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 Voca, TX. 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 committed to invest at least $10 billion to support Kuiper, and Amazon

[1] *In re 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 (2020) ("*Kuiper System Authorization*").

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

continues to advance toward its goal of providing affordable, reliable, high-quality connectivity to customers and communities around the world.

With this application, Amazon seeks authority to operate the proposed gateway in Voca, TX. 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."[3] 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 move forward and execute its plans to deliver satellite broadband communications services to tens of millions of unserved and underserved consumers and businesses in the United States and around the globe.[4] 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.

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

[4] *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).

III. SPECTRUM USE AND SHARING

Amazon will adhere to all International Telecommunication Union ("ITU") and Commission requirements and pertinent future FCC rulemakings governing NGSO Ka-band gateways. When sharing spectrum, Amazon will operate consistent with the *Kuiper System Authorization*[5] 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.

Table 1: Kuiper System Gateway Transmit Frequencies

Transmit Frequencies (GHz)	Status[6]
27.5-28.35	FSS secondary to UMFUS[7]
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

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

[6] *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").

[7] Equivalent power flux-density ("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.

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

NGSO FSS may transmit on a secondary basis without providing interference protection to the Upper Microwave Flexible Use Service ("UMFUS") in the 27.5-28.35 GHz band.[8] Exhibit A, the UMFUS analysis, demonstrates how the gateway satisfies the section 25.136(a) protection criteria and, therefore, does not need to protect future UMFUS deployments.[9] Exhibit C, the Comsearch report, establishes that Amazon has coordinated with UMFUS licensees consistent with section 101.103(d).[10]

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.[11] 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 Regulations Article 22 and Resolution 76 to ensure transmissions do not cause harmful interference.[12]

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[8] *See* 47 C.F.R. §§ 2.106, 25.136; *International Bureau Issues Guidance on Siting Methodologies for Earth Stations Seeking to Operate in the 24.75-25.25 GHz, 27.5-28.35 GHz, 37.5-40 GHz, 47.2-48.2 GHz, and 50.4-51.4 GHz Frequency Bands to Demonstrate Compliance with Section 25.136*, Public Notice, 35 FCC Rcd 6347 (IB 2020).

[9] *See* 47 C.F.R. § 25.136(a); Exhibit A.

[10] *See* 47 C.F.R. § 101.103(d); Exhibit C.

[11] *See* 47 C.F.R. § 2.106; Ka-band Plan.

[12] *See* 47 C.F.R. §§ 2.106, 25.115(f)(1), 25.146(a)(2); Ka-band Plan; ITU Radio Regulations Article 22 and Resolution 76 (WRC-15); *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").

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.[13] Amazon's operations as NGSO FSS possess primary status in the band.[14]

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.[15] 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.[16]

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 before commencing service[17] and employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.[18]

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[13] *See* 47 C.F.R. § 2.106; Ka-band Plan.

[14] *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.

[15] *See* 47 C.F.R. § 2.106; Ka-band Plan.

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

[17] 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).

[18] *See id.*

b. LMDS

To share with LMDS, Amazon will coordinate as required by the Commission's rules.[19]

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.[20]

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.[21]

Table 2: Kuiper System Gateway Receive Frequencies

Frequencies (GHz)	Status[22]
17.8-18.3	FSS secondary to FS[23]
18.3-18.6	NGSO FSS secondary to GSO FSS
18.8-19.3	NGSO FSS primary
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

[19] *See* 47 C.F.R. §§ 25.203, 101.103(d).

[20] *See* 47 C.F.R. § 2.106 n.NG62.

[21] 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).

[22] *See generally* 47 C.F.R. § 2.106; *NGSO FSS Order*; Ka-band Plan.

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

5. 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.[24] To share with FS, Amazon will meet the power flux-density limits in ITU Radio Regulations Article 21.[25] The Comsearch report confirms no additional limitations are necessary.[26]

6. 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.[27] To share with GSO FSS, Amazon will comply with the applicable EPFD limits in ITU Radio Regulations Article 22 and Resolution 76.[28]

7. 18.8-19.3 GHz (NGSO FSS primary)

NGSO FSS may receive on a primary basis in the 18.8-19.3 GHz band.[29] Amazon's operations are licensed as NGSO FSS and, therefore, possess primary status in the band.[30]

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[24] *See* 47 C.F.R. § 2.106; Ka-band Plan.

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

[26] *See* Exhibit C.

[27] *See* 47 C.F.R. § 2.106; Ka-band Plan.

[28] 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); *NGSO FSS Order*, 32 FCC Rcd at 7821 ¶ 36 n.84; *see also 2000 NGSO FSS Order*, 16 FCC Rcd at 4129-30 ¶ 77.

[29] *See* 47 C.F.R. § 2.106; Ka-band Plan.

[30] *See Kuiper System Authorization*, 35 FCC Rcd at 8327 ¶ 11.

8. 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.[31] To share with GSO FSS, Amazon will neither cause harmful interference to GSO FSS nor claim protection from harmful interference from GSO FSS.[32]

9. 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.[33] 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 service[34] and employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.[35]

10. 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.[36] To share with co-primary MSS feeder link systems, Amazon will coordinate use of the band with operators not in the March 2020 processing round before commencing service[37] and

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

[32] *See* 47 C.F.R. § 2.105(c)(2).

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

[34] 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).

[35] *See id*.

[36] *See* 47 C.F.R. § 2.106; Ka-band Plan.

[37] 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).

employ the section 25.261 spectrum-sharing framework with operators in the March 2020 processing round while operating service.[38]

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."[39] Amazon nonetheless will comply with the section 25.209(a)(1) mask for GSO Ka-band earth station antennas, as illustrated in Exhibit D's simulated antenna pattern.[40]

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

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[38] *See id*.

[39] *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. §§ 25.209, 25.132.

[40] *See* 47 C.F.R. § 25.209(a)(1); Exhibit D.

[41] *See* FCC OET Bulletin No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields* (Aug. 1997); Exhibit B.

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.[42] 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

February 18, 2022

[42] *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); *id.* §§ 17.7(e), 25.115(j).

EXHIBIT A (SECTION 25.136 UMFUS PROTECTION ANALYSIS)

This Exhibit A demonstrates that the proposed gateway earth station[1] satisfactorily protects 27.5-28.35 GHz Upper Microwave Flexible Use Service ("UMFUS") deployments in McCulloch County, TX ("County").

Section 25.136(a)(4) of the Commission's rules outlines how Fixed-Satellite Service ("FSS") operators may deploy gateways in the 27.5-28.35 GHz band without providing additional interference protection to co-frequency UMFUS licensees.[2] *First*, one U.S. county may not possess more than three co-frequency FSS earth stations operating in the 27.5-28.35 GHz band.[3] *Second*, the area in which the earth station generates a power flux-density ("PFD") greater than or equal to -77.6 dBm/m^2/MHz at 10 meters above ground level ("-77.6 dBm/m^2/MHz"), together with the similar area of any other gateway authorized under section 25.136(a)(1)-(4), may not cover more than certain population amounts.[4] *Third*, the -77.6 dBm/m^2/MHz PFD contour may not contain any major event venue, urban mass transit route, passenger railroad, cruise ship port, or certain roads (Interstate, Other Freeways and Expressways, or Other Principal Arterial).[5] *Fourth*, the FSS operator must have coordinated with existing UMFUS licensees located within a PFD contour greater than or equal to -77.6 dBm/m^2/MHz at 10 meters above ground level pursuant to section 101.103(d) of the Commission's rules.[6]

Amazon's analysis shows compliance with section 25.136(a)(4) and is consistent with the Guidance. No more than three FSS earth stations will operate under the provisions of section 25.136(a)(4) in the County hosting the proposed gateway. Amazon's -77.6 dBm/m^2/MHz PFD contour covers eight people of the County's total 7,630 people. The PFD contour does not contain any major event venue, urban mass transit route, passenger railroad, cruise ship port, Interstate, Other Freeways and Expressways, or Other Principal Arterial. Amazon has also completed coordination with existing UMFUS licensees, as required.[7] Accordingly, the Commission, should

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[1] In this document, earth stations are also referenced as gateways.

[2] *See* 47 C.F.R. § 25.136(a)(4). The Commission has offered additional guidance on how to present section 25.136 showings. *See generally International Bureau Issues Guidance on Siting Methodologies for Earth Stations Seeking to Operate in the 24.75-25.25 GHz, 27.5-28.35 GHz, 37.5-40 GHz, 47.2-48.2 GHz, and 50.4-51.4 GHz Frequency Bands to Demonstrate Compliance with Section 25.136*, Public Notice, 35 FCC Rcd 6347 (IB 2020) ("Guidance").

[3] *See* 47 C.F.R. § 25.136(a)(4)(i).

[4] *See* 47 C.F.R. § 25.136(a)(4)(ii); *id.* at Table 1 to Paragraph (a)(4)(ii) (permitting the PFD contour to cover 0.1 percent of the population in a county with more than 450,000 people; 450 people in a county with 6,000-450,000 people; and 7.5 percent of the population in a county with fewer than 6,000 people).

[5] *See* 47 C.F.R. § 25.136(a)(4)(iii). *See also In the Matter of Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, 11031-32, 11085-86 ¶ 131, Appendix B (2017).

[6] *See* 47 C.F.R. § 25.136(a)(4)(iv).

[7] *See* Exhibit C, Comsearch Coordination Report.

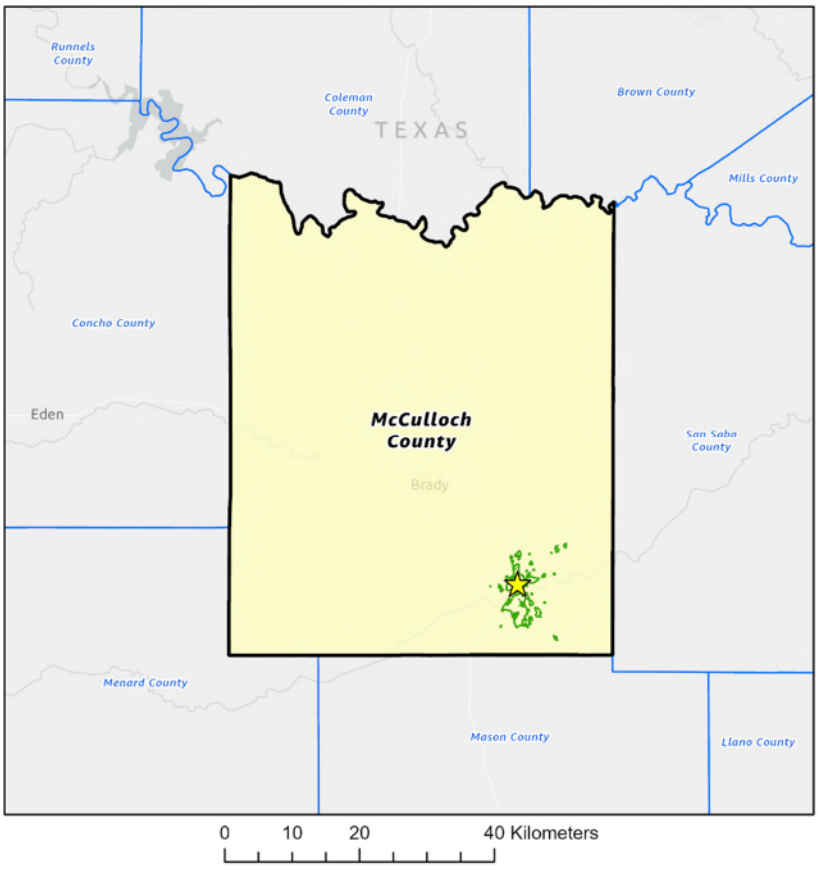
grant this application and not require Amazon to provide additional interference protection to UMFUS licensees in the County.

Section 25.136(a)(4)(i) (no more than three co-frequency FSS gateways in one county)

Section 25.136(a)(4)(i) of the Commission's rules requires the applicant to demonstrate that "[t]here are no more than two other authorized earth stations operating in the 27.5-28.35 GHz band within the county where the proposed earth station is located that meet the criteria contained in either paragraph (a)(1), (2), (3), or (4) of this section."[8] For purposes of this rule, "multiple earth stations that are collocated with or at a location contiguous to each other shall be considered as one earth station."[9]

Figure 1 depicts the proposed earth station's location in the County. The earth station location and McCulloch County PFD contour are shown in yellow and green.

Figure 1. Location of Amazon Earth Station



[8] 47 C.F.R. § 25.136(a)(4)(i).

[9] *Id.*

As of the date of this submission, the Commission's International Bureau Filing System shows no FSS earth station license applications using the 27.5-28.35 GHz band in the County.[10] As there are no more than two other authorized earth stations operating in the 27.5-28.35 GHz band within the County, this gateway application complies with section 25.136(a)(4)(i).

PFD Contour Generation – Sections 25.136(a)(4)(ii)–(iv)

To verify compliance with sections 25.136(a)(4)(ii)-(iv), Amazon generated the gateway's -77.6 dBm/m^2/MHz PFD contour as shown in Figure 2. The gateway's maximum aggregate equivalent isotropic radiated power ("EIRP") from its four active antennas will be -19.0 dBW/MHz at the horizon in any azimuth direction based on a simulated antenna pattern.[11] Based on the PFD analysis, this gateway will not require shielding to comply with 47 C.F.R. 25.136(a)(4).

Table 2. Amazon Earth Station Parameters

Field	Value	Units
County	McCulloch, TX	
Latitude	31° 1' 19.9" N	
Longitude	99° 13' 8.0" W	
Simulation Frequency	27.5	GHz
Number of Active Antennas	4	
Antenna Centerline Height (Above Ground Level)	1.9 - 2.74, depending on azimuth and elevation[12]	meters
Worst-case Antenna Gain toward the Horizon	-5.0	dBi
Average Gain toward the Horizon	-10.0	dBi
RF Transmit Power	-17.0	dBW/MHz
Aggregate EIRP toward the Horizon (without Shielding)[13]	-19.0	dBW/MHz

[10] *See International Bureau Filing System*, FCC, http://licensing.fcc.gov/myibfs/ (last visited Feb. 1, 2022).

[11] The gateway will have six antennas, but no more than four antennas will transmit on the same channel at any given time. The extra antennas will be used to reduce downtime by being passively pre-positioned to begin communicating with a rising satellite immediately after an active satellite sets. The extra antennas will also be used to ensure earth station availability in the event of an antenna failure.

[12] The Amazon antennas will use X/Y mounts. The height of the center of radiation of the antenna will vary depending on the azimuth and elevation of the antenna. At minimum elevation, the height will be under 2.5 meters in all azimuth directions.

[13] This figure is based on three of the four active antennas operating at average off-axis gain in the direction of an UMFUS receiver 10 meters above ground level (-10 dBi) and one of the four active antennas operating at the worst case off-axis gain in the direction of an UMFUS receiver 10 meters above ground level (-5.0 dBi).

Amazon generated the proposed earth station's -77.6 dBm/m^2/MHz PFD contour using internal satellite communications and geospatial analysis software and verified the results using Visualyse Pro. The PFD contours were generated by creating a raster grid of measurement points located 10 meters above ground level and surrounding the earth station, and calculating the path attenuation, received power and power flux-density to each point. When using Visualyse Pro, the receive antennas were assigned a receive gain of 50.24 dBi in the direction of the transmitting earth station to account for the difference between a received power calculation and power flux-density.[14] To assess radio propagation, Amazon used ITU-R Recommendation P.452 and National Aeronautics and Space Administration Shuttle Radar Topography Mission digital topology data, which employs a 1-arc second resolution.[15] The antenna gain toward the horizon is derived from antenna manufacturer calculations.[16] The PFD contour is generated using the worst-case input power density rather than the input power density during clear sky conditions.[17]

Figure 2 shows Amazon's PFD contour in Google Earth (shapefile attached in KML format) and confirms the contour complies with the Guidance.

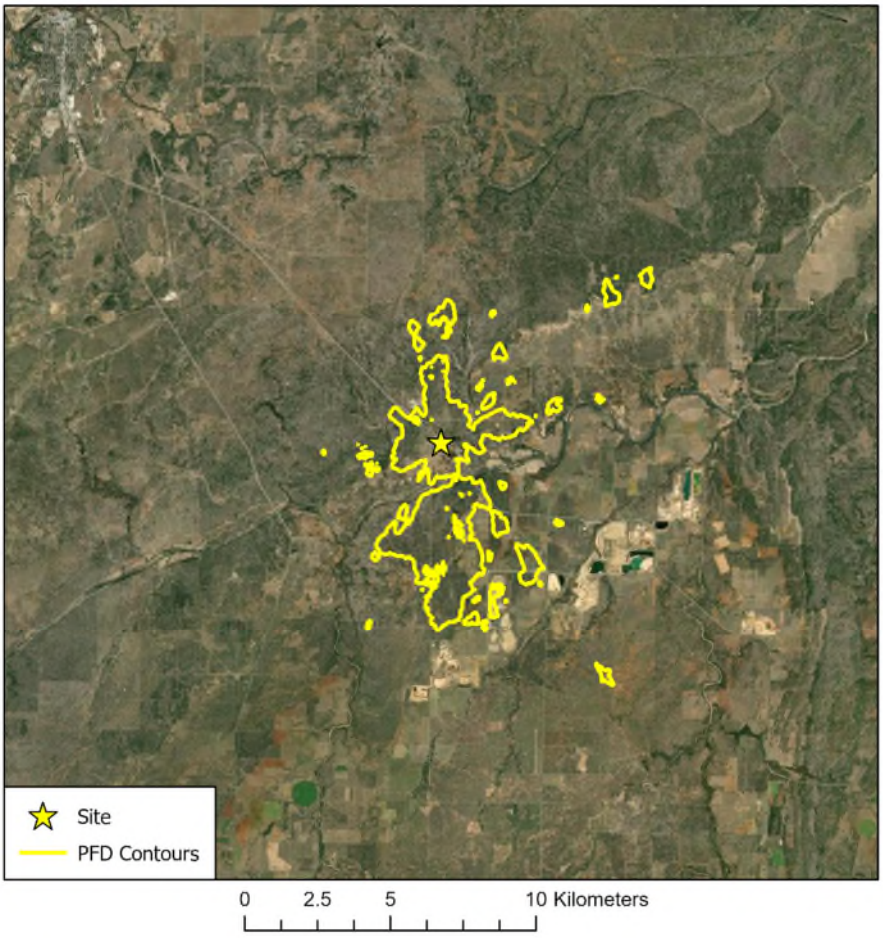
[14] This gain value is calculated as $10*\log(4\pi/\lambda^2)$ where λ is the wavelength at 27.5 GHz. The adjustment is due to a limitation of the Visualyse Pro software and the conversion from PFD to received power.

[15] *See* Guidance, 35 FCC Rcd at 6349 (computing PFD contours and protection zones at bullets 2 and 4). For the application of ITU-R Recommendation P.452, no clutter category was assumed. Accordingly, the PFD contours generated for this application are conservative.

[16] *See id*. (computing PFD contours and protection zones at bullet 3).

[17] *See id*. (computing PFD contours and protection zones at bullet 5).

Figure 2. Gateway PFD Contour (-77.6 dBm/m^2/MHz)



Section 25.136(a)(4)(ii) (-77.6 dBm/m^2/MHz PFD contour covering only certain population totals)

Section 25.136(a)(4)(i) requires the applicant to demonstrate that "[t]he area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m^2/MHz, together with the similar area of any other earth station authorized pursuant to paragraph (a) of this section, does not cover, in the aggregate, more than the amount of population of the UMFUS license area within which the earth station is located as noted in table 1 to this paragraph (a)(4)(ii)."[18] The table is reproduced below:

TABLE 1 TO PARAGRAPH (a)(4)(ii)

Population within UMFUS license area	Maximum permitted aggregate population within −77.6 dBm/m^2/MHz PFD contour of earth stations
Greater than 450,000	0.1 percent of population in UMFUS license area.
Between 6,000 and 450,000	450 people.
Fewer than 6,000	7.5 percent of population in UMFUS license area.

The PFD contour overlaps several census blocks, all within the County. The County's population totals 7,630 people, according to 2020 U.S. Census Bureau data.[19] As a result, the maximum population permitted within the FSS gateway's -77.6 dBm/m^2/MHz PFD contour is 450 people. Amazon's analysis demonstrates that the proposed gateway's PFD contour covers eight people—less than the 450 limit—using 2020 U.S. Census Bureau data and the actual area method.[20]

Section 25.136(a)(4)(ii) considers the aggregate population covered by the proposed earth station and the FSS earth stations operating in the 27.5-28.35 GHz band within the County. At the time of filing, there are no other earth station applications within the County.[21] The Amazon earth station's PFD contour, therefore, does not exceed the section 25.136(a)(4)(ii) *aggregate* population coverage allowance of 450 people for the County.

Figure 3 shows the census blocks that are fully or partially covered by the PFD contour. Table 3 shows the total population, fractional area coverage, and fractional population coverage for each fully and partially covered census block. Table 4 shows the total population covered in each county that the PFD contour overlaps.

[18] 47 C.F.R. § 25.136(a)(4)(ii).

[19] *See QuickFacts: McCulloch County, Texas*, U.S. Census Bureau, https://bit.ly/3gcLnaa (last visited Feb. 18, 2022).

[20] *See* Guidance, 35 FCC Rcd at 6350 (determining estimated aggregate population coverage at bullet 2).

[21] *See supra* note 10.

Figure 3. Census Block and Population Coverage of Gateway PFD Contour

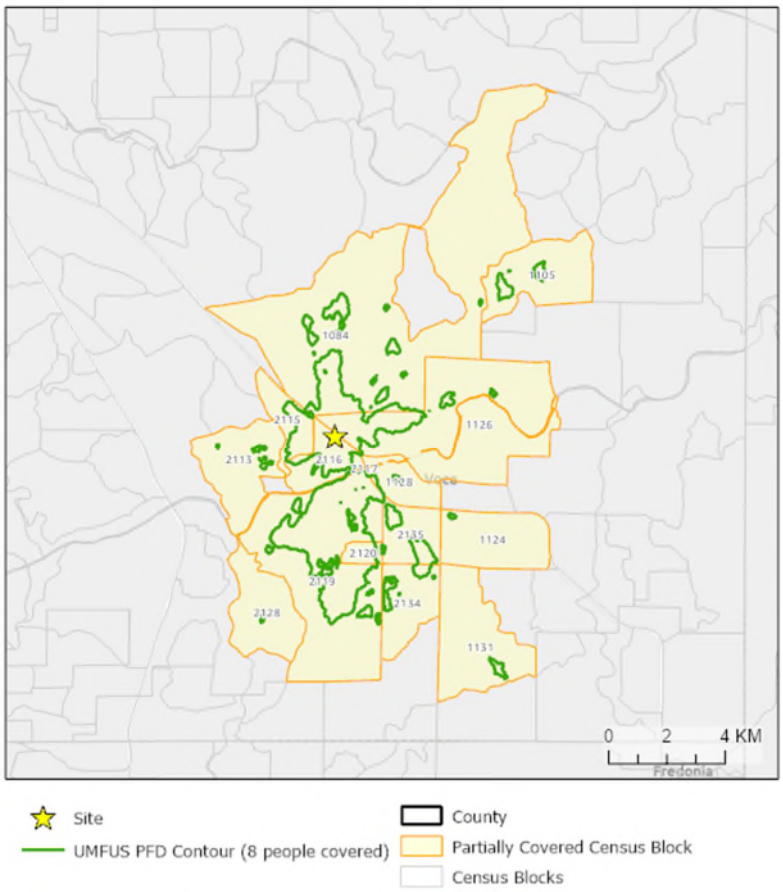


Table 3. PFD Contour Population Coverage, by Census Block

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	McCulloch	483079504001084	8	7.3%	1
Texas	McCulloch	483079504001105	2	6.1%	0
Texas	McCulloch	483079504001124	5	0.5%	0
Texas	McCulloch	483079504001126	15	12.6%	2
Texas	McCulloch	483079504001128	4	1.2%	0
Texas	McCulloch	483079504001131	0	1.6%	0
Texas	McCulloch	483079504002113	0	1.5%	0
Texas	McCulloch	483079504002115	0	40.7%	0
Texas	McCulloch	483079504002116	0	53.5%	0
Texas	McCulloch	483079504002117	0	9.2%	0
Texas	McCulloch	483079504002119	9	40.2%	4
Texas	McCulloch	483079504002120	0	84.1%	0
Texas	McCulloch	483079504002128	0	0.4%	0
Texas	McCulloch	483079504002134	0	9.7%	0
Texas	McCulloch	483079504002135	5	21.0%	1

Table 4. PFD Contour Population Coverage, by County

State	County	County Population	Allowable Population Coverage	Covered Population
Texas	McCulloch	7,630	450	8

Section 25.136(a)(4)(iii) (major event venue, urban mass transit route, passenger railroad, cruise ship port, Interstate, Other Freeways and Expressways, or Other Principal Arterial in the -77.6 dBm/m^2/MHz PFD contour)

Section 25.136(a)(4)(iii) requires an applicant to demonstrate as follows:

> The area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m^2/MHz does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port. In addition, the area mentioned in paragraph (a)(4)(ii) of this section shall not cross any of the following types of roads, as defined in functional classification guidelines issued by the Federal Highway Administration pursuant to 23 CFR 470.105(b): Interstate, Other Freeways and Expressways, or Other Principal Arterial. The Federal Highway Administration Office of Planning, Environment, and Realty Executive Geographic Information System (HEPGIS) map contains information on the classification of roads. For purposes of this rule, an urban

area shall be an Adjusted Urban Area as defined in section 101(a)(37) of Title 21 of the United States Code.[22]

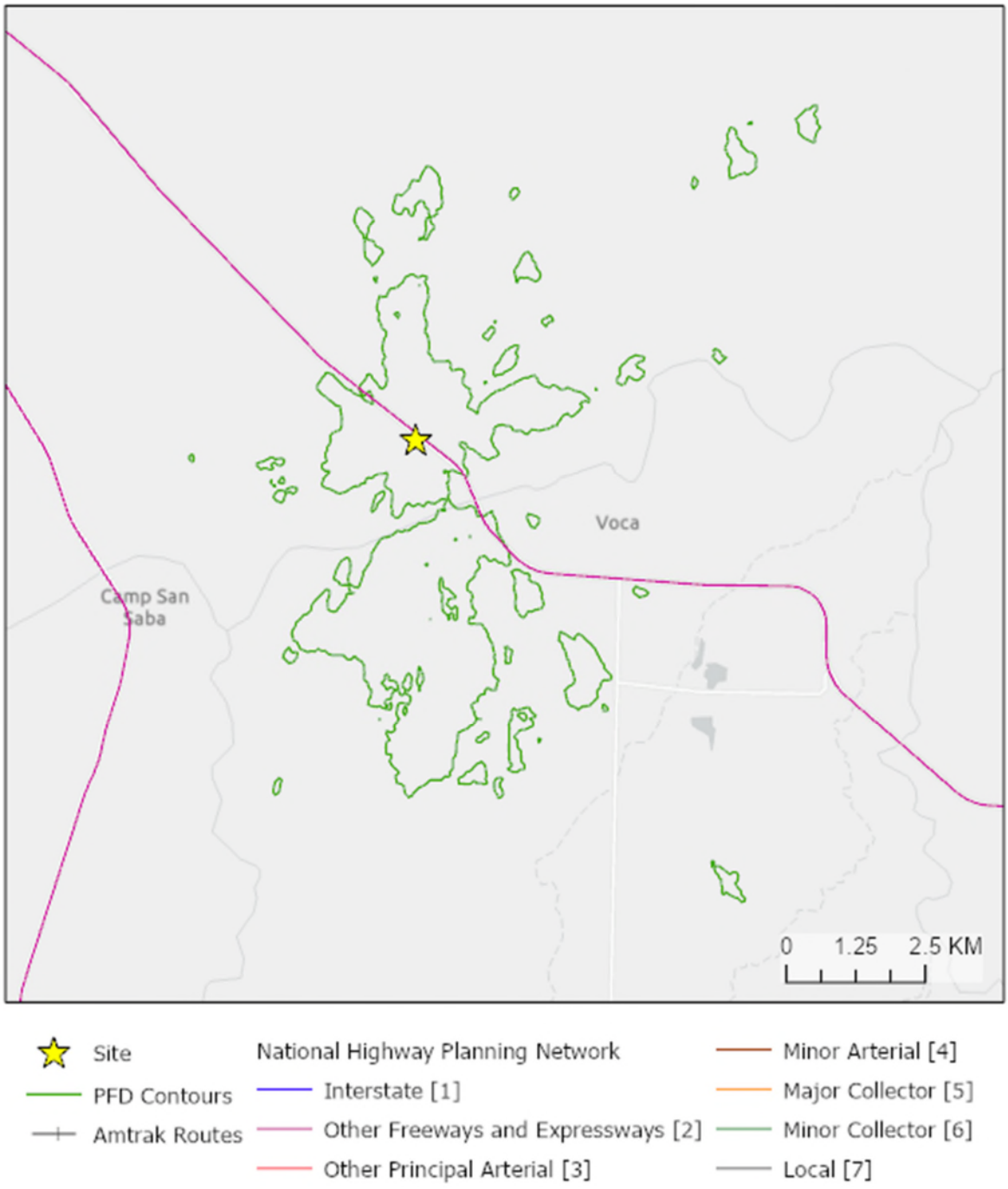
Using Google Earth, visual analysis, and shapefile data available on data.gov and the U.S. Census Bureau website, Amazon determined that the proposed gateway's -77.6 dBm/m^2/MHz PFD contour does not contain any major event venues, urban mass transit route, passenger railroad, or cruise ship port. As shown in Figure 2 and Figure 4, the PFD contour does not overlap any such infrastructure. Further, the PFD contour does not cross any Interstate, Other Freeways and Expressways, or Other Principal Arterial, as defined by the Federal Highway Administration Office of Planning, Environment, and Realty Executive Geographic Information System.[23] Amazon also consulted the state Department of Transportation functional classifications to confirm that the contour does not intersect any Other Freeways and Expressways or Other Principal Arterials.[24] The proposed gateway, therefore, is consistent with the requirements of section 25.136(a)(4)(iii).

[22] 47 C.F.R. § 25.136(a)(4)(iii).

[23] *See Planning, Environment, Realty (HEP) HEPGIS*, U.S. Dep't of Transp. Fed. Highway Admin., https://hepgis.fhwa.dot.gov/fhwagis/ (last visited Feb. 18, 2022). Texas State Highway 71, which intersects the proposed gateway's contour, is minor arterial.

[24] *See* Guidance, 35 FCC Rcd at 6351 (guidance regarding definition of roadways at bullet 2); *Statewide Planning Map*, Texas Dep't of Transp., https://bit.ly/3AWJec5 (last visited Feb. 18, 2022) (indicating no "Highway Designations," "Memorial Highway," "National Highway System," or "Strategic Highway Network (STRAHNET)" intersections in the proposed gateway's contour, and describing Texas State Highway 71 as "Minor Arterial" as per the functional classification system).

Figure 4. -77.6 dBm/m^2/MHz PFD contour overlaid with major roadways and passenger railroads[25]



[25] There are no railroads within the vicinity of the PFD contour. As such the legend item for "Amtrak Routes" does not appear in the figure.

Section 25.136(a)(4)(iv) (coordination with existing UMFUS licensees located within a PFD contour greater than or equal to -77.6 dBm/m^2/MHz)

Section 25.136(a)(4)(iv) requires the applicant to demonstrate that it "has successfully completed frequency coordination with the UMFUS licensees within the area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m^2/MHz with respect to existing facilities constructed and in operation by the UMFUS licensee."[26] The applicant is required to use the applicable processes in section 101.103(d) in coordinating with UMFUS licensees.[27]

Exhibit C, the Comsearch report, establishes that Amazon has completed coordination with existing UMFUS licensees, as section 25.136(a)(4)(iv) requires.[28]

[26] 47 C.F.R. § 25.136(a)(4)(iv).

[27] *See id.*

[28] *See* 47 C.F.R. § 101.103(d).

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	$G_{ff\ (dBi)} = 29 - 25log_{10}(\theta)$ $\theta = min\ elevation = 20°$	
Far-Field Off-Axis Gain		0.89	$G_{ff} = 10^{(\frac{G_{ff\ (dBi)}}{10})}$	
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]

[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.").

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 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 (COMSEARCH REPORT)

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Kuiper Systems LLC.
VOCA, TX
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
October 13, 2021

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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 09/01/2021.

Company
AMA Communications, LLC
AMG Technology Investment Group LLC
AT&T Mobility Spectrum LLC - North Texas
Abilene, City of
Air Canopy Internet Services, Inc.
Alamo Broadband, Inc
BASA Resources, Inc.
Bexar County Public Works
Business Only Broadband, LLC
Cedar Park, City of
CellTex Networks, LLC
Cellco Partnership - Texas
Cellco Partnership-C TX/LA/AR/OK
Cibolo, TX Police Dept
Citation Oil & Gas Corp.
City of Bee Cave
City of Belton
City of Cedar Park TX
City of Pflugerville
City of Round Rock
Clearwire Spectrum Holdings III, LLC
Conterra Ultra Broadband, LLC
Dailey and Wells Communications, Inc.
Digitex.com
Electronic Corporate Pages, Inc.
Elgin Independent School District
Emmis Austin Radio Broadcasting
Enterprise Products Operating, LLC
Evolve Cellular Inc
Faith Communications LLC
Flat Wireless, LLC
Global Telecom & Technology Americas
Granbury, City of
Gray Television Licensee, LLC (KWTX-KBTX
Guadalupe Valley Electric Coop., Inc.
HILCO Electric Cooperative, Inc.
KVUE Television, Inc.
La Vernia Holdings, Inc.
Last Mile Networks
Linxus Internet, LLC

Manor Independent School
Mid-Tex Cellular Ltd
NW Communications of Austin, Inc.
Netspend Corporation
New Cingular Wireless PCS LLC - N Texas
New Cingular Wireless PCS LLC - S Texas
New Source Broadband I LLC
Nexstar Media Inc.
Olympic Wireless, LLC
Pacific Communications
Particle Communications Wholesale, Inc.
Plains Internet, LLC
Resound Networks
Rhino Communications, Inc
San Angelo, City of
San Antonio Water System
Sprint Spectrum LLC
Sprintcom, Inc
T-Mobile License LLC
TMN, Inc.
TXWI Net LLC
Technical Chemical Corporation
Totelcom Communications, LLC
Transworld Network Corp
Travis County ESD No 12
Travis County Water District No 17
Union Pacific Railroad Company
VTX Communications LLC
WesTex Towers
West Central Wireless LP

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: 10/13/2021
Job Number: 210901COMSGE03

Administrative Information

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

Site Information — VOCA, TX

Venue Name	
Latitude (NAD 83)	31° 1' 19.9" N
Longitude (NAD 83)	99° 13' 8.0" W
Climate Zone	A
Rain Zone	2
Ground Elevation (AMSL)	479.77 m / 1574.1 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%	-151.0 dBW/4 kHz 20%
	Short Term	-146.0 dBW/MHz	0.01%	-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 / 18800.0 - 20200.0	50M0G7D - 500MG7D / 27500.0 - 30000.0
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	**VOCA, TX**			
Licensee Name	Kuiper Systems LLC.			
Latitude (NAD 83)	31° 1' 19.9" N			
Longitude (NAD 83)	99° 13' 8.0" W			
Ground Elevation (AMSL)	479.77 m / 1574.1 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)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.67	85.43	-0.50	247.00	-0.50	25.00
5	0.72	80.65	-0.50	247.00	-0.50	25.00
10	0.90	75.89	-0.50	247.00	-0.50	25.00
15	0.98	71.14	-0.50	247.00	-0.50	25.00
20	0.80	66.38	-0.50	247.00	-0.50	25.00
25	0.65	61.63	-0.50	247.00	-0.50	25.00
30	0.59	56.91	-0.50	247.00	-0.50	25.00
35	0.63	52.24	-0.50	247.00	-0.50	25.00
40	0.61	47.61	-0.50	247.00	-0.50	25.00
45	0.53	43.02	-0.50	247.00	-0.50	25.00
50	0.41	38.49	-0.50	247.00	-0.50	25.00
55	0.00	33.94	-0.50	247.00	-0.50	25.00
60	0.00	29.71	-0.50	247.00	-0.50	25.00
65	0.00	25.72	-0.50	247.00	-0.50	25.00
70	0.00	22.12	-0.50	247.00	-0.50	25.00
75	0.00	19.12	-0.50	247.00	-0.50	25.00
80	0.00	17.04	-0.50	247.00	-0.50	25.00
85	0.00	16.24	-0.50	247.00	-0.50	25.00
90	0.00	16.91	-0.50	247.00	-0.50	25.00
95	0.00	18.89	-0.50	247.00	-0.50	25.00
100	0.00	21.82	-0.50	247.00	-0.50	25.00
105	0.00	25.38	-0.50	247.00	-0.50	25.00
110	0.00	29.34	-0.50	247.00	-0.50	25.00
115	0.00	33.56	-0.50	247.00	-0.50	25.00
120	0.00	37.95	-0.50	247.00	-0.50	25.00
125	0.00	42.45	-0.50	247.00	-0.50	25.00
130	0.00	47.04	-0.50	247.00	-0.50	25.00
135	0.00	51.69	-0.50	247.00	-0.50	25.00
140	0.00	56.38	-0.50	247.00	-0.50	25.00
145	0.00	61.10	-0.50	247.00	-0.50	25.00
150	0.34	65.90	-0.50	247.00	-0.50	25.00
155	0.44	70.66	-0.50	247.00	-0.50	25.00
160	0.31	75.42	-0.50	247.00	-0.50	25.00
165	0.30	80.21	-0.50	247.00	-0.50	25.00
170	0.44	85.00	-0.50	247.00	-0.50	25.00
175	0.45	89.79	-0.50	247.00	-0.50	25.00
180	0.50	94.58	-0.50	247.00	-0.50	25.00
185	0.52	99.36	-0.50	247.00	-0.50	25.00

COMSEARCH

Earth Station Data Sheet

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

Coordination Values	**VOCA, TX**			
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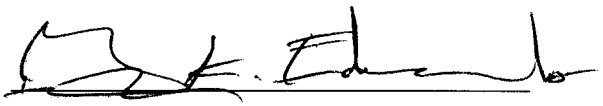
Antenna Centerline (AGL)	2.74 m / 9.0 ft			
Antenna Model	Kuiper 2.4 meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power		-41.0 (dBW/4 kHz)		

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.57	104.13	-0.50	247.00	-0.50	25.00
195	0.70	108.89	-0.50	247.00	-0.50	25.00
200	0.56	113.65	-0.50	247.00	-0.50	25.00
205	0.53	118.39	-0.50	247.00	-0.50	25.00
210	0.42	123.13	-0.50	247.00	-0.50	25.00
215	0.37	127.82	-0.50	247.00	-0.50	25.00
220	0.30	132.47	-0.50	247.00	-0.50	25.00
225	0.33	137.04	-0.50	247.00	-0.50	25.00
230	0.28	141.56	-0.50	247.00	-0.50	25.00
235	0.33	145.92	-0.50	247.00	-0.50	25.00
240	0.26	150.16	-0.50	247.00	-0.50	25.00
245	0.36	154.06	-0.50	247.00	-0.50	25.00
250	0.44	157.57	-0.50	247.00	-0.50	25.00
255	0.48	160.48	-0.50	247.00	-0.50	25.00
260	0.55	162.44	-0.50	247.00	-0.50	25.00
265	0.62	163.14	-0.50	247.00	-0.50	25.00
270	0.77	162.35	-0.50	247.00	-0.50	25.00
275	0.95	160.30	-0.50	247.00	-0.50	25.00
280	1.12	157.35	-0.50	247.00	-0.50	25.00
285	1.23	153.84	-0.50	247.00	-0.50	25.00
290	1.24	150.00	-0.50	247.00	-0.50	25.00
295	1.15	145.92	-0.50	247.00	-0.50	25.00
300	1.20	141.59	-0.50	247.00	-0.50	25.00
305	1.22	137.15	-0.50	247.00	-0.50	25.00
310	1.09	132.66	-0.50	247.00	-0.50	25.00
315	1.09	128.05	-0.50	247.00	-0.50	25.00
320	0.96	123.43	-0.50	247.00	-0.50	25.00
325	0.87	118.76	-0.50	247.00	-0.50	25.00
330	0.74	114.05	-0.50	247.00	-0.50	25.00
335	0.70	109.31	-0.50	247.00	-0.50	25.00
340	0.69	104.55	-0.50	247.00	-0.50	25.00
345	0.79	99.77	-0.50	247.00	-0.50	25.00
350	0.87	94.99	-0.50	247.00	-0.50	25.00
355	0.81	90.21	-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
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: October 13, 2021

Ka-Band Earth Station – Voca, TX

Frequency Coordination Report

28 GHz

Prepared on Behalf of
KUIPER SYSTEMS, LLC

October 12, 2021

COMSEARCH®
A CommScope Company

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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 Voca, TX, which will transmit at 28 GHz[1]. 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 12, 2021.

There are no unresolved 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 Voca, TX 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
None Identified	

A notification letter and datasheets for the Ka-Band earth station in Voca, TX 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 was one 28 GHz UMFUS licensee 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
Central Texas Communications	Market Based

There are no Unresolved 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 Voca, TX. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

Job Number:		210901COMSGE03		
Administrative Information				
Status		ENGINEER PROPOSAL		
Call Sign				
Licensee Code		KUIPER		
Licensee Name		Kuiper Systems LLC.		
Site Information		**VOCA, TX**		
Venue Name				
Latitude (NAD 83)		31° 1' 19.9" N		
Longitude (NAD 83)		99° 13' 8.0" W		
Climate Zone		A		
Rain Zone		2		
Ground Elevation (AMSL)		479.77 m / 1574.1 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%	-151.0 dBW/4 kHz 20%
	Short Term	-146.0 dBW/MHz	0.01%	-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 / 18800.0 - 20200.0		50M0G7D - 500MG7D / 27500.0 - 30000.0
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

Coordination Values	**VOCA, TX**		
Licensee Name	Kuiper Systems LLC.		
Latitude (NAD 83)	31° 1' 19.9" N		
Longitude (NAD 83)	99° 13' 8.0" W		
Ground Elevation (AMSL)	479.77 m / 1574.1 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)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.67	85.43	-0.50	247.00	-0.50	25.00
5	0.72	80.65	-0.50	247.00	-0.50	25.00
10	0.90	75.89	-0.50	247.00	-0.50	25.00
15	0.98	71.14	-0.50	247.00	-0.50	25.00
20	0.80	66.38	-0.50	247.00	-0.50	25.00
25	0.65	61.63	-0.50	247.00	-0.50	25.00
30	0.59	56.91	-0.50	247.00	-0.50	25.00
35	0.63	52.24	-0.50	247.00	-0.50	25.00
40	0.61	47.61	-0.50	247.00	-0.50	25.00
45	0.53	43.02	-0.50	247.00	-0.50	25.00
50	0.41	38.49	-0.50	247.00	-0.50	25.00
55	0.00	33.94	-0.50	247.00	-0.50	25.00
60	0.00	29.71	-0.50	247.00	-0.50	25.00
65	0.00	25.72	-0.50	247.00	-0.50	25.00
70	0.00	22.12	-0.50	247.00	-0.50	25.00
75	0.00	19.12	-0.50	247.00	-0.50	25.00
80	0.00	17.04	-0.50	247.00	-0.50	25.00
85	0.00	16.24	-0.50	247.00	-0.50	25.00
90	0.00	16.91	-0.50	247.00	-0.50	25.00
95	0.00	18.89	-0.50	247.00	-0.50	25.00
100	0.00	21.82	-0.50	247.00	-0.50	25.00
105	0.00	25.38	-0.50	247.00	-0.50	25.00
110	0.00	29.34	-0.50	247.00	-0.50	25.00
115	0.00	33.56	-0.50	247.00	-0.50	25.00
120	0.00	37.95	-0.50	247.00	-0.50	25.00
125	0.00	42.45	-0.50	247.00	-0.50	25.00
130	0.00	47.04	-0.50	247.00	-0.50	25.00
135	0.00	51.69	-0.50	247.00	-0.50	25.00
140	0.00	56.38	-0.50	247.00	-0.50	25.00
145	0.00	61.10	-0.50	247.00	-0.50	25.00
150	0.34	65.90	-0.50	247.00	-0.50	25.00
155	0.44	70.66	-0.50	247.00	-0.50	25.00
160	0.31	75.42	-0.50	247.00	-0.50	25.00
165	0.30	80.21	-0.50	247.00	-0.50	25.00
170	0.44	85.00	-0.50	247.00	-0.50	25.00
175	0.45	89.79	-0.50	247.00	-0.50	25.00
180	0.50	94.58	-0.50	247.00	-0.50	25.00
185	0.52	99.36	-0.50	247.00	-0.50	25.00

Coordination Values	**VOCA, TX**		
Licensee Name	Kuiper Systems LLC.		
Latitude (NAD 83)	31° 1' 19.9" N		
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Ground Elevation (AMSL)	479.77 m / 1574.1 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)	

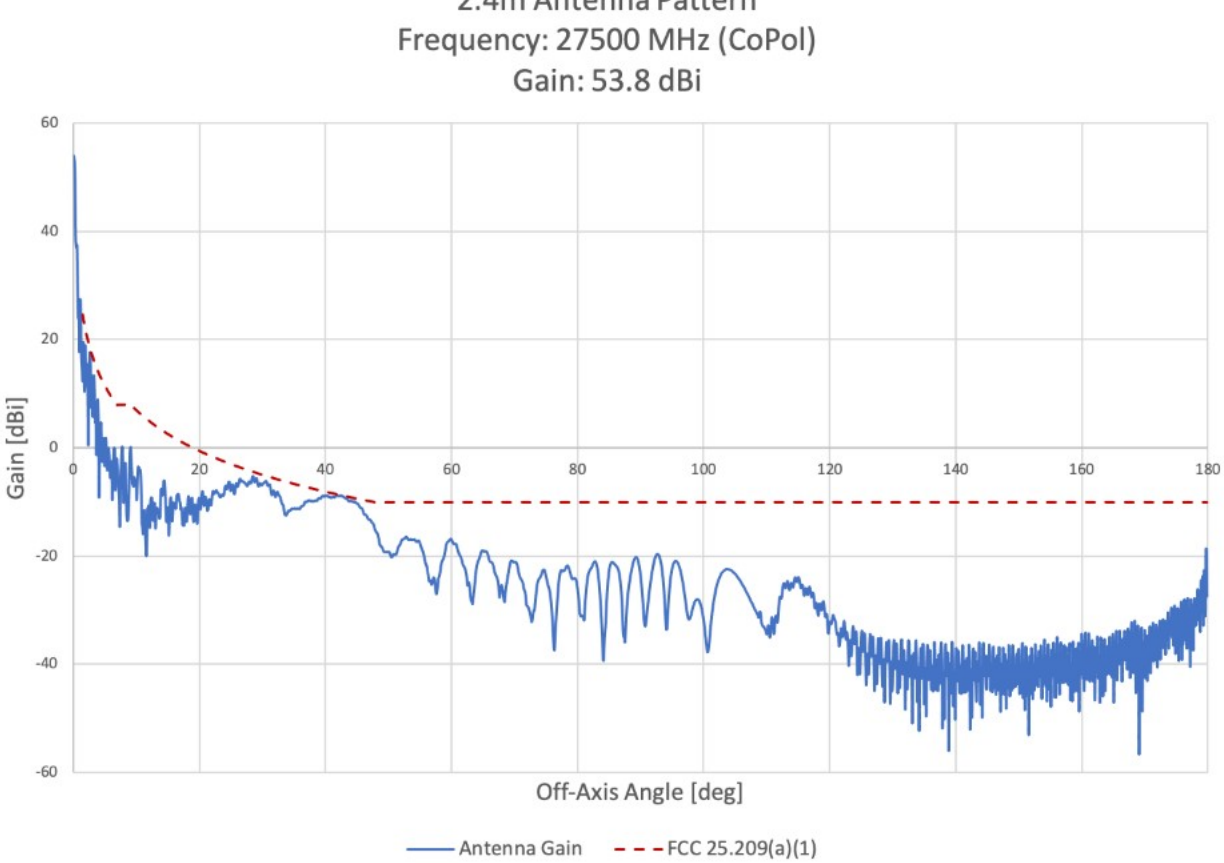
			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.57	104.13	-0.50	247.00	-0.50	25.00
195	0.70	108.89	-0.50	247.00	-0.50	25.00
200	0.56	113.65	-0.50	247.00	-0.50	25.00
205	0.53	118.39	-0.50	247.00	-0.50	25.00
210	0.42	123.13	-0.50	247.00	-0.50	25.00
215	0.37	127.82	-0.50	247.00	-0.50	25.00
220	0.30	132.47	-0.50	247.00	-0.50	25.00
225	0.33	137.04	-0.50	247.00	-0.50	25.00
230	0.28	141.56	-0.50	247.00	-0.50	25.00
235	0.33	145.92	-0.50	247.00	-0.50	25.00
240	0.26	150.16	-0.50	247.00	-0.50	25.00
245	0.36	154.06	-0.50	247.00	-0.50	25.00
250	0.44	157.57	-0.50	247.00	-0.50	25.00
255	0.48	160.48	-0.50	247.00	-0.50	25.00
260	0.55	162.44	-0.50	247.00	-0.50	25.00
265	0.62	163.14	-0.50	247.00	-0.50	25.00
270	0.77	162.35	-0.50	247.00	-0.50	25.00
275	0.95	160.30	-0.50	247.00	-0.50	25.00
280	1.12	157.35	-0.50	247.00	-0.50	25.00
285	1.23	153.84	-0.50	247.00	-0.50	25.00
290	1.24	150.00	-0.50	247.00	-0.50	25.00
295	1.15	145.92	-0.50	247.00	-0.50	25.00
300	1.20	141.59	-0.50	247.00	-0.50	25.00
305	1.22	137.15	-0.50	247.00	-0.50	25.00
310	1.09	132.66	-0.50	247.00	-0.50	25.00
315	1.09	128.05	-0.50	247.00	-0.50	25.00
320	0.96	123.43	-0.50	247.00	-0.50	25.00
325	0.87	118.76	-0.50	247.00	-0.50	25.00
330	0.74	114.05	-0.50	247.00	-0.50	25.00
335	0.70	109.31	-0.50	247.00	-0.50	25.00
340	0.69	104.55	-0.50	247.00	-0.50	25.00
345	0.79	99.77	-0.50	247.00	-0.50	25.00
350	0.87	94.99	-0.50	247.00	-0.50	25.00
355	0.81	90.21	-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:	Dennis Jimeno
Title:	Engineer III, Telecommunications
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5858
Fax:	703-726-5599
Email:	DJimeno@Comsearch.com
Web site:	www.comsearch.com

EXHIBIT D (ANTENNA PATTERN)


2.4m Antenna Pattern
Frequency: 27500 MHz (CoPol)
Gain: 53.8 dBi
Gain [dBi]
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
120
140
160
180
Off-Axis Angle [deg]
Antenna Gain
FCC 25.209(a)(1)