with Part 25 of the Commission's Rules (47 C.F.R. Part 25), and that I have either prepared or reviewed the technical information submitted in this application and found it to be complete and accurate to the best of my knowledge and belief.

By: /s/ *Christopher M. Hudson*
Christopher M. Hudson
Senior Technical Advisor
Intelsat General Corporation

June 26, 2017