



August 9, 2021

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

Re: *Ex Parte Presentation, Expanding Flexible Use of the 12.2-12.7 GHz Band, WT Docket No. 20-443*

RS Access, LLC recently submitted a rigorous, data-driven study conducted by RKF Engineering Solutions, LLC (RKF) assessing the feasibility of coexistence between a broadly deployed Starlink system and a nationwide 5G deployment in the 12 GHz band.¹ Having advised the Commission in many spectrum proceedings,² we expected good-faith questions and criticisms from interested stakeholders about our technical analysis. But, in its haste to attack the study, SpaceX has gone well beyond the bounds of zealous advocacy and professional decorum. In multiple Commission filings, SpaceX has impugned RKF's integrity, alleged without basis that RKF's technical findings were reached on a pay-for-play basis, equated the study to "[g]arbage,"³ and made many obviously false claims about the study's assumptions, methodology, and results. RKF stands behind its work, and on its behalf, I am submitting this letter to correct the record.

¹ RKF Engineering Solutions, LLC, *Assessment of Feasibility of Coexistence between NGSO FSS Earth Stations and 5G Operations in the 12.2 – 12.7 GHz Band* (May 7, 2021), Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183 (filed May 7, 2021) ("RKF NGSO Study").

² RKF has participated in many Commission proceedings. In the 6 GHz proceeding, the Commission relied on RKF's technical study assessing the feasibility of coexistence between unlicensed devices, Fixed Satellite Services, and Fixed Services. See *Unlicensed Use of the 6 GHz Band; Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020). The Commission has also procured RKF's engineering expertise to assist FCC staff on various technical matters. See, e.g., *Wireless Telecommunications Bureau Releases Final Cost Category Schedule for 3.7-4.2 GHz Band Relocation Expenses and Announces Process and Deadline for Lump Sum Elections*, Public Notice, 35 FCC Rcd 7967 (2020).

³ Letter from Letter from David Goldman Director, Satellite Policy, Space Exploration Technologies Corp., to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443 and GN Docket No. 17-183, Attachment, at 5 (filed Aug. 2, 2021) ("SpaceX Letter") ("Garbage In → Garbage Out").



SpaceX misreads our study to find harmful interference where none may exist. SpaceX claims that the RKF NGSO Study “[d]emonstrates that additional [5G] rights will block service to tens of thousands of customers.”⁴ SpaceX misunderstands our findings. We showed that—with *zero* coordination—the probability of an exceedance of the International Telecommunication Union’s nominal I/N limit of -8.5 dB would be to less than 1% of users.⁵ To be clear, the likelihood of a technically defined exceedance event is different from the likelihood of “harmful interference,” as would be conventionally understood or experienced by consumers.⁶ An exceedance event does not necessarily imply a loss or reduction in service. And good-faith coordination between non-geostationary orbit (NGSO) fixed-satellite service (FSS) and 5G operators would reduce the probability of such occurrences even further.

SpaceX ignores our study’s detailed siting discussion and falsely claims our study “assumes a 12 GHz 5G buildout will occur only in urban areas.”⁷ No, the study did not assume 5G would only be deployed in urban areas of the United States. Our study clearly explains that our siting methodology does not use the simplistic rural-urban typology that SpaceX now seeks to superimpose onto our results.⁸ 5G towers were sited in every PEA throughout the contiguous United States (CONUS), including tiny communities such as Bellows Falls, Vermont; Experiment, Georgia; Park Rapids, Minnesota; Clifton, Texas; Eagar, Arizona; and Davenport, Washington.⁹ While 5G operations were weighted toward comparatively more densely populated areas because that is where demand for mobile broadband capacity is greatest, the study’s siting algorithm simulated 5G base stations covering more than 500 communities with fewer than 10,000 POPs, nearly 1,000 communities

⁴ SpaceX Letter, Attachment at 3.

⁵ ITU-R Rec. SF.1006, *Determination of the Interference Potential Between Earth Stations of the Fixed-Satellite Service and Stations in the Fixed Service*, ITU, <https://bit.ly/3eYqhew>.

⁶ See, e.g., 47 C.F.R. § 2.1 (“*Harmful Interference*. Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with [the ITU] Radio Regulations.”).

⁷ SpaceX Letter, Attachment at 3.

⁸ RKF NGSO Study at 5 (“This is not a simple urban-rural dichotomy. The model uses a statistical sampling of many possible deployment scenarios to arrive at a composite view of the statistical likelihood of proximate deployments and, ultimately, the potential for interference under deployment conditions likely to be found in actual deployments.”).

⁹ *Id.* at 27 (“Excluding Alaska, Hawaii, territories and the Gulf of Mexico, there are 406 PEAs in CONUS versus 206 MVDs, and by definition many PEAs include mostly non-urban areas. So RKF’s methodology to ensure 10% of the population in each PEA is covered brings 12 GHz 5G service to the most populous parts of many rural markets, as well as to large portions of the largest cities.”).



with fewer than 20,000 POPs, and more than 1,200 communities with fewer than 30,000 POPs. We prepared a nationwide 5G deployment model and then explained the details of our 5G siting algorithm to be transparent and to avoid reliance on selective or artificially favorable geographic separation distances. Undeterred by the actual facts and methodology of our study, SpaceX falsely accuses us of doing the opposite.

SpaceX criticizes RKF for assuming, consistent with all publicly available information, that Starlink would focus on less densely populated areas. SpaceX claims that it “[a]ready had extensive demand for urban service” that the study assumes 5G would foreclose.¹⁰ Yet RS Access did not propose to preclude NGSO FSS licensees from operating in any part of the country. Likewise, the RKF NGSO Study neither assumes nor concludes that urban NGSO FSS deployments are foreclosed by 5G operations in the 12 GHz band. On the contrary, we provided our siting and operational assumptions, which included urban Starlink operations, and the study found that coexistence was still readily achievable. And even if SpaceX could not use the 12 GHz band in certain urban areas, it would still have 1.5 gigahertz of Ku-band user downlink spectrum and two gigahertz of V-band user downlink spectrum to do so. SpaceX also mentions that it received “significant support to serve urban areas as part of [the Rural Digital Opportunity Fund (RDOF)].”¹¹ This is a red herring—our study already factors in SpaceX’s urban RDOF support.¹²

All publicly available information and FCC filings make clear that SpaceX intends to focus on more sparsely populated areas, and our study’s assumptions accord with that operational reality. Indeed, SpaceX’s Chief Executive Officer, Elon Musk, has himself conceded, “[Starlink is] really meant for sparsely populated regions because its spot size is quite big, so we’re well suited for low to medium density areas but not high density areas. In high density areas we will be able to serve a limited number of customers.”¹³ We also note that SpaceX was just

¹⁰ SpaceX Letter, Attachment at 3.

¹¹ *Id.*

¹² RKF NGSO Study at 9 (“RKF’s methodology currently assumes such a dense deployment of satellite terminals in metropolitan centers where RDOF funds were assigned, such as Chicago, San Francisco, and Baltimore, that deployments there may already exceed the capacity of SpaceX’s satellite system to support them while still offering a competitive level of service.”).

¹³ CNET Highlights, WATCH: Elon Musk discuss Starlink Internet at MWC 2021 - Livestream, YouTube, at 4:34-39 (June 29, 2021), <https://youtu.be/RcnVTgrgThE>; see also Elon Musk (@elonmusk), Twitter (May 4, 2021, 5:22 PM), <https://bit.ly/3tmjtwz> (“[The o]nly limitation [for Starlink] is high density of users in urban areas.”); Jon Brodtkin, *Elon Musk: Starlink latency will be good enough for competitive gaming*, ARS TECHNICA (Mar. 10, 2020), <https://bit.ly/3dUrbbu> (“The challenge for anything that is space-based is that the size of the cell is gigantic ... it’s



asked by the FCC to consider defaulting on RDOF funding for many urbanized areas where “significant concerns [were raised] about wasteful spending, such as [for] parking lots and international airports,” areas our study assumed SpaceX would have to serve in order to retain its RDOF subsidies.¹⁴ Given the Commission’s stated concerns over certain “urban” RDOF areas claimed by SpaceX, our study might, in fact, have *overweighted* the potential for Starlink urban deployments. Beyond the “urban” RDOF markets that the FCC has recently questioned, there are also outstanding questions in the record about whether SpaceX can even fulfill its RDOF obligations to offer a low-latency broadband service at minimum speeds of 100/20 Mbps.¹⁵

SpaceX continues to talk around Starlink’s well-known technical limitations, claiming that it will provide service to tens of millions more customers than analysts’ long-term, “most aggressive” expectations. SpaceX claims its NGSO FSS system “can scale to support” “[a]t least 30 million Americans [that] are currently unserved” by existing broadband providers.¹⁶ We find this claim implausible because it is not consistent with the capacity limitations of SpaceX’s (and every NGSO FSS) system. We find more persuasive the industry analysis from MoffettNathanson, which explained that a fully deployed Phase I Starlink system can serve between 300,000-800,000 Americans and that, “even with the most aggressive assumptions presented (42,000 satellites and capacity per satellite triples to 60 Gbps), Starlink can address just a few million U.S. households over some extended time horizon.”¹⁷ At the

not good for high-density situations. We’ll have some small number of customers in LA. But we can’t do a lot of customers in LA because the bandwidth per cell is simply not high enough.”).

¹⁴ See Letter from Michael Janson, Director, Rural Broadband Auctions Task Force, FCC, *et al.*, to David Finlay, Starlink Services, LLC (July 26, 2021), <https://bit.ly/2VuZPmM>.

¹⁵ See, e.g., Letter from Amy R. Mehlman, Vice President, US Government Affairs and Policy, and Jarrett S. Taubman, Associate General Counsel, Government and Regulatory Affairs, Viasat, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443 *et al.* (filed Aug. 2, 2021); Letter from Gary Bolton, President and CEO, Fiber Broadband Association & Shirley Bloomfield, CEO, NTCA–The Rural Broadband Association, to Marlene H. Dortch, Secretary, FCC, WC Docket No. 19-126 and AU Docket No. 20-34, Attachment, at 3 (filed Feb. 8, 2021).

¹⁶ SpaceX Letter, Attachment at 3.

¹⁷ Craig Moffett *et al.*, *Is Starlink a Substitute for, or a Supplement to, Wired Broadband?*, MoffettNathanson, at 25 (Apr. 5, 2021); see also Mike Dano, *Starlink’s Network Faces Significant Limitations, Analysts Find*, LIGHT READING (Sept. 23, 2020) (“In crunching the number of satellites that would be covering the US at any one time, the [Cowen] analysts conclude that Starlink can serve 485,000 simultaneous data streams in the US with 100Mbit/s speeds if all 12,000 Starlink satellites are operational. . . . ‘Equating this number to actual customers depends on Starlink’s policy on oversubscription rate, for example assuming a 3x oversubscription rate could imply a 1.5 million total addressable market (not all customers will be online simultaneously, far from it, though we believe



reported deployment pace of 300 satellites per month,¹⁸ and assuming no satellite failures and a launch calendar that can keep pace, it would take SpaceX 11-12 years to launch a 42,000-satellite constellation.

SpaceX says RKF should have assumed more Starlink user terminals, even though that would not have changed the results. SpaceX criticizes our study because it posits 2.5 million user terminals instead of the five million fixed user terminals for which SpaceX has since applied. SpaceX is currently only authorized for one million user terminals. Our study generously assumed 2.5 million user terminals would be deployed, which is well beyond industry analysts' expectations.¹⁹ In any event, SpaceX's criticism is beside the point because our results would hold even if we had assumed five million or indeed *five hundred million* Starlink terminals. As our report makes clear: "This 0.888% [exceedance event probability] result is statistically valid for any large number of satellite user terminals. Stated differently, although the absolute number of terminals that may be affected by interference will change if the actual number of terminals were higher or lower than the 2,500,000 RKF examines, the percentage will not."²⁰ For the same reason, SpaceX's argument that "other authorized NGSO FSS systems [] will add many more users"²¹ does not bear on the statistical validity of the study.

SpaceX blames RKF for using the elevation of Starlink's partially deployed system instead of imaginary "[r]eality"-based elevation angles that have never been disclosed before. SpaceX also challenges our assumptions regarding the elevation angles of a fully deployed SpaceX system.²² SpaceX does not contest that RKF used the correct minimum elevation angles for SpaceX's system, consistent with SpaceX's recently granted redesign application. RKF's study models a fully deployed Starlink Ku-band NGSO FSS system with robust consumer uptake. After the RKF NGSO Study's submission, SpaceX provided a single "[r]eality" distribution of elevation angles. SpaceX submitted the same chart in its recently submitted reply comments with just this sentence: "In reality, however, the distribution of

the post-COVID era will drive more need for Internet reliability, thus more conservative oversubscription levels),' [the Cowen analysts] wrote."), <https://bit.ly/3CqvDE5>.

¹⁸ Darrell Etherington, *SpaceX launches 60 more Starlink satellites, now at 300 launched in just over one month*, TechCrunch (Apr. 7, 2021), <https://tcrn.ch/2VlfXrs>.

¹⁹ See *supra* note 17.

²⁰ RKF NGSO Study at 2.

²¹ SpaceX Letter, Attachment at 4.

²² *Id.* at 5, 8.



Starlink user terminal elevation angles is as follows.”²³ SpaceX seems to assert that it will operate at lower elevation angles than it previously said it would use but with no explanation as to what operating conditions would militate in favor of such operations.²⁴

We seriously question whether SpaceX would, in fact, use lower elevation angles for Starlink. Lower elevation angles imply more obstructions from buildings, trees, and other clutter, longer latency, and lower capacity. Like other observers,²⁵ we already have serious questions about whether Starlink can satisfy consumer demand for fixed and mobile broadband as efficiently as terrestrial systems, even with higher elevation angles, let alone lower ones.²⁶ Lower elevation angles also mean each SpaceX spot beam is covering a much larger area. To maintain an Nco value of 1 (i.e., no overlapping co-frequency beams),²⁷ a larger spot beam due to a sharper satellite-to-earth angle will result in lower system capacity.²⁸ If SpaceX believes its distribution of elevation angles accurately reflects how its fully deployed system will perform, then it should explain how it will be able to operate Starlink while both meeting its RDOF obligations and maintaining an Nco value of 1. In other words, SpaceX should clarify that, by submitting a purported “reality” distribution of elevation angles, it intends to operate at these angles while also fulfilling its RDOF obligations and protecting co-primary Digital Broadcast Service operations. For example, as shown in the figure below, going from

²³ Reply Comments of Space Exploration Holdings, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, at 9 (filed July 7, 2021).

²⁴ See *infra* note 30.

²⁵ Letter from Amy R. Mehlman, Vice President, US Government Affairs and Policy, Jarrett S. Taubman, Associate General Counsel Government and Regulatory Affairs, to Marlene H. Dortch, Secretary, FCC, WT Docket No. WT Docket No. 20-443 *et al.*, at n.41 (Apr. 5, 2021) (“The smallest Starlink Ku-band transmit beam (22 km) supports the highest density of users in a given area. The 22 km value is the beam diameter at the sub-satellite point, i.e., when the satellite is directly overhead, at 90° elevation. At lower elevation angles, the beam size becomes significantly larger and the location-density driven Starlink capacity shortfall increases. Insufficient capacity to cover geographically dense RDOF locations is the root source of SpaceX’s RDOF capacity shortfall problem.”).

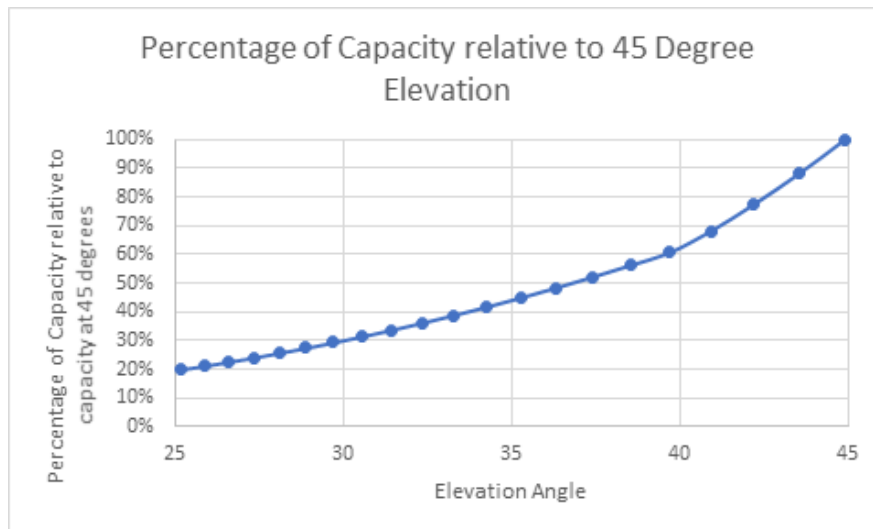
²⁶ See, e.g., Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, at 26 (filed May 7, 2021) (“In a spot beam area where SpaceX could serve only 200 simultaneous users at 100 Mbps, a terrestrial operator could reasonably fit hundreds of cells that reuse the same 2,000 megahertz many times over, increasing the capacity and utilization of the spectrum by *several orders of magnitude*.”).

²⁷ *Space Exploration Holdings, LLC Request for Modification of the Authorization for the SpaceX NGSO Satellite System*, Order and Authorization and Order on Reconsideration, IBFS File No. SAT-MOD-20200417-00037, FCC 21-48, ¶ 97.e (rel. Apr. 27, 2021) (“Operations in the 12.2-12.7 GHz (space-to-Earth) frequency band . . . are subject to the condition that SpaceX not use more than one satellite beam from any of its satellites in the same frequency in the same or overlapping areas at a time.”).

²⁸ See *supra* note 25.



an average look angle of 45° to 25° could diminish capacity by 80%. And, since the Nco value of 1 must be maintained, the lower look angles, which would normally have some advantage in covering additional landmass, could not do so.



SpaceX does not say where this new elevation angle data came from nor reconcile the new data with its conflicting submissions to the FCC. For example, SpaceX’s blanket earth station application’s narrative states: “In the very early phases of constellation deployment and as SpaceX first initiates service, this angle may be as low as 25 degrees, but this will return to 40 degrees as the constellation is deployed more fully and more satellites are in view of a given end-user.”²⁹ By contrast, SpaceX’s distribution appears to reflect Starlink’s present-day, less-than-fully-deployed system that is still in beta service.³⁰ It is not even clear whether SpaceX’s distribution includes all beta service terminals throughout the world or just in CONUS, suggesting that beta users at lower latitudes could skew the distribution lower than a CONUS-only distribution.

We rely on the data that is made available to us. SpaceX representatives have previously declined to provide actual elevation angle data to RS Access or submit that information into the record, and it remains unclear whether the current offering is for an end-state deployment or merely the pre-launch beta in which only a minority of Starlink satellites in the

²⁹ See Narrative, Application of SpaceX Services, Inc., SES-LIC-20190211-00151, at A-1 (filed Feb. 11, 2019) (“SpaceX Blanket Earth Station Application”).

³⁰ Stephen Clark, *SpaceX is about to begin launching the next series of Starlink satellites*, SPACEFLIGHT NOW (July 27, 2021), <https://bit.ly/3yn17jw> (“The completion of the first Starlink ‘shell’ will enable the network to provide high-speed, low-latency internet services to lower latitudes, such as the southern United States.”).



constellation are operational. That information still is not known, so it remains unclear to us how SpaceX's "[r]eality" portrayal of elevation angles is anything more than a results-driven fiction. It is also noteworthy that SpaceX's purported elevation angle data suggests that user terminals would be spending *more than half* of their time *below* the minimum elevation angle supported by the antenna's beamsteering functionality,³¹ which would require a large amount of mechanical steering that would lead to wear and tear on the user terminal, contrary to reasonable design practices for reliability and cost.

SpaceX faults RKF for presuming that Starlink would use the alternative Ku-band spectrum it is authorized to use. In response to observations that SpaceX has 1.5 gigahertz of Ku-band user downlink spectrum, SpaceX claims the study has a "deep and fundamental misunderstanding of FSS NGSO spectrum."³² To begin, SpaceX only lists a portion of its user downlink spectrum, omitting the two gigahertz of V-band spectrum that it can also use. Further, SpaceX claims that the 10.70-10.95 GHz band is "unusable to protect Radio Astronomy," essentially creating a 250 megahertz guard band. RKF is unaware of any public statement by SpaceX that it surrendered 250 megahertz of spectrum. To be sure, in 2019, SpaceX entered into a coordination agreement with the National Science Foundation, but there is no indication that SpaceX ceded the use of 250 megahertz of its downlink spectrum.³³ Tellingly, SpaceX describes the band as "*currently unusable*."³⁴ The likeliest explanation for this careful phrasing is because (1) the capacity is not currently needed due to the low user count and (2) the Starlink system is nowhere near fully deployed and must operate at lower elevation angles, creating a larger beam "spot" and, thus, a greater risk for Radio Astronomy operations than a fully deployed Starlink system would. Indeed, all of SpaceX's blanket earth station applications state that Starlink user terminals "will transmit in the 14.0-14.5 GHz band and *receive in the 10.7-12.7 GHz band*."³⁵ SpaceX's claims of a total encumbrance of the

³¹ See Narrative, SpaceX Blanket Earth Station Application at A-1, n.2 ("Operation at elevation angles below 40 degrees is achieved by tilting the antenna.").

³² SpaceX Letter, Attachment at 6.

³³ See Press Statement 19-005, Statement on NSF and SpaceX Radio Spectrum Coordination Agreement, National Science Foundation (June 4, 2019), <https://bit.ly/3ihRmMI>.

³⁴ SpaceX Letter, Attachment at 6.

³⁵ Narrative, SpaceX Blanket Earth Station Application at 1; *see also* Application of SpaceX Services, Inc., SES-MOD-20200731-00807 (filed July 31, 2020); Application of SpaceX Services, Inc., SES-LIC-20210708-01019 (filed July 8, 2021); Application of SpaceX Services, Inc., SES-LIC-20210309-00698 (filed Mar. 9, 2021); Application of SpaceX Services, Inc., SES-LIC-INTR2021-02902 (filed July 30, 2021); Application of SpaceX Services, Inc., SES-AMD-20210731-01295 (filed July 31, 2021); Application of SpaceX Services, Inc., SES-LIC-INTR2021-03015 (filed Aug. 3, 2021).



10.70-10.95 GHz band also conflict with the European Electronic Communications Committee's determination that NGSO FSS operations in the 10.7-10.95 GHz band need only "to be deactivated when in *visibility* of a RAS station performing observations."³⁶ Likewise, when recently asked about this issue, OneWeb stated "that it will protect the radioastronomy sites in 10.6-10.7 GHz primary allocation by not transmitting in the adjacent frequency channel when a OneWeb satellite *is in the visibility* of the radioastronomy receiver."³⁷ Given these important caveats, it is reasonable to assume the 10.70-10.95 GHz band was not fully ceded by SpaceX or any other operator. If SpaceX cannot use the 10.7-10.95 GHz band, it should explain why that is the case and whether that is expected to be the case in the future.

In any event, the Table of Frequency Allocations' footnote US131 requires that NGSOs coordinate with Radio Astronomy "to achieve a mutually acceptable agreement regarding the protection of the radio telescope facilities operating in the 10.6-10.7 GHz band."³⁸ Even if Radio Astronomy were to impair the 250 megahertz of spectrum assigned to SpaceX, which seems implausible, there are only 10 Radio Astronomy telescopes in CONUS, and at least five of these are in the southwest United States, which leaves the vast majority of CONUS unencumbered. SpaceX also suggests that microwave links in the 10.7-11.7 GHz band limits its use of that spectrum. RKF is examining whether those links would appreciably limit an NGSO FSS operator's channel selection, but our analysis of point-to-point links' effect on NGSO systems suggests that the real-world limitations imposed by these links will be minimal.

SpaceX says RKF should not have assumed that wireless operators would use modern antennas in their 5G systems. SpaceX, which still refuses to provide any detail on its antenna performance, objects to the study's use of 3GPP TR 38.820 specifications for the 5G base station's beamforming 3D pattern.³⁹ SpaceX criticizes the standard as "the most optimistic scenario for interference."⁴⁰ But this overlooks that the study is examining a shared band where multiple services will coexist and protect each other. Thus, it is not unreasonable to assume that a terrestrial deployment will use existing interference-mitigation technologies

³⁶ ECC Report 271, Compatibility and sharing studies related to NGSO satellite systems operating in the FSS bands 10.7-12.75 GHz (space-to-Earth) and 14-14.5 GHz (Earth-to-space), Electronic Communications Committee (last updated Jan. 25, 2019), at 22, <https://bit.ly/3rYM4ZJ> (emphasis added).

³⁷ Matt Daneman, *LEO Boom Increasingly Concerns Radio Astronomy*, COMMUNICATIONS DAILY (June 17, 2021), <https://bit.ly/3fuYT9g>.

³⁸ 47 C.F.R. § 2.106 Note US131.

³⁹ SpaceX Letter, Attachment at 5.

⁴⁰ *Id.*



to coexist. More importantly, these antennas are not unrealistic and incorporate interference-mitigation features found in today's wireless deployments. If anything, the study omitted the use of certain helpful coexistence tools like horizon nulling, which would have further reduced the probability of an exceedance event. Of course, the study could have used an antenna developed in 1995 or 2015 or an AM radio antenna from the 1930s for that matter, but none of those would have been a realistic assumption for a system being deployed in the 2020s. There is some irony in a technology company such as SpaceX criticizing the study's assumed use of state-of-the-art technologies.

SpaceX says RKF assumed the wrong Starlink antenna heights but refuses to provide the supposedly correct values. SpaceX also asserts that the study incorrectly assumed Starlink users would install user terminals on the ground.⁴¹ The blanket earth station license application uses an Above Ground Level value of 0.0 meters.⁴² SpaceX's default installation is a ground deployment. The Starlink kit includes no mounting tools beyond a mounting tripod that "is designed for ground level installation."⁴³ Any other type of deployment requires the purchase of additional equipment and, more likely than not, a professional installation to address the cabling and building penetration issues associated with rooftop mounting, including an "acknowledg[ment of] the potential risks associated with [a roof mount] installation."⁴⁴ Mr. Musk boasted that the "[i]nstructions are simply: plug in socket, point at sky" and joked that "[t]hese instructions work in either order."⁴⁵

And yet, without providing an affidavit, citation, or any data whatsoever, SpaceX claims that "most current users install antennas as high as possible (typically rooftop)."⁴⁶ How often is

⁴¹ SpaceX Letter, Attachment at 8.

⁴² Form 312, Application of SpaceX Services, Inc., IBFS File No. SES-LIC-20190211-00151 (filed Feb. 11, 2019); Form 312, Application of SpaceX Services, Inc., IBFS File No. SES-MOD-20200731-00807 (filed July 31, 2020).

⁴³ Frequently Asked Questions, Starlink, <https://bit.ly/3js6Z3B> (last visited Aug. 3, 2021) ("What comes in my Starlink kit? Your Starlink Kit includes everything you need to connect to the internet including your Starlink, wifi router, power supply, cables and mounting tripod. The mounting tripod is designed for ground level installation, or to support a quick start setup to test your internet connection. For users that require a roof install, roof mounts are available by signing into your account.").

⁴⁴ Starlink Pre-Order Agreement, Starlink, <https://bit.ly/3isXZMf> (last visited Aug. 6, 2021) ("If you require a permanent roof mount installation, you acknowledge the potential risks associated with this type of installation, including, without limitation, with respect to any warranty that applies to your roof or penetration of your roof membrane. Follow the Install Guide. If you cannot safely install the Starlink Kit, do not install it.").

⁴⁵ Elon Musk (@elonmusk), Twitter (Jan. 7, 2020, 9:06 AM), <https://bit.ly/3Asv1SK>.

⁴⁶ SpaceX Letter, Attachment at 8.



this the case? At what height? Are these figures self-reported? Or determined by survey? Here, as throughout its filing, SpaceX makes vague assertions attacking the study's assumptions but does not provide even basic information to show how those assumptions should be changed. If SpaceX has valid data to use, we urge the Commission to require that data to be shared with us or, better yet, placed in the record.

SpaceX says RKF should not have used the antenna gain values SpaceX provided the FCC but does not bother to provide the data RKF should have used. SpaceX argues that the study incorrectly assumed the antenna gain of Starlink terminals. The assumed gain figure was developed based on the blanket earth station authorization, which shows an antenna gain of 34.6 dBi at 14.25 GHz and 33.2 dBi at 11.83 GHz.⁴⁷ Those figures were interpolated to determine 33.7 dBi in the 12.2-12.7 GHz range. And while SpaceX refers to an ETSI standard applicable to NGSO user terminals, SpaceX does not state that Starlink terminals perform at this standard.⁴⁸ This argument, like the others before it, is a microcosm of the “hide-the-ball” tactics that SpaceX continues to play, often revealing no more than a half-truth and zero data.⁴⁹

SpaceX criticizes RKF for not proposing rules that the FCC never asked for. The SpaceX Letter begins with the audacious, goalpost-shifting claim that “the Commission will only act if [12 GHz terrestrial supporters] *could propose rules* that would protect existing satellite services in the band.”⁵⁰ But the Commission’s notice of proposed rulemaking did not require anyone to propose rules. Rather, it merely sought “comment on whether the Commission could add a new or expanded terrestrial Mobile allocation in the 12 GHz band without causing harmful interference to incumbent licensees.”⁵¹ In particular, the Commission asked for “further information and studies related to the feasibility, costs, and benefits of sharing among these services.”⁵² The RKF NGSO Study provided precisely such information.

⁴⁷ Form 312, Application of SpaceX Services, Inc., IBFS File No. SES-LIC-20190211-00151 (filed Feb. 11, 2019) (stating the Starlink terminal’s antenna gain is “33.2 dBi at 11.83 [GHz]” and “34.6 dBi at 14.25 GHz”).

⁴⁸ SpaceX Letter, Attachment at 8.

⁴⁹ Attorneys practicing before the Commission are obliged to “conform to standards of ethical conduct required of practitioners at the bar of any court of which [that practitioner] is a member.” 47 C.F.R. § 1.24(a)(2).

⁵⁰ SpaceX Letter at 1.

⁵¹ *Expanding Flexible Use of the 12.2-12.7 GHz Band et al.*, Notice of Proposed Rulemaking, 36 FCC Rcd 606 ¶ 2 (2021).

⁵² *Id.* ¶ 29.



SpaceX complains that no “geographic areas” or “geographic limitations” have been proposed. But the 12 GHz band is already geographically licensed, and the RKF NGSO Study uses Partial Economic Areas, which are widely used in bands that support 5G to simulate a 5G network and specifically addresses geographic licensing matters.⁵³ SpaceX states that power levels have not been suggested, but the RKF NGSO Study includes that information, too.⁵⁴

* * *

RKF welcomes reasonable, data-driven criticism and questions about our analysis. As a professional engineering consultancy, we understand hard questions come with the territory. We cannot, however, tolerate brazen misrepresentations about work we have performed, bad-faith explanations of our assumptions, or allegations casting doubt on our integrity. We stand behind our work and, as a respected firm that has assisted the Commission in many spectrum proceedings, we look forward to engaging with good-faith actors who seek to bring the Commission’s 12 GHz rulemaking to a successful conclusion.

Please contact me with any questions about this submission.

Sincerely,

/s/ David Marshack

Managing Director and Chief Operating Officer
RKF Engineering Solutions, LLC

⁵³ RKF NGSO Study at n.15.

⁵⁴ *Id.* at 34, 36, 38.