TECHNICAL ATTACHMENT

Gen 1 Kuiper System

TABLE OF CONTENTS

TECHNICAL APPENDIX

Amazon holds authority from the Federal Communications Commission ("FCC" or "Commission") to launch and operate a constellation of non-geostationary satellite orbit ("NGSO") low-Earth orbit ("LEO") satellites across three orbital shells (the "Gen 1 Kuiper System")[1] using Ka-band frequencies for gateways ("GWs"), customer terminals ("CTs"), and tracking, telemetry, and control ("TT&C"). In 2021, Amazon submitted an application ("V-band Application") to the Commission for 7,774 proposed NGSO satellites using V-band and Ku-band frequencies (the "Kuiper-V System"). As a part of the V-band Application, Amazon requested authorization to use V-band frequencies on the Gen 1 Kuiper System satellites. This Amendment now seeks to align the Gen 1 Kuiper System with Amazon's updated design parameters, including as authorized by the Commission in 2024 (the "Ka-band Reconfiguration Modification").[2] Specifically, the Amendment seeks to: (1) ensure the Gen 1 Kuiper System orbits are consistent with the currently authorized orbital parameters; (2) supplement the Gen 1 Kuiper System with frequencies in the 17.3 – 17.8 GHz band (the "17 GHz Band"); (3) supplement the requested V-band frequencies for the Gen 1 Kuiper System, as set forth in the V-band Application, with the 51.4 – 52.4 GHz band. This additional spectrum will enable the Gen 1 Kuiper System to offer enhanced and higher-quality services to customers while maintaining affordability.

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[1] *See Kuiper Systems LLC, Request for Modification of the Authorization for the Kuiper NGSO Satellite System*, Order and Authorization, 39 FCC Rcd 3987 (SB 2024).

[2] *Kuiper Systems LLC, Request for Modification of the Authorization for the Kuiper NGSO Satellite System*, Order and Authorization, 39 FCC Rcd 2180 (2024) ("*Ka-band Reconfiguration Modification*").

I. DESCRIPTION OF THE GEN 1 KUIPER SYSTEM

A. Orbital Reconfiguration

The Gen 1 Kuiper System originally consisted of three orbital shells with 3,236 satellites. In February of 2024, the Commission granted Amazon's request to update the Gen 1 Kuiper System by revising the orbital parameters, decreasing the size of the constellation to 3,232 satellites across the same three orbital shells, and reconfiguring the number of orbital planes and number of satellites per plane.[3] These changes facilitate the provision of improved services without altering the altitude of any satellite.

Amazon requests to amend the orbital parameters of the Gen 1 Kuiper System section of the Kuiper-V System as described in Table 1, below, to conform with the Commission's Ka-band authorization for the Gen 1 Kuiper System.

Table 1. Amendment Application – Constellation Design Showing Altitudes and Inclinations

		Original Parameters[4]			**Amended Parameters**		
Altitude (km)	**Inclination (deg)**	**Number of Planes**	**Satellites per Plane**	**Total Satellites**	**Number of Planes**	**Satellites per Plane**	**Total Satellites**
590	30			-	1	2	2
590	33	28	28	784	782	1	782
610	42	36	36	1296	1292	1	1292
630	51.9	34	34	1156	289	4	1156
		Total Satellites		**3236**	*Total Satellites*		**3232**

B. Frequency and Polarization Plan

In the V-band Application, Amazon sought authority to add payloads in the 37.5 – 42.5 GHz, 47.2 – 50.2 GHz, and 50.4 – 51.4 GHz bands to the Gen 1 Kuiper System. Amazon now asks

[3] *See id.*

[4] The "original parameters" reflect those requested in the V-band Application, and the "amended parameters" reflect the parameters as amended to accord with the Orbital Modification Grant.

to further supplement the Gen 1 Kuiper System with frequencies in: (1) 1 GHz of additional V-band spectrum (51.4 – 52.4 GHz); and (2) the 17 GHz Band. Table 2, below, provides a detailed overview of the Gen 1 Kuiper System frequency bands, considering both already authorized and newly requested frequencies. The ground segment for the Gen 1 Kuiper System will consist of both V-band and Ka-band gateways, customer terminals, and TT&C.[5] All of the Gen 1 1 System links will utilize dual-polarization through both left-handed and right-handed circular polarization ("LHCP & RHCP") methods.

Table 2. Frequency Bands used by the Gen 1 Kuiper System

Type of Link and Transmission Direction	**Gen 1 Kuiper System Currently Authorized Frequency Ranges**	**V-band Application Additional Frequency Ranges Requested**	**Amendment Additional Frequency Ranges Requested**
Satellite to Gateway	17.7 – 18.6 GHz 18.8 – 19.3 GHz 19.3 – 19.7 GHz 19.7 – 20.2 GHz	37.5 – 42.0 GHz *42.0 – 42.5 GHz (non-U.S. only)*	17.3 – 17.8 GHz
Gateway to Satellite	27.5 – 28.6 GHz 28.6 – 29.1 GHz 29.1 – 29.5 GHz 29.5 – 30.0 GHz	47.2 – 50.2 GHz 50.4 – 51.4 GHz	51.4 – 52.4 GHz
Satellite to Customer Terminal	17.7 – 18.6 GHz 18.8 – 19.3 GHz 19.3 – 19.4 GHz 19.7 – 20.2 GHz	37.5 – 42.0 GHz *42.0 – 42.5 GHz (non-U.S. only)*	17.3 – 17.8 GHz
Customer Terminal to Satellite	28.35 – 28.6 GHz 28.6 – 29.1 GHz 29.5 – 30.0 GHz	47.2 – 50.2 GHz 50.4 – 51.4 GHz	51.4 – 52.4 GHz

[5] *See* 47 C.F.R. §§ 25.115, 25.130. Additionally, Amazon recognizes that 37.5 – 40 GHz FSS space-to-Earth transmissions must be restricted "to individually licensed earth stations," which "must not be ubiquitously deployed and must not be used to serve individual consumers," 47 C.F.R. § 25.202(a)(1)(ii), and will use such transmissions consistent with the Commission's rules.

TT&C Downlink & Beacon	19.25 – 19.4 GHz	40.0 – 40.1 GHz	
TT&C Uplink	27.5 – 28.05 GHz	47.2 – 47.3 GHz	

The Gen 1 Kuiper System will perform TT&C functions using either Ka-band, V-band or both bands.[6] The Gen 1 Kuiper System will use TT&C beams primarily during launch and early operations ("LEOP"), satellite anomalies, and satellite decommissioning.

C. Cessation of Emissions

To meet Section 25.207 requirements,[7] the control of all antenna beams (sub-system and power amplifier) can be enabled or disabled individually via ground control commands sent over TT&C links under both on-orbit and deorbit conditions.

II. SPECTRUM SHARING

A. Space Station Beam Contours and Information

The Gen 1 Kuiper System will operate both Ka-band[8] and V-band gateway beams, service beams, and TT&C beams. All Gen 1 Kuiper System space station gateway and service beams are independently steerable within the satellite field-of-view. In compliance with Section 25.210(f),[9] the Gen 1 Kuiper System space stations will employ state-of-the-art full frequency reuse for gateway and service beams; TT&C beams will be low-gain and non-directional. The Gen 1 Kuiper System earth stations will only communicate with satellites when above the minimum elevation angle indicated in Table 3, below.

[6] The Ka-band TT&C frequencies are currently authorized and not a part of this application.

[7] *See* 47 C.F.R. § 25.207.

[8] This includes frequencies as authorized in the *Ka-band Reconfiguration Modification* as well as the 17 GHz Band frequencies requested herein.

[9] *See* 47 C.F.R. § 25.210(f).

Tables 3 and 4, below, summarize the Gen 1 Kuiper System space station transmit and receive beams. These values represent the range of beams the Gen 1 Kuiper System will employ, and include the use of beams with gain values between the minimum and maximum values shown. The space station antenna gain contours are provided in attachments to this Application. Annex B includes the detailed beam and channel IDs for the Gen 1 Kuiper System. The TV1 – TV5 beams and RV1 – RV5 beams were previously included in the V-band Application. The TK8 – TK11 beams are updated from the V-band Application but are consistent with beam parameters defined in the underlying application for Amazon's Ka-band authorization for the Gen 1 Kuiper System.

Table 3. Gen 1 Kuiper System Space Station Transmit Beams

Beam ID	**Link Type**	**Minimum Elevation Angle (deg)**	**Maximum Steering Angle from 590km Space Station Nadir (deg)**	**Peak Gain (dBi)**
TV1	Gateway	20	59.3	35.7
TV2	Gateway	20	59.3	42.0
TV3	Gateway, Customer Terminal	20	59.3	34.0
TV4	Gateway, Customer Terminal	20	59.3	44.0
TV5	TT&C	5	0	5.0
TK8	Gateway	20	59.3	34.4
TK9	Gateway	20	59.3	36.9
TK10	Customer Terminal	35	48.6	37.0
TK11	Customer Terminal	35	48.6	39.0

Table 4. Gen 1 Kuiper System Space Station Receive Beams

Beam ID	**Link Type**	**Minimum Elevation Angle (deg)**	**Maximum Steering Angle from 590km**	**Peak Gain (dBi)**

			Space Station Nadir (deg)	
RV1	Gateway	20	59.3	37.5
RV2	Gateway	20	59.3	43.7
RV3	Gateway, Customer Terminal	20	59.3	34.0
RV4	Gateway, Customer Terminal	20	59.3	44.0
RV5	TT&C	5	0	5.0

Amazon notes that, due to data entry limitations in the Schedule S Attachment, Amazon supplied beams meant to be interpreted as bounding beams: for each beam type, Amazon submitted minimum and maximum gain values which are not meant to preclude the use of beams with gain values in between the bounds. Similarly, transmit and receive channel information supplied in the Schedule S Attachment rely on a single channel size. Amazon requests the flexibility to use variable channel sizes other than the simple set specified in the Schedule S Attachment.

B. Interference Protection for FS Systems

Amazon has designed the Gen 1 Kuiper System to co-exist with terrestrial fixed service ("FS") operations. Gen 1 Kuiper System earth stations and satellites operate at high elevation angles and angles of arrival, limiting the amount of RF energy that is transmitted tangentially to the Earth's surface and fixed service operations. Both the Commission and the ITU have established limits on the Power Flux-Density ("PFD") of satellite downlink transmissions at the Earth's surface in order to protect terrestrial fixed service systems operating in the V-band and Ka-band, including the 17 GHz Band. As explained and demonstrated below, the Gen 1 Kuiper System's PFD levels will comply with all applicable PFD limits.

1. 17 GHz Band

Section 25.146(a)(1) of the Commission's rules and Article 21, Section V, Table 21-4 of the ITU Radio Regulations provide PFD limits for emissions from NGSO FSS space stations in the 17.7 – 19.3 GHz band. The PFD limits for NGSO FSS systems in the relevant frequencies are described below in Table 5. Section 25.146(a)(1)(ii) directs applicants to comply with these limits for the 17.3 – 17.7 GHz band.

Table 5. PFD Limits for the 17.3 – 17.8 GHz Band from Article 21 and Section 25.146(a)(1)

Angles of Arrival (δ) Above the Horizontal Plane	**0° - 5°**	**5° - 25°**	**25° - 90°**
PFD Limit in dB[W/m^2/MHz]	-115 – X	-115 – X + ((10 + X)/20)(δ – 5)	-105

Where X is a constant defined as a function of N, the number of satellites in the Constellation, and is calculated as follows:

Number of Satellites, N	**N ≤ 50**	**50 < N ≤ 288**	**288 < N ≤ 1000**	**1000 < N ≤ 6000**	**N > 6000**
X [dB]	0	(5/119)*(N-50)	(1/69)*(N+402)	max {20.3, 10*LOG$_{10}$(N$_v$)}	10*LOG$_{10}$(N$_v$) + 1

Where N_v is the maximum number of visible space stations – considering a minimum elevation angle equal to 0 degrees – from any location on the surface of the Earth and within the service area of the NGSO system.

The Gen 1 Kuiper System CT downlinks in the 17 GHz Band will maintain a nominal log-linearly decreasing PFD of -113 dBW/m^2/MHz at nadir to -115 dBW/m^2/MHz at 35-degree angle of arrival. For angles of arrival below 35 degrees, the PFD generated by the Gen 1 Kuiper System CT downlinks in the 17 GHz Band will be a function of the Gen 1 Kuiper System satellites' off-axis EIRP. The Gen 1 Kuiper System GW downlinks in the 17 GHz Band will maintain a nominal PFD of -123 dBW/m^2/MHz for elevation angles above 30 degrees. For angles of arrival between

20 and 30 degrees, the transmit power will be held constant, thus the PFD generated by the Gen 1 Kuiper System GW downlinks in the 17 GHz Band will decrease as a consequence of the increasing path loss. For angles of arrival below 20 degrees, the PFD generated by the Gen 1 Kuiper System GW downlinks in the 17 GHz Band will be a function of the Gen 1 Kuiper System satellites' off-axis EIRP.

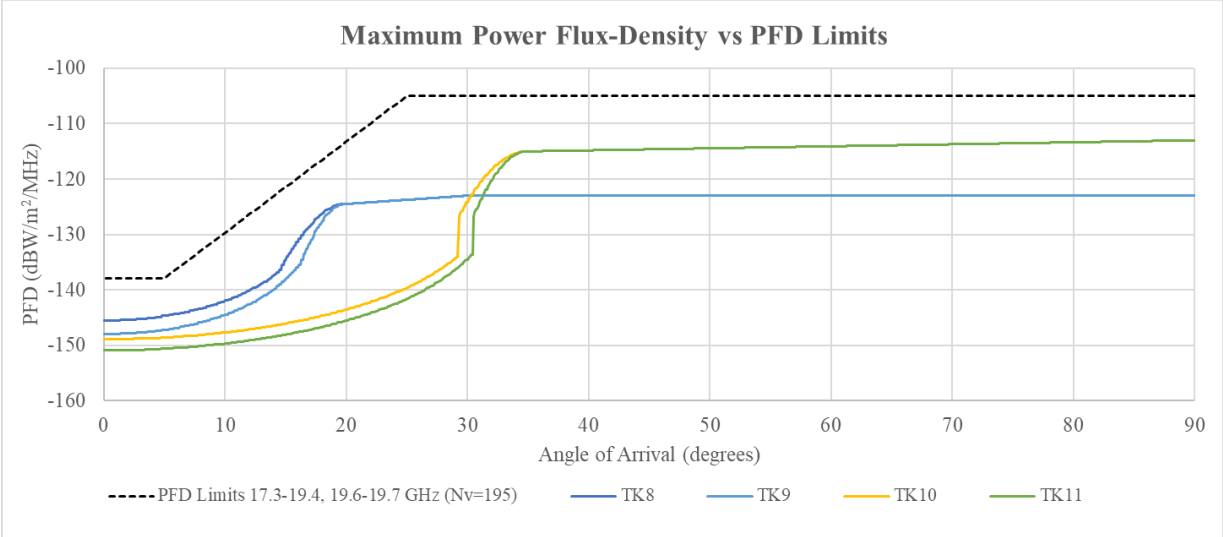

Figure 1. Gen 1 Kuiper Satellite Downlink Power Flux-Density Levels in the 17 GHz Band

2. V-band

The Gen 1 Kuiper System emissions in the 37.5 – 40.0 GHz band will comply with the PFD limits outlined in sections 25.208(r)(1) and 25.208(r)(2). The Gen 1 Kuiper System emissions in the 40.0 – 42.0 GHz band will comply with the PFD limits outlined in sections 25.208(s) and 25.208(t). As the V-band downlink beam PFD values have not been modified from the original application, there is no change in PFD compliance. For detailed descriptions and charts showing V-band downlink compliance to PFD limits in these bands, Amazon requests that the Commission refer to the V-band Application.

C. Interference Protections for GSO Systems

The Gen 1 Kuiper System can operate in the same frequency bands as GSO systems. Gen 1 Kuiper System beam emissions are highly directional and efficiently place the directed energy at Kuiper receivers and not GSO receivers. In addition, Gen 1 Kuiper System earth stations can reduce EIRP density levels for transmissions within a specified angular range of the GSO arc to minimize PFD levels toward GSO satellites. Similarly, Gen 1 Kuiper System satellites can reduce EIRP density levels for transmissions within a specified angular range of the GSO arc to minimize PFD levels toward GSO earth stations. This ability facilitates the protection of GSO systems in both the uplink and downlink directions.

1. 17 GHz Band

NGSO FSS applicants are required to comply with EPFD limits as set forth in Section 25.146(a)(2) and (c) of the Commission's rules, and Article 22 of the ITU Radio Regulations. These limits were initially promulgated to protect GSO FSS satellite networks in Ka-band frequencies from harmful interference due to NGSO FSS satellite networks, but, in practice, are decades old, significantly overprotect GSO incumbents, and do not reflect current satellite technology—particularly for downlink operations. Both the ITU and the Commission have recognized this in their recent efforts to study how to modernize these limits. For this reason, Amazon requests a partial waiver of the Commission's rules in Section 25.146(c) regarding downlink EPFD compliance for 17 GHz Band beams inside the United States. Amazon will bring the Gen 1 Kuiper System operations into conformance with the outcome of any Commission or international proceeding to update the EPFD rules in the downlink in the United States.[10] The Gen

[10] *See* Petition for Rulemaking of Space Exploration Holdings, LLC, RM-11990 (filed Aug. 9, 2024).

1 Kuiper System will comply with the Article 22 EPFD uplink and inter-satellite limits. Outside of the United States, the Gen 1 Kuiper System will comply with the Article 22 EPFD limits as required by local laws and licensing requirements. Annex A provides a detailed set of analyses to show how the Gen 1 Kuiper System will protect GSO systems inside the United States.

2. V-band

The ITU adopted requirements for NGSO systems to prevent single-entry and aggregate interference to GSO systems in the 37.5 – 42.5 GHz (space-to-Earth), 47.2 – 50.2 GHz (Earth-to-space) and 50.4 – 51.4 GHz (Earth-to-space) bands at WRC-19. These were codified in the ITU Radio Regulations in No. 22.5L and No. 22.5M of Article 22.[11] The ITU does not yet have software available with the capability to evaluate NGSO system compliance with these limits. Amazon has used its own software to evaluate compliance and certifies that the Gen 1 Kuiper System will comply with the single-entry limits in No. 22.5L of Article 22. Amazon certifies that the Gen 1 Kuiper System will comply with the aggregate limits in No. 22.5M of Article 22. The Gen 1 Kuiper System will use a variety of methods to meet these limits, including by: (1) limiting the number of satellites transmitting to and from earth station areas simultaneously on the same frequency and channel; (2) using space station and earth station antennas with narrow beamwidths; (3) using a GSO arc avoidance angle to prevent main-beam coupling between Gen 1 Kuiper System and GSO space station and earth station beams; and (4) limiting the power flux-density and EIRP of Gen 1 Kuiper System downlinks and uplinks respectively.

D. Interference Protections for NGSO Systems

Amazon designed the Gen 1 Kuiper System with flexible mitigation parameters, including the ability to implement satellite avoidance angles and adjust the uplink EIRP and downlink PFD

[11] *See* ITU RR Art. 22, Nos. 22.5L, 22.5M.

levels in selectable frequency bands. Amazon has participated in coordination discussions with other NGSO systems and can model the interference environment and perform reactive mitigation measures to protect the Kuiper Systems and other systems from harmful interference.

The Gen 1 Kuiper System will comply with the NGSO spectrum sharing rules outlined in section 25.261. The interference from the Gen 1 Kuiper System into other NGSO systems in the V-band frequencies does not increase when compared to the original V-band Application, since no changes are being requested to the existing V-band parameters in the Gen 1 Kuiper System, and the requested changes to the orbital parameters do not increase interference, as detailed in the legal narrative. For the previously authorized Ka-band frequencies on the Gen 1 Kuiper System, Amazon has either completed coordination or provided a compatibility showing demonstrating it will not cause harmful interference into members of earlier FCC processing rounds. Since the 17 GHz Band in the United States has not been a part of any FCC processing rounds, there are no prior authorized systems that require a compatibility showing. In the event that other NGSO systems apply for the 17 GHz Band, Kuiper will abide by the spectrum sharing rules outlined in section 25.261.

E. Sharing with Other Co-frequency and Adjacent Band Users

1. Radio Astronomy Service Interference Mitigation

Radio Astronomy Service ("RAS") has either shared or dedicated bands adjacent to the ones used by the Gen 1 Kuiper System. To ensure their protection, the Gen 1 Kuiper System will comply with all relevant protections and limits to PFD levels and other technical parameters set forward by the Commission, including incorporated ITU standards.

2. Earth Exploration-Satellite Service (Passive) Interference Mitigation

The Gen 1 Kuiper System will meet the unwanted emissions limits specified in both footnote US156 to Section 2.106 of the Commission's rules and ITU Resolution 750 established during WRC-19 to avoid interference to Earth exploration-satellite service ("EESS") (passive).

III. ORBITAL DEBRIS AND POST MISSION DISPOSAL PLAN

Section 25.114(d)(14) of the Commission's rules requires a description of the design and operational strategies that will be used to mitigate orbital debris.[12] Space safety is a core tenet for Amazon, and the Gen 1 Kuiper System's satellite design and operational strategies will mitigate orbital debris risks. Amazon has filed, and the Commission has granted, a modification to the Gen 1 Kuiper System Ka-band Authorization that provided an updated orbital debris mitigation plan and demonstrated Amazon's compliance with the Commission's orbital debris mitigation rules.[13] In modifying the orbital parameters of that authorization, Amazon also provided an updated statement.[14] Because this Amendment brings the Gen 1 Kuiper System portion of this application into conformity with the Ka-band authorization for the Gen 1 Kuiper System, Amazon hereby incorporates these statements by reference.

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[12] *See* 47 C.F.R § 25.114(d)(14).

[13] *See* Application of Kuiper Systems LLC for Modification of Authorization to Launch and Operate a Non-Geostationary Satellite Orbit System in Ka-Band Frequencies, ICFS File No. SAT-MOD-20211207-00186 (filed Dec. 7, 2021); *Kuiper Systems LLC, Request for Modification of the Authorization for the Kuiper NGSO Satellite System*, Order and Authorization, 38 FCC Rcd 1112 (IB 2023).

[14] *See* Application of Kuiper Systems LLC for Modification of Authorization for the Kuiper System, ICFS File No. SAT-MOD-20230228-00043 (filed Feb. 28, 2023); *Kuiper Systems LLC, Request for Modification of the Authorization for the Kuiper NGSO Satellite System*, Order and Authorization, 39 FCC Rcd 2180 (2024).

ANNEX A: NGSO-GSO SPECTRUM COMPATIBILITY ANALYSIS

EPFD limits in the Ka-band downlink are outdated and overly stringent in their protection of GSO FSS systems from NGSO FSS system interference. In this annex, Amazon provides an alternative approach to demonstrate that the Gen 1 Kuiper System will not cause harmful interference into GSO systems. In assessing the risk of interference from the Gen 1 Kuiper System to GSO systems operating 17 GHz Band space-to-Earth links over the territory of the United States, Amazon: (1) considered a variety of GSO reference links over the United States; (2) simulated the interference levels from the Gen 1 Kuiper System 17 GHz Band downlink emissions; and (3) computed short-term and long-term interference metrics into the reference GSO system links. As provided in greater detail in this Annex, the results demonstrate that GSO downlink transmissions in the 17 GHz Band within the United States will not experience harmful interference from the Gen 1 Kuiper System.

A. GSO Reference Links

Amazon reviewed GSO reference links from a multitude of sources, including the list of reference links collected by the ITU in the 1990s when the current EPFD rules were studied. Amazon selected several GSO reference links for various ground antenna sizes found in the ITU Radio Regulations Resolution 76 (0.7m, 0.9m, 1.0m, 2.0m, 2.5m, and 5.0m) to show that GSO FSS systems are protected from harmful interference. Amazon considered a variety of target Carrier-to-Noise ("C/N") ratios to account for a range of GSO reference links.

B. Protection Criteria

In order to demonstrate the adequacy of protection levels for GSO systems from NGSO systems with a dynamic interference environment, Amazon considered both short-term and long-term interference protection criteria. For the short-term protection criteria, Amazon evaluated the absolute increase in system unavailability of the GSO system. For long-term protection criteria,

Amazon utilized two metrics: (1) time-averaged throughput degradation and (2) percentage of time-based Interference-to-Noise ("I/N") threshold values. The absolute increase in system unavailability and the time-averaged degraded throughput metrics are an efficient way to evaluate the interference of a NGSO system into other systems. These metrics, referenced in Section 25.261, ensure NGSO systems can efficiently and fairly share spectrum.[15] The Commission ruled that threshold values of no greater than 3% time-average degraded throughput and no greater than 0.4% absolute increase in unavailability would result in acceptable interference.[16] The ITU has adopted degraded throughput and increase in unavailability methodologies to assess V-band interference from NGSO systems into GSO systems;[17] accordingly, these methodologies can be used for 17 GHz Band systems with adaptive coding and modulation. In addition to these protection criteria, Amazon considers a second long-term protection criteria to ensure GSO systems without the flexibility to adapt their link modulation and coding in real time are adequately protected. For this second long-term protection criterion, Amazon evaluated whether the downlink I/N from the Gen 1 Kuiper System into a GSO system does not exceed a value of -10.5 dB for 80% of the time.

C. Simulations

The simulation demonstrates that the Gen 1 Kuiper System will sufficiently protect GSO downlink operations in the 17 GHz Band in the United States. Figure A-1, below, shows a complementary cumulative density function ("CCDF") of I/N from a Gen 1 Kuiper System

[15] *See* 47 C.F.R. § 25.261.

[16] *See Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems*, Second Report and Order and Order on Reconsideration, IB Docket No. 21-456, FCC 24-117 (rel. Nov. 15, 2024).

[17] *See* ITU RR Art. 22, Nos. 22.5L, 22.5M.

downlink into several reference GSO system link downlinks; here, the I/N levels exceed -10.5 dB I/N less than 20% of the time. This is shown by the I/N curves never crossing the red dotted line in Figure A-1.

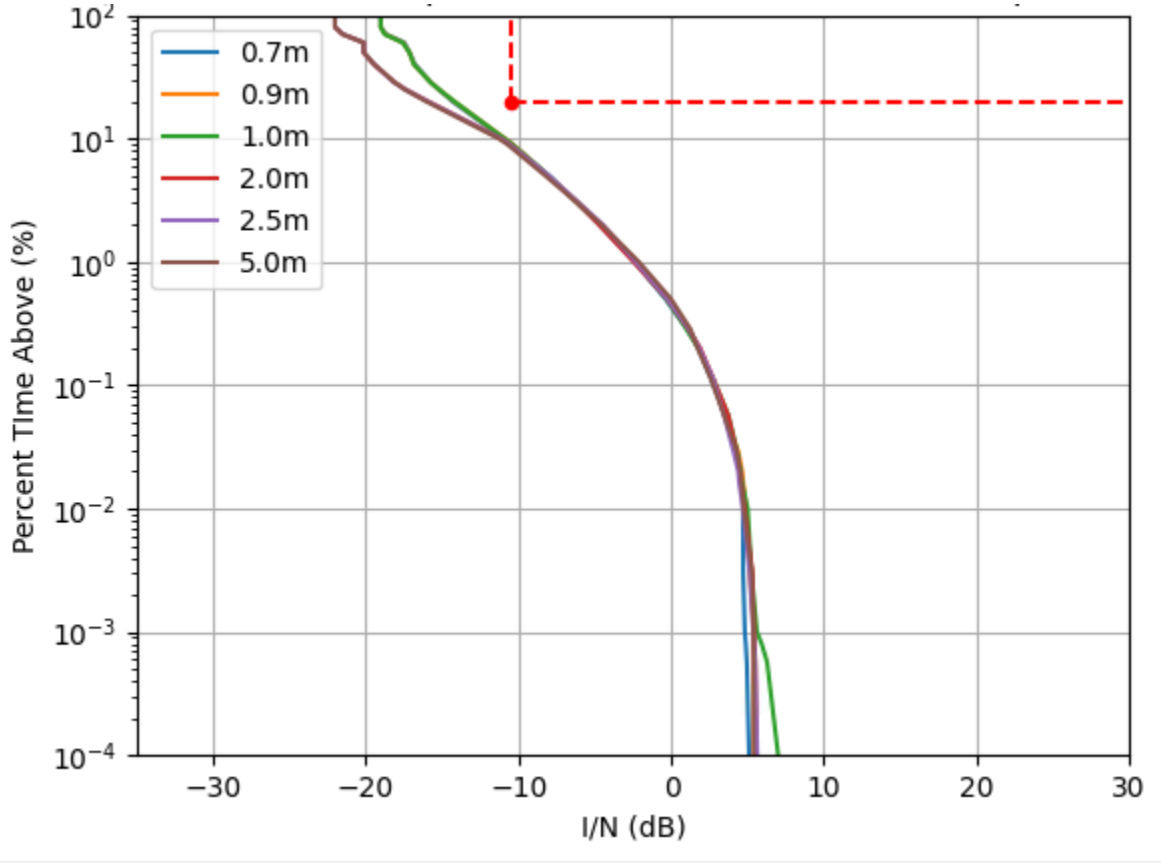

Figure A-1. Gen 1 Kuiper Satellite Downlink I/N CCDF

Similarly, Table A-1, below, shows the time-averaged throughput degradation and absolute increase in system unavailability for a variety of GSO downlink PFD levels, where the time-averaged throughput degradation is well below 3% and the absolute increase in unavailability never exceeds 0%. These results demonstrate that GSO systems will be sufficiently protected from harmful interference.

Table A-1. Throughput Degradation and Absolute Increase in Unavailability vs GSO Link PFD

GSO PFD	**-120 dBW/m^2/MHz**	**-125 dBW/m^2/MHz**

GSO Ground Antenna Diameter	GSO C/N	Throughput Degradation	Increase in Unavailability	GSO C/N	Throughput Degradation	Increase in Unavailability
0.7 m	17.6 dB	1.05%	0.00%	12.6 dB	1.31%	0.00%
0.9 m	19.8 dB	0.97%	0.00%	14.8 dB	1.19%	0.00%
1.0 m	20.7 dB	0.96%	0.00%	15.7 dB	1.14%	0.00%
2.0 m	27.4 dB	0.05%	0.00%	22.4 dB	0.73%	0.00%
2.5 m	29.3 dB	0.01%	0.00%	24.3 dB	0.70%	0.00%
5.0 m	35.4 dB	0.00%	0.00%	30.4 dB	0.00%	0.00%

ANNEX B: SCHEDULE S ATTACHMENT MAPPING

The Schedule S Attachment includes receiving beams, receiving channels, transmitting beams, and transmitting channels for the Gen 1 Kuiper System, Gen 2 Kuiper System, and Polar Kuiper System. In order to clarify which beams and channels are associated with the Gen 1 Kuiper System, Table B-1 and Table B-2 provide the IDs associated with the Gen 1 Kuiper System.

Table B-1. Gen 1 Kuiper System Beams

Beam ID	Schedule S Attachment Beam ID
RV1	RV1A, RV1B, RV1C, RV1D, RV1E, RV1F, RV1G, RV1H, RV1I, RV1J
RV2	RV2A, RV2B, RV2C, RV2D, RV2E, RV2F, RV2G, RV2H, RV2I, RV2J
RV3	RV3A, RV3B, RV3C, RV3D, RV3E, RV3F, RV3G, RV3H, RV3I, RV3J
RV4	RV4A, RV4B, RV4C, RV4D, RV4E, RV4F, RV4G, RV4H, RV4I, RV4J
RV5	RV5A, RV5B
TK8	TK8A, TK8B
TK9	TK9A, TK9B
TK10	TK10A, TK10B
TK11	TK11A, TK11B
TV1	TV1A, TV1B, TV1C, TV1D, TV1E, TV1F, TV1G, TV1H, TV1I, TV1J
TV2	TV2A, TV2B, TV2C, TV2D, TV2E, TV2F, TV2G, TV2H, TV2I, TV2J
TV3	TV3A, TV3B, TV3C, TV3D, TV3E, TV3F, TV3G, TV3H, TV3I, TV3J
TV4	TV4A, TV4B, TV4C, TV4D, TV4E, TV4F, TV4G, TV4H, TV4I, TV4J
TV5	TV5A, TV5B

Table B-2. Gen 1 Kuiper System Channels

Direction	Band	Schedule S Attachment Channel ID
Transmit	Ku-band	N/A
Transmit	Ka-band	TL5, TR5, TL6, TR6, TL7, TR7, TL8, TR8, TL9, TR9, TL10, TR10, TL11, TR11, TL12, TR12, TL13, TR13, TL14, TR14
Transmit	V-band	TL85, TR85, TL86, TR86, TL87, TR87, TL88, TR88, TL89, TR89, TL90, TR90, TL91, TR91, TL92, TR92, TL93, TR93, TL94, TR94, TL95, TR95, TL96, TR96, TL97, TR97, TL98, TR98, TL99, TR99, TL100, TR100, TL101, TR101, TL102, TR102, TL103, TR103, TL104, TR104, TL105, TR105, TL106, TR106, TL107, TR107, TL108, TR108, TL109, TR109, TL110, TR110, TL111, TR111, TL112, TR112, TL113
Receive	Ku-band	N/A
Receive	Ka-band	N/A

Receive	V-band	RL128, RR128, RL129, RR129, RL130, RR130, RL131, RR131, RL132, RR132, RL133, RR133, RL134, RR134, RL135, RR135, RL136, RR136, RL137, RR137, RL138, RR138, RL139, RR139, RL140, RR140, RL141, RR141, RL142, RR142, RL143, RR143, RL144, RR144, RL145, RR145, RL146, RR146, RL147, RR147, RL148, RR148, RL149, RR149, RL150, RR150, RL151, RR151, RL152, RR152, RL153, RR153, RL154, RR154, RL155, RR155, RL156, RR156, RL157, RR157, RL158, RR158, RL159, RR159, RL160, RR160, RL161, RR161