

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of

Kuiper Systems LLC

Application for Gateway Earth Station
Authorization

Call Sign _____

File No. SES-LIC _____

APPLICATION FOR GATEWAY EARTH STATION AUTHORIZATION

Kuiper Systems LLC (“Kuiper”), a wholly owned subsidiary of Amazon.com Services LLC (collectively “Amazon”), seeks authority to operate a fixed gateway earth station (“gateway”) in Blountstown, Florida. This narrative demonstrates why authorizing this gateway would serve the public interest and explains how Amazon will operate consistent with the Commission’s rules.

I. INTRODUCTION AND BACKGROUND

On July 30, 2020, the Commission authorized Amazon to deploy a 3,236 satellite non-geostationary satellite orbit (“NGSO”) system to provide service using certain Fixed-Satellite Service (“FSS”) and Mobile-Satellite Service (“MSS”) Ka-band frequencies (the “Kuiper System”).¹ As the basis for that authorization, the Commission determined that Amazon’s system would expand the availability of high-speed broadband, thus serving the public interest.² Since then, Amazon has taken significant steps to support deployment of the Kuiper System and advance its goal of providing affordable, reliable, high-quality connectivity to customers and communities

¹ See *Kuiper Systems LLC, Application for Authority to Deploy and Operate a Ka-band Non-Geostationary Satellite Orbit System*, Order and Authorization, 35 FCC Rcd 8324-25 ¶¶ 3-4 (2020) (“*Kuiper System Authorization*”).

² See *Kuiper System Authorization*, 35 FCC Rcd at 8326 ¶ 9.

around the world—including growing the team dedicated to the Kuiper System to more than 1,000 employees, and purchasing launch capacity from a diverse set of providers to carry into space the majority of the 3,236 satellites that make up the currently authorized Kuiper constellation.³ Amazon has also taken steps to comply with the conditions of its authorization, including by filing an updated orbital debris mitigation plan upon finalizing its space station design.⁴

With this application, Amazon seeks authority to operate the proposed gateway in Blountstown, Florida. The gateway will consist of six (6) technically identical 2.4-meter antennas that will communicate with Amazon’s NGSO FSS and MSS Kuiper System (call sign S3051) in the frequency bands 27.5-30.0 GHz (Earth-to-space) and 17.8-18.6 GHz and 18.8-20.2 GHz (space-to-Earth). No more than four (4) antennas will transmit on the same channel at any one time.

II. PUBLIC INTEREST BENEFITS

When the Commission originally authorized the Kuiper System, it “conclude[d] that grant of Kuiper’s application would advance the public interest” because the Kuiper System was “designed to increase the availability of high-speed broadband service to consumers, government, and businesses.”⁵ The same public interest considerations that supported grant of the original space station application support granting this gateway application now.

Grant of this application will allow Amazon’s Kuiper System to execute its plans to deliver satellite broadband communications services to tens of millions of unserved and underserved

³ See *Amazon Makes Historic Launch Investment to Advance Project Kuiper*, Amazon (Apr. 5, 2022), <https://bit.ly/3uvlwBT>.

⁴ See Kuiper Systems LLC, Application for Modification of Authorization for the Kuiper System, Call Sign S3051, File No. SAT-MOD-20211207-00186 (Dec. 7, 2021).

⁵ *Kuiper System Authorization*, 35 FCC Rcd at 8324 ¶ 3.

consumers and businesses in the United States and around the globe.⁶ Indeed, grant of this gateway application will accelerate Kuiper’s ability to bring connectivity to consumers and enterprise customers, enabling growth in local economies, improving access to government services, and supporting public safety and disaster relief communications.

III. SPECTRUM USE AND SHARING

Amazon will adhere to all International Telecommunication Union (“ITU”) and Commission requirements and pertinent future Commission rulemakings governing NGSO Ka-band gateways. When sharing spectrum, Amazon will operate consistent with the *Kuiper System Authorization*⁷ and the Commission’s rules, as discussed below.

A. Kuiper System Gateway Transmit Frequencies

The gateway will transmit to Kuiper System satellites in the frequencies listed in Table 1 and follow relevant sharing requirements in the Commission’s rules.

⁶ See, e.g., *In re Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, Fourteenth Broadband Deployment Report, 36 FCC Rcd 836, 837 ¶ 2 (2021) (noting that 14.5 million Americans lack access to fixed terrestrial broadband with benchmark download and upload speeds of 25 Mbps and 3 Mbps, respectively).

⁷ See *Kuiper System Authorization*, 35 FCC Rcd at 8344-45 ¶ 59.

Table 1: Kuiper System Gateway Transmit Frequencies

Transmit Frequencies (GHz)	Status⁸
27.5-28.35	FSS secondary to UMFUS ⁹ NGSO FSS secondary to GSO FSS
28.35-28.6	NGSO FSS secondary to GSO FSS
28.6-29.1	NGSO FSS primary
29.1-29.5	NGSO MSS feeder link co-primary
29.5-30.0	NGSO FSS secondary to GSO FSS

1. 27.5-28.35 GHz (NGSO FSS secondary to UMFUS and GSO FSS)

NGSO FSS may transmit on a secondary basis to the Upper Microwave Flexible Use Service (“UMFUS”) in the 27.5-28.35 GHz band.¹⁰ Amazon intends to operate the proposed gateway on a non-interference basis with respect to UMFUS systems in this band. Exhibit A, the

⁸ See generally 47 C.F.R. § 2.106; *In re 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 (2017) (“*NGSO FSS Order*”); *id.* at 7850-51 Appendix B (“Ka-band Plan”).

⁹ EPFD compliance permits NGSO and GSO FSS sharing. See *NGSO FSS Order*, 32 FCC Rcd at 7817, 7821-22 ¶¶ 23, 37, 39; 47 C.F.R. § 25.289.

¹⁰ See 47 C.F.R. §25.202(a)(1)(i) (“In the 27.5-28.35 GHz band, the FSS (Earth-to-space) is secondary to the Upper Microwave Flexible Use Service authorized pursuant to part 30 of this chapter, except for FSS operations associated with earth stations authorized pursuant to § 25.136”). See also O3b Gateway Earth Station Application, IBFS File No. SES-LIC-20210217-00350 (Feb. 17, 2021) (granting operations in the 27.5-28.35 GHz band on a secondary basis to UMFUS and finding that the NGSO applicant did not need to submit PFD contour or additional information ensuring protection to UMFUS to operate on a secondary basis).

Comsearch report,¹¹ establishes that Amazon has coordinated with terrestrial licensees consistent with section 101.103(d) and can operate without causing harmful interference to any such deployments.¹² In the event that Amazon’s operations create harmful interference to future UMFUS deployments, Amazon will take any necessary steps to resolve the harmful interference.

NGSO FSS must also operate on an unprotected, non-interference basis with respect to GSO FSS networks in this band.¹³ Amazon does not claim interference protection from GSO FSS in this band. In addition, Amazon certifies that it will comply with the applicable EPFD limits in ITU Radio Regulations Article 22 and Resolution 76,¹⁴ which the Commission has found to be sufficient to protect GSO systems against harmful interference,¹⁵ and will otherwise comply with the terms of the Kuiper Authorization.¹⁶

2. 28.35-28.6 GHz and 29.5-30.0 GHz (NGSO FSS secondary to GSO FSS systems)

NGSO FSS may transmit on a secondary basis to geostationary orbit (“GSO”) FSS in the 28.35-28.6 GHz and 29.5-30.0 GHz bands.¹⁷ Amazon does not claim interference protection from GSO FSS in these bands and certifies it will comply with the applicable EPFD limits in ITU Radio

¹¹ The gateway site is in Blountstown, Florida. The Comsearch report refers to the site location as “Clarksville, FL” due to the city of Clarksville’s proximity to the site location.

¹² See 47 C.F.R. § 101.103(d); Exhibit A.

¹³ See *NGSO FSS Order*, 32 FCC Rcd at 7817 ¶ 23.

¹⁴ See 47 C.F.R. §§ 25.108, 25.115(f)(1), 25.146(a)(2); ITU Radio Regulations Article 22 and Resolution 76 (WRC-15) (incorporated by reference at 47 C.F.R. § 25.108).

¹⁵ See, e.g., *2000 NGSO FSS Order*, 16 FCC Rcd 4096, 4129-30 ¶ 77 (concluding that implementation of EPFD limits “will adequately protect GSO FSS networks”); 47 C.F.R. § 25.289 (NGSO satellite systems that comply with EPFD limits will be deemed not to cause unacceptable interference to any GSO network).

¹⁶ See *Kuiper System Authorization*, 35 FCC Rcd at 8328 ¶ 16.

¹⁷ See 47 C.F.R. § 2.106; Ka-band Plan.

Regulations Article 22 and Resolution 76 to ensure transmissions do not cause harmful interference.¹⁸

3. 28.6-29.1 GHz (NGSO FSS primary)

NGSO FSS may transmit on a primary basis in the 28.6-29.1 GHz band.¹⁹ Amazon's operations as NGSO FSS possess primary status in the band.²⁰

4. 29.1-29.5 GHz (NGSO MSS feeder link co-primary)

NGSO MSS feeder links may transmit on a co-primary basis with the Local Multipoint Distribution Service ("LMDS") in the 29.1-29.25 GHz band and GSO FSS in the 29.25-29.5 GHz band.²¹ As described in the following sub-sections, the Commission has granted Amazon authority to operate NGSO MSS feeder links in this band and, therefore, the gateway may operate on a primary basis.²²

a. NGSO MSS feeder link

To share with other co-primary NGSO MSS feeder link systems, Amazon will coordinate use of the band with NGSO system operators not included in the March 2020 processing round

¹⁸ See 47 C.F.R. §§ 2.106, 25.108(a), (c), 25.115(f)(1), 25.146(a)(2); Ka-band Plan; ITU Radio Regulations Article 22 and Resolution 76 (WRC-15) (incorporated by reference at 47 C.F.R. § 25.108). See also *In re Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, First Report and Order and Further Notice of Proposed Rule Making, 16 FCC Rcd 4096, 4129-30 ¶ 77 (2000) ("2000 NGSO FSS Order") (concluding that compliance with EPFD limits "will adequately protect GSO FSS networks").

¹⁹ See 47 C.F.R. § 2.106; Ka-band Plan.

²⁰ See *Kuiper System Authorization*, 35 FCC Rcd at 8327 ¶ 11; 47 C.F.R. § 25.261. In the 28.5-29.1 GHz band, Amazon will not cause harmful interference to, or claim protection from, grandfathered Fixed Service ("FS") stations as required by the Commission's rules. See 47 C.F.R. § 2.106 n. NG62.

²¹ See 47 C.F.R. § 2.106; Ka-band Plan.

²² See *Kuiper System Authorization*, 35 FCC Rcd at 8325, 8330-31 ¶¶ 5 n.7, 24-25.

before commencing service²³ and employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.²⁴

b. LMDS

To share with LMDS, Amazon will coordinate as required by the Commission's rules.²⁵

c. FS

To share with FS, Amazon will not cause harmful interference to, or claim protection from, grandfathered FS stations as required by the Commission's rules.²⁶

B. Kuiper System Gateway Receive Frequencies

The gateway will receive transmissions from the Kuiper System in the frequencies listed in Table 2 and follow relevant sharing requirements in the Commission's rules.²⁷

Table 2: Kuiper System Gateway Receive Frequencies

Frequencies (GHz)	Status ²⁸
17.8-18.3	FSS secondary to FS ²⁹
18.3-18.6	NGSO FSS secondary to GSO FSS
18.8-19.3	NGSO FSS primary

²³ Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. *See Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i).

²⁴ *See Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i); 47 C.F.R. § 25.261.

²⁵ *See* 47 C.F.R. §§ 25.203, 101.103(d).

²⁶ *See* 47 C.F.R. § 2.106 n.NG62.

²⁷ Before operating in these bands, Amazon will complete coordination with U.S. Federal systems. *See id.* n.US334; *Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(m).

²⁸ *See generally* 47 C.F.R. § 2.106. *See also generally* *NGSO FSS Order*; Ka-band Plan.

²⁹ EPFD compliance permits NGSO and GSO FSS sharing. *See NGSO FSS Order*, 32 FCC Rcd 7809, 7812, 7821-22 ¶¶ 7 n.19, 37, 39; 47 C.F.R. § 25.289.

Frequencies (GHz)	Status ²⁸
19.3-19.4 and 19.6-19.7	NGSO FSS secondary to FS, NGSO MSS FL, and GSO FSS
19.4-19.6	NGSO MSS feeder link co-primary
19.7-20.2	NGSO FSS secondary to GSO FSS

1. 17.8-18.3, 19.3-19.4, and 19.6-19.7 GHz (NGSO FSS secondary to FS)

NGSO FSS may receive on a secondary basis to FS in the 17.8-18.3, 19.3-19.4, and 19.6-19.7 GHz bands.³⁰ To share with FS, Amazon will meet the power flux-density limits in ITU Radio Regulations Article 21.³¹ The Comsearch report confirms that no additional limitations are necessary.³²

2. 18.3-18.6 and 19.7-20.2 GHz (NGSO FSS secondary to GSO FSS)

NGSO FSS may receive on an unprotected, non-interference basis with respect to GSO FSS in the 18.3-18.6 GHz and 19.7-20.2 GHz bands.³³ To share with GSO FSS, Amazon will comply with the applicable EPFD limits in ITU Radio Regulations Article 22 and Resolution 76.³⁴

³⁰ See 47 C.F.R. § 2.106 n.NG166; Ka-band Plan.

³¹ See *Kuiper System Authorization*, 35 FCC Rcd at 8327, 8344 ¶¶ 13, 59(d)-(e).

³² See Exhibit A.

³³ See 47 C.F.R. § 2.106; Ka-band Plan.

³⁴ The Commission has found that EPFD demonstrations may permit NGSO FSS to share frequency bands with GSO FSS. See *Kuiper System Authorization*, 35 FCC Rcd at 8327-28, 8344 ¶¶ 13, 14, 59(d)-(e); 47 C.F.R. § 25.202(f); *NGSO FSS Order*, 32 FCC Rcd at 7821 ¶ 36 n.84. See also *2000 NGSO FSS Order*, 16 FCC Rcd 4096, 4129-30 ¶ 77.

3. 18.8-19.3 GHz (NGSO FSS primary)

NGSO FSS may receive on a primary basis in the 18.8-19.3 GHz band.³⁵ Amazon's operations are licensed as NGSO FSS and, therefore, possess primary status in the band.³⁶

4. 19.3-19.4 and 19.6-19.7 GHz (NGSO FSS secondary to GSO FSS)

NGSO FSS may receive on a secondary basis with respect to GSO FSS in the 19.3-19.4 GHz and 19.6-19.7 GHz bands.³⁷ To share with GSO FSS, Amazon will neither cause harmful interference to GSO FSS nor claim protection from harmful interference from GSO FSS.³⁸

5. 19.3-19.4 and 19.6-19.7 GHz (NGSO FSS secondary to NGSO MSS feeder link)

NGSO FSS may receive on a secondary basis to NGSO MSS feeder link systems in the 19.3-19.4 and 19.6-19.7 GHz bands.³⁹ To share with NGSO MSS feeder links, Amazon will coordinate use of the band with NGSO system operators not in the March 2020 processing round before commencing service⁴⁰ and employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.⁴¹

6. 19.4-19.6 GHz (NGSO MSS feeder link co-primary)

NGSO MSS feeder links may receive on a co-primary basis with FS in the 19.4-19.6 GHz band.⁴² To share with co-primary MSS feeder link systems, Amazon will coordinate use of the

³⁵ See 47 C.F.R. § 2.106; Ka-band Plan.

³⁶ See *Kuiper System Authorization*, 35 FCC Rcd at 8327 ¶ 11.

³⁷ See 47 C.F.R. § 2.106; Ka-band Plan; *NGSO FSS Order*, 32 FCC Rcd at 7815-16 ¶ 19.

³⁸ See 47 C.F.R. § 2.105(c)(2).

³⁹ See 47 C.F.R. § 2.106; Ka-band Plan.

⁴⁰ Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. See *Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i); 47 C.F.R. § 25.261.

⁴¹ See *Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i); 47 C.F.R. § 25.261.

⁴² See 47 C.F.R. § 2.106; Ka-band Plan.

band with operators not in the March 2020 processing round before commencing service and employ the section 25.261 spectrum-sharing framework with operators in the March 2020 processing round while operating service.⁴³

IV. ANTENNA PATTERN

There are no Commission standards for NGSO Ka-band gateway antenna pattern performance. The available standards consider only GSO Ku-/Ka-band or NGSO Ku-band operations because the Commission has “not yet determined what off-axis gain envelopes might be appropriate for [Ka-band gateways] operating with NGSO FSS space stations, either to facilitate NGSO-to-NGSO or NGSO-to-GSO interference protection.”⁴⁴ Amazon nonetheless will comply with the section 25.209(a)(1) mask for GSO Ka-band earth station antennas, as illustrated in Exhibit C’s simulated antenna pattern.⁴⁵

V. RADIATION HAZARD ANALYSIS

Exhibit B, the Radiation Hazard Analysis, confirms that Amazon complies with relevant Commission standards and demonstrates there is no risk of radiation exposure beyond the acceptable limits.⁴⁶ To further protect the general public, Amazon will site the gateway either behind a fence or on private commercial property with limited access. Trained technicians

⁴³ Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. *See Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i); 47 C.F.R. § 25.261.

⁴⁴ *In re Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713, 14784 ¶ 213 (2015). *See also NGSO FSS Order*, 32 FCC Rcd at 7827 ¶¶ 54-55 & n.121 (declining to adopt NGSO gateway antenna performance standards). *See generally* 47 C.F.R. §§ 25.132, 25.209.

⁴⁵ *See* 47 C.F.R. § 25.209(a)(1); Exhibit C.

⁴⁶ *See* FCC OET Bulletin No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields* (Aug. 1997), <https://bit.ly/3SCjsBB>; 47 C.F.R. § 1.1310; Exhibit B.

responsible for operating the gateway will turn off and secure the transmitters before performing any maintenance work.

VI. FAA NOTIFICATION

For an antenna structure of 6.1 meters or less in height above ground level, the Commission requires no Federal Aviation Administration (“FAA”) notification.⁴⁷ Amazon’s antenna structure for the gateway measures 6.1 meters or less in height above ground level and requires no FAA notification.

VII. CONCLUSION

Amazon has satisfied the Commission’s licensing standards for NGSO Ka-band gateways. Prompt grant of this application will accelerate the deployment of the Kuiper System and its ability to expand broadband access for consumers, schools, hospitals, businesses, and other organizations across the United States.

Respectfully submitted,

/s/ Liliana Farfan Roach
Liliana Farfan Roach
Corporate Counsel
Kuiper Systems LLC

November 28, 2022

⁴⁷ See 47 C.F.R. § 17.2 (defining antenna structure as a structure that is constructed or used to transmit and/or receive radio energy or that supports antennas that transmit and/or receive radio energy and other appurtenances mounted thereon). See also *id.* §§ 17.7(e), 25.115(j).

EXHIBIT A (COMSEARCH REPORT)

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Kuiper Systems LLC.
CLARKSVILLE, FL
Satellite Earth Station

Prepared By:
COMSEARCH
21515 Ridgetop Circle, Suite 300
Sterling, VA 20166
October 24, 2022

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1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

Coordination data for this earth station was sent to the below listed carriers with a letter dated 09/13/2022.

Company

Alabama Broadcatsing Partners
Alabama Power Company
Dish Wireless LLC
Diverse Power Inc
Gray Television Licensee, LLC
Kudzu Networks, Inc.
New Cingular Wireless PCS LLC - AL, MS
New Cingular Wireless PCS LLC - N FL
Olympic Wireless, LLC
SOM1101, LLC
Southern Company Services, Inc.
Sprint Spectrum LLC
Sprint Telephony PCS, L.P.
Sprintcom, Inc

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Date: 10/24/2022
Job Number: 220913COMSGE08

Administrative Information

Status: ENGINEER PROPOSAL
Call Sign:
Licensee Code: KUIPER
Licensee Name: Kuiper Systems LLC.

Site Information

CLARKSVILLE, FL

Venue Name:
Latitude (NAD 83): 30° 25' 26.2" N
Longitude (NAD 83): 85° 8' 53.8" W
Climate Zone: B
Rain Zone: 1
Ground Elevation (AMSL): 30.16 m / 99.0 ft

Link Information

Satellite Type: Low Earth Orbit
Mode: TR - Transmit-Receive
Modulation: Digital
Minimum Elevation Angle: 20.0°
Azimuth Range: 0.0° to 360°
Antenna Centerline (AGL): 2.74 m / 9.0 ft

Antenna Information

Receive - FCC32

Transmit - FCC32

Manufacturer	Kuiper	Kuiper
Model	Model 24001	Model 24001
Gain / Diameter	49.0 dBi / 2.4 m	53.8 dBi / 2.4 m
3-dB / 15-dB Beamwidth	0.77° / 1.70°	0.49° / 1.17°
Max Available RF Power (dBW/4 kHz)		-41.0
	(dBW/MHz)	-17.0
Maximum EIRP (dBW/4 kHz)		12.8
	(dBW/MHz)	36.8
Interference Objectives:	Long Term	-156.0 dBW/MHz 20%
	Short Term	-146.0 dBW/MHz 0.01%
		-151.0 dBW/4 kHz 20%
		-128.0 dBW/4 kHz 0.0025%

Frequency Information

Receive 18.0 GHz

Transmit 28.0 GHz

Emission / Frequency Range (MHz): 50M0G7D - 500MG7D / 17800.0 - 18600.0 50M0G7D - 500MG7D / 27500.0 - 30000.0
50M0G7D - 500MG7D / 18800.0 - 20200.0

Max Great Circle Coordination Distance: 247.0 km / 153.5 mi 25.0 km / 15.5 mi
Precipitation Scatter Contour Radius: 100.0 km / 62.1 mi 100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Coordination Values

CLARKSVILLE, FL

Licensee Name Kuiper Systems LLC.
Latitude (NAD 83) 30° 25' 26.2" N
Longitude (NAD 83) 85° 8' 53.8" W
Ground Elevation (AMSL) 30.16 m / 99.0 ft
Antenna Centerline (AGL) 2.74 m / 9.0 ft
Antenna Model Kuiper 2.4 meter
Antenna Mode Receive 18.0 GHz Transmit 28.0 GHz
Interference Objectives: Long Term -156.0 dBW/MHz 20% -151.0 dBW/4 kHz 20%
Short Term -146.0 dBW/MHz 0.01% -128.0 dBW/4 kHz 0.0025%
Max Available RF Power -41.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	92.46	-0.50	247.00	-0.50	25.00
5	0.00	87.47	-0.50	247.00	-0.50	25.00
10	0.00	82.49	-0.50	247.00	-0.50	25.00
15	0.00	77.50	-0.50	247.00	-0.50	25.00
20	0.00	72.52	-0.50	247.00	-0.50	25.00
25	0.00	67.54	-0.50	247.00	-0.50	25.00
30	0.00	62.56	-0.50	247.00	-0.50	25.00
35	0.00	57.58	-0.50	247.00	-0.50	25.00
40	0.00	52.60	-0.50	247.00	-0.50	25.00
45	0.00	47.62	-0.50	247.00	-0.50	25.00
50	0.00	42.66	-0.50	247.00	-0.50	25.00
55	0.00	37.69	-0.50	247.00	-0.50	25.00
60	0.00	32.74	-0.50	247.00	-0.50	25.00
65	0.00	27.80	-0.50	247.00	-0.50	25.00
70	0.00	22.88	-0.50	247.00	-0.50	25.00
75	0.00	18.01	-0.50	247.00	-0.50	25.00
80	0.00	13.24	-0.50	247.00	-0.50	25.00
85	0.00	8.70	-0.50	247.00	-0.50	25.00
90	0.00	5.12	-0.50	247.00	-0.50	25.00
95	0.00	5.16	-0.50	247.00	-0.50	25.00
100	0.00	8.77	-0.50	247.00	-0.50	25.00
105	0.00	13.30	-0.50	247.00	-0.50	25.00
110	0.00	18.08	-0.50	247.00	-0.50	25.00
115	0.00	22.96	-0.50	247.00	-0.50	25.00
120	0.00	27.87	-0.50	247.00	-0.50	25.00
125	0.00	32.81	-0.50	247.00	-0.50	25.00
130	0.00	37.76	-0.50	247.00	-0.50	25.00
135	0.00	42.73	-0.50	247.00	-0.50	25.00
140	0.00	47.70	-0.50	247.00	-0.50	25.00
145	0.00	52.67	-0.50	247.00	-0.50	25.00
150	0.00	57.65	-0.50	247.00	-0.50	25.00
155	0.00	62.63	-0.50	247.00	-0.50	25.00
160	0.00	67.61	-0.50	247.00	-0.50	25.00
165	0.00	72.59	-0.50	247.00	-0.50	25.00
170	0.00	77.58	-0.50	247.00	-0.50	25.00
175	0.00	82.56	-0.50	247.00	-0.50	25.00
180	0.00	87.54	-0.50	247.00	-0.50	25.00
185	0.00	92.53	-0.50	247.00	-0.50	25.00

COMSEARCH

Earth Station Data Sheet

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(703)726-5500 <http://www.comsearch.com>

Coordination Values

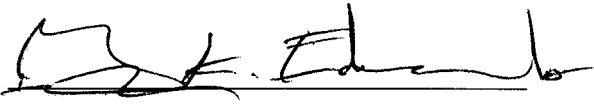
CLARKSVILLE, FL

Licensee Name Kuiper Systems LLC.
Latitude (NAD 83) 30° 25' 26.2" N
Longitude (NAD 83) 85° 8' 53.8" W
Ground Elevation (AMSL) 30.16 m / 99.0 ft
Antenna Centerline (AGL) 2.74 m / 9.0 ft
Antenna Model Kuiper 2.4 meter
Antenna Mode Receive 18.0 GHz Transmit 28.0 GHz
Interference Objectives: Long Term -156.0 dBW/MHz 20% -151.0 dBW/4 kHz 20%
Short Term -146.0 dBW/MHz 0.01% -128.0 dBW/4 kHz 0.0025%
Max Available RF Power -41.0 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	97.51	-0.50	247.00	-0.50	25.00
195	0.00	102.50	-0.50	247.00	-0.50	25.00
200	0.00	107.48	-0.50	247.00	-0.50	25.00
205	0.00	112.46	-0.50	247.00	-0.50	25.00
210	0.00	117.44	-0.50	247.00	-0.50	25.00
215	0.00	122.42	-0.50	247.00	-0.50	25.00
220	0.00	127.40	-0.50	247.00	-0.50	25.00
225	0.00	132.38	-0.50	247.00	-0.50	25.00
230	0.00	137.34	-0.50	247.00	-0.50	25.00
235	0.00	142.31	-0.50	247.00	-0.50	25.00
240	0.00	147.26	-0.50	247.00	-0.50	25.00
245	0.00	152.20	-0.50	247.00	-0.50	25.00
250	0.00	157.12	-0.50	247.00	-0.50	25.00
255	0.00	161.99	-0.50	247.00	-0.50	25.00
260	0.00	166.76	-0.50	247.00	-0.50	25.00
265	0.00	171.30	-0.50	247.00	-0.50	25.00
270	0.00	174.88	-0.50	247.00	-0.50	25.00
275	0.00	174.84	-0.50	247.00	-0.50	25.00
280	0.00	171.23	-0.50	247.00	-0.50	25.00
285	0.00	166.70	-0.50	247.00	-0.50	25.00
290	0.00	161.92	-0.50	247.00	-0.50	25.00
295	0.00	157.04	-0.50	247.00	-0.50	25.00
300	0.00	152.13	-0.50	247.00	-0.50	25.00
305	0.00	147.19	-0.50	247.00	-0.50	25.00
310	0.00	142.24	-0.50	247.00	-0.50	25.00
315	0.00	137.27	-0.50	247.00	-0.50	25.00
320	0.00	132.30	-0.50	247.00	-0.50	25.00
325	0.00	127.33	-0.50	247.00	-0.50	25.00
330	0.00	122.35	-0.50	247.00	-0.50	25.00
335	0.00	117.37	-0.50	247.00	-0.50	25.00
340	0.00	112.39	-0.50	247.00	-0.50	25.00
345	0.00	107.41	-0.50	247.00	-0.50	25.00
350	0.00	102.42	-0.50	247.00	-0.50	25.00
355	0.00	97.44	-0.50	247.00	-0.50	25.00

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

BY: 

Gary K. Edwards
Senior Manager
COMSEARCH
21515 Ridgetop Circle, Suite 300
Sterling, VA 20166

DATED: October 24, 2022

Ka-Band Earth Station – Clarksville, FL

Frequency Coordination Report

28 GHz



Prepared on Behalf of
KUIPER SYSTEMS, LLC

October 24, 2022



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1. Summary of Results

On behalf of KUIPER SYSTEMS, LLC, Comsearch performed a coordination notice under Section 25.203(c) and Section 25.136(a)(4) of the FCC's rules for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Clarksville, FL, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on October 24, 2022.

There were no reported objections from any of the incumbent 28 GHz licensees.

2. 28 GHz Common Carrier and LTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Clarksville, FL was prior-coordinated by Comsearch. A notification letter and datasheets for this earth station were sent to the following 28 GHz common carrier fixed microwave licensees. These licensees are authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a nationwide basis or local basis.

Licensee	Authorized Geographic Area
AT&T	Statewide: FL

A notification letter and datasheets for the Ka-Band earth station in Clarksville, FL were also sent to the following 28 GHz local television transmission licensee. This licensee is authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
None Identified	

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.5 – 30.0 GHz portion of the Ka-Band.

3. 28 GHz UMFUS Coordination

There were two 28 GHz UMFUS licensees identified within the coordination distance of the proposed earth station. The proposed earth station will operate on frequencies that overlap Channel L1 & L2 of the UMFUS service. The total frequency allocation for Channels L1 & L2 of the UMFUS spectrum appears below.

Channel: **L1** 27.500 - 27.925 GHz
 L2 27.925 - 28.350 GHz

Licensee	Authorized Geographic Area
Pine Belt Cellular	Market Based
Verizon	Market Based

There were no reported Objections from the UMFUS incumbents within coordination distance.



4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Clarksville, FL. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

Job Number: 220913COMSGE08

Administrative Information

Status: ENGINEER PROPOSAL
Call Sign:
Licensee Code: KUIPER
Licensee Name: Kuiper Systems LLC.

Site Information

CLARKSVILLE, FL
Venue Name:
Latitude (NAD 83): 30° 25' 26.2" N
Longitude (NAD 83): 85° 8' 53.8" W
Climate Zone: B
Rain Zone: 1
Ground Elevation (AMSL): 30.16 m / 99.0 ft

Link Information

Satellite Type: Low Earth Orbit
Mode: TR - Transmit-Receive
Modulation: Digital
Minimum Elevation Angle: 20.0°
Azimuth Range: 0.0° to 360°
Antenna Centerline (AGL): 2.74 m / 9.0 ft

Antenna Information

Manufacturer:
Model:
Gain / Diameter:
3-dB / 15-dB Beamwidth:

Receive - FCC32

Kuiper
Model 24001
49.0 dBi / 2.4 m
0.77° / 1.70°

Transmit - FCC32

Kuiper
Model 24001
53.8 dBi / 2.4 m
0.49° / 1.17°

Max Available RF Power (dBW/4 kHz)
(dBW/MHz)

-41.0
-17.0

Maximum EIRP (dBW/4 kHz)
(dBW/MHz)

12.8
36.8

Interference Objectives: Long Term
Short Term

-156.0 dBW/MHz 20%
-146.0 dBW/MHz 0.01%

-151.0 dBW/4 kHz 20%
-128.0 dBW/4 kHz 0.0025%

Frequency Information

Emission / Frequency Range (MHz)

Receive 18.0 GHz

50M0G7D - 500MG7D / 17800.0 - 18600.0
50M0G7D - 500MG7D / 18800.0 - 20200.0

Transmit 28.0 GHz

50M0G7D - 500MG7D / 27500.0 - 30000.0

Max Great Circle Coordination Distance
Precipitation Scatter Contour Radius

247.0 km / 153.5 mi
100.0 km / 62.1 mi

25.0 km / 15.5 mi
100.0 km / 62.1 mi

Coordination Values		CLARKSVILLE, FL		
Licensee Name		Kuiper Systems LLC.		
Latitude (NAD 83)		30° 25' 26.2" N		
Longitude (NAD 83)		85° 8' 53.8" W		
Ground Elevation (AMSL)		30.16 m / 99.0 ft		
Antenna Centerline (AGL)		2.74 m / 9.0 ft		
Antenna Model		Kuiper 2.4 meter		
Antenna Mode		Receive 18.0 GHz		Transmit 28.0 GHz
Interference Objectives: Long Term		-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz 20%
Short Term		-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power			-41.0 (dBW/4 kHz)	

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	92.46	-0.50	247.00	-0.50	25.00
5	0.00	87.47	-0.50	247.00	-0.50	25.00
10	0.00	82.49	-0.50	247.00	-0.50	25.00
15	0.00	77.50	-0.50	247.00	-0.50	25.00
20	0.00	72.52	-0.50	247.00	-0.50	25.00
25	0.00	67.54	-0.50	247.00	-0.50	25.00
30	0.00	62.56	-0.50	247.00	-0.50	25.00
35	0.00	57.58	-0.50	247.00	-0.50	25.00
40	0.00	52.60	-0.50	247.00	-0.50	25.00
45	0.00	47.62	-0.50	247.00	-0.50	25.00
50	0.00	42.66	-0.50	247.00	-0.50	25.00
55	0.00	37.69	-0.50	247.00	-0.50	25.00
60	0.00	32.74	-0.50	247.00	-0.50	25.00
65	0.00	27.80	-0.50	247.00	-0.50	25.00
70	0.00	22.88	-0.50	247.00	-0.50	25.00
75	0.00	18.01	-0.50	247.00	-0.50	25.00
80	0.00	13.24	-0.50	247.00	-0.50	25.00
85	0.00	8.70	-0.50	247.00	-0.50	25.00
90	0.00	5.12	-0.50	247.00	-0.50	25.00
95	0.00	5.16	-0.50	247.00	-0.50	25.00
100	0.00	8.77	-0.50	247.00	-0.50	25.00
105	0.00	13.30	-0.50	247.00	-0.50	25.00
110	0.00	18.08	-0.50	247.00	-0.50	25.00
115	0.00	22.96	-0.50	247.00	-0.50	25.00
120	0.00	27.87	-0.50	247.00	-0.50	25.00
125	0.00	32.81	-0.50	247.00	-0.50	25.00
130	0.00	37.76	-0.50	247.00	-0.50	25.00
135	0.00	42.73	-0.50	247.00	-0.50	25.00
140	0.00	47.70	-0.50	247.00	-0.50	25.00
145	0.00	52.67	-0.50	247.00	-0.50	25.00
150	0.00	57.65	-0.50	247.00	-0.50	25.00
155	0.00	62.63	-0.50	247.00	-0.50	25.00
160	0.00	67.61	-0.50	247.00	-0.50	25.00
165	0.00	72.59	-0.50	247.00	-0.50	25.00
170	0.00	77.58	-0.50	247.00	-0.50	25.00
175	0.00	82.56	-0.50	247.00	-0.50	25.00
180	0.00	87.54	-0.50	247.00	-0.50	25.00
185	0.00	92.53	-0.50	247.00	-0.50	25.00



KUIPER SYSTEMS, LLC
Ka-Band Earth Station – Clarksville, FL
Frequency Coordination Report
28 GHz

Coordination Values		CLARKSVILLE, FL	
Licensee Name		Kuiper Systems LLC.	
Latitude (NAD 83)		30° 25' 26.2" N	
Longitude (NAD 83)		85° 8' 53.8" W	
Ground Elevation (AMSL)		30.16 m / 99.0 ft	
Antenna Centerline (AGL)		2.74 m / 9.0 ft	
Antenna Model		Kuiper 2.4 meter	
Antenna Mode		Receive 18.0 GHz	Transmit 28.0 GHz
Interference Objectives: Long Term		-156.0 dBW/MHz 20%	-151.0 dBW/4 kHz 20%
	Short Term	-146.0 dBW/MHz 0.01%	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power		-41.0 (dBW/4 kHz)	

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	97.51	-0.50	247.00	-0.50	25.00
195	0.00	102.50	-0.50	247.00	-0.50	25.00
200	0.00	107.48	-0.50	247.00	-0.50	25.00
205	0.00	112.46	-0.50	247.00	-0.50	25.00
210	0.00	117.44	-0.50	247.00	-0.50	25.00
215	0.00	122.42	-0.50	247.00	-0.50	25.00
220	0.00	127.40	-0.50	247.00	-0.50	25.00
225	0.00	132.38	-0.50	247.00	-0.50	25.00
230	0.00	137.34	-0.50	247.00	-0.50	25.00
235	0.00	142.31	-0.50	247.00	-0.50	25.00
240	0.00	147.26	-0.50	247.00	-0.50	25.00
245	0.00	152.20	-0.50	247.00	-0.50	25.00
250	0.00	157.12	-0.50	247.00	-0.50	25.00
255	0.00	161.99	-0.50	247.00	-0.50	25.00
260	0.00	166.76	-0.50	247.00	-0.50	25.00
265	0.00	171.30	-0.50	247.00	-0.50	25.00
270	0.00	174.88	-0.50	247.00	-0.50	25.00
275	0.00	174.84	-0.50	247.00	-0.50	25.00
280	0.00	171.23	-0.50	247.00	-0.50	25.00
285	0.00	166.70	-0.50	247.00	-0.50	25.00
290	0.00	161.92	-0.50	247.00	-0.50	25.00
295	0.00	157.04	-0.50	247.00	-0.50	25.00
300	0.00	152.13	-0.50	247.00	-0.50	25.00
305	0.00	147.19	-0.50	247.00	-0.50	25.00
310	0.00	142.24	-0.50	247.00	-0.50	25.00
315	0.00	137.27	-0.50	247.00	-0.50	25.00
320	0.00	132.30	-0.50	247.00	-0.50	25.00
325	0.00	127.33	-0.50	247.00	-0.50	25.00
330	0.00	122.35	-0.50	247.00	-0.50	25.00
335	0.00	117.37	-0.50	247.00	-0.50	25.00
340	0.00	112.39	-0.50	247.00	-0.50	25.00
345	0.00	107.41	-0.50	247.00	-0.50	25.00
350	0.00	102.42	-0.50	247.00	-0.50	25.00
355	0.00	97.44	-0.50	247.00	-0.50	25.00



5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Gary Edwards
Title:	Senior Manager, Satellite Services
Company:	Comsearch
Address:	21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
Telephone:	703-726-5662
Fax:	703-726-5599
Email:	GEdwards@Comsearch.com
Web site:	www.comsearch.com

EXHIBIT B (RADIATION HAZARD ANALYSIS)

Introduction

In accordance with OET Bulletin 65,¹ this Radiation Hazard Analysis demonstrates that the Amazon 2.4m gateway antennas comply with Commission limits for human exposure to radiofrequency (“RF”).

OET Bulletin 65 and section 1.1310 of the Commission’s rules specify two separate tiers of maximum permissible exposure (“MPE”).² The occupational/controlled MPE limit is 5 milliwatts per centimeter squared averaged over any six minute period.³ The general population/uncontrolled MPE limit is 1 milliwatt per centimeter squared averaged over any thirty minute period.⁴

Amazon calculated the (i) power over the sub-reflector and antenna surface and (ii) near-field and far-field power density for the main and off-axis beams and confirms compliance with both MPE tiers’ limits for all regions.

- **Occupational/controlled exposure.** This population will not experience harmful radiation levels, as determined by the Commission. The results for the worst-case scenario (near-field, main-beam power density) support this conclusion.
- **General population/uncontrolled exposure.** This population will not experience harmful radiation levels, as determined by the Commission. The results for the worst-case scenario (near-field, off-axis power density) support this conclusion. Furthermore, gateways will be deployed in occupational/controlled exposure environments within access-controlled, locked facilities and will be inaccessible to the general population.

Input Parameters

Input Parameter	Unit	Value
Aperture Diameter	meters	2.4
Aperture Radius	meters	1.20
Sub-reflector Diameter	meters	0.408
Sub-reflector Radius	meters	0.204
Aperture Efficiency	Percentage	46%
Frequency	MHz	28750.00
Total Transmitter Power	W	80
Minimum Elevation Angle	degrees	20.00

¹ See FCC OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Aug. 1997) (“OET Bulletin 65”). Amazon is aware of and will comply with the recently modified rules for radiofrequency exposure that are relevant to fixed earth stations. *See generally Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields et al.*, Second Report and Order et al., 34 FCC Rcd 11687 (2019).

² See 47 C.F.R. § 1.1310.

³ See OET Bulletin 65 at Appendix A, Table 1(A).

⁴ See *id.* at Appendix A, Table 1(B).

Calculations

Calculated Variables	Unit	Value	Variable	OET Ref
Wavelength	meters	0.01	$\lambda = \frac{c}{f}$	
Area of Reflector	meters^2	4.52	$A = \pi r^2$	
Area of Sub-reflector	meters^2	0.1307	$A_{sub} = \pi r^2$	
Antenna Gain		240499.6	$G = \frac{\eta 4\pi A}{\lambda^2}$	(15)
Antenna Gain	dBi	53.8	$G_{dBi} = 10 * \log_{10}(G)$	
Near-Field Distance	meters	138.10	$R_{nf} = \frac{D^2}{4\lambda}$	(12)
Far-Field Distance	meters	331.43	$R_{ff} = \frac{0.6D^2}{\lambda}$	(16)
Far-Field Off-Axis Gain	dBi	-0.53	$G_{ff(dBi)} = 29 - 25\log_{10}(\theta)$ $\theta = \text{min elevation} = 20^\circ$	
Far-Field Off-Axis Gain		0.89	$G_{ff} = 10^{\left(\frac{G_{ff(dBi)}}{10}\right)}$	
Power over Sub-reflector	mW/cm^2	244.76	$S_{surface} = \frac{4P}{A_{sub}}$	(11)
Power over Antenna Surface	mW/cm^2	7.07	$S_{surface} = \frac{4P}{A}$	(11)
Near-Field Power Density (Main Beam)	mW/cm^2	3.25	$S_{nf} = \frac{16\eta P}{\pi D^2}$	(13)
Near-Field Power Density (Off-Axis)	mW/cm^2	0.033	$S_{nf} = \frac{16\eta P}{100\pi D^2}$	(13) ⁵
Far-Field Max Power Density (Main Beam)	mW/cm^2	1.39	$S_{ff} = \frac{PG}{4\pi R^2}$	(18)
Far-Field Max Power Density (Off-Axis)	mW/cm^2	0.000	$S_{ff off-axis} = \frac{PG_{ff}}{4\pi R^2}$	(18) ⁶

Additional Safety Measures

Access to Amazon's antennas will be carefully controlled. The antennas will be enclosed by a 3m tall fence with locked gates. There will be clear and visible signage that will warn individuals of potential RF exposure risk. Each antenna will have an emergency stop switch that is to be

⁵ See *id.* at 30 ("For off-axis calculations in the near-field and in the transition region it can be assumed that, if the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point would be at least a factor of 100 (20 dB) less than the value calculated for the equivalent distance in the main beam see Reference [15]).").

⁶ See *id.* ("For practical estimation of RF fields in the off-axis vicinity of aperture antennas, use of the antenna radiation pattern envelope can be useful. For example, for the case of an earth station in the fixed-satellite service, the Commission's Rules specify maximum allowable gain for antenna sidelobes not within the plane of the geostationary satellite orbit, such as at ground level. . . . Use of the gain obtained from these relationships in simple far-field calculations, such as Equation 18, will generally be sufficient for estimating RF field levels in the surrounding environment, since the apparent aperture of the antenna is typically very small compared to its frontal area.").

engaged whenever personnel are working on or close to the antenna. The emergency stop switch will disable all RF transmissions from the antenna. All pedestrian gates shall be fully access controlled. Emergency or delivery gates shall be secured with a lock and monitored. Additionally, the transmitter will be turned off during maintenance activities.

Results

In a controlled area accessible to the occupational population, the peak near-field power density (3.25 mW/cm^2) and peak far-field power density (1.39 mW/cm^2) levels do not exceed the MPE limit of 5 mW/cm^2 averaged over a period of six minutes.

In an uncontrolled area accessible to the general population, the off-axis near-field power density (0.033 mW/cm^2) and off-axis far-field power density (0.000 mW/cm^2) levels are below the MPE limit of 1 mW/cm^2 averaged over a period of thirty minutes.⁷

This Radiation Hazard Analysis demonstrates that harmful levels of radiation will not occur in the regions accessible by both the occupational and general populations.

⁷ The minimum elevation angle of 20 degrees mostly prohibits the potential for the general population to be affected by the peak power density levels. Additionally, the constant repositioning of the antennas as they track Kuiper System low-earth orbit satellites also ensures that the average power density levels will be significantly reduced when averaged over any six-minute period.

EXHIBIT C (ANTENNA PATTERN)

2.4m Antenna Pattern
Frequency: 27500 MHz (CoPol)
Gain: 53.8 dBi

