THALES

Thales Avionics, Inc.

STA Confirmation Number: EL992700

STA File Number: 0797-EX-ST-2021

Technical Narrative

May 19, 2021

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1 Introduction and Purpose of STA

Thales Avionics, Inc. ("Thales") seeks to modify its active STA license Call Sign: WJ2XSO, which is authorized to conduct tests on 4 units of 0.444- meter ACT-A Ka-band antennas on board aircrafts (ESAA).

The purpose of the STA is to add Telesat Telstar 19V at 63°W.L. satellite as a point of communication. In order to provide network coverage with seamless connectivity and compensate for the loss of AMC-16[1], Thales will be adding a new point of communication Telesat T19V and use the improved beam pointing characteristics of the AMC-15 and additional beams of Jupiter 2.

Thales Avionics currently has an active blanket license authorization to operate an ESAA earth station called the Advanced Connectivity Terminals, Ka-band (ACT-A) with five FCC-authorized GSO satellites whose Ka-band spot beam coverage areas include CONUS, most of Canada, and portions of Mexico and the Caribbean region.[2] Initially, five points of communication are: AMC-15 (S2180) at 105.0° W.L., AMC-16 (S2181) at 85.0° W.L., Jupiter 1 (S2753) at 107.1° W.L., Jupiter 2 (S2834) at 97.1° W.L, and Telenor Norway satellite Thor-7 at orbital location 0.65° W.L.

Long term, Thales Modification to ESAA blanket License Call Sign E170068, will remove SES AMC-16 at 85° W.L. as a point of communication and add Telesat Telstar 19V at 63°W.L. satellite as a point of communication. This needs to be tested in advance in order to provide network coverage with seamless connectivity and compensate for the loss of AMC-16 (due to solar anomalies).

2 System Description

2.1 Overview

Complete details of the Thales remote terminal and system architecture are included in the most recent Thales modification filing[3].

2.1.1 Network Architecture

Thales's Inter-Flight Connectivity (IFC) network operations will utilize Ka-band GSO satellite, connected hub satellite earth stations and the Hughes Jupiter platform baseband hub equipment, which will communicate with Hughes Jupiter aero modems on the aircraft. A high-

[1] As notified by SES, AMC-16 BEAMS being used to provide services by THALES Airline customers will not be functional and are experiencing Solar Anomalies.
[2] See IBFS File No. SES-MOD-20200818-00888, call sign E170068, granted August 26, 2020.
[3] See IBFS File No. SES-MOD-20200818-00888, call sign E170068, granted August 26, 2020.

level network architecture diagram is shown below in Figure 1. This architecture is very similar to that provided in Thales's initial filings.

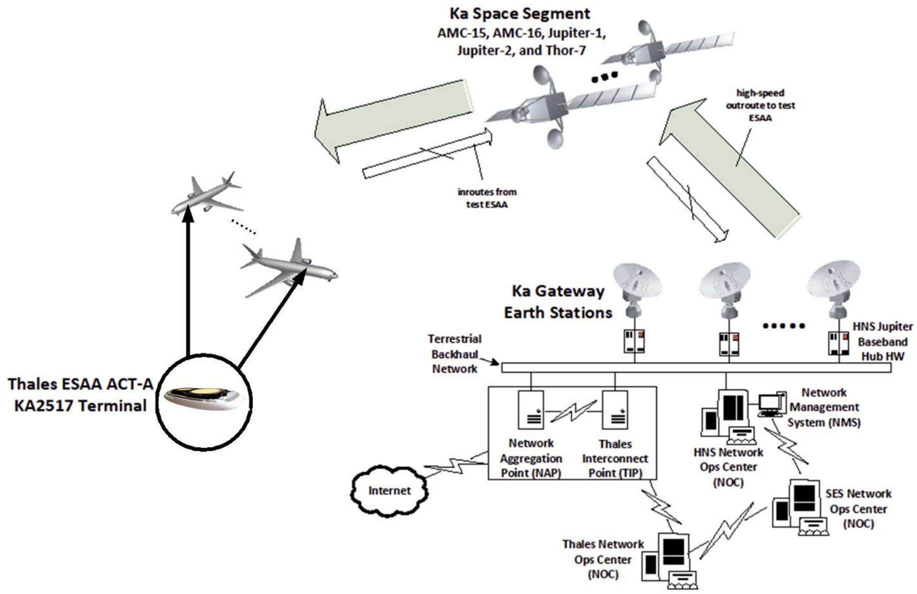


Figure 1 – Thales Aero Connectivity Network Architecture

The network is comprised of:

- a terrestrial IP backhaul network interconnecting the controlling Ka earth station gateways (detailed later in Section 2.4.2), and connecting the baseband hubs to the Virginia-based Network Aggregation Point (NAP) and Thales Interconnect Point (TIP)
- Ka space segment on five Ka-band GSO satellites.
- Thales Ka ESAAs, known as the Advanced Connectivity Terminals, Ka-band (ACT-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

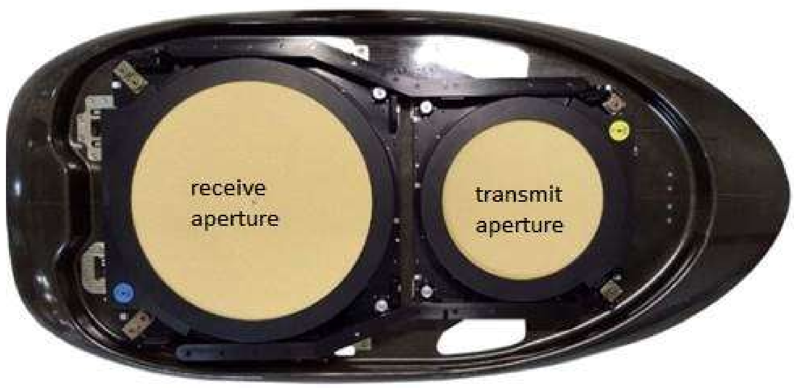
The operational details and specifications of the Thales ACT-A (ESAA) are provided below.

2.2.1 System Description

The Thales ACT-A terminal consists of:

- ThinKom Ka2517 antenna
- RF/IF Unit (KRFU)
- Antenna Control Unit (KANDU)
- Thales Modem Manager (TMM)

The ThinKom Ka2517 antenna is an array of 2 flat circular apertures, one for transmitting Ka-band signals and one for receiving, as shown in the picture below:



The ACT-A specifications are provided in Table 1 below.

Tx RF Parameter	**Performance (w/ Radome)**
Frequencies	27.5 GHz – 30.0 GHz
Antenna Coverage	360° in azimuth, 10-85° in elevation
Instantaneous Bandwidth	500 MHz
Axial Ratio (w/ Radome)	<2.5 dB typical (<29 dBW X-pol EIRP)
Polarization	Circular Switchable
EIRP (@29.5 GHz) typical[1]	49.0 dBW (P_{lin}, 85° elev)
	49.0 dBW (P_{lin}, 70° elev)
	48.0 dBW (P_{lin}, 45° elev)
	46.0 dBW (P_{lin}, 30° elev)
	44.5 dBW (P_{lin}, 20° elev)
	42.0 dBW (P_{lin}, 10° elev)
KRFU Output Flange Power	25 W (P_{lin}), 50 W (P_{sat})
KRFU Reference Signal	50 MHz
IF Input Frequency Range	950 – 1950 MHz
Beamwidth (@29.5 GHz)	<1.8° in ϕ
Sidelobe Suppression	1st E-Plane Sidelobe at least 12dB down from beam

[1] Assumes 2.5 dB SSPB-to-TX feed & interconnecting WG loss

Rx RF Parameter	**Performance (w/ Radome @ Cruise Altitude)**
Frequencies	17.8 GHz – 20.2 GHz
Antenna Coverage	360° in azimuth, 10-85° in elevation
Instantaneous Bandwidth	500 MHz (-1 dB DVB-S2)
Axial Ratio	<2.5 dB typical
Polarization	Circular Switchable
G/T (@19.7 GHz) typical	17.0 dB/K (85° elev)
	17.0 dB/K (70° elev)
	16.0 dB/K (45° elev)
	14.0 dB/K (30° elev)
	12.5 dB/K (20° elev)
	10.0 dB/K (10° elev)
LNB Reference Signal	50 MHz
IF Output Frequency Range	950 – 1950 MHz
Beamwidth (@19.7 GHz)	<1.8° in ϕ
Sidelobe Suppression	1st E-Plane Sidelobe at least 12dB down from beam

Table 1: Ka-band (ACT-A) Specifications

2.3 Space System

2.3.1 Satellite System List

Table 1 below provides the complete list of satellite modifications required for this STA[4].

Satellite (Call Sign)	Satellite Operator	GSO Orbital Location (W.L.)	Transmit Spectrum (MHz)	Receive Spectrum (MHz)	Mod to License
Telstar T19V	Telstar	63.0°	29500 – 30000	19700 – 20200	Yes, New PoC

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

Figure 1 below show the satellite coverage beams for the Telstar 19V satellites concerned with this modification. Also shown are the worst-case excursion with respect to skew and elevation angle for any terminal operating within these beams. A summary of all Satellite is outlined below in Figure 4:

- Figure 1 – The Telstar 19V operating beams with worst case elevation of 15° and skew of 40°

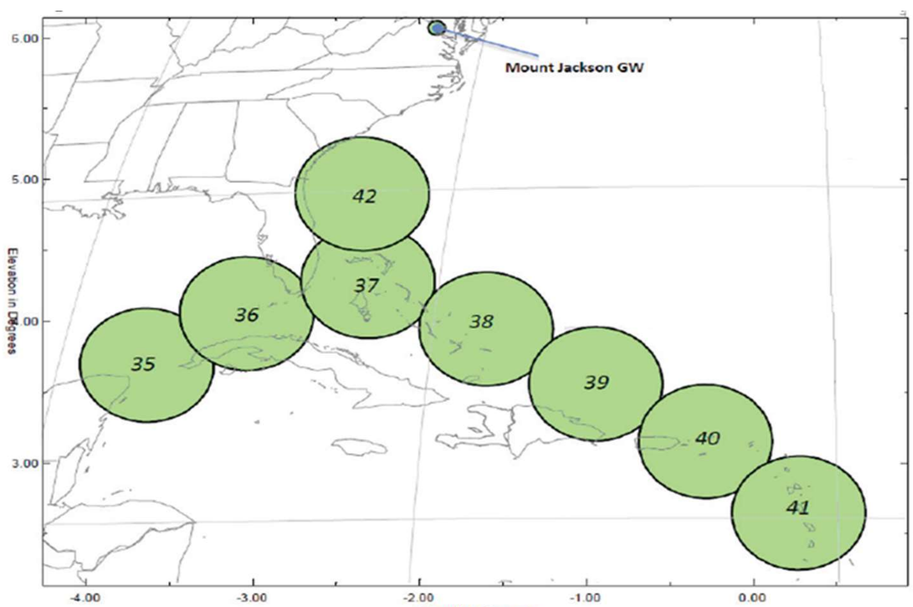


Figure 1: Telstar 19V Coverage Area and Skew Angles for Thales ESAA Operation (Worst-Case Skew Angle of ~45°, Elevation 45° at position P1 in red)

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[4] STA File Number: 0797-EX-ST-2021

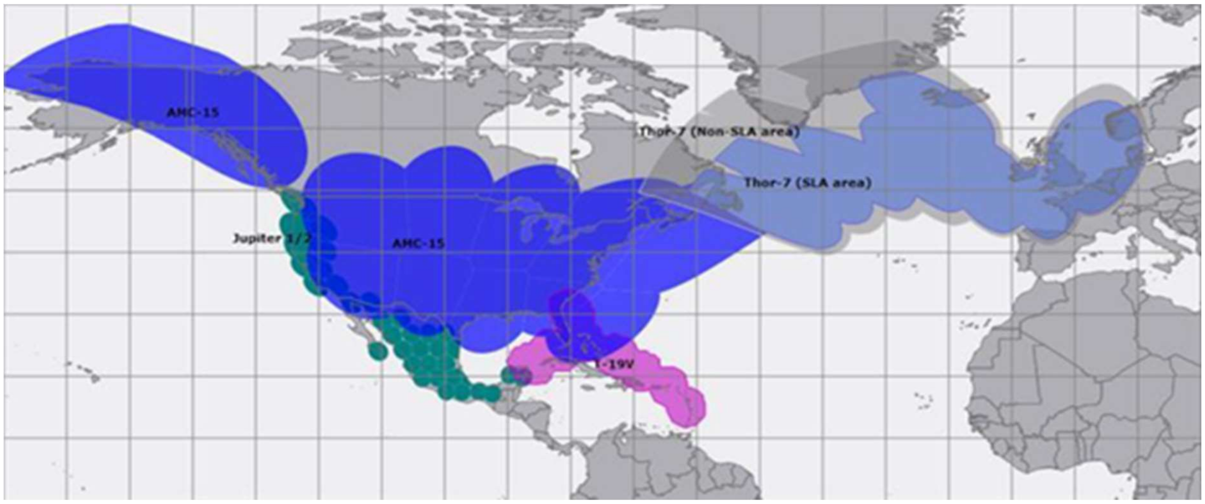


Figure 4 – Revised Thales ESAA Network showing all existing and revised beams.

2.4 Ground Segment

2.4.1 Remote Control Network Operations Centers (NOCs)

The network operations centers (NOCs) as described in Thales's current authorization 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 24/7/365 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 24/7/365:

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

The Thales NOC phone number is 407-812-2538, and the email address is: MOC@us.thalesgroup.com

2.4.2 Network Gateway Earth Stations

Thales's service will use FCC-licensed hub antennas at the gateway earth stations to communicate with AMC-15 and AMC-16. Full remote control of the ESAA terminals and the network will be possible from the Thales NOC. Satellite specific hub earth stations are identified below:

AMC-15 Earth Stations:

9815 West Hallett Road
Spokane, WA 99224
FCC callsign E040572

SES Washington Media Port
8000 Gainsford Court
Bristow, VA 20136

Jupiter 1 and Jupiter 2:

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.

Telstar 19V

Mt Jackson Teleport:
1305 Industrial Park
Mt Jackson, VA 22842

Teleport FCC call sign: E160135

2.5 ACT-A Necessary Emission Designators and Power

The waveforms and capabilities of the return link (inbound) channels and the forward link (outbound) channels as detailed in Thales's current authorization are not changing as a result of this modification request. However, Thales's ESAA operations is requesting require higher power for the return channel (from ESAA) only for operation on Telesat T19V. Full details these higher powered carriers are shown in Table 2 below and in the Form 312 submitted with this modification request.

Link	Emission Designator	Bandwidth [MHz]	Symbol Rate [Msps]	EIRPSD [dBW/MHz]	Frequency [MHz]	
					Earth to Space	Space to Earth
Inbound	4M80G7W	4.8	3.84	41.4	27612 – 27887 27868 – 28331 29300 – 29731	18300 – 19300 19700 – 20200
Inbound	5M20G7W	5.2	4.2	41.4	27612 – 27887 27868 – 28331 29300 – 29731	18300 – 19300 19700 – 20200
Inbound	7M00G7W	7.0	5.6	41.4	27612 – 27887 27868 – 28331 29300 – 29731	18300 – 19300 19700 – 20200

Table 2: Telesat T19V Carriers and Carrier EIRP Density Levels

Link budgets have been provided in Exhibit B of this narrative to confirm that the power density level of the new return carrier requested will provide the necessary performance. authorization.

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 all satellites, 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 compliant with FCC rule parts 25.228, 25.218, and 25.220. Specifically, the ACT-A terminal will comply with the EIRP Special Density requirements specified in 25.218(i)(1)-(5). Thales has worked with SES, Hughes, and Telenor to ensure that the off-axis emissions will comply with all applicable inter-satellite coordination agreements (see Exhibit C). The Thales system can limit emission power relative to the terminal's elevation and skew angle. For many such positions the terminal can achieve a maximum emission of 43 dBW/MHz, which is the highest EIRP spectral density requested in this filing. For other, more extreme, skew and elevation angles, Thales will limit the ESD as shown in the sections below.

3.1.1.1 Telstar 19V Off-Axis EIRP Spectral Density

Thales ESAA operation on Telstar 19V at 63° W.L. will utilize spot beams covering southern USA and the Caribbean. As shown in Figure 3 above the worst-case skew angles will be around 50 degrees with a corresponding elevation angle of 50 degrees. Thales will maintain their uplink EIRP densities to comply with the limits set in §25.218(i)(1) or the coordination agreements set by their satellite operator.

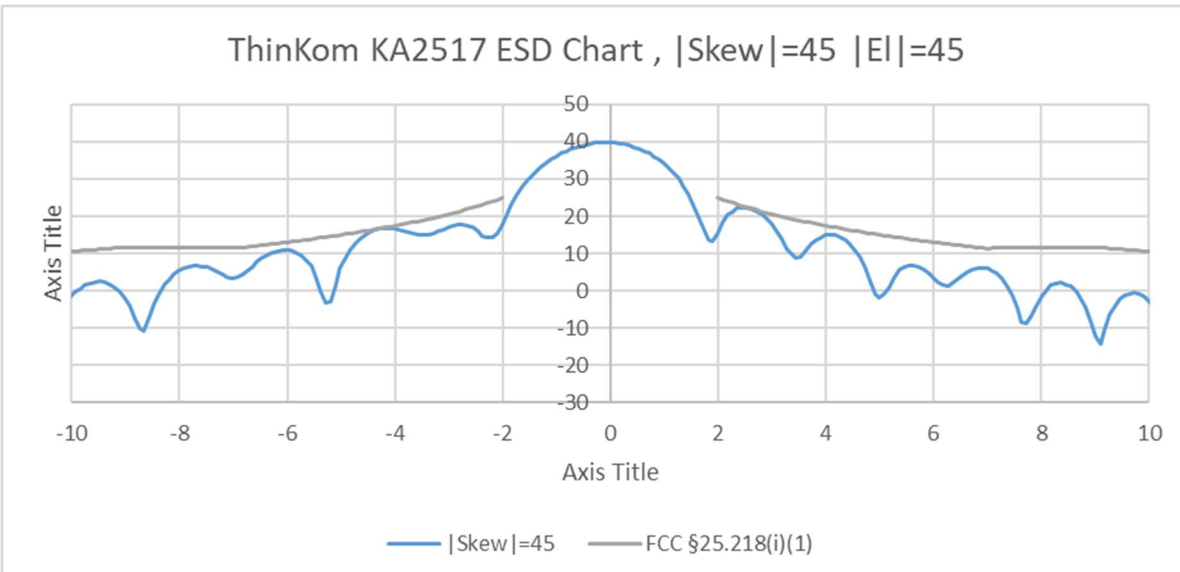


Figure 7 – **T19V worst case ESD operation.** The highest power level for this operation is 40.7 dBW//MHz (16.7 dBW/4kHz)

3.1.2 Protection of NGSO Systems

For operation on AMC-15, Jupiter-2, and **T19V** Thales does not intend to operate in spectrum allocated to NGSO systems. The NGSO transmit band is 28.6-29.1 GHz[5]. Thales will only operate as noted in Table 2 above, outside of the NGSO primary band. Thales agrees to coordinate with any authorized NGSO users in the GSO band which may be impacted by their ESAA operation. At the time of this filing there appears to be one such NGSO system authorized to use this

[5] 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)

portion of the band which will not overlap with the Thales operational spectrum[6]. Thales agrees to coordinate with any users of this band as is required in the future.

3.1.3 Protection of LMDS Systems

The nearest allocation for LMDS service is 27.5 – 28.350 GHz[7] and, as noted in Table 2 above, Thales will operate in this band when operating only on **T19V**. Thales will coordinate as required. 3.1.2 above, Thales will not operate within this band.

3.1.4 Protection of Mobile Satellite Systems at Ka-band

For ESAA operations on all satellites, Thales does not intend to operate in the 29.25 – 29.3 GHz band, which is allocated to GSO FSS and NGSO MSS feeder links on a co-primary basis.

3.1.5 Radiation Hazard Study

A radiation hazard study provided is provided in Exhibit D.

3.2 List of Exhibits

The following four exhibits are provided in this document:

- Exhibit A contains the link budgets for ACT-A Terminal for all new points of communication, Telstar 19V.
- **Exhibit B contains the certification letters for Telesat T19V Satellite**.
- Exhibit C contains the radiation hazard study. The highest EIRP required for these modifications is less than considered for the initial ACT-A terminal radhaz study and so the attached is the same as was included in the 2020 modification request.[8]

[6] O3B is currently authorized to operate in the 28.35-28.4 GHz band, see FCC File No.1 SES-LIC-20100723-00952. This upper band edge is below the Thales lower band edge of 28.438 GHz.
[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 IBFS Mod filing No. SES-MOD-20200818-00888, call sign E170068, granted August 26, 2020.

4 Exhibit A – Link Budgets

		COB	MOB	EOB
General Parameters				
Orbital Location	oE.L	-63.0	-63.0	-63.0
Beam Assignment		COB	MOB	EOB
Uplink Frequency	MHz	29.625	29.625	29.625
Downlink Frequency	MHz	18.4250	18.4250	18.4250
Terminal Transmit				
Antenna Size	m	0.43	0.43	0.43
Antenna Latitude	Deg N	20.70	19.80	18.89
Antenna Longitude	Deg E	-85.60	-85.70	-85.79
Antenna elevation Angle	degrees	54.7	55.3	55.9
Antenna skew Angle	degrees	-45.5	-47.0	-48.5
Antenna Gain	dBi	40.1	40.0	40.0
Earth station transmit EIRP/carrier	dBW	47.6	47.6	47.6
On-axis EIRP spectral density	dBW/40kHz	27.5	27.5	27.5
Gateway Receive				
Antenna Size	m	9.40	9.40	9.40
Antenna elevation angle	degrees	42.3	42.3	42.3
Rx E/S G/T clear sky	dB/K	38.6	38.6	38.6
Carrier				
Symbol rate	Msps	4.096	4.096	4.096
Allocated bandwidth	MHz	5.1	5.1	5.1
Modulation / FEC Coding		8PSK 4/5	8PSK 2/3	QPSK 4/5
Layer 1 Information rate	Mbps	9.8	8.2	6.6
Uplink				
Uplink path loss	dB	213.2	213.2	213.2
Uplink atmospheric loss	dB	0.9	0.9	0.9
G/T	dB/K	17.0	14.5	12.2
C/N uplink	dB	13.0	10.5	8.2
C/I uplink	dB	24.0	24.0	24.0
Downlink				
Downlink atmospheric loss	dB	0.40	0.40	0.40
Downlink path loss	dB	209.3	209.3	209.3
Carrier downlink EIRP at BC	dBW	37.0	34.5	32.3
PFD at earth's surface	dBW/m^2/MHz	-132.0	-134.5	-136.7
C/N downlink	dB	28.4	25.9	23.7
C/I downlink	dB	23.7	23.7	23.7
End-to-End				
C/I ASI	dB	23.5	22.9	21.9
C/(N+I) total	dB	11.9	9.8	7.7
Link margin	dB	0.2	0.3	0.4

5 Exhibit B – Satellite Operator Certification Letters

The certification letters are being provided by Telesat for access to Telstar 19V.

TELESAT

160 Elgin Street, Suite 2100
Ottawa, ON, Canada K2P 2P7

25 March 2021

Federal Communications Commission
International Bureau
45 L Street, NE
Washington, DC 20554

Re: Engineering Certification of Telesat

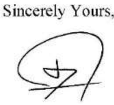
To Whom It May Concern:

This letter certifies that Telesat is aware that Thales is planning to file an application to the Federal Communications Commission ("FCC") seeking to operate Ka-band earth stations aboard aircraft ("ESAA"). The application will seek authority for Thales ESAA terminals to communicate with the T19V satellite at 63°W.L. under the current FCC rules, including Section 25.228.

Based on the information provided by Thales, Telesat understands the technical characteristics associated with the operation of the Thales ESAA terminals and:

- Telesat certifies that the operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from T19V satellite at 63°W.L.;
- If the FCC authorizes the operations proposed by Thales, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordination with adjacent satellite operators.

Sincerely Yours,



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