ATTACHMENT A

Technical Appendix to Supplement Schedule S

A.1 SCOPE AND PURPOSE

This attachment contains the information required by §25.114(d) and other sections of the Federal Communications Commission's ("Commission") Part 25 rules that cannot be captured by the Schedule S online submission system regarding the proposed operations of Kacific Broadband Satellites International Limited's ("Kacific") Japan-licensed, Ka-band geostationary orbit ("GSO") satellite at the 150°E.L. orbital location (the "Kacific-1").[1]

A.2 OVERALL DESCRIPTION OF SYSTEM FACILITIES (§25.114(d)(1))

With this blanket earth station application, Kacific seeks authority to provide broadband satellite services in the Commonwealth of the Northern Mariana Islands ("CNMI") and American Samoa using the Kacific-1 satellite. Kacific-1 is located at 150°E.L. and currently provides Ka-band services to Asia and the Pacific Ocean region. The Kacific-1 satellite will operate in the 29.6 – 29.7 GHz and 29.75 – 29.8 GHz bands (Earth-to-space) and the 19.7 – 20.2 GHz band (space-to-Earth), including the sub-bands 19.8 – 19.95 GHz and 20.05 – 20.125 GHz bands (space-to-Earth).

Kacific-1 has non-steerable transmit and receive spot beams that are directed toward CNMI and American Samoa. A gateway earth station located in Broken Hill, Australia, will support operations in CNMI, and a gateway earth station located in Subic Bay, Philippines will support operations in American Samoa. Table A2-1 outlines the overall frequency and polarization plan for the Kacific-1 satellite services for users in CNMI and American Samoa.

Table A2-1: Frequency and Polarization Plan for the Kacific-1 Satellite Service to CNMI and American Samoa

Link	Beam ID	Channel ID	Uplink Band Center Frequency (MHz)	Uplink Polarization	Downlink Band Center Frequency (MHz)	Downlink Polarization	Channel Bandwidth (MHz)
Downlink (CNMI)	B27T	C27	28887.5	LHCP	20087.5	LHCP	75
Downlink 1 (American Samoa)	B51T	C51a	28175	LHCP	19875	RHCP	150
Downlink 2 (American Samoa)	B51T	C51b	27250	LHCP	19950	RHCP	500
Uplink (CNMI)	B27R	C27	29775	RHCP	19475	RHCP	50
Uplink (American Samoa)	B51R	C51	29650	LHCP	19350	LHCP	100

[1] The Kacific-1 satellite is a joint JCSAT-18/Kacific-1 payload, which operates under a combination of the N-SAT-Y12-150E and N-SAT-Y15-150E ITU satellite network filings submitted by the administration of Japan. The satellite bus is operated by SKY Perfect JSAT Corporation ("JCSAT"), while Kacific operates the Ka-band payload.

The overall system architecture relies on the use of adaptive coding and uplink power control in order to meet the necessary link margins in clear-sky and rain-fade conditions. Downlink operations to users in CNMI will consist of a 71.5 MHz signal transmitted from the satellite within a 75 MHz channel centered at 20087.5 MHz. Depending on the rain conditions at the gateway earth station, the modulation and coding rates will be selected to ensure that the power received at the satellite has sufficient margin to close the link. This signal is received by the satellite and a transponder automatic level control (ALC) holds the downlink power constant and thus achieves a consistent downlink EIRP. The result is that the Kacific-1 satellite downlink maximum EIRP toward CNMI will be 53.0 dBW and the maximum EIRP density will be -25.5 dBW/Hz.

Downlinks to users in American Samoa will consist of a 142.5 MHz signal transmitted from the satellite within a 150 MHz channel centered at 19875 MHz. Uplink power control and adaptive coding will be used for the gateway uplink to ensure that the power received at the satellite has sufficient margin to close the link. This signal is received by the satellite and a transponder automatic level control (ALC) holds the downlink power constant and thus achieves a consistent downlink EIRP. The result is that the Kacific-1 satellite downlink maximum EIRP toward American Samoa will be 55.2 dBW and the maximum EIRP density will be -26.3 dBW/Hz.

Although the current configuration for the American Samoa downlink is the use of the 150 MHz channel, it is possible to trade the bandwidth with another beam via a simple waveguide switch resulting in a 450 MHz signal transmitted in the 500 MHz downlink channel centered at 19950 MHz. In this configuration, the maximum downlink EIRP toward American Samoa will be 60.4 dBW and the maximum EIRP density will be -26.1 dBW/Hz.

For the user terminal uplinks, the system also uses adaptive coding and uplink power control to overcome rain-faded conditions. The local user terminal signal conditions are reported via the return channel to the hub, which then tells the user terminal modem to drive more or less power or modify the coding to overcome the rain fade. It is noted that the increase in power supplied to the antenna will not exceed the value of the rain fade. There are several different user terminal antenna diameters and maximum input power levels that will be deployed in CNMI and American Samoa. These range from the smallest antenna, 0.75 m diameter with a maximum input power of 3 W to the largest, 4.5 m diameter with a maximum possible input power of 40 W. For each of the antennas, there will be a minimum and maximum data rate that can be supported as shown in Table A2-2. The input powers in the table reflect the maximum levels that will be used during operations for each of the antenna sizes.

Table A2-2: Minimum and Maximum Uplink Data Rates for the User Terminals Deployed in CNMI and American Samoa

Antenna Diameter (m)	Maximum Power to the Antenna (W)	Minimum Date Rate (Mbps)	Maximum Data Rate (Mbps)
0.75	3.0	0.5	10
1	3.0	0.5	10
1.2	3.0	0.5	10
1.8	3.9	0.5	25
2.4	2.0	0.5	35
4.5	0.6	0.5	50

The modulations planned to be used for the forward links and return links are QPSK, 8PSK, 8APSK and 16APSK with varying coding rates. The list of planned modulation and coding rates for the three forward link emissions along with the associated bandwidths and emission designators is contained in Annex 1.

For each of the different user terminals, there is a certain range of modulations and coding rates that can be used depending on the size of the antenna and the input power levels and these will be selected based upon the rain fade conditions. These selections and the use of uplink power control will result in a consistent maximum EIRP density from each user terminal independent of size and available input power such that the saturation flux density at the satellite will be the same regardless of the terminal, code, or rain fade. For the user terminals located in CNMI, the maximum uplink EIRP density transmitted toward the Kacific-1 satellite will be -15 dBW/Hz. For the user terminals located in American Samoa, the maximum uplink EIRP density transmitted toward the Kacific-1 satellite will be -16.2 dBW/Hz.

Examples of the available modulation and coding rates for the uplinks for each of the user terminal antenna diameters along with the associated bandwidths and emission designators are contained in Annex 1. The examples given in the Tables in Annex 1 are for the minimum and maximum data rates for each of the user terminal diameters. For other data rates, the bandwidths for the specific modulations and coding rates will fall within the range between the narrowest and widest bandwidths given in the Tables.

It is also noted that the antenna azimuth and elevation ranges contained in Schedule S were determined based upon the combination of the geographical area covered by the CNMI and American Samoa beams. The eastern limits were derived using the farthest point south and east in the service area for the American Samoa beam. The western limits were derived using the furthest point north and west in the service area for the CNMI beam.

A.3 TELEMETRY, TRACKING, AND CONTROL ("TT&C")

TT&C operations will be conducted from outside the U.S. and its territories and thus are not the subject of this application. The TT&C operations of JCSAT18 (JCSAT-1C)/Kacific 1 is conducted by SKY Perfect JSAT Corporation ("JCSAT") from Japan. Kacific contracts with JCSAT satellite control group in Yokohama, Japan ("YSCG") to operate the Kacific-1 satellite, including any configuration commanding needed as well as health monitoring. Kacific has an operational agreement with YSCG that includes an operational coordination plan such as paring if units fail, as well as with their network management group. Kacific maintains control of the communications payload and cessation of emissions, as described below.

TT&C frequency is Ku-band which is licensed under Japanese administration including 13.7525 GHz and 14.499 GHz for receive operations and 12.7485 GHz 12.7495 GHz for transmit operations. The TT&C ground facility is redundantly located in two cities in Japan.[2] The operation centers are operated 24/7.

Under §25.172 of the Commission's rules Kacific is providing the following information regarding its TT&C earth stations.

Kacific-1 Bus Operations

- Facility name: Yokohama Satellite Control Center (YSCC)
  City/country: Midori ku, Yokohama shi, Kanagawa, Japan

- Facility name: Space Port East (SPE)
  City/country: Hitachi-omiya shi, Ibaraki, Japan

Kacific Network Operation Center ("KNOC")

- Facility Name: Kacific Broadband Satellites Ltd.
- Address: 127 Jalan Sultan, 199012 Singapore
- Contact information:

KNOC for JSAT SOC	**TEL**	**FAX**
Primary – KNOC Operator on duty	+65 6309 9620 (desk)	+65 6826 4050
Secondary – Acting KNOC Manager: Kelvin Law	+65 9438 5190 (HP)	+65 6826 4050
Senior Management (Deputy COO): Guillaume de SAINT-BON	+65 9623 8289 (HP)	+65 6826 4050
Senior Management (COO): Cyril Annarella	+65 8198 9061 (HP)	+65 6826 4050

KNOC for JSAT NOC	**TEL**	**e-mail**	**Skype**	**24/7 Availability**
Level 1: KNOC Operator on duty	+65 6309 9620	noc@kacific.com	noc@kacific.com	Yes
Level 2: KNOC Manager: Kelvin Law	+65 9438 5190	kelvin@kacific.com	kelvin@kacific.com	Yes (on call)
Level 3: Deputy COO: Guillaume de SAINT-BON	+65 9623 8289	guillaume@kacific.com	guillaume@kacific.com	Yes (on call)

Additionally, Kacific is providing a U.S. point of contact as required by §25.271 of the Commission's rules. That contact is Bob Perpall, Email: bob@kacific.com, Phone: 4242546463.

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[2] General description of the facilities available at https://www.jsat.net/en/facilities.html.

A.4 PREDICTED SPACE STATION ANTENNA GAIN CONTOURS (§25.114(c)(4)(vi)(A))

The Kacific-1 satellite's antenna gain contours for the beams covering CNMI and American Samoa are being provided to the Commission in a GIMS container file that is embedded in the associated Schedule S submission. The transmit and receive antenna gain contours plotted in an equirectangular format in Longitude and Latitude are shown for the CNMI beams in Figures A4-1 and A4-2. The transmit and receive antenna gain contours for the American Samoa beams are shown in Figures A4-3 and A4-4.

Figure A4-1: Kacific-1 CNMI Beam Transmit Antenna Gain Contours (B27T)

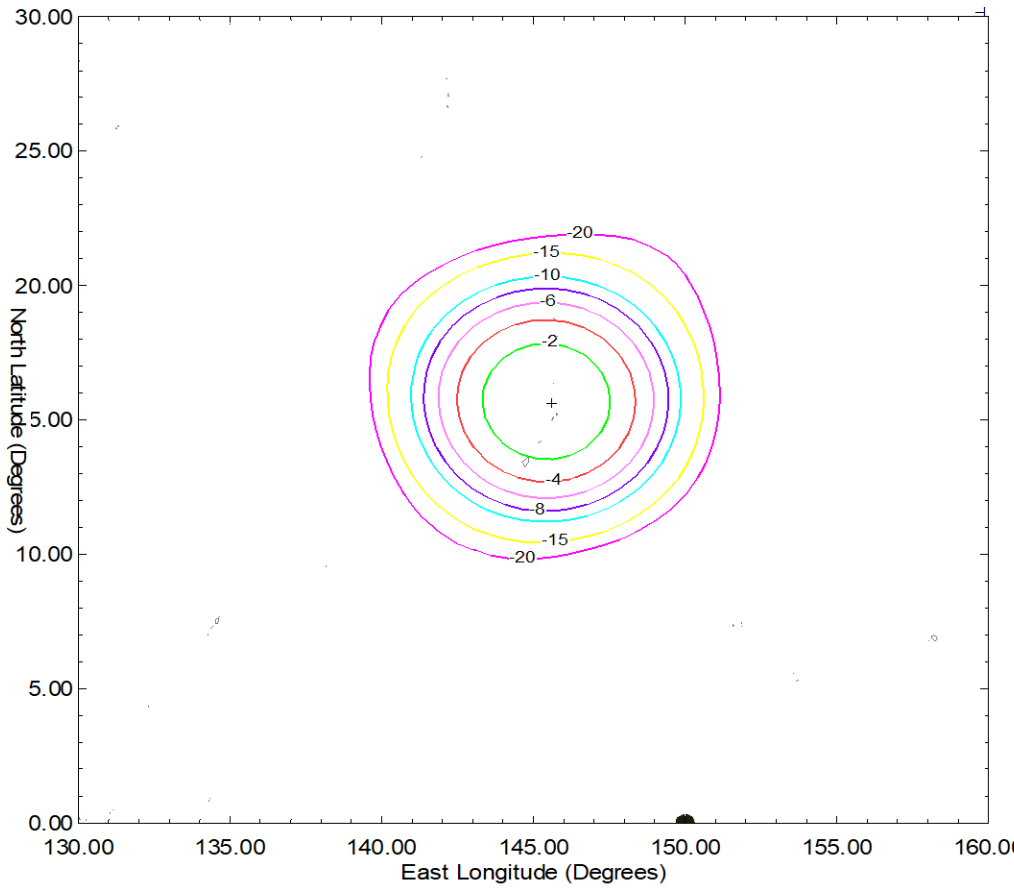


Figure A4-2: Kacific-1 CNMI Beam Receive Antenna Gain Contours (B27R)

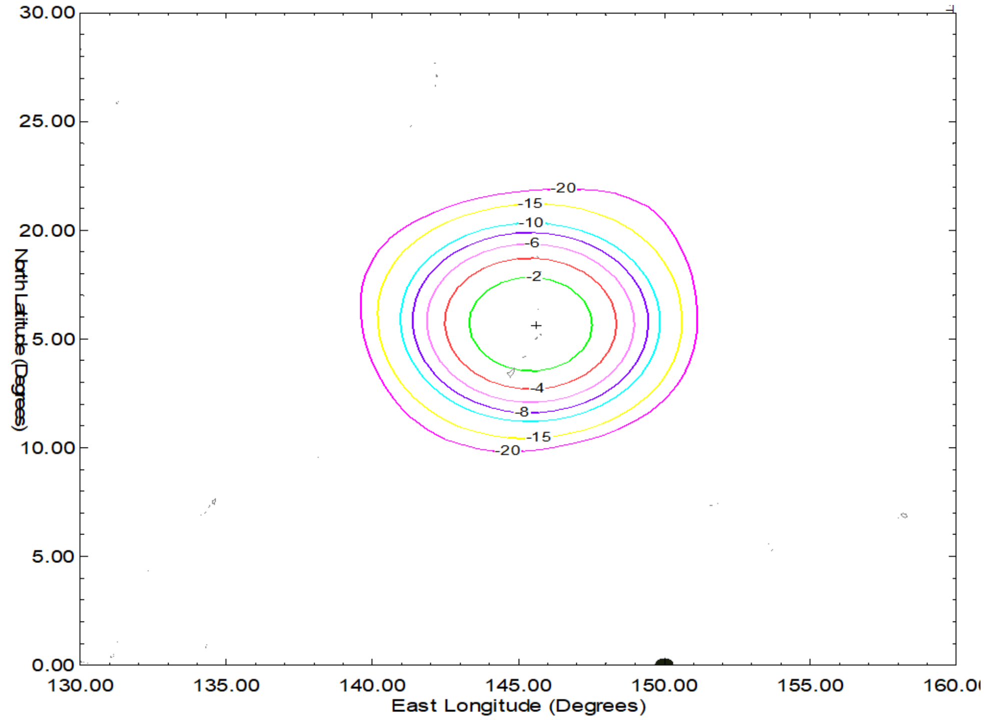


Figure A4-3: Kacific-1 American Samoa Beam Transmit Antenna Gain Contours (B51T)

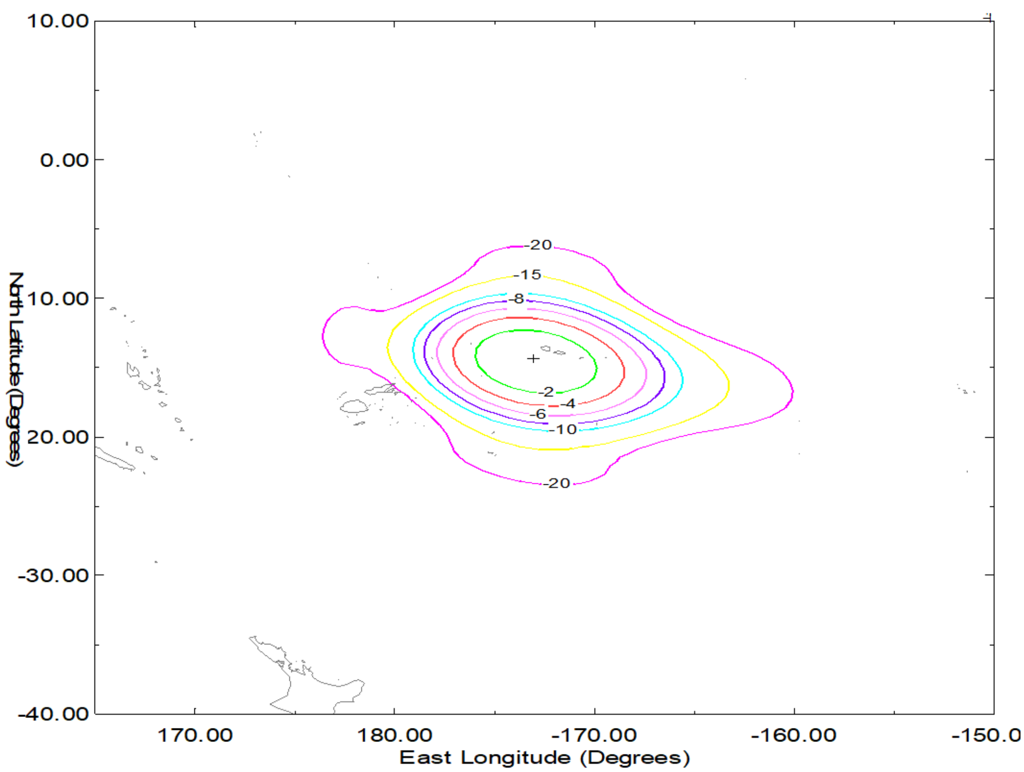
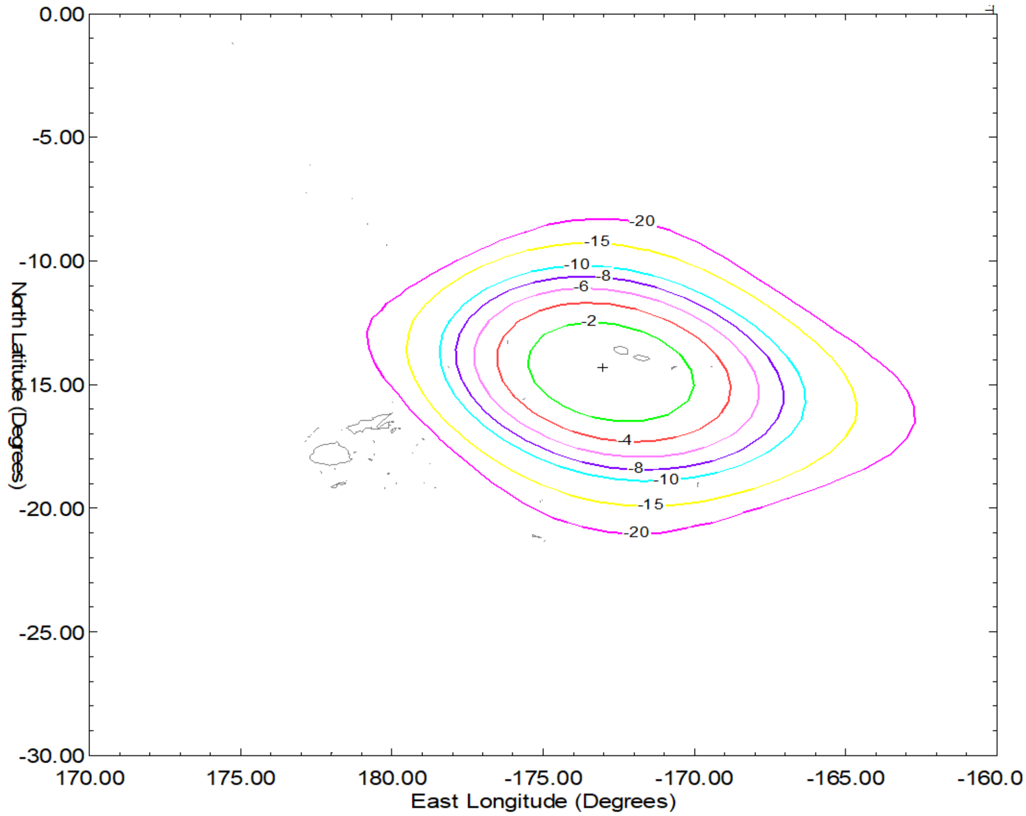


Figure A4-4: Kacific-1 American Samoa Beam Receive Antenna Gain Contours (B51R)



A.5 FURTHER REQUIREMENTS FOR LICENSE APPLICATIONS FOR GSO SPACE STATION OPERATION IN THE FSS (§25.140)

A GSO FSS space station is considered compliant with the Commission's two-degree spacing rules when operating in the conventional Ka-band by certifying that the proposed space station will not generate power flux-density at the Earth's surface in excess of −118 dBW/m^2/MHz and that associated uplink operation will not exceed applicable EIRP density envelopes in §25.218(i) unless coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of the orbital location.[3] As demonstrated below, the Kacific-1 satellite's operations are fully compliant with the Commission's two-degree spacing rules.

As an initial matter, while the Kacific-1 satellite will operate in bands addressed by §25.140(a)(3), there are no commercial satellites operating within two degrees of the Kacific-1 satellite using the same frequencies. Even so, the Kacific-1 satellite would be compatible with potential future satellites two degrees away.

The downlink transmissions from the Kacific-1 satellite using the CNMI and American Samoa beams will not generate a power flux-density ("PFD") at the Earth's surface in excess of -118

[3] 47 C.F.R. § 25.140.

dBW/m^2/MHz. For the CNMI beam, the maximum downlink transmit EIRP density will be 34.5 dBW/MHz. Near the center of the beam where the elevation angle from the ground to the satellite is at its highest value of 73.1 degrees, the resulting maximum PFD at the Earth's surface is -127.6 dBW/m^2/MHz. For the American Samoa beam downlinks using the 150 MHz channel, the maximum transmit EIRP density will be 33.7 dBW/MHz and, near the beam center where the elevation angle from the Earth to the satellite is 47.1 degrees, the maximum PFD at the Earth's surface will be -128.7 dBW/m^2/MHz. For the American Samoa beam downlinks using the 500 MHz channel, the maximum transmit EIRP density will be 33.9 dBW/MHz and the maximum PFD at the Earth's surface will be -128.5 dBW/m^2/MHz. It is noted that all locations on the surface of the Earth at elevation angles of 25 degrees or less, will be outside of the -20 dB contour of the Kacific-1 satellite's CNMI and American Samoa beams. Table A5-1 gives the maximum PFD levels for various ranges of elevation angle for the beams.

Table A5-1: Maximum PFD at the Earth's Surface from the Emissions of the Kacific-1 Satellite

Elevation Angle	CNMI Beam Maximum PFD (dBW/m^2/MHz)	American Samoa Beam Using 150 MHz Channel Maximum PFD (dBW/m^2/MHz)	American Samoa Beam Using 500 MHz Channel Maximum PFD (dBW/m^2/MHz)
0 - 5°	-148.7	-149.5	-149.3
5 - 10°	-148.6	-149.4	-149.2
10 - 15°	-148.5	-149.3	-149.1
15 - 20°	-148.4	-149.2	-149.0
20 - 25°	-148.3	-149.1	-148.9
25 - 90°	-127.6	-128.7	-128.5

If any non-routine uplink or downlink operations are contemplated, Kacific will seek modification of market access authority, will coordinate with operators of authorized co-frequency space stations at assigned locations within six degrees, and otherwise will ensure compliance with 47 C.F.R. §25.140(d). Likewise, to the extent a co-frequency satellite is assigned an orbital location that is less than two degrees from the assigned Kacific-1 location, Kacific will either coordinate or submit an interference analysis demonstrating compatibility of the systems.[4]

A.6 EARTH STATION ANTENNA OPERATION IN THE FSS (§25.132(a)(1), §25.209(a), 25.212(e) and §25.218(i))

The off-axis gain of the transmitting antennas located in CNMI and American Samoa communicating with the Kacific-1 satellite will not exceed the relevant levels specified in §25.209(a) and §25.209(b).

In accordance with §25.212(e), earth stations may be routinely licensed for digital transmission in the 28.35-28.6 GHz and/or 29.25-30.0 GHz bands if the input power spectral density into the antenna will not exceed 3.5 dBW/MHz and the application includes certification pursuant to

[4] *See* 47 C.F.R. § 25.140(a)(2).

§25.132(a)(1) of conformance with the antenna gain performance requirements in §25.209(a) and (b).

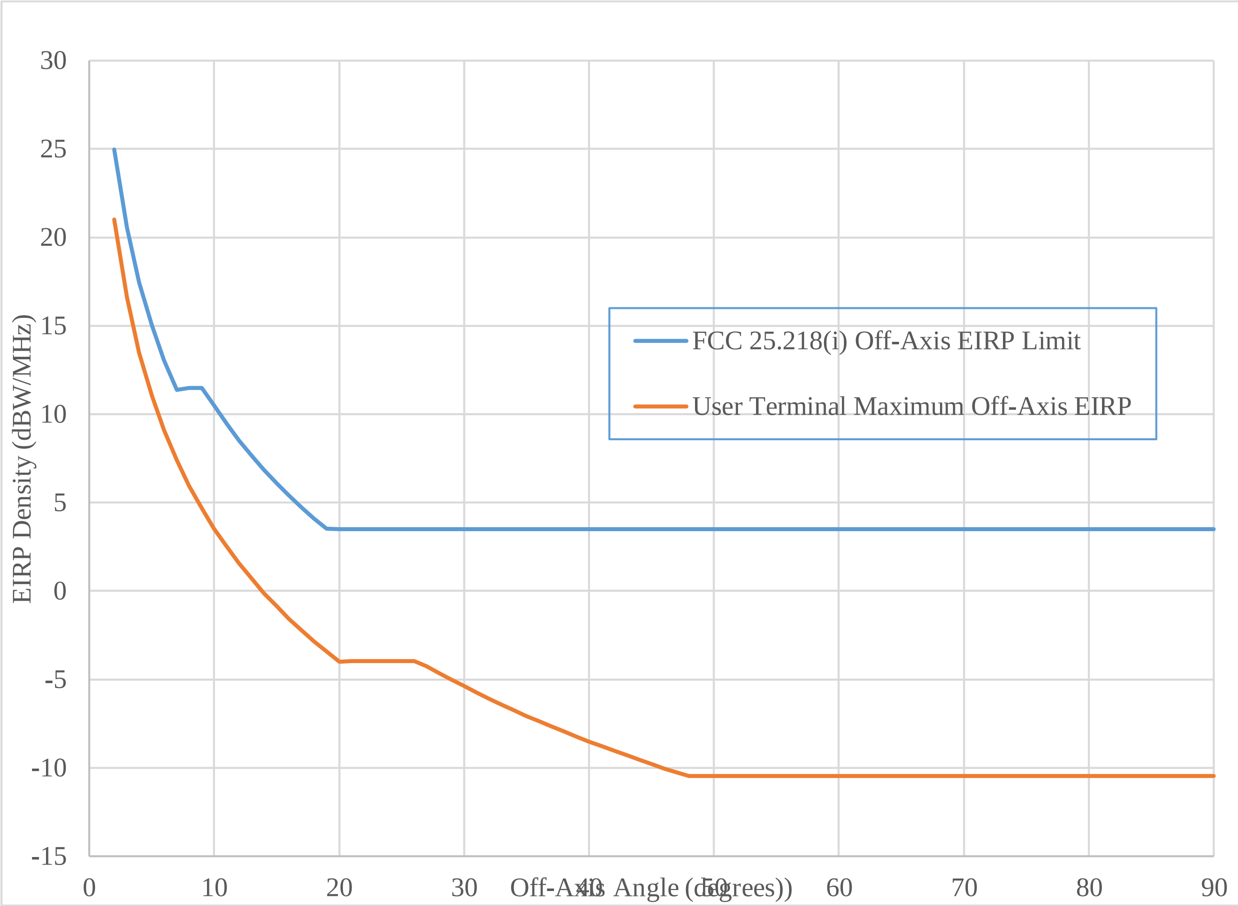
The maximum EIRP spectral density transmitted by any of the Kacific-1 user terminal will not exceed -15 dBW/Hz. For the lowest gain user terminal, this would result in a maximum input power spectral density into the antenna of -0.46 dBW/MHz, which is less than the 3.5 dBW/MHz limit given in §25.212(e). Table A6-1 gives the maximum input power spectral densities into the antenna for each of the user terminals.

Table A6-1: Kacific-1 User Terminal Maximum Power Spectral Density into the Antenna

Earth Station Make/Model	Transmit Gain at 29.650 GHz (dBi)	Maximum EIRP Spectral Density (dBW/Hz)	Maximum input power spectral density into antenna (dBW/Hz)	Maximum input power spectral density into antenna (dBW/MHz)
Newtec ANT2010	45.5	-15	-60.5	-0.5
JONSA E74	45.5	-15	-60.5	-0.5
Newtec ANT2025	48.0	-15	-63.0	-3.0
JONSA E0971V	47.1	-15	-62.1	-2.1
Newtec ANT2035	49.6	-15	-64.6	-4.6
Global Skyware #12159	49.2	-15	-64.2	-4.2
JONSA E1201V22-5	48.6	-15	-63.6	-3.6
General Dynamics 3180	52.3	-15	-67.3	-7.3
Newstar NS-SECK-180	52.8	-15	-67.8	-7.8
Newstar NS-SECK-240	55.1	-15	-70.1	-10.1
Newstar NS-SECK-450	60.6	-15	-75.6	-15.6

Using the highest EIRP spectral density into the antenna from Table A6-1 and the antenna off-axis gain pattern information, the off-axis EIRP density is compared to the values contained in §25.218(i). As shown below in Figure A6-1, the maximum off-axis EIRP density does not exceed the limits.

Figure A6-1: Kacific-1 User Terminal Off-Axis EIRP Density



Additional description of compliance with the Commission's rules may be found in the Narrative attachment.

A.7 ITU FILING INFORMATION

The Kacific-1 satellite operates under a combination of the N-SAT-Y12-150E and N-SAT-Y15-150E ITU satellite network filings submitted by the administration of Japan.

A.8 PUBLIC INTEREST CONSIDERATIONS (§25.114(d)(6))

As discussed in detail in the narrative, broadband Internet coverage in CNMI and American Samoa has lagged in the past decade. With the outbreak of Covid-19 and the migration to online platforms by schools, hospitals, businesses, governmental organizations, and the general community, current ISP networks have understandably come under even greater strain, and Internet traffic has slowed considerably. Kacific seeks to provide much needed services to remote and underserved communities in the Pacific region with service that is both highly affordable and geographically wide-reaching. Grant of market access to communicate with the Kacific-1 satellite is therefore necessary to support underserved U.S. territories and expeditious grant of this application would strongly favor the public interest.

A.9 FREQUENCY TOLERANCE (§25.202(e))

The frequency tolerance requirements of §25.202(e) that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency will be met.

A.10 OUT-OF-BAND EMISSIONS (§25.202(f))

The out-of-band emission limits of §25.202(f)(1), (2) and (3) will be met.

A.11 FREQUENCY REUSE (§25.210(f))

The beam polarizations for uplinks and downlinks of the Kacific-1 satellite are fixed and therefore it is not possible to provide full frequency reuse as noted in Section 25.210(f) of the Commission's rules. Kacific has requested an appropriate waiver in the narrative attachment.

A.12 CESSATION OF EMISSIONS (§25.207)

As required by §25.207 of the Commission's rules, the Kacific NOC can cease uplinks on command, which would cease emissions on the downlink. In the circumstances where a rogue carrier causes interference (*i.e.*, not Kacific) then YSCC can mute the transponder via ground command.

A.13 STATION-KEEPING TOLERANCE (§25.210(j))

The Kacific-1 satellite orbit will be maintained within 0.05° of its assigned orbital longitude in the east/west direction, except as provided in §25.283(b) regarding end-of-life disposal.

A.14 ORBITAL DEBRIS MITIGATION (§25.114(d)(14))

Kacific is proactive in ensuring safe operation and disposal of the Kacific-1 satellite as addressed below. The space station is licensed in Japan and the satellite bus is operated by JSAT which has provided a statement regarding the requirements contained in Section 25.114(d)(14)(i)-(iv) of the Commission's rules.[5]

[5] Kacific is aware of the Commission's adopted but not-yet-effective rules related to orbital debris mitigation. However, as the space station was launched in 2019, its orbital debris characteristics cannot now be changed.

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MD-A-19-058

JCSAT-18

The JCSAT-18 Spacecraft is a Boeing BSS702MP model satellite that will be positioned at 150° E.L. This statement addresses requirements contained in Section 25.114(d)(14)(i)-(iv) of the Commission's rules.

DEBRIS RELEASE ASSESSMENT - 25.114(d)(14)(i).

JSAT has assessed and limited the amount of debris released in a planned manner during normal operations of JCSAT-18 and has assessed and limited the probability of the spacecraft becoming a source of debris by collisions with small debris or meteoroids. No debris is generated during foreseeable on-station operations.

During the JCSAT-18 Spacecraft design, the possibility of the spacecraft itself becoming a source of debris due to collisions with small debris or meteoroids that could cause loss of control preventing appropriate deorbit or disposal was considered and mitigated with redundant components and minimization of single points of failure. In addition, critical components are located within the structure of the spacecraft and are shielded from external debris. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

MINIMIZING RISK OF ACCIDENTAL EXPLOSIONS – 25.114(d)(14)(ii)

JSAT has assessed and limited the probability of accidental explosions during and after completion of mission operations. The JCSAT-18 Spacecraft has been designed to minimize the risk that on-board hazardous materials within the Propulsion Subsystem and the Electrical Power Subsystem (e.g. batteries) will cause an event that has the potential to generate orbital debris. Specifically:

- The Propulsion Subsystem was designed, manufactured, and tested to ensure a very low risk of propellant leakage and a very low risk of undesired mixing of propellant to prevent conditions that could potentially result in the release of orbital debris.
- The Electrical Power Subsystem has multiple on-board safety systems to maintain the on-board batteries within their safe operating range as specified by the manufacturer to mitigate the risk of battery overcharge, undercharge, thermal runaway, or instability that could potentially result in the release of orbital debris, even in the event of an Electrical Power Subsystem component failure.

Throughout the JCSAT-18 mission, critical subsystems such as the Propulsion Subsystem and Electrical Power Subsystem will be monitored to further reduce the already very remote risk of an event that could result in the release of orbital debris. At the end of operational life, after the satellite has reached its final disposal orbit, unless prevented by technical failures beyond its control, JSAT will deplete or secure all on-board sources of stored energy by venting excess propellant, discharging batteries, relieving pressure vessels, and other appropriate measures to minimize any possibility that an explosion will create debris.

SAFE FLIGHT PROFILES AND ORBITAL COORDINATION – 25.114(d)(14)(iii)

JSAT has assessed and limited the probability of the JCSAT-18 Spacecraft becoming a source of debris through collision with large debris or another operating spacecraft. Apart from JCSAT-6, which is planned to be relocated away from 150° E.L. before the arrival of JCSAT-18, JSAT is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 150° E.L. or to nearby orbital locations such that there would be an overlap with the stationkeeping volume of JCSAT-18. In order to monitor nearby objects, JSAT receives conjunction data messages (CDM) from the Combined Space Operations Center (CSpOC) in a timely manner. As a result of CDM evaluation, collision avoidance maneuvers will be implemented if needed.

POST MISSION DISPOSAL – 25.114(d)(14)(iv)

At the end of mission life, the JCSAT-18 Spacecraft will be moved to a disposal orbit approximately 300 km higher than the geostationary orbit altitude, in compliance with:

(a) Recommendation ITU-R S.1003.2 12/2010 environmental protection of the geostationary satellite orbit. S Series Fixed-satellite services. Geneva, 2011;

(b) IADC Space Debris Mitigation Guidelines, IADC-02-01 Rev 1, Action Item number 22.4,9/2007; and

(c) Space systems - disposal of satellites operating at geosynchronous altitude, ISO 26872. Switzerland, 2010.

The minimum post-mission disposal altitude above the geostationary orbit is calculated as follows (using the IADC formula):

$$235 \text{ km} + (1000 \cdot CR \cdot A/m) = 276 \text{ km}$$

CR = 1.5 JCSAT-18 Solar radiation pressure coefficient

A= 82 m^2 JCSAT-18 Area based on deployed on-station configuration

M= 3006 kg JCSAT-18 dry mass

Planned post-mission disposal altitude: 300 km

Margin to minimum altitude requirement: 24 km

JSAT intends to reserve 5.2 kg of propellant to account for post-mission disposal of JCSAT-18. JSAT has assessed propellant gauging uncertainty and has provided an adequate margin of propellant reserve to address the assessed uncertainty.

ANNEX 1

Further Information on Modulation, Coding Rates and Bandwidths

The available modulations and coding rates for the downlinks to user terminals in CNMI and American Samoa are given in Table Annex1-1. Examples of the available modulations, coding rates, bandwidths, and emissions designators for the uplinks from various user terminals and data rates are given in Tables Annex1-2 through Annex1-4.

Table Annex1-1: Modulation Information for Downlinks to User Terminal

Beam	**CNMI**	**American Samoa**	**American Samoa**
Bandwidth	**71.5 MHz**	**142.5 MHz**	**450 MHz**
Emission Designator	**71M5G7W**	**143MG7W**	**450MG7W**
Modulation and Coding Rates	16APSK4/5	16APSK4/5	16APSK4/5
	16APSK7/9	16APSK7/9	16APSK7/9
	16APSK3/4	16APSK3/4	16APSK3/4
	16APSK13/18	16APSK13/18	16APSK13/18
	16APSK25/36	16APSK25/36	16APSK25/36
	8PSK9/10	8PSK9/10	8PSK9/10
	8PSK8/9	8PSK8/9	8PSK8/9
	16APSK2/3	16APSK2/3	16APSK2/3
	8PSK5/6	8PSK5/6	8PSK5/6
	16APSK28/45	16APSK28/45	16APSK28/45
	16APSK3/5-L	16APSK3/5-L	16APSK3/5-L
	16APSK26/45	16APSK26/45	16APSK26/45
	8PSK3/4	8PSK3/4	8PSK3/4
	16APSK5/9-L	16APSK5/9-L	16APSK5/9-L
	16APSK8/15-L	16APSK8/15-L	16APSK8/15-L
	8PSK2/3	8PSK2/3	8PSK2/3
	16APSK1/2-L	16APSK1/2-L	16APSK1/2-L
	QPSK9/10	QPSK9/10	QPSK9/10
	8PSK3/5	8PSK3/5	8PSK3/5
	QPSK8/9	QPSK8/9	QPSK8/9
	QPSK5/6	QPSK5/6	QPSK5/6
	8APSK5/9-L	8APSK5/9-L	8APSK5/9-L
	QPSK4/5	QPSK4/5	QPSK4/5
	QPSK3/4	QPSK3/4	QPSK3/4
	QPSK2/3	QPSK2/3	QPSK2/3
	QPSK3/5	QPSK3/5	QPSK3/5
	QPSK11/20	QPSK11/20	QPSK11/20
	QPSK1/2	QPSK1/2	QPSK1/2
	QPSK9/20	QPSK9/20	QPSK9/20
	QPSK2/5	QPSK2/5	QPSK2/5
	QPSK1/3	QPSK1/3	QPSK1/3
	QPSK13/45	QPSK13/45	QPSK13/45
	QPSK1/4	QPSK1/4	QPSK1/4

Table Annex1-2: Example Modulation Information for User Terminal Uplinks for Minimum Data Rate

Data Rate: 0.5 Mbps	0.75 meter, 1 meter, 1.2 meter, 1.8 meter	2.4 meter, 4.5 meter	Emission Designator
Modulation	BW (kHz)	BW (kHz)	
16APSK4/5	194	194	194KG7W
16APSK31/40	194	194	194KG7W
16APSK3/4	194	194	194KG7W
16APSK29/40	194	194	194KG7W
16APSK7/10	227	227	227KG7W
16APSK27/40	227	227	227KG7W
8PSK13/15	227	227	227KG7W
8PSK5/6	227	227	227KG7W
8PSK4/5	259	259	259KG7W
8PSK23/30	259	259	259KG7W
8PSK11/15	259	259	259KG7W
8PSK7/10	291	291	291KG7W
8PSK2/3	291	291	291KG7W
8PSK19/30	291	291	291KG7W
8PSK17/30	356	356	356KG7W
QPSK4/5	356	356	356KG7W
QPSK3/4	388	388	388G7W
QPSK7/10	421	421	421KG7W
QPSK13/20	453	453	453KG7W
QPSK11/20	518	518	518KG7W
QPSK1/2	583	583	583KG7W
QPSK9/20	615	615	615KG7W
QPSK7/20	809	809	809KG7W
QPSK3/10	939	939	939KG7W
QPSK1/2 SF		1133	1M13G7W
QPSK9/20 SF		1230	1M23G7W
QPSK4/10 SF		1392	1M39G7W
QPSK7/20 SF		1586	1M59G7W
QPSK3/10 SF		1845	1M85G7W
QPSK4/10 SF		2104	2M10G7W
QPSK7/20 SF		2395	2M40G7W
QPSK4/10 SF		2784	2M80G7W

Table Annex1-3: Example Modulation Information for User Terminal Uplinks for Maximum Data Rate (0.75 meter, 1 meter and 1.2 meter antennas)

Data Rate: 10 Mbps	0.75 meter	1 meter	1.2 meter	Emission Designator
Modulation	**BW (MHz)**	**BW (MHz)**	**BW (MHz)**	
16APSK7/10			3.949	3M95G7W
16APSK27/40		4.111	4.111	4M11G7W
8PSK13/15		4.273	4.273	4M27G7W
8PSK5/6	4.435	4.435	4.435	4M44G7W
8PSK4/5	4.629	4.629	4.629	4M63G7W
8PSK23/30	4.823	4.823	4.823	4M82G7W
8PSK11/15	5.05	5.05	5.05	5M05G7W
8PSK7/10	5.277	5.277	5.277	5M28G7W
8PSK2/3	5.536	5.536	5.536	5M54G7W
8PSK19/30	5.827	5.827	5.827	5M83G7W
8PSK17/30	6.507	6.507	6.507	6M51G7W
QPSK4/5	6.928	6.928	6.928	6M93G7W
QPSK3/4	7.381	7.381	7.381	7M38G7W
QPSK7/10	7.931	7.931	7.931	7M93G7W
QPSK13/20	8.514	8.514	8.514	8M51G7W
QPSK11/20	10.068	10.068	10.068	10M1G7w
QPSK1/2	11.071	11.071	11.071	11M1G7W
QPSK9/20	12.301	12.301	12.301	12M3G7W
QPSK7/20	15.862	15.862	15.862	15M9G7W
QPSK3/10	18.452	18.452	18.452	18M5G7W

Table Annex1-4: Example Modulation Information for User Terminal Uplinks for Maximum Data Rate (1.8 meter, 2.4 meter and 4.5 meter antennas)

Data Rate	25 Mbps		35 Mbps		50 Mbps	
Antenna Diameter	1.8 m		2.4 m		4.5 m	
Modulation	BW (MHz)	Emission Designator	BW (MHz)	Emission Designator	BW (MHz)	Emission Designator
16APSK4/5	8.64	8M64G7W	12.1	12M1G7W	17.3	17M3G7W
16APSK31/40	8.90	8M9G7W	12.5	12M5G7W	17.8	17M8G7W
16APSK3/4	9.23	9M23G7W	12.9	12M9G7W	18.4	18M4G7W
16APSK29/40	9.52	9M52G7W	13.3	13M3G7W	19.0	19M0G7W
16APSK7/10	9.87	9M87G7W	13.8	13M8G7W	19.8	19M8G7W
16APSK27/40	10.2	10M2G7W	14.3	14M3G7W	19.8	19M8G7W
8PSK13/15	10.7	10M7G7W	14.9	14M9G7W	19.8	19M8G7W
8PSK5/6	11.1	11M1G7W	15.5	15M5G7W	19.9	19M9G7W
8PSK4/5	11.5	11M5G7W	16.1	16M1G7W	20.0	20M0G7W
8PSK23/30	12.0	12M0G7W	16.8	16M8G7W	20.1	20M1G7W
8PSK11/15	12.6	12M6G7W	17.6	17M6G7W	20.2	20M2G7W
8PSK7/10	13.2	13M2G7W	18.5	18M5G7W	20.3	20M3G7W
8PSK2/3	13.8	13M8G7W	19.4	19M4G7W	20.3	20M3G7W
8PSK19/30	14.5	14M5G7W	20.3	20M3G7W	20.3	20M3G7W
8PSK17/30	16.3	16M3G7W	20.5	20M5G7W	20.5	20M5G7W
QPSK4/5	17.3	17M3G7W	20.5	20M5G7W	20.5	20M5G7W
QPSK3/4	18.5	18M5G7W	20.7	20M7G7W	20.7	20M7G7W
QPSK7/10	19.8	19M8G7W	20.7	20M7G7W	20.7	20M7G7W
QPSK13/20	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W
QPSK11/20	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W
QPSK1/2	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W
QPSK9/20	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W
QPSK7/20	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W
QPSK3/10	20.8	20M8G7W	20.8	20M8G7W	20.8	20M8G7W

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/

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