ATTACHMENT A

Analysis of Potential Interference between Jupiter-3 and SpaceX Satellite Networks in the 18.8-19.3 GHz and 28.6-29.1 GHz Frequency Bands

1 Introduction

This report evaluates the potential interference levels between the EchoStar XXIV (or Jupiter-3) geostationary satellite orbit (GSO) and SpaceX non-geostationary satellite orbit (NGSO) networks in the 18.8-19.3 GHz (downlink) and 28.6-29.1 GHz (uplink**)** frequency bands.

Jupiter-3 transmissions considered in the analysis occur in the following frequency bands:

Freq. band (GHz)	Direction	User beam	Gateway beam
18.8-19.3	Downlink	✓	
28.6-29.1	Uplink		✓

The interference analysis includes the following links:

Link no.	Direction	Victim receiver	Interfering station
K1	Uplink	SpaceX satellite	Jupiter-3 gateway
K2	Downlink	SpaceX gateway	Jupiter-3 satellite (user beam)

Dynamic simulations were performed using Visualyse Professional software with a simulation duration of 15 days and a time step of 1 second to obtain cumulative distribution function (CDF) diagrams of interference-to-noise (I/N) ratios at the victim receiver. To further assess the interference impact, equivalent degradation of carrier-to-noise (C/N) ratios are subsequently calculated based on the I/N ratios.

Jupiter-3 and SpaceX network parameters used for the purpose of the analysis are based upon their respective FCC-approved applications and ITU filings. The parameters are listed in Tables 1a, 1b, 2a, and 2b below.

The simulations include scenarios in which a SpaceX earth station (E/S) is communicating with a satellite in the constellation that has the highest elevation angle and avoids the GSO arc by 22 degrees, as specified in SpaceX's application with the FCC so as to meet applicable equivalent power flux density limits (see sections A.8.1.2, A.8.1.3 and A.8.2 of Technical Attachment of IBFS File No. SAT-LOA-20161115-00118). The resulting CDF diagrams of I/N ratios and the associated degradation of C/N ratios are provided in Figures K1 to K2.

In summary, based on the authorized satellite network parameters, this report concludes that the SpaceX satellite network will not suffer any significant effects of harmful interference due to the operation of the Jupiter-3 network.

2 Network Parameters

Table 1a. Jupiter-3 Orbital Parameters

Parameter	Jupiter-3 Satellite	Note
Orbital location	95.2° W	GSO

Table 1b. Jupiter-3 Transmission Parameters

UPLINK		
Parameter	**User terminal (UT)**	**Gateway (TYP-9.2M)**
E/S location	Not applicable	40.223°N, -98.059°E (Note: example location close to center of continental US.)
E/S antenna tx peak gain (dBi)		66.6
3-dB beamwidth (degree)		0.08
E/S antenna pattern		ITU-R S.580-6
Uplink carrier bandwidth (MHz)		500 (Note: Jupiter-3 UT carriers can access a maximum of 200 MHz in any 500 MHz band occupied by SpaceX gateway uplink carrier. The simulation assumes 100 Jupiter-3 UT carriers at 2 MHz bandwidth each.)
Uplink power spectral density (dBW/Hz)		-80.6 (clear sky) -74.6 (maximum during faded conditions)
Target minimum received power excluding rx antenna gain (using power control) (dBW)		-139.8

DOWNLINK		
Parameter	**User terminal (UT)**	**Gateway**
E/S location	40.223°N, -98.059°E (Note: example location close to center of continental US. To evaluate downlink interference to SpaceX gateway, one Jupiter-3 UT is collocated with the SpaceX gateway.)	Not applicable (Note: no downlink transmission to Jupiter-3 gateway in the band overlapping with SpaceX.)
Satellite antenna pattern	ITU-R S.672-3 Ls = -25	
Downlink carrier bandwidth (MHz)	500 (Note: one downlink carrier overlapping with the SpaceX gateway downlink carrier.)	
Satellite antenna tx peak gain (dBi)	59.4	
Downlink power spectral density (dBW/Hz)	-79.4	
E/S rx peak gain (dBi)	41.1	
3-dB beamwidth (degree)	1.4	
E/S antenna pattern	REC-580-6	

Table 2a. SpaceX Orbital Parameters

Parameter	**Sub-constellation (SC) 1**	**SC 2**	**SC 3**	**SC 4**	**SC 5**
Number of planes (orbit)	72	72	36	6	4
Number of satellites per plane	22	22	20	58	43
Total number of satellites	1584	1584	720	348	172
Orbit altitude (km)	550	540	570	560	560
Inclination	53	53.2	70	97.6	97.6
Additional characteristics					
Total number of satellites	4408				
Exclusion angle towards GSO (degree)	22				
Minimum E/S elevation angle (degree)	5				

Note: Orbital parameters as per SpaceX FCC applications (IBFS File Nos. SAT-MOD-20200417-00037 & SAT-LOA-20161115-00118).

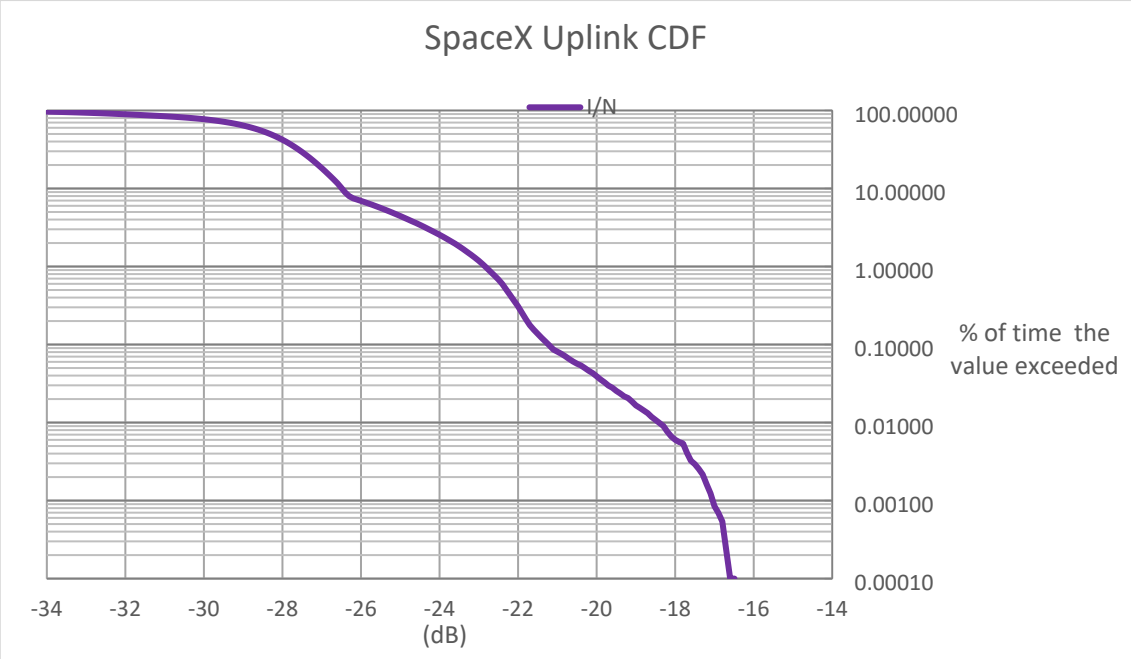
Table 2b. SpaceX Transmission Parameters

Parameter	
E/S location	40.223°N, -98.059°E (Note: example location close to centre of continental US.)
UPLINK	
Uplink carrier bandwidth (MHz)	500
Satellite antenna rx peak gain (dBi)	38.5
Satellite antenna pattern	ITU-R S.1528 Ln = -20
Rx system noise temperature (K)	501.2
DOWNLINK	
Satellite antenna pattern	ITU-R S.1528 Ln = -20
Downlink carrier bandwidth (MHz)	2
E/S rx peak gain (dBi)	29
3-dB beamwidth (degree)	6
E/S antenna pattern	ITU-R Appendix 8
Rx system noise temperature (K)	290

3 Simulation Results: Potential Interference from Jupiter-3 to SpaceX Satellite Operations (Links K1 and K2)

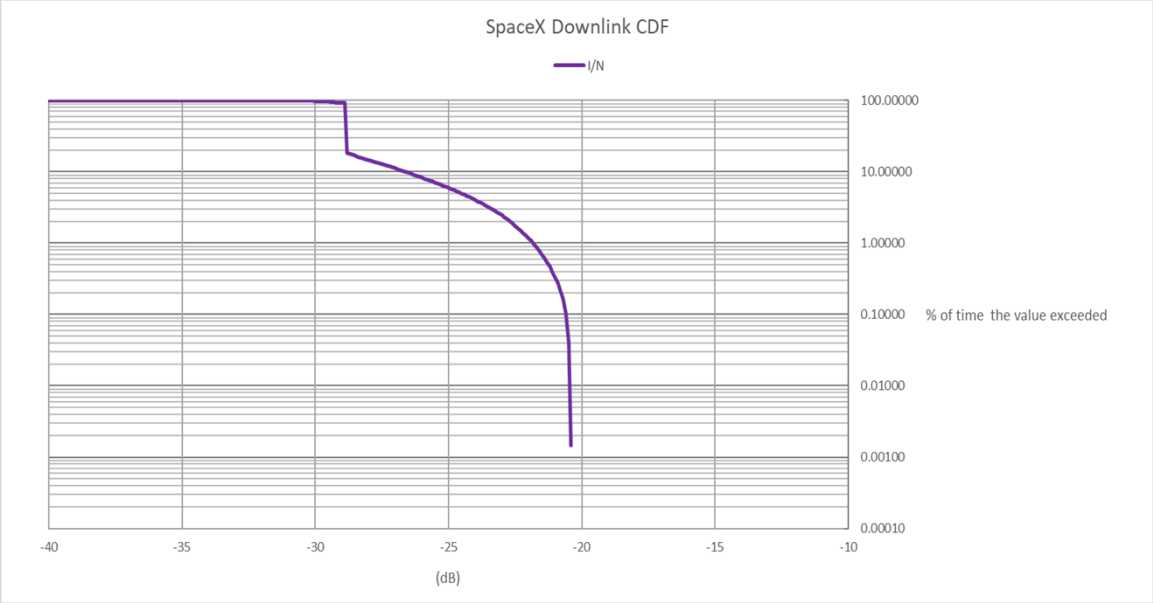
As shown in Figure K1 below, the resulting maximum I/N is -16.5 dB, which translates to a very small reduction of 0.096 dB in the wanted link C/N performance. In addition, it occurs at extremely low time percentage of 0.0001%.

Figure K1. SpaceX Uplink I/N CDF Diagram in the 28.6-29.1 GHz Band



Furthermore, as shown in Figure K2 below, the resulting maximum I/N is -20.4 dB, which translates to a very small reduction of 0.04 dB in the wanted link C/N performance. In addition, it occurs at very low time percentage of 0.0015%.

Figure K2. SpaceX Downlink I/N CDF Diagram in the 18.8-19.3 GHz Band



4 Summary and Conclusion

Table 3 below summarizes the interference results in the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands.

Table 3. Summary of Results

Link no.	Direction	Victim receiver	Interfering station	Highest I/N (dB)	C/N degradation (dB) and time %
K1	Uplink	SpaceX satellite	Jupiter-3 gateway	-16.5	0.096 (0.0001%)
K2	Downlink	SpaceX gateway	Jupiter-3 satellite (UT beam)	-20.4	0.04 (0.0015%)

Based on the authorized satellite network parameters and the interference simulation results summarized above, the potential interference from Jupiter-3 to SpaceX operations, in terms of I/N and the associated link performance degradation of C/N, is negligible (*i.e.*, a maximum I/N of -16.4 dB and a C/N reduction of 0.098 dB for 0.0001% of the time).

Therefore, the SpaceX satellite network will not suffer any significant effects of harmful interference due to Jupiter-3 network operations in the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands.

ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge and belief.

/s/ Hendri Lucky
Hendri Lucky
Director of Spectrum Management
ManSat Ltd.

April 24, 2023