Panasonic Avionics Corporation ESAA Blanket License Modification Application

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I. Apstar 6C



亞太通信衛星有限公司 APT SATELLITE COMPANY LIMITED 香港新界大埔工業村大貴街22號 No.22 Dai Kwai Street, Tai Po Industrial Estate Tai Po, NT, Hong Kong

August 17, 2018

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

Re: Engineering Certification of APT Satellite Company Limited.

To Whom It May Concern:

This letter certifies that APT Satellite Company Limited is aware that Panasonic Avionics Corporation ("Panasonic") is planning to modify its earth stations aboard aircraft ("ESAA") blanket license from the Federal Communication Commission ("FCC"), Call Sign E100089, to add the APSTAR-6C satellite, located at 134° E.L., as an authorized point of communication for its PPA and SPA ESAA terminals. APT Satellite Company Ltd understands that Panasonic will file the modification application pursuant to the FCC rules governing ESAA operations, including Section 25.227.

APT Satellite Company Limited, confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements with the satellites with +/-6 degrees of the APSTAR-6C satellite's orbit location, and acknowledges that the proposed operation of Panasonic's PPA and SPA ESAA terminals has the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

If the FCC authorizes the operation proposed by Panasonic, APT Satellite Company Limited will include the power density levels specified by Panasonic, defined within





the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to the satellite addressed by this letter.

Sincerely,

Zhang

Shilin Zhang

Vice President

APT Satellite Company Limited.



Statement on Conformity of APSTAR-6C Satellite with FCC Rules regarding Orbital Debris Mitigation

APT Satellite Company Limited ("APT") provides the following showing regarding compliance with 47 C.F.R. § 25.114(d)(14)(i)-(iv) and §25.283 of the Federal Communications Commission's ("FCC") rules regarding the orbital debris mitigation/end-of-life disposal of the APSTAR-6C satellite. In addition, APT acknowledges that the APSTAR-6C orbital debris mitigation/end-of-life disposal plan is consistent with guidelines issued by the Office of Telecommunications Authority ("OFTA") of Hong Kong in July 2007.

(http://tel_archives.ofca.gov.hk/en/report-paperguide/guidance-notes/gn_200706.pdf)

a. Debris Release Assessment-§25.114(d)(14)(i).

APT has assessed the operations of APSTAR-6C and has determined that no debris has been released by the spacecraft. All separation and deployment mechanisms were fully controlled by China Academy of Space Technology and the launching service provider and no debris is planned to leave the spacecraft after the commission of service.

In the spacecraft integration and manufacturing phase, the stiffness and strength of the satellite structure are verified by a series of test, including the vibration and acoustics test. These tests prove that the structure is tough enough to provide the protection of the satellite components and capable to reduce generation of space debris to the maximum extent possible during a collision.

All critical components (i.e. the Service Module, the Communication Module and the Upper Module) are built within the structure.

The APSTAR-6C spacecraft can be controlled through both the dish antennas and omni antennas. In the different control mode (Normal Mode, Earth Pointing Mode, Inertial Attitude Acquisition Mode and Sun Acquisition Mode), the omni and dish antennas can be used accordingly.



Furthermore, the spacecraft redundancy scheme protects against the failure of any one component by having spare components available. In case, if the primary component fails, the other redundant unit remains functional to maintain the satellites mission. The reliability has been assessed for each subsystem and for each phase of the mission, based on the analysis, the bus reliability is greater than 0.71 at 15 years. According to the goal of the design, there is no item in the bus whose failure will cause loss of the satellite mission unless that item has a probability of success that is superior or equal to 0.99 for 15 years. This redundancy scheme should ensure the control and de-orbit capability of the satellite after a collision.

b. Accidental Explosion Assessment-§25.114(d)(14)(ii).

APT has conducted the assessment the possibility of an accidental explosion onboard APSTAR-6C via reviewing failure modes for all equipment. In order to ensure that the spacecraft does not explode on orbit, the designers of the spacecraft have taken specific precautions. All batteries and fuel tanks are monitored for pressure or temperature variations. Alarms in the SCC (Satellite Control Center) inform controllers of any variations. Additionally, long-term trending analysis will be performed to monitor for any unexpected trends. Operationally, batteries will be operated utilizing the manufacturer's automatic recharging scheme during eclipse season. This scheme will ensure that the batteries will not over-charge. Under the FDIR process, in the event that an overcharge condition is detected, overcharge protection will be triggered to prevent from overheated and do not raise its internal pressure for Li-Ion battery cells.

APSTAR-6C uses a bipropellant system. In order to protect the propulsion system, fuel tanks will all be operated in a blow down mode. At the completion of orbit raising, the helium tanks were isolated from the propulsion system by firing of pyrotechnic valves. This causes the pressure in the propellant tanks to decrease over the life of the spacecraft. In order to ensure that the spacecraft has no explosive risk after it has been successfully de-orbited, all stored energy onboard the spacecraft will be removed except for a small amount of pressurant remaining when the valves were sealed after orbit raising, discussed below in Section (d).

Upon successful de-orbit of the spacecraft, based on the procedure, all propulsion lines and latch valves will be vented and left open. All battery chargers will be turned off and batteries will be left in a



permanent discharge state. These steps will ensure that no buildup of energy can occur resulting in an explosion after the spacecraft de-orbited.

c. Assessment Regarding Collision with Larger Debris and Other Space Stations-§25.114(d)(14)(iii).

APT has also conducted the assessment of the probability of APSTAR-6C becoming a source of debris by collisions with large debris or other operational space stations. The probability of the collision between APSTAR-6C and other Space stations is negligible as Orbital Analyst regularly determines the satellite's orbit trends and assess the risk of collision based on ranging result. As a standard practice, in case of other satellite flyby or collocation with APSTAR-6C, the orbital ephemeris data of both sides is exchanged prior to and during operations and the avoidance maneuver is planned accordingly.

APT will maintain APSTAR-6C within 0.05° of the assigned orbital position (134 E.L.) in both the longitude and latitude, this orbit is mainly for geo-stationary satellite, all of the necessary coordination agreements have been successfully completed and signed to ensure the stable and interference-free operation of APSTAR-6C at this orbital slot, and all such notification information has been filed and registered with ITU. APT will continue to monitor launch details to verify that no new spacecraft takes residence in the vicinity of the APSTAR-6C spacecraft unless ongoing operational coordination is conducted with the nearby satellite(s).

d. Post-Mission Disposal Plans-§25.114(d)(14)(iv) and §25.283.

At the completion of its mission, APSTAR-6C will be removed from its geostationary orbit at 134 E.L. to a perigee altitude no less than 262.4 km above the standard geostationary orbit of 35,786 km. This post-disposal perigee takes into account gravitational perturbations and solar radiation pressure that could alter the satellite orbit in the years after decommissioning. APT has planned the tracking telemetry and control transmissions required for end-of-life repositioning so as to avoid electrical interference to other space stations, and coordinated with any potentially affected satellite networks.

Further, in accordance with Section 25.283(c), the minimum post-mission disposal altitude above the geostationary-Earth orbit (i.e., minimum perigee) is calculated as follows (using the relevant IADC formula):



235 km + (1000·CR·A/M) =235 km +1000×59.1/2155 =262.4 km Here:

CR =Solar radiation pressure coefficient;
A= Average cross sectional area based on deployed on-station configuration;
Notes: CR·A is a parameter derived by Orbital determination software ≈59.1 m²;
M= Satellite dry mass ≈2,155 kg (the satellite mass at de-orbit);

The amount of fuel reserved for the post-mission orbital raising is shown below: Disposal altitude: GEO + 300 km (set 300 km as a target to instead 262.4 km to cover uncertainties); Required Delta V: 10.94 m/s. Required fuel (reserved): **11.04 kg**.

The propellant needed to achieve the minimum deorbit altitude is based on the delta-V required and specified by the spacecraft manufacturer, the required mass of propellant for de-orbit operation will be reserved in the tank before the end of life. Propellant tracking is accomplished using a bookkeeping method, this method is provided by the satellite manufacture with a good accuracy.

Any propellant in excess of expected bookkeeping values will be consumed by further raising the orbit until combustion is no longer possible.

Finally, all stored energy sources on board the satellite will be discharged by venting excess propellant, discharging batteries, relieving pressure vessels, and other appropriate measures. The table below provides further information regarding the amount of helium (pressure, container and volume) from the APSTAR-6C propulsion system remaining at end-of-life:

	APSTAR-6C (SB4000C2)			
container		status on end of life		
1	fuel	vent by leaving thruster valve open		
2	oxidizer	vent by leaving thruster valve open		
3	helium	sealed: 50litre,6Mbar,0-40°C		
4	helium	sealed: 50litre,6Mbar,0-40°C		
5	helium	sealed: 50litre,6Mbar,0-40°C		



As noted above, propellant and oxidizer tanks will be vented at end-of-life by leaving the thruster valve open. The three (3) helium tanks, however, are sealed after orbit raising, cannot be reopened and will have residual helium at a pressure of 6MPa until the end-of-life. The existence of residual helium is a result of the satellite design – isolating the helium tanks after orbit-raising for reducing the risks associated with valves between these tanks and pressurized fuel/oxidizer tanks during the long operating life. The remaining helium pressure is far below tank's qualified pressure tolerance at 30MPa. Accordingly, APT requests a waiver of §25.283 of the Commission's rules with respect to the remaining helium.

Yours truly,

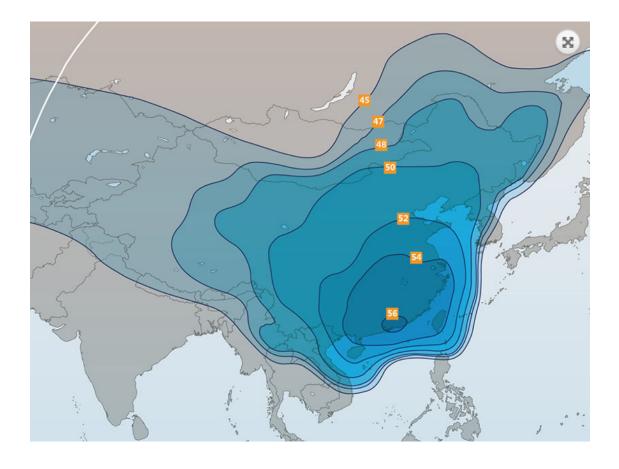
Su Peng

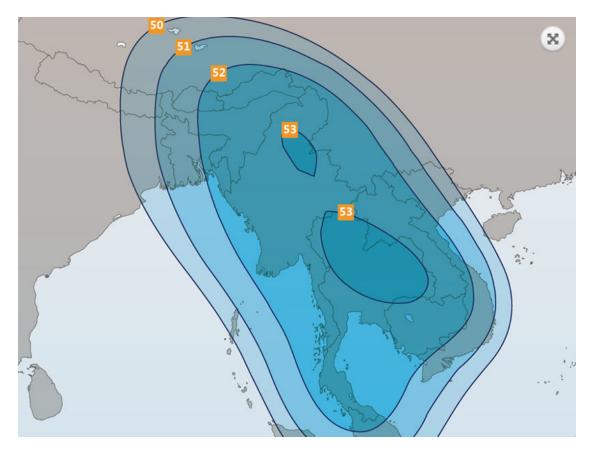
Su Peng

APT ETO SCC Director

APT Satellite Company Limited

3. Coverage Maps





Forward Link Budget

Antenna Type DPA Lat 26.1 deg Lon 119.0 deg EIR max 47.2 deW G/T 11.3 dB/K Satellite Name Name APSTAR-6C Longitude 134.0 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Lon 116.27 deg EIR max 80.0 deW G/T 37.4 dB/K Signal Waveform Waveform DVB-52X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.60 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.16 bps/Hz Data Rate 1.11E+08 bps Information Rate (Data + Overhead) 1.23E+08 bps Symbol Rate 5.14E+07 Hz Cotupid Bandwidth 5.40E+07 Hz Cyn Threshold 7.2 dB	eXConnect Terminal		
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SFD @ Hub-90.9 dBW/m2Small Signal Gain (IBO/OBO)2.5 dBOBO1.2 dBDownlinkFrequency12.315 GHzTransponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak55.9 dBWCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, LS205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Satellite		
Small Signal Gain (IBO/OBO)2.5 dBOBO1.2 dBDownlinkFrequency12.315 GHzTransponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Flux Density	-94.7	dBW/m2
OBO1.2 dBDownlinkFrequency12.315 GHzTransponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, LS205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	SFD @ Hub	-90.9	dBW/m2
DownlinkFrequency12.315 GHzTransponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Small Signal Gain (IBO/OBO)	2.5	dB
Frequency12.315 GHzTransponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	OBO	1.2	dB
Transponder Sat. EIRP @ Beam Peak57.2 dBWTransponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Downlink		
Transponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)86.0 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Frequency	12.315	GHz
DL PSD Limit19.7 dBW/4kHzDL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Transponder Sat. EIRP @ Beam Peak	57.2	dBW
DL PSD @ Beam Peak14.8 dBW/4kHzCarrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Transponder Sat. EIRP @ Terminal	55.0	dBW
Carrier EIRP @ Beam Peak55.9 dBWCarrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	DL PSD Limit	19.7	dBW/4kHz
Carrier EIRP @ Terminal53.8 dBWSlant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to End1.5 dBEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	DL PSD @ Beam Peak	14.8	dBW/4kHz
Slant Range36775 kmSpace Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to End C/(No+Io)End to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Carrier EIRP @ Beam Peak	55.9	dBW
Space Loss, Ls205.6 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to EndEnd to End C/(No+Io)End to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Carrier EIRP @ Terminal		
Pointing Loss, Lpnt 0.1 dB Atmosphere / Weather Loss, La 0.0 dB Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 87.4 dBHz C/(No+Io) 87.2 dBHz End to End C/(No+Io) 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB			
Atmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.4 dBHzC/(No+Io)87.2 dBHzEnd to EndEnd to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB	Space Loss, Ls	205.6	dB
Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 87.4 dBHz C/(No+Io) 87.2 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB			
PCMA Loss 0.0 dB Thermal Noise, C/No 87.4 dBHz C/(No+Io) 87.2 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB			
Thermal Noise, C/No 87.4 dBHz C/(No+Io) 87.2 dBHz End to End 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB		0.5	dB
C/(No+Io) 87.2 dBHz End to End 86.0 dBHz End to End C/(No+Io) 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB			
End to End End to End C/(No+Io) 86.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 7.4 dB	Thermal Noise, C/No		
End to End C/(No+Io)86.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB		87.2	dBHz
Implementation Loss1.5 dBEnd to End C/N w/ Imp Loss7.4 dB			
End to End C/N w/ Imp Loss 7.4 dB			
			-
Link Margin 0.2 dB			
	Link Margin	0.2	dB

Return Link Budget

eXConnect Terminal		
Antenna Type	DPA	
Lat	26.1 de	•
Lon	119.0 de	•
EIRP max	47.2 di	
G/T	11.3 di	B/K
Satellite		
Name	APSTAR-6C	
Longitude	134.0 de	eg
Hub Earth Station		
Site	Beijing	
Lat	40.05 de	eg
Lon	116.27 de	eg
EIRP max	80.0 di	BW
G/T	37.4 dI	в/к
Signal		
Waveform	MxDMA	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.50	
Overhead Rate	0.90	
Channel Spacing	1.05	
Spectral Efficiency (Rate/Noise BW)	0.90 bi	ns/Hz
Data Rate		
	6.86E+06 bi	
Information Rate (Data + Overhead)	7.62E+06 b	
Symbol Rate	7.62E+06 H	
Chip Rate (Noise Bandwidth)	7.62E+06 H	
Occupied Bandwidth	8.00E+06 H	
Power Equivalent Bandwidth	1.68E+06 H	
C/N Threshold	1.6 di	В
Uplink		
Frequency	14.063 G	Hz
Back off	0.0 di	
EIRP Spectral Density	14.4 di	BW/4kHz
Slant Range	36775 kr	n
Space Loss, Ls	206.7 di	В
Pointing Loss, Lpnt	0.1 di	В
Atmosphere / Weather Loss, La	0.0 dl	В
Radome, Lr	0.5 dl	В
Transponder G/T @ Terminal	9.0 di	в/к
Thermal Noise, C/No	77.5 di	BHz
C/(No+lo)	77.0 di	BHz
Satellite		
Flux Density	-115.7 dl	BW/m2
SFD @ Terminal	-96.9 di	
Small Signal Gain (IBO/OBO)	2.5 dl	
OBO	16.3 di	
Downlink	10.5 01	-
Frequency	12.315 G	Hz
Transponder Sat. EIRP @ Beam Peak	57.2 dl	
Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub	57.2 di 51.0 di	
-		
DL PSD Limit		BW/4kHz
DL PSD @ Beam Peak		BW/4kHz
Carrier EIRP @ Beam Peak	40.8 dl	
Carrier EIRP @ Hub	34.7 dl	
Slant Range	37771 kr	
Space Loss, Ls	205.8 di	В
Pointing Loss, Lpnt	0.0 di	В
Atmosphere / Weather Loss, La	3.5 di	В
Radome, Lr	0.0 dl	В
PCMA Loss	0.0 di	В
Thermal Noise, C/No	91.4 di	
	86.3577 di	BHz
C/(No+lo)		
End to End	76.5 dl	BHz
End to End End to End C/(No+Io)		
C/(No+Io) End to End End to End C/(No+Io) Implementation Loss End to End C/N w/ Imp Loss	76.5 dl 5.5 dl 2.2 dl	В
End to End End to End C/(No+Io)	5.5 dI	B B

Forward Link Budget

eXConnect Terminal		
Antenna Type	SPA	
Lat	26.1	-
Lon	119.0	-
EIRP max		dBW
G/T	11.5	dB/K
Satellite		
Name	APSTAR-6C	daa
Longitude Hub Earth Station	134.0	deg
Site	Beijing	
Lat	40.05	deg
Lon	116.27	-
EIRP max		dBW
G/T		dB/K
Signal		
Waveform	DVB-S2X	
Modulation	16APSK	
Bits per symbol	4	
Spread Factor	1	
Coding Rate	0.60	
Overhead Rate	0.90	
Channel Spacing	1.05	
Spectral Efficiency (Rate/Noise BW)	2.16	bps/Hz
Data Rate	1.11E+08	
Information Rate (Data + Overhead)	1.23E+08	
Symbol Rate	5.14E+07	
Chip Rate (Noise Bandwidth)	5.14E+07	
Occupied Bandwidth	5.40E+07	
Power Equivalent Bandwidth	5.40E+07	
C/N Threshold	7.2	dB
Uplink	11000	<u>cu</u>
Frequency Back off	14.063	
Back off EIRP Spectral Density	9.2	ив dBW/4kHz
Slant Range	37771	
Space Loss, Ls	207.0	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	2.9	-
Radome, Lr	0.0	
Transponder G/T @ Hub		dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)	92.0	dBHz
Satellite		
Flux Density	-94.7	dBW/m2
SFD @ Hub	-90.9	dBW/m2
Small Signal Gain (IBO/OBO)	2.5	dB
ОВО	1.2	dB
Downlink		
Frequency	12.315	GHz
Transponder Sat. EIRP @ Beam Peak	57.2	dBW
Transponder Sat. EIRP @ Terminal		dBW
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Terminal		dBW
Slant Range	36775	
Space Loss, Ls	205.6	
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz dBHz
C/(No+lo) End to End	87.2	dBHz
End to End C/(No+lo)	86 N	dBHz
Implementation Loss	1.5	
End to End C/N w/ Imp Loss	7.3	
Link Margin	0.2	
	0.2	

Return Link Budget

eXConnect Terminal		
Antenna Type	SPA	
Lat	26.1	•
Lon	119.0	•
EIRP max		dBW
G/T	11.5	dB/K
Satellite	ADCTAD CC	
Name	APSTAR-6C	dog
Longitude Hub Earth Station	134.0	ueg
Site	Beijing	
Lat	40.05	deg
Lon	116.27	-
EIRP max		dBW
G/T		dB/K
Signal		
Waveform	MxDMA	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.50	
Overhead Rate	0.90	
Channel Spacing	1.05	
Spectral Efficiency (Rate/Noise BW)	0.90	bps/Hz
Data Rate	6.86E+06	bps
Information Rate (Data + Overhead)	7.62E+06	bps
Symbol Rate	7.62E+06	
Chip Rate (Noise Bandwidth)	7.62E+06	Hz
Occupied Bandwidth	8.00E+06	
Power Equivalent Bandwidth	1.00E+06	Hz
C/N Threshold	1.6	dB
Uplink		
Frequency	14.063	
Back off	0.0	
EIRP Spectral Density		dBW/4kHz
Slant Range	36775	
Space Loss, Ls	206.7	
Pointing Loss, Lpnt	0.2	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	dB/K
Transponder G/T @ Terminal Thermal Noise, C/No		dBHz
C/(No+lo)		dBHz
Satellite		UDIIZ
Flux Density	/4./	
		dBW//m2
	-118.0	dBW/m2 dBW/m2
SFD @ Terminal	-118.0 -96.9	dBW/m2
SFD @ Terminal Small Signal Gain (IBO/OBO)	-118.0 -96.9 2.5	dBW/m2 dB
SFD @ Terminal	-118.0 -96.9	dBW/m2 dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink	-118.0 -96.9 2.5	dBW/m2 dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency	-118.0 -96.9 2.5 18.6 12.315	dBW/m2 dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink	-118.0 -96.9 2.5 18.6 12.315 57.2	dBW/m2 dB dB GHz
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0	dBW/m2 dB dB GHz dBW
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7	dBW/m2 dB dB GHz dBW dBW
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8	dBW/m2 dB dB GHz dBW dBW dBW dBW/4kHz
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW km
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW km dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW km dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW km dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW dBW dB dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5 0.0 0.0	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW dBW dB dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5 0.0 0.0	dBW/m2 dB dB GHz dBW dBW dBW 4kHz dBW/4kHz dBW 4kHz dBW dB dB dB dB dB dB dB dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5 0.0 0.0 89.1	dBW/m2 dB dB GHz dBW dBW dBW 4kHz dBW/4kHz dBW 4kHz dBW dB dB dB dB dB dB dB dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, LS Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io)	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5 0.0 0.3 5 0.0 0.0 89.1 84.1021	dBW/m2 dB dB GHz dBW dBW dBW 4kHz dBW/4kHz dBW 4kHz dBW dB dB dB dB dB dB dB dB dB dB dB
SFD @ Terminal Small Signal Gain (IBO/OBO) OBO Downlink Frequency Transponder Sat. EIRP @ Beam Peak Transponder Sat. EIRP @ Hub DL PSD Limit DL PSD @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, LS Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	-118.0 -96.9 2.5 18.6 12.315 57.2 51.0 19.7 5.8 38.6 32.4 37771 205.8 0.0 3.5 0.0 0.3 5 0.0 0.0 89.1 84.1021	dBW/m2 dB dB GHz dBW dBW dBW/4kHz dBW/4kHz dBW/4kHz dBW dBW dB dB dB dB dB dB dB dB dB dB dB dB dB
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II. Apstar 6D



APT MOBILE SATCOM LIMITED

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September 17, 2018

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

Re: Engineering Certification of APT MOBILE SATCOM LIMITED ("APSATCOM")

To Whom It May Concern:

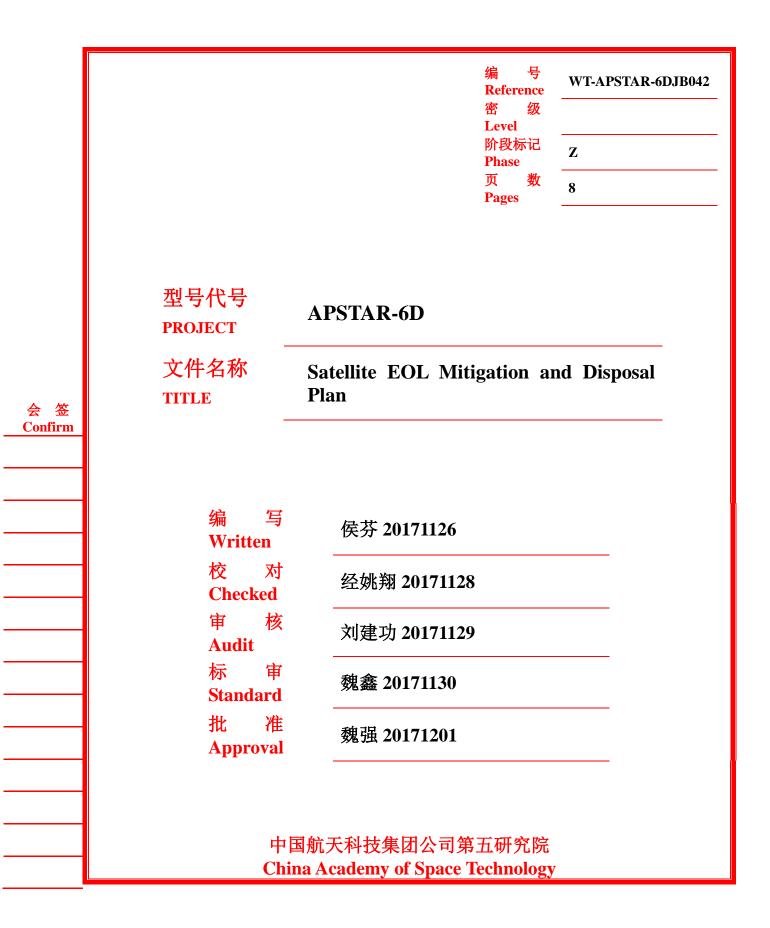
This letter certifies that APSATCOM is aware that Panasonic Avionics Corporation ("Panasonic") is planning to modify its earth stations aboard aircraft ("ESAA") blanket license from the Federal Communication Commission ("FCC"), Call Sign E100089, to add the APSTAR-6D satellite, located at 134° E.L., as an authorized point of communication for its PPA and SPA ESAA terminals. APSATCOM understands that Panasonic will file the modification application pursuant to the FCC rules governing ESAA operations, including Section 25.227.

APSATCOM confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements with the satellites with +/-6 degrees of the APSTAR-6D satellite's orbit location, and acknowledges that the proposed operation of Panasonic's PPA and SPA ESAA terminals has the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

If the FCC authorizes the operation proposed by Panasonic, APSATCOM will include the power density levels specified by Panasonic, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to the satellite addressed by this letter.

Sincerely,

Li Jie President APT Mobile Satcom Limited



内容概要 / SUMMARY

This document gives the description of EOL mitigation and disposal of APSTAR-6D

with respect to space debris mitigation regulation rules.

主题词 / KEY WORDS APSTAR-6D, Satellite Mitigation, Satellite Disposal

更改栏 / CHANGE

更改单号	更改日期	更改人 Changed by	更改办法
Serial No.	Date	Changed by	Methods

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Satellite EOL Mitigation and disposal plan (CDR)

1 INTRODUCTION

APSTAR-6D is a telecommunication satellite which is based on DFH4E platform and has a dry mass of 2744 kg. Its designed life time is 15 years, and it's scheduled to carry out space debris mitigation and disposal plan at the end of its life according to the related international conventions.

This document describes the content of EOL disposal, including the minimum propellant requirement budget, de-orbiting manipulation and energy storage components disposals with respect to space debris mitigation regulation rules. And this document also provides inputs to support the satellite operator.

2 APPLICABLE AND REFERENCE DOCUMENTS

GJB 421A-1997 SATELLITE GLOSSARY GJB 1702-1993 SPACECRAFT ORBIT GLOSSARY QJ 3221-2005 SPACE DEBRIS MITIGATION REQUIREMENTS

3 GLOSSARY AND DEFINITION

3.1 DISPOSAL PHASE

Satellite EOL disposal phase starts from the end of satellite life until corresponding measures taken to avoid potential damage to other spacecrafts.

3.2 POST-MISSION DISPOSAL

EOL disposal includes satellite de-orbiting measure, and the energy storage components passivation and shutting off satellite downlink signal.

3.3 GLOSSARIES

GEO: the orbit with its inclination and eccentricity close to 0, and period close to Earth

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rotation period. Those synchronous orbits with small orbit inclination and small orbit eccentricity are generally classified into GEO.

GEO region: the region decided by the GEO radius ± 40 km, and ± 0.1 °of sub-satellite latitude.

GEO protected region: means the annular region defined by the GEO orbit radius ± 200 km and ± 15 °of sub-satellite latitude.

3.4 PASSIVATION

Satellite passivation measures includes exhausting the remnant propellant and helium in pressure tank, elimination of energy in storage battery, shutting the wheels and pyro disposal.

3.5 STORED ENERGY DEVICES

Stored energy devices include: propellant tank, pressure helium tank, storage battery and whirling wheel.

4 GENERAL REQUIREMENTS

4.1 EOL DISPOSAL PLANNING

EOL disposal plan is supposed to be scheduled together by satellite customer and satellite producer, and its contents should include:

- a) The criterion of mission end;
- b) The opportunity and condition to start satellite EOL disposal;
- c) The capability and corresponding subsystem status for completing EOL disposal;
- d) Grave orbit design;
- e) The estimation of propellant requirement for de-orbiting;
- f) Energy stored devices disposal requirement and method;
- g) Orbit maneuver strategy;
- i) Other devices status setting.

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4.2 EMERGENCY DISPOSAL PLANNING

The emergency disposal plan deals with the situation of mission ending ahead of schedule, and its content should include:

- a) The start condition for emergency disposal;
- b) The minimum requirements of satellite status for carrying out the emergency disposal;
- c) It is supposed to re-design the grave orbit and maneuver strategy to minimize the effect exerted by the emergency situation, if the satellite has not the capability of transferring into the required grave orbit under emergency situation;
- d) Orbit maneuver strategy;
- e) Emergency disposal program of stored energy devices;
- i) Other devices on-board status setting.

4.3 DISPOSAL REPORT

EOL disposal report include:

- a) Process description of satellite EOL disposal;
- b) The time of satellite de-orbit;
- c) The satellite ephemeris after de-orbit;
- d) The status of shutting off of devices on-board;
- e) The power supply status of satellite(including storage battery);
- f) The status of propellant exhaust;
- g) The status of movable devices;
- h) The status of high pressure tank and stored energy devices;
- i) The shut off of satellite downlink signal.

5 DETAILED REQUIREMENTS

5.1 SATELLITE DE-ORBITING

5.1.1 REQUIREMENT OF EOL DISPOSAL ORBIT

The satellite that has finished its mission is supposed to deviate from the GEO protected region in avoidance of disturbing the working spacecraft in GEO.

The perigee height increase should satisfy the following equation: $\Delta H = 235+$ (1000 CRA/m) Among which:

 ΔH ——the minimum increase of perigee height, km;

CR——The coefficient of Sun radiation pressure;

A/m——The ratio of satellite area under Sun radiation pressure with satellite dry mass, m2/kg;

235km—— The sum of the up limit height of GEO protected region above GEO and the maximal descend height caused by the third body gravitation and the Earth gravitation.

And the final orbit eccentricity should be smaller than 0.003.

5.1.2 REQUIREMENT OF MINIMUM PROPELLANT

By the end of satellite mission, it is supposed to budget enough propellant for EOL disposal. Generally the remnant propellant should afford a Delta Velocity of 10m/s at least.

5.1.3 THE EOL DE-ORBIT STRATEGY PLANNING

The strategy of raising perigee height by every half orbit period is proper to satellite de-orbit, and it is reasonable to carry out each orbit maneuver when the right ascension of satellite is close to 90/270 degree. Considering the precision of remnant propellant estimation and for the sake of the security of satellite de-orbit manipulation, the alternation of each orbit maneuver should be determined carefully, especially not more than 5m/s. Thus the orbit will gain a height increase of 275km after 2 times of orbit maneuvers with an eccentricity near to 0. Then the next orbit maneuvers should be

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taken to implement the propellant exhaustion at the same time of raising orbit height.

During the process of de-orbit, the satellite should be in the field of TC&R.

5.2 SATELLITE PASSIVATION

In order to minimize the risk to the other working spacecrafts caused by satellite de-orbit manipulation or unexpected satellite disassembly after emergency disposal, all the stored energy devices on-board should carry out passivation measures by the end of de-orbit.

The main content of passivation program should include at least the following:

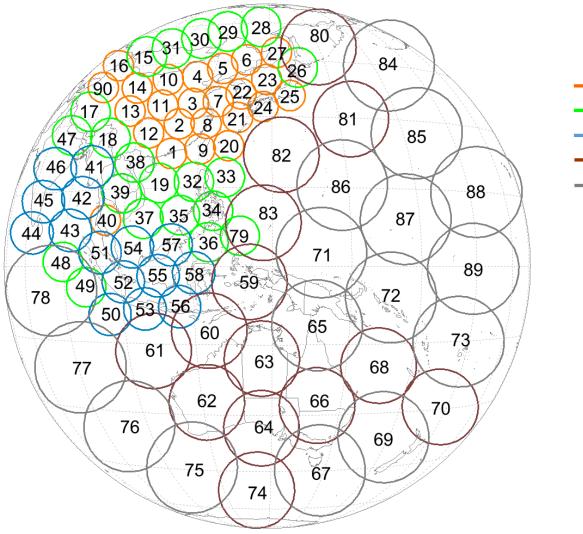
 a) Farther orbit maneuvers are supposed to taken to carry out remnant propellant exhaustion. If Delta Velocities are along to the direction of orbit tangent, and the requirement of grave orbit eccentricity smaller than 0.003 should be considered together with the uncertainty of remnant propellant;

b) Storage battery discharge should be carry out in avoidance of causing satellite disassembly;

- c) By the end of EOL disposal, the recharging circuitry of storage battery should be shut off;
- d) Gas exhaustion of high pressure tank should be carry out;
- e) Momentum wheels should be shut down;
- f) Evaluation of other stored energy devices without passivation being implemented.

5.3 CUTTING OFF DOWN-LINK SIGNAL

Satellite down-link signal should be cut off by the end of EOL disposal, including payload and telemetry in avoidance of disturbing other working spacecrafts.



1.0° ____ 1.3° 1.4° 2.5°

3.0°

Forward Link Budget

eXConnect Terminal Antenna Type PPA Lat 30.4 deg Lon 153.6 deg EIRP max 47.0 dBW G/T 11.0 dB/K Satellite Name Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Site Perth Lat -313186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 db/K Signal QPSK Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.45 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.81 bps/Hz Data Rate 1.08E+08 bps Information Rate (Data + Overhead) 1.20E+08 bps Symbol Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz	
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Thermal Noise, C/No 84.0 dBHz	
IC/(NO+IO) 83.6 dBHz	
End to End	
End to End C/(No+Io) 83.4 dBHz	
Implementation Loss 1.5 dB	
End to End C/N w/ Imp Loss 0.7 dB	
Link Margin 0.7 dB	

Return Link Budget

130.4 deg Lon 153.6 deg Lon 153.6 deg LIRP max 47.0 dBW G/T 11.0 dB/K Satellite Name Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Site Perth Lat -31.9186 deg Lon 115.9159 deg LRP max 80.0 dBW G/T 40.0 dB/K Signal 2 Waveform MxDMA Modulation QPSK Bits per symbol 2 Spread Factor 3 Coding Rate 0.35 Overhead Rate 0.90 Chip Rate (Noise Bandwidth) 2.00E+07 Hz Data Rate 4.20E+06 bps Information Rate (Data + Overhead) 4.67E+06 hz C/IN Threshold -5.6 dB Uplink 7.42E+06 Hz Frequency 14.125 GHz Back off 0.0 dB Back off 0.0 dB	eXConnect Terminal		
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EIRP max 47.0 dBW G/T 11.0 dB/K Satellite	Lat	30.4	deg
G/T 11.0 dB/K Satellite Name Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Waveform Waveform MxDMA Modulation QPSK Bits per symbol 2 Spread Factor 3 Coding Rate 0.35 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.21 bps/Hz Data Rate 4.20E+06 bps Information Rate (Data + Overhead) 4.67E+06 bps Symbol Rate 6.67E+06 Hz Chip Rate (Noise Bandwidth) 2.00E+07 Hz Power Equivalent Bandwidth 7.142E+06 Hz C/N Threshold -5.6 dB Uplink Frequency Frequency 14.125 GHz Back of	Lon	153.6	deg
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Implementation Loss5.5 dBEnd to End C/N w/ Imp Loss-5.2 dB	End to End C/(No+Io)	73.3	dBHz
· · · ·	Implementation Loss	5.5	dB
Link Margin 0.4 dB	End to End C/N w/ Imp Loss	-5.2	dB
	Link Margin	0.4	dB

Forward Link Budget

Antenna Type SPA Lat 30.4 deg Lan 30.4 deg Lon 13.5.6 deg EIRP max 45.0 dBW G/T 11.5 dB/K Satellite Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Waveform DVB-S2X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Data Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Overhead Rate 0.80 Occupied Bandwidth 1.40E+08 Hz Over tequivalent Bandwidth 1.40E+08 Hz Over tequivale	eXConnect Terminal		
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EIRP max 45.0 dBW G/T 11.5 dB/K Satellite Name Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Waveform Waveform QVB-S2X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.90 bps/Hz Data Rate 1.33E+08 hz Chip Rate (Data + Overhead) 1.38E+08 hz Occupied Bandwidth 1.40E+08 Hz Occupied Bandwidth 1.40E+08 Hz C/N Threshold 0.8 dB Uplink Frequency Section 5.2 dB Pointing Loss, Lpnt 0.0 dB </td <td>Lat</td> <td>30.4</td> <td>deg</td>	Lat	30.4	deg
G/T 11.5 dB/K Satellite APSTAR-6D Name APSTAR-6D Longitude 134.0 deg Hub Earth Station Site Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal QPSK Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Chip Rate (Data + Overhead) 1.33E+08 bps Symbol Rate 1.33E+08 bps Symbol Rate 1.32E+08 Hz Occupied Bandwidth 1.40E+08 Hz Overhead Kate 0.8 dB Uplink Frequency Frequency 28.500 GHz Back off 4.7 dB EIRP Spectral Density 30.0 dBW/4kHz Shate (Mase Support 0.0 dB Pointing Loss, Lpnt 0.0 dB		153.6	deg
Satellite APSTAR-6D Longitude 134.0 deg Hub Earth Station Perth Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Waveform Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.90 bps/Hz Data Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz C/N Threshold 0.8 dB Uplink Erequency Pack (Noise Bandwidth) 1.33E+08 Hz C/N Threshold 0.8 dB Uplink Irequency Frequency 28.500 GHz Back off 4.7 dB Pointing Loss, Lpnt <td></td> <td>45.0</td> <td>dBW</td>		45.0	dBW
NameAPSTAR-6DLongitude134.0 degHub Earth StationSitePerthLat-31.9186 degLon115.9159 degEIRP max80.0 dBWG/T40.0 dB/KSignalWaveformWaveformDVB-52XModulationQPSKBits per symbol2Spread Factor1Coding Rate0.50Overhead Rate0.90Channel Spacing1.05Spectral Efficiency (Rate/Noise BW)0.90 bps/HzData Rate1.33E+08 bpsInformation Rate (Data + Overhead)1.33E+08 HzCocupied Bandwidth1.40E+08 HzChip Rate (Noise Bandwidth)1.33E+08 HzOccupied Bandwidth1.40E+08 HzC/N Threshold0.8 dBUpinkFrequencyFrequency28.500 GHzBack off4.7 dBEIRP Spectral Density30.0 dBW/4kHzSlant Range37214 kmSpace Loss, Ls2.13 d dBPointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La7.9 dBRadome, Lr0.0 dBCrinophere / Weather Loss, La7.9 dBRadome, Lr0.0 dB/KTransponder Sat. EIRP @ Beam Peak55.2 dBW/m2Stamall Signal Gain (IBO/OBO)3.0 dBOb Si LidB0.0 dBDownink11.325 GHzFransponder Sat. EIRP @ Terminal55.0 dBW/m2Shanal Signal Gain (IBO/OBO)3.0 dBOB Sind Big3.1 dBDownink<		11.5	dB/K
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Hub Earth Station Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Waveform Waveform DVB-S2X Modulation QPSK Bits per symbol 2 Syread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.90 bps/Hz Data Rate 1.33E+08 bps Symbol Rate 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz C/N Threshold 0.8 dB Uplink EIRP Spectral Density 30.0 dBW/4kHz Sace off 4.7 dB EIRP Spectral Density 30.0 dBW/4kHz Sland Radome, Lr 0.0 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La <td< td=""><td></td><td></td><td></td></td<>			
Site Perth Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW Sfral -40.0 dB/k Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.90 bps/Hz Data Rate 1.20E+08 bps Information Rate (Data + Overhead) 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Occupied Bandwidth 1.40E+08 Hz Orwer Equivalent Bandwidth 1.40E+08 Hz C/N Threshold 0.8 dB Uplink U Frequency 28.500 GHz Back off 4.7 dB Sportal Ens Spectral Density 30.0 dBW/4kHz Slant Range 37214 km Spectral Density -9.0 dB Atmosphere / Weather Loss, La 7.9 dB Radome, Lr 0.0 dB </td <td></td> <td>134.0</td> <td>deg</td>		134.0	deg
Lat -31.9186 deg Lon 115.9159 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.50 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.90 bps/Hz Data Rate 1.33E+08 bps Information Rate (Data + Overhead) 1.33E+08 bps Symbol Rate 1.33E+08 bps Chip Rate (Noise Bandwidth) 1.40E+08 Hz Occupied Bandwidth 1.40E+08 Hz C/N Threshold 0.8 dB Uplink Terequency Frequency 28.500 GHz Back off 4.7 dB EIRP Spectral Density 30.0 dBW/4kHz Slant Range 37214 km Space Loss, Ls 213.0 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 7.9 dB Radome, Lr		D II	
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Space Loss, Ls204.9 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No84.5 dBHzC/(No+Io)84.0 dBHzEnd to EndEnd to End C/(No+Io)83.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss1.1 dB	Carrier EIRP @ Terminal	49.9	dBW
Pointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No84.5 dBHzC/(No+Io)84.0 dBHzEnd to EndEnd to End C/(No+Io)Balance83.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss1.1 dB	Slant Range	37169	km
Atmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No84.5 dBHzC/(No+Io)84.0 dBHzEnd to EndEnd to End C/(No+Io)Balance83.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss1.1 dB	Space Loss, Ls	204.9	dB
Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 84.5 dBHz C/(No+lo) 84.0 dBHz End to End End to End C/(No+lo) End to End C/(No+lo) 83.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 1.1 dB	Pointing Loss, Lpnt	0.1	dB
PCMA Loss 0.0 dB Thermal Noise, C/No 84.5 dBHz C/(No+Io) 84.0 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 83.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 1.1 dB	Atmosphere / Weather Loss, La	0.0	dB
Thermal Noise, C/No 84.5 dBHz C/(No+Io) 84.0 dBHz End to End 83.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 1.1 dB	Radome, Lr	0.5	dB
C/(No+lo) 84.0 dBHz End to End End to End C/(No+lo) 83.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 1.1 dB	PCMA Loss	0.0	dB
End to End End to End C/(No+Io) 83.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 1.1 dB	Thermal Noise, C/No	84.5	dBHz
End to End C/(No+Io)83.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss1.1 dB		84.0	dBHz
Implementation Loss1.5 dBEnd to End C/N w/ Imp Loss1.1 dB			
End to End C/N w/ Imp Loss 1.1 dB			
LINK IVIARGIN 0.3 dB	-		
	LINK Wargin	0.3	aв

Return Link Budget

eXConnect Terminal		
Antenna Type	SPA	
Lat	30.4	•
Lon	153.6	-
EIRP max		dBW
G/T	11.5	dB/K
Satellite Name	APSTAR-6D	
Longitude	134.0	deg
Hub Earth Station	154.0	ucg
Site	Perth	
Lat	-31.9186	deg
Lon	115.9159	deg
EIRP max	80.0	dBW
G/T	40.0	dB/K
Signal		
Waveform	MxDMA	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	3	
Coding Rate Overhead Rate	0.35 0.90	
Channel Spacing	0.90	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	4.20E+06	• •
Information Rate (Data + Overhead)	4.67E+06	•
Symbol Rate	6.67E+06	•
Chip Rate (Noise Bandwidth)	2.00E+07	Hz
Occupied Bandwidth	2.10E+07	Hz
Power Equivalent Bandwidth	4.67E+06	Hz
C/N Threshold	-5.6	dB
Uplink		
Frequency	14.125	GHz
Back off	0.0	
EIRP Spectral Density		dBW/4kHz
Slant Range	37169	
Space Loss, Ls	206.9	
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.2 0.0	
Radome, Lr	0.0	
Transponder G/T @ Terminal		dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)	71.6	dBHz
Satellite		
Flux Density	-118.1	dBW/m2
SFD @ Terminal	-86.0	dBW/m2
Small Signal Gain (IBO/OBO)	3.0	dB
ОВО	29.1	dB
Downlink		<u>cu</u>
Frequency	18.500	-
Transponder Sat. EIRP @ Beam Peak		dBW dBW
Transponder Sat. EIRP @ Hub DL PSD Limit		авw dBW/4kHz
DL PSD Limit DL PSD @ Beam Peak		dBW/4kHz dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Hub		dBW
Slant Range	37214	
Space Loss, Ls	209.2	
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	5.7	dB
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	89.6	dBHz
C/(No+lo)	83.3422	dBHz
End to End		1
	71.3	dBHz
End to End C/(No+lo)		10
Implementation Loss	3.5	
		dB

III. AsiaSat 9



Ref: TM21/220818/0054

22th Aug, 2018

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

Re: Engineering Certification of Asia Satellite Telecommunications Co. Ltd

To Whom It May Concern:

This letter certifies that Asia Satellite Telecommunications Co. Ltd (herein after "AsiaSat") is aware that Panasonic Avionics Corporation ("Panasonic") is planning to modify its earth stations aboard aircraft ("ESAA") blanket license from the Federal Communication Commission ("FCC"), Call Sign E100089, to add the ASIASAT-9 satellite, located at 122° E.L., as an authorized point of communication for its DPA and SPA ESAA terminals. AsiaSat understands that Panasonic will file the modification application pursuant to the FCC rules governing ESAA operations, including Section 25.227.

AsiaSat confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements with the satellites with +/-6 degrees of the ASIASAT-9 satellite's orbit location, and acknowledges that the proposed operation of Panasonic's DPA and SPA ESAA terminals has the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

If the FCC authorizes the operation proposed by Panasonic, AsiaSat will include the power density levels specified by Panasonic, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to the satellite addressed by this letter.

Sincerely,

Wai Fai, NG Manager, Communications Engineering





AsiaSat 9 Orbital Debris Mitigation Plan

47 C.F.R. Section 25.114(d)(14): A description of the design and operational strategies that will be used to mitigate orbital debris, including the following information:

(i) A statement that the space station operator has assessed and limited the amount of debris released in a planned manner during normal operations, and has assessed and limited the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal;

(ii) A statement that the space station operator has assessed and limited the probability of accidental explosions during and after completion of mission operations. This statement must include a demonstration that debris generation will not result from the conversion of energy sources on board the spacecraft into energy that fragments the spacecraft. Energy sources include chemical, pressure, and kinetic energy. This demonstration should address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application;

(iii) A statement that the space station operator has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Where a space station will be launched into a low-Earth orbit that is identical, or very similar, to an orbit used by other space stations, the statement must include an analysis of the potential risk of collision and a description of what measures the space station operator plans to take to avoid in-orbit collisions. If the space station operator is relying on coordination with another system, the statement must indicate what steps have been taken to contact, and ascertain the likelihood of successful coordination of physical operations with, the other system. The statement must disclose the accuracy—if any—with which orbital parameters of non-geostationary satellite orbit space stations will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system is not able to maintain orbital tolerances, *i.e.*, it lacks a propulsion system for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. Where a space station requests the assignment of a geostationary-Earth orbit location, it must assess whether there are any known satellites located at, or reasonably expected to be located at, the requested orbital location, or assigned in the vicinity of that location, such that the station keeping volumes of the respective satellites might overlap. If so, the statement must include a statement as to the identities of those parties and the measures that will be taken to prevent collisions;

(iv) A statement detailing the post-mission disposal plans for the space station at end of life, including the quantity of fuel—if any—that will be reserved for post-mission disposal maneuvers. For geostationary-Earth orbit space stations, the statement must disclose the altitude selected for a post-mission disposal orbit and the calculations that are used in deriving the disposal altitude. The statement must also include a casualty risk assessment if planned post-mission disposal involves



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atmospheric re-entry of the space station. In general, an assessment should include an estimate as to whether portions of the spacecraft will survive re-entry and reach the surface of the Earth, as well as an estimate of the resulting probability of human casualty.

The AsiaSat 9 spacecraft is a reliable Space Systems/Loral ("SSL") 1300 spacecraft, which is widely known as a mature product and one of the most reliable satellite platforms, and is designed and has been demonstrated to withstand the harsh space environment. In general, the SSL 1300 spacecraft design has taken orbital debris mitigation into account and is aligned with general industry practices and standards.

(i) Debris Release Assessment

AsiaSat has assessed and limited the amount of debris released in a planned manner during normal operations, and has assessed and limited the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent postmission disposal. The satellite has been designed such that no debris will be released by the spacecraft under the normal operation of the satellite. In the event of collisions with small debris or meteoroids, the spacecraft hardware has been designed with redundant units such that individual faults will not cause the loss of the entire spacecraft and the spacecraft will retain the post-mission disposal capability. All critical components (e.g. on-board processors and control devices etc.) have been built within the structure and shielded from external influences. External items that could not be installed within the spacecraft structure nor shielded (e.g. antennas and attitude sensors etc.) are able to withstand impact. The spacecraft can be controlled through both the normal communications payload antennas and the wide angle omni antennas. The likelihood of both being damaged during a collision with small debris or meteoroids is minimal.

(ii) Accidental Explosion Assessment

AsiaSat has assessed and limited the probability of accidental explosions during and after completion of mission operations. The failure modes for all equipment have been reviewed to assess the possibility of an accidental explosion onboard the spacecraft. In order to ensure that the spacecraft does not explode on-orbit AsiaSat will continue to operate the satellite in accordance with SSL's recommended procedures. All batteries and propellant tanks are monitored for pressure or temperature variations. All critical satellite parameters are telemetered from the spacecraft and limits are checked by the real-time computers in the SOC (Satellite Operations Centre) and any out-of-limit conditions will alert the on-duty SOC controllers to take the required action. Additionally, long term trending analysis will be performed to monitor for any unexpected or anomalous trends.

Batteries are operated under SSL's automatic recharging scheme. This means normal battery charging termination does not require ground commanding to ensure no additional heat and pressure build up in the battery cells. Furthermore, each battery cell is protected by individual over voltage and over current protection circuits. As this process occurs wholly within the spacecraft, it also affords protection from command link failures from the ground station.



To protect the propulsion subsystem, propellant tanks are operated in a blow down mode during onorbit operation. At the completion of orbit raising, the pressurant was isolated from the propellant tanks. Therefore the pressure in the propellant tanks will decrease as the propellant is consumed during the stationkeeping manoeuvres over the life of the spacecraft. There is also a regulator installed between the pressurant tanks and the propellant tanks such that if a pressure valve fails open the propellant tanks would not be over-pressurized.

To ensure that the spacecraft has no explosive risk after it has been successfully de-orbited, all stored energy onboard the spacecraft will be removed. Firstly, all latch valves will be open to ensure all residual propellant and pressurant are vented out and released. All battery chargers will be turned off and batteries will be left in a permanent discharge state. All remaining active pyrotechnics will be fired to eliminate explosive risk. All reaction wheels will be turned off to release all stored kinetic energy. These steps will ensure that no build-up of energy can occur resulting in an explosion in the years after the spacecraft is de-orbited.

(iii) Assessment Regarding Collision with Large Debris and Other Space Stations

AsiaSat has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations.

AsiaSat 9 is operating at GEO at longitude of 122 deg E +/-0.1 deg and using industry standard and time proven techniques in the station-keeping maneuvering and orbit determination. These are the same techniques that AsiaSat has and continues to use for all its spacecraft fleet.

To minimize the possibility of a large body impact collision, the proximity of other known Space Stations / satellites has been assessed. In addition to working with other satellite operators of all known neighbouring satellites, AsiaSat utilizes other methods to identify the collision risk. All satellites in GEO or near GEO are tracked by downloading the orbital parameters from the NORAD database every day, and an internal satellite movement report is generated to AsiaSat's Engineering and Operations staff. AsiaSat will also get alerts from the JSpOC for any approaching bodies.

Any new spacecraft launch or satellite relocation will be closely monitored to verify that no new spacecraft will be introduced in the vicinity of AsiaSat 9. In the event that some spacecraft does locate within the vicinity of AsiaSat 9, AsiaSat will coordinate and work closely with that satellite operator on orbit control and stationkeeping strategies as it has done in the past with many other operators.

(iv) Post-Mission Disposal Plans

As a licensed satellite operator in Hong Kong, AsiaSat complies with the requirements as stipulated by the "Guidelines for De-commissioning of Satellite" (the "Guidelines") issued by OFCA (Hong Kong Office of Communications Authority) and adheres to prevailing international best practices and standards to reduce space debris.

According to the Guidelines, which are also consistent with the FCC requirement in §25.283 of the Commission's rules pertaining to end-of-life satellite disposal, any expired satellite which has to be



de-orbited to outer space shall be disposed to an orbit with a delta-perigee (Δa) higher than geosynchronous orbit of no less than:

235 km + (1000 x CR x A/m)

where CR is the solar pressure radiation coefficient of the spacecraft, and A/m is the solar pressure area-to-mass ratio, in square meters per kilogram, of the spacecraft.

AsiaSat will take into account this requirement for any de-orbit of the AsiaSat 9 satellite and will reserve sufficient propellant in order to conform to the regulations set forth in the Guidelines:

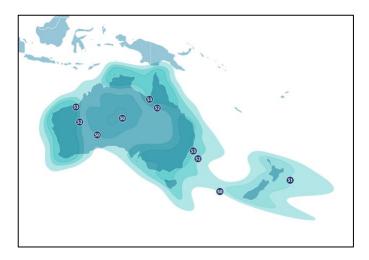
	Δa requirement	Propellant Needed
AsiaSat 9	279 km	12.17 kg

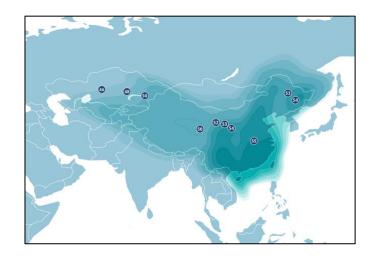
Any remaining propellant will be consumed by further raising the orbit until combustion is no longer possible. The remaining species of propellant, i.e. Oxidizer (N_2O_4) or Fuel (MMH), will be vented, placing the spacecraft's propulsion subsystem in a "safe" state.

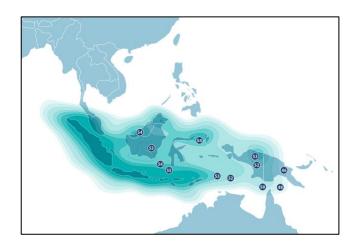
Propellant tracking is accomplished using a bookkeeping method. This method will track the number of jet seconds utilized for stationkeeping, momentum control and other attitude control events. From jet seconds, amount of propellant consumed is determined. This process has been calibrated using data collected from thruster tests conducted on the ground.

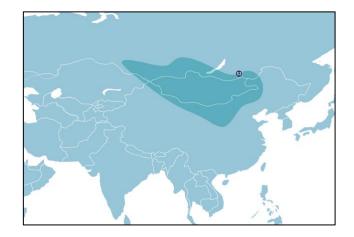
Asia Satellite Telecommunications Company Limited

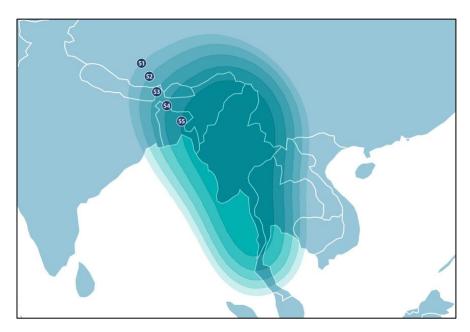
William Ma Satellite Engineering & Orbital Dynamics Manager











Forward Link Budget

Antenna Type DPA Lat 25.6 deg Lon 113.8 deg EIRP max 47.3 dBW G/T 11.4 dB/K Satellite	eXConnect Terminal		
Lat 25.6 deg Lon 113.8 deg EIRP max 47.3 dBW G/T 11.4 dB/K Satellite Name Name A9 Longitude 122.1 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 36.8 dB/K Signal Waveform Waveform DVB-S2X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Chanel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Chip Rate (Noise Bandwidth) 5.41E+07 Hz Chip Rate (Noise Bandwidth) 5.42E+07 Hz Chip Rate (Noise Bandwidth <td></td> <td>DPA</td> <td></td>		DPA	
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G/T 11.4 dB/K Satellite A9 Name A9 Longitude 122.1 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Vaveform DVB-52X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Chanel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Occupied Bandwidth 5.14E+07 Hz Occupied Bandwidth 5.14E+07 Hz Overte Equivalent Bandwidth 5.40E+07 Hz <td>Lon</td> <td></td> <td></td>	Lon		
Satellite A9 Name A9 Longitude 122.1 deg Hub Earth Station Beijing Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 36.8 dB/K Signal Waveform Waveform DVB-52X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Chip Rate (Noise Bandwidth) 5.14E+07 Hz Occupied Bandwidth 5.40E+07 Hz C/N Threshold 8.2 dB Uplink - Frequency 14.330 GHz Back off 9.7 dB Bint Range	EIRP max	47.3	dBW
Name A9 Longitude 122.1 deg Hub Earth Station 122.1 deg Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW Signal VVB-52X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Occupied Bandwidth 5.40E+07 Hz Opin Rate 5.14E+07 Hz Orwer Equivalent Bandwidth 5.40E+07 Hz Opin Rate 5.14E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz Space Loss, Is 207.1 dB Pack off 9.7 dB EIRP Spectral Density 29.2 dBW/4kHz Slant Range 3754	G/T	11.4	dB/K
Longitude 122.1 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 36.8 dB/K Signal Waveform Waveform DVB-52X Modulation 16AP5K Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Occupied Bandwidth 5.40E+07 Hz Occupied Bandwidth 5.40E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz Optimk Frequency Frequency 14.330 GHz Back off 9.7 dB EIRP Spectral Density 29.2 dBW/4kHz Slant Range 37540 km	Satellite		
Hub Earth Station Beijing Site Beijing Lat 40.05 deg Lan 40.05 deg Lan 116.27 deg EIRP max 80.0 dBW G/T 3.6.8 dB/K Signal Waveform Waveform DVB-S2X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.32E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Chip Rate (Noise Bandwidth) 5.14E+07 Hz Occupied Bandwidth 5.40E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz C/N Threshold 8.2 dB Uplink Frequency 14.330 GHz Frequency 14.330 GHz Sate diff	Name	A9	
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Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 36.8 dB/K Signal DVB-52X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Chip Rate (Noise Bandwidth) 5.14E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz C/N Threshold 8.2 dB Uplink - Frequency 14.330 GHz Back off 9.7 dB EIRP Spectral Density 29.2 dBW/4kHz Slant Range 37540 km Space Loss, Ls 2.0 dB/K Thermal Noise, C/No 96.0 dBHz C/(No+lo) 95.5 dBHz SFD @ Hub -91.0 dBW/m2<	Hub Earth Station		
Lon 116.27 deg EIRP max 80.0 dBW G/T 36.8 dB/K Signal			
EIRP max 80.0 dBW G/T 36.8 dB/K Signal			0
G/T 36.8 dB/K Signal VVB-S2X Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 2.40 bps/Hz Data Rate 1.23E+08 bps Information Rate (Data + Overhead) 1.37E+08 bps Symbol Rate 5.14E+07 Hz Chip Rate (Noise Bandwidth) 5.14E+07 Hz Occupied Bandwidth 5.40E+07 Hz Power Equivalent Bandwidth 5.40E+07 Hz C/N Threshold 8.2 dB Uplink			-
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Transponder Sat. EIRP @ Terminal55.0 dBWDL PSD Limit16.0 dBW/4kHzDL PSD @ Beam Peak12.9 dBW/4kHzCarrier EIRP @ Beam Peak54.0 dBWCarrier EIRP @ Terminal54.0 dBWSlant Range36593 kmSpace Loss, Ls205.7 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.0 dBHzEnd to End C/(No+Io)87.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB		55.0	dBW
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Carrier EIRP @ Beam Peak54.0 dBWCarrier EIRP @ Terminal54.0 dBWSlant Range36593 kmSpace Loss, Ls205.7 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.6 dBHzEnd to End1.5 dBEnd to End C/(No+Io)1.5 dBEnd to End C/N w/ Imp Loss8.4 dB	DL PSD Limit	16.0	dBW/4kHz
Carrier EIRP @ Terminal54.0 dBWSlant Range36593 kmSpace Loss, Ls205.7 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.6 dBHzEnd to EndEnd to EndEnd to End C/(No+Io)87.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB	DL PSD @ Beam Peak	12.9	dBW/4kHz
Slant Range36593 kmSpace Loss, Ls205.7 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.6 dBHzEnd to EndEnd to End C/(No+Io)End to End C/(No+Io)87.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB	Carrier EIRP @ Beam Peak	54.0	dBW
Space Loss, Ls205.7 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.6 dBHzEnd to EndEnd to End C/(No+Io)End to End C/(No+Io)87.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB	Carrier EIRP @ Terminal	54.0	dBW
Pointing Loss, Lpnt 0.1 dB Atmosphere / Weather Loss, La 0.0 dB Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 87.6 dBHz C/(No+Io) 87.6 dBHz End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	Slant Range	36593	km
Atmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No87.6 dBHzC/(No+Io)87.6 dBHzEnd to EndEnd to End C/(No+Io)87.0 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB	Space Loss, Ls	205.7	dB
Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 87.6 dBHz C/(No+Io) 87.6 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	Pointing Loss, Lpnt	0.1	dB
PCMA Loss 0.0 dB Thermal Noise, C/No 87.6 dBHz C/(No+Io) 87.6 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	Atmosphere / Weather Loss, La	0.0	dB
Thermal Noise, C/No 87.6 dBHz C/(No+Io) 87.6 dBHz End to End 87.0 dBHz End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	Radome, Lr	0.5	dB
C/(No+Io) 87.6 dBHz End to End 87.0 dBHz End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	PCMA Loss	0.0	dB
End to End End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB	Thermal Noise, C/No	87.6	dBHz
End to End C/(No+Io) 87.0 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss 8.4 dB		87.6	dBHz
Implementation Loss1.5 dBEnd to End C/N w/ Imp Loss8.4 dB			
End to End C/N w/ Imp Loss 8.4 dB			
Link Margin 0.2 dB	-		
	Link Margin	0.2	dB

Return Link Budget

G/T Satellite Name Longitude Hub Earth Station Site	DPA 25.6 113.8 47.3 11.4 8 9	deg dBW
Lon EIRP max G/T Satellite Name Longitude Hub Earth Station Site	113.8 47.3 11.4 A9	deg dBW
EIRP max G/T Satellite Name Longitude Hub Earth Station Site	47.3 11.4 A9	dBW
G/T Satellite Name Longitude Hub Earth Station Site	11.4 o	
Site		
Longitude Hub Earth Station Site		
Hub Earth Station Site	177 1	
	122.1	deg
Site		
	Beijing	
Lat	40.05	deg
Lon	116.27	deg
EIRP max	80.0	dBW
G/T	36.8	dB/K
Signal		
Waveform	MxDMA	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.45	
Overhead Rate	0.90	
Channel Spacing	1.05	hnc/U-
Spectral Efficiency (Rate/Noise BW)		bps/Hz bps
Data Rate Information Rate (Data + Overhead)	6.17E+06 6.86E+06	
Symbol Rate	7.62E+06	•
Chip Rate (Noise Bandwidth)	7.62E+06	
Occupied Bandwidth	8.00E+06	
Power Equivalent Bandwidth	2.99E+06	
C/N Threshold	0.9	
Uplink		
Frequency	14.210	GHz
Back off	0.0	dB
EIRP Spectral Density		dBW/4kHz
Slant Range	36593	-
Space Loss, Ls	206.8	dB
Pointing Loss, Lpnt	0.1	dB
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.5	dB
Transponder G/T @ Terminal	8.0	dB/K
Thermal Noise, C/No	76.5	dBHz
C/(No+Io)	76.0	dBHz
Satellite		
Flux Density	-115.6	dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	2.0	
OBO	15.6	dB
Downlink		~
Frequency	12.462	
Transponder Sat. EIRP @ Beam Peak	55.0	
Transponder Sat. EIRP @ Hub	54.0	
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak Carrier EIRP @ Hub	39.4	
Carrier EIRP @ Hub Slant Range	38.4	
0	37540 205.9 (
Space Loss, Ls Pointing Loss, Lont		
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0 (4.7 (
-	4.7 (0.0 (
	0.0	
PCMA Loss	022	
PCMA Loss Thermal Noise, C/No	93.2 (88 6164 (
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	93.2 88.6164	
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End	88.6164	dBHz
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io)	88.6164	dBHz dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	88.6164	dBHz dBHz dB

Forward Link Budget

eXConnect Terminal	
Antenna Type	SPA
Lat	25.6 deg
Lon	113.8 deg
EIRP max	45.0 dBW
G/T	11.5 dB/K
Satellite Name	A9
Longitude	122.1 deg
Hub Earth Station	122.1 005
Site	Beijing
Lat	40.05 deg
Lon	116.27 deg
EIRP max	80.0 dBW
G/T	36.8 dB/K
Signal	
Waveform	DVB-S2X
Modulation	16APSK
Bits per symbol	4
Spread Factor Coding Rate	0.67
Overhead Rate	0.90
Channel Spacing	1.05
Spectral Efficiency (Rate/Noise BW)	2.40 bps/Hz
Data Rate	1.23E+08 bps
Information Rate (Data + Overhead)	1.37E+08 bps
Symbol Rate	5.14E+07 Hz
Chip Rate (Noise Bandwidth)	5.14E+07 Hz
Occupied Bandwidth	5.40E+07 Hz
Power Equivalent Bandwidth	5.40E+07 Hz
C/N Threshold	8.2 dB
Uplink	
Frequency	14.330 GHz
Back off	9.7 dB
EIRP Spectral Density	29.2 dBW/4kHz 37540 km
Slant Range Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.8 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	7.0 dB/K
Thermal Noise, C/No	96.0 dBHz
C/(No+lo)	95.5 dBHz
Satellite	
Flux Density	-95.0 dBW/m2
SFD @ Hub	-91.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO Downlink	1.0 dB
Frequency	12.582 GHz
Transponder Sat. EIRP @ Beam Peak	55.0 dBW
Transponder Sat. EIRP @ Terminal	55.0 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak	12.9 dBW/4kHz
Carrier EIRP @ Beam Peak	54.0 dBW
Carrier EIRP @ Terminal	54.0 dBW
Slant Range	36591 km
Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No C/(No+Io)	87.8 dBHz 87.8 dBHz
End to End	07.0 UDTZ
End to End C/(No+lo)	87.1 dBHz
Implementation Loss	1.5 dB
End to End C/N w/ Imp Loss	8.5 dB
	8.5 dB 0.3 dB

Return Link Budget

Antenna Type	SPA
Lat	25.6 deg
Lon	113.8 deg
EIRP max	45.0 dBW
G/T	11.5 dB/K
Satellite	
Name	A9
Longitude	122.1 deg
Hub Earth Station	
Site	Beijing
Lat	40.05 deg
Lon	116.27 deg
EIRP max	80.0 dBW
G/T	36.8 dB/K
Signal	NADNAA
Waveform	MxDMA
Modulation Bits par symbol	QPSK 2
Bits per symbol	1
Spread Factor Coding Rate	0.45
Overhead Rate	0.45
Channel Spacing	1.05
Spectral Efficiency (Rate/Noise BW)	0.81 bps/Hz
Data Rate	6.17E+06 bps
Information Rate (Data + Overhead)	6.86E+06 bps
Symbol Rate	7.62E+06 Hz
Chip Rate (Noise Bandwidth)	7.62E+06 Hz
Occupied Bandwidth	8.00E+06 Hz
Power Equivalent Bandwidth	1.73E+06 Hz
C/N Threshold	0.9 dB
Uplink	
Frequency	14.210 GHz
Back off	0.0 dB
EIRP Spectral Density	12.2 dBW/4kHz
Slant Range	36591 km
Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.2 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	8.0 dB/K
Thermal Noise, C/No	74.2 dBHz
C/(No+lo)	73.7 dBHz
Satellite	
Flux Density	-117.9 dBW/m2
SFD @ Terminal	-98.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	17.9 dB
Downlink	12 462 611-
Frequency	12.462 GHz
Transponder Sat. EIRP @ Beam Peak	55.0 dBW
Transponder Sat. EIRP @ Hub	54.0 dBW
DL PSD Limit	16.0 dBW/4kHz
DL PSD @ Beam Peak Carrier EIRP @ Beam Peak	4.2 dBW/4kHz
Carrier EIRP @ Beam Peak Carrier EIRP @ Hub	37.1 dBW 36.1 dBW
Carrier EIRP @ Hub Slant Range	36.1 dBW 37540 km
Slant Range Space Loss, Ls	205.9 dB
Space Loss, Ls Pointing Loss, Lpnt	205.9 dB 0.0 dB
	4.7 dB
	4.7 dB 0.0 dB
	0.0 ub
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0 0 40
Radome, Lr PCMA Loss	0.0 dB
Radome, Lr PCMA Loss Thermal Noise, C/No	90.9 dBHz
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End	90.9 dBHz 86.2496 dBHz
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io)	90.9 dBHz 86.2496 dBHz 73.4 dBHz
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End	90.9 dBHz 86.2496 dBHz

IV. ChinaSat 10



September 28, 2018

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

Re: Engineering Certification of China Satcom

To Whom It May Concern:

This letter certifies that China Satcom is aware that Panasonic Avionics Corporation ("Panasonic") is planning to modify its earth stations aboard aircraft ("ESAA") blanket license from the Federal Communication Commission ("FCC"), Call Sign E100089, to add the Chinasat-10 satellite, located at 110.5° E.L., as an authorized point of communication for its PPA and SPA ESAA terminals. China Satcom understands that Panasonic will file the modification application pursuant to the FCC rules governing ESAA operations, including Section 25.227.

China Satcom confirms and hereby certifies that the power density levels of the proposed operations are consistent with existing satellite coordination agreements with the satellites with +/-6 degrees of the Chinasat-10 satellite's orbit location, and acknowledges that the proposed operation of Panasonic's PPA and SPA ESAA terminals has the potential to create and receive harmful interference from adjacent satellite networks that may be unacceptable.

If the FCC authorizes the operation proposed by Panasonic, China Satcom will include the power density levels specified by Panasonic, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to the satellite addressed by this letter.

Sincerely,

2.



China Satellite Communications Co., Ltd.

Chinasat-10@110.5E Space Debris Mitigation Plan

1. Introduction

This document describes the space debris mitigation plan that Chinsatcom shall apply to the Chinasat-10 satellite at 110.5E longitude orbital location.

Chinasat-10 is based on the DFH 4 bus and it was manufactured by China Academy of Space Technology. The satellite is 3-axis stabilized and uses bi-propellant chemical propulsion for attitude and on-station control.

ChinaSat-10 was launched on June21, 2011. It provides communications services with C-band and Ku-band transponders for commercial usage. The satellite service area includes China (Hong Kong and Taiwan are included) and Asia.

2. **Chinasat-10 Operations**

Chinsatcom operates the satellite to control and limit the amount of debris released in a planned manner during normal operations, and assesses and limits the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal.

Chinsatcom has assessed the amount of debris released in a planned manner and no intentional debris will be released during normal operations of the Chinsat-10 spacecraft. A sage operational configuration of the satellite system is ensured thanks to the hardware design and operational procedures.

Chinsatcom minimizes the probability of the satellite becoming a source of debris by collisions with large debris or other operational satellites. Chinsatcom assessed and determined that there are no other satellites located at or sufficiently near Chinsat-10 planned orbital location that might result in overlap of satellite orbit control windows.

Chinsat-10 will be controlled within its orbit control window(110.5E +/- 0.05°) by standard routine periodic orbit correction maneuvers. In case of anticipated violation of the window, correction maneuvers would be implemented to avoid such violation.

Chinsatcom has assessed the probability of accidental explosions during and after completion of mission operations. Thanks to design safety margins, the probability of occurrence of accidental explosion of the Chinasat-10 satellite is negligible.

Satellite design is such that high levels of thruster activity and orbit perturbation do not result when foreseeable on-board events occur.



3. Chinsat-10 End of life disposal

The post-mission disposal activities have been planned as follows

1) PLANNING

a) De-orbit (EWSK) maneuver planning, including number and duration of maneuvers, fuel usage planning. Maneuver timing, including ranging and orbit determination.

b) Compile de-orbit coordination contact lists, including internal leads/management and also other satellite operators.

c) Antenna visibility assessment. Antenna prediction files creation and distribution.

d) Coordinate with other operators to determine TT&C configurations and/or command/telemetry blackout periods.

e) De-orbit drift Sun/Moon interference planning (manual/automatic/Macro/TEMA control of ESA/SSA determination).

f) De-orbit drift pointing planning to assure TT&C coverage/link closure.

2) INITIAL SETUP

a) Inclination NSSKs, including as-needed momentum adjusts as desired.

b) Update Macros/TEMAs as needed (including TT&C coverage Macro, ESA/SSA Sun/Moon inhibit control, and no-contact "phone home" Macro)

c) TT&C reconfigurations for de-orbit drift: use of horns or Omni antenna as needed.

Note: Set one transmitter to Omni to increase ability to command S/C.

d) Pointing reconfiguration for de-orbit drift as needed

Note: If T&C antenna beams are global coverage beams, Earth target pointing may not be necessary. Nadir pointing would be sufficient. If T&C beams are not global beams, Earth target pointing is needed.

e) Payload reconfiguration (RCVRs OFF, TWTAs OFF, panel heaters reconfiguration if needed)

3) DE-ORBIT MANEUVERS

a) T+0 hours: Execute EWSK utilizing East-facing REAs to raise apogee ~100 km. Collect range data, perform orbit determination.

b) T+12 hours: Execute 2nd ESWK to circularize the orbit. Ranging/OD.

c) Maneuver reconstruction. Update maneuver plans based on actual REA performance.

d) T+48 hours: Execute EWSK to raise apogee ~100 km. Ranging/OD.

e) T+60 hours: Execute EWSK to circularize the orbit. Ranging/OD.

f) Maneuver reconstruction. Update maneuver plans based on actual REA performance.

g) T+96 hours: Execute EWSK to raise apogee ~100 km. Ranging/OD.

h) T+108 hours: Execute EWSK to circularize the orbit. Ranging/OD.

i) As needed throughout de-orbit maneuvers:

i) update pointing for TT&C coverage

ii) ESA/SSA Sun/Moon interference commanding

iii) Solar array position adjustments

iv) Coordinate with other operators for TT&C configurations and blackout periods.

4) TANK DEPLETION MANEUVERS

a) Execute alternating EWSK cancellation maneuvers, or NSSKs to deplete the remaining fuel.

b) Tank repressurization to depressurize GHe tank, as needed.

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中国航天 China Satellite Communications Co.,Ltd.

c) Continue maneuvers to deplete fuel and depressurize tanks. Time constraints include antenna visibility limits, and command/telemetry coordination.

5) SPACECRAFT SAFING

a) Solar Array positioning and spacecraft loading

i) Slew solar arrays to East or West facing (array angles of 180° or 360°), and stop SADA rotation when arrays are edge onto sun in final spin axis.

ii) Turn off SADAs 1 & 2 (disable control circuit relays via SADNSPB_DS).

iii) Turn on heaters to load power bus. [Not needed since RIU power loss will open the FET for the heaters]

b) Non-Critical Equipment OFF

i) Disable ESA/SSA REDMAN (commands ESSA_COMT_DS, ESSA_RTST_DS,

ESSA_SST_DS and ES_FLMCR_DS)

ii) SSA 2 OFF

iii) ESA 2 OFF

iv) Thruster control disabled.

v) Battery Charge rates to 0 A.

vi) Enable and Turn On Battery letdown resistors

vii) Disable PT, PT load shed, AHSOC, AHSOC load shed, TCI, SCM, and BOTP.

c) Critical Equipment OFF

i) Close Latch Valves: LV1 and LV2

ii) Stop all Macros

iii) Disable all TEMA tests and Global TEMA

iv) Disable REDMAN (REDMAN_DS), Disable all REDMAN tests, disable Hardware Switching (HDWR SWCH DS), send REDMAN disable Macro commands.

v) Disable RT-RT transfers with Monitor OBC (command BOBC XFER DS)

vi) OBC Monitor OFF.

6) FINAL SHUTOFF

a) SSA OFF

b) ESA OFF

c) RWAs 1-4 OFF

d) IMU OFF

e) RIUs OFF

f) BPCs OFF (use commands BPCn_OFF)

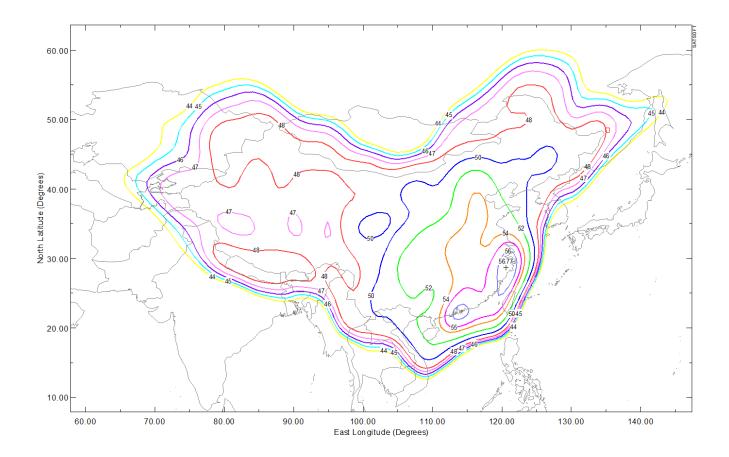
g) OBC Control OFF

h) Telemetry Beacon Transmitter OFF

Traffic Operation Center Chinasat-10 Engineer

Signature:

3. Coverage Map



4. Link Budgets

Forward Link Budget

eXconnect Terminal DPA Lat 28.7 deg Lon 120.6 deg EIRP max 47.2 dBW G/T 11.2 dB/K Satellite Name Name ChinaSat-10 Longitude 110.5 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.00 dBW G/T 37.0 dB/K Signal VV8-52 Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.94 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 2.50 bps/Hz Data Rate 1.12E+08 bps Information Rate (Data + Overhead) 1.20 Symbol Rate 4.50E+07 Hz Chip Rate (Noise Bandwidth) 5.40E+07 Hz Chip Rate (Noise Bandwidth) 5.40E+07 Hz Cocupied Bandwidth
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Pointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La2.8 dBRadome, Lr0.0 dBTransponder G/T @ Hub4.0 dB/KThermal Noise, C/No94.3 dBHzC/(No+Io)93.8 dBHzSatelliteFlux Density-93.9 dBW/m2SFD @ Hub-90.0 dBW/m2Small Signal Gain (IBO/OBO)3.0 dBOBO0.9 dBDownlink-Frequency12.273 GHzTransponder Sat. EIRP @ Beam Peak56.9 dBWTransponder Sat. EIRP @ Terminal56.0 dBWDL PSD Limit15.5 dBW/4kHzDL PSD @ Beam Peak55.1 dBW
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Radome, Lr 0.0 dB Transponder G/T @ Hub 4.0 dB/K Thermal Noise, C/No 94.3 dBHz C/(No+Io) 93.8 dBHz Satellite -93.9 dBW/m2 Flux Density -93.9 dBW/m2 SFD @ Hub -90.0 dBW/m2 Small Signal Gain (IBO/OBO) 3.0 dB OBO 0.9 dB Downlink - Frequency 12.273 GHz Transponder Sat. EIRP @ Beam Peak 56.9 dBW Transponder Sat. EIRP @ Terminal 56.0 dBW DL PSD Limit 15.5 dBW/4kHz DL PSD @ Beam Peak 15.5 dBW/4kHz Carrier EIRP @ Beam Peak 56.0 dBW Carrier EIRP @ Terminal 55.1 dBW
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C/(No+lo)93.8 dBHzSatelliteFlux Density-93.9 dBW/m2SFD @ Hub-90.0 dBW/m2Small Signal Gain (IBO/OBO)3.0 dBOBO0.9 dBDownlinkFrequency12.273 GHzTransponder Sat. EIRP @ Beam Peak56.9 dBWTransponder Sat. EIRP @ Terminal56.0 dBWDL PSD Limit15.5 dBW/4kHzDL PSD @ Beam Peak55.0 dBWCarrier EIRP @ Beam Peak56.0 dBWCarrier EIRP @ Terminal55.1 dBW
Satellite Flux Density -93.9 dBW/m2 SFD @ Hub -90.0 dBW/m2 Small Signal Gain (IBO/OBO) 3.0 dB OBO 0.9 dB Downlink - Frequency 12.273 GHz Transponder Sat. EIRP @ Beam Peak 56.9 dBW Transponder Sat. EIRP @ Terminal 56.0 dBW DL PSD Limit 15.5 dBW/4kHz DL PSD @ Beam Peak 55.0 dBW Carrier EIRP @ Beam Peak 56.0 dBW Carrier EIRP @ Terminal 55.1 dBW
Flux Density-93.9 dBW/m2SFD @ Hub-90.0 dBW/m2Small Signal Gain (IBO/OBO)3.0 dBOBO0.9 dBDownlinkFrequency12.273 GHzTransponder Sat. EIRP @ Beam Peak56.9 dBWTransponder Sat. EIRP @ Terminal56.0 dBWDL PSD Limit15.5 dBW/4kHzDL PSD @ Beam Peak15.5 dBW/4kHzCarrier EIRP @ Beam Peak56.0 dBWCarrier EIRP @ Terminal55.1 dBW
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OBO0.9 dBDownlink12.273 GHzFrequency12.273 GHzTransponder Sat. EIRP @ Beam Peak56.9 dBWTransponder Sat. EIRP @ Terminal56.0 dBWDL PSD Limit15.5 dBW/4kHzDL PSD @ Beam Peak15.5 dBW/4kHzCarrier EIRP @ Beam Peak56.0 dBWCarrier EIRP @ Terminal55.1 dBW
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Carrier EIRP @ Beam Peak 56.0 dBW Carrier EIRP @ Terminal 55.1 dBW
Carrier EIRP @ Terminal 55.1 dBW
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Slant Range 36806 km
Space Loss, Ls 205.5 dB
Pointing Loss, Lpnt 0.1 dB
Atmosphere / Weather Loss, La 0.0 dB
Radome, Lr 0.5 dB
PCMA Loss 0.0 dB
Thermal Noise, C/No 88.8 dBHz
C/(No+lo) 88.4 dBHz
End to End
End to End C/(No+Io) 87.3 dBHz
Implementation Loss 1.0 dB
End to End C/N w/ Imp Loss 9.8 dB
Link Margin 0.2 dB

Return Link Budget

eXConnect Terminal Antenna Type	DPA	
Lat	28.7	deg
Lon	120.6	-
EIRP max		dBW
G/T		dB/K
Satellite		
Name	ChinaSat-10	
Longitude	110.5	deg
Hub Earth Station		Ū
Site	Beijing	
Lat	40.05	deg
Lon	116.27	
EIRP max		dBW
G/T	37.0	dB/K
Signal		
Waveform	iDirect	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.75	
Overhead Rate	0.82	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	8.19E+06	• •
Information Rate (Data + Overhead)	1.00E+07	•
Symbol Rate	6.67E+06	
Chip Rate (Noise Bandwidth)	6.67E+06	
Occupied Bandwidth	8.00E+06	
Power Equivalent Bandwidth	7.98E+05	
C/N Threshold	5.9	
Uplink	5.9	uв
1	14.023	CH-
Frequency Back off	14.023	
Back off		
EIRP Spectral Density	36806	dBW/4kHz
Slant Range	206.7	
Space Loss, Ls		
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
Transponder G/T @ Terminal Thermal Noise, C/No		dB/K
		dBHz
C/(No+lo)	76.0	dBHz
Satellite	115.0	dD14/m 2
Flux Density		dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
OBO	18.8	aв
Downlink	<i></i>	CUE
Frequency	12.273	
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Hub		dBW
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Hub		dBW
Slant Range	37540	
Space Loss, Ls	205.7	dB
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	4.0	
Radome, Lr	0.0	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	89.2	dBHz
C/(No+lo)	83.4604	dBHz
End to End		
End to End C/(No+Io)	75.3	dBHz
Implementation Loss	1.0	dB
End to End C/N w/ Imp Loss	6.0	dB

Antenna TypeSPALat28.7 degLon120.6 degEIRP max45.0 dBWG/T11.5 dB/KSatelliteNameChinaSat-10Longitude110.5 degHub Earth StationSiteBeijingLat40.05 degLon116.27 degEIRP max80.0 dBWG/T37.0 dB/KSignalUVB-52Modulation16APSKBits per symbol4Spread Factor1Coding Rate0.67Overhead Rate0.94Channel Spacing1.20Spectral Efficiency (Rate/Noise BW)2.50 bps/HzData Rate1.12E+08 bpsInformation Rate (Data + Overhead)1.20E+08 bpsSymbol Rate4.50E+07 HzChip Rate (Noise Bandwidth)4.50E+07 HzOccupied Bandwidth5.40E+07 HzOccupied Bandwidth5.40E+07 HzPower Equivalent Bandwidth4.88E+07 HzC/N Threshold9.6 dBUplinkFrequencyFrequency14.023 GHZBack off8.6 dBEIRP Spectral Density30.9 dBW/4kHzSlant Range37540 kmSpace Loss, Ls206.9 dBPointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La2.8 dBRadome, Lr0.0 dB/Transponder G/T @ Hub4.0 dB/K
Lon 120.6 deg EIRP max 45.0 dBW G/T 11.5 dB/K Satellite Name ChinaSat-10 Longitude 110.5 deg Hub Earth Station Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 37.0 dB/K Signal Waveform DVB-S2 Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.94 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 2.50 bps/Hz Data Rate 1.12E+08 bps Information Rate (Data + Overhead) 1.20E+08 bps Symbol Rate 4.50E+07 Hz Chip Rate (Noise Bandwidth) 4.50E+07 Hz Cocupied Bandwidth 5.40E+07 Hz Occupied Bandwidth 5.40E+07 Hz Occupied Bandwidth 4.88E+07 Hz C/N Threshold 9.6 dB Uplink Frequency 14.023 GHz Back off 8.6 dB EIRP Spectral Density 30.9 dBW/4kHz Shart Range 37540 km Space Loss, Ls 206.9 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 2.8 dB Radome, Lr 0.0 dB/K
EIRP max 45.0 dBW G/T 11.5 dB/K SatelliteNameChinaSat-10Longitude 110.5 deg Hub Earth StationSiteSiteBeijingLat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 37.0 dB/K SignalDVB-S2WaveformDVB-S2Modulation $16APSK$ Bits per symbol4Spread Factor1Coding Rate 0.67 Overhead Rate 0.94 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 2.50 bps/Hz Data Rate $1.12E+08 \text{ bps}$ Information Rate (Data + Overhead) $1.20E+08 \text{ bps}$ Symbol Rate $4.50E+07 \text{ Hz}$ Chip Rate (Noise Bandwidth) $4.50E+07 \text{ Hz}$ Occupied Bandwidth $5.40E+07 \text{ Hz}$ Occupied Bandwidth $5.40E+07 \text{ Hz}$ Power Equivalent Bandwidth $4.88E+07 \text{ Hz}$ C/N Threshold 9.6 dB UplinkIffequencyFrequency 14.023 GHz Back off 8.6 dB EIRP Spectral Density 30.9 dBW/4kHz Slant Range 37540 km Space Loss, Ls 206.9 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 2.8 dB Radome, Lr 0.0 dB Transponder G/T @ Hub 4.0 dB/K
G/T 11.5 dB/K Satellite Name ChinaSat-10 Longitude 110.5 deg Hub Earth Station Site Site Beijing Lat 40.05 deg Lon 116.27 deg EIRP max 80.0 dBW G/T 37.0 dB/K Signal Waveform Waveform DVB-S2 Modulation 16APSK Bits per symbol 4 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.94 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 2.50 bps/Hz Data Rate 1.12E+08 bps Information Rate (Data + Overhead) 1.20E+08 bps Symbol Rate 4.50E+07 Hz Chip Rate (Noise Bandwidth) 4.50E+07 Hz Chip Rate (Noise Bandwidth) 4.88E+07 Hz C/N Threshold 9.6 dB Uplink Frequency 14.023 GHz Back off 8.6 dB EIRP
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Pointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La2.8 dBRadome, Lr0.0 dBTransponder G/T @ Hub4.0 dB/K
Atmosphere / Weather Loss, La2.8 dBRadome, Lr0.0 dBTransponder G/T @ Hub4.0 dB/K
Radome, Lr0.0 dBTransponder G/T @ Hub4.0 dB/K
Transponder G/T @ Hub 4.0 dB/K
C/(No+lo) 93.8 dBHz Satellite
Flux Density -93.9 dBW/m2
SFD @ Hub -90.0 dBW/m2
Small Signal Gain (IBO/OBO) 3.0 dB
OBO 0.9 dB
Downlink
Frequency 12.273 GHz
Transponder Sat. EIRP @ Beam Peak 56.9 dBW
Transponder Sat. EIRP @ Terminal 56.0 dBW
DL PSD Limit 15.5 dBW/4kHz
DL PSD @ Beam Peak 15.5 dBW/4kHz
Carrier EIRP @ Beam Peak 56.0 dBW
Carrier EIRP @ Terminal 55.1 dBW
Slant Range 36806 km
Space Loss, Ls 205.5 dB
Pointing Loss, Lpnt 0.1 dB
Atmosphere / Weather Loss, La 0.0 dB
Radome, Lr 0.5 dB
PCMA Loss 0.0 dB
Thermal Noise, C/No 89.1 dBHz
C/(No+Io) 88.5 dBHz
End to End
End to End C/(No+Io) 87.4 dBHz
Implementation Loss 1.0 dB
•
End to End C/N w/ Imp Loss 9.9 dB Link Margin 0.3 dB

Return Link Budget

eXConnect Terminal		
Antenna Type	SPA	
Lat	28.7	deg
Lon	120.6	•
EIRP max		dBW
G/T	11.5	dB/K
Satellite		
Name	ChinaSat-10	
Longitude	110.5	deg
Hub Earth Station	Beijing	
Lat	40.05	dog
Lon	116.27	•
EIRP max		dBW
G/T		dB/K
Signal	0,110	ubjit
Waveform	iDirect	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.50	
Overhead Rate	0.83	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.83	bps/Hz
Data Rate	5.55E+06	bps
Information Rate (Data + Overhead)	6.67E+06	bps
Symbol Rate	6.67E+06	
Chip Rate (Noise Bandwidth)	6.67E+06	
Occupied Bandwidth	8.00E+06	
Power Equivalent Bandwidth	4.77E+05	
C/N Threshold	3.6	dB
Uplink		
Frequency	14.023	-
Back off	0.0	
EIRP Spectral Density	36806	dBW/4kHz
Slant Range Space Loss, Ls	206.7	
Pointing Loss, Lpnt	0.2	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
Transponder G/T @ Terminal		dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)	73.7	dBHz
Satellite		
Flux Density	-118.0	dBW/m2
SFD @ Terminal	-94.0	dBW/m2
Small Signal Gain (IBO/OBO)	3.0	dB
ОВО	21.0	dB
Downlink		
Frequency	12.273	GHz
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Hub		dBW
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Hub		dBW
Slant Range	37540	
Space Loss, Ls	205.7	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	4.0	-
Radome, Lr	0.0	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz dBHz
C/(No+lo) End to End	81.2243	UDTIZ
End to End C/(No+Io)	72 0	dBHz
Implementation Loss	73.0 0.0	
End to End C/N w/ Imp Loss	4.8	
Link Margin	4.8	
Link mulgin	1.2	U U

V. SES-12



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

19 November 2018

Subject: Engineering Certification of SES Americom, Inc. for the SES-12 and SES-14 Satellites

To whom it may concern,

This letter confirms that SES is aware that Panasonic Avionics Corporation ("Panasonic Avionics"), licensed by the Federal Communications Commission ("FCC") as Panasonic Avionics Corporation, is planning to file an application seeking a modification to its blanket authorization (the "Modification Application") to operate technically identical Ku-band Earth Stations Aboard Aircraft ("ESAA") pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules (Call Sign E100089). The Modification Application will seek authority for Panasonic Avionics' ESAA terminals to communicate with the SES-12 satellite at 95° E.L. and the SES-14 satellite at 47.5° W.L., under the current ESAA rules, including Section 25.227.

Based upon the representations made to SES by Panasonic Avionics concerning how it will operate on SES-12 and SES-14 according to its letter dated November 15, 2018:

- SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by Panasonic Avionics are consistent with any existing coordination agreements to which SES is a party with adjacent satellite operators within +/- 6 degrees of orbital separation from SES-12 and SES-14.
- If the FCC authorizes the operations proposed by Panasonic Avionics, SES will include the power density levels specified by Panasonic Avionics in all future satellite network coordination with other operators of satellites adjacent to SES-12 and SES-14.

Yours Sincerely

Philippe Secher Senior Manager Spectrum Management & Development, Americas

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SES-12 ORBITAL DEBRIS ANALYSIS REPORT

1.0 Mitigation of Orbital Debris (§25.114(d)(14))

Spacecraft Hardware design. SES has assessed and limited the amount of debris that will be released in a planned manner during normal operations of SES-12. During the satellite ascent, after separation from the launcher, no debris will be generated. As with all recent SES satellite launches, all deployments will be conducted using pyrotechnic devices designed to retain all physical debris. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration.

SES has also assessed and limited the probability of the space station becoming a source of orbital debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. The design of SES's recent spacecraft locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft will not use any subsystems for end-of-life disposal that are not used for normal operations.

Minimizing Accidental Explosions. SES has assessed and limited the probability of accidental explosions during and after completion of mission operations. As part of the Safety Data Package submission for SES spacecraft, an extensive analysis is completed by the spacecraft

manufacturer, reviewing each potential hazard relating to accidental explosions. A matrix is generated indicating the worst-case effect, the hazard cause, and the hazard controls available to minimize the severity and the probability of occurrence. Each subsystem is analyzed for potential hazards, and the Safety Design Package is provided for each phase of the program running from design phase, qualification, manufacturing and operational phase of the spacecraft. Also, the spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. The risk of accidental explosion is included as part of this analysis. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.

The design of the SES-12 spacecraft is such that the risk of explosion is minimized both during and after mission operations. In designing and building the spacecraft, the manufacturer took steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. Burst tests are performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. Bipropellant mixing is prevented by the use of valves that prevent backwards flow in propellant and pressurization lines. All pressures, including those of the batteries, will be monitored by telemetry. At the end of operational life, after the satellite has reached its final disposal orbit, all on-board sources of stored energy will be depleted or secured, excess propellant remaining in the chemical propulsion tanks will be vented, excess pressurant remaining in the helium tanks will be vented, and the batteries will be discharged.

Safe Flight Profiles. SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to

be located at, the requested orbital location or assigned in the vicinity of that location. Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude station-keeping limits, collision with another controlled object (excluding where the satellite is collocated with another object) is the direct result of that object entering the allocated space.

SES-12 will be positioned at 95.0° E.L. In considering current and planned satellites that may have a station-keeping volume that overlaps the SES-12 satellite, SES has reviewed publicly available databases for satellite networks operating at 95° E.L. In addition, networks for which a request for coordination has been published by the ITU within ±0.15 degrees of 95.0° E.L. have also been reviewed. Only those networks that either operate, or are planned to operate, and have an overlapping station-keeping volume with the SES-12 satellite, have been taken into account in the analysis. Based on these reviews, the satellites operating nominally at 95° W.L. are NSS-6, SES-8, which are also controlled and operated by SES. The Luch 5V and Skynet 5A satellites are also operating near the nominal 95° E.L. orbital location at 94.7° E.L.+/- 0.1° and 95.25°E.L.+/- 0.1° respectively. Based on the preceding, it is concluded that physical coordination of the SES-12 satellite with another party is not required at the present time. On-station operations require station-keeping within the +/- 0.1 degree N-S and +/- 0.05 degree E-W control box, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit. SES will use the proven inclination-eccentricity technique to ensure adequate separation between the satellites. This strategy is presently in use by SES at several orbital locations to ensure proper operation and safety of multiple satellites within one orbital box.

SES uses the Space Data Center ("SDC") system from the Space Data Association to monitor the risk of close approach of its satellites with other objects. Any close encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions. During any relocation, the moving spacecraft is maneuvered such that it is at least 30 km away from the synchronous radius at all times. In most cases, much larger deviation from the synchronous radius is used. In addition, the SDC system is used to ensure no close encounter occurs during the move. When de-orbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

Post-Mission Disposal. Post-mission disposal of the satellite from operational orbit will be accomplished by carrying out maneuvers to a higher orbit. The upper stage engine remains part of the satellite, and there is no re-entry phase for either component. The fuel budget for elevating the satellite to a disposal orbit is included in the satellite design. SES plans to maneuver SES-12 to a disposal orbit with a minimum perigee of 264 km above the normal GSO operational orbit. This proposed disposal orbit altitude results from application of the IADC formula based on the following calculation:

Total Solar Pressure Area "A" = 121.0 m^2

"M" = Dry Mass of Satellite = 4178.0 kg

"CR" = Solar Pressure Radiation Coefficient = 1.00

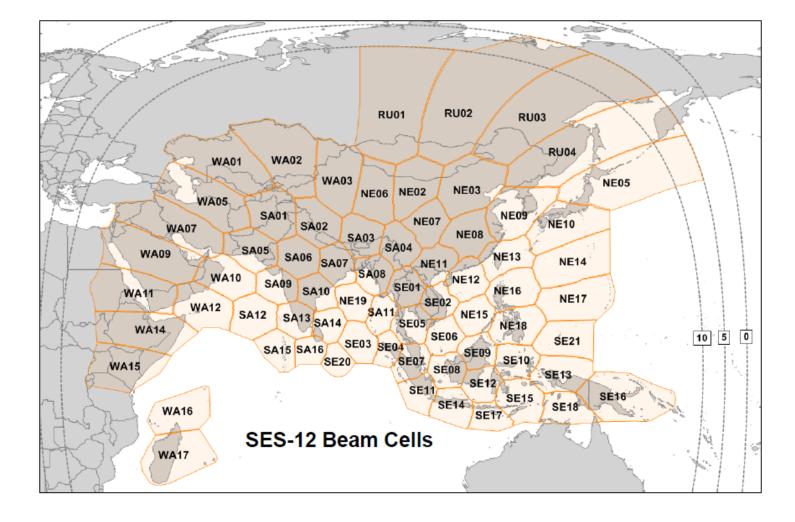
Therefore the Minimum Disposal Orbit Perigee Altitude:

= 36,021 km + 1000 x CR x A / m
= 36,021 km + 1000 x 1.00 x 121.0 / 4178.0

- = 36,050 km
- = 264 km above GSO (35,786 km)

SES intends to reserve 15.5 kg of propellant in order to account for post-mission disposal of SES-12. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

3. Coverage Map



eXConnect Terminal		
Antenna Type	PPA	
Lat		deg
Lon	96.7	
EIRP max		dBW
G/T	11.9	dB/K
Satellite		
Name	SES-12	
Longitude	95.0	deg
Hub Earth Station		
Site	Adelaide	
Lat	-34.7677	0
Lon	138.6978	0
EIRP max		dBW
G/T Signal	40.0	dB/K
Signal Waveform	DVB-S2X	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.67	
Overhead Rate	0.90	
Channel Spacing	1.05	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	1.60E+08	• •
Information Rate (Data + Overhead)	1.77E+08	bps
Symbol Rate	1.33E+08	Hz
Chip Rate (Noise Bandwidth)	1.33E+08	Hz
Occupied Bandwidth	1.40E+08	Hz
Power Equivalent Bandwidth	5.92E+07	Hz
C/N Threshold	2.9	dB
Uplink		
Frequency	28.500	GHz
Back off	0.0	
EIRP Spectral Density		dBW/4kHz
Slant Range	38721	
Space Loss, Ls	213.3	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	9.1	-
Radome, Lr	0.0	
Transponder G/T @ Hub Thermal Noise, C/No		dB/K dBHz
C/(No+lo)		dBHz
Satellite	38.5	UDITZ
Flux Density	-91.9	dBW/m2
SFD @ Hub		dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
ОВО	-0.4	dB
Downlink		
Frequency	11.000	GHz
Transponder Sat. EIRP @ Beam Peak	51.5	dBW
Transponder Sat. EIRP @ Terminal	51.0	dBW
DL PSD Limit	12.5	dBW/4kHz
DL PSD @ Beam Peak	6.7	dBW/4kHz
Carrier EIRP @ Beam Peak	51.9	dBW
Carrier EIRP @ Terminal		dBW
Slant Range	35820	
Space Loss, Ls	204.4	
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz
C/(No+lo) End to End	86.4	dBHz
End to End C/(No+Io)	8 6 1	dBHz
Implementation Loss	1.5	
End to End C/N w/ Imp Loss	3.4	
Link Margin	0.5	

Return Link Budget

eXConnect Terminal	
Antenna Type	PPA
Lat	4.5 deg
Lon	96.7 deg
EIRP max	47.9 dBW
G/T	11.9 dB/K
Satellite	
Name	SES-12
Longitude	95.0 deg
Hub Earth Station	
Site	Adelaide
Lat	-34.7677 deg
Lon	138.6978 deg
EIRP max	80.0 dBW
G/T	40.0 dB/K
Signal Waveform	MxDMA
Modulation	QPSK
Bits per symbol	2 2
Spread Factor	2
Coding Rate	0.50
Overhead Rate	0.90
Channel Spacing	1.05
Spectral Efficiency (Rate/Noise BW)	0.90 bps/Hz
Data Rate	1.80E+07 bps
Information Rate (Data + Overhead)	2.00E+07 bps
Symbol Rate	2.00E+07 Hz
Chip Rate (Noise Bandwidth)	2.00E+07 Hz
Occupied Bandwidth	2.10E+07 Hz
Power Equivalent Bandwidth	8.24E+06 Hz
C/N Threshold	1.6 dB
Uplink	
Frequency	14.000 GHz
Back off	0.0 dB
EIRP Spectral Density	10.9 dBW/4kHz
Slant Range	35820 km
Space Loss, Ls	206.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	14.0 dB/K
Thermal Noise, C/No	83.4 dBHz
C/(No+Io)	82.0 dBHz
Satellite	
Flux Density	-114.8 dBW/m2
SFD @ Terminal	-87.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	24.8 dB
Downlink	
Frequency	18.500 GHz
Transponder Sat. EIRP @ Beam Peak	59.9 dBW
Transponder Sat. EIRP @ Hub	59.9 dBW
DL PSD Limit	12.5 dBW/4kHz
DL PSD @ Beam Peak	-1.9 dBW/4kHz
Carrier EIRP @ Beam Peak	35.1 dBW
Carrier EIRP @ Hub	35.1 dBW
Slant Range	38721 km
Space Loss, Ls	209.6 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	87.7 dBHz
C/(No+lo)	86.5166 dBHz
End to End	00 7 17.1
End to End C/(No+lo)	80.7 dBHz
Implementation Loss	5.5 dB
	5.5 dB 2.1 dB 0.6 dB

Antenna Type SPA Lat 4.5 deg Lon 96.5 deg EIRP max 45.0 dBW G/T 11.5 dB/K Satellite	eXConnect Terminal		
Lon 96.5 deg EIRP max 45.0 dBW G/T 11.5 dB/k Satellite 11.5 dB/k Name SE5.12 Longitude 95.0 deg Hub Earth Station 34.7677 deg Site Adelaide Lat -34.7677 deg Lon 138.6978 deg EIRP max 80.0 dBW G/T 40.0 dB/k Signal Uweform Waveform DVB-S2X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 1.20 bps/Hz Data Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.40E+08 Hz Power Equivalent Bandwidth 1.40E+08 Hz Cocupied Bandwidth 1.40E+08 Hz Dubrink EIRP Spectral Density 34.8 dBW/AkHz Share Loss, Is 213.3 dB	Antenna Type	SPA	
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G/T 11.5 dB/K Satellite	Lon	96.5	deg
Satellite Name SES-12 Longitude 95.0 deg Hub Earth Station Site Site Adelaide Lat -34.7677 deg Lon 138.6978 deg EIRP max 80.0 dBW G/T 40.0 dB/K Signal Uverstand Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.67 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 1.20 bps/Hz Data Rate 1.384-08 Hz Occupied Bandwidth 1.384-08 Hz Occupied Bandwidth 5.924-07 Hz C/N Threshold 2.9 dB Uplink Erequency Frequency 28.500 GHz Back off 0.0 dB Space Loss, L5 213.3 dB Pointing Loss, Lpnt 0.0 dB Tansponder G/T @ Hub 13.3 dB/K			
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End to End C/N w/ Imp Loss 2.9 dB			
LINK IVIARGIN 0.0 dB			
	LINK Wargin	0.0	aв

Return Link Budget

eXConnect Terminal	
Antenna Type	SPA
Lat	4.5 deg
Lon	96.5 deg
EIRP max	45.0 dBW
G/T	11.5 dB/K
Satellite	
Name	SES-12
Longitude	95.0 deg
Hub Earth Station Site	A.J.J.
	Adelaide
Lat Lon	-34.7677 deg 138.6978 deg
EIRP max	80.0 dBW
G/T	40.0 dB/K
Signal	40.0 UB/K
Waveform	MxDMA
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.65
Overhead Rate	0.90
Channel Spacing	1.05
Spectral Efficiency (Rate/Noise BW)	1.17 bps/Hz
Data Rate	2.34E+07 bps
Information Rate (Data + Overhead)	2.60E+07 bps
Symbol Rate	2.00E+07 Hz
, Chip Rate (Noise Bandwidth)	2.00E+07 Hz
Occupied Bandwidth	2.10E+07 Hz
Power Equivalent Bandwidth	4.19E+06 Hz
C/N Threshold	3.5 dB
Uplink	
Frequency	14.000 GHz
Back off	0.0 dB
EIRP Spectral Density	8.0 dBW/4kHz
Slant Range	35820 km
Space Loss, Ls	206.5 dB
Pointing Loss, Lpnt	0.2 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	14.0 dB/K
Thermal Noise, C/No	80.5 dBHz
C/(No+lo)	79.5 dBHz
Satellite	
Flux Density	-117.8 dBW/m2
SFD @ Terminal	-87.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
OBO	27.8 dB
Downlink	10 500 011
Frequency	18.500 GHz
Transponder Sat. EIRP @ Beam Peak	59.9 dBW
Transponder Sat. EIRP @ Hub	59.9 dBW
DL PSD Limit	12.5 dBW/4kHz
DL PSD @ Beam Peak Carrier EIRP @ Beam Peak	-4.9 dBW/4kHz 32.1 dBW
-	
Carrier EIRP @ Hub	32.1 dBW 38721 km
Slant Range	209.6 dB
Space Loss, Ls Pointing Loss, Lpnt	209.6 dB 0.0 dB
Atmosphere / Weather Loss, La	6.5 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	84.7 dBHz
C/(No+lo)	83.5760 dBHz
End to End	03.3700 UDHZ
End to End C/(No+lo)	78.0 dBHz
Implementation Loss	1.5 dB
End to End C/N w/ Imp Loss	3.5 dB
Link Margin	0.0 dB
D	0.0 00

VI. SES-14



Philippe Secher Senior Manager, Spectrum Management & Development, Americas

> Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

19 November 2018

Subject: Engineering Certification of SES Americom, Inc. for the SES-12 and SES-14 Satellites

To whom it may concern,

This letter confirms that SES is aware that Panasonic Avionics Corporation ("Panasonic Avionics"), licensed by the Federal Communications Commission ("FCC") as Panasonic Avionics Corporation, is planning to file an application seeking a modification to its blanket authorization (the "Modification Application") to operate technically identical Ku-band Earth Stations Aboard Aircraft ("ESAA") pursuant to ITU RR 5.504A and Section 25.227 of the Commission's rules (Call Sign E100089). The Modification Application will seek authority for Panasonic Avionics' ESAA terminals to communicate with the SES-12 satellite at 95° E.L. and the SES-14 satellite at 47.5° W.L., under the current ESAA rules, including Section 25.227.

Based upon the representations made to SES by Panasonic Avionics concerning how it will operate on SES-12 and SES-14 according to its letter dated November 15, 2018:

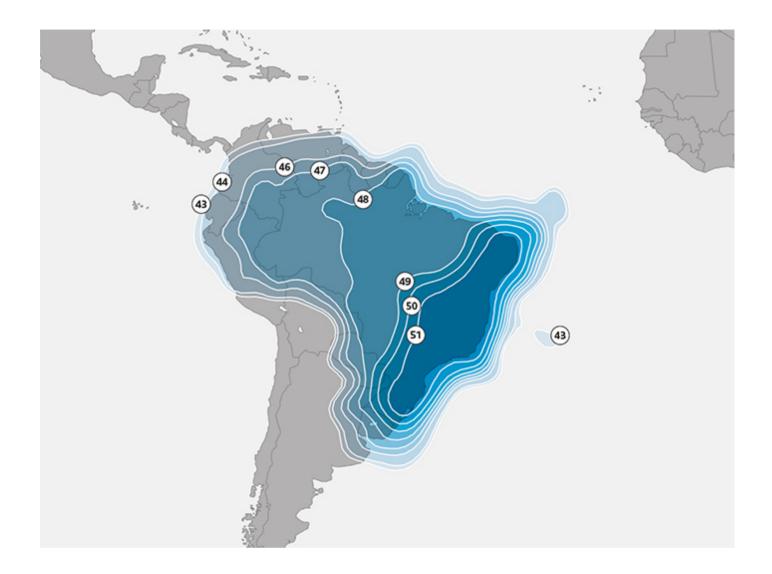
- SES certifies that it has completed coordination as required under the FCC's rules and that the power density levels specified by Panasonic Avionics are consistent with any existing coordination agreements to which SES is a party with adjacent satellite operators within +/- 6 degrees of orbital separation from SES-12 and SES-14.
- If the FCC authorizes the operations proposed by Panasonic Avionics, SES will include the power density levels specified by Panasonic Avionics in all future satellite network coordination with other operators of satellites adjacent to SES-12 and SES-14.

Yours Sincerely

Philippe Secher Senior Manager Spectrum Management & Development, Americas

Tel. +1 609 987 4000 Fax +1 609 987 4517 Enter sender e-mail www.ses.com

2. Coverage Map



Antenna Type PPA Lat -2.2 deg Lon -50.3 deg EIRP max 47.9 dBW G/T 12.0 dB/K Satellite Name Name SES14 Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal Waveform Waveform DVB-S2X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Symbol Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz Coding Bandwidth 1.4000 GHz Frequency 14.000 GHz Space Loss, Ls 206.9 dB Pointing Loss, Lpnt 0.0 dB Rad omf, L	eXConnect Terminal		
Lat -2.2 deg Lon -5.0.3 deg EIRP max 47.9 dBW G/T 12.0 dB/K Satellite		ΡΡΔ	
Lon -50.3 deg EIRP max 47.9 dBW G/T 12.0 dB/K Satellite -47.5 deg Name SES14 Longitude -47.5 deg Hub Earth Station -47.5 deg Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal			deg
EIRP max 47.9 dBW G/T 12.0 dB/k Satellite Name Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW Signal Waveform Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Power Equivalent Bandwidth 1.40E+08 Hz C/In Threshold -16 dB Uplink - Frequency 14.000 GHz Back off 0.0 dB Radome, Lr			•
G/T 12.0 dB/K Satellite			•
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Name SES14 Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal		12.0	abyrk
Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal UV8-52X Wodulation QP5K Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Coccupied Bandwidth 1.40E+08 Hz Power Equivalent Bandwidth 1.95E+07 Hz C/N Threshold -1.6 dB Uplink - Frequency 14.000 GHz Back off 0.0 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 4.9 dB Radome, Lr 0.0 dB		SES14	
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Signal DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Occupied Bandwidth 1.95E+07 Hz C/N Threshold -1.6 dB Uplink -1.6 dB Frequency 14.000 GHz Back off 0.0 dB Power Equivalent Bandwidth 1.95E+07 Hz C/N Threshold -1.6 dB Uplink -1.6 dB Frequency 14.000 GHz Back off 0.0 dB Pointing Loss, Lpnt 0.0 dB Radome, Lr 0.0 dB Transponder G/T @ Hub 8.0 dB/K Thermal Noise, C/No 104.3 dBHz StD @ Hub <	G/T	37.5	dB/K
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Slant Range37566 kmSpace Loss, Ls206.9 dBPointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La4.9 dBRadome, Lr0.0 dBTransponder G/T @ Hub8.0 dB/KThermal Noise, C/No104.8 dBHzC/(No+Io)104.3 dBHzSatelliteFlux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBW/4kHzDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Back off	0.0	dB
Space Loss, Ls206.9 dBPointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La4.9 dBRadome, Lr0.0 dBTransponder G/T @ Hub8.0 dB/KThermal Noise, C/No104.8 dBHzC/(No+lo)104.3 dBHzSatelliteFlux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBW/4kHzDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+lo)81.9 dBHzEnd to End C/(No+lo)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	EIRP Spectral Density	34.8	dBW/4kHz
Pointing Loss, Lpnt0.0 dBAtmosphere / Weather Loss, La4.9 dBRadome, Lr0.0 dBTransponder G/T @ Hub8.0 dB/KThermal Noise, C/No104.8 dBHzC/(No+Io)104.3 dBHzSatelliteFlux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBW/dHzDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPorting Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End1.5 dBEnd to End C/(No+Io)1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Slant Range	37566	km
Atmosphere / Weather Loss, La 4.9 dB Radome, Lr 0.0 dB Transponder G/T @ Hub 8.0 dB/K Thermal Noise, C/No 104.8 dBHz C/(No+Io) 104.3 dBHz Satellite	Space Loss, Ls	206.9	dB
Radome, Lr 0.0 dB Transponder G/T @ Hub 8.0 dB/K Thermal Noise, C/No 104.8 dBHz C/(No+Io) 104.3 dBHz Satellite	Pointing Loss, Lpnt	0.0	dB
Transponder G/T @ Hub 8.0 dB/K Thermal Noise, C/No 104.8 dBHz C/(No+Io) 104.3 dBHz Satellite	Atmosphere / Weather Loss, La	4.9	dB
Thermal Noise, C/No 104.8 dBHz C/(No+Io) 104.3 dBHz Satellite -87.4 dBW/m2 Flux Density -87.4 dBW/m2 SFD @ Hub -81.0 dBW/m2 Small Signal Gain (IBO/OBO) 2.0 dB OBO 4.4 dB Downlink - Frequency 11.000 GHz Transponder Sat. EIRP @ Beam Peak 52.6 dBW Transponder Sat. EIRP @ Terminal 51.0 dBW/M2 DL PSD Limit 14.0 dBW/4kHz DL PSD @ Beam Peak 3.0 dBW/4kHz Carrier EIRP @ Beam Peak 46.6 dBW Slant Range 35808 km Space Loss, Ls 204.4 dB Pointing Loss, Lpnt 0.1 dB Atmosphere / Weather Loss, La 0.0 dB Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 82.2 dBHz C/(No+Io) 81.9 dBHz End to End End to End End to End C/(No+Io) 81.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss <	Radome, Lr	0.0	dB
C/(No+lo)104.3 dBHzSatelliteFlux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+lo)81.9 dBHzEnd to End C/(No+lo)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Transponder G/T @ Hub	8.0	dB/K
SatelliteFlux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBW/4kHzDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Thermal Noise, C/No	104.8	dBHz
Flux Density-87.4 dBW/m2SFD @ Hub-81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBW/dkHzDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	C/(No+lo)	104.3	dBHz
SFD @ Hub81.0 dBW/m2Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Satellite		
Small Signal Gain (IBO/OBO)2.0 dBOBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD Q Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Flux Density	-87.4	dBW/m2
OBO4.4 dBDownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, LS204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	SFD @ Hub	-81.0	dBW/m2
DownlinkFrequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, LS204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End1.5 dBEnd to End C/(No+Io)1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Small Signal Gain (IBO/OBO)	2.0	dB
Frequency11.000 GHzTransponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End1.5 dBEnd to End C/(No+Io)1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	ОВО	4.4	dB
Transponder Sat. EIRP @ Beam Peak52.6 dBWTransponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End1.5 dBEnd to End C/(No+Io)1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Downlink		
Transponder Sat. EIRP @ Terminal51.0 dBWDL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Frequency	11.000	GHz
DL PSD Limit14.0 dBW/4kHzDL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Transponder Sat. EIRP @ Beam Peak	52.6	dBW
DL PSD @ Beam Peak3.0 dBW/4kHzCarrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	•		
Carrier EIRP @ Beam Peak48.2 dBWCarrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	DL PSD Limit	14.0	dBW/4kHz
Carrier EIRP @ Terminal46.6 dBWSlant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	DL PSD @ Beam Peak	3.0	dBW/4kHz
Slant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to End C/(No+Io)End to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Carrier EIRP @ Beam Peak	48.2	dBW
Space Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to EndEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	_		-
Pointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to EndEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Slant Range	35808	km
Atmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No82.2 dBHzC/(No+Io)81.9 dBHzEnd to EndEnd to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB	Space Loss, Ls	204.4	dB
Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 82.2 dBHz C/(No+Io) 81.9 dBHz End to End End to End C/(No+Io) Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -0.8 dB			
PCMA Loss 0.0 dB Thermal Noise, C/No 82.2 dBHz C/(No+Io) 81.9 dBHz End to End End to End C/(No+Io) Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -0.8 dB			
Thermal Noise, C/No 82.2 dBHz C/(No+Io) 81.9 dBHz End to End 81.9 dBHz End to End C/(No+Io) 81.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -0.8 dB		0.5	dB
C/(No+Io) 81.9 dBHz End to End End to End C/(No+Io) 81.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -0.8 dB			
End to End End to End C/(No+Io) 81.9 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -0.8 dB	Thermal Noise, C/No		
End to End C/(No+Io)81.9 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB		81.9	dBHz
Implementation Loss1.5 dBEnd to End C/N w/ Imp Loss-0.8 dB			
End to End C/N w/ Imp Loss -0.8 dB			
			-
Link Margin 0.8 dB			
	Link Margin	0.8	dB

Return Link Budget

eXConnect Terminal	
Antenna Type	PPA
Lat	-2.2 deg
Lon	-50.3 deg
EIRP max	47.9 dBW
G/T	12.0 dB/K
Satellite	
Name	SES14
Longitude	-47.5 deg
Hub Earth Station	h dta sat
Site	Miami
Lat	25.77 deg
Lon	-80.19 deg
EIRP max G/T	80.0 dBW
Signal	37.5 dB/K
Waveform	MxDMA
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.70
Overhead Rate	0.90
Channel Spacing	1.05
Spectral Efficiency (Rate/Noise BW)	1.26 bps/Hz
Data Rate	2.52E+07 bps
Information Rate (Data + Overhead)	2.80E+07 bps
Symbol Rate	2.00E+07 Hz
Chip Rate (Noise Bandwidth)	2.00E+07 Hz
Occupied Bandwidth	2.10E+07 Hz
Power Equivalent Bandwidth	6.61E+06 Hz
C/N Threshold	4.1 dB
Uplink	
Frequency	14.000 GHz
Back off	0.0 dB
EIRP Spectral Density	10.9 dBW/4kH
Slant Range	35808 km
Space Loss, Ls	206.5 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	13.0 dB/K
Thermal Noise, C/No	82.4 dBHz
C/(No+Io)	81.2 dBHz
Satellite	
Flux Density	-114.8 dBW/m2
SFD @ Terminal	-91.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0 dB
OBO	21.8 dB
Downlink	
Frequency	11.800 GHz
Transponder Sat. EIRP @ Beam Peak	55.0 dBW
Transponder Sat. EIRP @ Hub	55.0 dBW
DL PSD Limit	14.0 dBW/4kH
DL PSD @ Beam Peak	-3.8 dBW/4kH
Carrier EIRP @ Beam Peak	33.2 dBW
Carrier EIRP @ Hub	33.2 dBW
Slant Range	37566 km
Space Loss, Ls	205.4 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	5.6 dB
De de contra de c	0.0 dB
	· · · ·
PCMA Loss	0.0 dB
PCMA Loss Thermal Noise, C/No	88.3 dBHz
PCMA Loss Thermal Noise, C/No C/(No+Io)	
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End	88.3 dBHz 86.9097 dBHz
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io)	88.3 dBHz 86.9097 dBHz 80.1 dBHz
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	88.3 dBHz 86.9097 dBHz 80.1 dBHz 2.5 dB
Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss End to End C/N w/ Imp Loss Link Margin	88.3 dBHz 86.9097 dBHz 80.1 dBHz

Antenna Type SPA Lat -2.2 deg Lon -50.3 deg EIRP max 45.0 dBW G/T 11.5 dB/K Satellite	eXConnect Terminal		
Lon -50.3 deg EIRP max 45.0 dBW G/T 11.5 dB/K Satellite -47.5 deg Name SES14 Longitude -47.5 deg Hub Earth Station -47.5 deg Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal	Antenna Type	SPA	
EIRP max 45.0 dBW G/T 11.5 dB/k Satellite	Lat	-2.2	deg
G/T 11.5 dB/K Satellite			-
Satellite Sets14 Name SES14 Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/k Signal Waveform Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.27E+07 bps Symbol Rate 1.33E+08 Hz Charle Spaceladwidth 1.40E+08 Hz Charle Spectral Density 3.4.8 dBW/4kHz Slant Range 37566 km Space Loss, Ls 206.9 dB Pointing Loss, Lpnt 0.0 dB Tansponder G/T @ Hub 8.0 dB/K			
NameSE514Longitude-47.5 degHub Earth Station-47.5 degSiteMiamiLat25.77 degLon-80.19 degEIRP max80.0 dBWG/T37.5 dB/KSignal	,	11.5	ав/к
Longitude -47.5 deg Hub Earth Station Site Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Symbol Rate 1.38E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.40E+08 Hz Power Equivalent Bandwidth 1.95E+07 Hz C/N Threshold -1.6 dB Uplink		SES1/	
Hub Earth Station Site Miami Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal Waveform Waveform DVB-52X Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Power Equivalent Bandwidth 1.49E+08 Hz C/In Threshold -1.6 dB Uplink			deg
Lat 25.77 deg Lon -80.19 deg EIRP max 80.0 dBW G/T 37.5 dB/K Signal DVB-52X Modulation QP5K Bits per symbol 2 Spread Factor 1 Coding Rate 0.33 Overhead Rate 0.90 Channel Spacing 1.05 Spectral Efficiency (Rate/Noise BW) 0.60 bps/Hz Data Rate 7.98E+07 bps Information Rate (Data + Overhead) 8.87E+07 bps Symbol Rate 1.33E+08 Hz Chip Rate (Noise Bandwidth) 1.33E+08 Hz Occupied Bandwidth 1.40E+08 Hz Power Equivalent Bandwidth 1.95E+07 Hz C/N Threshold -1.6 dB Uplink Trequency Frequency 14.000 GHz Back off 0.0 dB EIRP Spectral Density 34.8 dBW/4kHz Slant Range 37566 km Space Loss, Ls 206.9 dB Pointing Loss, Lpnt 0.0 dB Transponder G/T @ Hub <td></td> <td></td> <td></td>			
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Slant Range35808 kmSpace Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No81.7 dBHzC/(No+Io)81.4 dBHzEnd to EndEnd to End C/(No+Io)81.4 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-1.3 dB	Carrier EIRP @ Beam Peak	48.2	dBW
Space Loss, Ls204.4 dBPointing Loss, Lpnt0.1 dBAtmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No81.7 dBHzC/(No+Io)81.4 dBHzEnd to EndEnd to End C/(No+Io)81.4 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-1.3 dB	Carrier EIRP @ Terminal	46.6	dBW
Pointing Loss, Lpnt 0.1 dB Atmosphere / Weather Loss, La 0.0 dB Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 81.7 dBHz C/(No+Io) 81.4 dBHz End to End C/(No+Io) 81.4 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -1.3 dB	-		
Atmosphere / Weather Loss, La0.0 dBRadome, Lr0.5 dBPCMA Loss0.0 dBThermal Noise, C/No81.7 dBHzC/(No+Io)81.4 dBHzEnd to EndEnd to End C/(No+Io)81.4 dBHzImplementation Loss1.5 dBEnd to End C/N w/ Imp Loss-1.3 dB			-
Radome, Lr 0.5 dB PCMA Loss 0.0 dB Thermal Noise, C/No 81.7 dBHz C/(No+Io) 81.4 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 81.4 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -1.3 dB			
PCMA Loss 0.0 dB Thermal Noise, C/No 81.7 dBHz C/(No+Io) 81.4 dBHz End to End End to End C/(No+Io) End to End C/(No+Io) 81.4 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -1.3 dB			-
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End to End End to End C/(No+Io) 81.4 dBHz Implementation Loss 1.5 dB End to End C/N w/ Imp Loss -1.3 dB			
Implementation Loss1.5 dBEnd to End C/N w/ Imp Loss-1.3 dB			
End to End C/N w/ Imp Loss -1.3 dB		81.4	dBHz
	Implementation Loss	1.5	dB
Link Margin 0.3 dB	End to End C/N w/ Imp Loss	-1.3	dB
	Link Margin	0.3	dB

Return Link Budget

eXConnect Terminal		
Antenna Type	SPA	
Lat	-2.2	deg
Lon	-50.3	deg
EIRP max	45.0	dBW
G/T	11.5	dB/K
Satellite		
Name	SES14	
Longitude	-47.5	deg
Hub Earth Station	N 411	
Site	Miami	
Lat	25.77 -80.19	-
Lon EIRP max	-80.19 80.0	0
G/T	37.5	
Signal	57.5	ubyk
Waveform	MxDMA	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.60	
Overhead Rate	0.90	
Channel Spacing	1.05	
Spectral Efficiency (Rate/Noise BW)	1.08	bps/Hz
Data Rate	2.16E+07	bps
Information Rate (Data + Overhead)	2.40E+07	bps
Symbol Rate	2.00E+07	Hz
Chip Rate (Noise Bandwidth)	2.00E+07	
Occupied Bandwidth	2.10E+07	
Power Equivalent Bandwidth	3.34E+06	
C/N Threshold	2.9	dB
Uplink		~
Frequency	14.000	
Back off	0.0	
EIRP Spectral Density	35808	dBW/4kHz
Slant Range Space Loss, Ls	206.5	
Pointing Loss, Lpnt	0.2	
Atmosphere / Weather Loss, La	0.0	
Radome, Lr	0.5	
Transponder G/T @ Terminal	13.0	
Thermal Noise, C/No	79.5	-
C/(No+lo)	78.6	
Satellite		
Flux Density	-117.7	dBW/m2
SFD @ Terminal	-91.0	dBW/m2
Small Signal Gain (IBO/OBO)	2.0	dB
ОВО	24.7	dB
Downlink		
Frequency	11.800	GHz
Transponder Sat. EIRP @ Beam Peak	55.0	
Transponder Sat. EIRP @ Hub	55.0	
DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak		dBW/4kHz
Carrier EIRP @ Beam Peak	30.3	
Carrier EIRP @ Hub	30.3	
Slant Range	37566	
Space Loss, Ls	205.4	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	5.6	
Radome, Lr	0.0	
PCMA Loss	0.0 85.3	
Thermal Noise, C/No C/(No+Io)	85.3 83.9518	
End to End	02.2218	
	77.5	dBHz
		~ 21 12
End to End C/(No+Io)		dB
Implementation Loss	1.5	
		dB

VII. eXConnect System Satellites and Gateway Tables

Satellite	Licensing Admin.	Orbital Location	Downlink Freq. (GHz)	ITU Satellite Network	ITU Region	Service to U.S.
Express AM5	Russia	140° E	10.95-11.2; 11.45-11.7; 12.5-12.75	EXPRESS-10B	1	No
Express AM6	Russia	53° E	10.95-11.2; 11.45-11.7; 12.5-12.75	EXPRESS-5B	1	No
Anik G1	Canada	107.3° W	11.7-12.2	CANSAT-34	2	No
Apstar 6	China	134° E	10.7-12.75	APSTAR-2	3	No
Apstar 6C	China	134° E	12.25-12.75	G4SAT-134E	3	No
Apstar 6D	China	134° E	10.7-12.75	APSTAR-2, CHINASAT- 134E, G4SAT-134E	3	No
Apstar 7	China	76.5° E	10.7-12.75	APSTAR-4	1, 3	No
AsiaSat 5	China	100.5° E	11.45-12.2	ASIASAT-EKX	1	No
AsiaSat 7	China	105.5° E	12.25-12.75	ASIASAT-CKX	3	No
AsiaSat 9	China	122° E	10.95-11.2 11.45-11.7 12.25-12.75	ASIASAT-AKX	3	No
ChinaSat 10	China	110.5° E	12.25-12.75	CHINASAT-2, CHINASAT-6, DFH-3A-OB	3	No
Eutelsat 10A	France	10° E	11.7-12.2; 10.95-11.7; 12.5-12.75	EUTELSAT 2- 10E / EUTELSAT 3- 10E	1, 3	No
Eutelsat 70B	France	70.5° E	10.95-11.7; 12.5-12.75	EUTELSAT 3- 70.5E	1, 3	No
Eutelsat 115WB	Mexico	114.9° W	11.7-12.2	MEXSAT- 114.9-KU-EXT	2	Yes
Eutelsat 117WA	Mexico	116.8° W	11.7-12.2	MEXSAT- 116.8-KU-EXT	2	Yes
Eutelsat 172B	U.S.	172° E	10.95-11.7; 12.2-12.75	U.Slicensed 1, 2, 3		Yes
Eutelsat 172B	France	172° E	11.2-11.45	F-SAT-E-30B- 172E	1, 3	No

Table 1. Satellite Points of Communication

Galaxy 16	U.S.	99° W	11.7-12.2	U.Slicensed	2	Yes
IS-14	U.S.	45° W	11.45-	U.Slicensed	1, 2	No
			11.95;		,	
			12.25-12.75			
IS-15	U.S.	85° E	12.25-12.75	U.Slicensed	3	No
IS-21	U.S.	58° W	11.45-12.2	U.Slicensed	1, 2	Yes
IS-29e	U.S.	50° W	10.95-12.2	U.Slicensed	1, 2	Yes
IS-33e	U.S.	60° E	10.95-11.2;	U.Slicensed	1, 3	No
			11.45-12.2;			
			12.5-12.6			
JCSAT-2B	Japan	154° E	11.45-11.7	N-SAT-154E	3	No
JCSAT-5A	Japan	132° E	12.25-12.75	N-STAR-A	1	No
NSS-6	Netherlands	95° E	11.45-12.75	NSS-9	3	No
SES-12	Netherlands	95° E	10.7-11.45	NSS-G2-18	3	No
SES-14	Brazil &	47.5° E	10.95-11.2;	B-SAT-1 W-2;	2	No
	Netherlands		11.45-12.45	NSS-BSS 47.5W	-	110
050.15		100.1503	107100		V	2
SES-15	Gibraltar	129.15°W	10.7-12.2	GIBSAT-129W	Yes	2
Superbird	Japan	144° E	12.2-12.75	N-SAT2-144E	3	No
C2						
Telstar 11N	U.S.	37.5° W	11.45-12.2	U.Slicensed	1, 2	Yes
Telstar 12V	U.S.	15° W	10.95-12.2	U.Slicensed	1	No
Telstar 14R	Brazil	63° W	11.45-12.2	B-SAT1	2	Yes
Yamal 300K	Netherlands	183° E	10.95-11.7	NSS-19	1, 2	Yes
Yamal 401	Russia	90° E	10.95-11.2;	EXPRESS-7C	1, 3	No
			11.45-12.75			

Satellite	Satellite Operator	Gateway Earth Station Location	Country	Gateway Operator	FCC Call Sign
Ekspress AM5	RSCC	Khabarovsk	Russia	AltegroSky	N/A
Ekspress AM6	RSCC	Moscow	Russia	AltegroSky	N/A
Anik G1	Telesat	Lima	Peru	NewCom	N/A
Apstar 6	APT	Beijing	China	ChinaTelecom Satellite	N/A
Aptar 6C	APT	Beijing	China	ChinaTelecom Satellite	N/A
Apstar 6D	APT	Hong Kong	China	Speedcast	N/A
Apstar 7	APT	Kofinou	Cyprus	Stellar	N/A
AsiaSat 5	AsiaSat	Kofinou	Cyprus	Stellar	N/A
AsiaSat 7	AsiaSat	Beijing	China	China Telecom Satellite	N/A
AsiaSat 9	AsiaSat	Hong Kong	China	China Telecom Satellite	N/A
ChinaSat 10	China SatCom	Beijing	China	China SatCom	N/A
Eutelsat 10A	Eutelsat	Cologne	Germany	Stellar	N/A
Eutelsat 70B	Eutelsat	Kofinou	Cyprus	Stellar	N/A
Eutelsat 115WB	Eutelsat Americas	Brewster, WA	U.S.	USEI	E120043
Eutelsat 117WA	Eutelsat Americas	Brewster, WA	U.S.	USEI	E120043
Eutelsat 172B (Spot/Wide)	Eutelsat S.A.	Kapolei, HI	U.S.	Hawaii Pacific Teleport LP	E010236

Satellite	Satellite Operator	Gateway Earth Station Location	Country	Gateway Operator	FCC Call Sign
Eutelsat 172B (NP/SEP)	Eutelsat S.A.	Brewster, WA	U.S.	USEI	E120043
Eutelsat 172B (SP)	Eutelsat S.A.	Bayswater	Australia	SpeedCast	N/A
Galaxy 16	Intelsat	Brewster, WA	U.S.	U.S. Electrodynami cs	E120043
IS-14	Intelsat	Cologne	Germany	Stellar	N/A
IS-15	Intelsat	Kofinou	Cyprus	Stellar	N/A
IS-21	Intelsat	Sussex, NJ	U.S.	USEI	E150116
IS-29E	Intelsat	Hagerstown, MD	U.S.	Intelsat	E140121
IS-33E	Intelsat	Cologne	Germany	Stellar	N/A
JCSAT-2B	SKY Perfect JSAT	Kapolei, HI	U.S.	Hawaii Pacific Teleport LP	E010236
JCSAT-5A	SPJSAT	Yokohama	Japan	SPJSAT	N/A
NSS-6	SES	Kofinou	Cyprus	Stellar	N/A
SES-12	SES	Adelaide	China	China SatCom	N/A
SES-14 (MI)	SES	Port St. Lucie	U.S.	United Teleports	E160081
SES-14 (WN)	SES	Mount Airy, MD	U.S.	SES Americom	E050287
SES-14 (SW)	SES	Mount Airy, MD	U.S.	SES Americom	E050287
SES-15 (Beam 51)	SES	Somis, CA	U.S.	SES Americom	KA318

Satellite	Satellite Operator	Gateway Earth Station Location	Country	Gateway Operator	FCC Call Sign
SES-15 (Beam 48)	SES	Mount Airy, MD	U.S.	SES Americom	E050287
SES-15 (Beam 52)	SES	Brewster, WA	U.S.	SES Americom	E920585
Superbird C2	SPJSAT	Hong Kong	China	PCCW	N/A
Telstar 11N – (CA/US)	Skynet	Cologne	Germany	Stellar	N/A
Telstar 11N (AO)	Skynet	Ellenwood, GA	U.S.	Intelsat	E990365
Telstar 12V (MW, MC, ME, MN)	Skynet	Mt. Jackson, VA	U.S.	Telesat	E030029
Telstar 12V (NS)	Skynet	Chalfont	U.K.	Arqiva	N/A
Telstar 14R	Telesat	Mt. Jackson, VA	U.S.	Telesat	E030029
Yamal 300K	Gazprom	Brewster, WA	U.S.	USEI	E120043
Yamal 401	Gazprom	Moscow	Russia	RuSat	N/A

VIII. Section 25.227 Certifications

Panasonic Avionics Corporation ("Panasonic"), 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, Panasonic 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), Panasonic certifies that its proposed operations comply with the following requirements of Section 25.227:
 - Per Section 25.227(a)(6), for each ESAA transmitter, Panasonic 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. Panasonic 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. 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/_____

Mark DeFazio Panasonic Avionics Corporation

Nov. 26, 2018