Before the

FEDERAL COMMUNCATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
	)	
Application of Space Exploration Holdings, LLC	)	File No. SAT-MOD-20181108-00083
For Modification of Authorization for the	)	
SpaceX NGSO Satellite System	)	

To: The International Bureau

REPLY COMMENTS OF KEPLER COMMUNICATIONS INC. TO CONSOLIDATED OPPOSITION OF SPACE EXPLORATION HOLDINGS, LLC

Kepler Communications Inc. ("Kepler") hereby submits[1] these comments in reply to the consolidated response[2] of Space Exploration Holdings, LLC ("SpaceX") to the separate petitions of Kepler and the Commercial Smallsat Spectrum Management Association (CSSMA),[3] wherein SpaceX opposed Kepler's Petition to conditionally deny the above-referenced application.[4] The Modification requested, *inter alia*, that 1,584 satellites currently authorized at 1,150 km be moved to an altitude of 550 km, and that SpaceX expand its gateway transmissions with these satellites into presently-unauthorized frequencies in Ku-band. In its Petition, Kepler raised its concern that an approval of the Modification could negatively affect both the physical and radio interference environment in the proposed 550 km region based on the influx of a significant number of new

[1] This document was originally submitted under IBFS File No. SAT-LOA-20170726-00110 on Feb. 22, 2019 and has been resubmitted under IBFS File No. SAT-MOD-20181108-00083 for clarity.

[2] *See* Space Exploration Holdings, LLC. Consolidated Opposition to Petitions and Response to Comments of Space Exploration Satellite Holdings, LLC, File No. SAT-MOD-20181108-00083 (Feb. 11, 2019) ("Response")

[3] *See* Kepler Communications Inc., Comments and Conditional Petition to Deny of Kepler Communications Inc., IBFS File No. SAT-MOD-20181108-00083 (Jan. 29, 2019) ("Petition"); *See also* CSSMA, Comments and Petition to Defer, IBFS File No. SAT-MOD-20181108-00083 (Jan. 29, 2019).

[4] *See* Application for Modification of Authorization for the SpaceX NGSO Satellite System, IBFS File No. SAT-MOD-20181108-00083 (Nov. 8, 2018) ("Modification").

large satellites, the increased use of Ku-band, and the insufficient analysis provided by SpaceX surrounding the effects of these changes. In its Response, SpaceX made the claim that the material already provided by the Modification is sufficient for the combined petitioner's concerns, and that they should thus be dismissed. Kepler believes that neither the Modification, nor the Response have addressed its concerns, nor those of the Commercial Smallsat Spectrum Management Association (CSSMA) to which Kepler endorses.

I. CONCERNS REGARDING INCREASED ORBITAL COLLISION RISK

Kepler's physical coordination concerns are in alignment with those of the CSSMA and it formally supports the position taken in the CSSMA's respective comments, including its petition to defer, to which Kepler hereby directs the reader.[5] The singular exception to this alignment is that Kepler has, with its own Petition, formally taken a position on whether the Bureau should grant the Modification whereas the CSSMA has not.

II. CONCERNS REGARDING NEW INTERFERENCE IN KU-BAND

In its Petition, Kepler requested that SpaceX should be required to "accept all additional interference into its system received as a result of the modifications proposed in full, and that it must protect all ground and space stations that would be newly victimized by the proposed changes", and that to do otherwise would place an unjust burden on Kepler to accommodate the proposed modifications.[6] In its Response, SpaceX did not raise opposition to Kepler's request that it "accept all additional interference to its system received as a result of [its] modifications", and thus Kepler will spend no further time on this point. With regards to the protection of Kepler's

[5] *See* CSSMA, Joint Reply, IBFS File No. SAT-MOD-20181108-00083 (Feb. 22, 2019). *See also* CSSMA Petition to Defer, *supra* at n. 2.
[6] *See* Petition at 5.

ground stations, SpaceX reiterated the claim made in its Modification that its newly requested use of Ku-band for gateway transmissions would not increase the overall interference to other NGSO FSS systems, and asserted specifically that it "should have no material effect on Kepler's operations", though it did so without providing sufficient detail to support its claim.

SpaceX first points out that Kepler's concern for interference was not paired with an analysis of its own. Kepler notes that such a concern does not require a quantitative analysis to be valid in principle. As for the analysis provided in the Modification, Kepler highlighted that SpaceX's comparison with the IK-NGSO-A10K-1 network operating at 10,355 km was not meaningful, to which SpaceX offered no response. To reiterate, SpaceX oddly chose the IK-NGSO-A10K-1 network as its singular point of comparison to NGSO FSS systems in general, despite the fact that it is neither part of the current NGSO processing round nor is it authorized by the Commission in any other respect. SpaceX pledged that "[its] proposed modification will not increase interference to any other NGSO system operating in the bands used by SpaceX satellites" and yet, the single system around which it centered its analysis bears little similarity to many of the systems in the processing round, including Kepler's own constellation, and thus forms, on its own, an exceedingly poor basis for a comparative evaluation of interference to the many NGSO systems that share SpaceX's requested bands.[7]

Critically, SpaceX has made the claim multiple times that its system, as modified, will not increase interference more so than what would have been done under its original authorization.[8]

[7] The flaws of this analysis were further explored by others. *See* Petition to Deny or Defer of WorldVu Satellites Limited (the "OneWeb petition") at 3-4. *See also* Comments of SES Americom, Inc. and O3b Limited at 3-4 (the "SES/O3b petition").

[8] *See* Modification, Legal Narrative at i; SpaceX has broadly claimed that its modification will accomplish its objectives "without increasing overall interference". *See also* Legal Narrative at 11; SpaceX asserts that "[n]one of SpaceX's modifications will increase interference to other NGSOs, GSOs, or terrestrial wireless spectrum users". *See also* Modification, Technical Narrative at 24; "the proposed modification will not increase interference to any other NGSO system operating in the bands used by SpaceX satellites".

As much as Kepler would desire this to be true, the claim that SpaceX will cause no additional interference at all is not supported by adequate evidence, and it would require SpaceX to assure that:

1. Its wholly new utilization of Ku-band for gateway transmissions, in combination with its Ku user terminal links, will not produce an increased level of interference in the frequencies within which they operate, unless its user terminal transmissions would be proportionally reduced to compensate for those made in aggregate to and from its gateways [9]
2. It bears the responsibility for the execution of all conjunction avoidance maneuvers such that Kepler's system would not experience an undue capacity loss resulting from needing to execute those maneuvers itself [10]

In the absence of the second requirement specifically, and under its obligation to reject modifications that cause additional interference, the Commission would be forced to allow Kepler to increase its constellation size to accommodate for the reduced capacity mentioned, unless the Commission's non-interference requirements are themselves waived, however doing so would break with existing precedent and be grossly unfair for other operators. As Kepler believes it unlikely that SpaceX will cause no additional interference, its practical concern shifts to understanding the degree to which this interference will be harmful, and an analysis undertaken to explore these outcomes cannot be meaningfully completed without several key details surrounding

[9] In its Response, SpaceX claims that it "does not plan to increase the total number of beams in use at any given time and will allocate its Ku-band downlink beams between users and gateways as necessary to optimize traffic". Kepler asks that SpaceX clarify this point: does SpaceX intend to reduce its user terminal beams in Ku-band to compensate for the new use of this band for its gateway beams?

[10] *See* Kepler Communications Inc., Petition for Declaratory Ruling, IBFS File No. SAT-PDR-20161115-00114 (Nov. 15, 2016). As discussed in its application for market access, Kepler's system uses adaptive drag managed via spacecraft attitude for its avoidance maneuvers. The holding of these attitude configurations for maneuver execution necessarily requires the suspension of the satellite's commercial services, which require the spacecraft to be body-pointed to customer terminals on the ground.

SpaceX's newly requested use of Ku-band spectrum. For example, SpaceX claims that it will operate only a "handful" of gateways, but Kepler has not previously been made aware any details regarding the scope of this use. If only a "handful" of gateways are to be used, then its activity around those stations would be reasonably expected to be high, as that limited number would be required to support the full breadth of satellites active during its initial demonstration phase (and perhaps those in the final phase as well; further clarification from SpaceX is needed here), and any other operators with ground stations collocated with these gateways would therefore have especially good reason to be concerned about the new traffic. Kepler adds that SpaceX's elevation angle reduction from 40 to 25 degrees during its initial demonstration phase would act to further intensify this traffic by increasing the number of visible satellites that are permitted to transmit to any given location, and offsetting to a significant degree the improvements obtained by the reduction of total visible satellites achieved with its move to a lower altitude. To help elucidate these matters, and to protect NGSO operators and therefore the public interest,[11] the Commission should require SpaceX to provide more information to substantiate its interference claims, including, but not limited to, providing its planned number of Ku gateways, the duration of its initial deployment phase, the extent of its use of Ku-band in its final deployment phase, and the manner in which its gateway communications will occur, including how often satellites would employ their gateway transmissions, the frequency bands on which they would operate, and the method of frequency reuse across gateways and user terminals that are collocated.

For these reasons, and to alleviate the concerns of Kepler and others,[12] SpaceX should commit to accept all new interference made to its system as a result of its Modification, and act to

[11] *See* 47 CFR § 25.117(d)(2)(ii), and 47 CFR § 25.156(a) on the rejection of modifications on the basis that, if implemented, would not "serve the public interest, convenience, and necessity".
[12] *See supra* at n. 6.

protect ground stations that would be newly victimized by interference stemming from their proposed Ku-band gateway transmissions or, alternatively, provide further details to sufficiently demonstrate that these transmissions will not cause harmful interference to those ground stations. Kepler believes that a commitment to these conditions, and/or the provision of the supplementary details as described above, would act to sufficiently inform Kepler of the impacts of the Modification, and if acceptable, serve to protect the current NGSO operating environment and the overall public interest, and to align SpaceX's Modification with its existing requirements to minimize interference to other operators in the current processing round.[13]

Considering that similar interference concerns were raised by WorldVu Satellites Limited ("OneWeb") and SES Americom Inc./O3b Limited ("SES/O3b") in their own respective comments, Kepler takes a direct interest in the analysis that was provided to them by SpaceX in response,[14] and also wonders why its own concerns were not similarly addressed. However, the analysis provided to the above-mentioned parties was flawed in several respects, as it did not appear to correctly assign relevant parameters to the original and modified configurations used for its calculations. Critically, SpaceX uses gateway transmissions in the calculations that applied to its original authorization, which both does not reflect their actual authorized system and, by their own admission,[15] provides a worse assumption than if it were to use user terminals, and in doing

[13] *See* Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System; Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System Supplement, Memorandum Opinion, Order and Authorization, 33 FCC Rcd 3391 (2018).

[14] *See* Space Exploration Holdings LLC, Further Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20181108-00083 (Feb. 21, 2019). SpaceX provided an analysis centered around the proposed systems of OneWeb and SES/O3b.

[15] *See* Id. at A-1. SpaceX states "the analysis assumes that the SpaceX earth station is a gateway rather than a user terminal. This is a worst-case assumption because SpaceX satellites can transmit only one co-frequency, co-polar beam to a user terminal, but can transmit up to four such beams in the Ku-band and up to eight such beams in the Ka-band.

so, SpaceX artificially inflates the severity of the I/N values for its original configuration and thus corrupts the comparison it makes to its modified system.

Further, the analysis took great pains to ensure it was using many other worst-case assumptions that appear to favor the victim,[16] but Kepler notes these conditions only affect the absolute level of interference experienced by simulated victim stations, and in fact have zero effect on the relative difference between its original and modified configurations, serving better as a distraction to the reader than they do as a useful contribution. Therefore, Kepler believes these analyses were fundamentally misleading and do not adequately address the interference concerns of the parties to which they were addressed, many of which Kepler shares. This remains especially true in Kepler's case, as its constellation is not sufficiently similar to those proposed by OneWeb and SES/O3b to draw reliable comparisons from the analyses they were provided.[17]

Finally, Kepler wishes to echo the concerns of OneWeb regarding SpaceX's EPFD showing, and notes that to Kepler's knowledge, SpaceX does not appear to have filed its modified orbital characteristics with the ITU, and Kepler thus has no means to evaluate the full EPFD characteristics of the modified proposal, including its associated masks.

[16] *See* Id. Among others, assumptions included the use of high gain victim antennas, the exclusion of atmospheric attenuation, and the direction of mainbeams to the SpaceX systems that are closest to victim receiving antennas.

[17] For example, OneWeb's constellation uses a 45° elevation mask on uplink and downlink, and thus its potential for new interference caused by SpaceX's widening of its own elevation mask from 40° to 25° is geometrically limited. A similar type of discrepancy occurs with a comparison to O3b's system, which from an interference-area perspective appears similar to the GEO arc. Kepler's interference-area profile resembles neither of these systems, and thus cannot be compared effectively.

CONCLUSION

For the reasons discussed above, Kepler remains unpersuaded that the information already contained in the Modification is sufficient to alleviate its concerns. To alleviate these, SpaceX must:

1. Accept any new interference to its system received as a result of the changes requested by its Modification and,
2. Guarantee that Kepler earth stations will not receive additional interference as a result of its proposed use of Ku-only gateway links or, at minimum, be required to supply an analysis to adequately demonstrate that their use of the gateway links will, as they have claimed, not cause any more interference than would have been caused by their user terminals alone in that band, in accordance with the suggestions made herein.

If these conditions are met, then Kepler will be persuaded that it will not be unduly forced to modify its own system to accommodate the changes proposed by the Modification, and will have no further reason to justify its associated Petition to Deny.

Respectfully Submitted

/S/ Nickolas G. Spina

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CERTIFICATE OF SERVICE

I hereby certify that, on February 22, 2019, a true and correct copy of these comments was sent via Canada Post, first class postage prepaid, to the following:

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