**Before the**
**Federal Communications Commission**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
| | ) | |
| O3B LIMITED | ) | IBFS File No. SES-MOD-20190207-00084 |
| | ) | Call Sign E100088 |
| Application to Modify License for Fixed Earth Station in Haleiwa, Hawaii | ) | |

## OPPOSITION OF O3B LIMITED

O3b Limited ("O3b") opposes the petition to deny filed by Iridium Constellation LLC ("Iridium")[1] regarding the above-captioned O3b application to modify its license for a gateway earth station in Haleiwa, Hawaii.[2] As discussed below, granting O3b's request to operate in the 29.1-29.3 GHz and 19.4-19.6 GHz frequencies used by Iridium for mobile-satellite service ("MSS") feeder links pending completion of coordination with Iridium is fully consistent with Commission rules and policies and poses no threat to Iridium's network. Moreover, there is no basis for Iridium's suggestion that O3b must obtain Commission authority for MSS user terminals prior to seeking to add MSS feeder link frequencies. Accordingly, the Commission should dismiss the Iridium Petition and grant the Modification to allow O3b to use additional spectrum bands for which O3b's non-geostationary orbit ("NGSO") satellite network has received U.S. market access authority.[3]

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[1] Petition to Deny of Iridium Constellation LLC, Call Sign E100088, File No. SES-MOD-20190207-00084, filed Sept. 20, 2019 (the "Iridium Petition").

[2] O3b Limited, Call Sign E100088, File No. SES-MOD-20190207-00084 (the "Modification").

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

## I. COMMISSION RULES DO NOT REQUIRE COMPLETION OF COORDINATION PRIOR TO GRANT OF THE MODIFICATION

As Iridium observes, O3b has repeatedly stated its commitment to coordinating with Iridium,[4] but Iridium's claims that such coordination must be finalized before O3b can even request operating authority are unfounded. Instead, Commission rules contemplate that coordination discussions can occur in parallel with the application process or after a license is awarded. Moreover, the technical analysis O3b performed regarding compatibility of co-frequency operations by Iridium and O3b, attached as Annex 1 hereto, shows that O3b's MSS feeder link transmissions will have no discernible effect on Iridium's link performance, suggesting that completing coordination should be straightforward.

Iridium's assertion that a finalized coordination agreement is a prerequisite to seeking authority for MSS gateway operations stems from Iridium's erroneous reading of Commission rules. Iridium's arguments about the adequacy of the O3b application rely on Section 25.203(k) of the Commission's rules[5] and largely ignore the provisions of Section 25.250. This choice is puzzling to say the least, as Section 25.250 explicitly applies here – the regulation is entitled "Sharing between NGSO MSS Feeder links Earth Stations in the 19.3-19.7 GHz and 29.1-29.5 GHz Bands."[6] Commission precedent confirms that Section 25.250 is the relevant provision governing O3b applications to use MSS feeder link spectrum. In granting O3b's satellite network U.S. market access in these bands over Iridium's objections, the Commission emphasized that "coordination pursuant to Section 25.250 will be required between O3b's NGSO MSS feeder

[4] Iridium Petition at 4 & n.7, *citing* Modification, Exhibit 1 at 3.

[5] Iridium Petition at 3-5, *citing* 47 C.F.R. § 25.203(k).

[6] 47 C.F.R. § 25.250.

links in these bands and any previously authorized NGSO MSS systems not included in this processing round, including the Iridium system."[7]

In contrast, the Commission's Market Access Grant does not refer to Section 25.203(k) at all, and the language of that provision does not support Iridium's assumption that its requirements apply to the Modification. Specifically, the scope of Section 25.203(k) is limited to earth station applications in "a shared frequency band."[8] In context, that phrase refers to situations involving sharing between different services with allocations in the spectrum,[9] not to a case like this one where the parties both are authorized to operate in the same service – NGSO MSS feeder links.

Thus, there can be no legitimate question that Section 25.250 applies to the Modification, and the better reading of Section 25.203(k) is that it does not govern sharing among NGSO MSS feeder link operators. Nor is it possible to reasonably take the view that both provisions are applicable, as there are significant inconsistencies between them. Although Section 25.250 cross-references Section 25.203, no specific subsection of the latter rule is mentioned. Section 25.250 unequivocally states that "[l]icensees of NGSO MSS feeder link earth stations separated by

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[7] Market Access Grant, 33 FCC Rcd at 5517, ¶ 23. *See also id.* at 5525, ¶ 46(c) ("Until any coordination agreement required under Section 25.250 is obtained, transmissions to or from any earth station located in U.S. territory shall not be conducted in [the 19.4-19.6 and 29.1-29.3 GHz] frequency bands.").

[8] 47 C.F.R. § 25.203(k).

[9] For example, Telesat submitted a showing under Section 25.203(k) in support of its application to communicate with a geostationary orbit ("GSO") satellite using the 29.25-29.3 GHz band segment that is allocated on a co-primary basis to GSO operations and NGSO MSS feeder links. *See Telesat Network Services, Inc.*, Call Sign E150128, File No. SES-AMD-20151209-00922, granted Jan. 11, 2016. Elsewhere in Section 25.203, the term "shared" is used to refer to spectrum bands in which satellite and terrestrial services have equal rights. *See* 47 C.F.R. § 25.203(a), (b).

800 km or less are required to coordinate."[10] As Iridium recognizes, however, Section 25.203(k) allows an applicant either to certify that its operations "will conform to established coordination agreements" or to demonstrate "that its proposed earth station will not cause unacceptable interference to any other satellite network that is authorized to operate in the same frequency band."[11] Such a technical showing under Section 25.203(k) would relieve an applicant of any coordination obligation, regardless of the geographical separation between two feeder link sites, nullifying the language of Section 25.250. Indeed, if the Commission accepts Iridium's claim that Section 25.203(k) controls here, O3b asks that the Commission accept the technical analysis in Annex 1 as a showing that operations of the O3b Hawaii gateway will not cause unacceptable interference to Iridium and release O3b from any further requirement to coordinate the operations described in the Modification with Iridium.

On the other hand, if the Commission shares O3b's view that Section 25.250 rather than Section 25.203(k) is the controlling regulatory provision for assessing the Modification, the Commission must conclude that O3b's decision to apply for an NGSO MSS feeder link site while coordination discussions remain pending is fully compliant with the rules. As noted above, Section 25.250 imposes a coordination duty when feeder link sites are within 800 km of each other but does not state when that coordination must occur. If anything, the rule's reference to licensees rather than applicants suggests that the Commission expressly anticipated that coordination could appropriately take place after authority was granted. Certainly nothing in the rule indicates that coordination needs to be complete before a feeder link earth station application can be submitted, as instead of requiring that confirmation of coordination be supplied as part of

[10] 47 C.F.R. § 25.250(b).

[11] Iridium Petition at 3, *citing* 47 C.F.R. § 25.203(k).

an application, the rule simply states that the "results of the coordination shall be reported to the Commission."[12] In short, Iridium's accusation that O3b has "jumped the gun" by seeking operating authority for NGSO MSS feeder link spectrum prior to reaching an agreement with Iridium[13] is unsupported by applicable rules and precedent.

## II. O3B'S PROPOSED OPERATIONS ARE FULLY COMPATIBLE WITH IRIDIUM'S NGSO MSS FEEDER LINKS

O3b appreciates Iridium's commitment to coordinate in good faith,[14] and O3b's analysis of the interference risks suggests that there is no technical obstacle to a speedy and satisfactory conclusion to coordination discussions despite the close proximity of the O3b gateway to an existing Iridium site in Hawaii. Iridium accurately observes that O3b had previously anticipated it would need to rely on geographic separation between its NGSO MSS feeder link locations and the established Iridium gateways.[15] The O3b calculations presented in Annex 1, however, demonstrate that under the specific conditions for the Hawaii location, O3b's planned operations would not significantly alter Iridium's link performance even if O3b's antennas were installed at the Iridium gateway site. The data show that the major factors affecting Iridium transmissions to and from its Hawaii gateway are rain and noise, and that the addition of interference from O3b during the rare and brief in-line events between the two constellations has a negligible impact on overall performance for Iridium.

In its analysis, O3b used techniques that have been validated and accepted in coordination discussions between O3b and NGSO systems using other portions of the Ka-band

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[12] 47 C.F.R. § 25.250(b).

[13] Iridium Petition at 4.

[14] *Id*.

[15] *Id*. at 4 & n.8.

spectrum. O3b performed a simulation using known characteristics of the O3b network and assumed characteristics for Iridium based on publicly available data for the Iridium space and earth station operations. As noted in Annex 1, the analysis could be refined by using real-world data regarding the Iridium system. However, although O3b has actively been pursuing coordination with Iridium, the non-disclosure agreement intended to lay the groundwork for the exchange of operational data has not yet been executed. For purposes of the analysis, O3b ignored the 17 kilometer separation between the O3b and Iridium gateway sites and simply assumed the ground stations were collocated.

The graphs in Annex 1 depict the impact on availability and throughput in both the uplink and downlink directions. In each case, the plot of the relevant carrier to noise ("C/N") ratio is virtually indistinguishable from the plot of the carrier to noise and interference ("C/N+I") ratio. The calculated effect on availability attributable to interference from O3b is 0% in both the uplink and downlink directions, and the throughput impacts are minimal: 0.003% for the downlink and 0.007% for the uplink.[16] These values demonstrate that activation of the proposed O3b NGSO MSS feeder link operations in Haleiwa will have no meaningful effect on Iridium's network. As Iridium has confirmed its readiness to coordinate and O3b remains committed to the coordination process, the compatibility showing in Annex 1 suggests that the parties should be able to quickly reach an agreement that can be reported to the Commission under Section 25.250.

## III. COMMISSION AUTHORITY FOR MSS USER TERMINALS IS NOT A PREREQUISITE FOR SEEKING A FEEDER LINK LICENSE

Finally, there is no basis for Iridium's assertion that the Modification lacks an "essential element" because O3b has not yet obtained Commission authority to operate MSS user

[16] *See* Annex 1 at 3-5.

terminals.[17] Iridium cites no precedent in support of its claim that operators are barred from requesting feeder links until a user terminal license is in place, and O3b is not aware of any Commission decisions suggesting such a sequencing requirement. To the contrary, O3b sought and was granted Commission licenses for Haleiwa and other U.S. gateway earth stations before O3b applied for any user terminal authority in the Ka-band fixed-satellite service.[18] Moreover, the Haleiwa gateway could be used to support customer MSS operations outside the United States, in which case O3b might never need to seek a Commission license for MSS terminals. Accordingly, Iridium's wholly unsupported claim that a prior Commission license or application for MSS customer earth stations is a necessary precondition to seeking MSS feeder link authority should be dismissed as frivolous.

## IV. CONCLUSION

For the foregoing reasons, authorizing O3b to use the additional spectrum described in the Modification subject to completion of coordination is fully consistent with Commission rules

[17] Iridium Petition at 5-6.

[18] *See, e.g., O3b Limited,* Call Sign E100088, File No. SES-LIC-20141022-00809, Narrative at 4-5 (seeking authority to establish the Haleiwa gateway and stating that applications will be filed in the future with the Commission for customer terminals), granted June 5, 2015.

and poses no threat to the performance of Iridium's network. The Commission should therefore dismiss the Iridium Petition and promptly grant the Modification.

Respectfully submitted,

**O3b LIMITED**


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# ANNEX 1: Compatibility study between Iridium and O3b Ka-band NGSO systems

## 1. Introduction

This compatibility study considers the dynamic likelihood and magnitude of interference into the Iridium NGSO system and O3b NGSO system both operating or planned to operate in portions of the Ka-band.

## 2. Methodology

O3b has applied a methodology based upon Recommendation ITU-R S.1323, which describes the permissible levels of interference from NGSO systems. This method is applied here to determine what interference levels are permissible between the two NGSO systems in terms of an increase in unavailability and decrease in achievable capacity. O3b also applied a methodology based upon Recommendation ITU-R S.2131 (pending simultaneous approval and adoption) which describes a method for determining the loss in spectral efficiency of systems employing adaptive coding and modulation (ACM). We treat this loss in spectral efficiency to mean a loss in available capacity.

## 3. Orbital parameters

### 3.1. Iridium

The simulation considers the orbital parameters from the HIBLEO-2FL2 satellite system. The following table contains the relevant orbital information used in the simulation.

| Parameter | 66 satellites |
|---|---|
| Number of planes | 6 |
| Number of satellites per plane | 11 |
| Number of satellites per sub-constellation | 66 |
| Orbit altitude (km) | 775 |
| Orbit inclination (deg) | 86.4 |
| Minimum elevation angle (deg) | 10 |
| Number of co-frequency satellites | 2 |

### 3.2. O3b

The O3b NGSO system has two sub-configurations operating simultaneously as presented in the following table.

| Parameter | Equatorial sub-configuration | Inclined sub-configuration |
|---|---|---|
| Number of planes | 1 | 2 |
| Number of satellites per orbit | 24* | 5 |
| Number of satellites per sub-constellation | 24 | 10 |
| Total number of satellites | 34 | |
| Orbit altitude (km) | 8062 | 8062 |
| Orbit inclination (deg) | 0 | 70 |
| Minimum elevation angle (deg) | 10 | 10 |
| Number of co-frequency satellites | 2 | |

* Note that O3b only has requested market access for 12 satellites in the equatorial orbit, but this analysis considers additional interference potential of a future-looking constellation.

# 4. Emission parameters

## 4.1. Iridium

Iridium has provided representative emission characteristics in its FCC applications. The table below shows an emission used in the simulation derived from Iridium's earth station license (SES-MOD-20170208-00137) and space station application (SAT-MOD-20131227-00148).

| Downlink | Value | Notes |
|---|---|---|
| Peak EIRP (dBW) | 28 | From Schedule S |
| Carrier bandwidth (MHz) | 15.453 | From Schedule S |
| EIRP density (dBW/Hz) | −43.9 | Calculated |
| RX ES size (m) | 3 | From ES license |
| RX ES pattern | S.580 | Mainlobe modeled using ITU APL |
| RX ES noise temp (K) | 731 | HIBLEO-2FL2 AP4 data |
| **Uplink** | | |
| Peak EIRP (dBW) | 58.8 | From Schedule S |
| Carrier bandwidth (MHz) | 15.453 | From Schedule S |
| Input PSD (dBW/Hz) | −70.5 | Calculated |
| TX ES size (m) | 3 | From ES license |
| TX ES pattern | S.580 | Mainlobe modeled using ITU APL |
| RX Sat gain (dBi) | 32.5 | From Schedule S |
| RX Sat noise temp (K) | 940 | From Schedule S |

## 4.2. O3b

O3b has representative emission characteristics and antenna parameters in its ITU filings. For this analysis, two example links were considered using a 7.3m antenna as shown the table below.

| Downlink | Value | Notes |
|---|---|---|
| EIRP density (dBW/Hz) | −39.3 | Operational |
| RX ES size (m) | 7.3 | Operational |
| RX ES pattern | S.580 | Mainlobe modeled using ITU APL |
| RX ES noise temp (K) | 149.4 | Operational |
| **Uplink** | | |
| Input PSD (dBW/Hz) | -76.5 | Operational |
| TX ES size (m) | 7.3 | Operational |
| TX ES pattern | S.580 | Mainlobe modeled using ITU APL |
| RX Sat gain (dBi) | 37.6 | Operational |
| RX Sat noise temp (K) | 600 | Operational |

# 5. Simulation setup and use cases

For this dynamic analysis, O3b used in-house software to model and simulate the two NGSO systems. O3b assumed that the satellite earth stations are collocated and will randomly track the number of co-frequency satellites (in this case, 2) from the total number of visible satellites at each time step. Based on other coordination efforts with NGSO systems, O3b believes this approach provides a representative analysis without needing to exchange potentially proprietary CONOP (concept of operation) information. However, alternative tracking strategies that better represent real-world operations of either NGSO system could be considered.

Each simulation time step is one second, and the simulation duration is 10 days. At each time step the C/N faded, C/I faded and C/N+I faded are collected. The C/N+I faded assumes that the victim and interfering link will experience the same propagation path conditions. No power control is assumed to combat link fading. The fading losses are determined using the ITU P-series Recommendations for rain, cloud, gas and scintillation attenuations.

## 6. Results

The graphs in Annex 1 illustrate the likelihood and magnitude of the interference from the O3b NGSO system in the downlink and uplink directions. The two graphs for each direction show the two criteria: increase in unavailability and decrease in spectral efficiency or capacity.

In Figures 1 and 3, considering the unavailability increase criteria, the blue line showing the C/N faded and the yellow line for the C/N+I CDF (cumulative distribution function) are nearly the same curve, appearing as a single green line that makes it difficult to distinguish the two separately. This indicates the total C/N+I is dominated by C/N, and is not significantly altered by the interference from O3b. For this analysis, O3b has assumed a minimum C/N for the Iridium link to be −3 dB, corresponding to a modem implementing a DVB-S2 coding scheme which has a minimum C/N (to maintain the link) of around −3 dB.

Very similarly, in Figures 2 and 4, considering the spectral efficiency decrease criteria, the solid blue C/N and the dashed red C/N+I CDF curves are nearly the same curve. This again indicates that the Iridium link performance is dominated by rain and noise effects rather than interference from O3b. The time-weighted average loss in throughput in the downlink is 0.003% and in the uplink 0.007%.

## 7. Summary

O3b has performed an analysis that considers the likelihood and magnitude of interference from the O3b NGSO system into the Iridium system for an earth station collocated in Hawaii. The Iridium link performance is defined by two criteria: an increase in unavailability and a decrease in spectral efficiency. The analysis demonstrates that the Iridium link performance is dominated by rain and noise rather than interference from O3b.

# Output graphs

Figure 1. Iridium downlink unavailability check

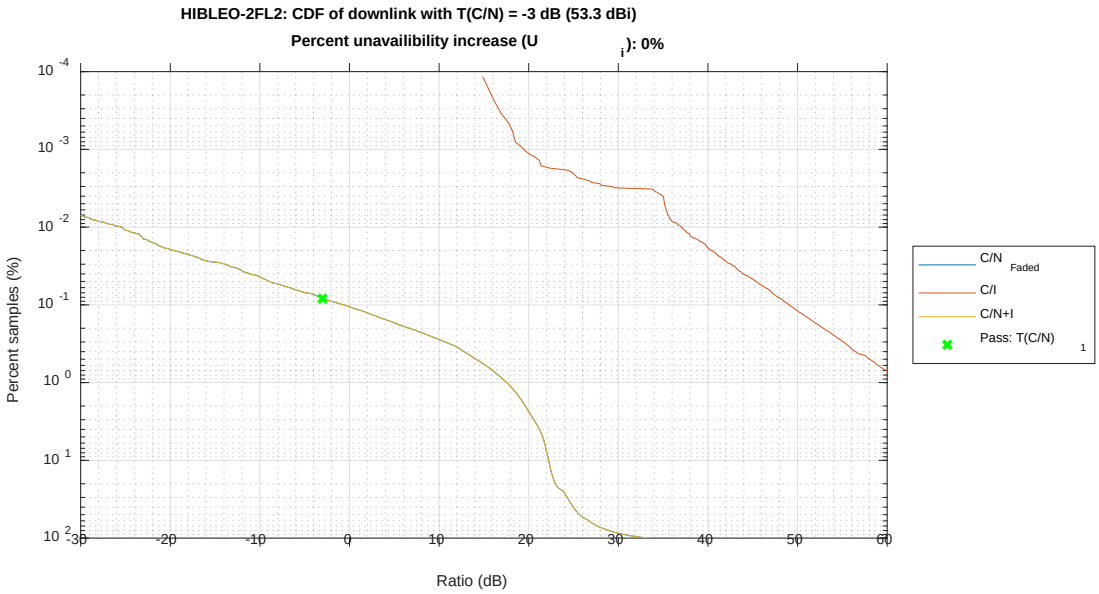



Figure 2. Iridium downlink capacity check

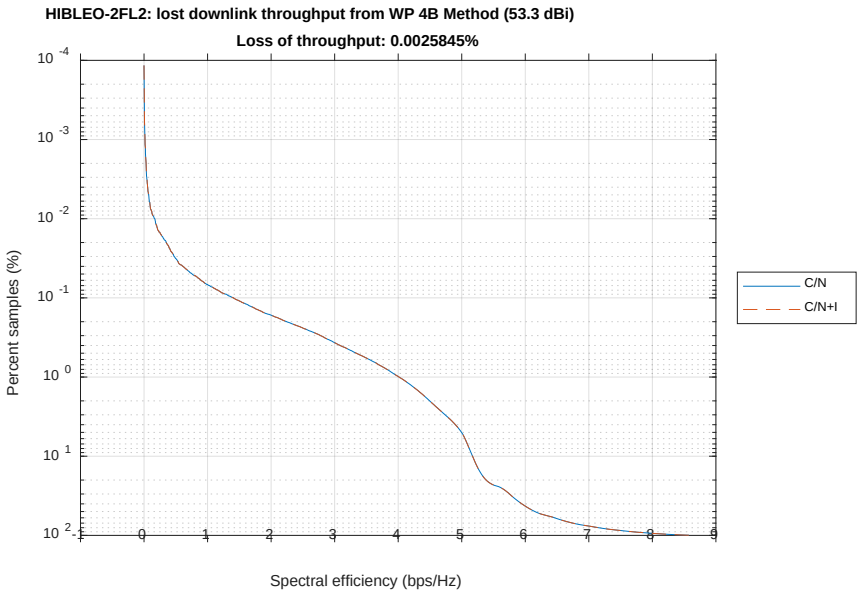


Figure 3. Iridium uplink unavailability check

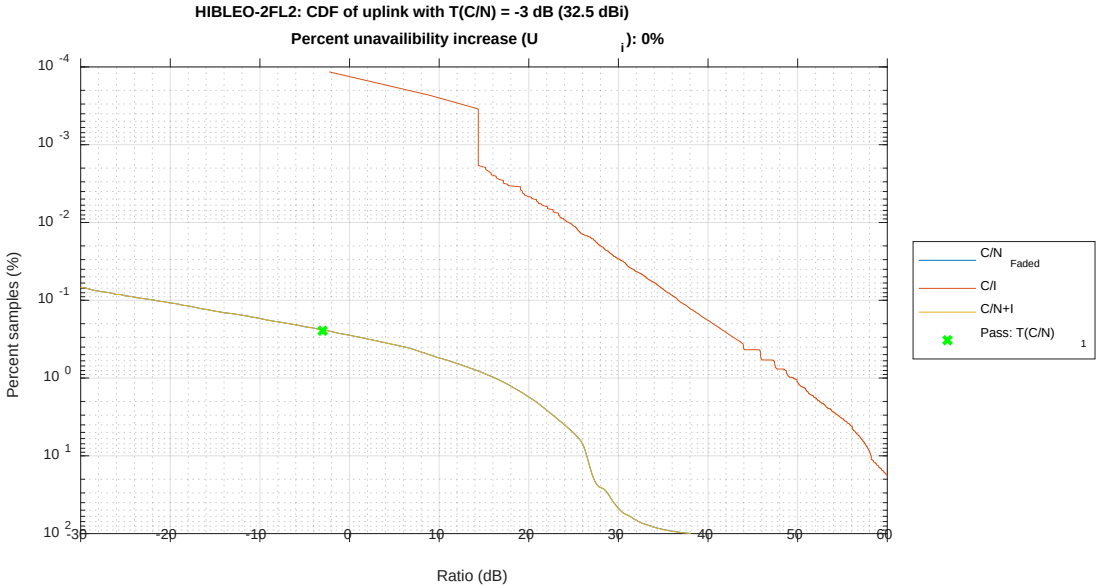
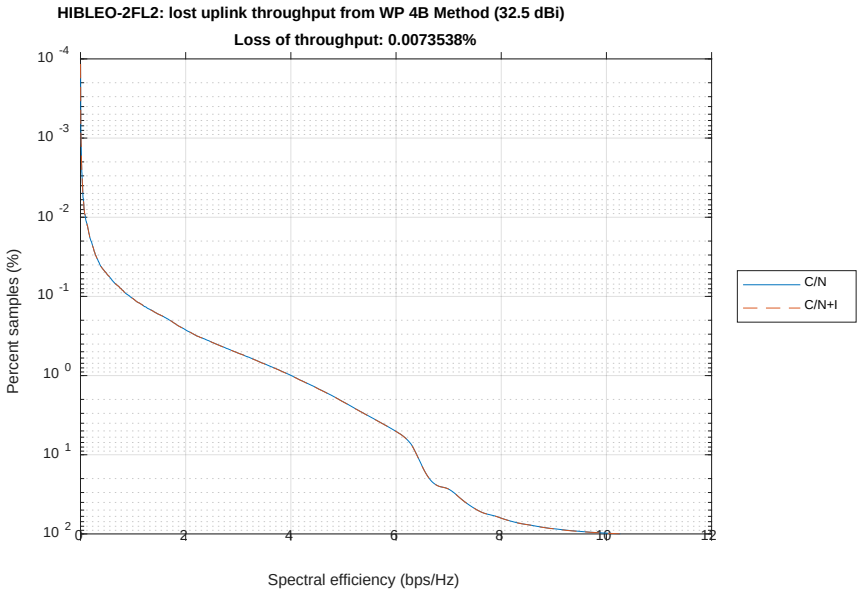



Figure 4. Iridium uplink capacity check



## DECLARATION

I, Zachary Rosenbaum, hereby certify under penalty of perjury that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing Annex 1; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the annex and that it is complete and accurate to the best of my knowledge, information and belief.

/*s*/

Head of Spectrum Management
and Development Americas and
NGSO, SES

Dated: 3 October 2019

**CERTIFICATE OF SERVICE**

I hereby certify that on this 3rd day of October, 2019, I caused to be served a true copy of the foregoing "Opposition of O3b Limited" by first class mail, postage prepaid, upon the following:

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