

November 12, 2021

VIA ECFS

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

Dear Ms. Dortch:

RS Access, LLC (“RS Access”) submitted to the record a rigorous economic study by the Brattle Group that estimated adding flexible use rights into the 12.2-12.7 GHz (“12 GHz”) band could produce a net present value in social welfare benefits well above \$1 trillion.¹ While a handful of commenters allege contradictions and inconsistencies in the Brattle Group’s assumptions and methodology, the Brattle Group study in fact provides a meticulously consistent analysis that comports with other studies now on the record. RS Access addresses the unfounded claims to the contrary below.

The Brattle Study reasonably used the C-band as the most comparable spectrum band to the 12 GHz band. SpaceX and other opponents of reform are substantively incorrect that the 12 GHz band more closely resembles the millimeter-wave bands than the C-band.² The report by the wireless industry consultancy Roberson and Associates, LLC examined this precise question and concluded that the 12 GHz band is “significantly” more akin to the C-band than the millimeter-wave band, particularly in “three key aspects” of radiofrequency propagation: (1) basic free-space path loss and building entry loss; (2) environmental effects, such as foliage; and (3) atmospheric absorption.³ The Roberson Report also found that a millimeter-wave deployment would require “5 to 15 times as many base station sites to provide equivalent coverage as a 12 GHz-based network.”⁴ Like the C-band, the 12 GHz band can add much greater network capacity at a dramatically lower deployment cost than

¹ Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, Appendix B (filed May 7, 2021) (“Brattle Study”); *see also id.*, Appendix A (“RKF NGSO Study”).

² Reply Comments of Space Exploration Holdings, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, at 15 (filed July 7, 2021) (“SpaceX Reply Comments”) (“12 GHz is not C-band; any deployment more closely resembles millimeter wave”); Reply Comments of OneWeb, WT Docket No. 20-443 and GN Docket No. 17-183, at 7 (file July 7, 2021) (“The limited propagation characteristics of 12 GHz spectrum mean that its terrestrial mobile use is as a capacity band—a role already filled by many millimeter wave (‘mmWave’) spectrum bands”).

³ Reply Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, Appendix A, at 1 (filed July 7, 2021) (“Roberson Report”).

⁴ *Id.* at 5.

millimeter-wave spectrum. The RKF NGSO Study similarly explains that “[b]ase station transmitters using high capacity 12 GHz spectrum would most likely be deployed as part of a multi-band spectrum strategy.”⁵

The Roberson Report thus confirms that the Brattle Study reasonably chose the C-band as a reference point for valuing the 12 GHz band based on the performance similarities between the two bands.⁶ Indeed, both the RKF and Brattle studies use the same coverage radii estimates for the 12 GHz band.⁷ Unlike the 12 GHz band, operators deploy services on millimeter-wave spectrum in areas of exceptionally high population density that are experiencing capacity shortfalls.⁸ New Street Research estimated in October 2020 that Verizon’s Ultra Wideband footprint provided coverage to only 0.5% of Americans.⁹ As the Roberson Report shows, the 12 GHz band does not suffer from those propagation limitations.

The assumptions and methodologies of the Brattle Study and the RKF NGSO Study accord with one another. SpaceX and its allies assert that the Brattle Study and the RKF NGSO Study reach different conclusions about the 12 GHz band’s deployment use cases and associated 5G market opportunity.¹⁰ As an initial matter, the satellite licensees’ exercise of contriving inconsistencies makes little sense because the Brattle Study and the RKF NGSO Study are designed to answer different (but complementary) questions. The Brattle Study is focused on deriving the economic value of allowing more flexible operations in the band. The RKF NGSO Study explored whether and how much introducing 5G in the band might impair non-geostationary orbit Fixed-Satellite Service (“NGSO FSS”) operations—*if* the satellite operators succeed in acquiring subscribers and *if* no reasonable mitigation measures are performed. The RKF NGSO Study focused on deployment factors that can affect physical phenomena around signal reception, while the Brattle Study focused on deployment factors that drive societal and economic value.

⁵ RKF NGSO Study at 3.

⁶ Brattle Study at n.46 (“The 12 GHz band’s performance is [more] similar to the C-band than other higher bands.”).

⁷ RKF NGSO Study at 3-4 (“The analysis generates a network of terrestrial base stations across CONUS by placing them randomly in the most densely populated areas comprising at least 10% of the population of each Partial Economic Area (PEA), approximating the siting of a terrestrial 12 GHz network operator’s macro-cell base stations. This model results in a 12 GHz deployment area that includes smaller cities and towns as well as the largest and most populous cities in CONUS.”); Brattle Study at 23 (“We treat urban and non-urban population differently in our analysis (100% 12 GHz reach of urban population, fractional 12 GHz reach of non-urban population). We define the urban population as population in tracts with a population density of at least 7,500 pops per square mile. The remaining population, comprised of suburban and rural population, is the non-urban population set.”).

⁸ *Deploying 5G NR mmWave to unleash the full 5G potential*, Qualcomm, at 32 (Nov. 2020), <https://bit.ly/3miFfku> (“Traditional fiber backhaul can be expensive for mmWave cell sites[.] mmWave access inherently requires small cell deployment[.]”).

⁹ Mike Dano, *Verizon covers 0.5% of Americans with mmWave 5G – analysts*, LIGHT READING (Oct. 22, 2020), <https://bit.ly/2WpM0q1>.

¹⁰ SpaceX Reply Comments at 14-15; Reply Comments of AT&T Services, Inc., WT Docket No. 20-443 *et al.*, at 27-30.

The two studies are also fully compatible. The Brattle Study's decision to use the C-band as a valuation baseline, for instance, tracks the RKF NGSO Study's siting methodology, contrary to the claims of 5G opponents. To see why, one must first understand how the Brattle Study sought to measure the economic value of the 12 GHz band. First, the Brattle Study identified another spectrum band that would serve as the baseline for valuation. The technique of using "comparables" is standard practice; after all, to prospectively estimate the value of a new spectrum band, it is useful to look at auction or transaction history for a similar band. Second, having identified the C-band as a reasonable starting point for valuing the 12 GHz band, the Brattle Study then adjusted that value *downward* based on the relevant propagation and other market-driven differences between the two bands. In particular, the Brattle Study discounted the value of the 12 GHz band based on the expectation that a 12 GHz network likely would cover fewer U.S. subscribers than a C-band network¹¹ when used as part of a multi-band network deployment strategy.¹² The Brattle Study also conducted a sensitivity analysis that layers in a dissimilarity discount to provide a range of estimated values for the 12 GHz band.

Valuation factors like network utilization rates, unlicensed spectrum, and international harmonization are sufficiently addressed by the Brattle Study. When using a market comparable for valuation, economists adjust for relevant differences between the use of the comparable spectrum (the C-band in the Brattle Study's analysis) and the spectrum being valued (the 12 GHz band). For example, the Brattle Study took into account differences between the propagation characteristics of C-band and 12 GHz spectrum and made adjustments to the estimated value of the 12 GHz band based on those differences. Equally important, when there are no identifiable differences, no value adjustment is warranted. Microsoft makes a number of criticisms about the Brattle Study's analysis, but fails to identify a relevant difference between C-band and 12 GHz spectrum that the Brattle Study had not already considered and addressed.

For example, Microsoft incorrectly asserts that the Brattle Study ignores the assumed 50% utilization rate used by the RKF NGSO Study.¹³ By using a market comparable as a basis for valuation, the Brattle Study does not explicitly model things such as network utilization rates, but rather relies on the market participants involved in the comparable transactions to understand how best to use their

¹¹ Although the 12 GHz band would be available for terrestrial use throughout the continental United States, the Brattle Study's analysis focuses on one particular deployment scenario. That scenario focuses on a restricted deployment and measures the economic value of the initial, most profitable deployments of 12 GHz in an integrated wireless carrier network. That focus is not intended to imply that 12 GHz will not be deployed more widely. 12 GHz licensees will deploy so long as the value created exceeds the cost of incremental deployments. But since the economic value created by additional deployments is expected to be less than the value from the initial deployments modeled, the Brattle Study conservatively left them out of the *economic* analysis. Doing so in no way suggests that further deployments are not likely.

¹² Reply Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, at 10 (filed July 7, 2021) ("Integrating the 12 GHz band into the Commission's 5G plan would result in much more efficient use of existing spectrum, creating a 'golden spike' that bridges lower mid-band and millimeter-wave bands into a seamless whole. By freeing up other bands and using each megahertz of scarce spectrum more efficiently, the 12 GHz band would permit carriers to maximize coverage and capacity. For example, mobile operators could assign 12 GHz capacity blocks to users who are closer to the cell center, allowing C-band, 2.5 GHz, and AWS spectrum to support the mid-range and freeing a greater portion of low-band spectrum for service to the cell's edge.").

¹³ Reply Comments of Microsoft Corporation, WT Docket No. 20-443 and GN Docket No. 17-183, at 15 (filed July 7, 2021) ("Microsoft Reply Comments").

spectrum. Microsoft's criticism would potentially have merit only if the utilization rate for 12 GHz spectrum were, for some reason, markedly different from the utilization rates assumed by C-band auction participants.¹⁴ But Microsoft has not suggested that the network utilization of the 12 GHz band would be any different from other bands; therefore, Microsoft's argument is irrelevant, has no foundation, and cannot withstand scrutiny.

Microsoft similarly appears to misunderstand the Brattle Study's market price calculations by falsely asserting that the Brattle Study did not account for unlicensed spectrum in evaluating the 12 GHz band.¹⁵ In fact, the Brattle Study did account for unlicensed spectrum. As with network utilization, the presence of alternative licensed and unlicensed spectrum is an inherent element of valuation, and the C-band comparable that the Brattle Study uses fully incorporates all expectations about the availability of unlicensed spectrum and how it will be used in the new 5G ecosystem.¹⁶ There were no significant changes in the availability of unlicensed spectrum since the C-band auction; thus, additional adjustments were neither appropriate nor necessary. Microsoft is simply incorrect that the Brattle Study ignores unlicensed spectrum in its value calculations.

Microsoft's assertion that manufacturers will only belatedly, "if ever," build 12 GHz hardware without international harmonization is similarly meritless.¹⁷ As shown by extensive U.S. deployments in the 600 MHz, 700 MHz, 2.5 GHz, and many other bands that do not have globally harmonized allocations, the lack of harmonization is not an insurmountable barrier to developing technology.¹⁸ It is, at best, a factor that increases some costs, putting downward pressure on spectrum value, as reflected in the Brattle Study when it made a *downward* adjustment to value based on a lack of globally harmonized rules for the 12 GHz band. The Roberson Report also reviewed these issues in detail and explained why U.S. leadership in the 12 GHz band would not be stymied by a lack of international harmonization or an ostensible lack of vendor interest in the band.¹⁹ Due to the 12 GHz band's similarity to other

¹⁴ Even then, an adjustment would only be warranted if, after adjusting for any implications of different utilization rates, the impact of different utilization rates flowed through to differences in spectrum value.

¹⁵ *Id.* at 15-16.

¹⁶ The Commission's 6 GHz R&O, which is paving the way for Wi-Fi 6E deployment in the United States, was adopted April 23, 2020—more than seven months before the start of the C-band auction (December 8, 2020). 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).

¹⁷ Microsoft Reply Comments at 16.

¹⁸ See, e.g., Comments of RS Access, LLC, WT Docket No. 20-443 and GN Docket No. 17-183, 68-69 (filed May 7, 2021) ("RS Access Comments") ("The Commission has often acted before the ITU in facilitating mobile use in spectrum bands with latent potential. Examples include 600 MHz, 700 MHz, 2 GHz, 3.7 GHz, and 28 GHz.") (citing *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567 ¶ 319 (2014); *Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002); *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, First Report and Order and Order and Third Notice of Proposed Rulemaking, 7 FCC Rcd 6886 ¶ 3 (1992); *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343 (2020); *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (2016)).

¹⁹ Roberson Report at 34-37.

mid-band frequencies that already have a robust equipment ecosystem, it is more than feasible for vendors to develop 12 GHz-compatible units cost-effectively at scale in a rapid timeframe.

The Brattle Study did not ignore the cost of potential harmful interference to NGSO FSS systems. Microsoft also wrongly faults the Brattle Study as ignoring the cost of potential harmful interference to NGSO FSS systems.²⁰ As an initial matter, all radio systems must live with some potential risk of interference. NGSO FSS systems must be frequency-agile to manage co-channel interference with other NGSO FSS systems.²¹ The RKF NGSO Study estimates that, if co-channel operations were completely uncoordinated, I/N exceedance events of -8.5 dB would occur less than 1 percent of the time.²² Microsoft misunderstands this result and incorrectly mischaracterizes it to mean “NGSO customers will experience harmful interference nearly 1% of the time.”²³ A nominal exceedance event before any form of coordination is different from “harmful interference.”²⁴ In other words, the RKF NGSO Study simply identifies the possibility that, absent mitigation, the conditions necessary to create interference *could* occur. Contrary to Microsoft’s misreading, the RKF NGSO Study emphatically does not conclude that harmful interference *will* occur at this rate and finds instead that any interference will prove inconsequential once the system resources and performance characteristics of satellite and terrestrial systems are taken into account.²⁵ Among other things, for example, frequency-agile NGSO FSS systems have access to up to 3,500 megahertz additional user downlink spectrum.²⁶ In addition, 5G base stations will use beamforming, which focuses energy where its use is most productive and minimizes energy where it is not.²⁷ These and other features embedded

²⁰ Microsoft Reply Comments at 14-15.

²¹ Space Exploration Holdings, LLC Application for Approval for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, IBFS File No. SAT-LOA-20200526-00055, at 6 (filed May 26, 2020). (“And by ensuring every consumer has multiple satellites in view from any given point on the ground, SpaceX’s next-generation system will have flexibility to deliver robust service, even in a crowded spectrum environment. These same attributes will give SpaceX the agility to address any spectrum coordination issues that may arise . . .”).

²² RKF NGSO Study at ii.

²³ Microsoft Reply Comments at 8.

²⁴ See 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.”).

²⁵ RKF NGSO Study at 55 (“[T]he model does not implement any of the case-by-case mitigation measures that operators routinely employ to mitigate the potential for interference in the ordinary course of business (and that – if needed – are particularly easy to implement before systems are widely deployed).”).

²⁶ See, e.g., Letter from David Marshack, Managing Director and Chief Operating Officer, RKF Engineering Solutions, LLC, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443, at 3 (filed Aug. 9, 2021) (“[E]ven 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.”).

²⁷ See, e.g., RKF NGSO Study at iii (“[S]everal qualitative factors account for the highly favorable coexistence environment in the 12 GHz band. . . . 5G macro-cell base stations in 12 GHz will be beamforming, which further focuses their radiated energy on the UEs being served and not on NGSO user terminals.”).

into system resource configurations and designs will mitigate the effects of any exceedance in the unlikely event it occurs.²⁸

Even if an unmitigated exceedance event were to occur, moreover, a proper evaluation of incremental effects would require analysis of how an exceedance event would affect NGSO FSS network performance and the user experience. Tellingly, after having months to prepare a response to this very fundamental question, neither Microsoft nor its NGSO FSS partners have provided any technical explanation as to what the actual impairment would be. Microsoft claims, with no citation or analysis, that a -8.5 dB exceedance event is “enough to impair the operation of key NGSO FSS use cases and Microsoft’s own planned services.”²⁹ What use cases? How would Microsoft’s own planned services be affected? Microsoft does not say.

Expectations matter, too. What actual service impediments would hypothetical future NGSO consumers see after the FCC authorizes more intensive use of the 12 GHz band? SpaceX does not say. The truth, of course, is that NGSO FSS systems must remain resilient to coexist with one another and other users in the bands they operate, and there is always a risk of harmful interference to any system. Data network operators design with resiliency in mind, and a network’s baseline performance helps identify the impact, if any, that episodic, localized performance constraints may create. In the case of Starlink and other broadband NGSO systems, advanced routing protocols increase resiliency end-to-end across the network. Thus, even if exceedance events were to occur and even if some subset of those events were to result in harmful interference (neither of which is, in fact, likely), routing protocols embedded in the network design contemplate real-time event dampening, convergence, route redistribution, and other features to avoid single points of failure.

No evidence has been put on the record suggesting there would be any actual user impairment even if an exceedance event were to occur. And so, without specific or quantified estimates of the actual potential impairment to NGSO FSS systems on the record, the Brattle Study assumed that the actual economic impact of the risk of harmful interference would likely be negligible. But more importantly, the Brattle Study found that even if there were some small impact on the value of a hypothetical, yet-to-exist NGSO FSS service, the impairment would fall massively short of the positive value created by adding terrestrial deployments to the 12 GHz band for the benefit of hundreds of millions of potential consumers, including many who are currently underserved.

The demonstrated high likelihood of coexistence in the 12 GHz band also explains why Microsoft is wrong to assert that flexible use would undermine NGSO FSS operators’ investment-backed expectations: no impairment is likely to exist. And even if some burden were to unexpectedly emerge, the Commission has consistently conditioned grants of 12 GHz NGSO FSS authority on the outcome of the 12 GHz flexible-use rulemaking. Therefore, NGSO FSS licensees, investors, and the public received more than sufficient warning that they proceed in their deployments at their own risk.³⁰

²⁸ RKF NGSO Study at 2-3, n.7.

²⁹ Microsoft Reply Comments at 2.

³⁰ The Commission most recently reminded NGSO operators that the agency may seek to expand the terrestrial capabilities in the 12 GHz band when it granted SpaceX’s third modification. *See, e.g., 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-

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In sum, the Brattle Study's analysis offers a sound economic assessment of the enormous societal value of introducing 5G in the 12 GHz band. Taken together with the RKF NGSO Study, the Roberson Report, and RS Access's submissions in this proceeding, the Brattle Study provides powerful support to the proposition that adding flexible use rights to existing terrestrial authorizations in the 12 GHz band represents the quickest and most reliable way to achieve vastly more intensive use of the band on behalf of hundreds of millions of American consumers. RS Access looks forward to rapidly bringing the rulemaking process to a close and encourages the Commission to update 12 GHz rules so the benefits of 5G may be brought to market as soon as possible.

Please contact me with any questions regarding this submission.

Sincerely,

/s/ Trey Hanbury

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00037, 36 FCC Rcd 7995 ¶ 50 (2021) ("As with prior grants, we condition this grant, subject to any modification necessary to bring it into conformance with future actions in Commission rulemakings, including but not limited to the 12 GHz proceeding, which is expressly referenced in the ordering clauses below. Therefore, SpaceX proceeds at its own risk."). These conditions exist in other 12 GHz NGSO authorizations. See Comments of DISH Network Corporation, WT Docket No. 20-443, at 58-59 & n.202 (filed May 7, 2021) (identifying similar conditions in grants for Space Norway, Kepler, and other NGSO operators in the 12 GHz band); see also RS Access Comments at n.10.