FCC Form 312
Exhibit 1

O3b LIMITED

MODIFICATION OF EARTH STATION LICENSE TO ADD AN ANTENNA

NARRATIVE STATEMENT

Pursuant to Section 25.117 of the Commission's Rules, O3b Limited ("O3b") seeks modification of its gateway earth station authorization at Haleiwa, Hawaii (the "Hawaii Gateway") to add an antenna.

O3b operates a U.K.-authorized non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") system operating in the Ka-band. In September 2012, the Commission granted O3b a license to operate the Hawaii Gateway, which is comprised of three earth station antennas. *See* FCC File No. SES-LIC-20100723-00952, Call Sign E100088, granted September 25, 2012 ("Hawaii Gateway Authorization"). The Hawaii Gateway Authorization also granted O3b authority ("landing rights") to operate in the United States. Subsequently, the Commission modified its grant of access to the U.S. market by authorizing O3b to add four new medium earth NGSO satellites. *See* File No. SAT-LOI-20141029-00118, Call Sign S2935, granted January 22, 2015 ("O3b PDR").

By this application, O3b is requesting a modification of its authority to add a fourth antenna at the Hawaii Gateway. O3b is expanding its satellite constellation and will add an additional eight satellites in 2018 in response to market demand.[1] The fourth antenna will enable O3b to bring more capacity to the regions served by the Hawaii Gateway, including the U.S. market.

The fourth antenna will be identical to the three 7.3-meter VIASAT antennas already authorized to operate at the Hawaii Gateway, and it will operate in the same manner, on the same frequencies, and at the same power levels. O3b notes that, pursuant to Section 25.136(a)(2) of the Commission's rules, the Hawaii Gateway is grandfathered for transmit operations in the 27.6 – 28.35 GHz band, as a station authorized before July 14, 2016.

[1] *See* Modification Application of O3b Limited, IBFS File No. SAT-MOD-20160624-00060 (filed June 24, 2016) ("Modification Application"); Amendment Application of O3b Limited, IBFS File No. SAT-AMD-20161115-00116 (filed Nov. 15, 2016) ("November Amendment"). In those applications, O3b requested authority to serve the U.S. using additional frequencies (19.7-20.2 GHz and 29.5-30.0 GHz) on four of the eight satellites proposed in the Modification Application and requested U.S. market access for up to twenty-four new satellites that will operate in a circular equatorial orbit and for up to sixteen new satellites that will operate in an inclined orbit using the frequencies covered by the Market Access Grant as well as the 17.7-17.8 GHz, 19.3-19.7 GHz, and 29.1-29.5 GHz frequency bands. Those applications are currently pending before the Commission.

Application for Modification of License Complies with Section 25.203

Section 25.203(c)(6) provides as follows:

> Multiple antennas in an NGSO FSS gateway earth station complex located within an area bounded by one second of latitude and one second of longitude may be regarded as a single earth station for purposes of coordination with terrestrial services.

The new antenna will be located within one second of the latitude and longitude of the existing earth station antennas at the Hawaii Gateway. As a result, O3b is not required to conduct or file a new coordination report. Attachment 1 is an overhead image showing the location of the existing antennas and the proposed new antenna.

Public Interest Statement

The public interest showing in O3b's original Hawaii Gateway application is hereby incorporated by reference. For the reasons stated therein, grant of this application (and associated waiver requests) for an additional antenna will serve the public interest, convenience and necessity.

U.S. Market Access

Under the Commission's "DISCO II" procedure, a company may obtain U.S. "landing rights" for a non-U.S. licensed space station by filing an initial earth station application that lists the space station as a "point of communication" and demonstrating that the space station meets applicable Commission requirements.[2] O3b provided such a showing as part of its Hawaii Gateway earth station application. The Commission found that O3b meets the criteria for U.S. market access when it granted the Hawaii Gateway Authorization and the O3b PDR.

In its DISCO II decision, the Commission adopted requirements that apply once an initial application seeking U.S. market access for a non-U.S. satellite system has been granted. There is no need, the Commission found, for a new DISCO II showing to be made by future earth station applicants requesting authority to communicate with the non-U.S. satellite system.[3] Rather, it is sufficient that any such earth station applicant cite to the initial grant of market access; confirm that there has been no change in the services the satellite system will be used to provide; and represent that there has been no change to the satellite system's operating parameters.[4]

Consistent with these requirements, O3b hereby cites to the Hawaii Gateway Authorization and the O3b PDR; confirms that there has been no change in the services its

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[2] *See Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States ("DISCO II")*, 15 FCC Rcd 7207, ¶ 5 (1999).
[3] *DISCO II*, 15 FCC Rcd 7207 at ¶ 192.
[4] *Id.*

satellite system will be used to provide; and represents that there has been no change to its satellite system's operating parameters.

O3b System and Frequency Plan

O3b proposes to operate the additional antenna on the same frequencies as were previously licensed at the Hawaii Gateway. For ease of reference, the O3b frequencies are summarized in the following Table:

Downlink Frequency	Ka-Band Plan	O3B Proposed Use
17.8-18.3 GHz	FS	Service Links and Gateway Links
18.3-18.6 GHz	GSO FSS down	Service Links and Gateway Links
18.8-19.3 GHz	NGSO FSS down	Service Links, Gateway Links and TT&C[5]
Uplink Frequency	**Ka-Band Plan**	**O3B Proposed Use**
27.6-28.35 GHz	UMFUS fss (secondary)	Service Links and Gateway Links
28.35-28.4 GHz	GSO FSS up ngso fss up (secondary)	Service Links and Gateway Links
28.6-29.1 GHz	NGSO FSS up gso fss up (secondary)	Service Links, Gateway Links and TT&C[6]

O3b Operations in Shared Bands

O3b requests that the waivers already granted for the Hawaii Gateway be applied to the fourth antenna. These bands, and the corresponding waiver requests as applicable, are described below.

27.6-28.35 GHz – Secondary uplink band shared with primary terrestrial stations. The 27.6-28.35 GHz uplink band is allocated to the Upper Microwave Flexible Use Service ("UMFUS") on a primary basis. NGSO FSS operations are allocated on a secondary basis in the same band.

However, as noted above, the Hawaii Gateway meets the criteria of 25.136(a)(2) and may operate consistent with the terms of its existing authorization without providing any additional interference protection to UMFUS stations.

[5] O3b will conduct TT&C operations in the band edges just below 19.3 GHz (downlink) and 29.1 GHz (uplink). *See* 47 C.F.R. § 25.202(g).
[6] *Id.*

A Comsearch frequency coordination report for the 28 GHz band, filed with O3b's original application for the Hawaii Gateway, demonstrated that O3b can operate the Hawaii Gateway in this band without causing harmful interference to LMDS licensees.

28.35-28.4 GHz – Secondary uplink band shared with primary GSO FSS stations. In the 28.35-28.4 GHz band, there is a primary allocation for geostationary satellite orbit ("GSO") FSS systems and a secondary allocation for NGSO FSS systems. O3b's Hawaii Gateway earth station transmissions in this band will be consistent with their secondary status vis-à-vis GSO FSS transmissions. As a secondary user of the 28.35-28.4 GHz band in the United States, O3b makes no claim of protection from interference from U.S.-licensed GSO FSS networks in this band segment.

In the 28.35-28.4 GHz band, the ITU has developed uplink equivalent power flux density limits ("$EPFD_{up}$") limits to protect co-frequency GSO FSS operations from unacceptable interference from NGSO FSS systems operating in the same frequencies.[7] Specifically, in accordance with Article 22 of the ITU Radio Regulations, if the applicable $EPFD_{up}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference. In this band, transmissions from the Hawaii Gateway to the O3b constellation will meet the applicable ITU $EPFD_{up}$ limits.

17.8-18.3 GHz – Non-conforming downlink band shared with terrestrial stations – waiver requested to the extent necessary. The 17.8-18.3 GHz band is allocated on a primary basis to the Fixed Service, and there is no secondary allocation for NGSO FSS in the band. For that reason, in its original Hawaii Gateway application O3b requested, and the Commission granted, a waiver of the Ka-Band Plan and Section 2.106 of the Commission's rules to permit O3b to operate its NGSO FSS system in the 17.8-18.3 GHz band for downlink operations on a non-conforming, non-interference basis.

18.3-18.6 GHz – Non-conforming downlink band shared with GSO FSS stations – waiver requested to the extent necessary. The 18.3-18.6 GHz band is allocated in the United States on a primary basis to GSO FSS. Because the 18.3-18.6 GHz band is not allocated to NGSO FSS downlink transmissions on a primary or secondary basis, for its Hawaii Gateway O3b proposed, and the Commission granted, authority for the Hawaii Gateway earth station to use the band on a non-conforming basis – *i.e.*, on a non-harmful interference, non-protected basis relative to any service allocated in that band. O3b also requested – and was granted -- a waiver of the Ka-Band Plan and Section 2.106 (footnote NG 164) of the Commission's rules to permit such use.

O3b acknowledges that it has no protection against interference from U.S.-licensed GSO FSS networks in the 18.3-18.6 GHz band and commits to maintain the downlink transmissions in the band from its space stations within the downlink equivalent power flux density ("$EPFD_{down}$") limits developed by the ITU to protect GSO FSS networks from unacceptable interference from NGSO FSS systems operating on the same frequencies.

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[7] *See* ITU Radio Regulations, Article 22. *See also* O3b's Hawaii Gateway application, *Technical Attachment* at A.10.1 for a discussion of O3b's compliance with the operational limits in Article 22 of the ITU Radio Regulations.

Radiofrequency Radiation Hazard Study (RF Hazard Study)

O3b submits as Attachment 2 the RF Hazard Study for the Hawaii Gateway earth station.

Technical Certification

O3b submits as Attachment 3 the requisite technical certification.

Conclusion

As demonstrated in this application, grant of this earth station application will serve the public interest, convenience and necessity. O3b respectfully requests that the Commission promptly grant this application.

Respectfully submitted,

O3B LIMITED

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May 22, 2017

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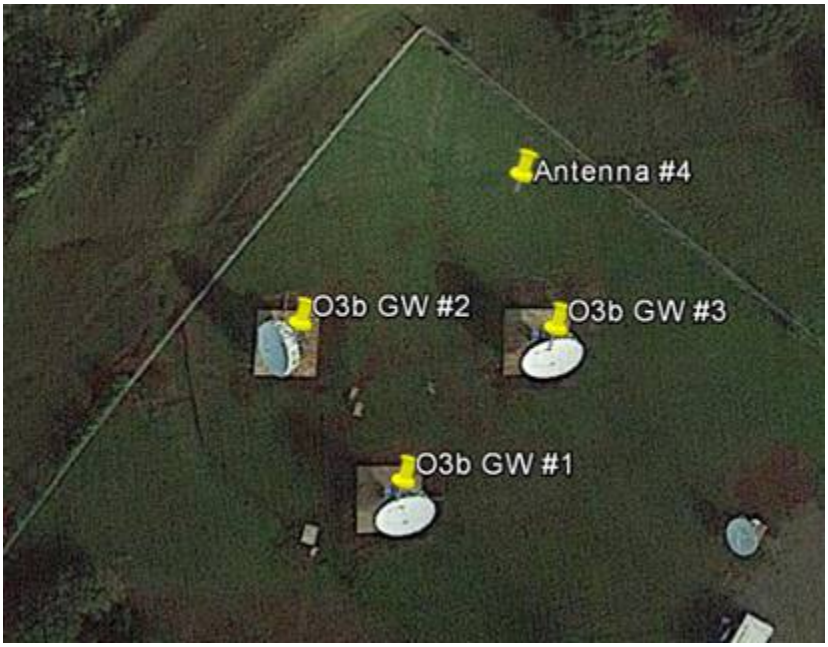
Attachment 1: Site Plan



Attachment 2: RF Hazard Study

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REPORT TITLE:

Non-Ionizing Radiation Hazard Analysis

SCOPE/TEXT (ATTACH ADDITIONAL SHEETS AS REQUIRED)

This report analyzes non-ionizing radiation levels for O3b's 7.3m MEO earth stations. Calculations are performed in accordance with FCC Office of Engineering and Technology's "Bulletin No. 65 Edition 01-01 Supplement C" with regard to the frequencies and antenna types being used. Maximum Permissible Exposure (MPE) limits at O3b uplink frequencies include two exposure situations with limits as described below.

General Population/Uncontrolled Exposure (MPE), averaging window of 30 minutes or less:

1500-100,000 (MHz) = **1.0 mW/cm²**

Occupational/Controlled Exposure (MPE), averaging window of 6 minutes or less:

1500-100,000 (MHz) = **5.0 mW/cm²**

This analysis compares MPE limits to the calculated power flux densities at the antenna feed, main reflector surface, between the edge of the main reflector and the ground, near-field region, transition region, and the beginning of the far field.

The result of the analysis is a summary table which describes the power flux densities at key locations and the strategy for limiting General Population and Occupational exposure.

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1. Formulas and Parameters Used

The following data is used throughout the analysis:

Parameters	Symbol	Value	Units	Notes/Formulas
Transmit Power	P	447.23	W	RH traffic + LH traffic + LH CMD (TT&C)
Frequency	F	29089	MHz	
Wavelength	λ	0.010	m	299.792458 / F
Antenna Diameter	Dref	7.3	m	
Antenna Surface Area	Aref	41.854	m^2	π $Dref^2$ / 4
Subreflector Diameter	Dsub	0.610	m	
Subreflector Surface Area	Asub	0.292	m^2	π $Dsub^2$ / 4
Feed Flange Diameter	Dflange	0.137	m	
Feed Flange Area	Aflange	0.015	m^2	π $Dflange^2$ / 4
Antenna Gain	Ges	65.66	dBi	Mfg spec
Antenna Gain	G	3681289.736		10^(Ges / 10)
Antenna Efficiency	η	0.743		G λ^2 / π^2 $Dref^2$
Pi	π	3.142		

2. Density at Feed Flange

The maximum power flux density at the surface of the feed flange is as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Density @ flange		121355.623	W/m^2	4 P / Aflange
	Sflange	12135.562	mW/cm^2	

3. Density at Subreflector

The maximum power flux density at the surface of the Cassegrain subreflector is as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Density @ Main Reflector		6121.268	W/m^2	4 P / Asub
	Ssub	612.127	mW/cm^2	

4. Density at Main Reflector

The maximum power flux density at the surface of the main reflector is as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Density @ Main Reflector		42.742	W/m^2	4 P / Asub
	Ssurface	4.274	mW/cm^2	

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5. Density between Main Reflector and Ground

The maximum power flux density in the area between the edge of the main reflector and the ground is as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Density, Main Reflector/Ground		10.686	W/m²	P / Aref
	Sground	1.069	mW/cm²	

6. Density within the Near Field

The Near Field environment for a parabolic reflector antenna is contained within a cylinder with the same diameter as the main reflector which extends to a distance called the Near Field Extent.

Power within the Near Field is constant with the following maximum flux density:

Parameters	Symbol	Value	Units	Notes/Formulas
Range to Near Field Extent	Rnf	1292.688	m	$Dref^2 / 4 \lambda$
Density within the Near Field		31.776	W/m²	$16.0 \eta P / \pi Dref^2$
	Snf	3.178	mW/cm²	

7. Density at Transition Region

The Transition Region is the area between the Near Field and Far Field regions where power decreases linearly with distance.

The maximum power flux density within the Transition Region is located at the Near Field extent range and is calculated as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Range to Transition Region	Rt	136.357	m	Occurs at near field extent
Density @ Transition		31.776	W/m²	Snf Rnf / Rt
	Snf	3.178	mW/cm²	

8. Density at Beginning of the Far Field

The Far Field region is the range at which power decreases inversely with the square of the distance. The maximum power flux density within the Far Field region occurs at the Far Field Boundary and is calculated as follows:

Parameters	Symbol	Value	Units	Notes/Formulas
Range to Far Field Boundary	Rff	3102.452	m	$0.6 D^2 / \lambda$
Density @ Far Field Boundary		13.612	W/m²	$P G / 4 \pi Rff^2$
	Sff	1.361	mW/cm²	

9. Range to Far Field General Population Exposure Limit

In addition to the power flux density calculations at key locations, it's valuable to locate the specific range at which MPE limits are reached to aid in managing exposure control.

The following calculation show the range at which the Far Field General Population MPE limit occurs:

Parameters	Symbol	Value	Units	Notes/Formulas
Range to 1 mW/cm²		4107	m	Range to General Population Limit
		10.001	W/m²	
		1.000	mW/cm²	

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10. Non-Ionizing Radiation Summary

Flux Densities & Exposure Limits

General Population Exposure Limit = 1.0 mW/cm²
Occupational Exposure Limit = 5.0 mW/cm²

Region	Symbol	Level	Units	Hazard Assessment
Density @ Antenna Flange	Sflange	12135.562	mW/cm²	Exceeds General Population Exposure limit
				Exceeds Occupational Exposure limit
Density @ Subreflector	Ssub	612.127	mW/cm²	Exceeds General Population Exposure limit
				Exceeds Occupational Exposure limit
Density @ Main Reflector	Ssurface	4.274	mW/cm²	Exceeds General Population Exposure limit
				Does not exceed Occupational Exposure limit
Density Between Main Reflector and Ground	Sground	1.069	mW/cm²	Exceeds General Population Exposure limit
				Does not exceed Occupational Exposure limit
Max Density @ Near Field Extent	Snf	3.178	mW/cm²	Exceeds General Population Exposure limit
				Does not exceed Occupational Exposure limit
Max Density @ Transition Region	St	3.178	mW/cm²	Exceeds General Population Exposure limit
				Does not exceed Occupational Exposure limit
Density @ Beginning of Far Field	Sff	1.361	mW/cm²	Exceeds General Population Exposure limit
				Does not exceed Occupational Exposure limit

Range to Key Points and General Population Exposure Limit Avoidance Methods

Distance from Antenna	Symbol	Value	Units	Protection Method
Antenna Immediate Area				Fencing and Signage, no public access
Range to Near Field Extent	Rnf	1292.688	m	Main lobe offset greater than 1 diameter
Range to Far Field Boundary	Rff	3102.451	m	Main lobe offset greater than 1 diameter
Range to 1 mW/cm² MPE Limit		4107	m	Main lobe offset greater than 1 diameter

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Conclusion

The above analysis confirms the presence of hazardous power flux densities at the O3b Gateway terminal which will require physical and operational protections to manage General Population and Occupational exposure.

O3b's gateway facility is enclosed by a fence to restrict access to the antenna area for RF safety, physical safety, and security purposes. The size of the enclosed area considers the RF hazards, moving antenna 'swept volume', and the surrounding terrain. In addition to fencing, the area contains signage which clearly states the standard Radiation Hazard warning.

O3b will ensure antenna tracking geometry maintains angular limits which equates to at least one antenna diameter of separation between the antenna's main beam and nearby buildings and other occupied areas where the calculated General Population MPE levels may be exceeded.

All HPAs automatically shut down if the elevation angle of the antenna is less than 5 degrees.

Finally, to mitigate the risk of hazardous emissions exposure to operators and maintenance personnel, the antenna system will have an "Emergency Stop" safety switch located on an outdoor enclosure adjacent to the antenna system. Personnel with access to the antenna area will be trained to ensure that HPA's are off and system motion is disabled via the Emergency Stop switch before working in the vicinity of or on the antenna systems directly.

FCC Form 312
Exhibit 1

MODIFICATION OF EARTH STATION LICENSE TO ADD AN ANTENNA
NARRATIVE STATEMENT

ATTACHMENT 3
TECHNICAL CERTIFICATION

I hereby certify that I am the technically qualified person responsible for the preparation of the engineering information contained in this application, that I am familiar with part 25 of the Commission's Rules, and 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.

By: _____

Gary Mattie
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Dated: 16 May 2017