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

In the Matter of	)	
	)	
Space Exploration Holdings, LLC	)	File No. SAT-MOD-20200417-00037
	)	Call Signs S2983 and S3018
Application for Modification of Authority for the SpaceX NGSO Satellite System	)	

REPLY OF SES AMERICOM, INC. AND O3B LIMITED

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SES Americom, Inc. ("SES Americom") and O3b Limited ("O3b," and collectively, "SES") submit this reply regarding the above-captioned application by Space Exploration Holdings, LLC ("SpaceX") to modify its license to launch and operate a Ku/Ka-band non-geostationary satellite orbit ("NGSO") fixed-satellite service system.[1] The SES Petition to Deny or Defer[2] demonstrates that the Application would worsen the NGSO interference environment, harm geostationary orbit ("GSO") networks, and raise space safety concerns, factors that preclude the Commission from finding that grant would serve the public interest.

In its Opposition,[3] SpaceX relies on a combination of evasions, mischaracterizations, and outright falsehoods in an attempt to distract the Commission's attention from the holes in its proposal but fails to directly rebut the SES arguments. Based on the record, the Commission should deny the Application outright, but at least must determine that the daisy chain of revisions

[1] Space Exploration Holdings, LLC, Call Signs S2983 and S3018, File No. SAT-MOD-20200417-00037 ("Application").

[2] Petition to Deny or Defer of SES Americom, Inc. and O3b Limited, Call Signs S2983 and S3018, File No. SAT-MOD-20200417-00037, filed July 13, 2020 ("SES Petition").

[3] Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, Call Signs S2983 and S3018, File No. SAT-MOD-20200417-00037, filed July 27, 2020 ("Opposition").

to the SpaceX system disqualify it from maintaining its former status in the processing round that closed in November of 2016.

INTRODUCTION AND SUMMARY

The SES Petition makes clear that both the O3b Ka-band NGSO system and the SES Ku- and Ka-band GSO networks would be harmed by the changes SpaceX seeks to its NGSO system license, which has already been modified twice.[4] The across-the-board lowering of the SpaceX satellites' altitude and the accompanying decrease in the minimum earth station elevation angle will increase both the number and duration of conjunction events between SpaceX and O3b that mandate band-splitting absent coordination. Furthermore, the facts do not support SpaceX's claims that its system as proposed will comply with applicable equivalent power flux density ("EPFD") limits designed to protect GSO systems. The record also shows that the SpaceX plan to place all of its remaining satellites in lower orbits will make physical coordination more difficult for O3b and others planning to deploy satellites near the altitudes now sought by SpaceX, with no assurances that the collision avoidance measures SpaceX identifies will be effective in practice.

Rather than confronting these valid concerns head-on, SpaceX engages in an aggressive strategy of attacking its challengers and attempting to burnish its own reputation by denigrating others. For example, SpaceX suggests that petitioners are "mostly competitors whose deployment lags behind that of SpaceX" who fail to raise any "genuine issues" but are instead engaged in "competitive gamesmanship that ultimately hurts the consumer."[5]

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[4] *See Space Exploration Holdings, LLC*, Memorandum Opinion, Order and Authorization, 33 FCC Rcd 3391 (2018); *Space Exploration Holdings, LLC*, Order and Authorization, 34 FCC Rcd 2526 (IB 2019) ("SpaceX First Modification Order"); *Space Exploration Holdings, LLC*, Order and Authorization, DA 19-1294 (IB rel. Dec. 19, 2019).

[5] Opposition at ii.

Speaking for SES, nothing could be further from the truth. O3b, which commenced commercial operations in September of 2014, is certainly not attempting to delay the SpaceX rollout to gain a timing advantage. Instead, O3b's sole objective is to protect the continuity and reliability of service to its customers in the United States and around the globe. The same goal applies on the GSO side as well, where SES Americom and its predecessors have an operating history that dates back to 1975 and have a legitimate and overriding interest in preserving service quality.

SES certainly is not motivated by any anti-SpaceX bias. To the contrary, SES has long been a supporter of SpaceX's launch business, having previously deployed six GSO satellites on SpaceX Falcon 9 rockets, and earlier this week SES selected SpaceX to launch two additional spacecraft.[6] The next-generation O3b mPOWER satellites are also slated to go up on SpaceX Falcon 9 launches.[7] Given the long relationship between SES and SpaceX, it is all the more disappointing that the SpaceX Opposition fails to seriously address the SES concerns here.

The resulting record provides no substantive response to the key elements of the SES Petition. Because the evidence shows that the changes SpaceX proposes would worsen the interference environment, the Commission cannot conclude that grant of the Application is consistent with the public interest. And the radical alterations of the SpaceX system – including an apparent antenna technology change that has not been reported to the Commission – require at a minimum that the system be considered further only as part of the NGSO processing round that closed this past May.

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[6] ULA, SpaceX win contracts to launch satellites for SES in 2022, Spaceflight Now (Aug. 6, 2020), https://spaceflightnow.com/2020/08/05/ula-spacex-win-contracts-to-launch-satellites-for-ses-in-2022/.

[7] "SES selects SpaceX for two Falcon 9 launches, Spaceflight Now (Sept. 12, 2019), https://spaceflightnow.com/2019/09/12/ses-selects-spacex-for-two-falcon-9-launches/.

SpaceX also refuses to answer the SES questions regarding the basis for its claims that it will protect GSO networks from harmful interference, disingenuously suggesting that SES is relying on outdated information. Rather than defend its space safety record or elaborate on the measures it has put in place to avoid collisions, SpaceX mounts a baseless attack on the SES orbital debris compliance record.

This pattern of obfuscation and misrepresentation profoundly undercuts SpaceX's credibility and leaves the Commission with no basis for granting the SpaceX Application.

I. THE RECORD ESTABLISHES THAT GRANT OF THE SPACEX APPLICATION WOULD HARM NGSO SYSTEMS AND IS THEREFORE CONTRARY TO THE PUBLIC INTEREST

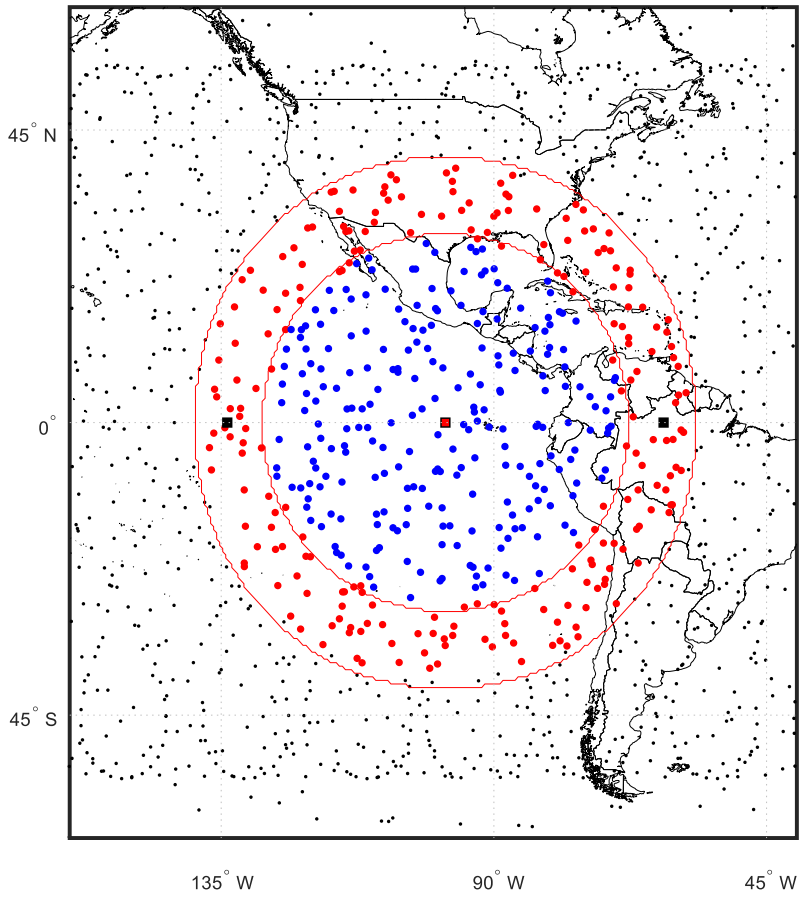
Under established Commission precedent, if "a modification would worsen the interference environment, that would be a strong indication that grant of the modification would not be in the public interest."[8] Because the facts here make clear that O3b would experience significant new interference stemming from the revised SpaceX system configuration, the Application should be denied. At the very least, the Commission must conclude that the current iteration of the SpaceX system is so substantially different from the company's initial proposal that it cannot be considered as part of the November 2016 processing round.

A. SpaceX Does Not Dispute SES's Showing that the Modified SpaceX System Geometry Would Cause New Conjunction Events with O3b Over the U.S.

The SES Petition conclusively demonstrates that the revisions to the SpaceX system parameters described in the Application – lowering the satellite altitudes and the earth station elevation angles – will "lead to new conjunction events with O3b over a substantial portion of the contiguous United States ("CONUS") where such events would have been impossible

[8] SpaceX First Modification Order, 34 FCC Rcd at 2529, ¶ 9.

before."[9] The following figure from the Petition illustrates the magnitude of the impact, with the blue dots showing SpaceX satellites that could have a conjunction event with O3b under the current SpaceX configuration and the red dots representing the additional SpaceX satellites capable of creating a conjunction event with O3b under the revised design described in the Application.



[9] SES Petition at 6. Kepler and OneWeb make similar observations. *See* Petition to Deny of Kepler Communications, Inc., File No. SAT-MOD-20200417-00037, filed July 13, 2020, at 3 (because of the changes in orbital planes and the lowering of the minimum earth station elevation angle, "Kepler's analyses find that the modification actually acts to increase the number and duration of inline events, counter to SpaceX's claim"); Comments of OneWeb, File No. SAT-MOD-20200417-00037, filed July 13, 2020 ("OneWeb Comments") at 10 ("the reduction of the SpaceX gateway earth station minimum elevation angle from 40° to 25° effectively increases the probability of in-line interference events").

The SES Petition explains that the new conjunction events will create interference concerns for O3b in both the uplink and downlink directions and provides quantification of those effects. Specifically, simulations performed by SES show that the changes requested in the Application would raise both the number and persistence of inline events with O3b, producing a 434% increase in the total duration of conjunction events experienced by the O3b link.[10] Under the standard set forth in decisions on prior SpaceX modifications, the fact that the proposed changes would cause a substantially higher "number of spatial configurations that have the potential for generating interference" between SpaceX and other NGSO systems[11] provides a clear indication that the public interest would not be served by grant of the Application.

The SpaceX Opposition provides no valid rebuttal to the evidence presented in the SES Petition regarding the significant increase in interference to O3b that would result from the changes SpaceX seeks. The brief discussion in the Opposition of interference from SpaceX uplinks into other NGSO systems does not even mention the SES analysis.[12] Moreover, the SpaceX claim that it is taking "a more sharing-friendly approach" by lowering the power levels of its earth station transmissions[13] is a complete red herring. SpaceX suggests that if it were "forced to operate at its currently authorized altitudes," it would need to use higher uplink power levels, intensifying the uplink interference its system would create.[14] SpaceX concludes that "the

[10] SES Petition at 8 & Technical Annex at 4-7.

[11] SpaceX First Modification Order, 34 FCC Rcd at 2530, ¶ 11.

[12] Opposition at 26-27.

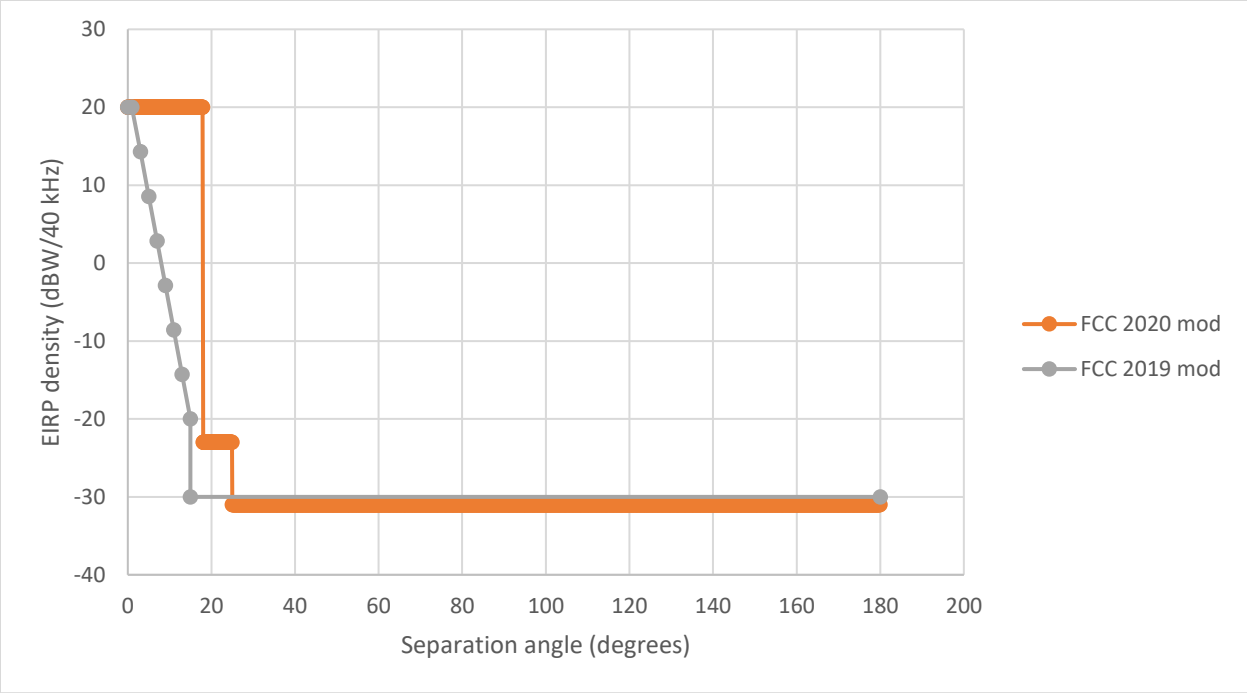
[13] *Id*. at 26.

[14] *Id*.

uplink interference environment would be better for other NGSO systems as a result of the modification" because it will allow SpaceX to use lower uplink power levels.[15]

As a threshold matter, data reviewed by SES call into question whether SpaceX in fact plans to use lower earth station power levels across the board. SES compared two sets of the EPFD information SpaceX provided to SES, one set in October 2019 and one set in April 2020, for earth stations operating in the 27.5-28.6 GHz and 29.5-30 GHz frequency ranges. The October 2019 data reflects the SpaceX network configuration with the changes approved in the SpaceX First Modification Order, which authorized a subset of satellites to be deployed at an altitude of 550 km rather than 1150 km. The EPFD data SpaceX shared with SES this past April reflects the configuration in the current Application, with all the satellites positioned at orbits between 540 and 570 km. A plot of the two uplink EIRP density masks used to perform the EPFD(↑) analysis in these filings appears below and shows that the EIRP density levels in this Application are higher than the previously authorized system for separation angles between 1 and 24.9 degrees, which is a meaningful segment of the curve where O3b could experience 50 dB higher interference.

[15] *Id*.



Moreover, SpaceX's argument completely ignores the substantial increase in the number and duration of inline events resulting from the changes in system geometry SpaceX proposes. As discussed above, the Commission has previously recognized that the relevant factor in assessing whether a SpaceX modification would adversely affect other systems is the "number of spatial configurations that have the potential for generating interference"[16] – and that number clearly goes up under this Application. The fact that the intensity of the uplink interference SpaceX produces will be lower in cases where it does use reduced earth station transmit power will not compensate for the 434% increase in duration of interference O3b will experience under the system revisions SpaceX proposes.

The SpaceX discussion of the risk that its system would create downlink interference to O3b is similarly flawed. Rather than directly responding to the demonstrations by SES and others of increased inline events, SpaceX employs a convoluted set of arguments based on

[16] SpaceX First Modification Order, 34 FCC Rcd at 2530, ¶ 11.

contrasting the likelihood that uplink interference from another NGSO system to SpaceX satellites at their current altitudes would exceed the 6% ΔT/T band-splitting threshold to the likelihood that interference from SpaceX downlinks will exceed that threshold under the altitudes proposed in the Application. Specifically with respect to O3b, SpaceX alleges that uplink interference to SpaceX would exceed the threshold that requires band segmentation absent coordination 88% of the time under the existing SpaceX network configuration, while downlink interference from SpaceX to O3b under the proposed revised configuration would exceed that limit only 3% of the time.[17]

As an initial matter, SES questions the accuracy of the SpaceX calculations. O3b's own predictions suggest that its uplinks would cause the 6% ΔT/T threshold to be exceeded with respect to SpaceX only about 20% of the time with the existing SpaceX configuration. Moreover, SpaceX incorrectly suggests that O3b failed to account for the 18 degree GSO avoidance angle used by SpaceX,[18] when in fact the analysis in the SES Petition explicitly incorporates that value.[19] Importantly, SES's use of this GSO avoidance angle results in a conservative estimate of the increase in conjunction events due to the changes proposed in the Application, as presumably SpaceX will not implement this avoidance technique in the NGSO-primary spectrum where protection of GSO operations is not required.

But in any event, the apples-to-oranges comparison between O3b-caused uplink interference with the existing configuration and SpaceX-caused downlink interference with the

[17] Opposition at 28.

[18] *Id*. at 28-29.

[19] SES Petition, Technical Annex at 5 (identifying the parameters used to perform the simulations regarding the number and duration of inline events, including the "SpaceX GSO avoidance angle" of 18 degrees under the proposed configuration).

new configuration provides no support for the SpaceX claims. SpaceX asserts based on the 88% and 3% values that "the modification will cause no material change to the number or duration of in-line events because [O3b's] uplinks will exceed the [band-splitting] trigger long before any effect on [O3b's] downlinks would do so."[20] This statement is illogical on its face, as it presumes that every band-splitting event will necessarily include both uplink and downlink spectrum.

Again, precedent makes clear that the critical factor in determining the acceptability of the SpaceX modification is whether it will change the system's geometry in a way that will create additional conjunction events, and as discussed above, this Application would result in a 434% increase in the duration of inline events between SpaceX and O3b. Whether in any individual instance the O3b uplinks or the SpaceX downlinks are what first triggers the exceedance of the 6% $\Delta T/T$ threshold is immaterial. In either case, the altered SpaceX geometry produced by the changes in the Application would lead directly to a significant number of new conjunction events that would not have occurred under the current configuration.

Thus, the SpaceX conclusion that "any impact SpaceX's modified operations might have on other NGSO systems' downlinks will not increase the amount of time that the parties will have to split common spectrum in the absence of a coordination agreement"[21] is flat-out wrong. Instead, both the number and the duration of conjunction events between O3b and SpaceX would increase under the SpaceX proposal, subjecting O3b to the risk of spectrum splitting in an unacceptably high number of new situations in new geographies.

[20] Opposition at 29.

[21] *Id*. at 29.

B. The Radical Changes Proposed in the Application Require the Commission to Treat It as Newly Filed

If the Commission does not deny the Application outright based on the flaws described above, it must at the very least determine that the SpaceX system is no longer eligible for consideration as part of the processing round that closed in November 2016. The daisy chain of modifications SpaceX has filed renders its current system design fundamentally different than what it proposed in its November 2016 application, as multiple key technical aspects of the constellation have changed, including the satellites' altitude, the minimum elevation angles to be used, and the satellites' scan angles. Together, these changes substantially worsen the NGSO interference environment, as discussed above.

Moreover, evidence suggests that SpaceX may have implemented another significant alteration without ever disclosing it to the Commission and other parties. The SpaceX 2016 Application expressly stated that phased array antennas would be used for both the Ku-band user beams and the Ka-band gateway beams, representing that the antennas' "beam-forming and digital processing technologies within the satellite payload give the system the ability to make highly efficient use of Ku- and Ka-band spectrum resources and the flexibility to share that spectrum with other licensed users."[22] In subsequent filings, including the instant Application, SpaceX has continued to explicitly represent that the Ku-band user beams will employ phased array antennas[23] and has indicated that the Ka-band gateway beams have the same

[22] Space Exploration Holdings, LLC, Call Sign S2983, File No. SAT-LOA-20161115-00118 ("SpaceX 2016 Application"), Attachment A at 2. *See also id.* at 13 (discussing how SpaceX operates the "Ka-band phased array gateway antenna").

[23] Application, Attachment A at 6 (describing Ku-band user beams and noting that "the shape of a phased array beam at boresight is circular but becomes increasingly elliptical when steered away from boresight").

characteristics, strongly implying that they also use phased array antennas.[24] Based on these materials, the SES Petition assumes that the Ka-band gateway antennas are phased array designs,[25] and the Opposition perpetuates this idea, as SpaceX responds to the SES concern about the potential for harmful grating lobes in the Ka-band by stating that the SpaceX phased array antennas are designed in such a way as to avoid creating grating lobes.[26]

Yet significant signals point to the possibility that SpaceX is relying on parabolic, rather than phased array, antennas onboard its satellites for the Ka-band gateway links. In public documents SpaceX has acknowledged that its satellites have both phased array and parabolic antennas,[27] and the picture below excerpted from a SpaceX video stream of a launch earlier this year[28] shows what appear to be two parabolic antennas for Ka-band operations, circled in blue.

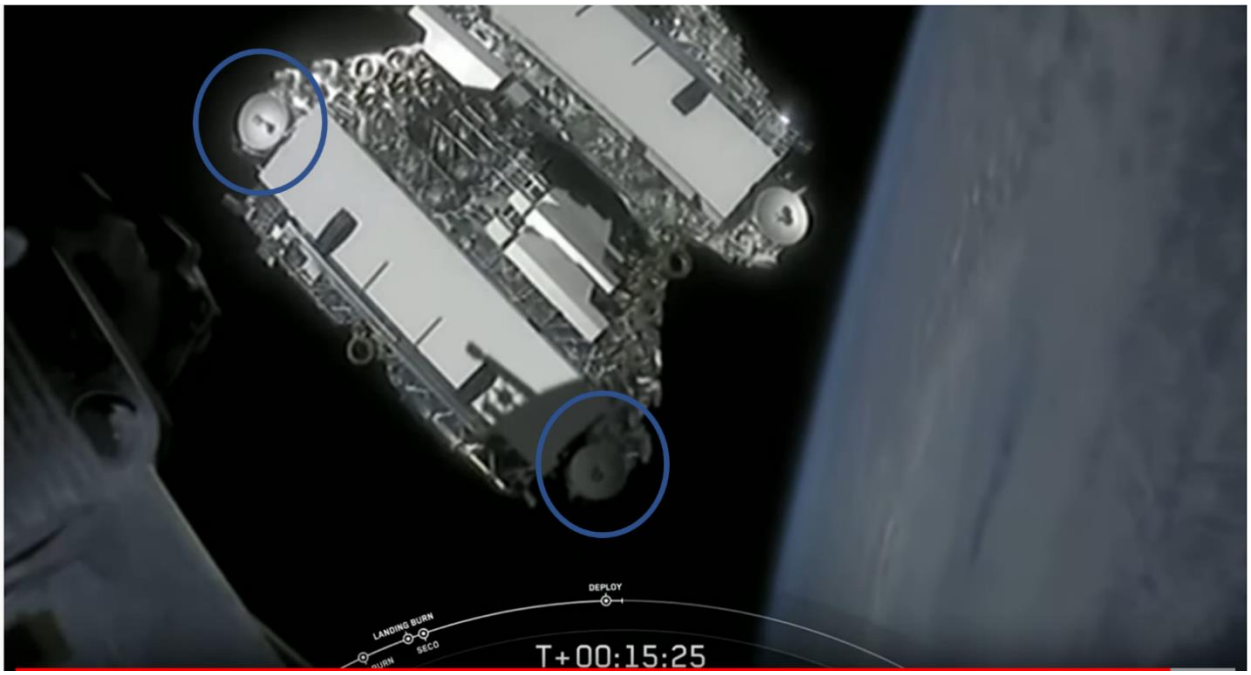
[24] *See id*. at 7 ("As with Ku-band beams, the shape of the gateway beam becomes elliptical as it is steered away from boresight.").

[25] SES Petition, Technical Annex at 10 ("SES understands that SpaceX will employ phased array antennas for both its Ka-band and Ku-band operations").

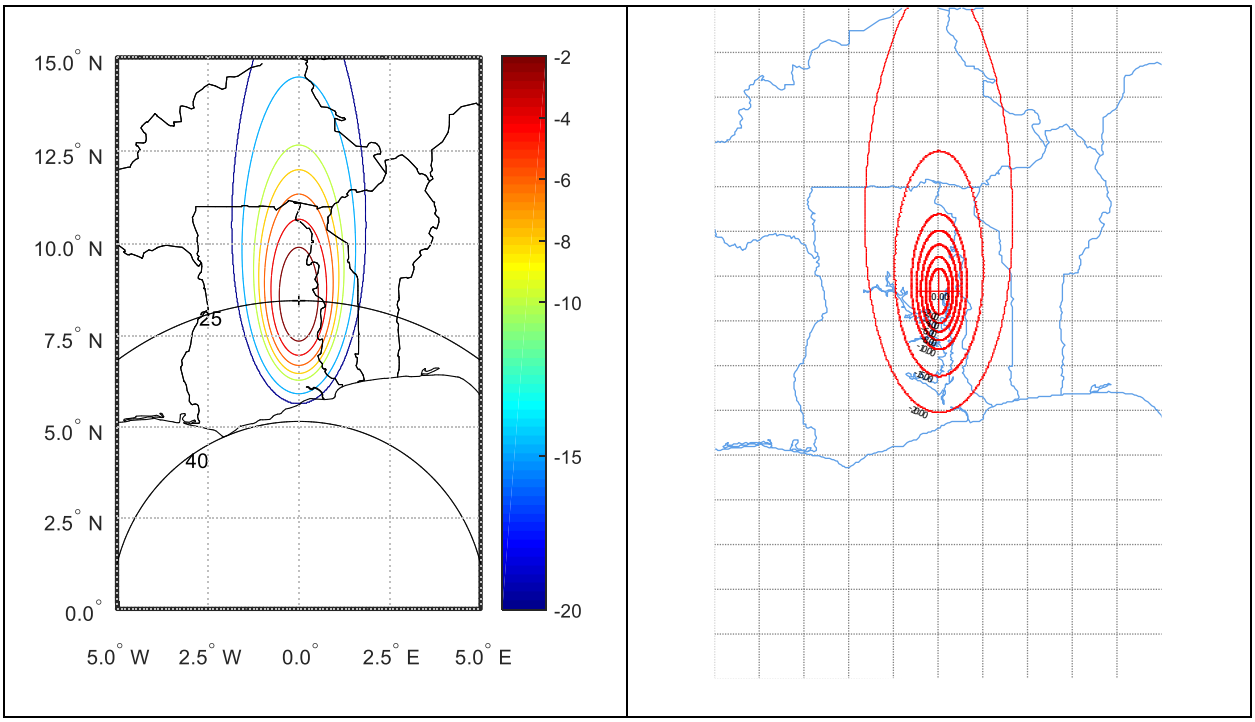
[26] Opposition at 32-33.

[27] *See* "Starlink Discussion National Academy of Sciences," (Apr. 28, 2020), https://www.spacex.com/updates/starlink-update-04-28-2020/ (discussing measures SpaceX has undertaken to reduce solar reflections from its parabolic and phased array antennas).

[28] *See* Starlink Mission live stream (Apr. 22, 2020), https://youtu.be/wSge0I7pwFI?t=1827. The picture was captured at the 30:27 point in the video.



The Ka-band gateway beam patterns supplied with the Application also have a size and shape that are consistent with what would be expected from parabolic antennas. In the figures below, SES shows on the left a typical parabolic antenna pattern using Recommendation ITU-R S.672 assuming a 15 cm antenna diameter operating at 20.2 GHz and a scan angle of 57 degrees and on the right a diagram of the GXT information provided by SpaceX in the instant Application for a Ka-band transmitting beam at a 57-degree scan angle. The 15 cm size reflects SES's estimate of the diameter of the parabolic antennas pictured above.



This comparison demonstrates that the parabolic antennas visible in the photograph above, if operated at Ka-band, would yield antenna beam contours very similar to those supplied by SpaceX in the Application.

SES can find no mention of the parabolic antennas or description of their operating characteristics anywhere in the series of SpaceX submissions to the Commission describing its system – these applications refer only to phased array antennas. As required by Section 25.117 of the Commission's rules,[29] SpaceX has certified that apart from the items identified in each modification application, "all other technical information provided in its previous Ku/Ka-band applications . . . remains unchanged."[30] If SpaceX has indeed altered how it will conduct its Ka-band gateway operations, the Commission must question the veracity of this certification.

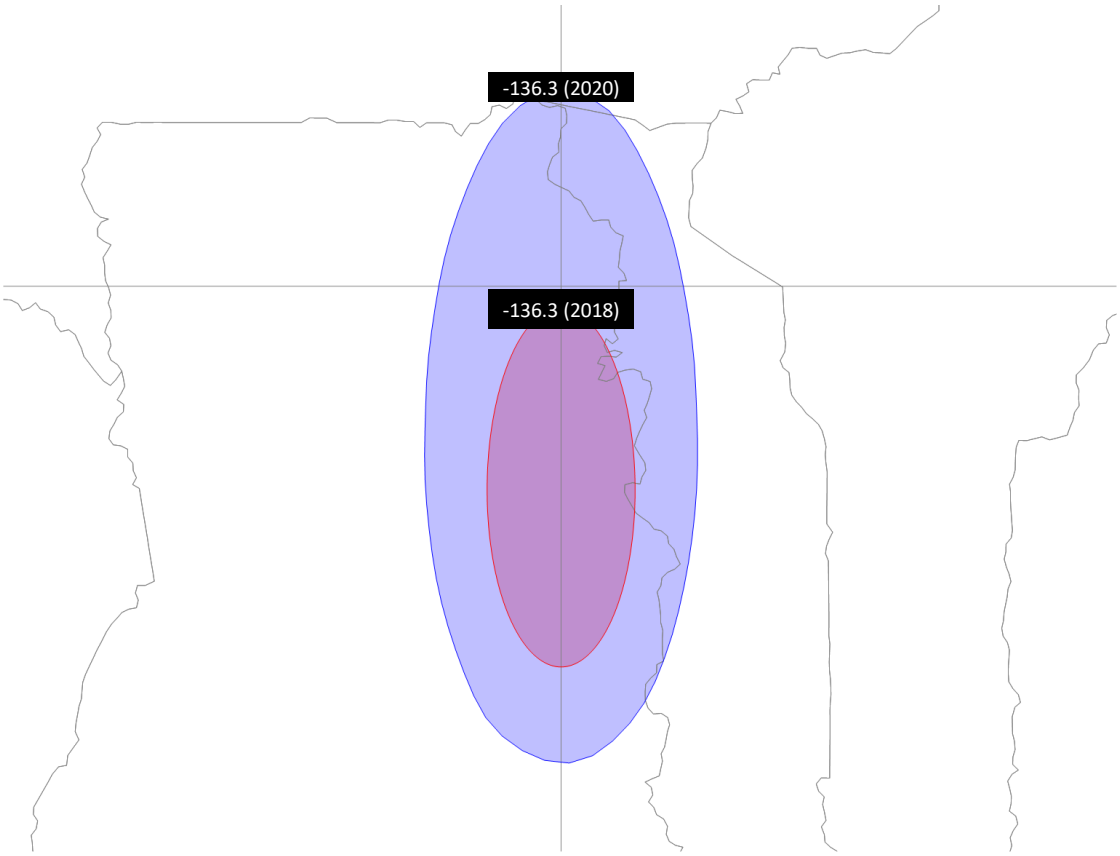
[29] 47 C.F.R. § 25.117(c).

[30] Application, Attachment A at 2.

Confirming whether SpaceX has altered its Ka-band gateway plan is critical, because like the changes identified in the Application, shifting from phased array to parabolic antennas for Ka-band gateway operations has significant implications for the interference environment. SpaceX has touted its ability to control the elements of the phased array antenna in order to manage interference issues.[31] Parabolic antennas lack this functionality, raising the question of how SpaceX will provide comparable interference mitigation if it is employing such antennas for Ka-band gateway links.

Comparing the downlink beam contour submitted with the Application to contours from the first SpaceX modification application filed in 2018 illustrates the magnitude of the potential interference issues. The map below compares the largest Ka-band downlink beam contour from the 2018 modification to a beam from the current Application with the same power flux density level, −136.3 dBW/m^2/MHz, using a scan angle of 57 degrees in both cases. The area of the beam from this Application covers 66,288 square km, more than three times the 2018 beam area of 19,105 square km.

[31] SpaceX 2016 Application, Attachment A at 7 ("The SpaceX System offsets . . . beamwidth variations by switching antenna elements in the phased array on and off at certain steering angles. By ensuring that radio energy is transmitted in the desired direction, this switching helps to mitigate interference with other systems.").



As discussed above, because the beam appears to be generated by a parabolic antenna, the beam shaping tools that would allow the coverage area to be reduced are not available. Consequently, O3b terminals will be subject to potential interference from SpaceX downlinks within a much larger area with no potential measures that would allow mitigation of the harm.

Given these facts, the Commission must require SpaceX to explain whether it has departed from its originally stated plan to use phased array antennas to communicate with Ka-band gateway earth stations. If SpaceX has in fact made such a change, the Commission should determine whether SpaceX's failure to disclose material facts – and its repeated statements implying there has been no change – reflect adversely on the truth and accuracy of SpaceX's statements to the Commission.[32]

[32] *See* 47 C.F.R. § 1.17 (requirement for truthful and accurate statements to the Commission).

However, regardless of the outcome of this inquiry, the Commission must conclude that the changes proposed on the face of the Application will materially harm other NGSO operators. As the SES Petition makes clear, the degradation to the interference environment justifies denial of the Application,[33] but at the very least requires the Commission to treat the Application as a new filing ineligible for co-equal status with other participants in the November 2016 processing round. SpaceX has previously acknowledged that explicit Commission precedent requires this outcome, specifying that if a modification presents "significant interference problems" the Commission will "treat the modification as a newly filed application and would consider the modification application in a subsequent satellite processing round."[34]

Expulsion of the SpaceX system from the November 2016 processing round is clearly justified because the current constellation design bears no resemblance to the original SpaceX proposal. Allowing SpaceX to maintain its status in that round notwithstanding the radical changes SpaceX has made in its operating parameters would deprive O3b and other round participants of the certainty essential to support investment in NGSO operations. As the Commission has recently reiterated, preserving this certainty is a critical element of the public interest rationale for the processing round system.[35]

II. THE APPLICATION POSES MATERIAL RISKS TO GSO OPERATIONS

The SpaceX pattern of evading or dismissing inconvenient arguments extends to matters involving protection of SES's Ku-band and Ka-band GSO space stations, as the Opposition does

[33] SES Petition at 15 & n.31, *citing* SpaceX First Modification Order, 34 FCC Rcd at 2529, ¶ 9 (if "a modification would worsen the interference environment, that would be a strong indication that grant of the modification would not be in the public interest").

[34] *See* SpaceX 2018 Application, Waiver Requests at 2 & n.9, *quoting Teledesic LLC*, 14 FCC Rcd 2261 (IB 1999) at 2264, ¶ 5.

[35] *See Kuiper Systems, LLC*, Order and Authorization, FCC 20-102 (rel. July 30, 2020) at ¶ 42.

not substantively address the issues raised by SES. In response to SES concerns regarding the potential for harmful interference resulting from grating lobes created by the SpaceX phased array antennas, SpaceX simply asserts that its antennas are not subject to this common phenomenon.[36] SpaceX provides no analysis or explanation to support this claim. Given the magnitude of the harm to SES's networks that would result if grating lobes affect ground stations communicating with SES GSO satellites, SES cannot simply accept SpaceX's unsupported statement that the problem will not occur, and neither should the Commission.

The SES Petition also highlights the inconsistency between the statements in the Application regarding the number of co-frequency SpaceX satellite transmissions and the data SpaceX used to produce its EPFD compliance showing, and on this issue the SpaceX response suggests an affirmative attempt to mislead the Commission. Specifically, the SES Petition notes that although the Application states that "up to eight satellites [transmit] to a gateway location, for a maximum of sixteen co-frequency beams,"[37] data files regarding the EPFD calculations SpaceX supplied with its prior modification used a value of one for the "N_co" parameter that specifies the number of co-frequency satellites transmitting at a given time.[38] The SES Petition goes on to note that:

> SpaceX does not disclose whether it used an N_co value of eight as appropriate to produce the graphs attached as Annex 2 of the Application's technical showing. If it did not, SpaceX should be required to disclose what value it did use and why.[39]

[36] Opposition at 32-33.

[37] Application, Attachment A at 8.

[38] SES Petition at 16.

[39] *Id*.

Rather than supplying a straightforward answer to the SES questions, SpaceX suggests that the SES argument is "speculative" because it cites "EPFD data provided in connection with SpaceX's *last* modification."[40] But contrary to SpaceX's claims, SES also received EPFD data files from SpaceX in April of this year that correspond to the orbital characteristics of *this* Application, and those data files continue to use an N_co value of one.

Thus, there is nothing speculative about the SES concerns that SpaceX is playing fast and loose with the facts when it comes to representing its compliance with Ka-band EPFD limits. Instead, SpaceX's own documentation establishes the conflict between the system design that allows eight co-frequency satellite transmissions to a single earth station and the SpaceX decision to calculate its system's EPFD levels as if only one such co-frequency satellite transmission is possible. The Commission clearly cannot take SpaceX's statements that it will comply with EPFD limits designed to protect the operations of SES and other GSO networks at face value.

Moreover, SpaceX's refusal to come clean regarding this matter fundamentally undermines its credibility. SpaceX's willingness to conceal the facts related to its EPFD performance should cause the Commission to question whether to accept any unverified SpaceX representations about its system's technical performance and characteristics.

III. SPACEX FAILS TO ADDRESS THE SIGNIFICANT SPACE SAFETY ISSUES RAISED BY THE APPLICATION

The record also highlights the serious questions regarding SpaceX's ability to meet space safety standards, and rather than providing evidence that would allay those concerns, SpaceX chooses to dodge the issues, including through casting false aspersions on the SES compliance

[40] Opposition at 33 (emphasis in original).

history. As a result, the Commission is left without the supporting evidence needed to determine that SpaceX is committed to and capable of acting to protect a safe space environment.

The SES Petition observes that the orbital altitudes requested in the Application are already home to multiple systems and that O3b has requested authority to add satellites at a nominal orbital altitude of 507 kilometers,[41] just three kilometers below the lower end of the span of altitudes sought by SpaceX when taking into account its proposed large tolerance.[42] SES notes that SpaceX has failed to supply any concrete information regarding how the "autonomous conjunction avoidance technology"[43] deployed on its spacecraft actually operates or to specify to what extent SpaceX will take responsibility for collision avoidance.[44]

Other parties emphasize that the failure rate of SpaceX satellites deployed so far substantially exceeds the projections SpaceX previously made, calling into question the reliability of SpaceX's collision risk estimates.[45] In addition, filers cite an incident in which the European Space Agency ("ESA") had to maneuver a spacecraft to avoid one of the SpaceX satellites because SpaceX had not responded to messages regarding the possible collision risk.[46]

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[41] *See* O3b Limited, Call Sign S2935, File No. SAT-MOD-20200526-00058, Legal Narrative at 1.

[42] SES Petition at 17 & n.35.

[43] Application, Attachment A at 22.

[44] SES Petition at 17-18.

[45] *See, e.g.*, OneWeb Comments at 6 (noting that the "current failure rate for the SpaceX constellation stands at 3.14 percent as of last month," in contrast to SpaceX statements that a failure rate of 1 percent is unlikely); Petition to Defer or Deny of Viasat, Inc., File No. SAT-MOD-20200417-00037, filed July 13, 2020 ("Viasat Petition") at ii (the failure rate experienced by SpaceX is significantly greater than what it had predicted).

[46] Viasat Petition at 4 & nn.10, 11; Letter from Astroscale U.S. Inc., File No. SAT-MOD-20200417-00037, filed June 30, 2020, at 4 & n.12.

Rather than responding constructively to these legitimate questions regarding the effectiveness of its orbital debris mitigation measures, SpaceX lashes out, launching unjustified attacks and maligning the intentions of any party that dares to express concern about space safety matters. For example, in an obvious attempt to divert the Commission's attention away from the significant failure rate of SpaceX satellites to date, SpaceX falsely suggests that SES was unable to successfully complete the orbit-raising maneuvers for one of its GSO satellites, AMC-9.[47] Had SpaceX bothered to do more research, it would have learned that SES recovered control of AMC-9 after the satellite suffered an anomaly, and SES subsequently raised the satellite to a disposal orbit and passivated the spacecraft.[48] In fact, neither SES Americom, its predecessors, or any of its affiliates has ever failed to remove a satellite from the geostationary orbit at end of life. Thus, rather than the 5 percent failure rate SpaceX posits, SES has a zero failure rate over the more than four decades it has been a satellite operator, a stark contrast to SpaceX, which has experienced at least fifteen satellite failures in a matter of months – a record that does not instill confidence.[49]

[47] Opposition at 16.

[48] *See* Letter from Karis A. Hastings, Counsel to SES, to Marlene H. Dortch, Call Sign S2434, File Nos. SAT-STA-20170929-00138 *et al.*, dated Dec. 13, 2017 (reporting that AMC-9 was placed into a disposal orbit with a perigee approximately 277 km above the geostationary arc). Moreover, although there were initial reports of what appeared to be debris separating from the satellite, *see* Opposition at 16, the accuracy of those observations is in question given that SES confirmed no major spacecraft elements were missing when it regained control of the satellite, and no debris was sighted on later observations.

[49] SpaceX also incorrectly claims that O3b has "refused to provide much (if any) orbital debris information" on its NGSO system. Opposition at 7. In fact, prior to the Commission determining that O3b was under direct and effective regulation by the United Kingdom on orbital debris matters, O3b submitted a full orbital debris mitigation plan to the Commission. *See* O3b Limited, Call Sign E100088, File No. SES-LIC-20100723-00952, Attachment A at 34-40.

SpaceX similarly tries to deflect attention away from the serious issues raised by the ESA collision avoidance event, noting that "due to an error in an on-call paging system, SpaceX did not learn of ESA's correspondence" regarding the close approach of the two satellites.[50] SpaceX seems to think this explanation disposes of any possible concern, but in fact it only raises more questions with respect to SpaceX's reliance on autonomous collision avoidance technology. First, the fact that SpaceX did not discover the "error" in its paging system until after the close approach incident occurred highlights the risks associated with reliance on automated systems – one has to wonder what could happen if the SpaceX collision avoidance software includes a similar as yet undiscovered bug.

Second, SpaceX's reliance on autonomous maneuvers to avoid collisions could compromise the reliability of the positioning information that allowed the ESA to maneuver away from the SpaceX satellite. SpaceX quotes an ESA official who commented that the information SpaceX previously provided allowed ESA to determine that the Starlink satellite would be exactly where expected.[51] But as Kuiper notes, the possibility that autonomous maneuvers could be done "without warning or screening" could make it "difficult for other system operators to predict the positions of SpaceX satellites and react accordingly."[52]

Under these circumstances, SpaceX's refusal to provide additional detail regarding the operating parameters of its autonomous collision avoidance system deprives the Commission as well as interested parties such as SES of the information needed to reasonably assess the collision risks associated with the SpaceX system.

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[50] Opposition at 17.

[51] *Id*. at 17-18 & n.54.

[52] Kuiper Systems LLC Petition to Deny and Comments, File No. SAT-MOD-20200417-00037, filed July 13, 2020, at 4.

IV. CONCLUSION

For the reasons set forth herein and in the SES Petition, the Commission should deny the Application or at the very least defer consideration of the reconfigured SpaceX system to the second Ku/Ka-band processing round and condition any grant to protect the SES NGSO and GSO operations.

Respectfully submitted,

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August 7, 2020

AFFIDAVIT

1. I am Vice President, Regulatory for O3b Limited.

2. I have reviewed the foregoing Reply of SES Americom, Inc. and O3b Limited. All statements made therein are true and correct to the best of my knowledge, information, and belief.

I declare under penalty of perjury that the foregoing is true and correct.

By: /s/ Suzanne Malloy

Date: August 7, 2020

CERTIFICATE OF SERVICE

I hereby certify that on this 7th day of August, 2020, I caused to be served a true and correct copy of the foregoing "Petition to Deny or Defer of SES Americom, Inc. and O3b Limited" on the following:

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