GATEWAY LICENSE NARRATIVE

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

Amazon's Kuiper System will deliver satellite broadband communications services to tens of millions of unserved and underserved consumers and businesses in the United States and around the globe. According to the 2021 Broadband Deployment Report, 14.5 million Americans lack access to fixed terrestrial broadband with benchmark download and upload speeds of 25 Mbps and 3 Mbps, respectively.[1] Amazon's Kuiper System will help close this digital divide by offering broadband communications services, including connectivity to homes, schools, hospitals, government offices, businesses of all sizes, first responders, and disaster relief operations, to rural and hard-to-reach areas. The Kuiper System will also enable mobile network operators to expand wireless services to unserved and underserved mobile customers and provide high-throughput mobile broadband connectivity services for aircraft, maritime vessels, and land vehicles. This gateway will be another step toward providing these urgently needed services to the American public.

The proposed gateway will consist of six (6) technically identical antennas that will communicate with Amazon's non-geostationary orbit ("NGSO") fixed-satellite service ("FSS") and mobile-satellite service ("MSS") Kuiper System in the frequency bands 27.5-30.0 GHz (Earth-

[1] *See Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, Fourteenth Broadband Deployment Report, 36 FCC Rcd 836 ¶ 2 (2021).

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.

I. PUBLIC INTEREST BENEFITS

In July 2020, Amazon received Commission authority to launch and operate its Kuiper System in the frequency bands 17.7-18.6 GHz,[2] 18.8-20.2 GHz, and 27.5-30.0 GHz.[3] As noted above, compelling public interest benefits justify expeditious authorization of this gateway. Amazon's customer-centric approach inspired the development of the Kuiper System and delivery of reliable, high-speed, low-latency broadband. The gateway will allow Amazon to deliver its broadband service to residential, mobility, enterprise, and government customers.

II. 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 its License[4] 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.

[2] Although Amazon requested access to the frequency band 17.7-17.8 GHz, it will only use this segment for space-to-Earth gateway operations outside the United States and its territories. *See Kuiper Systems, LLC*, Order and Authorization, 35 FCC Rcd 8324 ¶ 59(g) (2020) ("License").

[3] *See id.* ¶ 2.

[4] *See id.* ¶ 59.

Table 1: Kuiper System Gateway Transmit Frequencies

Transmit Frequencies (GHz)	Status[5]
27.5-28.35	FSS secondary to UMFUS[6]
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

i. 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.[7] 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.[8] Exhibit C, the Comsearch report, establishes that Amazon has coordinated with UMFUS licensees consistent with section 101.103(d).[9]

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[5] *See generally* 47 C.F.R. § 2.106; *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Notice of Proposed Rulemaking, 32 FCC Rcd 7809 (2017) ("*NGSO FSS Order*"); *id*. at Appendix B ("Ka-band Plan").

[6] Equivalent power flux-density ("EPFD") compliance permits NGSO and GSO FSS sharing. *See NGSO FSS Order* ¶¶ 23, 37, 39; 47 C.F.R. § 25.289.

[7] *See* 47 C.F.R. §§ 2.106, 25.136; *International Bureau Issues Guidance on Siting Methodologies for Earth Station 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 (2020).

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

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

ii. 28.35-28.6 GHz and 29.5-30.0 GHz (NGSO FSS secondary to GSO 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.[10] 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.[11]

iii. 28.6-29.1 GHz (NGSO FSS primary)

NGSO FSS may transmit on a primary basis in the 28.6-29.1 GHz band.[12] Amazon's operations as NGSO FSS possess primary status in the band.[13]

iv. 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.[14] As described in the following sub-sections, the Commission has granted Amazon authority

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

[11] *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 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*, 16 FCC Rcd 4096 ¶ 77 (2000) (concluding that compliance with EPFD limits "will adequately protect GSO FSS networks") ("*2000 NGSO FSS Order*").

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

[13] *See* License ¶ 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.

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

to operate NGSO MSS feeder links in this band and, therefore, the gateway may operate on a primary basis.[15]

1. 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[16] and employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.[17]

2. LMDS

To share with LMDS, Amazon will coordinate as required by the Commission's rules.[18]

3. 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.[19]

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.[20]

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[15] *See* License ¶¶ 24-25 and n.7.

[16] Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. *See* License ¶ 59(i).

[17] *See id.*

[18] *See* 47 C.F.R. §§ 25.203; 101.103(d).

[19] *See* 47 C.F.R. § 2.106 n.NG62.

[20] Before operating in these bands, Amazon will complete coordination with U.S. Federal systems. *See id.* n.US334; License ¶ 59(m).

Table 2: Kuiper System Gateway Receive Frequencies

Frequencies (GHz)	Status[21]
17.8-18.3	FSS secondary to FS[22]
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

i. 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.[23] To share with FS, Amazon will meet the power flux-density limits in ITU Radio Regulations Article 21.[24] The Comsearch report confirms no additional limitations are necessary.[25]

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

[22] EPFD compliance permits NGSO and GSO FSS sharing. *See NGSO FSS Order* n.19 and ¶¶ 37, 39; 47 C.F.R. § 25.289.

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

[24] *See* License ¶¶ 13, 59(d)-(e).

[25] *See* Exhibit C.

ii. 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.[26] To share with GSO FSS, Amazon will comply with the applicable EPFD limits in ITU Radio Regulations Article 22 and Resolution 76.[27]

iii. 18.8-19.3 GHz (NGSO FSS primary)

NGSO FSS may receive on a primary basis in the 18.8-19.3 GHz band.[28] Amazon's operations are licensed as NGSO FSS and, therefore, possess primary status in the band.[29]

iv. 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.[30] To share with GSO FSS, Amazon will neither cause harmful interference to GSO FSS nor claim protection from harmful interference from GSO FSS.[31]

v. 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.[32] 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

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

[27] The Commission has found that EPFD demonstrations may permit NGSO FSS to share frequency bands with GSO FSS. *See* License ¶¶ 13, 14, 59(d)-(e); *NGSO FSS Order* n.84; *see also 2000 NGSO FSS Order* ¶ 77.

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

[29] *See* License ¶ 11.

[30] *See* 47 C.F.R. § 2.106; Ka-band Plan; *NGSO FSS Order* ¶ 19.

[31] *See* 47 C.F.R. § 2.105(c)(2).

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

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

vi. 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.[35] 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[36] and employ the section 25.261 spectrum-sharing framework with operators in the March 2020 processing round while operating service.[37]

III. 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."[38] Amazon, nonetheless, will comply

[33] Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. *See* License ¶ 59(i).

[34] *See id*.

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

[36] Before using this band, Amazon will coordinate with NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. *See* License ¶ 59(i).

[37] *See id*.

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

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

IV. 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.[40] 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.

V. 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.[41] Amazon's antenna structure for the gateway measures 6.1 meters or less in height above ground level and requires no FAA notification.

VI. CONCLUSION

Amazon has satisfied the Commission's licensing standards for NGSO Ka-band gateways. As a result, timely action on 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 country.

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

[40] *See* FCC OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Exhibit B.

[41] *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), 17.7(e), 25.115(j).

EXHIBIT A (SECTION 25.136 UMFUS PROTECTION ANALYSIS)

This exhibit demonstrates that the proposed gateway earth station[1] satisfactorily protects 27.5-28.35 GHz Upper Microwave Flexible Use Service ("UMFUS") deployments in Honolulu County, HI ("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. *Second*, an FSS gateway generating 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.[3] *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). *Fourth*, the FSS operator must coordinate with existing UMFUS licensees located within a PFD contour greater than or equal to -77.6 dBm/m^2/MHz.

Amazon's analysis shows compliance with Section 25.136(a)(4) and the Guidance. No more than three FSS earth stations will operate under the provisions of 25.136(a)(4) in the County hosting the proposed gateway. Amazon's -77.6 dBm/m^2/MHz PFD contour covers zero people of the County's total 953,206 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.[4]

The Commission, therefore, should authorize this proposed gateway and not require Amazon to provide additional interference protection to UMFUS licensees in this County.

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

[2] *See* 47 C.F.R. § 25.136(a)(4) ("Section 25.136"). 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* Section 25.136 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).

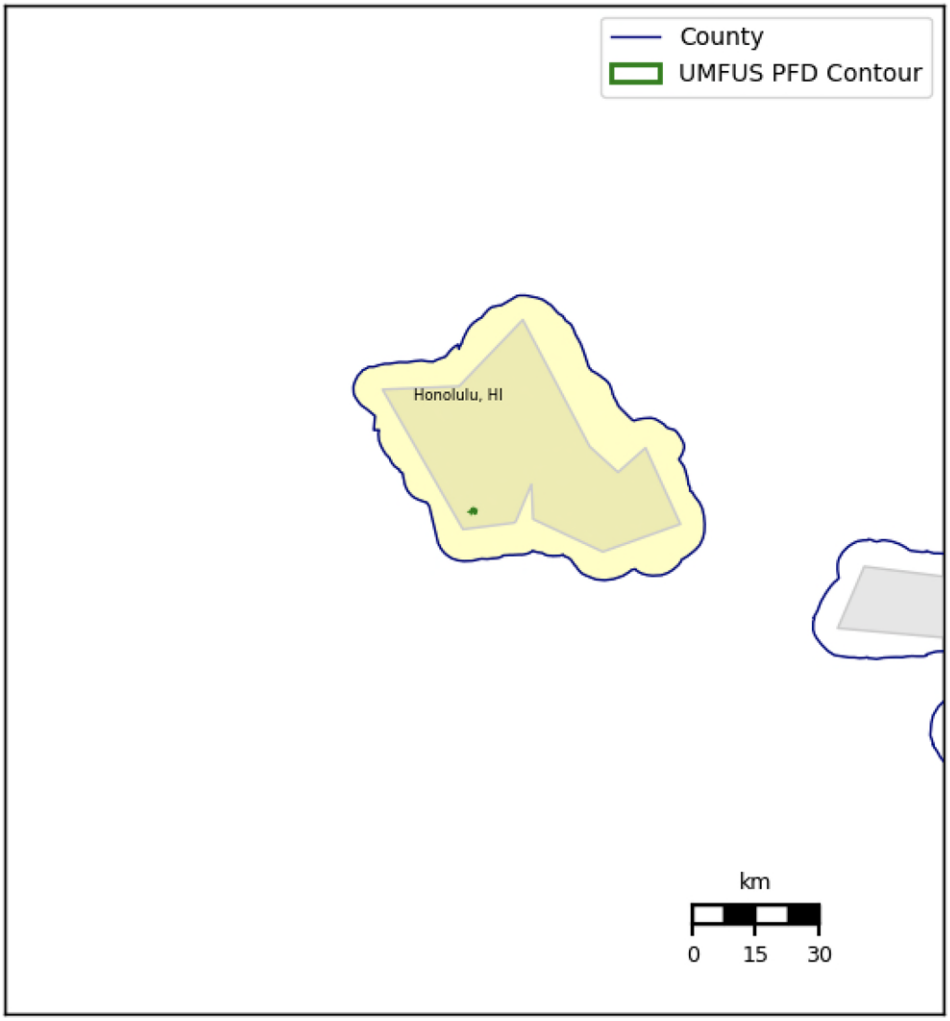
[4] *See* Exhibit C, Comsearch Coordination Report.

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

(i) There 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. For purposes of this requirement, multiple earth stations that are collocated with or at a location contiguous to each other shall be considered as one earth station.

Figure 1 depicts the proposed earth station's location in the County. The earth station location and PFD contour are shown in green in the southwest corner of the island.

Figure 1. Location of Amazon Earth Station



As of the date of this submission, the Commission's International Bureau Filing System shows three FSS licensees using the 27.5-28.35 GHz band in the County, under five callsigns. These earth stations, listed in Table 1 below, are grouped at two sites: (1) the Hawaii Pacific Teleport LLLP ("Hawaii Pacific") site at 91-340 Farrington Hwy and (2) the O3b Limited ("O3b") gateway at 58-350 Kamehameha Hwy. For purposes of 25.136(a)(4)(i), earth stations that are collocated

with each other shall be considered as one earth station. 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).

Table 1. FSS Earth Stations in the 27.5-28.35 GHz band in Honolulu County, HI.

Address	Applicant	Callsign
91-340 Farrington Hwy	Viasat, Inc. ("Viasat")	E110046
	Hawaii Pacific	E150010
58-350 Kamehameha Hwy	O3b	E202133
	O3b	E140107
	O3b	E100088

PFD contour generation for 25.136(a)(4)(ii)–(iv)

To verify compliance with 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 -19.1 dBW/MHz at the horizon in any azimuth direction based on a simulated antenna pattern.[5]

Amazon will also deploy this gateway with a shielding solution that will entirely surround the antennas and provide a minimum of 16 dB of attenuation on the gateway transmissions.[6] The effective EIRP at the horizon will be no greater than -35.1 dBW/MHz with the shielding attenuation included. The shielding will comply with local code requirements and will consist of a non-perforated corrugated metal fence with a frame constructed from metal poles or pressure treated lumber and will be covered with an outer layer made of corrugated steel or aluminum. The fence's outer layer will be constructed of solid corrugated metal panels fastened with screws to the frame. Amazon will design the shielding to ensure that the height, material, and distance of the shielding from the earth station provide sufficient attenuation to ensure the PFD produced by the earth station does not exceed -77.6 dBm/m^2/MHz at 10 meters above ground level anywhere outside of the contour specified in this application.

Table 2. Amazon Earth Station Parameters

Field	Value	Units
County	Honolulu County, HI	
Latitude	21° 20' 9.2" N	
Longitude	158° 5' 20.8" W	
Simulation Frequency	27.5	GHz

[5] 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.

[6] *See* Guidance at 3 (computing PFD contours and protection zones at bullet 4).

Field	Value	Units
Number of Active Antennas	4	
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)[7]	-19.1	dBW/MHz
Aggregate EIRP toward the Horizon (with Shielding)[8]	-35.1	dBW/MHz

Amazon generated the proposed earth station's -77.6 dBW/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.[9] 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.[10] The antenna gain toward the horizon is derived from antenna manufacturer calculations.[11] The PFD contour is generated using the worst-case input power density rather than the input power density during clear sky conditions.[12]

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

[7] 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).

[8] This figure is the Aggregate EIRP toward the Horizon (without Shielding) minus an additional 16 dB of attenuation for shielding.

[9] 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.

[10] *See* Guidance at 3 (computing PFD contours and protection zones at bullets 2 and 4). For the application of ITU-R Recommendation P.452, the "village centre" clutter category was used, per Table 4 of ITU-R Recommendation P.452. This clutter category assumes a nominal clutter height of 5 meters. The clutter height in the south of the site exceeds this value, and this nominal clutter category underestimates the attenuation that will exist in the southeast direction.

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

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

Figure 2. Gateway PFD Contour

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

(ii) 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, 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).

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 in the County. The County's population totals 953,206 people, according to 2010 U.S. Census Bureau data.[13] As a result, the maximum population permitted within the FSS gateway's -77.6 dBW/m^2/MHz PFD contour is 953 people. Amazon's analysis demonstrates that the proposed gateway's PFD contour covers zero people—less than the 953 limit—using 2010 U.S. Census Bureau data and the actual area method.[14]

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. The aggregate population covered by the two currently authorized earth stations and Amazon's proposed earth station is 225 people. The O3b and Hawaii Pacific earth station applications contain analysis demonstrating that they cover 75 people and 0 people respectively.[15] The Viasat earth station application was submitted in 2011, and thus does not contain a detailed population coverage analysis. Using the technical parameters from the Viasat earth station application, including its antenna location, height, antenna pattern, and EIRP, Amazon computed the population coverage from the Viasat earth station to be 150 people.[16] The Amazon earth station's PFD contour, therefore, does not exceed the Section 25.136(a)(ii) *aggregate* population coverage allowance of 953 people for the County.

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[13] *See Honolulu County, Hawaii*, U.S. Census Bureau, https://bit.ly/3h1Q1rs (last visited June 22, 2021).

[14] *See* Guidance at 4 (determining estimated aggregate population coverage at bullet 2).

[15] *See* Letter from Will Lewis, Senior Legal Counsel, O3b, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SES-MOD-20190207-00084, Supplemental Showing at 3 (filed June 20, 2019), https://bit.ly/3gN3EMh; Application of Hawaii Pacific, IBFS File No. SES-MFS-20170721-00787, Attachment 25.136 Compliance (filed July 21, 2017), https://bit.ly/35PnC2S.

[16] *See* Application of Viasat, IBFS File No. SES-LIC-20110328-00376 (filed Mar. 25, 2011).

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.

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

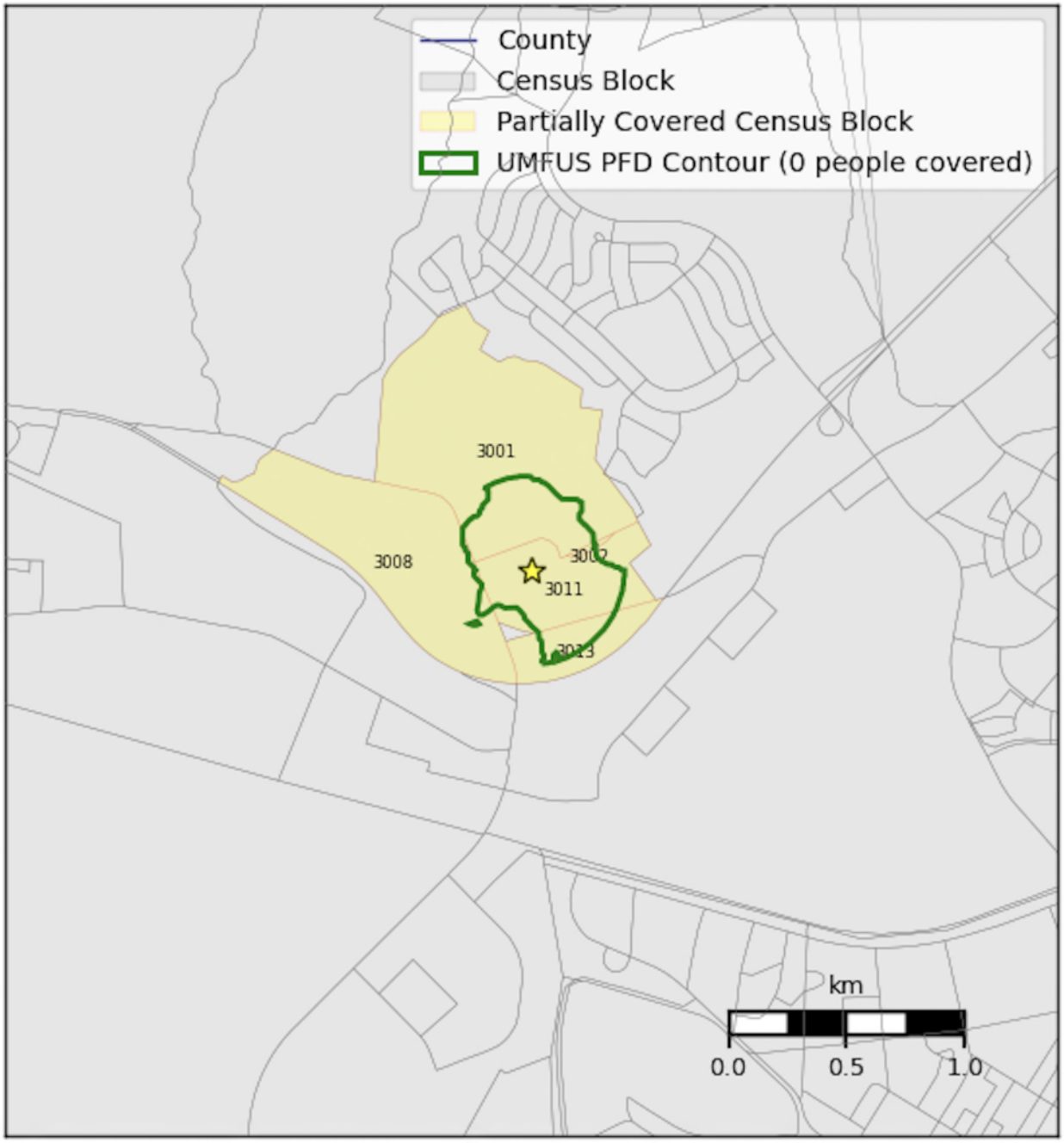


Table 3. PFD Contour Population Coverage, by Census Block

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Hawaii	Honolulu	150030086223001	0	18%	0
Hawaii	Honolulu	150030086223002	0	66%	0
Hawaii	Honolulu	150030086223008	0	2%	0
Hawaii	Honolulu	150030086223011	0	75%	0
Hawaii	Honolulu	150030086223013	0	31%	0

Table 4. PFD Contour Population Coverage, by County

State	County	County Population	Allowable Population Coverage	Covered Population
Hawaii	Honolulu	953,206	953	0

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)

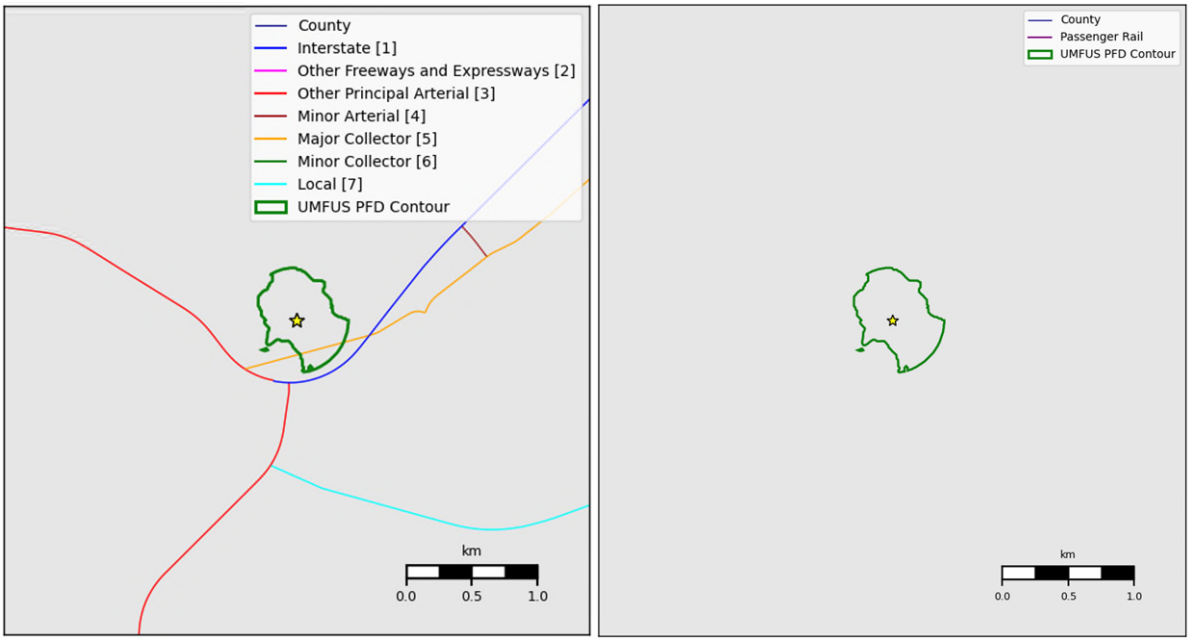
(iii) The area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m^2/MHz does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port. In addition, the area mentioned in paragraph (a)(4)(ii) 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.

Using Google Earth and 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 venue, 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.[17] 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.[18] The proposed gateway, therefore, adheres to the requirements of Section 25.136(a)(iii).

[17] *See Planning, Environment, Realty (HEP) HEPGIS*, U.S. Department of Transportation Federal Highway Administration, https://hepgis.fhwa.dot.gov/fhwagis/ (last visited March 23, 2021).

[18] *See* Guidance at 5 (defining roadways at bullet 2); *Federal-Aid Functional Classification Update: Policy and Procedures*, State of Hawaii Department of Transportation Highways Division Planning Branch at 80, 148 (Dec. 2012), https://bit.ly/3j5cIh1.

Figure 4. -77.6 dBm/m^2/MHz PFD contour overlaid with major roadways (left) and passenger railroads (right)



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)

(iv) The applicant 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. In coordinating with UMFUS licensees, the applicant shall use the applicable processes contained in §101.103(d) of this chapter.

Exhibit C, Comsearch report, establishes that Amazon has completed coordination with existing UMFUS licensees, as Section 25.136(a)(iv) requires.[19]

[19] *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.
KAPOLEI, HI
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
March 09, 2021

TABLE OF CONTENTS

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.

The following companies reported potential great circle interference conflicts that did not meet the objectives on a line-of-sight basis. When over-the-horizon losses are considered on the interfering paths, sufficient blockage exists to negate harmful interference from occurring with the proposed transmit-receive earth station.

Company
T-Mobile License LLC

No other carriers reported potential interference cases.

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 02/02/2021.

Company
AT&T Mobility Spectrum LLC - Hawaii
AT&T Mobility Spectrum LLC - ID, MT, WY
Cellco Partnership - Hawaii
Clearwire Hawaii Partners Spectrum LLC
Coral Wireless Licenses, LLC
County of Maui Dept of Water Supply
Hawaii, State of
Hawaiian Telcom, Inc.
Honolulu Board of Water Supply
Honolulu City & County Dept of Info Tech
Maui, County of
Spectrum Oceanic, LLC
Sprint Spectrum L.P.
Sprintcom, Inc
T-Mobile Lic LLC - Voicestream PCS BTA I
T-Mobile License LLC
Trex Broadband
US Internet Wireless
Verizon Wireless VAW LLC - (Hawaii)
Wavecom Solutions Corporation

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: 03/09/2021
Job Number: 210202COMSGE04

Administrative Information

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

Site Information — KAPOLEI, HI

Venue Name	
Latitude (NAD 83)	21° 20' 9.2" N
Longitude (NAD 83)	158° 5' 20.8" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	34.94 m / 114.6 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	**KAPOLEI, HI**			
Licensee Name	Kuiper Systems LLC.			
Latitude (NAD 83)	21° 20' 9.2" N			
Longitude (NAD 83)	158° 5' 20.8" W			
Ground Elevation (AMSL)	34.94 m / 114.6 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	10.06	79.15	-0.50	247.00	-0.50	25.00
5	10.13	78.18	-0.50	247.00	-0.50	25.00
10	10.12	77.25	-0.50	247.00	-0.50	25.00
15	9.99	76.31	-0.50	247.00	-0.50	25.00
20	9.56	75.19	-0.50	247.00	-0.50	25.00
25	8.46	73.55	-0.50	247.00	-0.50	25.00
30	8.72	73.23	-0.50	247.00	-0.50	25.00
35	8.98	73.07	-0.50	247.00	-0.50	25.00
40	9.83	73.64	-0.50	247.00	-0.50	25.00
45	8.93	72.59	-0.50	247.00	-0.50	25.00
50	6.19	69.84	-0.50	247.00	-0.50	25.00
55	6.78	70.58	-0.50	247.00	-0.50	25.00
60	7.86	71.93	-0.50	247.00	-0.50	25.00
65	7.35	71.87	-0.50	247.00	-0.50	25.00
70	5.20	70.46	-0.50	247.00	-0.50	25.00
75	3.13	69.45	-0.50	247.00	-0.50	25.00
80	2.96	70.35	-0.50	247.00	-0.50	25.00
85	1.92	70.74	-0.50	247.00	-0.50	25.00
90	0.00	70.77	-0.50	247.00	-0.50	25.00
95	0.38	72.66	-0.50	247.00	-0.50	25.00
100	0.00	74.18	-0.50	247.00	-0.50	25.00
105	0.00	76.05	-0.50	247.00	-0.50	25.00
110	0.00	78.02	-0.50	247.00	-0.50	25.00
115	0.00	80.06	-0.50	247.00	-0.50	25.00
120	0.00	82.17	-0.50	247.00	-0.50	25.00
125	0.00	84.32	-0.50	247.00	-0.50	25.00
130	0.00	86.51	-0.50	247.00	-0.50	25.00
135	0.00	88.72	-0.50	247.00	-0.50	25.00
140	0.00	90.94	-0.50	247.00	-0.50	25.00
145	0.00	93.16	-0.50	247.00	-0.50	25.00
150	0.00	95.35	-0.50	247.00	-0.50	25.00
155	0.00	97.51	-0.50	247.00	-0.50	25.00
160	0.00	99.63	-0.50	247.00	-0.50	25.00
165	0.00	101.68	-0.50	247.00	-0.50	25.00
170	0.00	103.66	-0.50	247.00	-0.50	25.00
175	0.00	105.54	-0.50	247.00	-0.50	25.00
180	0.00	107.33	-0.50	247.00	-0.50	25.00
185	0.00	108.99	-0.50	247.00	-0.50	25.00

COMSEARCH

Earth Station Data Sheet

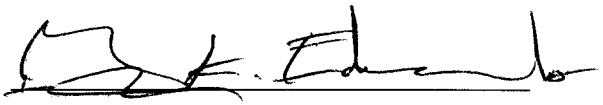
19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**KAPOLEI, HI**			
Licensee Name	Kuiper Systems LLC.			
Latitude (NAD 83)	21° 20' 9.2" N			
Longitude (NAD 83)	158° 5' 20.8" W			
Ground Elevation (AMSL)	34.94 m / 114.6 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	0.00	110.52	-0.50	247.00	-0.50	25.00
195	0.00	111.89	-0.50	247.00	-0.50	25.00
200	0.00	113.11	-0.50	247.00	-0.50	25.00
205	0.00	114.15	-0.50	247.00	-0.50	25.00
210	0.00	115.00	-0.50	247.00	-0.50	25.00
215	0.00	115.65	-0.50	247.00	-0.50	25.00
220	0.00	116.09	-0.50	247.00	-0.50	25.00
225	0.00	116.32	-0.50	247.00	-0.50	25.00
230	0.00	116.34	-0.50	247.00	-0.50	25.00
235	0.00	116.14	-0.50	247.00	-0.50	25.00
240	0.00	115.73	-0.50	247.00	-0.50	25.00
245	0.00	115.11	-0.50	247.00	-0.50	25.00
250	0.00	114.29	-0.50	247.00	-0.50	25.00
255	0.00	113.28	-0.50	247.00	-0.50	25.00
260	0.00	112.09	-0.50	247.00	-0.50	25.00
265	0.00	110.73	-0.50	247.00	-0.50	25.00
270	0.00	109.23	-0.50	247.00	-0.50	25.00
275	0.00	107.58	-0.50	247.00	-0.50	25.00
280	0.71	105.41	-0.50	247.00	-0.50	25.00
285	1.53	103.18	-0.50	247.00	-0.50	25.00
290	1.77	101.22	-0.50	247.00	-0.50	25.00
295	1.83	99.29	-0.50	247.00	-0.50	25.00
300	1.69	97.36	-0.50	247.00	-0.50	25.00
305	2.47	95.18	-0.50	247.00	-0.50	25.00
310	3.34	93.07	-0.50	247.00	-0.50	25.00
315	4.03	91.09	-0.50	247.00	-0.50	25.00
320	5.42	89.24	-0.50	247.00	-0.50	25.00
325	6.17	87.55	-0.50	247.00	-0.50	25.00
330	6.72	85.95	-0.50	247.00	-0.50	25.00
335	9.07	84.98	-0.50	247.00	-0.50	25.00
340	10.35	84.04	-0.50	247.00	-0.50	25.00
345	11.28	83.19	-0.50	247.00	-0.50	25.00
350	11.15	81.98	-0.50	247.00	-0.50	25.00
355	10.43	80.47	-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: March 09, 2021

Ka-Band Earth Station – Kapolei, HI

Frequency Coordination Report

28 GHz

Prepared on Behalf of
KUIPER SYSTEMS, LLC

March 9, 2021

COMSEARCH®
A CommScope Company

Table of Contents

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 Kapolei, HI, 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 March 9, 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 Kapolei, HI 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
Frontier	Nationwide

A notification letter and datasheets for the Ka-Band earth station in Kapolei, HI 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
Information Super Station, LLC	Continental US

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
Verizon	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 Kapolei, HI. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

Job Number:	210202COMSGE04

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

Site Information	**KAPOLEI, HI**
Venue Name	
Latitude (NAD 83)	21° 20' 9.2" N
Longitude (NAD 83)	158° 5' 20.8" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	34.94 m / 114.6 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	**KAPOLEI, HI**			
Licensee Name	Kuiper Systems LLC.			
Latitude (NAD 83)	21° 20' 9.2" N			
Longitude (NAD 83)	158° 5' 20.8" W			
Ground Elevation (AMSL)	34.94 m / 114.6 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 0.0025%	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	
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	10.06	79.15	-0.50	247.00	-0.50	25.00
5	10.13	78.18	-0.50	247.00	-0.50	25.00
10	10.12	77.25	-0.50	247.00	-0.50	25.00
15	9.99	76.31	-0.50	247.00	-0.50	25.00
20	9.56	75.19	-0.50	247.00	-0.50	25.00
25	8.46	73.55	-0.50	247.00	-0.50	25.00
30	8.72	73.23	-0.50	247.00	-0.50	25.00
35	8.98	73.07	-0.50	247.00	-0.50	25.00
40	9.83	73.64	-0.50	247.00	-0.50	25.00
45	8.93	72.59	-0.50	247.00	-0.50	25.00
50	6.19	69.84	-0.50	247.00	-0.50	25.00
55	6.78	70.58	-0.50	247.00	-0.50	25.00
60	7.86	71.93	-0.50	247.00	-0.50	25.00
65	7.35	71.87	-0.50	247.00	-0.50	25.00
70	5.20	70.46	-0.50	247.00	-0.50	25.00
75	3.13	69.45	-0.50	247.00	-0.50	25.00
80	2.96	70.35	-0.50	247.00	-0.50	25.00
85	1.92	70.74	-0.50	247.00	-0.50	25.00
90	0.00	70.77	-0.50	247.00	-0.50	25.00
95	0.38	72.66	-0.50	247.00	-0.50	25.00
100	0.00	74.18	-0.50	247.00	-0.50	25.00
105	0.00	76.05	-0.50	247.00	-0.50	25.00
110	0.00	78.02	-0.50	247.00	-0.50	25.00
115	0.00	80.06	-0.50	247.00	-0.50	25.00
120	0.00	82.17	-0.50	247.00	-0.50	25.00
125	0.00	84.32	-0.50	247.00	-0.50	25.00
130	0.00	86.51	-0.50	247.00	-0.50	25.00
135	0.00	88.72	-0.50	247.00	-0.50	25.00
140	0.00	90.94	-0.50	247.00	-0.50	25.00
145	0.00	93.16	-0.50	247.00	-0.50	25.00
150	0.00	95.35	-0.50	247.00	-0.50	25.00
155	0.00	97.51	-0.50	247.00	-0.50	25.00
160	0.00	99.63	-0.50	247.00	-0.50	25.00
165	0.00	101.68	-0.50	247.00	-0.50	25.00
170	0.00	103.66	-0.50	247.00	-0.50	25.00
175	0.00	105.54	-0.50	247.00	-0.50	25.00
180	0.00	107.33	-0.50	247.00	-0.50	25.00
185	0.00	108.99	-0.50	247.00	-0.50	25.00

Coordination Values	KAPOLEI, HI			
Licensee Name	Kuiper Systems LLC.			
Latitude (NAD 83)	21° 20' 9.2" N			
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Ground Elevation (AMSL)	34.94 m / 114.6 ft			
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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 0.0025%	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	
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	0.00	110.52	-0.50	247.00	-0.50	25.00
195	0.00	111.89	-0.50	247.00	-0.50	25.00
200	0.00	113.11	-0.50	247.00	-0.50	25.00
205	0.00	114.15	-0.50	247.00	-0.50	25.00
210	0.00	115.00	-0.50	247.00	-0.50	25.00
215	0.00	115.65	-0.50	247.00	-0.50	25.00
220	0.00	116.09	-0.50	247.00	-0.50	25.00
225	0.00	116.32	-0.50	247.00	-0.50	25.00
230	0.00	116.34	-0.50	247.00	-0.50	25.00
235	0.00	116.14	-0.50	247.00	-0.50	25.00
240	0.00	115.73	-0.50	247.00	-0.50	25.00
245	0.00	115.11	-0.50	247.00	-0.50	25.00
250	0.00	114.29	-0.50	247.00	-0.50	25.00
255	0.00	113.28	-0.50	247.00	-0.50	25.00
260	0.00	112.09	-0.50	247.00	-0.50	25.00
265	0.00	110.73	-0.50	247.00	-0.50	25.00
270	0.00	109.23	-0.50	247.00	-0.50	25.00
275	0.00	107.58	-0.50	247.00	-0.50	25.00
280	0.71	105.41	-0.50	247.00	-0.50	25.00
285	1.53	103.18	-0.50	247.00	-0.50	25.00
290	1.77	101.22	-0.50	247.00	-0.50	25.00
295	1.83	99.29	-0.50	247.00	-0.50	25.00
300	1.69	97.36	-0.50	247.00	-0.50	25.00
305	2.47	95.18	-0.50	247.00	-0.50	25.00
310	3.34	93.07	-0.50	247.00	-0.50	25.00
315	4.03	91.09	-0.50	247.00	-0.50	25.00
320	5.42	89.24	-0.50	247.00	-0.50	25.00
325	6.17	87.55	-0.50	247.00	-0.50	25.00
330	6.72	85.95	-0.50	247.00	-0.50	25.00
335	9.07	84.98	-0.50	247.00	-0.50	25.00
340	10.35	84.04	-0.50	247.00	-0.50	25.00
345	11.28	83.19	-0.50	247.00	-0.50	25.00
350	11.15	81.98	-0.50	247.00	-0.50	25.00
355	10.43	80.47	-0.50	247.00	-0.50	25.00

5. Contact Information

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

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Title:	Engineer III, Telecommunications
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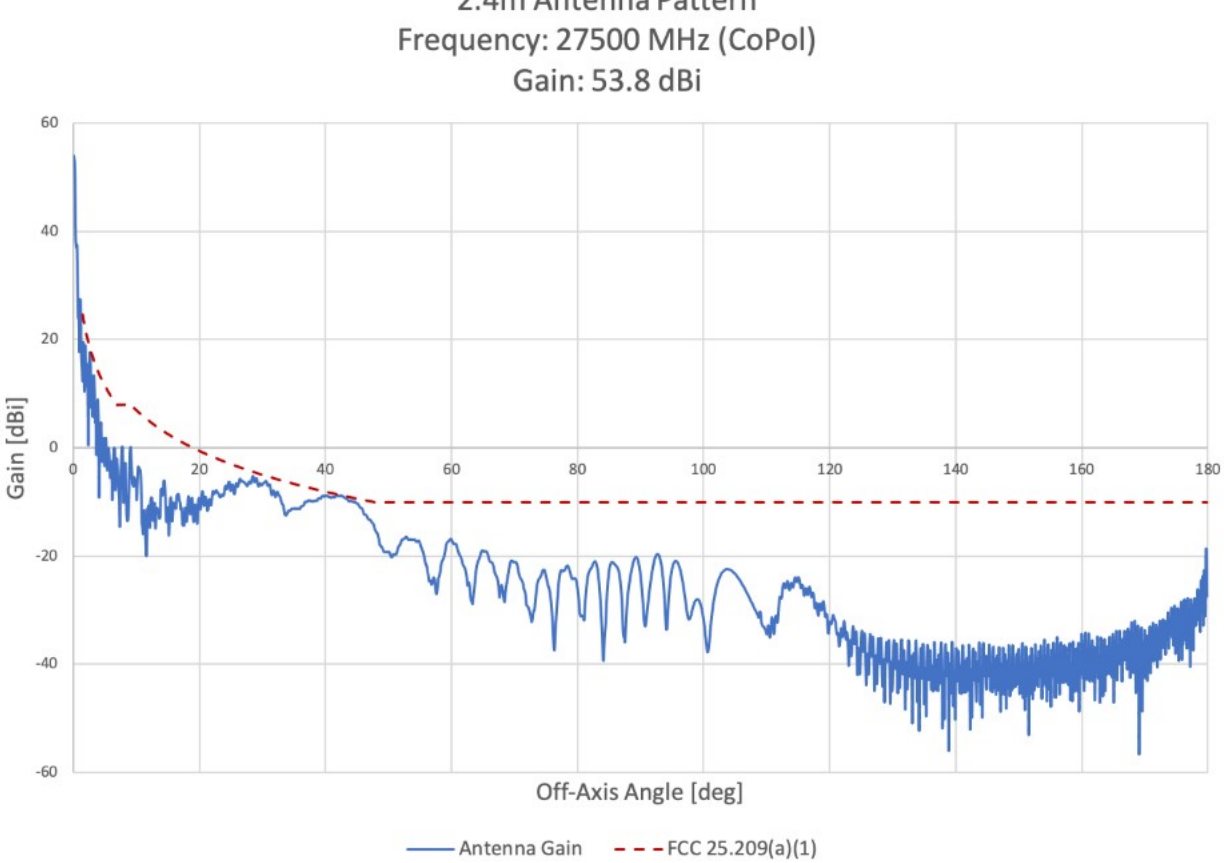
EXHIBIT D (ANTENNA PATTERN)


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)