Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Kymeta Corporation Application for	)	File No. SES-MOD- ___________
Modification of Blanket License to Add	)	Call Sign E170070
10,000 Second-Generation Ku-Band	)	
Transmit/Receive Fixed-Satellite Service	)	
Earth Stations in Motion		

APPLICATION FOR MODIFICATION OF BLANKET LICENSE

Kymeta Corporation ("Kymeta") respectfully requests that the Commission modify the above-captioned blanket license to authorize Kymeta to add 10,000 second-generation ("u8 Terminal") earth stations in motion ("ESIMs") operating in Ku-band Fixed-Satellite Service ("FSS") frequencies. Grant of the requested authority is consistent with Commission rules, policy and precedent, and will serve the public interest by enabling Kymeta to deploy its u8 Terminals to provide broadband mobility service to a wide variety of customers.

I. INTRODUCTION AND PUBLIC INTEREST SHOWING

Kymeta has developed, and is ready to deploy, the second-generation of its innovative antenna for satellite communications to facilitate further reductions in the cost of broadband deployment and enable entirely new applications for satellite technology. Like the first-generation u7 Terminal, the second-generation u8 Terminal employs a flat panel antenna using software and metamaterials technology to electronically and dynamically steer the antenna beam from a flat thin film transistor ("TFT") panel to track the target satellite. The Kymeta technology enables thinner, lighter, more efficient, and less expensive antennas compared to traditional satellite antenna technologies. The u8 Terminal provides better gain for both transmit and receive operations than the u7 Terminal. In addition, the u8 Terminal enables a wider tunable bandwidth for receive operations, and increased instantaneous bandwidth.

II. DESCRIPTION OF KYMETA u8 TERMINAL

Kymeta's u8 Terminal uses software and metamaterials technology to electronically and dynamically steer the antenna beam from a flat TFT panel to track the target satellite. The u8 Terminal combines transmit and receive capabilities in a single aperture (although the transmit and receive functions are controlled separately). In vehicle applications, the antenna will be mounted horizontally on the top of a vehicle (such as a train, bus, commercial truck, or a civilian armored vehicle). In maritime applications, the antenna will typically be mounted on a platform or surface at or near the highest point of the vessel.

The u8 Terminal uses electronic beam steering to track the target satellite. The receive antenna employs a closed-loop pointing algorithm to track the target satellite with the transmit antenna pointing being continuously slaved to the resulting pointing vector.

Table 1 summarizes important transmit and receive characteristics of the u8 Terminal.

Table 1. u8 Terminal Characteristics

Specification	**Antenna and Terminal Data**
Antenna dimensions	82 cm diameter (antenna is circular)
Transmit Band	14.0 – 14.5 GHz
Receive Band	10.95 – 11.2 GHz; 11.45 – 11.7 GHz; and 11.7 – 12.2 GHz Note: Kymeta does not claim interference protection from any authorized terrestrial stations for downlink operations in the 10.95 – 11.2 GHz and 11.45 – 11.7 GHz bands.
Maximum EIRP	47.2 dBW @ 0 degree scan
Transmit Gain	35.1 dBi at 14.0 GHz
Polarization	Linear or circular

III. KYMETA'S u8 TERMINAL COMPLIES WITH THE RULES IN SECTION 25.228 GOVERNING ESIMs

Kymeta's u8 Terminal complies with all relevant provisions of Part 25, including Section 25.228 governing ESIMs.

Table 2 provides a summary of these requirements.

Table 2
Information Required by Part 25 and Section 25.228
(Earth Stations in Motion)

Rule Section	Requirement	Section of Application
25.228(a)	Compliance with off-axis EIRP power spectral density standards set forth in Section 25.218. Note: These provisions incorporate Section 25.115(g)(1).	III.A, Exhibits A and B
25.228(b)	Compliance with self-monitoring requirement and ability to automatically cease transmissions in excess of authorized off-axis EIRP density limits within 100 milliseconds	III.B
25.228(c)	Compliance with requirement that each ESIM must be monitored and controlled by a network control and monitoring center (NCMC)	III.C
25.228(d)	Compliance with requirement that VMES Terminals be installed by qualified installers; compliance with RF hazard labelling requirement if RF exposure levels exceed 1.0 mW/cm2 in accessible areas.	III.D
25.228(e)(1)	Operators shall control all ESVs by a NCMC located in the United States, with limited exceptions	III.E
25.228(e)(2) and (f)	24/7 Point of Contact in the U.S. (including phone number and address), with authority and ability to cease all emissions from ESVs	III.F

25.228(e)(3)	Operators communicating with ESVs on vessels of foreign registry must maintain detailed information on each vessel's country of registry and a point of contact for the relevant administration responsible for licensing ESVs	III.G
25.228(j)(1) and (2)	Protection of NASA TDRSS Facilities operating in the 14.0 – 14.2 GHz band: The Terminal will use GPS to ensure compliance.	III.H
25.228(j)(3)	Protection of Radio Astronomy Services (RAS) operating in the 14.47 – 14.5 GHz band: The Terminal will use GPS to ensure compliance.	III.I
25.115(a)(1)	FCC Form 312 and associated Schedule B are submitted electronically	III.J
25.115(m)(3)(ii)	Geographic Area of Operation	III.K
1.1310	RF Safety analysis	III.L and Exhibit C
Points of communications	Permitted Space Station List	III.M

A. Off-Axis EIRP Spectral Density

Kymeta's u8 Terminal complies with the off-axis effective isotropically radiated power ("EIRP") power spectral density ("PSD") standards (the "off-axis mask") set forth in Section 25.218(f). Exhibits A and B to the Technical Appendix consist of comprehensive tables and a series of measured antenna patterns demonstrating compliance with the off-axis mask.

B. Cessation of Emissions

Kymeta certifies that the u8 Terminal will be self-monitoring, and will automatically cease transmissions within 100 milliseconds if a condition occurs that would cause the u8 Terminal to exceed the off-axis mask. The receive antenna employs a closed loop pointing algorithm to track the target satellite with the transmit antenna pointing being continuously slaved to the resulting pointing vector. The u8 Terminal employs self-monitoring and issues a mute command to the transmit modem when a tracking problem is encountered. The detection and mute function execution is done in less than 100 milliseconds. The u8 Terminal will not resume transmission until the condition that caused it to exceed the off-axis mask is corrected.

C. Network Control and Monitoring Center ("NCMC")

Each u8 Terminal will be monitored by an NCMC. Further, each u8 Terminal will comply with a "disable transmission" command from the NCMC within 100 milliseconds of receiving the command. The NCMC will monitor the operation of each u8 Terminal in its network, and transmit a "disable transmission" command to any u8 Terminal that exceeds the authorized off-axis mask. The NCMC will not allow the u8 Terminal to resume transmissions until the condition that caused the u8 Terminal to exceed the off-axis mask is corrected.

D. Installation of u8 Terminals

The installation of u8 Terminals on vehicles will be done by qualified installers who understand the antenna's radiation environment.

E. Control of Maritime u8 Terminals

Maritime u8 Terminals will be controlled by an NCMC located in the United States.

F. Point of Contact

A 24/7 point of contact with the authority and ability to cease all emissions from maritime u8 Terminals will be maintained.

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G. Recording and Retention of Transmit Data

The NCMC communicating with ESVs on vessels of foreign registry will maintain detailed information on each vessel's country of registry and a point of contact for the relevant administration responsible for licensing those ESVs.

H. Protection of NASA TDRSS Facilities

VMES and ESV licensees proposing to operate in the 14.0-14.2 GHz (Earth-to-space) frequency band within 125 km of the NASA Tracking and Data Relay Satellite System ("TDRSS") facilities at Guam; White Sands, New Mexico; and Blossom Point, Maryland are subject to coordination with NASA through NTIA's Interdepartmental Radio Advisory Committee ("IRAC"). Kymeta will use GPS to ensure that u8 Terminals do not operate in the 14.0 – 14.2 GHz sub-band within 125 km of NASA's TDRSS facilities at Guam, White Sands, or Blossom Point until and unless it completes coordination. Kymeta acknowledges that it is required to notify the International Bureau once it has completed such coordination.

I. Protection of Radio Astronomy Services ("RAS")

VMES and ESV licensees proposing to operate in the 14.47 – 14.5 GHz sub-band in the vicinity of RAS observatories observing in the 14.47 - 14.5 GHz band are subject to coordination with the National Science Foundation ("NSF"). Kymeta will use GPS to ensure that u8 Terminals do not operate in the 14.47 - 14.5 GHz sub-band within the delineated coordination radius of the RAS facilities listed in Table 1 to Section 25.228(j)(3) until and unless it completes such coordination. Kymeta acknowledges that it is required to notify the International Bureau once it has completed such coordination.

J. FCC Form 312 and Schedule B

Kymeta has completed and electronically submitted FCC Form 312 and Schedule B, together with the required application fee.

K. Geographic Areas in Which the u8 Terminals will Operate

Kymeta requests authority to operate the u8 Terminals in the continental United States ("CONUS"), Alaska, Hawaii, and U.S. territories and possessions, as well as territorial and international waters (in the case of ESVs).

L. Radio Frequency Hazard Analysis

Kymeta provides a radio frequency ("RF") safety analysis as Exhibit C to the Technical Appendix.

M. Points of Communication

Kymeta seeks authority to communicate with all satellites on the Permitted Space Station List.

IV. CONCLUSION

Kymeta requests that the Commission expeditiously grant this application for modification of its blanket license.

Respectfully submitted,

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June 11, 2020

TECHNICAL APPENDIX

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EXHIBIT A

COMPLIANCE WITH THE OFF-AXIS MASK

Off-axis EIRP spectral density is managed on an individual Terminal basis. Only one Terminal transmits at a given time and in a given bandwidth, so management of aggregate emissions is not required. The off-axis EIRP spectral density of an individual Terminal is a function of its transmit signal bandwidth, input power to the antenna, the projection of the antenna gain pattern along the geostationary arc, and antenna pointing error. Input power to the Terminal is controlled by limiting the output power of the modem. Integrated software monitors the scan and skew angles and automatically adjusts the output power of the modem.

One attribute of an electronically steered flat panel antenna is its level of scan loss. Scan loss refers to the decrease in gain that occurs as a flat panel antenna operates at an increased scan angle. The antenna gain falls off nearly as the cosine of the scan angle. The design specifications for the Terminal allow for operating scan angles of up to 75° (*i.e.* 15° elevation angle). At a minimum, the Terminal can acquire and maintain track within a cone extending to a 75 degree scan from vertical over a full 360 degrees of azimuth.

Flat panel antennas by nature exhibit changes in antenna pattern (especially sidelobe content) as a function of scan angle. Kymeta conducted extensive testing of its antenna to ensure compliance with FCC regulations. In Table 1 below, Kymeta includes data for 16 test cases that are representative of the overall antenna performance. For these 16 test cases, Kymeta submits PSD plots and PSD vs. off-axis angle data. In Table 2 below, Kymeta submits a summary table of expected performance for a total of 96 test cases, evaluating two frequencies, four theta angles, three phi planes, two polarizations, and two skew orientations.

Explanation of Certain Defined Terms

Theta in the context of the Kymeta antenna (as referenced in Table 1) is the angle away from the broadside of the antenna. One can also think of *theta* as the on-axis angle. To describe beam position Kymeta uses the spherical coordinate system, which in turn uses *theta* and *phi* as standard angles of measurement.

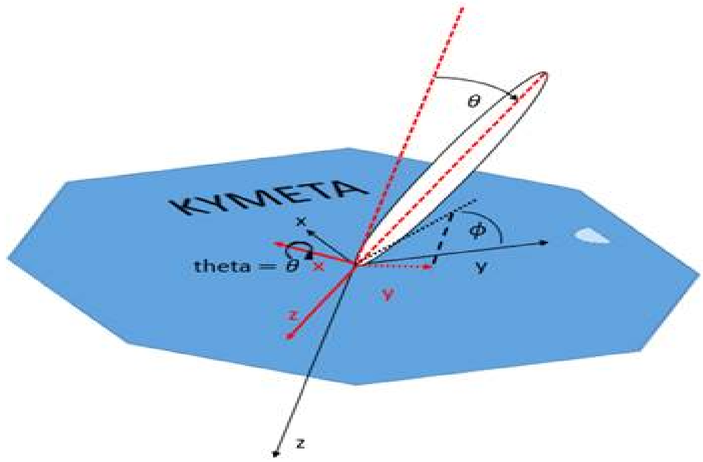
There is a difference between broadside and boresight with the Kymeta antenna. Broadside is the angle perpendicular to the surface of the antenna, while boresight is the on-axis direction of the beam. When the beam is commanded to *theta* = 0 position, broadside and boresight are the same. But for any other *theta* command boresight and broadside will be different. This is different from traditional parabolic dish antennas, where broadside and boresight are often the same, even when mounted on a gimbal for tracking purposes.

Phi is the angle of the beam as it is rotated around the broadside axis.

LPA is the Linear Polarization Angle of the Kymeta beam required to match the satellite's polarization.

Skew 90 is the cut of the 3D beam in the *phi* plane of scan, while skew 0 is the cut of the beam orthogonal to that of skew 90.

Set forth below are three drawings to help understand the antenna's spherical coordinate system.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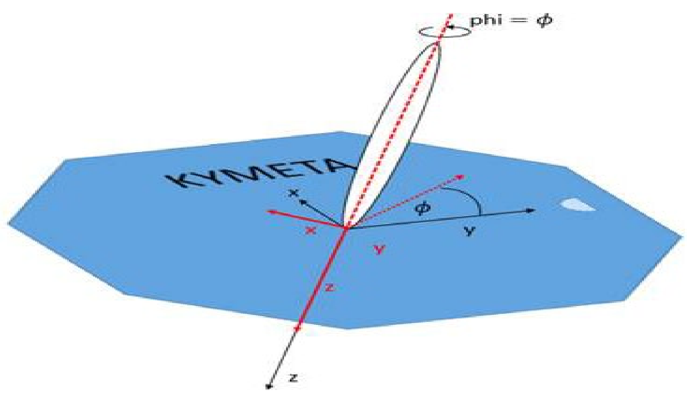
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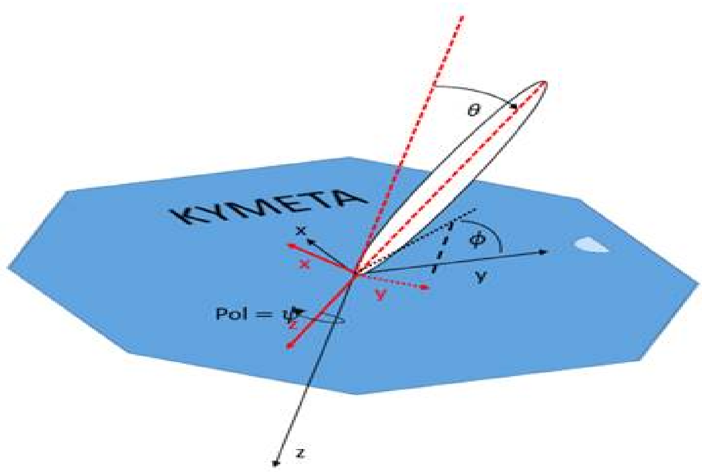
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Table 1: Highlighted test cases and expected performance

Theta	Phi	LPA	Skew	Freq	PSD Max	% Exceedance Spurious Sidelobes
0	0	0	0	14.0	17.91	0.0
0	0	0	0	14.5	19.57	0.0
0	0	0	90	14.0	15.95	0.0
0	0	0	90	14.5	19.37	0.3
30	0	0	0	14.0	19.72	0.0
30	0	0	0	14.5	20.21	0.4
30	0	0	90	14.0	15.12	0.0
30	0	0	90	14.5	16.35	0.0
45	0	0	0	14.0	19.19	0.1
45	0	0	0	14.5	19.44	0.0
45	0	0	90	14.0	13.58	0.0
45	0	0	90	14.5	15.41	0.5
60	0	0	0	14.0	18.14	0.0
60	0	0	0	14.5	19.46	0.2
60	0	0	90	14.0	9.32	0.0
60	0	0	90	14.5	10.65	0.0

Table 2: Overall summary with 96 test cases

Theta	Phi	LPA	Skew	Freq	PSD Max	% Exceedance Spurious Sidelobes
0	0	0	0	14	17.91	0.0
0	0	0	0	14.5	19.57	0.0
0	0	0	90	14	15.95	0.0
0	0	0	90	14.5	19.37	0.3
0	0	90	0	14	19.23	0.4
0	0	90	0	14.5	20.10	0.3
0	0	90	90	14	17.83	0.0
0	0	90	90	14.5	18.06	0.0

Theta	Phi	LPA	Skew	Freq	PSD Max	% Exceedance Spurious Sidelobes
0	110	0	0	14	16.80	0.0
0	110	0	0	14.5	16.46	0.0
0	110	0	90	14	18.90	0.6
0	110	0	90	14.5	19.91	0.1
0	110	90	0	14	17.50	0.1
0	110	90	0	14.5	20.92	0.4
0	110	90	90	14	18.56	0.2
0	110	90	90	14.5	17.87	0.0
0	260	0	0	14	18.92	0.3
0	260	0	0	14.5	19.10	0.0
0	260	0	90	14	18.22	0.0
0	260	0	90	14.5	20.20	0.6
0	260	90	0	14	16.92	0.0
0	260	90	0	14.5	19.72	0.6
0	260	90	90	14	19.47	0.2
0	260	90	90	14.5	19.92	0.3
30	0	0	0	14	19.72	0.0
30	0	0	0	14.5	20.21	0.4
30	0	0	90	14	15.12	0.0
30	0	0	90	14.5	16.35	0.0
30	0	90	0	14	19.43	0.0
30	0	90	0	14.5	19.82	0.0
30	0	90	90	14	15.56	0.0
30	0	90	90	14.5	16.09	0.0
30	110	0	0	14	18.92	0.0
30	110	0	0	14.5	18.64	0.0
30	110	0	90	14	16.78	0.3
30	110	0	90	14.5	17.36	0.0
30	110	90	0	14	18.53	0.0
30	110	90	0	14.5	19.43	0.0
30	110	90	90	14	16.98	0.0
30	110	90	90	14.5	16.43	0.0
30	260	0	0	14	18.07	0.0
30	260	0	0	14.5	20.06	0.0

Theta	Phi	LPA	Skew	Freq	PSD Max	% Exceedance Spurious Sidelobes
30	260	0	90	14	15.75	0.0
30	260	0	90	14.5	16.68	0.0
30	260	90	0	14	17.40	0.0
30	260	90	0	14.5	20.58	0.0
30	260	90	90	14	16.67	0.4
30	260	90	90	14.5	17.22	0.3
45	0	0	0	14	19.19	0.1
45	0	0	0	14.5	19.44	0.0
45	0	0	90	14	13.58	0.0
45	0	0	90	14.5	15.41	0.5
45	0	90	0	14	19.08	0.0
45	0	90	0	14.5	20.54	0.3
45	0	90	90	14	13.58	0.0
45	0	90	90	14.5	14.23	0.0
45	110	0	0	14	18.80	0.0
45	110	0	0	14.5	19.52	0.3
45	110	0	90	14	14.25	0.0
45	110	0	90	14.5	14.38	0.0
45	110	90	0	14	18.28	0.0
45	110	90	0	14.5	19.73	0.0
45	110	90	90	14	14.47	0.0
45	110	90	90	14.5	15.16	0.0
45	260	0	0	14	19.27	0.0
45	260	0	0	14.5	19.84	0.0
45	260	0	90	14	14.18	0.0
45	260	0	90	14.5	14.48	0.0
45	260	90	0	14	17.59	0.0
45	260	90	0	14.5	19.57	0.0
45	260	90	90	14	14.81	0.0
45	260	90	90	14.5	14.89	0.0
60	0	0	0	14	18.14	0.0
60	0	0	0	14.5	19.46	0.2
60	0	0	90	14	9.32	0.0
60	0	0	90	14.5	10.65	0.0

Theta	Phi	LPA	Skew	Freq	PSD Max	% Exceedance Spurious Sidelobes
60	0	90	0	14	19.13	0.0
60	0	90	0	14.5	19.50	0.7
60	0	90	90	14	9.25	0.0
60	0	90	90	14.5	10.45	0.0
60	110	0	0	14	18.92	0.0
60	110	0	0	14.5	18.52	0.0
60	110	0	90	14	10.45	0.0
60	110	0	90	14.5	11.63	0.0
60	110	90	0	14	18.18	0.0
60	110	90	0	14.5	19.83	0.0
60	110	90	90	14	11.20	0.0
60	110	90	90	14.5	11.28	0.0
60	260	0	0	14	19.60	0.2
60	260	0	0	14.5	19.01	0.0
60	260	0	90	14	10.75	0.0
60	260	0	90	14.5	11.26	0.0
60	260	90	0	14	18.34	0.0
60	260	90	0	14.5	19.24	0.3
60	260	90	90	14	10.55	0.0
60	260	90	90	14.5	11.17	0.0

Due to the blanket nature of this application, Kymeta focused on meeting the tangent-to-GEO-arc mask. Whether one applies the tangent or orthogonal mask will in large part depend on the geographic location of the Terminal in question. In high latitude areas, the stricter tangent mask is designed to protect neighboring satellites which are "left and "right" from the target satellite with respect to the Terminal. In low latitude areas, the stricter tangent mask is designed to protect the same neighboring satellites, which are now "back" and "forth" relative to the Terminal. In essence, the definition of tangent and orthogonal changes as a function of geographic area from where the Terminal is operating. Therefore, Kymeta performed all analyses against the stricter tangent mask, to demonstrate compliance regardless of the Terminal's geographic location. See Figure 1 below for a comparison of tangent and orthogonal masks, with the reference antenna pattern applied.

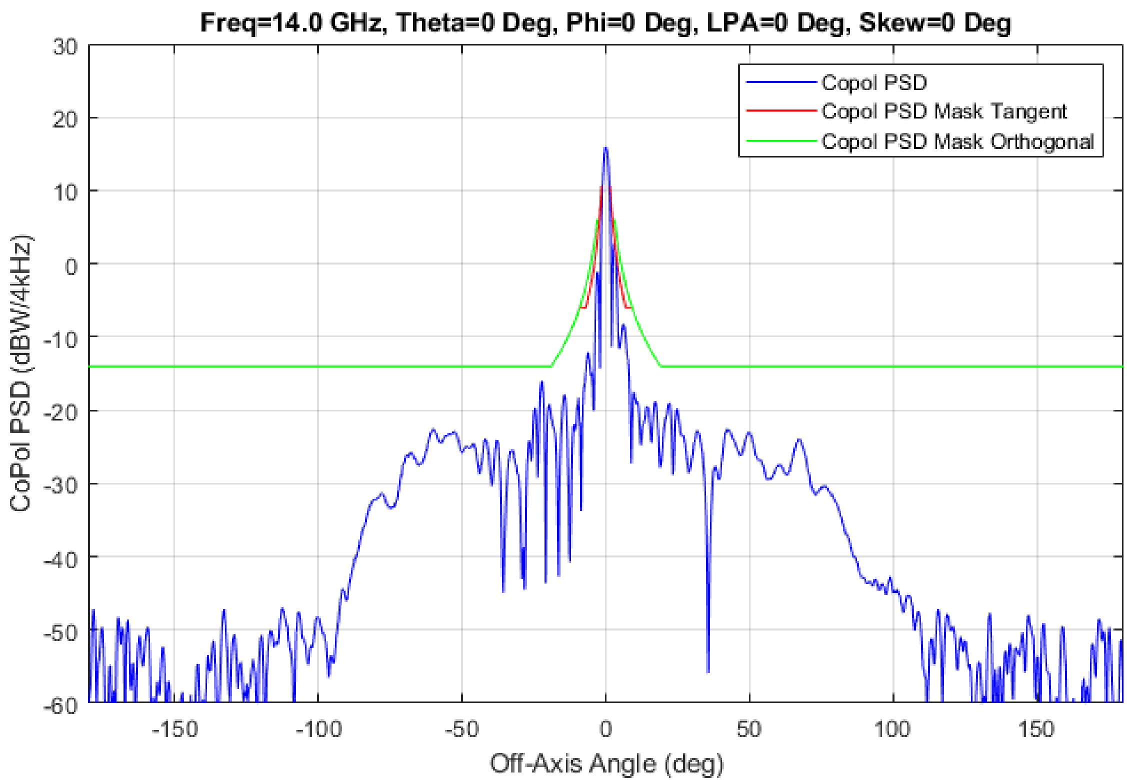

Figure 1: Comparison of Tangent and Orthogonal Masks

EXHIBIT B

OFF-AXIS EIRP SPECTRAL DENSITY PATTERNS

The Terminal meets the off-axis limits on EIRP spectral density as defined in Section 25.218(f), and set forth below. Table 1 to Exhibit A includes data for 16 test cases that are representative of overall antenna performance. Attachment 1 to Exhibit B includes the patterns for the 16 test cases plotted against the relevant FCC off-axis PSD masks, which are set forth below. Attachment 2 to Exhibit B is an Excel spreadsheet providing a table of performance for a total of 96 test cases, evaluating two frequencies, four theta angles, three phi planes, two polarizations, and two skew orientations.

Off-Axis EIRP Spectral Density Limits

(b) Earth station applications subject to this section may be routinely processed if they meet the applicable off-axis EIRP density envelopes set forth in this section.

(f)(1) For co-polarized transmissions in the plane tangent to the GSO arc:

$15-25\log\theta$	dBW/4 kHz	for $1.5° \leq \theta \leq 7°$.
-6	dBW/4 kHz	for $7° < \theta \leq 9.2°$.
$18-25\log\theta$	dBW/4 kHz	for $9.2° < \theta \leq 19.1°$.
-14	dBW/4 kHz	for $19.1° < \theta \leq 180°$.

Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite. The EIRP density levels specified for $\theta > 7°$ may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.

(2) For co-polarized transmissions in the plane perpendicular to the GSO arc:

18-25logθ	dBW/4 kHz	for $3.0° \leq \theta \leq 19.1°$.
−14	dBW/4 kHz	for $19.1° < \theta \leq 180°$.

Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.

(3) For cross-polarized transmissions in the plane tangent to the GSO arc and in the plane perpendicular to the GSO arc:

5-25logθ	dBW/4 kHz	for $1.8° \leq \theta \leq 7.0°$.

Where theta (θ) is the angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite.

EXHIBIT C

TECHNICAL CERTIFICATION

I, Ryan A. Stevenson, hereby certify that I am:

- the technically qualified person responsible for the preparation of the technical information contained in the Application, including the Technical Appendix and its Exhibits;
- that I am familiar with Part 25 of the Commission's Rules; and
- that I have either prepared or reviewed the technical information submitted in the Application and found it to be complete and accurate to the best of my knowledge and belief.

Signed: /s/ Ryan A. Stevenson
Dated: June 11, 2020

Ryan A. Stevenson
Vice President and Chief Scientist
Kymeta Corporation