THALES

Thales Avionics
700 S. Babcock Street
Melbourne, FL 32901 USA

April 13, 2017

FILED ELECTRONICALLY VIA IBFS

Ms. Marlene H. Dortch, Secretary
Federal Communications
Commission 445 12th Street, SW
Washington, DC 20554

Re: Thales Avionics Request for ESAA Blanket Authorization – Amendment Request

Dear Ms. Dortch:

Thales Avionics, Inc. (Thales) files this letter pursuant to Section 1.65 of the Federal Communications Commission's ("FCC" or "Commission") rules for authorization for blanket license to operate network of Earth Station Aboard Aircraft (ESAA) terminals at Ka-band.

Thales has designed this filing under the requirements of §25.138 for operation of GSO FSS at Ka-band, the existing FCC Rules governing ESAA, §25.227, and previously granted licenses for ESAAs using GSO FSS at Ka-band.

Please direct any questions regarding this matter to the undersigned.

Sincerely,

/s/ Pat Amodio

Pat Amodio
Senior Director - Regulatory Compliance

THALES

Thales Avionics, Inc.

Ka-band Earth Station Aboard Aircraft (ESAA)

FCC Authorization Submission

Amendment to IBFS File No. SES-LIC-20170217-00183

Technical Narrative

April 13, 2017

Table of Contents

1 Introduction

Thales Avionics, Inc. seeks to amend its initial blanket license filing of February 17, 2017, request for ESAA operation over GSO FSS Ka-band capacity[1] as follows:

1) Adding Echostar XVII (Jupiter-1) and Jupiter-2 as points of communication, and;
2) Adding new carriers and designators, and;
3) Adding new Ka spectrum.

Thales's ESAA will operate over Hughes Network Systems (Hughes) Ka-band capacity on the Jupiter-1 and Jupiter-2 satellites to provide in-flight connectivity (IFC) services on commercial airliners flying in the North American region.

Thales's initial blanket license request and this amendment have been designed to the requirements set forth in 47 CFR §25.138 rules for GSO FSS Ka-band Earth Stations, §25.227 rules for ESAAs operating with GSO FSS Ku-band blanket licensing provisions[2], and FCC precedents set by previous Ka-band ESAA blanket license grants[3].

2 System Description

2.1 Overview

Thales's Modular Connectivity Terminals, Ka-band (MCT-A) ESAA will operate over Hughes satellites Jupiter-1 (orbital location of 107.1° W.L., Call Sign S2753) and Jupiter-2 (orbital location of 97.1° W.L., Call Sign S2968) in the Ka bands 29.25 – 30.0 GHz (uplink), and 18.3 – 19.3 GHz and 19.7 – 20.2 GHz (downlink). In the future, Thales's IFC service may use Ka space segment on other satellites to increase coverage areas in the North American region and beyond. If so, Thales will seek appropriate FCC approvals to utilize other space segments for this service.

2.1.1 Network Architecture

Thales's IFC network will use Hughes Jupiter Ka space segment and gateway earth stations, and the Hughes Jupiter satellite platform of baseband hubs and aero modems. Figure 1 below shows the network architecture. This architecture is virtually identical to the one provided in Thales's initial filing, depicting the SES Ka space segment and gateway earth stations. The changes in this amendment's architecture illustrate the Jupiter-1 and Jupiter-2 space segment and a Hughes Network Operations Center (NOC) added for management and control of the Hughes satellites.

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[1] IBFS File No. SES-LIC-20170217, Call Sign E170068, filed February 17, 2017

[2] Per Thales's meeting with the International Bureau (IB) on December 15, 2016, while §25.227 ESAA rules currently only apply to Ku-band ESAA operations, IB staff has expressed its intentions to develop parallel Ka-band rules in the future. Thales's technical showings in its initial filing (see Footnote 1) and this amendment demonstrate the extent to which the proposed operations are consistent with those Ku-band ESAA requirements that may be adopted for Ka-band ESAA in the future.

[3] See ViaSat Ka-band filing Call Sign E120075

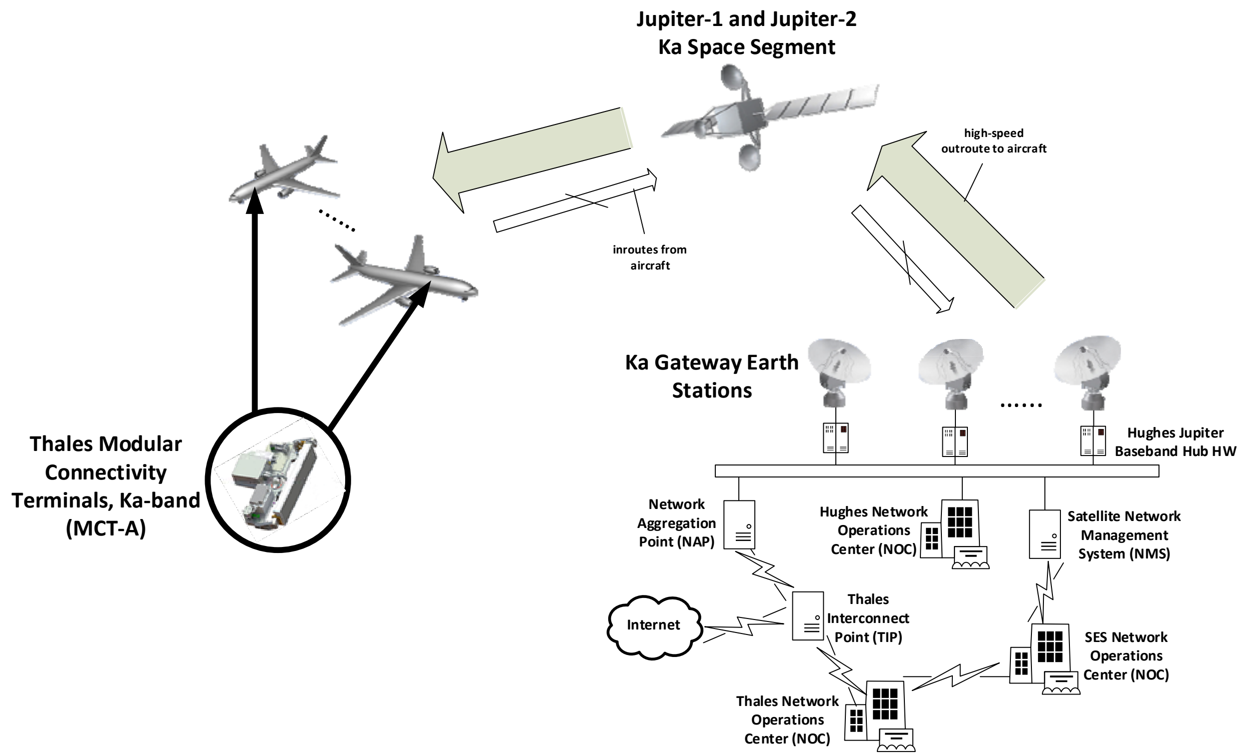

Figure 1 – Thales Aero Connectivity Network Architecture

The network is comprised of:

- a terrestrial IP backhaul network interconnecting multiple controlling Ka earth station gateways (detailed later in Section 2.4.2), with radio frequency terminals (RFTs) and Hughes Jupiter hub baseband equipment co-located at each gateway
- Ka space segment on Jupiter-1 and Jupiter-2
- Thales Ka ESAA, known as Modular Connectivity Terminals, Ka-band (MCT-A) including the Hughes Jupiter aero modem, installed on commercial aircraft

The SES Network Operations Center (NOC) in Bristow, VA remains as the primary NOC for the network. The SES NOC has real-time visibility into the Hughes Jupiter Network Management System (NMS) in Germantown, MD for management and control of every aero modem in the network (on aircraft) and the hub baseband instances (at gateways). The SES NOC also provides the Thales NOC in Orlando, FL with data that Thales requires to deliver and manage the overall service.

2.2 ESAA Segment Details

The Thales MCT-A (ESAA) operational details and specifications as provided in Thales's initial filing remain the same.[4]

[4] See Section 2.2, ESAA Segment Details (pp. 5-9) of Thales's FCC Authorization Submission for Ka-band Earth Station Aboard Aircraft (ESAA), dated February 16, 2017.

2.3 Space System

2.3.1 Satellite System List

Table 1 below provides the complete list of satellites and spectrum details for Thales's proposed ESAA operations. Thales's service using these satellites will not use Ka spectrum in the LMDS band 29.1 – 29.25 GHz.

Satellite (Call Sign)	Satellite Operator	GSO Orbital Location (W.L.)	Transmit Spectrum (MHz)	Receive Spectrum (MHz)
Echostar XVII (Jupiter-1) (S2753)*	Hughes	107.1°	28350 – 29100 29250 – 30000	18300 – 19300 19700 – 20200
Jupiter-2 (S2968)*	Hughes	97.1°	27850 – 29100 29250 – 30000	18300 – 19300 19700 – 20200
AMC-15 (S2180)**	SES	105.05°	28438 – 28563 29500 – 30000	18638 – 18763 19700 – 20200
AMC-16 (S2181)**	SES	85.0°	28438 – 28563 29500 – 30000	18638 – 18763 19700 – 20200

Notes: *covered in this amendment
**covered in Thales's initial filing

Table 1: Satellite List and Spectrum Details for Thales's ESAA Operations

The beam coverage areas and skew angle contours for Jupiter-1 and Jupiter-2 are shown below in Figure 2 and Figure 3, respectively.

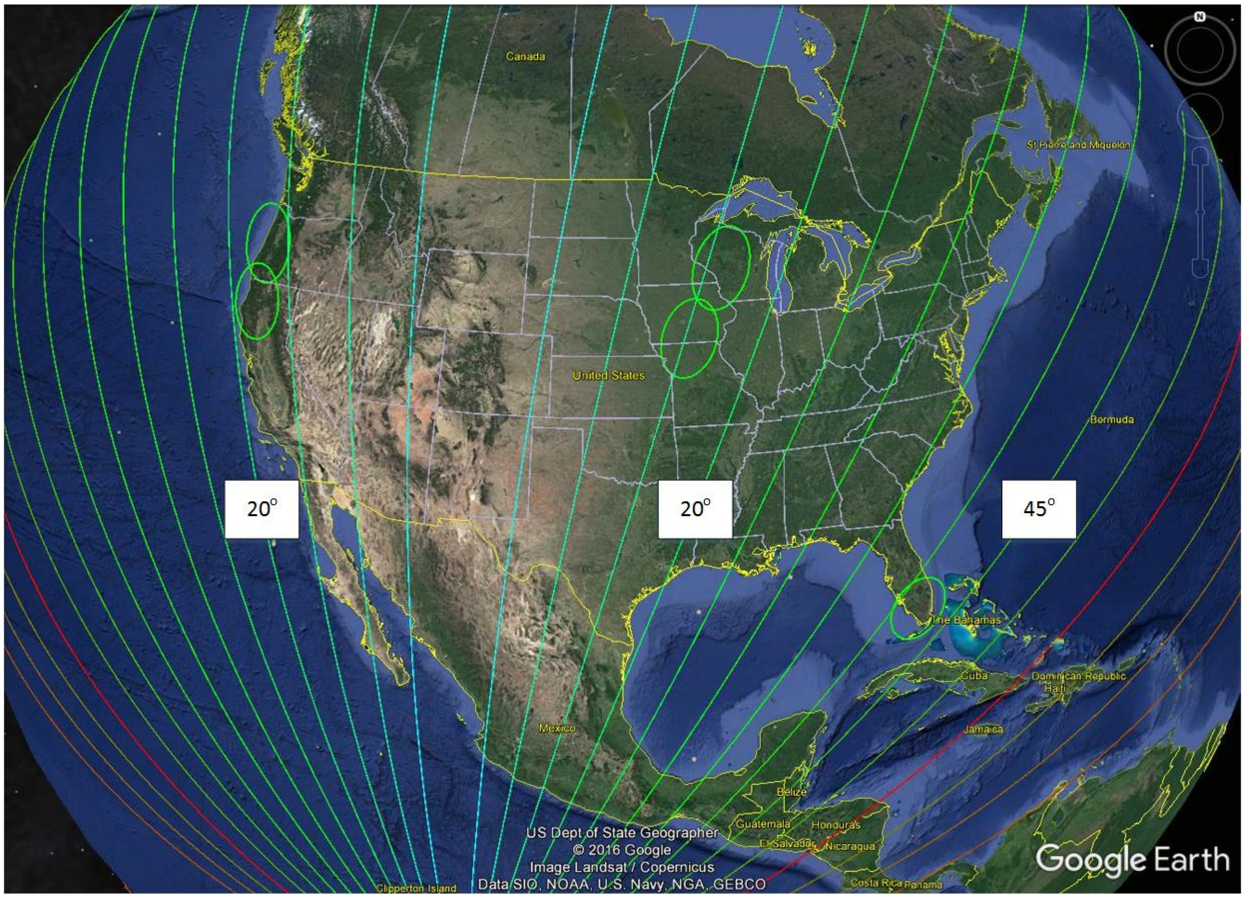

Figure 2: Jupiter-1 Coverage Area and Skew Angles (Worst-Case Skew Angle of 45°) for Thales ESAA Operation

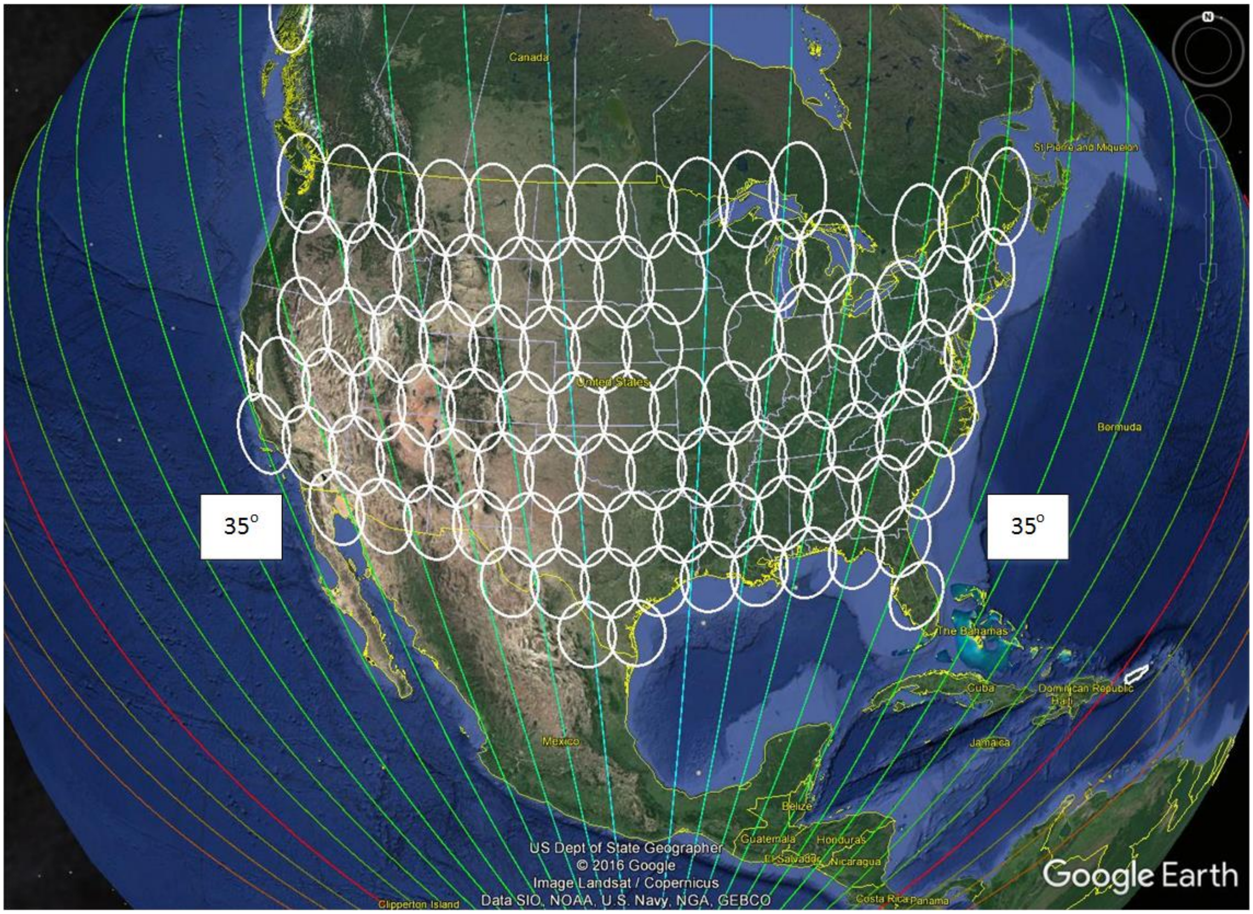

Figure 3: Jupiter-2 Coverage Area and Skew Angles (Worst-Case Skew Angle of 35°) for Thales ESAA Operation

2.4 Ground Segment

2.4.1 Remote Control Network Operations Centers (NOCs)

The network operations centers (NOCs) as described in Thales's initial filing are not affected by this amendment request. The SES NOC remains as the primary NOC for this network:

SES Network Operations Center - Manassas
8000 Gainsford Court
Bristow, VA 20136

The SES NOC 24/7 phone number is +1 703-330-3305, Option 1

The Thales NOC is also responsible for overall management of the service and can be reached 24/7:

Thales Network Operations Center
7415 Emerald Dunes Drive, Suite 2000
Orlando, FL 32822

The Thales NOC 24/7 phone number is 949-754-6985

2.4.2 Network Gateway Earth Stations

Thales's service will use Hughes's authorized gateway hub antennas to communicate with Jupiter-1 and Jupiter-2. Full remote control of the ESAA terminals and the network will be possible from the Thales NOC.

2.5 Additional Carriers, Emission Designators, and Spectrum

The waveforms and capabilities of the return link (inbound) channels and the forward link (outbound) channels as detailed in Thales's initial filing are not changing as a result of this amendment request. However, Thales's ESAA operations on Jupiter-1 and Jupiter-2 will require new carriers, emission designators, and spectrum in addition to those detailed in the initial filing. These additions are detailed in Table 2 below and in the Form 312 submitted with this amendment request.

Link	Emission Designator	Carrier Symbol Rate (Msps)	Power Density at Antenna Flange		Jupiter-1 and Jupiter-2 Spectrum (MHz)	
					Earth-to-Space	Space-to-Earth
Gateway Forward (Outbound)	47M0G7D	47.0	N/A	N/A	27850 – 28350* 28350 – 29100 29250 – 30000	18300 – 19300 19700 – 20200
ESAA Return (Inbound)	2M00G7D	2.0	42.4 dBW/MHz	18.4 dBW/4 kHz**	29250 – 30000	18300 – 19300 19700 – 20200
ESAA Return (Inbound)	4M10G7D**	4.1	39.4 dBW/MHz	15.4 dBW/4 kHz**	29250 – 30000	18300 – 19300 19700 – 20200
ESAA Return (Inbound)	6M10G7D	6.1	37.6 dBW/MHz	13.6 dBW/4 kHz	29250 – 30000	18300 – 19300 19700 – 20200

Note: *Jupiter-2 only
**already part of Thales's initial filing; only new spectrum is being requested in this amendment

Table 2: New Carriers, Power Density Levels, and Spectrum for Thales ESAA Operation on Jupiter-1 and Jupiter-2

Link budgets provided in Exhibit B of this narrative confirm that the power density levels of the new carriers are equal to or below those in Thales's initial filing. Therefore, no increases in power density levels are being requested in this amendment.

2.5.1 NOC Monitoring and Control

At all times the SES NOC and the Thales NOC will monitor and have control of the transmission parameters of all Thales ESAA operating in the network on Jupiter-1 and Jupiter-2, including the ability to remotely disable terminals in the event of harmful interference.

3 Protection of Other Services

3.1 Protection of Other Ka-band Services

3.1.1 GSO

Thales intends to operate its ESAA network with Jupiter-1 at orbital location 107.1° W.L. and Jupiter-2 at orbital location 97.1° W.L. Operation on both satellites will be compliant with 25.138(a)(1). Thales has worked with Hughes to ensure that the off-axis emissions will comply with applicable Jupiter-1 and Jupiter-2 coordination agreements (see Exhibit C).

3.1.1.1 Jupiter-1 Off-Axis EIRP Spectral Density

On Jupiter-1, Thales will limit their ESAA operation to the worst-case skew angle of 45° for off-axis EIRP emission in the GSO plane, as shown earlier in Figure 2. Exhibit B attached contains Jupiter-1 return link budgets including operation for three operational scenarios:

- Location at the center of the beam (peak G/T) and 0° skew angle
- Location at mid-beam (average G/T) and 35° skew angle
- Location at the edge of the beam (worst-case G/T) and 45° skew angle

Thales's initial filing provided the EIRP density plots and peak densities for the 0° and 35° skew angles[5], so these are not included here. As shown in the return link budgets in Exhibit B, the peak density for ESAA operation at 0° skew is 37.6 dBW/MHz, and for 35° skew it is 39.4 dBW/MHz. These densities are 1.8 dB and 3.0 dB lower, respectively, than the peak densities for ESAA operation at 0° and 35° skew angles covered in Thales's initial filing.

As shown in Exhibit B, the peak EIRP density for ESAA operation at 45° skew angle is 42.4 dBW/MHz. The plots below in Figures 4 and 5 show compliance with §25.138(a)(1) and (a)(2), respectively, at a worst-case 45° skew angle and consider up to 0.2° antenna mispointing.

[5] Note the following typographical corrections in Thales's initial filing FCC Authorization Submission for Ka-band Earth Station Aboard Aircraft (ESAA), dated February 16, 2017 : 1) on p.15, the Figure 6 caption "…39.1 dBW/MHz…" should read "…39.4 dBW/MHz…", and 2) on p.16, the Figure 7 caption "…43.0 dBW/MHz…" should read "…39.4 dBW/MHz…".

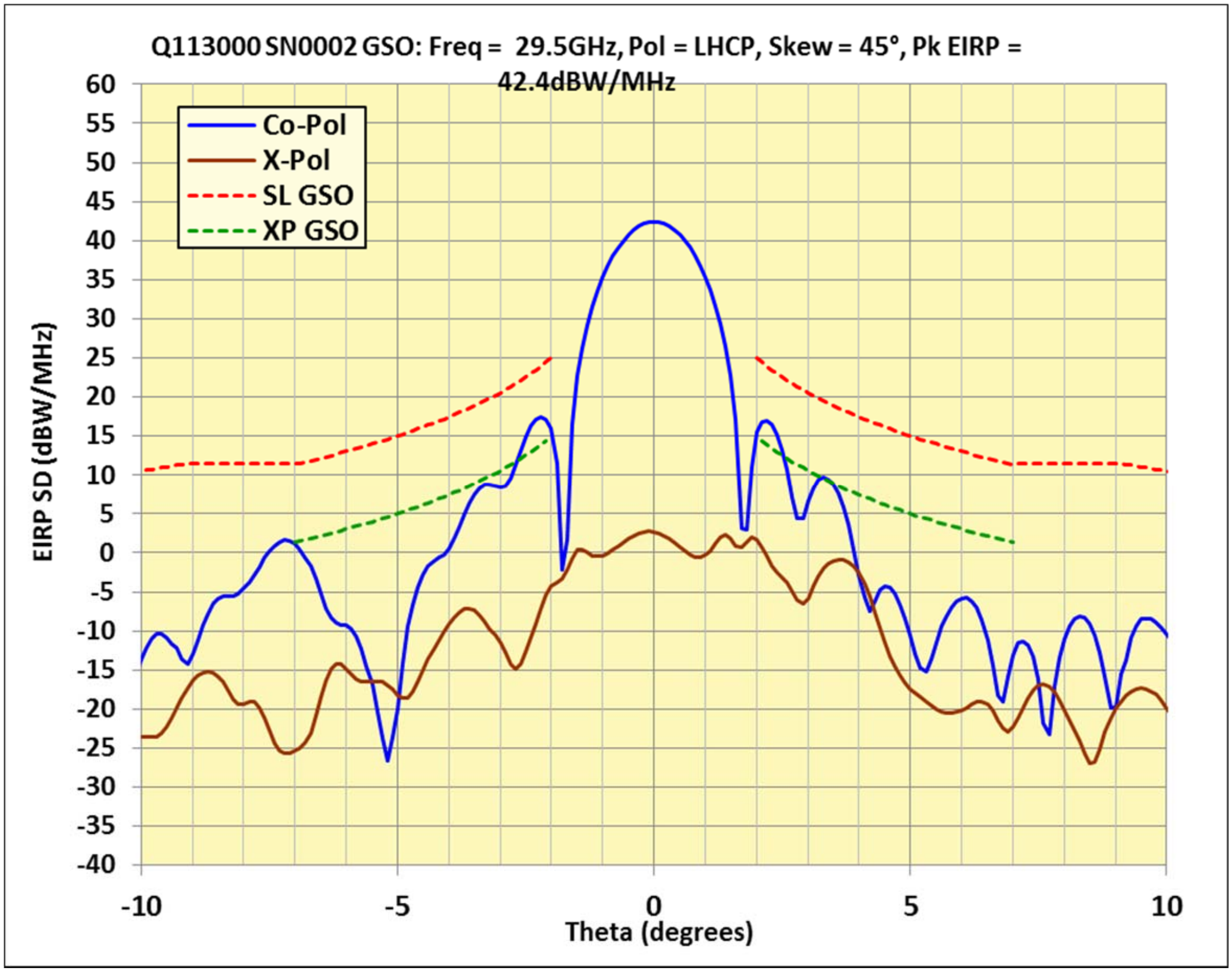

Figure 4: 45° skew angle at 29.5 GHz; Co-Pol and Cross-Pol LHCP; GSO Plane +/- 10°

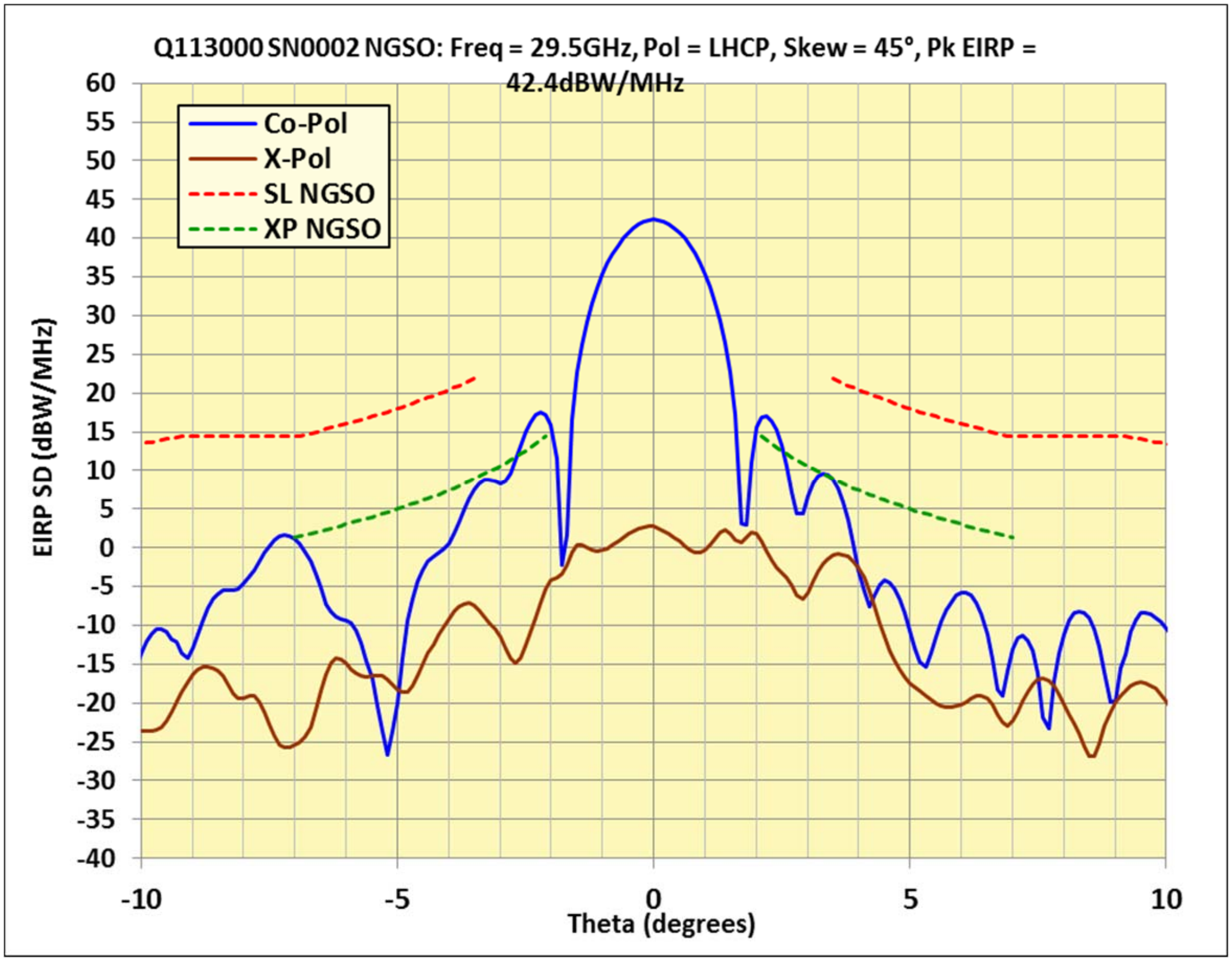

Figure 5: 45° skew angle at 29.5 GHz; Co-Pol and Cross-Pol LHCP; NGSO Plane +/- 10°

3.1.1.2 Jupiter-2 Off-Axis EIRP Spectral Density

As shown earlier in Figure 3, Thales ESAA operations on Jupiter-2 at orbital location 97.1° W.L. will utilize spot beams covering most of CONUS, and will be limited to a worst-case skew angle of 35°. Thales will maintain their uplink EIRP densities to never exceed the limits set in §25.138(a)(1). Exhibit B attached contains Jupiter-2 return link budgets for operational scenarios at 0° and 35° skew angles. All EIRP densities at 0° and 35° skew angles are equal to or below those detailed in Thales's initial filing.

3.1.2 Protection of NGSO Systems

For operation on Jupiter-1 and Jupiter-2 Thales does not intend to operate in spectrum allocated to NGSO systems. The NGSO transmit band is 28.6 – 29.1 GHz[6]. Thales will only operate between 29.25 and 30.0 GHz.

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[6] See, e.g., Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Serv. Use, 16 FCC Rcd 19808, at ¶ 23 (2001)

3.1.3 Protection of LMDS Systems

The nearest allocation for LMDS service is 27.5 – 28.35 GHz[7] and, as noted in Section 3.1.2 above, Thales will not operate within this band.

3.1.4 Protection of Mobile Satellite Systems at Ka-band

Thales will work closely with authorized MSS gateway service providers and respond to any requests for coordination as necessary with respect to its ESAA operations with Jupiter-1 and Jupiter-2 in the 29.25 – 29.5 GHz band, which is allocated to GSO FSS and NGSO MSS feeder links on a co-primary basis.

3.1.5 Radiation Hazard Study

Since the Thales MCT-A (ESAA) characteristics and specifications are not changing as part of this amendment, the radiation hazard study provided in Thales's initial filing[8] still applies and is not repeated in this narrative.

3.2 List of Exhibits

The following four exhibits are provided in this document:

- Exhibit A contains the waiver request.

- Exhibit B contains the link budgets for Jupiter-1 and Jupiter-2.

- Exhibit C contains the Hughes certification letters for Thales's operations on Jupiter-1 and Jupiter-2.

- Exhibit D contains the compliance tables for §25.227 and §25.138.

Two exhibits are provided separately:

- Exhibit E contains the receive and transmit antenna gain plots and tables for the skew angle of 45°.

- Exhibit F contains the transmit EIRP density plots and tables for the skew angle of 45°.

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[7] Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, First Report and Order, 11 FCC Rcd 19005 ¶ 85 (1996).

[8] See Exhibit D – Radiation Hazard Study (p.30) of Thales's FCC Authorization Submission for Ka-band Earth Station Aboard Aircraft (ESAA), dated February 16, 2017.

4 Conclusion

As demonstrated herein and in Thales's initial filing of February 17, 2017, the grant of this application will serve the public interest by enabling Thales to offer a new innovative and competitive IFC service to airline passengers in a manner fully consistent with the FCC rules. As such, Thales respectfully requests grant of this application.

5 Exhibit A – Waiver Request

Waiver of 25.138(a)(2) for Certain Skew Angles

The non-symmetrical shape of the terminal will cause the off-axis EIRP density levels to exceed the FCC limits set forth in rule part 25.138(a)(2) in the plane perpendicular to the GSO arc (the NGSO plane). At a skew angle of 0° the off-axis EIRP may exceed the limits by as much as 6.9 dB, the levels may also be exceeded for a skew angles of 5°[9]. Because of this, Thales requests any necessary waiver of this rule part. The intention of this rule is prevent interference into NGSO systems. As detailed in our application and further explained in Section 3.1.2 above, Thales will only operate in the GSO primary allocation 29.25 – 30.0 GHz and will not operate in the NGSO primary allocation of the Ka-band, 28.6-29.1 GHz, see band Ka-band plan in Figure 6 below. At the time of this filing there is one authorized NGSO user in the GSO band[10] but there is no spectrum overlap between the Thales system and the authorized NGSO system. Also, as noted in 3.1.1 above, Hughes, the satellite operator for Jupiter-1 and Jupiter-2, has certified that the Thales ESAA operation will comply with their coordination agreements, see Exhibit C for certification letters. Given the above, Thales respectfully requests that the FCC grant this waiver request.

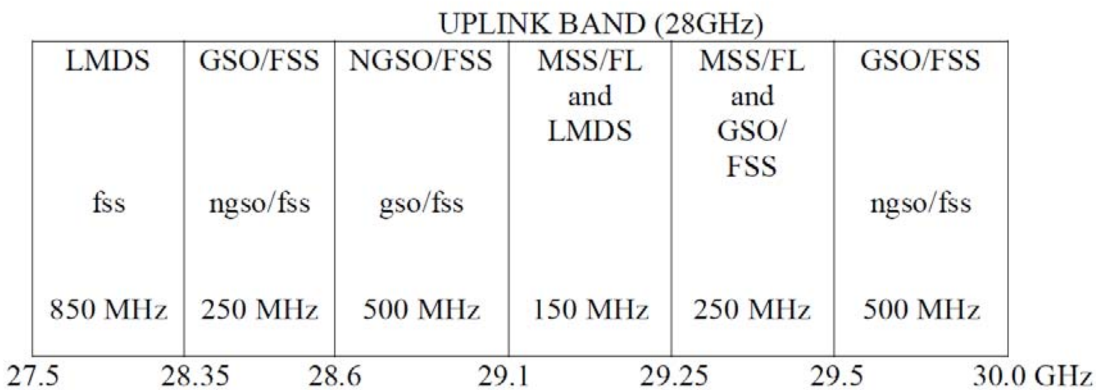

Figure 6: FCC Ka-Band Frequency Band Plan, 27.5 GHz – 30.0 GHz[11]

[9] At 5° skew the NGSO mask, 25.138(a)(2), exceedance may be up to 4.6 dB. All other skew angles will meet the NGSO mask.

[10] O3b is currently authorized to operate in the 28.35-28.4 GHz band, see FCC File No. SES-LIC-20100723-00952. This upper band edge is below Thales ESAA earth-to-space low band edge of 29.25 GHz.

[11] See FCC IB Docket No. 98-172, *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use*, R&O Adopted: June 8, 2000, p. 10.

6 Exhibit B – Link Budgets

Jupiter-1 Link Budgets

Return link budgets on Jupiter-1 (Echostar 17) covering ESAA operation scenarios at 0°, 35°, and 45° skew angles are attached below. Representative forward link budgets are also provided.

(Note: COB = Center of Beam; MOB = Middle of Beam; EOB = Edge of Beam)

Echostar 17 Return Link Budget				
		COB	**MOB**	**EOB**
		0° Skew	**35° Skew**	**45° Skew**
General Parameters				
Orbital Location	° E.L	-107.1	-107.1	-107.1
Uplink Frequency	MHz	29.6875	29.6875	29.6875
Downlink Frequency	MHz	18.9875	18.9875	18.9875
Transmit Earth Station				
Antenna Size	m	0.623 x 0.158	0.623 x 0.158	0.623 x 0.158
Antenna elevation Angle	degrees	40.0	40.0	40.0
Antenna Gain	dBi	39.0	39.0	39.0
Earth station transmit EIRP/carrier	dBW	45.5	45.5	45.5
Receive Earth Station				
Antenna Size	m	5.60	5.60	5.60
Antenna elevation angle	degrees	50.9	50.9	50.9
Rx E/S G/T clear sky	dB/K	34.3	34.3	34.3
Carrier				
Information rate	Mbps	11.1	6.6	3.3
FEC Coding				
Modulation		QPSK 9/10	QPSK 4/5	QPSK 4/5
Symbol rate	Msps	6.1	4.1	2.0
Allocated bandwidth	MHz	7.7	5.1	2.6
Uplink				
Uplink path loss	dB	213.4	213.4	213.4
Uplink atmospheric loss	dB	0.5	0.5	0.5
G/T	dB/K	22.0	19.0	16.0
C/N uplink	dB-Hz	14.3	13.0	13.0
C/I uplink (prior to ASI)	dB-Hz	20.6	16.7	12.9
On-axis EIRP spectral density	dBW/MHz	37.6	39.4	42.4
Downlink				
Downlink atmospheric loss	dB	0.50	0.50	0.50
Downlink path loss	dB	209.4	209.4	209.4
Carrier downlink EIRP at BC	dBW	39.1	37.3	34.3
PFD at earth's surface	dBW/m^2/MHz	-131.6	-131.6	-131.6
C/N downlink	dB-Hz	24.2	24.2	24.2
C/I downlink (prior to ASI)	dB-HZ	12.0	12.0	12.0
End-to-End				
C/I adjacent spacecraft interference	dB-Hz	19.7	21.3	23.8
C/(N+I) total	dB-Hz	9.1	8.4	7.6
Link margin	dB	1.2	2.1	1.3

Echostar 17 Forward Link Budget				
		COB	**MOB**	**EOB**
General Parameters				
Orbital Location	° E.L	-107.1	-107.1	-107.1
Uplink Frequency	MHz	29.375	29.375	29.375
Downlink Frequency	MHz	19.825	19.825	19.825
Transmit Earth Station				
Antenna Size	m	5.60	5.60	5.60
Antenna elevation Angle	degrees	50.9	50.9	50.9
Antenna Gain	dBi	62.4	62.4	62.4
Earth station transmit EIRP/carrier	dBW	69.0	69.0	69.0
Receive Earth Station				
Antenna Size	m	0.623 x 0.158	0.623 x 0.158	0.623 x 0.158
Antenna elevation angle	degrees	40.0	40.0	40.0
Rx E/S G/T clear sky	dB/K	12.5	12.5	12.5
Carrier				
Information rate	Mbps	81.8	54.5	30.1
FEC Coding				
Modulation		8PSK 3/5	QPSK 3/5	QPSK 1/3
Symbol rate	Msps	47	47	47
Allocated bandwidth	MHz	49.4	49.4	49.4
Uplink				
Uplink path loss	dB	213.2	213.2	213.2
Uplink atmospheric loss	dB	0.5	0.5	0.5
G/T	dB/K	22.0	22.0	22.0
C/N uplink	dB-Hz	29.2	29.2	29.2
C/I uplink (prior to ASI)	dB-Hz	24.9	24.9	24.9
On-axis EIRP spectral density	dBW/MHz	52.3	52.3	52.3
Downlink				
Downlink atmospheric loss	dB	0.5	0.5	0.5
Downlink path loss	dB	209.9	209.9	209.9
Carrier downlink EIRP at BC	dBW	54.2	51.2	48.2
PFD at earth's surface	dBW/m^2/MHz	-125.5	-128.5	-131.5
C/N downlink	dB-Hz	8.2	5.2	2.2
C/I downlink (prior to ASI)	dB-HZ	20.0	11.6	5.9
End-to-End				
C/I adjacent spacecraft interference	dB-Hz	16.0	13.0	10.0
C/(N+I) total	dB-Hz	7.2	3.7	0.2
Link margin	dB	1.7	1.5	1.4

Jupiter-2 Link Budgets

Return link budgets on Jupiter-2 (Echostar 19) covering ESAA operation scenarios at 0° and 35° skew angles are attached below. Representative outbound link budgets are also provided.

(Note: COB = Center of Beam; MOB = Middle of Beam; EOB = Edge of Beam)

Echostar 19 Return Link Budget				
		COB	**MOB**	**EOB**
		0° Skew	**35° Skew**	**35° Skew**
General Parameters				
Orbital Location	° E.L	-97.1	-97.1	-97.1
Uplink Frequency	MHz	29.6875	29.6875	29.6875
Downlink Frequency	MHz	18.9875	18.9875	18.9875
Transmit Earth Station				
Antenna Size	m	0.623 x 0.158	0.623 x 0.158	0.623 x 0.158
Antenna elevation Angle	degrees	46.0	46.0	46.0
Antenna Gain	dBi	39.0	39.0	39.0
Earth station transmit EIRP/carrier	dBW	45.5	45.5	45.5
Receive Earth Station				
Antenna Size	m	5.60	5.60	5.60
Antenna elevation angle	degrees	48.1	48.1	48.1
Rx E/S G/T clear sky	dB/K	34.3	34.3	34.3
Carrier				
Information rate	Mbps	11.1	6.6	3.3
FEC Coding				
Modulation		QPSK 9/10	QPSK 4/5	QPSK 4/5
Symbol rate	Msps	6.1	4.1	2.0
Allocated bandwidth	MHz	7.7	5.1	2.6
Uplink				
Uplink path loss	dB	213.3	213.3	213.3
Uplink atmospheric loss	dB	0.5	0.5	0.5
G/T	dB/K	22.0	19.0	16.0
C/N uplink	dB-Hz	14.4	13.1	13.1
C/I uplink (prior to ASI)	dB-Hz	20.6	16.7	12.9
On-axis EIRP spectral density	dBW/MHz	37.6	39.4	42.4
Downlink				
Downlink atmospheric loss	dB	0.50	0.50	0.50
Downlink path loss	dB	209.4	209.4	209.4
Carrier downlink EIRP at BC	dBW	39.1	37.3	34.3
PFD at earth's surface	dBW/m^2/MHz	-131.6	-131.6	-131.6
C/N downlink	dB-Hz	24.2	24.2	24.2
C/I downlink (prior to ASI)	dB-HZ	12.0	12.0	12.0
End-to-End				
C/I adjacent spacecraft interference	dB-Hz	19.7	21.3	23.7
C/(N+I) total	dB-Hz	9.1	8.4	7.7
Link margin	dB	1.2	2.1	1.4

Echostar 19 Forward Link Budget				
		COB	**MOB**	**EOB**
General Parameters				
Orbital Location	° E.L	-97.1	-97.1	-97.1
Uplink Frequency	MHz	29.375	29.375	29.375
Downlink Frequency	MHz	19.825	19.825	19.825
Transmit Earth Station				
Antenna Size	m	5.60	5.60	5.60
Antenna elevation Angle	degrees	48.1	48.1	48.1
Antenna Gain	dBi	62.4	62.4	62.4
Earth station transmit EIRP/carrier	dBW	69.0	69.0	69.0
Receive Earth Station				
Antenna Size	m	0.623 x 0.158	0.623 x 0.158	0.623 x 0.158
Antenna elevation angle	degrees	46.0	46.0	46.0
Rx E/S G/T clear sky	dB/K	12.5	12.5	12.5
Carrier				
Information rate	Mbps	81.8	54.5	30.1
FEC Coding				
Modulation		8PSK 3/5	QPSK 3/5	QPSK 1/3
Symbol rate	Msps	47	47	47
Allocated bandwidth	MHz	49.4	49.4	49.4
Uplink				
Uplink path loss	dB	213.2	213.2	213.2
Uplink atmospheric loss	dB	0.5	0.5	0.5
G/T	dB/K	22.0	22.0	22.0
C/N uplink	dB-Hz	29.2	29.2	29.2
C/I uplink (prior to ASI)	dB-Hz	24.9	24.9	24.9
On-axis EIRP spectral density	dBW/MHz	52.3	52.3	52.3
Downlink				
Downlink atmospheric loss	dB	0.5	0.5	0.5
Downlink path loss	dB	209.8	209.8	209.8
Carrier downlink EIRP at BC	dBW	54.2	51.2	48.2
PFD at earth's surface	dBW/m^2/MHz	-125.4	-128.4	-131.4
C/N downlink	dB-Hz	8.3	5.3	2.3
C/I downlink (prior to ASI)	dB-HZ	20.0	11.6	5.9
End-to-End				
C/I adjacent spacecraft interference	dB-Hz	16.1	13.1	10.1
C/(N+I) total	dB-Hz	7.3	3.8	0.2
Link margin	dB	1.8	1.5	1.5

7 Exhibit C – Satellite Certification Letters

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April 11th, 2017

Paul Blais
Chief, System Analysis Branch
Satellite Division
International Bureau
Federal Communications Commission
445 12th Street, W.W.
Washington, D.C. 20554

Subject: Certification of Hughes Network Systems, LLC (HNS) for the ECHOSTAR XVII satellite

Dear Mr. Blais:

Pursuant to §25.227(b)(2)(ii) and 25.220(d) of the FCC rules, Hughes Network Systems, LLC provides this certification letter regarding the application by which Thales Avionics, Inc. (Thales) is seeking authorization from the FCC to operate technically identical Ka-band transmit/receive terminals on domestic and international flights, consistent with ITU RR 5.526 and the Commission's current rules for the Ka band. Thales Avionics is seeking authorization for these aeronautical Ka-band earth stations to utilize the ECHOSTAR XVII satellite located at the 107° WL nominal orbital position, in conformance with the off-axis EIRP density and power flux density (PFD) levels specified in Section 25.138(a) of the FCC rules.

Having reviewed the contents of the Thales' application, as well as all material presented by them on how they will utilize the ECHOSTAR XVII satellite included in their letter dated April 11, 2017, HNS

- Certifies that coordination for the ITU filing associated with the operation of the ECHOSTAR XVII satellite has been concluded with all relevant geostationary satellite networks located in an orbital arc at +/- 6 degrees from the 107° WL nominal orbital position.
- Certifies that power density levels as specified by Thales are consistent with the existing agreements signed by HNS for the inter-satellite coordination of the ITU filings associated with

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the operation of the ECHOSTAR XVII satellite with respect of all relevant geostationary satellite networks located in an orbital arc at +/- 6 degrees from the 107° WL nominal orbital position.

- Will ensure that, if the operations proposed by Thales are authorized by the FCC, all future inter-satellite coordination agreements associated with the operation of the ECHOSTAR XVII satellite will include the power density levels specified by Thales.

With my warmest regards,

Fernando Carrillo
Senior Principal Engineer
Regulatory Affairs

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April 11th, 2017

Paul Blais
Chief, System Analysis Branch
Satellite Division
International Bureau
Federal Communications Commission
445 12th Street, W.W.
Washington, D.C. 20554

Subject: Certification of Hughes Network Systems, LLC (HNS) for the ECHOSTAR XIX satellite

Dear Mr. Blais:

Pursuant to §25.227(b)(2)(ii) and 25.220(d) of the FCC rules, Hughes Network Systems, LLC provides this certification letter regarding the application by which Thales Avionics, Inc. (Thales) is seeking authorization from the FCC to operate technically identical Ka-band transmit/receive terminals on domestic and international flights, consistent with ITU RR 5.526 and the Commission's current rules for the Ka band. Thales Avionics is seeking authorization for these aeronautical Ka-band earth stations to utilize the ECHOSTAR XIX satellite located at the 97° WL nominal orbital position, in conformance with the off-axis EIRP density and power flux density (PFD) levels specified in Section 25.138(a) of the FCC rules.

Having reviewed the contents of the Thales' application, as well as all material presented by them on how they will utilize the ECHOSTAR XIX satellite included in their letter dated April 11, 2017, HNS

- Certifies that coordination for the ITU filing associated with the operation of the ECHOSTAR XIX satellite has been concluded with all relevant geostationary satellite networks located in an orbital arc at +/- 6 degrees from the 97° WL nominal orbital position.
- Certifies that power density levels as specified by Thales are consistent with the existing agreements signed by HNS for the inter-satellite coordination of the ITU filings associated with

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the operation of the ECHOSTAR XIX satellite with respect of all relevant geostationary satellite networks located in an orbital arc at +/- 6 degrees from the 97° WL nominal orbital position.

- Will ensure that, if the operations proposed by Thales are authorized by the FCC, all future inter-satellite coordination agreements associated with the operation of the ECHOSTAR XIX satellite will include the power density levels specified by Thales.

With my warmest regards,

Fernando Carrillo
Senior Principal Engineer
Regulatory Affairs

8 Exhibit D - §25.227 and §25.138 Rules Compliance Tables

FCC Rules §25.227 Compliance Table		
FCC Rule Part	**Description**	**Comments**
§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.	Thales will not comply in the NGSO plane for skew angles between 0° and 5°, see Exhibit A
§25.227(a)(2)(i)	(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.	Thales will comply, see Section 3.1 and Exhibit B
§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.	Thales understands that the Ka-band spectrum sought could be used by terrestrial microwave in the 18.3-18.8 GHz band and does expect to receive protection from interference. The possibility for interference while in operation is very remote
§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.	Thales understands and expects similar protection from Ka-band satellites
§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:	Thales will comply with 25.138 downlink PFD limits, see Section 3.1 and Link Budgets in Exhibit B

	-132 + 0.5 · θ dB(W/(m2 · MHz)) For θ ≤40°	
	-112 dB(W/(m2 · MHz)) For 40° <θ ≤90°	
§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.	Thales will comply, see Sections 3.1 and Exhibits E and F
§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:	Thales will comply, see Sections 3.1 and Exhibits E and F
§25.227(b)(2)(i)	(i) Off-axis EIRP density data pursuant to §25.115(g)(1);	See Section 3.1.1 and Exhibit F
§25.227(b)(2)(ii)	(ii) The certifications required by §25.220(d); and	See Exhibit C
§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 Section 2.3.1

FCC Rules §25.138 Compliance Table		
FCC Rule Part	**Description**	**Comments**
25.138(a)	Applications for earth station licenses in the GSO FSS in the conventional Ka-band that indicate that the following requirements will be met and include the information required by relevant provisions in §§25.115 and 25.130 may be routinely processed:	
25.138(a)(1)	The EIRP density of co-polarized signals in the plane tangent to the GSO arc, as defined in §25.103, will not exceed the following values under clear sky conditions:	Thales will comply, see Section 3.1 and Exhibit F
	32.5-25log(θ) dBW/MHz for 2.0° ≤ θ ≤ 7°.	
	11.5 dBW/MHz for 7° ≤ θ ≤ 9.2°	
	35.5-25log(θ) dBW/MHz for 9.2° ≤ θ ≤ 19.1°	
	3.5 dBW/MHz for 19.1° < θ ≤ 180°	
	Where:	
	θ is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite.	

25.138(a)(2)	In the plane perpendicular to the GSO arc, as defined in §25.103, the EIRP density of co-polarized signals will not exceed the following values under clear sky conditions: 35.5-25log(θ) dBW/MHz for 3.5° ≤ θ ≤ 7° 14.4 dBW/MHz for 7° < θ ≤ 9.2° 38.5-25log(θ) dBW/MHz for 9.2° < θ ≤ 19.1° 6.5 dBW/MHz for 19.1° < θ ≤ 180° Where θ is as defined in paragraph (a)(1) of this section.	Thales may exceed for certain skew angles, see Section 3.1, Exhibit A, and Exhibit F
25.138(a)(3)	The EIRP density levels specified in paragraphs (a)(1) and (2) of this section may be exceeded by up to 3 dB, for values of θ > 7°, over 10% of the range of theta (θ) angles from 7-180° on each side of the line from the earth station to the target satellite.	Thales understands
25.138(a)(4)	The EIRP density of cross-polarized signals will not exceed the following values in the plane tangent to the GSO arc or in the plane perpendicular to the GSO arc under clear sky conditions: 22.5-25log(θ) dBW/MHz for 2.0° < θ ≤ 7.0° Where θ is as defined in paragraph (a)(1) of this section.	Thales will comply, see Section 3.1 and Exhibit F
25.138(6)(a)	(6) Power flux-density (PFD) at the Earth's surface produced by emissions from a space station for all conditions, including clear sky, and for all methods of modulation shall not exceed a level of −118 dBW/m2/MHz, in addition to the limits specified in §25.208 (d).	Thales understand and will not exceed, See outbound LBAs in Exhibit B
25.138(6)(b)	(b) Operation with off-axis EIRP density exceeding a relevant envelope specified in paragraph (a) of this section and applications proposing such operation are subject to coordination requirements in §25.220.	Thales understand and will comply
25.138(6)(c)-(e)	(c)-(e) [Reserved]	
25.138(6)(f)	(f) The holder of a blanket license pursuant to this section will be responsible for operation of any transceiver to receive service provided by that licensee or provided by another party with the blanket licensee's consent. Space station operators may not transmit communications to or from user transceivers in the United States in the 18.3-18.8 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz, or 29.25-30.0 GHz band unless such communications are authorized under an FCC earth station license.	Thales understands and will comply