Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
O3b Limited	)	File No. SAT-MOD-20200526-_____
	)	Call Sign: S2935
Application to Modify	)	
U.S. Market Access Grant for the	)	
O3b Ka-band Satellite System	)	

MODIFICATION

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May 26, 2020

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MODIFICATION

O3b Limited ("O3b") seeks modification of its authority to serve the U.S. market using a system of Ka-band satellites in medium earth orbit ("MEO").[1] O3b submits this modification (the "Modification") pursuant to Sections 25.117 and 25.137 of the Commission's rules[2] for consideration as part of the non-geostationary satellite orbit ("NGSO") processing round the International Bureau established on March 24, 2020.[3]

The Modification requests U.S. market access for the following satellites to be added to the O3b NGSO network:

- Ten satellites in a circular equatorial orbit at 8062 kilometers
- Twenty-four satellites in an inclined orbit at 8062 kilometers
- Thirty-six satellites in an inclined orbit at 507 kilometers

All the satellites will operate in the 17.8-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz frequencies covered by the Market Access Grant.[4] This spectrum will be used for Fixed-Satellite

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[1] *See O3b Limited*, Order and Declaratory Ruling, 33 FCC Rcd 5508 (2018) (the "Market Access Grant").

[2] 47 C.F.R. §§ 25.117, 25.137.

[3] *See Cut-Off Established for Additional NGSO FSS Applications or Petitions for Operations in the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.8-14.5 GHz, 17.7-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz Bands*, Public Notice, DA 20-325 (Mar. 24, 2020).

[4] The new satellites will also be capable of operating in the 17.7-17.8 GHz and 18.6-18.8 GHz bands, but O3b is not seeking U.S. market access for space station operations in these bands. O3b will seek Commission authority for U.S. receive operations in the 17.7-18.8 GHz frequencies via earth station applications. O3b does not propose to use the 18.6-18.8 GHz band in the United States.

Service ("FSS"), Mobile Satellite Service ("MSS"), and satellite-to-satellite operations, as discussed herein. Technical information regarding the proposed operations is provided on Schedule S and in the Technical Annex supplied as Attachment A.

The proposed expansion will allow O3b to respond to growing demand from Internet service providers, fixed and mobile network operators, large enterprises and governments for low-latency, high-throughput satellite capacity that enables fast, flexible and affordable broadband connectivity in locations unserved or underserved by terrestrial networks.[5] Grant of this Modification will allow O3b to build on its proven record of meeting customer requirements for high-quality, cost-effective satellite services and will therefore serve the public interest.

I. INTRODUCTION AND SUMMARY

O3b operates a robust and growing Ka-band NGSO system of MEO satellites authorized by the United Kingdom ("UK"). O3b began providing global service on September 1, 2014, and its constellation now comprises 20 satellites. Following the success of its initial MEO fleet, O3b is moving to deploy the next-generation mPOWER system of high-throughput, low-latency MEO satellites, each capable of generating thousands of electronically-steered beams that can be dynamically adjusted to serve customers in a broad range of market segments.

In order to meet evolving customer demand, O3b seeks U.S. market access for additional satellites that will add capacity and coverage to the O3b fleet. O3b proposes to supplement its MEO equatorial orbit constellation, add MEO inclined orbit satellites, and introduce a low earth orbit ("LEO") component. O3b anticipates that Space Activity Licenses covering launch and space operations of the additional satellites will be issued pursuant to the UK's Outer Space Act. O3b will submit these licenses to the Commission once they have been issued.

The new satellites will also be equipped with the ability to perform satellite-to-satellite communications. O3b's LEO satellites will use the 27.5-29.1 GHz and 29.5-30 GHz FSS spectrum to transmit to O3b's MEO satellites and to geostationary satellite orbit ("GSO") space stations. The O3b MEO satellites will use the 17.8-18.6 GHz and 18.8-20.2 GHz FSS and MSS feeder link spectrum to transmit to O3b's LEO satellites, and the LEO satellites will receive transmissions in these bands from GSO space stations as well. This functionality will enhance the overall network's ability to support innovative offerings that use a combination of space station assets to satisfy developing customer needs.

O3b's proposed operations will give U.S. customers access to an expanding range of service capabilities, foster enhanced competition that promotes new technologies and places

[5] The O3b service is comparable to fiber, making it the ideal solution to bring broadband quality Internet connectivity to places that are unserved or underserved by fiber or other terrestrial networks.

downward pressure on pricing, and contribute to efficient use of spectrum to address marketplace demand. Accordingly, grant of the Modification will serve the public interest.

II. O3B's MODIFICATION SATISFIES THE COMMISSION'S LEGAL REQUIREMENTS

O3b complies with Section 25.137(f) of the Commission's rules,[6] which sets forth the requirements for seeking changes to U.S. market access authorizations. O3b demonstrates in this filing that its request to add satellites and functionalities to its system is consistent with Commission policies and is in the public interest. As a result, O3b's request for a market access modification should be granted.

A. O3b's Modification Conforms to Section 25.137(f)

Section 25.137(f) of the rules states that a non-U.S. licensed satellite operator may modify its grant of U.S. market access in accordance with the procedures set forth in Section 25.117(d) of the rules.[7] The Modification meets the rule's requirements:

- O3b has identified all information required by Section 25.114 that has changed, and it hereby certifies that there has been no change to the remaining information.
- O3b demonstrates herein that the proposal to add satellites and capabilities to its system does not affect O3b's qualifications to operate a space station network under the Commission's rules because:
    - the Modification does not affect the factors relevant to the Commission's market access analysis under *DISCO II*;[8]
    - the Modification satisfies the Commission's legal and technical qualification requirements for holders of space station authorizations; and
    - the limited waivers of Commission policies and rules O3b is requesting are justified under Commission precedent.
- O3b demonstrates in this filing that grant of its market access modification request would be in the public interest.

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[6] 47 C.F.R. § 25.137(f).

[7] 47 C.F.R. § 25.117(d).

[8] *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*, Report and Order, 12 FCC Rcd 24094 (1997) ("*DISCO II Order*"), *on reconsideration*, 15 FCC Rcd 7207 (1999).

B. O3b Will Continue to Satisfy the *DISCO II* Requirements

In its *DISCO II* proceeding, the Commission established a framework for considering requests for non-U.S. licensed space stations to access the U.S. market. In evaluating requests for such authority, the Commission considers the effect on competition in the United States; eligibility and operational requirements; concerns related to national security, law enforcement, foreign policy, and trade; and spectrum availability. The Market Access Grant reflects the Commission's determination that authorizing O3b to serve U.S. customers is consistent with applicable precedent, and the addition of satellites and operating capabilities proposed herein does not alter the *DISCO II* analysis.

Effect on competition in the United States. The proposed expansion of O3b's system will enhance competition in the United States by enabling O3b to add capacity and compete more effectively. In any event, under the *DISCO II* framework, allowing satellites licensed by WTO member countries to serve the U.S. is presumed to be pro-competitive,[9] and O3b's satellites will be licensed by the United Kingdom, a member of the WTO.[10]

Eligibility and operational requirements. As shown in Section II.C below, O3b's request to add satellites and functionalities is consistent with the *DISCO II* criteria that address eligibility and operational requirements.

Concerns related to national security, law enforcement, foreign policy, and trade. O3b's prior granted applications for U.S. market access raised no national security, law enforcement, foreign policy, and trade issues, and the addition of satellites and functionalities does not present any new concerns in these areas.

Spectrum availability. Operation of the O3b system as modified does not implicate spectrum availability under the *DISCO II* framework[11] because it will not create the potential for harmful interference with U.S.-licensed satellite and terrestrial systems.

In the Market Access Grant, the Commission determined that the O3b system, operating in conformance with the terms and conditions specified in the decision, will adequately protect U.S.-licensed satellite and terrestrial systems from interference. In the Technical Annex that is

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[9] *See DISCO II Order* at ¶ 29.

[10] O3b is headquartered in St. John, Jersey, Channel Islands, which is a British Crown Dependency. The Commission treats British Crown Dependencies like Jersey and Guernsey as members of the WTO. *See, e.g.*, *Intelsat Holdings, Ltd., Transferor, and Serafina Holdings Limited, Transferee, Consolidated Application for Consent to Transfer Control of Holders of Title II and Title III Authorizations*, Memorandum Opinion and Order, 22 FCC Rcd 22151, ¶ 25 n.57 (2007).

[11] *See DISCO II Order* at ¶¶ 149-50.

included with this filing, O3b supplements its prior showing on these matters to address the proposed addition of satellites and functionalities to its system. The Technical Annex explains that:

- O3b's expanded system will continue to comply with relevant Commission and International Telecommunication Union ("ITU") Power Flux Density ("PFD") limits developed to ensure that satellite downlink transmissions do not adversely affect terrestrial services.
- O3b's expanded system will continue to comply with Equivalent Power Flux Density ("EPFD") limits for uplink and downlink transmissions from NGSO satellite systems that must be met in certain frequency ranges to avoid unacceptable interference to GSO satellite networks.
- O3b will continue to rely on Commission-approved approaches to manage any in-line interference events with other NGSO satellite systems.
- O3b will comply with rules adopted in the Spectrum Frontiers proceeding[12] regarding sharing with Upper Microwave Flexible Use Service operations as required.
- O3b will comply with Commission requirements for sharing with other authorized users of MSS feeder link spectrum.
- Coordination with U.S. government satellite networks under footnote US334 of the Table of Frequency Allocations was previously completed for the first-generation O3b MEO system, and O3b will seek revisions to the agreement to reflect the changes proposed herein.
- O3b's proposed satellite-to-satellite operations will not create harmful interference to authorized users of the 17.8-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz bands.

Accordingly, grant of O3b's Modification is consistent with Commission policies designed to protect U.S.-licensed satellite and terrestrial systems.

C. O3b Will Continue to Satisfy the Commission's Legal and Technical Qualification Requirements

The information set forth in this legal narrative, the attached Technical Annex, Schedule S, and the accompanying FCC Form 312 demonstrates that O3b's proposed addition of satellites and capabilities conforms to the Commission's legal and technical qualification

[12] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, *et al*., Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016).

requirements for holders of space station authorizations. In this regard, O3b notes that it is not required to make an orbital debris mitigation showing for the proposed new satellites to be licensed by the UK because the Commission has already determined that O3b's system is "subject to direct and effective regulation by the United Kingdom concerning orbital debris mitigation."[13]

D. Waivers of Commission Rules and Policies Are Warranted for the O3b Modification

O3b seeks waivers of the Commission's rules in connection with this Modification. Grant of these waivers is consistent with Commission policy:

> The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[14]

O3b's proposal for additional satellites and functionalities substantially complies with the Commission's rules, but certain waivers are necessary in light of the spectrum used and the technical characteristics of the system. The Commission has granted similar waivers in other cases. As shown below, the changes to O3b's operations proposed in the Modification will allow O3b to continue and expand its services, and grant of the requested waivers will therefore serve the public interest.

Table of Frequency Allocations and Ka-Band Plan

The U.S. Table of Frequency Allocations in Section 2.106 of the Commission's rules, the associated footnotes, and the designations in the Commission's Ka-band frequency plan[15] include limitations on use of some frequency bands for which O3b is seeking authority in this Modification. O3b seeks waivers of these restrictions as discussed below. Waivers of Commission allocations are generally granted "when there is little potential for interference into any service authorized under the Table of Frequency Allocations and when the nonconforming

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[13] Market Access Grant at ¶ 53.

[14] *PanAmSat Licensee Corp*., 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).

[15] *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters,* Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809 (2017) at Appendix B ("Ka-band Plan").

operator accepts any interference from authorized services."[16] The O3b waiver requests meet this test.

19.7-20.2 GHz and 29.5-30 GHz: O3b proposes to use the 19.7-20.2 GHz band for service and gateway downlinks and to use the 29.5-30 GHz band for service and gateway uplinks. These band segments are allocated for FSS operations, but O3b seeks authority to use the frequencies for MSS operations as well.[17] O3b's use of the spectrum for MSS will not cause interference to FSS operations and will comply with applicable EPFD limits for GSO networks, even when the operations are conducted within the MSS. In addition, O3b will accept any interference from authorized services. Waiver of the Ka-Band Plan would therefore serve the public interest and is consistent with the Commission's decision in the Market Access Grant.[18]

17.8-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz: O3b proposes to use the 17.8-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz bands for satellite-to-satellite communications as discussed above and seeks any necessary waiver of the U.S. Table of Frequency Allocations and the Ka-Band Plan to permit such operations. The planned satellite-to-satellite links will conform to the transmission directions specified for FSS operations in each band segment: the MEO satellites will transmit to LEO satellites in the 17.8-18.6 GHz and 18.8-20.2 GHz bands designated for space-to-Earth operations, and the LEO satellites will transmit to MEO and GSO satellites in the 27.5-29.1 GHz and 29.5-30 GHz bands designated for Earth-to-space use. The Technical Annex explains that these satellite-to-satellite links will be comparable to typical satellite operations and will not cause harmful interference to other authorized users of the spectrum. Moreover, O3b will accept any interference from authorized services to its satellite-to-satellite operations in these bands.

The implementation of satellite-to-satellite links will allow O3b to manage its constellation more effectively and support multi-orbit services to customers. These satellite-to-satellite links are envisaged to enable high-throughput, low latency transmission of a variety of satellite-collected data from sectors like agriculture, energy and the environment.

The Commission has previously granted U.S. market access for a foreign-licensed NGSO system that proposed to perform satellite-to-satellite communications in Ka-band frequencies

[16] *See The Boeing Company*, 16 FCC Rcd 22645 (IB & OET 2001) at 22651 & n.48 (citing cases).

[17] O3b's MSS operations will be supported by feeder links in the 19.3-19.7 GHz and 29.1-29.5 GHz bands, a use consistent with the Table of Frequency Allocations and the Ka-Band Plan.

[18] Market Access Grant at ¶¶ 19-23, 61.

subject to conditions designed to protect other satellite and terrestrial operations.[19] Grant of the O3b Modification, including any necessary rule waivers to permit satellite-to-satellite communications, is consistent with this Commission precedent and will serve the public interest.[20]

Section 25.114(c) – Schedule S

Section 25.114(c) of the Commission's rules identifies information that must be provided in the online Schedule S and specifies the required format for that information.[21] As described in the Technical Annex, because of the constraints of the Schedule S software, O3b is not able to provide all of the required data in the specified format. In these cases, O3b is supplementing the Schedule S with additional descriptive materials to ensure the Modification comprehensively describes the O3b operations proposed herein. O3b seeks any necessary waiver of Section 25.114(c) to allow presentation of the required information through these alternative showings. Grant of this request is consistent with Commission precedent.[22]

III. GRANT OF O3B's MODIFICATION WILL SERVE THE PUBLIC INTEREST

Adding new satellites and functionalities to O3b's NGSO system will further enhance O3b's ability to serve U.S. customers. The system expansion described in this Modification builds upon O3b's proven success in providing high-throughput and low-latency NGSO satellite services in Ka-band and will allow O3b to offer even more innovative and affordable services in the future. Grant of O3b's Modification, therefore, would be in the public interest.

As O3b has previously explained, it has installed and operates essential components of its ground infrastructure in the United States, representing several multimillion-dollar investments. O3b provides large data capacity and enables real time applications, even where fiber access is limited or non-existent, driving demand from both the civilian and military arms of the U.S. government. O3b's ability to provide a connectivity comparable to fiber where there is no or

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[19] *See ViaSat, Inc.*, Order and Declaratory Ruling, File Nos. SAT-PDR-20161115-00120 and SAT-APL-20180927-00076, FCC 20-56 (rel. Apr. 23, 2020) ("*ViaSat Order*") at ¶¶ 21-23, ¶ 52(f), (g), (h), and (i).

[20] O3b recognizes that authority for any U.S.-licensed GSO satellite to communicate with the O3b LEO space stations would be addressed in the context of the GSO satellite's license. *See id.* at ¶ 14.

[21] 47 C.F.R. § 25.114(c).

[22] *See ViaSat Order* at ¶¶ 49, 60.

limited terrestrial infrastructure has also made it an ideal solution for maritime and transportable applications, as well as for energy installations, as data and mobility demands grow.

For example, O3b services to ships at sea in U.S. waters and around the globe expand the bandwidth available to passengers and crew, keeping them connected and ensuring they have access to essential weather and operational data. O3b's network also plays a critical role in disaster recovery. In 2017, for example, O3b used its MEO constellation's advanced spot beam capabilities in conjunction with Alphabet's Project Loon to restore 4G/LTE services to Puerto Rico following hurricane Maria.[23]

Adding satellites and functionalities, which O3b will utilize to provide even more innovative and affordable offerings, will enable O3b to expand and improve upon the services described above and introduce additional capabilities to U.S. customers. Accordingly, grant of the Modification is unquestionably in the public interest.

IV. CONCLUSION

For the reasons stated herein, the Commission should modify the Market Access Grant to permit O3b to deploy additional satellites and functionalities for service to U.S. customers.

Respectfully submitted,

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[23] *See SES Networks Works with Project Loon to Restore Connectivity in Puerto Rico,* https://www.ses.com/press-release/ses-networks-works-project-loon-restore-connectivity-puerto-rico*; see also* SES Networks, *Delivering 4G/LTE Services*, https://www.ses.com/case-study/delivering-4glte-services (May 6, 2019).

O3b Modification

Attachment A

Technical Annex

A.1 Scope

This attachment contains the information required by §25.114(d) and other sections of the Commission's Part 25 rules that cannot be captured by the Schedule S software.

This modification seeks changes to the U.S. market access authority for the O3b non-geostationary orbit (NGSO) satellite system to allow the following additional satellites to serve the United States in the 17.8-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz bands:

- 10 additional equatorial satellites in medium-Earth orbit (MEO) at 8062 km,
- 24 inclined MEO satellites at 8062 km and
- 36 inclined satellites in low-Earth orbit (LEO) at 507 km

A.2 General Description of Overall System Facilities, Operations and Services (§25.114(d)(1))

A.2.1 Frequency Plan for Additional Satellites

Pursuant to the Order and Declaratory Ruling adopted June 4, 2018, O3b is authorized to serve the U.S. market with a system of MEO satellites. In this modification, O3b proposes to add 10 equatorial MEO satellites, 24 inclined MEO satellites and 36 sun-synchronous LEO satellites operating in the same Ka-band frequencies previously authorized: the 17.8-18.6 and 18.8-20.2 GHz (space-to-Earth) and 27.5-30.0 GHz (Earth-to-space) frequencies in the fixed-satellite service (FSS), the 19.7-20.2 GHz (space-to-Earth) and 29.5-30.0 GHz (Earth-to-space) frequencies in the mobile-satellite service (MSS), and the 19.3-19.7 GHz (space-to-Earth) and 29.1-29.5 GHz (Earth-to-space) frequencies for MSS feeder-links (FLs). In addition, the new LEO and MEO satellites will be equipped with the ability to perform satellite-to-satellite communications. O3b's LEO satellites will use the 27.5-29.1 GHz and 29.5-30 GHz FSS spectrum to transmit to O3b's MEO satellites and to geostationary satellite orbit (GSO) space stations. The O3b MEO satellites will use the 17.8-18.6 and 18.8-20.2 GHz FSS spectrum to transmit to O3b's LEO satellites, and the LEO satellites will receive transmissions in these bands from GSO space stations as well.

Under the Commission's Ka-Band Plan, terrestrial services are primary in the 17.8-18.3 GHz and 27.5-28.35 GHz frequency bands in the United States and FSS is secondary. O3b requests U.S. market access for these bands consistent with these allocations. In the 17.8-18.3 GHz band, terrestrial services are protected from satellite emissions by power flux density (PFD) limits on the Earth's surface. As discussed below, O3b will comply with these PFD limits. In the 27.5-28.35 GHz band, FSS operations must provide interference protection to Upper Microwave Flexible Use Service (UMFUS) stations except as authorized pursuant to the detailed earth station siting requirements set out in §25.136 of the Commission's rules. O3b will make the necessary technical showing when seeking U.S. earth station authorizations in this frequency band.

The Commission's Ka-Band Plan designates the 18.3-18.6 GHz, 19.7-20.2 GHz, 28.35-28.6 GHz, and 29.5-30 GHz frequency bands as available for use by NGSO satellite systems on a secondary basis to GSO networks. Accordingly, NGSO systems may not create harmful interference into or claim protection from GSO satellite networks operating on a primary basis in these bands. As discussed below in Section A.8 of this attachment, O3b will comply with the equivalent power flux density (EPFD) limits defined in Article 22 of the ITU Radio Regulations, which were developed to ensure protection of GSO networks from NGSO operations.

The Commission's Ka-Band Plan designates the 18.8-19.3 GHz and 28.6-29.1 GHz frequency bands as available for primary use by NGSO satellite systems. The interference sharing mechanism among NGSO systems is defined in §25.261 of the Commission's rules. O3b commits to coordinating with other NGSO systems so that harmful interference is avoided. This is described in greater detail in Section A.8.

The Commission's Ka-Band Plan designates the 19.3-19.7 GHz and 29.1-29.5 GHz frequency bands as available for primary use by NGSO satellite systems for MSS feeder-links (FLs). The interference sharing mechanism between NGSO MSS FL systems is defined in §25.250 and §25.203(k) of the Commission's rules. O3b recognizes coordination is only necessary in the portions of these bands used by existing NGSO systems.

The Commission's Ka-Band Plan designates the 19.7-20.2 GHz and 29.5-30.0 GHz frequency bands for FSS operations, but O3b seeks authority to use the frequencies for MSS as well in conjunction with the MSS feeder link operations discussed above. The ITU Table of Frequency Allocations has a primary MSS allocation in the 19.7-20.2 GHz and 29.5-30.0 GHz frequency bands. In the legal narrative for this application O3b requests waiver of the Commission's frequency designations to allow MSS operations in these bands. Because these MSS operations are similar to the FSS operations in this band, O3b is able to protect the primary GSO satellite networks using EPFD limits and avoid harmful interference into other NGSO systems using these bands for FSS operations. O3b also will not claim protection from systems using these bands for FSS operations.

The Commission's Ka-band Plan designates the 17.8-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz frequency bands for FSS, and O3b proposes to use these bands for satellite-to-satellite communications. In the legal narrative for this application O3b requests any necessary waiver of the Commission's frequency designations to allow satellite-to-satellite operations in these bands.

Lastly, the satellites also have the ability to operate in the 17.7-17.8 GHz and 18.6-18.8 GHz frequency bands, but O3b is not seeking U.S. market access for this spectrum. O3b will seek Commission authority to use the 17.7-17.8 GHz frequency band when applying for U.S. earth station licenses in this band.

O3b has included in the accompanying Schedule S the information regarding the Ka-band operations previously authorized as well as the new Ka-band satellites proposed in this modification.

A.2.2 U.S. Market Access Request for MEO Satellites

O3b is seeking U.S. market access for additional MEO satellites in equatorial and inclined orbits as part of this application. O3b proposes to add 10 satellites that will operate in an equatorial circular orbit at an altitude of 8,062 km. These satellites will be the third generation of O3b satellites to seek U.S. market access, following the original 20 satellites in orbit and operational today and the second-generation O3b mPOWER spacecraft that are scheduled to begin service in 2021/2022.

The same ground facilities and infrastructure used today with the in-flight O3b satellites will also support these third-generation O3b satellites. These new satellites take into account technology advancements that have occurred since the procurement of the O3b mPOWER satellites and can operate either independently of, or in conjunction with, the first- and second-generation satellites, depending on customer requirements and other factors. The three generations of equatorial O3b satellites will be operating together with a minimum angular separation between any two active co-frequency, co-coverage satellites of $\geq$3.5 degrees. This will be managed operationally by the advanced network operating center.

O3b is also seeking U.S. market access for 24 new satellites that will operate in circular orbits at an altitude of 8,062 km in 4 planes of 6 satellites having an inclination angle of 90 degrees and right ascension of the ascending nodes of 0, 45, 90 and 135 degrees. The orbital characteristics are provided in the Schedule S.

These new inclined satellites, much like the additional equatorial satellites, will take advantage of recent innovations in available technology. The same advanced payload technology used on the equatorial MEO satellites will be used on these satellites but on a smaller satellite bus. This satellite bus has a unique form factor that allows for more satellites to fit within available launchers but has a modular platform capable of reusing the advanced communications payload on board the third-generation equatorial MEO satellites.

The same ground facilities and infrastructure used today with the in-flight O3b satellites will also be used to support the new inclined orbit MEO satellites. O3b will either build or lease additional gateway facilities at higher latitudes to support TT&C operations and/or customers in areas farther north and south of what is visible from existing O3b facilities. These installations and/or leases will be driven by business requirements.

As with the equatorial satellites, the new inclined satellites can operate independently of the inclined space stations authorized under O3b's existing market access grant or as a combined network with those satellites. O3b will use the advanced network operating center to ensure that a minimum angular separation of 3.5 degrees is maintained between any two active co-frequency, coverage satellites.

The satellite control center for the O3b satellites will be in Betzdorf, Luxembourg, with a back-up facility located in Manassas, Virginia. Network operations will be controlled from a facility in Manassas, VA. Connectivity between these control centers and the TT&C earth stations will be implemented using terrestrial leased circuits or secure Internet virtual private networks.

O3b has built a successful business providing broadband communications supporting various applications including maritime, aeronautical, mobile backhaul, IP Trunk, and miscellaneous IP communications from existing MEO satellites. O3b proposes to expand its constellation to meet continuing and evolving demand for these applications.

A.2.3 U.S. Market Access Request for LEO Satellites

O3b seeks U.S. market access for 36 LEO satellites at an altitude of 507 km in 4 planes of 9 satellites to be deployed in a Sun-Synchronous Orbit (SSO) to support applications including Internet of Things (IoT) and data relay. These satellites will use the full range of Ka-band frequencies as requested above to provide high data rate communications for these applications and others.

Sectors like transport, energy, and agriculture need business-critical information coming from areas not covered by terrestrial networks. LEO satellites are well positioned to serve these distributed connectivity requirements and complement terrestrial networks. The advantage of LEO orbits for IoT as compared to higher-orbit satellites is their lower path loss, which helps simplify design of the IoT terminals, allowing operations with low power and for a lower cost. Moreover, LEO satellites can provide IoT communications in extreme topographies where low elevation angles to other satellite orbits can block signal delivery. O3b's proposed LEO satellites with full Ka-band payloads will provide global coverage with extremely high data rates for IoT applications that require variable gigabit links.

The LEO satellites will create less interference than the MEO portion of the O3b network due to the lower downlink EIRP levels generated by the LEO satellites. The likelihood of interference from the LEO satellite should also be less than for MEO satellites because there will be fewer LEO satellites visible to any point on the Earth at a given time. In the uplink direction, lower earth station uplink EIRP levels will be used to communicate with the LEO satellites than with the MEO satellites because of the reduced distance to the LEO orbit.

The satellite control center for the O3b satellites will be in Betzdorf, Luxembourg, with a back-up facility located in Manassas, Virginia. Network operations will be controlled from a facility in Manassas, VA. Connectivity between these control centers and the TT&C earth stations will be implemented using terrestrial leased circuits or secure Internet virtual private networks.

A.2.4 Satellite-to-Satellite Capabilities

O3b's proposed new LEO and MEO satellites will be equipped with data-relay payloads enabling communications between the LEO and MEO satellites and between the LEO satellites and GSO satellites. The LEO satellites will transmit (uplink) to MEO and GSO space stations in the 27.5-29.1 GHz and 29.5-30 GHz band segments and receive (downlink) signals transmitted by MEO and GSO space stations in the 17.8-18.6 GHz and 18.8-20.2 GHz band segments. These satellite-to-satellite links provide signal routing options that can be crucial to support applications that need real-time or "always-on" connectivity, requiring the ability to complete a link between a LEO satellite and the ground network when the LEO satellite is not visible from the ground location.

The LEO-to-MEO or LEO-to-GSO links transmitting in the Earth-to-space direction in the 27.5-29.1 GHz and 29.5-30 GHz bands will behave very much like traditional FSS earth stations in motion (ESIMs) such as aeronautical terminals that can track and communicate with the wanted satellite. However, since these LEO satellites are at much higher altitudes than ESIMs, the far-off axis gain discrimination and increased path loss reduce the possibility of interference to terrestrial services that share this band with the FSS. Moreover, the EIRP of these LEO-to-MEO or LEO-to-GSO links would be comparable to that of an ESIM, but with less required input power due to the decreased path loss between transmitter and receiver to achieve the same received signal power. These links also pose a lower risk of interference into other non-GSO satellite receivers because their high angular velocity means the duration of an in-line event is reduced from that of a station on or close to the Earth. Lastly, the LEO satellite transmissions to MEO satellites will comply with EPFD(up) requirements designed to protect GSO satellite networks from NGSO satellite Earth-to-space emissions in portions of the Ka-band uplink spectrum.

It is not possible to enter beam information related to the LEO-to-MEO and LEO-to-GSO links into the Schedule S. As explained above, these beams will behave as FSS ESIMs and will comply with the off-axis EIRP density envelopes specified in §25.218(i). GXT files are not provided as these beams are pointed spacewards towards either MEO or GEO satellites, and therefore the beam contours fall entirely beyond the Earth's surface.

The MEO-to-LEO links transmitting in the space-to-Earth direction in the 17.8-18.6 GHz and 18.8-20.2 GHz bands will behave exactly like any other downlink transmission from the MEO satellites. As a result, these MEO-to-LEO transmissions will pose no greater interference threat than typical space-to-Earth transmissions from the MEO satellites.

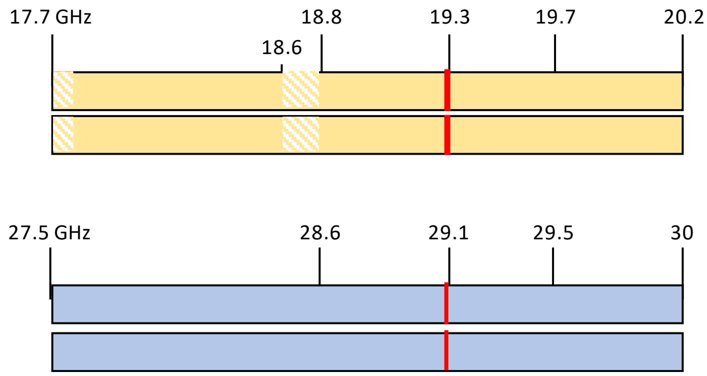
A.3 Frequency Plan, Channels and TT&C Characteristics (§25.114(c)(4)(i) and §25.202(g))

A.3.1 Channels and Frequency Plan

The proposed additional satellites will employ an advanced digital channelizer that will be able to dynamically route the uplink to the downlink. The transmit and receive antennas are steerable and will have shapeable gain patterns. Each antenna beam will be pointed to a constant position on the Earth as the satellite traverses its active arc above these constant positions on the Earth. At the beginning and end of the active arc that serves each ground position, the satellite antennas will be repointed to provide the necessary connectivity for the next active arc. Handover of traffic between satellites will be seamless, as there will always be at least two satellites visible to each earth station at the times that satellite handover is required. Payload operations and traffic management will be handled globally by a software-driven dynamic resource manager.

Each additional satellite will use the 27.5-30.0 GHz uplink bands and the 17.8-18.6 GHz and 18.8-20.2 GHz downlink bands. TT&C operations will be performed at all phases of the mission in the 20 MHz band edges just below 29.1 GHz (uplink) and 19.3 GHz (downlink). Frequency re-use (per satellite) is achieved by a combination of dual-polarization (RHCP and LHCP), beam forming, and spatial isolation between co-frequency, co-polarized antennas. A schematic of the use of the spectrum is given in Figure A.3-1 below. The TT&C frequencies are shown by the red shaded area just below the 19.3 GHz and 29.1 GHz frequencies.

Figure A.3-1: Frequency plan with TT&C band shown in red



The satellites will be capable of operating across the entire 17.7-20.2 GHz spectrum range, and for completeness, O3b has included the full frequency range in the Schedule S. However, O3b is not seeking U.S. market access for the satellites in the 17.7-17.8 and 18.6-18.8 GHz frequency bands.

As the satellites will employ a digital channelizer, there will be varying channel bandwidths over the range 17.8-18.6 and 18.8-20.2 GHz in the space-to-Earth direction and 27.5-30 GHz in the Earth-to-space direction in both RHCP and LHCP.

A.3.2 TT&C

The TT&C sub-system provides for communications during pre-launch, transfer orbit and on-station operations, as well as during spacecraft emergencies. The TT&C sub-system will operate at the edges of the uplink and downlink frequency ranges allocated to NGSO satellite systems during all phases of the mission. The TT&C transmissions cause no greater interference and require no greater protection from harmful interference than the communications traffic on the satellite network. As a result, the TT&C configuration complies with §25.202(g) of the Commission's rules.

During all phases of the mission, including transfer orbit, spacecraft emergencies and normal operations, the TT&C uplink signals will be received by the satellite using a combination of antennas on the satellite that create a near omni-directional gain pattern. The TT&C downlink signals will also be transmitted by the satellite using a combination of antennas on the satellite that create a near omni-directional gain pattern. However, for normal operations, when the spacecraft is directed towards the Earth, the minimum operational antenna gain of the TT&C downlink antenna will be higher than for safe-mode operations (i.e., during transfer orbit and spacecraft emergencies). The satellites will have a flexible TT&C component that allows the center frequency to shift up and down within a given range. This range is designed to be 20 MHz with the ability to shift in 0.5 MHz steps for both telemetry and command. A summary of the TT&C subsystem characteristics is given in Table A.3-1.

Table A.3-1 TT&C Performance Characteristics

Command Modulation	PCM/PSK/APSK
Command Frequencies	29090 MHz (variable)
Uplink Flux Density (Minimum)	−100 dBW/m^2 (Command)
Polarization of Satellite Rx/Tx Antennas	Rx: LHC or RHC Tx: LHC and RHC
Telemetry Frequencies	19290 MHz (variable)
Maximum Downlink EIRP	26.3 dBW

A.4 Predicted Space Station Antenna Gain Contours (§25.114(c)(4)(vi)(B) & (C))

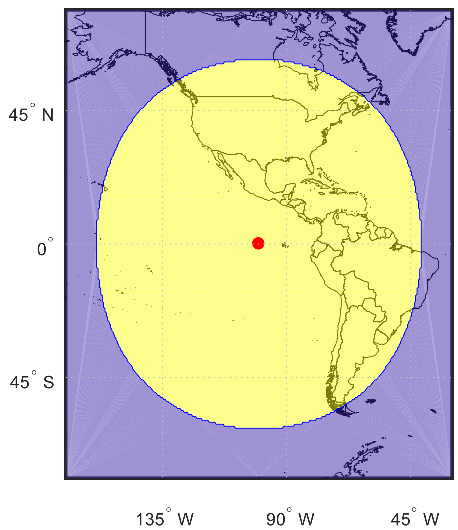
The antenna gain contours for the MEO and LEO satellite receive and transmit beams required by §25.114(c)(4)(vi)(B) are given in PDF format and attached to the Schedule S. For these contours, the position of the MEO satellite is arbitrarily set at 100° W.L. and 0° N.L. The LEO satellite is assumed to be at 77° W.L. and 37° N.L. The antenna gain contours are representative of both customer and gateway beams. For ease of reference the table below identifies the new beams associated with the present modification request.

Table A.4-1 New beams added to the Schedule S

Satellites	Tx/Rx	Beam ID
MEO	Tx	THL1*, THR1*, TLM3, TLM4
	Rx	RHL1*, RHR1*, CMD3, CMD4
LEO	Tx	TLL1, TLR1, TLM5, TLM6
	Rx	RLL1, RLR1, CMD5, CMD6
* These beam IDs will also be used for the MEO-to-LEO and LEO-to-MEO transmissions.		

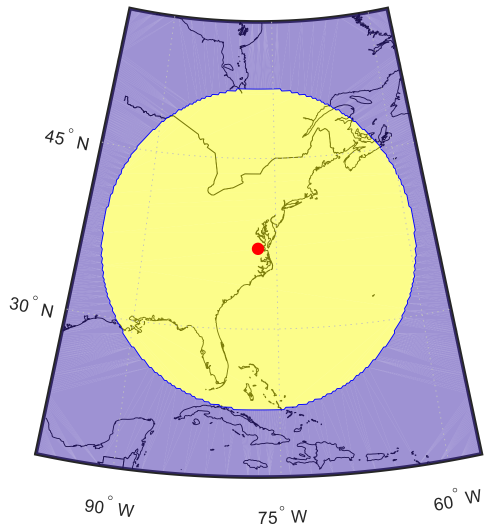
As these antenna beams are steerable and shapeable, §25.114(c)(4)(vi)(C) applies and so representative antenna gain contours for the transmit and receive antennas are provided for both a beam pointed over the United States and nadir. The 0-dB relative gain isoline for a MEO satellite is shown in Figure A.4-1 where the maximum coverage area is the 5° elevation angle. This is a representative isoline for a MEO satellite at a longitude of 100° W.L. and latitude of 0° N.L.

Figure A.4-1: Maximum MEO coverage area of the 0-dB relative antenna gain isoline



The LEO satellite antenna beams are also steerable and shapeable and so representative antenna gain contours for the transmit and receive antennas are provided for both a beam pointed over the United States and nadir. The 0-dB relative gain isoline is shown in Figure A.4-2 where the maximum coverage area is the 5° elevation angle. This is a representative isoline for a LEO satellite at 77° W.L. and 37° N.L.

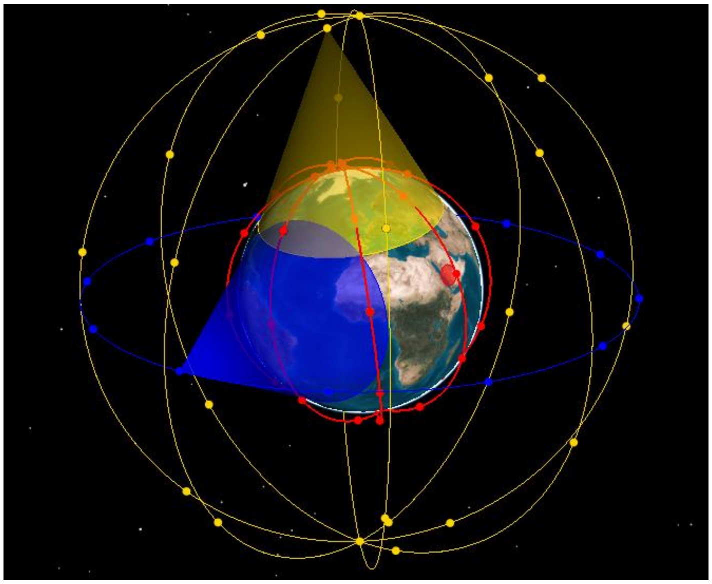
Figure A.4-2: Maximum LEO coverage area of the 0-dB relative antenna gain isoline



A.5 Geographic Coverage (§25.146(b))

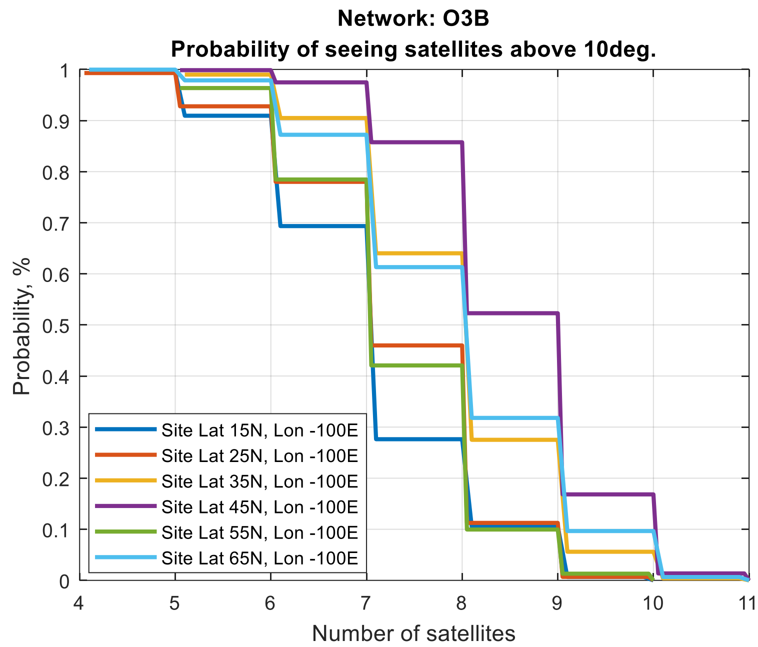
The MEO satellites will have global coverage with the combination of equatorial and inclined satellites. The LEO satellites will be visible from every part of the Earth but will not have continuous coverage of the Earth due to their lower altitude. However, it is important to note that the O3b system is designed to make efficient use of spectrum and satellite power by using bandwidth and power only where it is needed, *i.e.* where customers are located. Rather than covering the entire visible earth at all times, the steerable beams on the O3b satellites will be focused on customer locations and gateways, thus maximizing the throughput between those locations. As customers are added or their needs change, the O3b system capacity can adapt accordingly. The graphic in Figure A.5-1 illustrates these additional MEO and LEO satellites.

Figure A.5-1. 3D visualization of O3b satellites



The satellites comply with §25.146(b) of the Commission's rules for geographic coverage by NGSO FSS systems in the Ka-band, which requires the system be capable of providing FSS on a continuous basis throughout the fifty states, Puerto Rico, and the U.S. Virgin Islands. The following graph demonstrates the likelihood of having a MEO and/or LEO satellite visible at latitudes 15° N.L. and 65° N.L. down to a minimum elevation angle of 10°.

Figure A.5-2. Number of satellites visible from different latitudes



A.6 Cessation of Emissions (§25.207)

Each satellite transmission chain (channelizer connection and HPA) can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required by §25.207 of the Commission's rules.

A.7 Compliance with PFD Limits (§25.146(a)(1))

O3b certifies that it will comply with all applicable Commission and ITU PFD limits as required by §25.146(a)(1). O3b did not modify the maximum PFD values in the Schedule S for beams of previously authorized satellites. O3b recognizes, however, that the PFD limits that apply in the 17.7-19.3 GHz and 19.3-19.7 GHz bands depend on the total number of satellites deployed. With a maximum of 112 satellites now considered, if O3b operated beams of these previously authorized satellites at the maximum PFD levels specified, the PFD limits for the system might be exceeded. O3b will prevent such exceedances by adjusting the downlink power as new satellites are being deployed to ensure ongoing compliance with the PFD limits specified in §25.146(a)(1).

A.8 Interference Scenarios

A.8.1 Interference with Respect to GSO Satellite Networks

O3b certifies that it will comply with all applicable Commission and ITU EPFD limits as required by §25.146(a)(2).

A.8.2 Interference with Respect to NGSO Satellite Systems

According to ITU procedures (No. 9.12), for nearly all of the Ka-band frequency ranges to be used by O3b, coordination among NGSO systems is based on a first-come, first-served basis, depending on the ITU date priority of the relevant ITU filings. O3b is actively pursuing coordination arrangements with other NGSO satellite operators and their administrations.

Under Commission rules (§25.261), sharing among NGSO satellite systems in the 28.6-29.1 GHz uplink and 18.8-19.3 GHz downlink bands should be achievable, using whatever means can be coordinated between the operators to avoid in-line interference events, or by resorting to band segmentation in the absence of any such coordination agreement. The O3b equatorial orbit is inherently well isolated from in-line interference events with respect to other types of NGSO orbits, particularly those involving highly inclined orbit geometries. In the case of the inclined MEO and LEO satellites, these are relatively low-density configurations, which will limit the likelihood of having in-line interference events. In the rare case of co-frequency, co-coverage in-line interference events with either the equatorial or inclined satellites, O3b believes coordination can be achieved based on time-varying protection thresholds similar to a sun or rain outage event or, if all else fails, a band segmentation scheme with respect to the other NGSO systems as contemplated by §25.261.

A.8.3 Interference with Respect to Terrestrial Networks in the 17.8-18.3 GHz and 19.3-19.7 GHz Bands

O3b seeks U.S. market access for the new satellites to use the 17.8-18.3 GHz and 19.3-19.7 GHz bands, which are allocated on a primary or co-primary basis, according to the U.S. Table of Frequency Allocations, to terrestrial fixed service (FS) systems. O3b is seeking authority to use the 17.8-19.3 GHz band pursuant to the secondary FCC allocation in that spectrum and is seeking to use the 19.3-19.7 GHz band for MSS feeder links on a co-primary basis with FS networks. As discussed above, transmissions from the proposed O3b satellites in the space-to-Earth direction will comply with applicable ITU and Commission PFD limits designed to protect FS receivers in the 17.8-18.3 GHz and 19.3-19.7 GHz bands from harmful interference.

A.8.4 Interference with Respect to Terrestrial Networks in the 27.5-28.35 GHz Band

The O3b system also uses the 27.5-28.35 GHz band in which the Upper Microwave Flexible Use Service (UMFUS) has a primary allocation subject to measures intended to preserve access to this spectrum for FSS operations, which retain a secondary allocation. O3b is licensed for earth stations with grandfathered status in this spectrum, and future O3b earth station applications will conform to the new regulatory framework applicable to this band segment.

A.8.5 Interference with Respect to MSS Feeder Links in the 19.3-19.7 GHz and 29.1-29.5 GHz Bands

O3b proposes to use the 19.3-19.7 GHz and 29.1-29.5 GHz bands for MSS feeder link operations. Iridium operates a licensed NGSO satellite system of approximately 70 low-earth orbit satellites with user links in the L-band at a nominal circular altitude of 780 km that uses 200 MHz of the Ka-band in each direction (19.4-19.6 GHz and 29.1-29.3 GHz) for its feeder links, using RHCP for uplinks and LHCP for downlinks. O3b is in active coordination discussions with Iridium and has presented analyses to demonstrate the compatibility of its planned operations with those of Iridium due to factors including the angular separation between the O3b satellites and Iridium satellites. Pursuant to §25.203(k), O3b understands that in order to receive authorization by the Commission to operate earth stations in the band segments Iridium uses, O3b will have to demonstrate that it will not cause unacceptable interference to the Iridium system or certify that it will conform to established coordination agreements.

A.8.6 Interference from Satellite-to-Satellite Links

O3b proposes to use the 17.8-18.6 GHz, 18.8-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz bands for satellite-to-satellite links. The transmissions in the space-to-Earth direction from O3b's MEO satellites will be within the existing MEO satellite emission envelopes and will comply with relevant PFD limits, EPFD limits, and/or existing coordination agreements, as discussed above. Because the technical characteristics of the MEO-to-LEO transmissions will conform to the operational parameters of other MEO downlink signals, the interference profile will be the same. In the 19.3-19.7 GHz frequency band, the MEO-to-LEO transmissions will be subject to No. **22.2** of the ITU Radio Regulations, which requires NGSO operators to protect GSO networks. NGSO systems using this frequency band for MSS FLs will also be protected, as O3b's MEO-to-LEO transmissions would use lower power (due to lower path loss) and will be time-varying in nature when compared to MEO-to-Earth transmissions communicating with MSS FL earth stations. These factors decrease the potential for interference from the MEO-to-LEO transmissions into other NGSO MSS FL earth stations.

In the Earth-to-space direction, LEO transmissions to GSO satellites will not create harmful interference into GSO satellite networks adjacent to the target GSO satellite or into other NGSO systems. In both cases, the potential for interference due to the LEO satellite transmissions is equal to or lower than the interference potential from an earth station on the ground transmitting in these bands. This is due to the LEO transmit antenna having comparable performance to the earth station antenna but using lower input power spectral density given the shorter distance and decreased path loss for a link originating from a LEO satellite rather than a terminal on the ground.

In these circumstances, the off-axis power flux density levels at the GSO of a LEO-to-GSO signal will be no greater than those that would be produced by a ground-based antenna operating in compliance with the off-axis EIRP density limits contained in §25.218(i). O3b's LEO satellites providing LEO-to-GSO links will have the same tracking, monitoring, and network control capabilities as those for ESIMs specified in §25.228 of the Commission's rules.

The LEO-to-MEO scenario is comparable to the LEO-to-GSO links because the antenna onboard the LEO satellites will have the same or comparable performance and behavior as a ground-based antenna transmitting to the MEO satellites but will employ lower input power given the reduced path loss. Due to this decrease in power, the PFD from the LEO-to-MEO link received by satellites in other NGSO systems operating in this band would be no higher than for a signal originating from Earth. O3b commits to meeting EPFD(up) limits in the portions of the Ka-band where these limits apply and adhering to coordination agreements with other GSO networks and NGSO systems in the portions of the Ka-band where coordination applies.

The LEO-to-GSO and LEO-to-MEO transmissions will not create harmful interference into terrestrial services in the 27.5-28.35 GHz frequency band. These LEO satellite transmissions are directed away from Earth, meaning that any energy radiating towards the Earth's surface would be from the backlobe of the antenna, which has lower gain relative to peak. The ITU has studied a similar issue in this frequency band and decided to adopt PFD limits to protect terrestrial services. O3b certifies that these PFD limits will be met on the Earth's surface to protect terrestrial services.

A.9 ITU Filings for O3b

The O3b system is registered with the ITU under the administrations of the United Kingdom (O3B-series) and France (MCSAT-2 HEO) on O3b's behalf. These satellite systems have been submitted for coordination at the ITU.

A.10 Coordination with U.S. Government Satellite Networks (Footnote US334 to U.S. Table of Frequency Allocations)

Footnote US334 requires coordination of the O3b system with U.S. government satellite networks, both GSO and NGSO. For the frequencies used on the in-orbit O3b satellites, coordination has been completed with U.S. government satellite networks (including both GSO and NGSO networks, as well as their associated specific earth stations filed under 9.7A and 9.7B of the ITU Radio Regulations through other administrations). In frequency bands not covered by the existing coordination, O3b will pursue a revision of the existing agreement but in the interim will conform operations in these bands to the terms of the existing agreement.

A.11 Orbital Debris (§25.114(d)(14))

This matter is addressed in the legal narrative.

A.12 Schedule S Notes

The following notes are intended to clarify the information contained in the Schedule S:

a) In Orbital Plane 2, there are 4 spare satellites at nominal mean anomalies of 1, 91, 181 and 271 degrees in longitude. These spares are associated with the 20 active in-orbit satellites.
b) The receive beams CMD3, CMD4, CMD5 and CMD6 (for command and control) do not have antenna gain contours attached to the Schedule S as they are near-omni directional, wide angle antennas whose relative gain contours do not intersect with the surface of the Earth below approximately −4 dB.
c) The transmit beams TLM3, TLM4, TLM5 and TLM6 (for telemetry and tracking) do not have antenna gain contours attached to the Schedule S as they are near-omni directional, wide angle antennas whose relative gain contours do not intersect with the surface of the Earth below approximately −4 dB.
d) As discussed above, beam information for the LEO-to-MEO and LEO-to-GSO satellite-to-satellite links cannot be entered into the Schedule S, and GXT files are not provided for these beams because their contours fall entirely beyond the Earth's surface.

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/ Zachary Rosenbaum
Zachary Rosenbaum
1129 20th Street, NW, Suite 1000
Washington, DC 20036
(202) 813-4021

May 26, 2020

ATTACHMENT 1:
INFORMATION CONCERNING SHAREHOLDERS, OFFICERS, AND DIRECTORS
Response to Form 312, Question 40

Ownership Information

The applicant, O3b Limited, is a Jersey, Channel Islands company and an indirect, wholly-owned subsidiary of SES S.A. ("SES"). The intermediate companies in the ownership chain are O3b Networks Limited, also a Jersey, Channel Islands company, SES Finance Services AG ("SES Finance"), a Switzerland company, SES Asia S.A., a Luxembourg company, and SES Holdings (Netherlands) BV, a Netherlands company. See attached organizational chart.

SES is a Luxembourg company that in addition to O3b Limited, wholly owns SES ASTRA (formerly Société Européenne des Satellites S.A.), New Skies Satellites B.V., and SES Americom, Inc. Through its subsidiaries and affiliates, SES engages in the provision of satellite services in North and South America, Europe, Africa and Asia.

The registered office address for O3b Limited and O3b Networks Limited is:

First Floor, Liberation Station
Esplanade
St Helier, Jersey JE2 3AS
Channel Islands

The registered office address for SES Finance is:

Acton Treuhand AG
Gotthardstrasse 28, CH-6302 Zug
Switzerland

The registered office address for SES Holdings (Netherlands) BV is:

Rooseveltplantsoen 4
2517 KR The Hague
The Netherlands

The registered office address for SES and SES Asia S.A. is:

L-6815 Château de Betzdorf
Luxembourg

The names, addresses, and citizenship of stockholders owning of record and/or voting 10 percent or more of SES voting stock are:

The Etat du Grand Duché de Luxembourg (the "State of Luxembourg") – and Banque et Caisse d'Epargne de l'Etat ("BCEE") and Société Nationale de Crédit et d'Investissement ("SNCI"), each of which is an institution created by act of the Luxembourg Parliament and 100% owned by the State of Luxembourg – hold Class B shares of SES representing a combined effective economic interest of 16.67% and effective voting power of 33.33%. In addition, in 2007 and 2008 these entities received SES Fiduciary Deposit Receipts ("FDRs"), each of which represents one Class A share of SES. The FDRs distributed to these entities represented a combined 5.43% economic interest and effective voting power of 4.35%. SES does not know how many of these FDRs, if any, are still held by the Class B shareholders, as they are entitled to sell the FDRs without notice to SES. The principal business of both BCEE and SNCI is financial services. The addresses of BCEE and SNCI are as follows:

Banque et Caisse d'Epargne de l'Etat
1, place de Metz
L-2954 Luxembourg

Société Nationale de Crédit et d'Investissement
7, rue du Saint Esprit
BP 1207, L-1012 Luxembourg

The address for the State of Luxembourg is Ministry of State, 4 rue de la Congrégation, L-2910, Luxembourg.

Officers and Directors

The following individuals serve as officers and directors of O3b Limited and can be contacted at the O3b Limited address listed above:

Name	**Title**	**Nationality**
Steve Collar	Director, CEO	U.K.
Mandy Andrade	Director	U.K.
Jonathan Leckie	Company Secretary	Australia

ORGANIZATIONAL CHART

This is a simplified chart depicting the O3b Limited ownership structure. The percentages shown reflect equity interests on a fully diluted basis.