Exhibit B

Technical Annex

This annex provides technical information regarding Viasat's proposed modification of its VIASAT-NGSO satellite system for which the Commission granted market access in April 2020. The proposed modification (i) utilizes extremely-high-capacity satellites, each of which is expected to have up to 4 to 5 times the capacity of any low-earth-orbit (LEO) satellite proposed to date, (ii) supports sub-100 ms latency broadband service, and (iii) is optimized to cover homes and small businesses in the CONUS. Moreover, the design of the constellation allows the highest standards of space safety to be met for this LEO constellation as a whole, while also providing innovative, affordable, sub-100 ms latency broadband service. In addition, it does so without adversely affecting the interference environment with respect to other authorized NGSO networks.

In order to achieve these goals, this modification increases the number of satellites from 20 to 288 and lowers the orbital altitude and inclination from 8,200 km and 87° to 1,300 km and 45°, respectively. This modification is consistent with all of the conditions imposed by the Commission in its existing grant related to power density and compatibility with other spectrum users,[1] and incorporates some additional modifications in compliance with these conditions.

Viasat does not restate the technical information contained in its original Petition, as amended,[2] but rather addresses only changed parameters in this Technical Annex. As such, the

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[1] Viasat, Inc., Petition for Declaratory Ruling Granting Access for a Non-U.S.-Licensed Non-Geostationary Orbit Satellite Network, IBFS File Nos. SAT-PDR-20161115-00120; SAT-APL-20180927-00076, Call Sign S2985, Order and Declaratory Ruling, FCC 20-56 (rel. Apr. 23, 2020) ("Viasat NGSO Authorization").

[2] Viasat, Inc., IBFS File Nos. SAT-PDR-20161115-00120, Attachment A (filed Nov. 15, 2016; granted Apr. 22, 2020) ("Viasat Petition"); SAT-APL-20180927-00076, Exhibit A (filed Sept. 27, 2018; granted Apr. 22, 2020) ("Viasat Amendment"); *see* 47 C.F.R. § 25.117(d)(1).

updated technical information provided herein should be read in conjunction with the Technical Annex included in Viasat's initial Petition, as amended, as well as the accompanying Schedule S, which has been amended and restated in its entirely to reflect the changes described herein.

Description of the Modification

The modified system will continue to operate in the Ka-band and V-band using the same specific frequencies as in its current grant: 17.8-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz and 37.5-42.0 GHz (space-to-Earth); and 27.5-29.1 GHz, 29.5-30.0 GHz, 47.2-50.2 GHz, and 50.4-51.4 GHz (Earth-to-space).[3]

Viasat proposes to modify its VIASAT-NGSO constellation as shown in Table 1.

Table 1

	Prior to Modification	After Modification
Number of Satellites	20	288
Number of Planes	4	8
Number Per Plane	5	36
Altitude	8,200 km	1,300 km
Inclination	87°	45°

Apogee and perigee will be maintained to a tolerance of ±20 km and inclination will be maintained to ±0.5°. The right ascension of the ascending nodes will precess and span the full range of 0° to 360°. Viasat will coordinate physical operations of spacecraft with any operator using similar orbits, for the purpose of seeking to eliminate collision risk and minimizing operational impacts. The modified VIASAT-NGSO satellite system will continue to provide broadband access and communications to customers with the same 25° elevation mask.

[3] See Viasat NGSO Authorization at ¶ 1.

The lower orbit will significantly decrease each satellite's footprint on the Earth, from a coverage area of 65 million km^2 to one of 10 million km^2. It will also significantly decrease the round-trip latency, from 143 ms at edge-of-coverage to 32 ms, allowing Viasat to provide low-latency service throughout the CONUS. Each satellite has a capacity of up to 96 Gbit/s, for a total of up to 27 Tbit/s for the constellation.

The modified VIASAT-NGSO system allows continuous sub-100 ms latency service to all locations on the Earth between 60° South latitude and 60° North latitude, including the CONUS, Hawaii, Puerto Rico, the U.S. Virgin Islands, and the southern portion of Alaska. The proposed coverage is consistent with the Commission's proposal to eliminate the coverage requirement in Section 25.146(b).[4] To the extent necessary, Viasat seeks a waiver of the coverage requirement in Section 25.146(b) because the inclination and altitude of the orbital planes do not support coverage north of 60° North latitude or south of 60° South latitude.

The modified system will operate within the power flux density (PFD) levels already authorized.[5] The applicable PFD limits from the grant conditions are shown in the following table. The X parameter in the Art. 21 limits is a function of the number of satellites in the NGSO constellation. For the 288-satellite VIASAT-NGSO constellation, the value of X is 10.

Table 2

Band Segment	**Grant Condition Limitation**	**Limit dB(W/m²) in any 1 MHz**		
		0°-5°	**5°-25°**	**25°-90°**
17.8-18.6 GHz	Art. 21	-115-X	-115−X + ((10 + X)/20)(δ−5)	-105
18.8-19.3 GHz	Art. 21	-115-X	-115−X + ((10 + X)/20)(δ−5)	-105
37.5-40.0 GHz	25.208(r)(1)	-132	-132+0.75(δ-5)	-117
40.0-42.0 GHz	25.208(s) & (t)	-115	-115+0.5(δ-5)	-105

[4] *See* Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809 ¶ 76 (2017) ("NGSO Order").
[5] Viasat NGSO Authorization at ¶¶ 51(c), (e), (j), (k), (n).

The peak PFD at the Earth's surface occurs at the sub satellite point, the spreading loss at this point is 133.3 dB. The following table demonstrates that the VIASAT-NGSO satellite system meets the applicable limits for elevation angles from 25° to 90°, and the combination of increasing path loss, antenna gain falloff with increasing off-axis angle, and operational limits are sufficient to ensure that the applicable limits are met for all elevation angles.

Table 3

Band Segment	**EIRP Density (dBW/MHz)**	**Peak PFD (dBW/m²/MHz)**
17.8-18.6 GHz	28.3	-105
18.8-19.3 GHz	28.3	-105
37.5-40.0 GHz	16.3	-117
40.0-42.0 GHz	28.3	-105

Pursuant to Section 25.146 of the Commission's rules, Viasat certifies that the modified system will continue to comply with all applicable EPFD limits, as specified in the Viasat NGSO Authorization.[6] While conclusions of the EPFD analysis previously submitted[7] remain unaffected, the inputs to that analysis are no longer the same, and such a showing is no longer required.

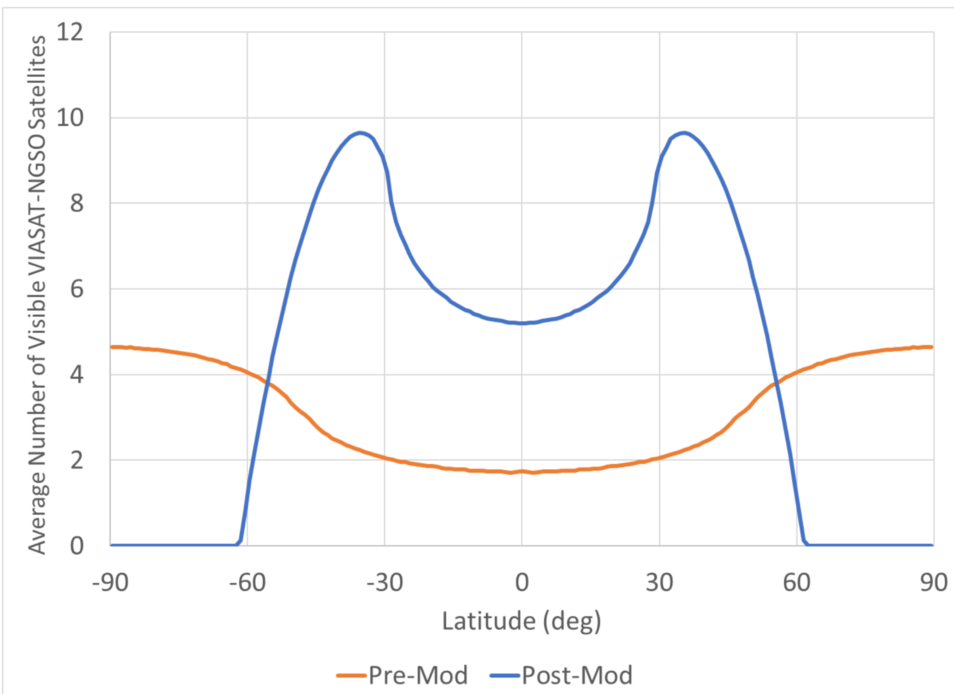
NGSO Sharing

While this modification increases the number of satellites, it does not adversely affect the interference environment with respect to other FCC-authorized NGSO systems. Rather, the modification provides Viasat with the flexibility needed to more efficiently share spectrum with other NGSO satellite systems. It better enables Viasat to mitigate the disproportionate impact of

[6] *Id*. at ¶¶ 37, 51(f), (g), (p).
[7] Viasat Petition, Attachment A, Exhibit 1; Viasat Amendment at 7-14.

the default band-splitting rules on certain NGSO constellation designs, by providing Viasat with increased flexibility to employ satellite diversity as a mitigation technique more often than otherwise would have been possible with its previous design. Figure 1 shows the average number of VIASAT-NGSO satellites visible as a function of latitude for the authorized (pre-mod) and proposed (post-mod) designs. It can be seen that the modification significantly increases the number of diversity options over the CONUS.

Figure 1



By way of example, Viasat performed an analysis of the effect of the proposed modification on uplink and downlink interference using the characteristics of four NGSO systems authorized through the Commission's most recent Ka-band processing round – SpaceX, OneWeb, Telesat, and O3b, and one system authorized through the Commission's most recent V-band processing round – SpaceX. This analysis is provided in the attached Exhibit 1 and shows that the probabilities of exceeding the "band splitting" threshold with the modified system do not exceed the probabilities that otherwise would have been experienced with the currently-authorized VIASAT-NGSO system. This analysis uses the same methodology as in other recent NGSO modification applications.[8]

Because the number of times that other currently-authorized NGSO constellations will be required to reduce spectrum will be no greater than before, there will be no significant increase in interference and sharing with other NGSO FSS systems will not be significantly more difficult.

Orbital Debris Mitigation Plan

Viasat is committed to space safety, and with this proposed modification is able to reduce the probability of the VIASAT-NGSO constellation, taken as a whole, resulting in a large object collision — from less than 0.04 over 15 years to less than 0.001 over 15 years. Viasat is designing the VIASAT-NGSO satellites to comply with the current NASA debris standards for single satellites, and also is able to comply with the Commission's recently proposed requirements for large constellations as a whole, should those requirements be adopted. The following discussion is based on the assumption that those requirements are adopted; should less stringent requirements be adopted, Viasat reserves the right modify this orbital debris mitigation plan to incorporate any less-stringent requirements.

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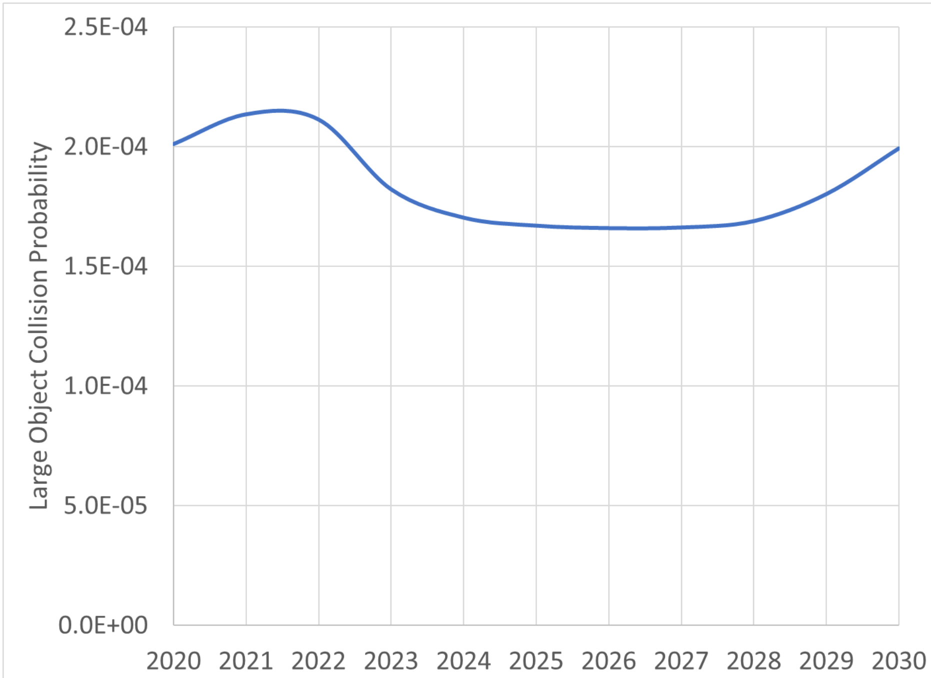
[8] *See, e.g.,* Space Exploration Holdings, LLC, IBFS File Nos. SAT-MOD-20181108-00083, Technical Information, at 25 (filed Nov. 8, 2018; granted Apr. 26, 2019); SAT-MOD-20190830-00087, Technical Attachment, at Annex 1 (filed Aug. 30, 2019; granted Dec. 19, 2019); SAT-MOD-20200417-00037, Technical Attachment, at Annex 1 (filed Apr. 17, 2020; pending).

The VIASAT-NGSO satellites are designed to limit the amount of debris released in a planned manner during normal operations to only those releases associated with launch. Also, Viasat is designing the satellites to limit the probability that they will become a source of debris by collision with small debris or meteoroids that would cause loss of control and prevent disposal to less than 0.01 for an individual VIASAT-NGSO satellite, as calculated using the NASA Debris Assessment Software (DAS).

The VIASAT-NGSO satellites are designed to limit the probability, during and after completion of mission operations, of accidental explosions or of release of liquids that could persist in droplet form. Further, the design ensures that debris generation will not result from the conversion of on-board energy sources (chemical, pressure, or kinetic) into energy that fragments the satellite. Stored energy will be removed at the satellite's end of life, by depleting residual fuel and leaving all fuel line valves open, venting all pressurized systems, leaving all batteries in a permanently discharge state, and removing all other remaining sources of stored energy.

Viasat's design limits the probability of a collision between any VIASAT-NGSO satellite and other large objects (10 cm or larger in diameter) during the total orbital lifetime of the satellite, including the deorbit phase, to less than 0.00025, as calculated using the NASA DAS. Figure 2 shows the large object collision probability as a function of launch year.

Figure 2



The VIASAT-NGSO satellites are designed with high reliability, propulsion-based, maneuver capability, including redundancy and the use of artificial intelligence to monitor the health of all components in the maneuver chain and deorbit satellites with predicted failures. The expected maneuver capability reliability over the satellite lifetime will be designed to be greater than 99.5%, as necessary to comply with any adopted requirement that the total probability of collision for the system as a whole[9] be less than 0.001. This calculation is based on the assumption that satellites with active maneuvering capability will maneuver effectively to avoid colliding with large objects, (i.e., zero-collision risk during active maneuvering).

[9] Calculated as the sum of the probability of collision associated with each individual space station, for the estimated number of space stations to be deployed over a 15-year period, including replacement space stations.

Such a 99.5% maneuver capability reliability over satellite lifetime also would ensure that VIASAT-NGSO satellites will be able to successfully deorbit with a probability of success greater than the Commission's 99% goal for large NGSO systems.

As previously noted, the apogee and perigee of the VIASAT-NGSO satellites will be maintained to a tolerance of ±20 km and inclination will be maintained to ±0.5°. The right ascension of the ascending nodes will precess and span the full range of 0° to 360°. To seek to eliminate collision risk and minimize operational impacts, Viasat will coordinate physical operations of the VIASAT-NGSO satellites with all operators using similar orbits.

SpaceX is currently authorized to operate 375 satellites at 1,275 km with 81° inclination, and an additional 300 satellites at 1,325 km with 70° inclination. Viasat understands that SpaceX plans to move these satellites to altitudes below 600 km.[10] To the extent that SpaceX continues plans to deploy satellites in the 1,275 km and 1,325 km orbits, Viasat will coordinate physical operations of the VIASAT-NGSO satellites with those SpaceX satellites.

The VIASAT-NGSO satellites will implement active, propulsion-based collision avoidance from their injection orbit, through their operational orbit, and until they reach the point in deorbiting that atmospheric effects render maneuvering impossible (at which point they would no longer be a collision risk). At all times during this descent, including the period during which they will traverse the orbital altitude of the ISS and other NASA assets, the spacecraft will retain sufficient fuel (with margin) to perform maneuvers.

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[10] *See* Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20200417-00037 (filed Apr. 17, 2020; pending).

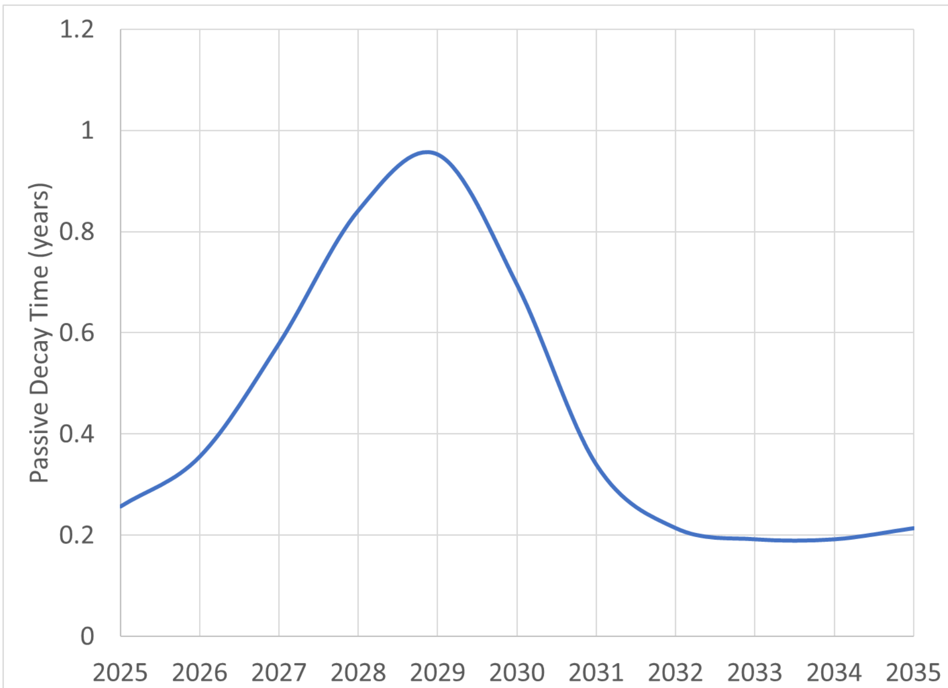
All VIASAT-NGSO satellites will completely burn-up (demise) on reentry and no part of the satellites will survive. In fact, no objects will impact the surface of the Earth and there is zero risk of human casualty. With the passive deorbit phase, the atmospheric reentry will be uncontrolled. With the complete demise of the satellites on reentry, this will not pose any additional risk compared to a controlled reentry.

Upon receipt of a space situational awareness conjunction warning, Viasat will review and take all possible steps to assess the collision risk and will mitigate it as appropriate. These steps will include contacting the operator of any active spacecraft involved in such a warning, sharing ephemeris data and other appropriate operational information with any such operator, and modifying the satellite orbits as necessary.

The VISAT-NGSO satellites are of sufficient size that they can be passively tracked with ease. Viasat will register each of the VIASAT-NGSO satellites with the 18th Space Control Squadron (18 SPCS) (or any successor to this function) prior to deployment. Viasat plans to share information regarding initial deployment, ephemeris, and planned maneuvers with 18 SPCS, other entities that engage in space situational awareness or space traffic management functions, and other operators.

At end-of-mission, the VIASAT-NGSO satellites will be disposed of through atmospheric reentry. An active disposal maneuver will be used to lower the orbital perigee to 300 km, and then the satellite orbit will be allowed to passively decay until the satellite burns-up in the atmosphere. A quantity of fuel sufficient to provide the required 256 m/s of ΔV, plus margin, will be reserved for this maneuver. The time required for the passive deorbit phase has been computed using the NASA DAS tool, and is plotted in Figure 3 as a function of end-of-mission year. The worst case is less than one year, significantly less than the 25-year standard.

Figure 3



Consistent with Commission practice, upon finalization of its space station design and prior to initiation of service to and from the United States, Viasat will seek the Commission's approval of a modification containing an updated description of its orbital debris mitigation plans.

The modified VIASAT-NGSO system has the operational flexibility to facilitate co-existence with other NGSO systems that the Commission already has authorized, and Viasat is committed to achieving mutually satisfactory coordination agreements with those systems. The modified VIASAT-NGSO system has been designed and will be operated such that the probability of exceeding the 6% ΔT/T threshold, above which parties are required to either coordinate or split the spectrum ("band splitting"), is not increased. To demonstrate this compatibility, Viasat performed an analysis of the effect of the proposed modification on uplink and downlink interference using the characteristics of four NGSO systems authorized through the Commission's most recent Ka-band processing round – SpaceX, OneWeb, Telesat, and O3b, and one NGSO system authorized through the Commission's most recent V-band processing round – SpaceX.

This analysis considers the dynamic, time-varying interference calculated from a time-domain simulation of the two NGSO systems over sufficient time to produce meaningful statistics. The probability of exceeding the -12.2 dB I/N (6% ΔT/T) threshold, above which parties would be required to either coordinate or split the spectrum, is determined.[11] To present a worst-case assessment of the interference environment, the analysis also assumes that the two systems do not implement any interference mitigation strategies. As demonstrated in Table E1-1, the probabilities of exceeding the threshold with the modified system do not exceed the probabilities that would be experienced with the currently authorized system.

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[11] 47 C.F.R. § 25.261(c).

In conducting the analysis, Viasat used the following assumptions:

- The VIASAT-NGSO earth station and the victim earth station are collocated near the center of the CONUS.[12]

- The VIASAT-NGSO earth station and the victim earth station can each communicate with any satellite in its respective system following the rules applicable for that system (e.g. GSO avoidance angle and minimum elevation angle). Within those constraints, the satellites are chosen randomly.

- Operational EPFD spectral densities are used to model the VIASAT-NGSO transmitters based on the current grant and on the proposed modification.

Note that this simulation is conservative (i.e., it overestimates I/N), as it does not consider the effects of atmospheric attenuation.

Table E1-1. Probability of Exceeding 6% ΔT/T Threshold

Victim System	Uplink		Downlink	
	Current	Modified	Current	Modified
SpaceX Ka	0.691560	0.001775	0.276867	0.079498
SpaceX V	1.000000	0.005620	0.276320	0.078407
OneWeb	0.107556	0.000393	0.275247	0.081145
Telesat	0.005142	0.000295	0.276706	0.085481
O3b	0.000492	0.000182	0.300856	0.099939

The I/N cumulative distribution functions ("CDFs") for each of the cases are provided in Figures E1-1 through E1-10. They show the fraction of time the I/N value is exceeded versus the I/N value for the presently authorized system (pre-modification curve) and the modified system (post-modification curve), in addition to a line at I/N = -12 dB. In all cases, the post-modification curve is below the pre-modification curve on the I/N = -12 dB line. Thus, the modification reduces the probability of exceeding the -12 dB I/N trigger, significantly for the uplinks and slightly for the downlinks.

[12] Viasat has run the simulation with multiple locations in the CONUS and achieved similar results for both the uplink and downlink analyses and chose 39°50' North and 98°35' West as a representative location.

Figure E1-1. SpaceX Ka-Band Uplink Comparison for Typical User Terminal Antennas

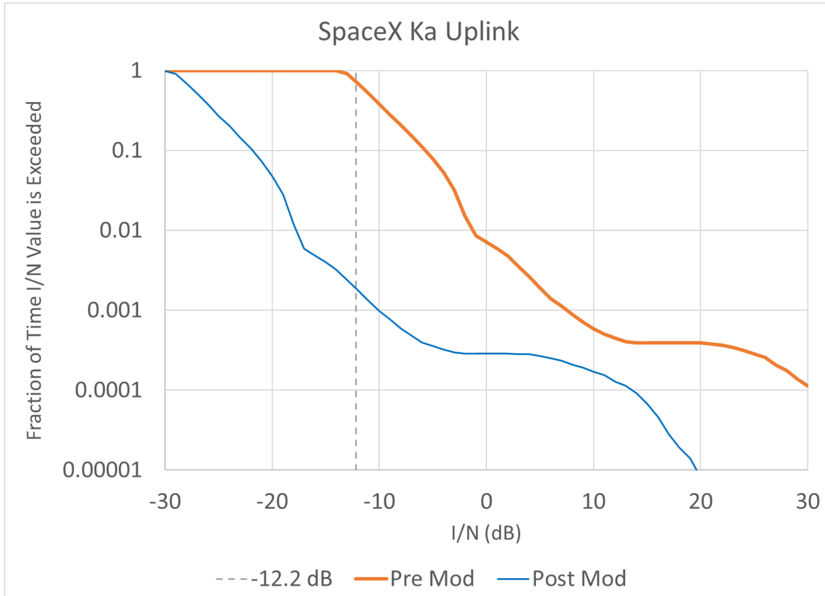


Figure E1-2. SpaceX Ka-Band Downlink Comparison for Typical User Terminal Antennas

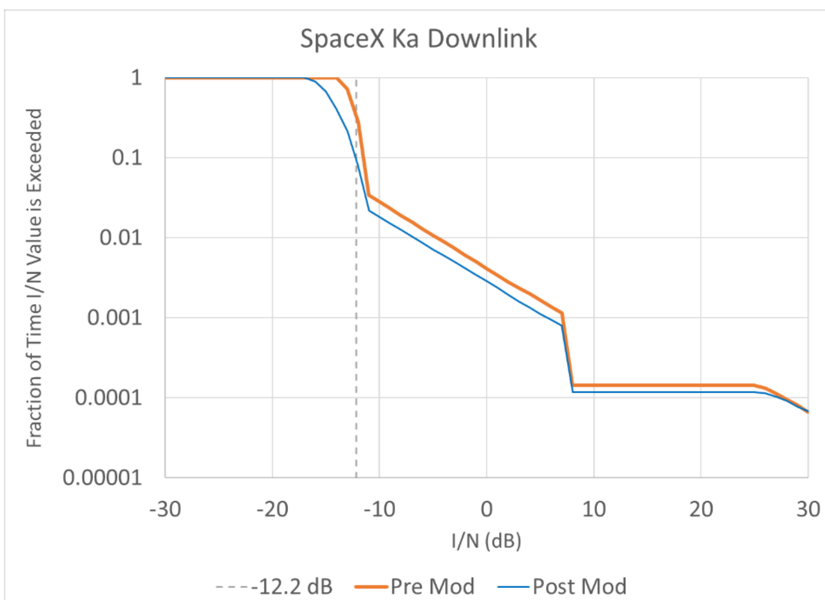


Figure E1-3. SpaceX V-Band Uplink Comparison for Typical User Terminal Antennas

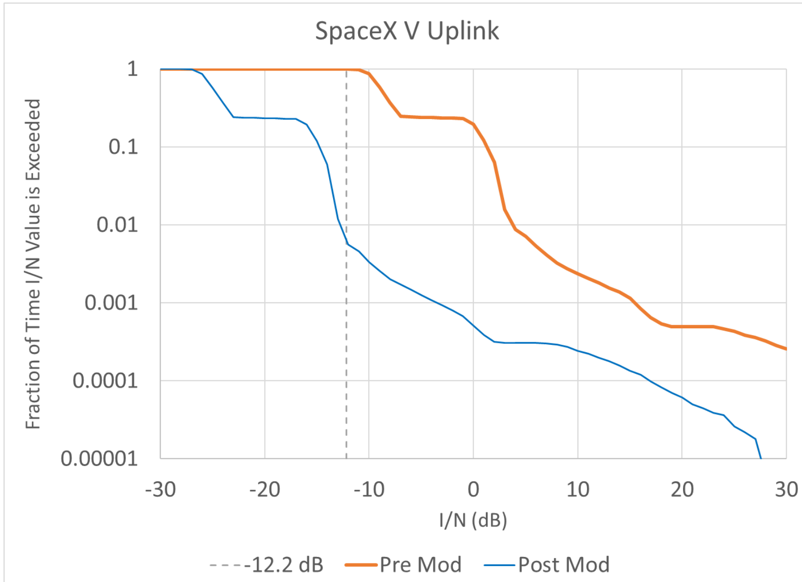


Figure E1-4. SpaceX V-Band Downlink Comparison for Typical User Terminal Antennas

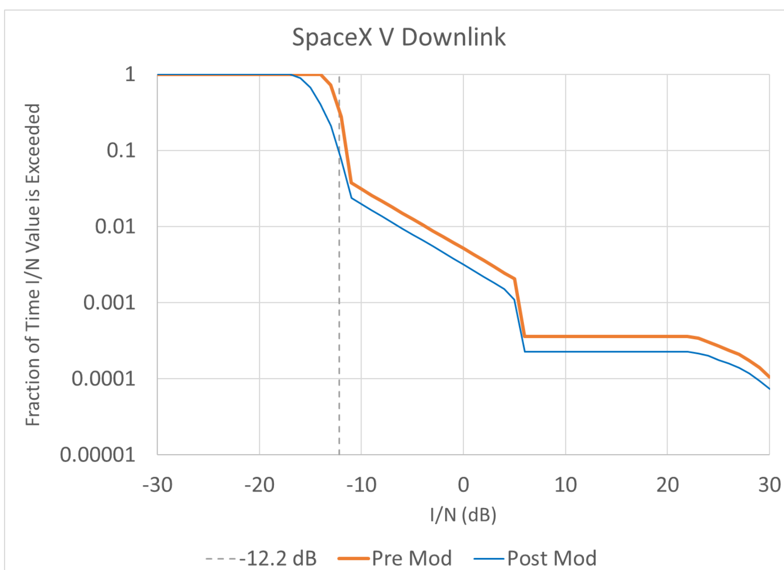


Figure E1-5. OneWeb Uplink Comparison for Typical User Terminal Antennas

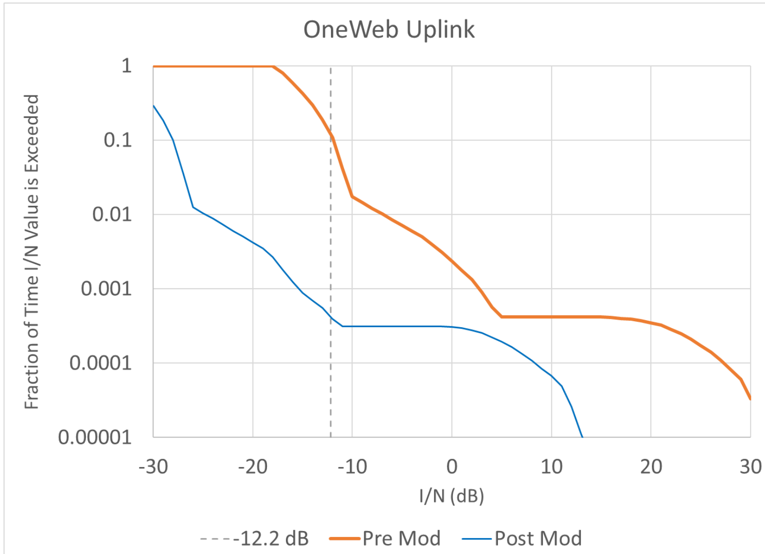


Figure E1-6. OneWeb Downlink Comparison for Typical User Terminal Antennas

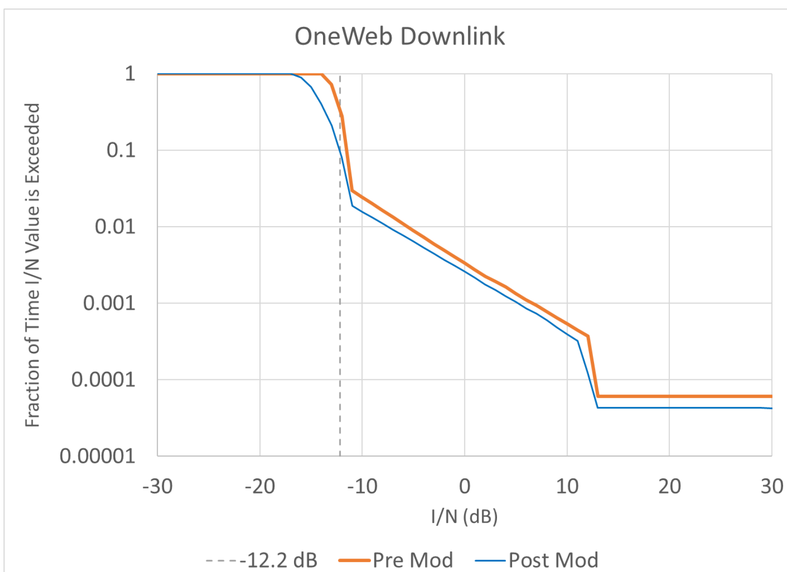


Figure E1-7. Telesat Uplink Comparison for Typical User Terminal Antennas

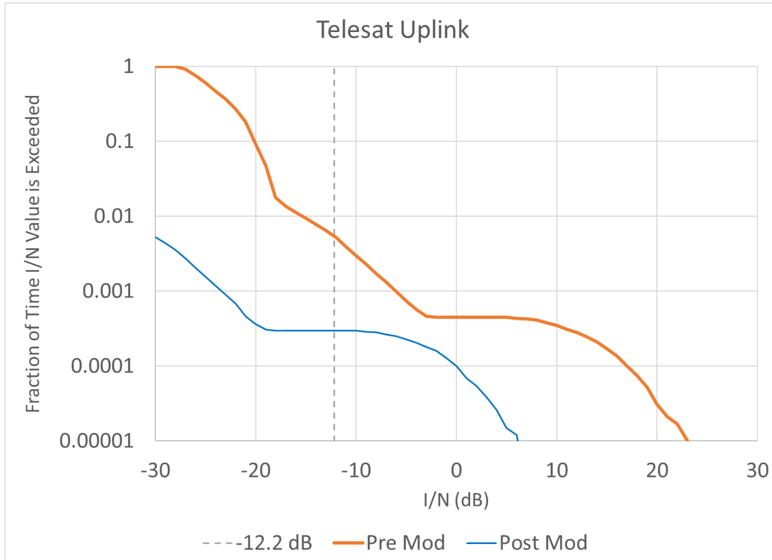


Figure E1-8. Telesat Downlink Comparison for Typical User Terminal Antennas

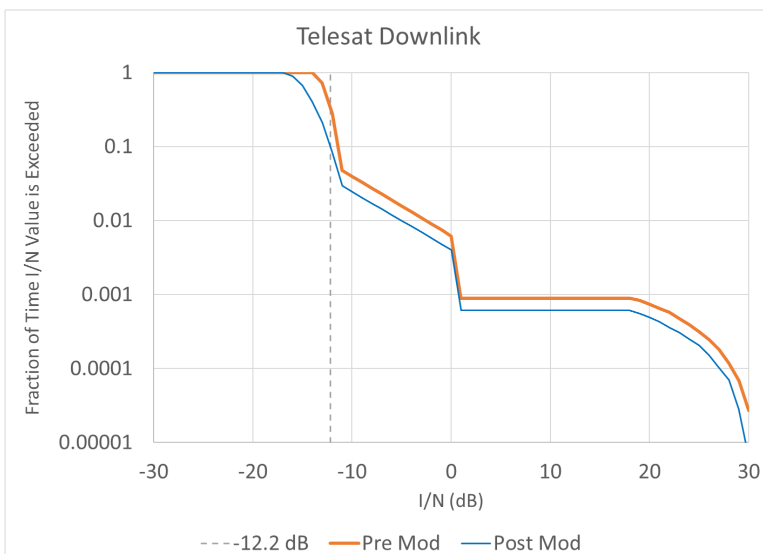


Figure E1-9. O3B Uplink Comparison for Typical User Terminal Antennas

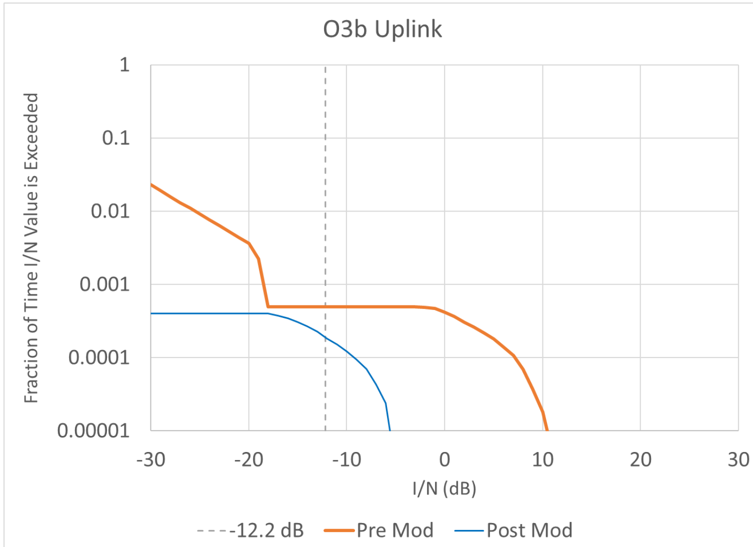
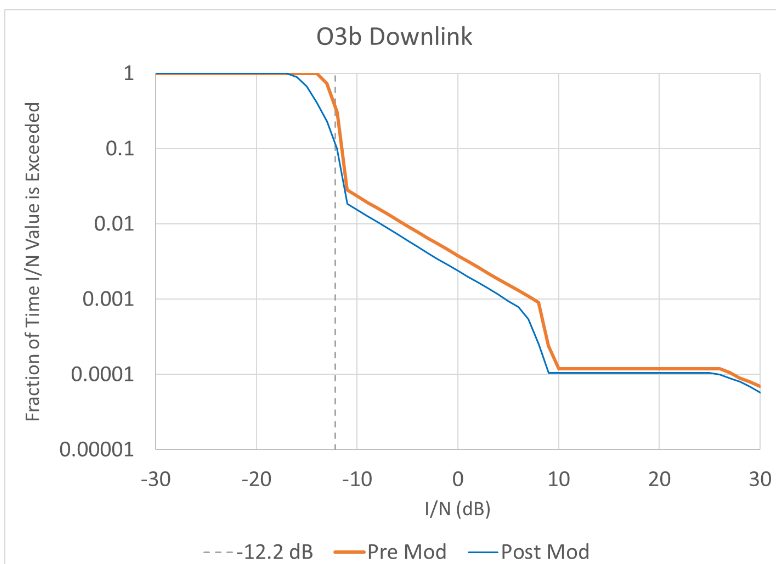


Figure E1-10. O3B Downlink Comparison for Typical User Terminal Antennas



Dated: May 26, 2020

Prepared by:

_Mark Alan Sturza______

Mark A. Sturza
President
3C Systems Company

DECLARATION

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

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May 26, 2020