Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Expanding Flexible Use of the 12.2-12.7 GHz Band	)	WT Docket No. 20-443
	)	
	)	
Expanding Flexible Use in Mid-Band Spectrum Between 3.7-24 GHz	)	GN Docket No. 17-183
	)	

COMMENTS OF RS ACCESS, LLC

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EXECUTIVE SUMMARY

The 12.2-12.7 GHz band ("12 GHz band") offers 500 megahertz of prime mid-band spectrum for 5G mobile broadband that economists from the Brattle Group estimate could produce a net present value in social welfare benefits in excess of $1 trillion. This proceeding presents the Commission with a critical opportunity to accelerate the deployment of 5G wireless services in the United States.

Terrestrial 12 GHz authorizations, licensed under the Multichannel Video Distribution and Data Service ("MVDDS"), were purchased in FCC auctions in 2004 and 2005. Today, MVDDS licensees stand ready, willing, and able to put this spectrum to its highest and best use. But obsolete rules written in 2002, well before the smartphone era, are subverting the promise of the 12 GHz band. However sensible these rules may have been nearly 20 years ago, they have long outlived their original purpose. Terrestrial 12 GHz licensees find themselves prohibited from offering two-way mobile services at power levels suitable for commercially viable broadband. By refreshing the MVDDS rules to reflect the manifold changes in consumer demand and technology since the rules were adopted, the Commission can make critical mid-band spectrum available for 5G without harming other current or nascent 12 GHz licensees.

Releasing additional mid-band spectrum will preserve U.S. 5G leadership and serve consumers. Despite the Commission's leadership in opening new bands for wireless broadband, the United States continues to lag behind 5G powerhouses like China and South Korea. Even after scheduled and pending auctions conclude, the United States will still remain behind other countries in deployed and licensed 5G spectrum, with no other mid-band spectrum available to be added to the pipeline for domestic demand. By taking swift action to modify the 500 megahertz of existing terrestrial licenses in the 12 GHz band, the Commission can propel the

United States into a global leadership position in the amount of mid-band spectrum available for next-generation broadband.

The 12 GHz band should be the next 5G band. The 12 GHz band is uniquely well positioned to boost U.S. 5G leadership. Its sheer size—500 megahertz—would allow for the massive channels that 5G demands. Its unique location, between the lower mid-band and millimeter-wave frequencies, would allow operators to bridge the gap in their spectrum portfolios. Just as the "golden spike" in the Nineteenth Century marked the completion of the transcontinental railroad and unlocked massive synergies and economic potential, so too would action in this proceeding unleash the 12 GHz band, allowing operators to seamlessly unite the low- and mid-band with millimeter-wave frequencies into a unified whole. Indeed, the 12 GHz band is the only band situated between the 3.70-3.98 GHz band ("C-band") and the millimeter-wave bands that offers multiple 100-megahertz channels; propagation characteristics similar to the C-band; capacity akin to that of the millimeter-wave bands; lower deployment costs compared to the millimeter-wave bands; and a relatively simple implementation path into the 5G ecosystem. Moreover, the band is already terrestrially licensed, meaning new services can be deployed without the need for a legally and logistically complex process to assign new spectrum authorizations. And, not least important, the band has no other federal users or federal encumbrances that could complicate and delay commercial deployment.

Coexistence is readily achievable, desirable, and in the public interest. 5G operations in the 12 GHz band will coexist with nascent non-geostationary satellite orbit ("NGSO") Fixed Satellite Service ("FSS") and existing Direct Broadcast Satellite ("DBS") services in the band. Rapid technical advances in antenna design and mobile network architectures have made 5G/DBS/NGSO coexistence even more achievable now than it was when this proceeding's

petition for rulemaking was submitted in 2016. For example, advances in massive MIMO and advanced beamforming and beamsteering—technologies that were still in laboratories in 2016—are now being widely deployed by commercial mobile operators. These technologies limit unfocused radiation between communications points and give 12 GHz mobile operators the tools needed to deploy massive capacity at scale while avoiding NGSO and DBS users.

The outdated MVDDS rules stipulate a co-primary relationship among MVDDS, DBS, and NGSO operators. DISH Network, which has nearly nine million active DBS subscribers, actively participated in the coalition that submitted a study attesting to the feasibility of coexistence between DBS and expanded terrestrial use that reflects the modern-day needs of Americans. NGSO services have yet to provide meaningful commercial service to subscribers, and they have long been on notice that the Commission may seek to expand the terrestrial capabilities in the 12 GHz band—a fact the Commission reiterated when it granted Space Exploration Holdings, LLC's ("SpaceX's") third modification.

To assess the feasibility of coexistence, RKF Engineering Solutions, LLC conducted a statistically robust simulation of likely NGSO and 5G deployments based on real-world operating parameters and data—to the extent knowable given the nascent and often opaque nature of emerging NGSO deployments ("RKF Study"). The RKF Study methodically analyzed coexistence in a hypothetical future that assumes high consumer adoption of SpaceX's currently-in-beta NGSO service offering in realistic deployment scenarios. The report demonstrates that 5G and NGSO operations are complementary and can coexist. In the simplest of terms, NGSO receivers will look up from the ground to satellite transmitters in low-earth orbit, but 5G base station transmitters will look down toward 5G user equipment on the ground. And while NGSO systems can connect sparsely populated areas, these systems—unlike terrestrial 5G networks—

are not as practical as terrestrial mobile for meaningfully serving regions of higher population density using the 12 GHz band. The report shows that, even in instances where an exceedance of the International Telecommunication Union's -8.5 dB interference-to-noise ratio limit is more likely to occur, the probability is minimal. More than 99% of terminals never experience an exceedance event and, for those that do, the risk can be addressed through mitigation techniques, good-faith coordination, and other time-tested measures.

Coexistence not only is readily achievable but also maximizes the public interest and consumer benefits compared to the regulatory status quo. An economic study from the Brattle Group finds that terrestrial broadband in the 12 GHz band could be worth as much as $54 billion and create as much as $1,082 billion of net present value in consumer welfare benefits. In other words, every year of delay by the Commission in authorizing 5G use in the 12 GHz band corresponds to an implicit tax of as much as $54 billion on all American consumers. That corresponds to as much as a tax of $163 per year—or more than $13 per month—for each person in America.

The time to act is now. The 12 GHz band is in the midst of transformational change. Demand for 5G services from the more than 300 million U.S. mobile subscribers continues to explode, and mobile operators are looking for additional spectrum to expand the capacity and meet consumer demand. NGSO systems promise to deliver broadband with a focus on unserved and underserved regions of the United States. The feasibility of these business models, currently in beta and pre-commercial stages, to deliver robust service and attract significant subscriber scale remains highly uncertain. And DBS subscribership, currently at 21.8 million, nationally continues to decline annually by the millions as subscribers abandon satellite television for streaming video. Taken together, the 12 GHz band sits at the intersection of a generational shift

in use cases where terrestrial, NGSO FSS, and DBS can all play a role in maximizing the utility of the 12 GHz band. However, only one use case (1) is commercially proven, (2) has demonstrated continually growing demand over many years, (3) boasts a current installed base of connected user equipment far exceeding the total population of the country, and (4) is many times larger than either DBS or the most wildly optimistic projections of NGSO. That use case is terrestrial 5G. And the Commission need not discard or harm NGSO FSS or DBS to achieve this use case because they can coexist in a win-win-win for American consumers and the American economy.

The Commission has the unique opportunity to reset the service rules and to craft a durable set of policies that would ensure all three co-primary services remain viable for years to come. But the Commission must act in the narrow window afforded to it. Abandoning the terrestrial rights at the 12 GHz band to outdated service restrictions would stymie innovation, squander valuable spectrum resources, and, in the process, scrap what economists estimate may be a trillion dollars or more worth of consumer benefit.

Updating the 12 GHz band to allow 5G will stimulate economic growth, produce immense consumer benefits, promote national security, preserve co-primary services, and foster civil, economic, social, and educational progress.

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COMMENTS OF RS ACCESS, LLC

I. INTRODUCTION.

RS Access, LLC ("RS Access") welcomes the Commission's release of a Notice of Proposed Rulemaking that seeks input on whether and how the 12.2-12.7 GHz band ("12 GHz band") could rapidly expand the supply of 5G-ready mid-band spectrum by permitting two-way mobile services that coexist with satellite operations.[1] Maximizing terrestrial use of the 12 GHz band is even more important now than when the MVDDS 5G Coalition filed its Petition for Rulemaking five years ago.[2] Despite the Commission's best efforts, wireless operators continue to face a shortage of contiguous mid-band spectrum ideal for 5G. The Commission's spectrum inventory offers few viable mid-band options to bridge the gap between lower-mid band spectrum, on the one hand, and the millimeter-wave frequencies, on the other.[3] Meanwhile,

[1] *Expanding Flexible Use of the 12.2-12.7 GHz Band et al.*, Notice of Proposed Rulemaking, 36 FCC Rcd 606 ¶ 19 (2021) ("*NPRM*").

[2] *See* Petition of MVDDS 5G Coalition for Rulemaking, RM-11768 (filed Apr. 26, 2016) ("MVDDS 5G Coalition Petition").

[3] The Commission's 2017 Notice of Inquiry defined "mid-band" spectrum as the range between 3.7-24 GHz. *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd 6373 (2017) ("*Mid-Band NOI*"). In the *Mid-Band NOI*, the Commission specifically referred to the then-pending MVDDS 5G Coalition Petition. *Id.* at n.14. These

other nations continue to release large amounts of mid-band spectrum for their 5G networks—a reality that, if unaddressed, will harm the United States economically and geopolitically.

The 500-megahertz block of spectrum in the 12 GHz band is the *only* candidate between 6 and 24 GHz that can be quickly harnessed to turbocharge 5G deployment in the United States.[4] The band has many advantages: (1) because it is already licensed for terrestrial use, the Commission can quickly facilitate its use for 5G without delay; (2) the band sits at the mid-point of mid-band frequencies allowing operators to enhance their spectrum portfolios and optimize deployments from the 600 MHz band to the millimeter-wave frequencies; (3) it is free from federal incumbents; and (4) it can allow channel sizes of 100 megahertz or more.

While terrestrial services are already co-primary, the promise of dramatically enhanced 5G in the 12 GHz band remains stymied by legacy rules dating from the early 2000s—before the advent of smartphones and mobile broadband. The current rules are archaic: they impose severe power limits; require onerous, expensive, and unnecessary coordination efforts; and prohibit two-way mobile communications. After nearly two decades of extraordinary technological advancement, these anachronistic regulations still govern the use of the 12 GHz band and prohibit Multichannel Video Distribution and Data Service ("MVDDS") licensees from offering robust wireless services to meet the exploding demand for mobile broadband. The Commission can unleash the 12 GHz band's untapped potential by modernizing the MVDDS rules to reflect: (1) the public interest benefits of mobile broadband, (2) the burgeoning demand for mid-band spectrum for 5G, and (3) the enhanced ability of 5G operators to coexist with co-primary Direct

comments will treat spectrum 3-24 GHz as "mid-band" spectrum and spectrum above 24 GHz as millimeter wave or "high-band" spectrum.

[4] Since the initial issuances of MVDDS licenses, a small number of authorizations have been relinquished and a few others remain subject to review.

Broadcast Satellite ("DBS") services currently operating in the 12 GHz band and non-geostationary satellite orbit ("NGSO") Fixed-Satellite Service ("FSS") systems that are beginning to deploy or may deploy in the future.

The Commission can rapidly enhance 5G deployment without undermining potential NGSO FSS operations.[5] In a study accompanying these comments, RKF Engineering Solutions, LLC ("RKF") demonstrates that the emerging NGSO FSS operators can continue to deploy their nascent services simultaneously with the authorization and rapid deployment of mobile and two-way terrestrial services in the same spectrum.[6] Of all the options before the Commission, updating the MVDDS service rules is the only way to create a transformative new 5G band quickly enough to keep pace with burgeoning consumer demand.

The expedited time to deployment, in turn, will allow super-fast speeds, broader 5G coverage, new jobs, and economic growth years earlier than otherwise possible. As detailed below and in the attached report from Coleman Bazelon and Paroma Sanyal of the Brattle Group, the annual consumer welfare value of authorizing 5G services in the 12 GHz band is as much as $54 billion.[7] Every year of delay by the Commission in authorizing 5G use in the 12 GHz band corresponds to an implicit tax of as much as $54 billion on all American consumers. That

[5] *See, e.g.*, Letter from David Goldman, Director of Satellite Policy, SpaceX, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-133, Attachment at 7 (filed May 3, 2021) (stating that Starlink's "Public Beta Service [is] underway" with a "[f]ocus initially on remote, rural communities with un/underserved households"); *see also NPRM* ¶ 19 (seeking "comment on how to weigh the spectrum the Commission has already made available for 5G over the past four years and the hundreds of satellites that have been launched by the NGSO FSS operators").

[6] *See infra* Appendix A, RKF, *Assessment of Feasibility of Coexistence between NGSO FSS Earth Stations and 5G Operations in the 12.2 – 12.7 GHz Band* (May 2021) ("RKF Study").

[7] *See infra* Section II.D; Appendix B, Coleman Bazelon & Paroma Sanyal, *Valuing the 12 GHz Spectrum Band with Flexible-Use Rights*, The Brattle Group (May 2021) ("Brattle Study").

amount corresponds to as much as a tax of $163 per year—or more than $13 per month—for each person in America.

If the Commission fails to act and instead maintains the regulatory status quo, it will lock the band into essentially satellite-only services and ignore the largest potential beneficiary of authorizing 5G deployment in the band: the more than 300 million U.S. mobile subscribers who rely on these services today. The 12 GHz band is in a transitional period. DBS service is declining as millions of subscribers switch[8] to over-the-top video services; demand for 5G is skyrocketing; and NGSO FSS services are nascent. During this transitional phase, the Commission has a unique chance to establish a new, forward-looking framework based on current technology trajectories rather than outmoded 2G-era assumptions. Now is the time to modernize the 12 GHz band so that all three co-primary services have a durable set of rules that create stable parameters for sharing the band, protecting all users, and maximizing the band's potential. NGSO operators will deploy either in a manner that impedes the use of the 12 GHz band for 5G or in a manner compatible with 5G. If NGSO operators such as Space Exploration Holdings, LLC ("SpaceX") see 5G providers as rivals,[9] they may choose to take actions that have the effect of diminishing policymakers' decisionmaking flexibility, even as the Commission has stipulated that NGSO operators have long been on notice that the Commission may seek to

[8] *See, e.g.*, *Communications Marketplace Report*, 2020 Communications Marketplace Report, GN Docket No. 20-60, FCC 20-188, ¶ 156, Fig. II.D.1 (rel. Dec. 31, 2020) (citing S&P Global, *Multichannel Industry Benchmarks* (last visited Oct. 27, 2020)) (finding a year-over-year decrease in DBS subscribership of about 3.75 million); *see also infra* note 116 and accompanying discussion.

[9] *See, e.g.*, Reply to Comments on ETC Designation Petition of Starlink Services, LLC, WC Docket No. 09-197, at 1 (filed Apr. 22, 2021) (arguing that the Ensuring RDOF Integrity Coalition "essentially repackages filings made by *Starlink's would-be competitors, such as Dish Network Corporation*") (emphasis added).

expand the terrestrial capabilities in the 12 GHz band[10]—a fact that the Commission reiterated when it granted Space Exploration Holdings, LLC's ("SpaceX's") third modification.[11] Therefore, the time for the Commission to act is now, while it still holds all options to maximize the utility of the band for the greatest societal benefit.

II. THE 12 GHZ BAND REPRESENTS THE BEST OPPORTUNITY TO DELIVER MID-BAND SPECTRUM THE UNITED STATES NEEDS FOR 5G LEADERSHIP.

A. 5G Leadership Is Essential for U.S. Economic and Security Interests, and Mid-Band Spectrum Is Critical for 5G.

The *NPRM* asks whether releasing more mid-band spectrum for terrestrial 5G serves the public interest.[12] The answer is unequivocal: yes. Freeing more mid-band spectrum is essential to advancing U.S. 5G leadership, which will serve broader economic and national security interests.

Technological leadership in mobile broadband has propelled U.S. competitiveness and prosperity in ways that were unimaginable a decade ago. The numbers all tell the same story and point in the same direction. According to one study, U.S. leadership in 4G created roughly $100

[10] *See, e.g., Space Exploration Holdings, LLC Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System et al.*, Memorandum Opinion, Order and Authorization 33 FCC Rcd 3391, n.88 (2018); *WorldVu Satellites Limited, d/b/a OneWeb (OneWeb) Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, Order and Declaratory Ruling, 32 FCC Rcd 5366, 5369 (2017).

[11] *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, ¶ 50 (rel. Apr. 27, 2021) ("*SpaceX Mod3 Order*") ("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.").

[12] *NPRM* ¶ 58.

billion of the increase in annual GDP in 2016, growing 70 percent in just three years.[13] That analysis found that the launch of 4G in the United States increased total wireless-related jobs by 84 percent from 2011 to 2014.[14] 4G leadership enabled the United States to set the pace for global innovation for mobile broadband services and applications for the last decade. According to another study, between 2011 and 2019, 10 percent of *all* U.S. GDP growth was attributable to the U.S. wireless industry, which led the world in 4G.[15]

The same dramatically positive economic effects will accompany the development of 5G. As Chairwoman Rosenworcel recently remarked:

> By exponentially increasing the connections between people and things around us, this technology could become an input in everything we do—improving agriculture, education, healthcare, energy, transportation, and more. The data we derive from all these connections is powerful—it will inform machine learning, artificial intelligence, and the next generation of innovation across the economy.[16]

The public's returns on these investments are expected to be massive. While estimates vary, there is broad consensus that the deployment and use of 5G networks represents a major boon to the U.S. economy. An economic analysis by ACT | The App Association, for example, found "that 8.5 million jobs will be created over 2019-2025 compared to a counterfactual 4G-only world, with an average of 1.2 million jobs each year. These workers will earn more than $560 billion during that time, create $1.7 trillion in additional output, and add over $900 billion to

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[13] Recon Analytics, *How America's 4G Leadership Propelled the U.S. Economy*, at 9 (Apr. 16, 2018) https://bit.ly/2PRJ0zJ ("In 2011, wireless industry GDP totaled $195.5 billion. In 2014, when 4G reached 40% penetration in the US, wireless industry GDP was $332.9 billion. In the space of three years, the GDP contribution of the US wireless industry had grown 70%.").

[14] *Id.* at 10.

[15] Recon Analytics, *The 4G Decade: Quantifying the Benefits*, CTIA, at 5 (July 29, 2020), https://bit.ly/3egbMna.

[16] Jessica Rosenworcel, Acting Chairwoman, Fed. Commc'ns Comm'n, *Accelerating 5G in the United States*, Center for Strategic and International Studies, DOC-370910, at 2 (Mar. 18, 2021).

U.S. GDP."[17] Accenture, likewise, estimates[18] that between 2021-2025, the impact of 5G will add up to $1.5 trillion to U.S. GDP and "has the potential to create or transform up to 16 million jobs across all sectors of the economy."[19]

The demand for high-speed, low-latency services will only continue to grow. In August 2020, CTIA reported 30 percent year-over-year U.S. mobile data growth,[20] and Ericsson estimates that there will be 5 billion cellular IoT connections by 2025.[21] To meet this insatiable demand for connectivity, the United States must continue its efforts to expand network capacity by identifying spectrum bands suitable for 5G—especially mid-band spectrum. Satisfying burgeoning consumer demand is why wireless operators have invested more than $100 billion to build out their 5G networks over the past four years[22] and why those operators are expected to invest an estimated $275 billion in total building 5G networks.[23]

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[17] Letter from Brian Scarpelli, Senior Global Policy Counsel, and Alexandra McLeod, Associate Policy Counsel, ACT | The App Association, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 14-177 *et al.*, Att. at 2 (filed Apr. 17, 2020).

[18] Jefferson Wang *et al.*, *5G accelerates economic growth*, Accenture (Feb. 22, 2021), https://accntu.re/3dfNidf.

[19] This figure includes full-time, part-time, and temporary jobs. *Id.* As another example, Boston Consulting Group estimates that 5G deployment over the next decade is expected to contribute between $1.4 trillion and $1.7 trillion to U.S. GDP. That economic growth will, in turn, create 3.8 million to 4.6 million jobs in the next decade. Enrique Duarte Melo *et al.*, *5G Promises Massive Job and GDP Growth in the US*, Boston Consulting Group, at 2 (Feb. 2021), https://bit.ly/2NxrBv6.

[20] CTIA, 2020 Annual Survey Highlights (Aug. 25, 2020), https://bit.ly/3qLu2bX ("CTIA 2020 Annual Survey Highlights").

[21] Christian Kuhlins *et al.*, Cellular networks for Massive IoT, Ericsson (Jan. 2020), https://bit.ly/3kcjCQ5.

[22] Nick Ludlum, *CTIA 5G Summit: Nationwide 5G is Here, But it's Only the Beginning.*, CTIA (Nov. 20, 2020), https://bit.ly/33fTOLu ("Over the past four years, the wireless industry has invested a staggering level of private capital—over $100 billion—to bring 5G connectivity to communities from New York City to Cedar Rapids, IA").

[23] *Id.*

Recognizing the economic imperative of 5G, the United States' economic competitors have moved aggressively to free up additional mid-band spectrum for terrestrial mobile services at a faster pace than the United States. Analysys Mason projects that five top 5G countries (China, Japan, the U.K., South Korea, and Canada) will assign an average of 660 megahertz of mid-band spectrum by the end of 2022.[24] In that same timeframe, the United States is slated to have approximately 380 megahertz assigned but not fully deployable, with another 70 megahertz of lower-power licensed Citizens Broadband Radio Service ("CBRS") spectrum.[25] Analysys Mason also found that "[o]utside the U.S., every [mobile network operator]—19 out of 19—that has launched 5G in [Analysys Mason's 5G benchmark countries] has used mid-band spectrum to do so."[26] The Chairwoman may have said it best when she testified before the Senate Commerce Committee last year about the need for decisive U.S. leadership on spectrum policy: "While we argue among ourselves about what to do with . . . spectrum resources, other nations are moving forward . . . ."[27]

The Department of Defense's Defense Innovation Board explained the importance of being a 5G first mover to U.S. economic and technological superiority: "First-mover advantage will likely drive significant increases in [Chinese] handset and telecom equipment vendors market along with their domestic semiconductor and system suppliers. As a result, Chinese internet companies will be well-positioned to develop services and applications for their home

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[24] Janette Stewart *et al.*, *5G Mid-Band Spectrum Global Update*, Analysys Mason, at 1 (Mar. 2020), https://bit.ly/3cinQnw ("*Analysys Mason 5G Mid-Band Spectrum Global Update*").

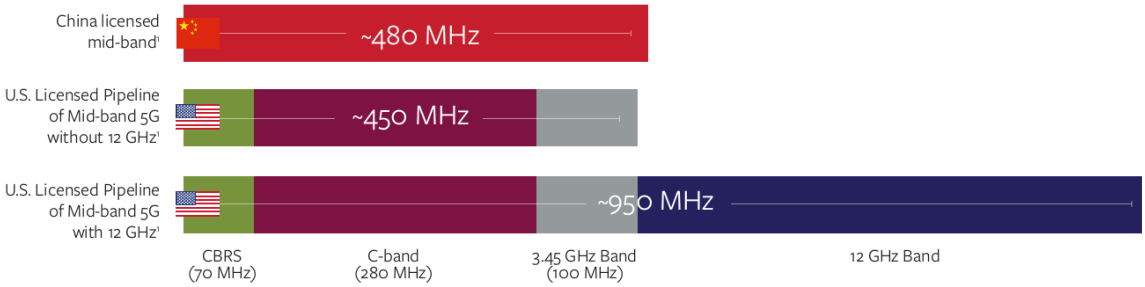
[25] *See id*. The accelerated clearing deadline for the 3.8-3.98 GHz band is December 5, 2023. *See* 47 C.F.R. § 27.1412(b)(2).

[26] *Analysys Mason 5G Mid-Band Spectrum Global Update* at 1.

[27] *Oversight of the Fed. Commc'ns Comm'n: Hearing Before the S. Comm. on Com., Sci., & Transp.*, Statement of Jessica Rosenworcel, Commissioner, Fed. Commc'ns Comm'n (June 24, 2020), https://bit.ly/3e1AMxb.

market that take advantage of 5G speed and low latency."[28] As Figure 1 shows, China and America are currently neck-and-neck in the mid-band race, but the 12 GHz band would introduce a staggering amount of additional mid-band spectrum that would pull the United States into a decisive lead.

Figure 1: U.S.-China Mid-Band Spectrum Pipeline[29]



To meet these critical economic and security interests, the Commission has made major strides in refilling the spectrum pipeline during the last two commissions and has emphasized the critical nature of the mid-band opportunity. As Commissioner Starks recently noted: "Mid-band spectrum is critical to our broadband future but it's nearly impossible to identify bands that aren't occupied by existing users with ongoing operations."[30] Urging rapid FCC action on the 2,496-2,690 MHz band ("2.5 GHz band") white spaces auction, Commissioner Carr said, "This is prime, mid-band spectrum that needs to get to market ASAP."[31] Commissioner Simington has

[28] Defense Innovation Board, *The 5G Ecosystem: Risks & Opportunities for DoD*, at 4 (Apr. 3, 2019), https://bit.ly/3xBhCXU.

[29] *Analysys Mason 5G Mid-Band Spectrum Global Update* at 2. This report determined that 350 megahertz would be assigned by the end of 2022, but since publication, the FCC is slated to auction another 100 megahertz in the 3.45 GHz band, with the auction slated to begin in 2021.

[30] Statement of Commissioner Geoffrey Starks, *Facilitating Shared Use in the 3100-3550 MHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 11078, 11171 (2020).

[31] Brendan Carr, Commissioner, Fed. Commc'ns Comm'n, *Extending America's 5G Leadership*, American Enterprise Institute, DOC-370781, at 4 (Mar. 15, 2021).

touted recent efforts to release mid-band spectrum as "critical to U.S. 5G competitiveness" and has highlighted the benefits of "preserv[ing] the model of high-power exclusive flexible use" in those bands.[32]

Yet only one recent Commission proceeding—the 3.70-3.98 GHz band ("C-band") proceeding—has so far led to the release of large blocks of contiguous mid-band spectrum suitable for mobile deployment that can deliver high-throughput, low-latency services over large geographic areas.[33] The blockbuster C-band auction, at which wireless carriers spent more than $80 billion—with another $15 billion in estimated clearing costs and incentive payments—vividly illustrates the continuing demand for 5G spectrum.[34] By comparison, all FCC auctions for spectrum suitable for wireless broadband between 1994 and December 2019 collectively generated spending of $117 billion.[35]

Despite the Commission's commendable efforts in recent spectrum proceedings, especially the C-band proceeding, mobile broadband operators still urgently require more mid-band spectrum to offer the coverage and capacity that 5G will demand.[136] As Figure 2 from the

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[32] Statement of Commissioner Nathan Simington, *Facilitating Shared Use in the 3100-3550 MHz Band*, Second Report and Order, Order on Reconsideration, and Order of Proposed Modification, WT Docket No. 19-348, FCC 21-32, at 113 (rel. March 18, 2021).

[33] *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) ("*C-Band R&O*"). While CBRS spectrum constitutes mid-band spectrum that is able to be used for mobile broadband, the Commission determined that it was not "suitable and available for the provision of mobile telephony/broadband services in the same manner as other spectrum bands." *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, at n.276 (2015).

[34] *See* Monica Alleven, *C-band's first phase tops charts with $80.9B*, FIERCE WIRELESS (Jan. 15, 2021), https://bit.ly/3tbO6Ws.

[35] *See* Federal Communications Commission, *2021 Budget Estimates to Congress*, at 8, 38 (Feb. 2020), https://bit.ly/3umAfgN.

[36] *See* Letter from Meredith Atwell Baker, President & CEO, CTIA, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 19-348 *et al.*, at 3 (filed Jan. 21, 2021) ("With the right policies

Brattle Study accompanying these comments shows, the current inventory of mid-band spectrum (inclusive of low-power CBRS and yet-to-be-deployed C-band and 3.45-3.55 GHz band ("3.45 GHz band")) is limited and has a major gap above the C-band and below the millimeter-wave frequencies that the 12 GHz is uniquely situated to address.

Figure 2: 5G Spectrum Options[37]

	Band Name	Location	Potential Spectrum Supply (MHz)
	[a]	[b]	[c]
[1]	600 MHz	600 MHz	70
[2]	700 MHz		
[3]	Paired	700 MHz	58
[4]	Unpaired	700 MHz	12
[5]	Cellular	800 MHz	50
[6]	SMR	800 MHz / 900 MHz	14
[7]	NOAA/Ligado	1670 - 1680 MHz	10
[8]	AWS-1	1.7 GHz / 2.1 GHz	90
[9]	PCS	1.9 GHz	120
[10]	G-Block	1.9 GHz	10
[11]	H-Block	1.9 GHz /2.0 GHz	10
[12]	AWS-3		
[13]	Paired	1.7 GHz / 2.1 GHz	50
[14]	Unpaired	1.7 GHz	15
[15]	AWS-4	2.0 GHz / 2.2 GHz	40
[16]	WCS	2.3 GHz	20
[17]	BRS/EBS	2.5 GHz	156.5
[18]	EBS New	2.5 GHz	23.5
[19]	3.45 - 3.55 GHz	3.45 - 3.55 GHz	100
[20]	CBRS	3.5 GHz	70
[21]	C-Band	3.7 GHz / 4.2 GHz	280
[22]	12 GHz	12 GHz	500
[23]	24 GHz	24 GHz	700
[24]	28 GHz	28 GHz	850
[25]	37 GHz	37 GHz	1,000
[26]	39 GHz	39 GHz	1,400
[27]	47 GHz	47 GHz	1,000
[28]	**Total**		**6,649**

in place, 5G will be transformative—making our lives better, our communities safer, and our nation more prosperous. The key is spectrum, particularly mid-band spectrum."); Reply Comments of AT&T Services, Inc., WT Docket No. 19-348, at 8 (filed Dec. 7, 2020) ("Importantly, assembling large, contiguous blocks of mid-band spectrum will be critical to enabling the high-speed, high-throughput network performance 5G contemplates."); Comments of Verizon, WT Docket No. 19-348, at 4 (filed Nov. 20, 2020) ("The demand for 5G will require investment, innovation, new deployments, and yes, more spectrum resources."); Letter from Steve B. Sharkey, Vice President of Government Affairs, T-Mobile, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 18-120, at 1-2 (filed Jan. 7, 2021) ("[A]ccess to additional 2.5 GHz spectrum will help deliver 5G services to even more Americans.").

[37] *See* Brattle Study.

Put differently, the mid-band spectrum currently targeted for 5G deployment is simply insufficient to meet U.S. needs. Aside from the C-band, the mid-band spectrum the Commission has released and is currently considering has historical encumbrances and unique limitations. For example, the 2.5 GHz band spectrum being auctioned soon is an important step but is largely being done to assign the remaining, relatively small white spaces.[38] The 3.10-3.45 GHz band remains heavily encumbered by federal users.[39] The 3.45-3.55 GHz band slated for auction later this year will free up an additional 100 megahertz of critical mid-band spectrum, but with small blocks and significant federal encumbrances.[40] The Commission has released a significant amount of millimeter-wave spectrum, and these high-frequency bands' utility can be supercharged with complementary mid-band spectrum that can provide greater coverage and better in-building penetration. The 12 GHz band's inherent features provide for exactly this type of solution, which is unavailable in any other frequency on the horizon.

Spectrum is a scarce and precious national resource. While achieving greater efficiency requires a rigorous exploration of all spectrum blocks for additional mechanisms to extract more

[38] *Transforming the 2.5 GHz Band*, Report and Order, 34 FCC Rcd 5446 ¶ 77 (2019) ("*2.5 GHz R&O*") ("To make the unlicensed EBS spectrum as attractive as possible to potential entrants, while protecting the rights of incumbent EBS licensees and their lessees, we conclude that offering geographic overlay licenses that are subject to competitive bidding in those markets where white spaces (*i.e.*, spectrum that is not associated with an active license) exist is the best mechanism for assigning this spectrum.").

[39] According to the Commission's recent 3.45 GHz report and order, 72 partial economic areas are expected to be encumbered by Cooperative Planning Areas. *Facilitating Shared Use in the 3100-3550 MHz Band*, Second Report and Order, Order on Reconsideration, and Order of Proposed Modification, WT Docket No. 19-348, FCC 21-32 (rel. Mar. 18, 2021).

[40] *See* Consolidated Appropriations Act, 2021, H.R. 133, Div. FF. § 905 (2020); *Facilitating Shared Use in the 3100-3550 MHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 11078 (2020); *see also* Letter from Jeffrey H. Blum, DISH Network Corporation, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 19-348, at 2 (filed Mar. 5, 2021) ("This accelerated [Auction 110] schedule recognizes the urgent need for more mid-band spectrum . . . .")

use from available resources, few, if any, bands offer greater potential for profound and far-reaching improvements than the 12 GHz band. The 12 GHz band offers a rare opportunity for the U.S. to take account of technical advances and put mid-band spectrum resources to work for the public.

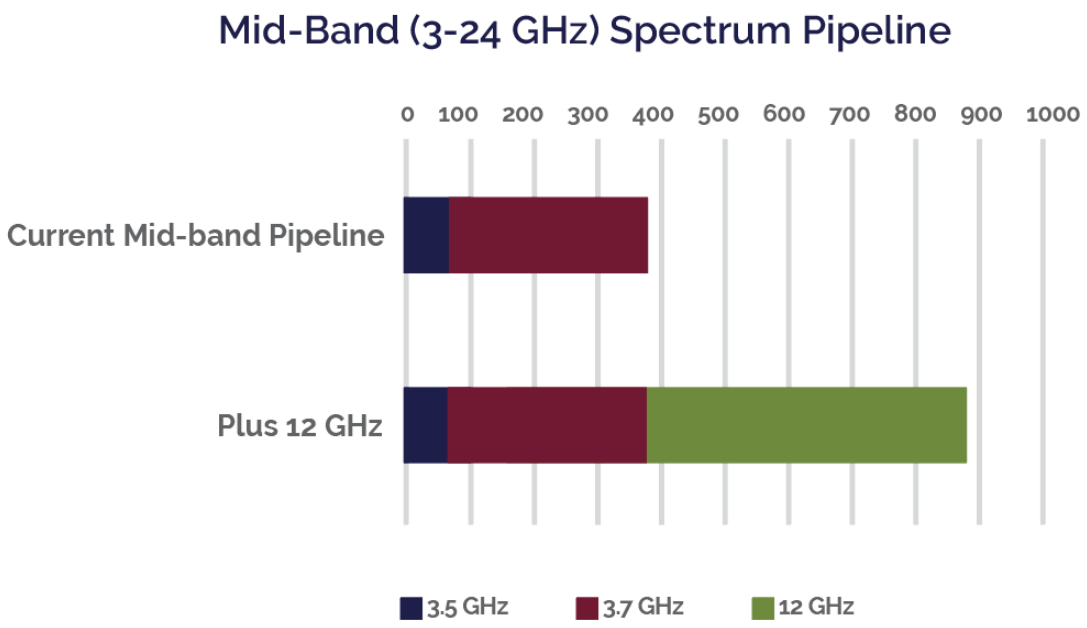
B. The 12 GHz Band Is the *Only* Opportunity to Quickly Release Large Amounts of 5G-Ready Mid-Band Spectrum.

The 12 GHz band is *the* timely and compelling solution to meet America's burgeoning need for 5G spectrum. Several technical and historical factors distinguish the band from others and make it the premier opportunity presently before the Commission or likely to emerge in the foreseeable future.

The sheer size of the band will help accommodate 5G services for years to come. In the United States, 380 megahertz of spectrum between 3-24 GHz is currently slated to be made available for 5G mobile broadband deployment over the next four years.[41] Without sufficient spectrum capacity, the true promise of 5G will not be realized. There is only one other band, the C-band, that *can* support 100-megahertz channels, but the 12 GHz band is the *only* set of mid-band frequencies that could simultaneously support more than two such channels.

[41] This includes the 3.45 GHz and 3.7-3.98 GHz bands.

Figure 3: Near-Term 5G Mid-Band Prospects



Even beyond the amount of available bandwidth that will offer both capacity and coverage for 5G, significant technological advancements (particularly since 2016) have made the 12 GHz band a prime candidate for multi-band spectrum deployment strategies.

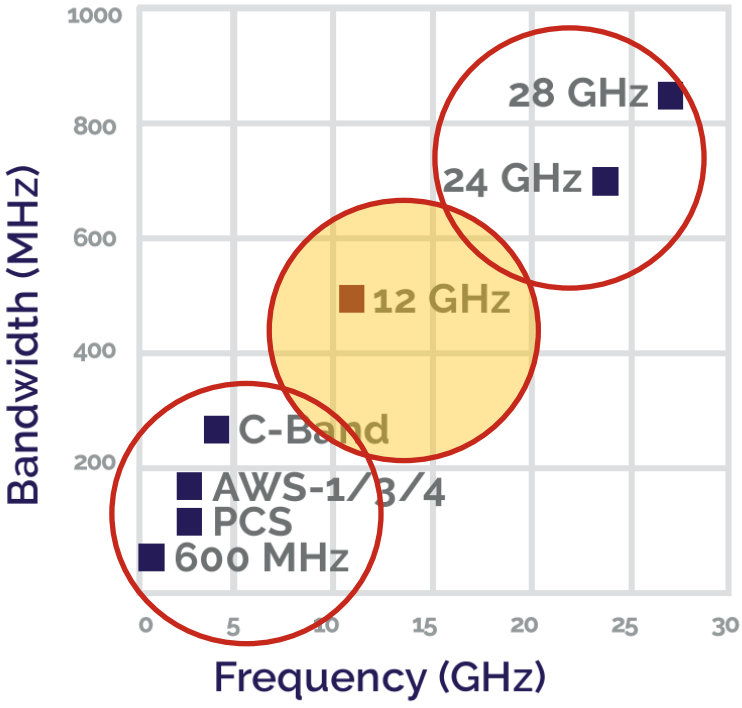
Vendors have addressed 5G mid-band coverage limitations by developing a flexible 5G carrier aggregation[42] solution that supports (1) lower-bandwidth uplink using lower frequency bands, increasing cell coverage and improving battery life and (2) higher-bandwidth downlinking using higher frequency bands, increasing capacity and data throughput. Carriers can use the 12 GHz band to maximize a cell's coverage and capacity by freeing up other spectrum bands (*e.g.*,

[42] *See*, *e.g.*, Carrier aggregation in 5G, Ericsson, https://bit.ly/3xLRrxV (last visited May 4, 2021); Press Release, Verizon, Verizon will rapidly integrate C-band spectrum with mmWave for customers (May 5, 2021), https://vz.to/3nUJ26T ("In a recent lab trial, Verizon worked with Ericsson and MediaTek to aggregate C-band spectrum with mmWave spectrum, achieving speeds of 4.3 Gbps in the trial. . . . The radios leverage massive Multiple Input Multiple Output (MIMO) architectures, offering high performance through Ericsson Uplink Booster and advanced beamforming technology to provide a better user experience.").

the C-band) to provide broader coverage. This maximizes the coverage and capacity of both lower mid-band frequencies and the 12 GHz band. For example, by allowing mobile operators to assign 12 GHz capacity blocks to users who are close to the cell center, large amounts of capacity delivered by C-band, 2.5 GHz, and Advanced Wireless Service ("AWS") spectrum can be used for the mid-range of the cell, and thus also a greater portion of the low-band spectrum can deliver service closer to the cell's edge. The 12 GHz band therefore can ensure each cell is using each megahertz of spectrum more efficiently by placing the burden of most of the cell on higher capacity bands, while also increasing the effective capacity of the better-propagating spectrum bands for users outside. This ensures better coverage, capacity, and consistency of experience than could be delivered on a network without the 12 GHz band.

Figure 4 shows the unique balance of coverage and capacity that 12 GHz can provide compared to other bands authorized for commercial mobile radio service.

Figure 4: Bandwidth vs. Frequency Comparison



In other words, the 12 GHz band can be the "golden spike" to connect high capacity/limited coverage millimeter-wave spectrum with lower capacity/broader coverage in the lower mid-band, such as frequencies in the 3 GHz range.[43] As Table 1 summarizes, the 12 GHz band is uniquely situated, offering (1) multiple 100-megahertz channels, (2) propagation characteristics similar to the C-band, (3) capacity closer to the millimeter-wave bands, (4) lower deployment costs compared to millimeter-wave bands, and (5) a relatively straightforward implementation path to bring the band into the 5G ecosystem.

Table 1: Qualitative Comparison of Spectrum Bands[44]

Band	Propagation	Capacity	Cost ($/MHz-PoP)
Low-band (up to 1 GHz)	Very good	Limited	High
Lower mid-band (1-6 GHz)	Good	Good	Medium-high
Upper mid-band (6-24 GHz)	Good	Very good	Medium
Millimeter-wave (24+ GHz)	Poor	Very good	Low

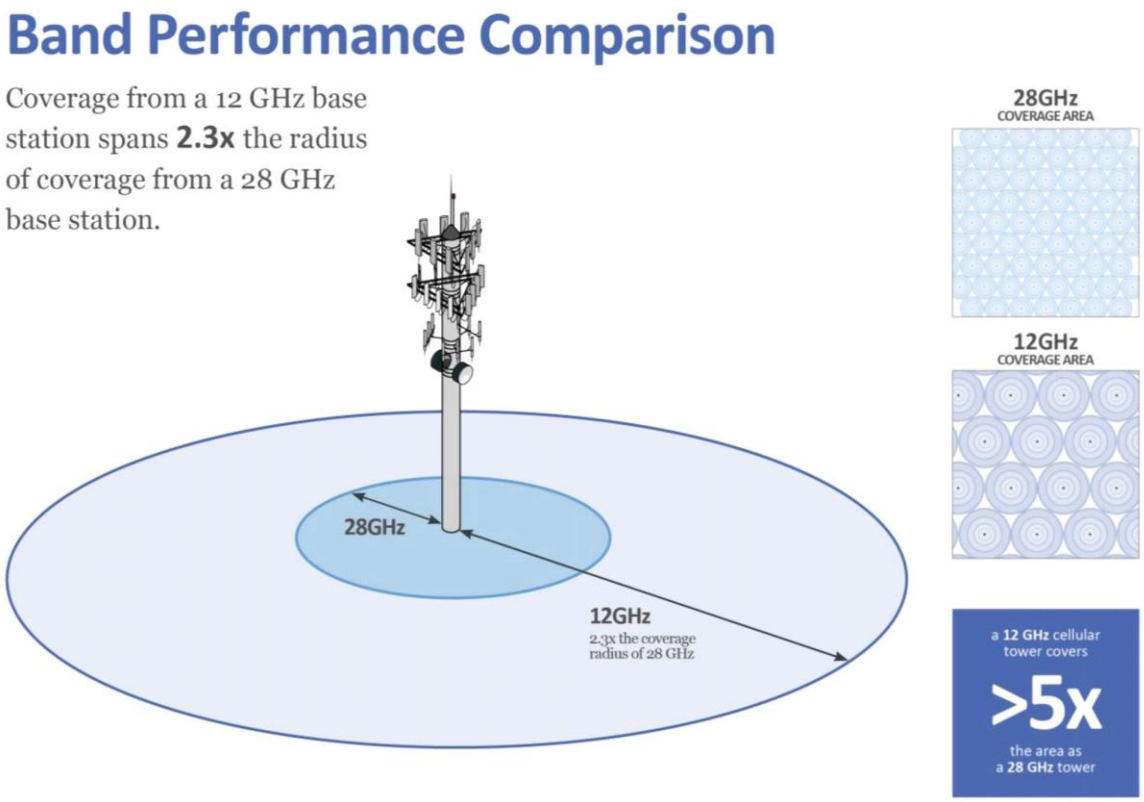
Many 5G use cases will demand significantly higher peak data rates for faster connections and low latency, which will require wider channels than what is available in the lower bands. Wide channelization supports the data-intensive, high throughput applications that 5G can support. The 12 GHz band is the only mid-band segment with the possibility of five 100-megahertz channels, as the visual below illustrates.

[43] The completion of the first U.S. transcontinental railroad—an immense technological achievement in the 19th Century that connected the east and west coasts of the North America—was celebrated with a golden railroad spike driven by American industrialist and politician Leland Stanford.

[44] Calculations performed by Roberson and Associates, LLC ("RAA"), a wireless technology-focused consulting company. RAA has submitted numerous studies analyzing spectrum issues to the FCC and also have advised multiple U.S. Executive Branch departments on spectrum matters.

The 12 GHz band enables small cells with high capacity without the large path loss of higher frequencies. At the same time, the 12 GHz band has significant propagation advantages over millimeter-wave frequencies and allows for greater throughput than lower frequency bands. While approximately halfway between the C-band and 28 GHz band, the 12 GHz band's performance characteristics are closer to the C-band than the 28 GHz band. For example, the International Telecommunication Union's ("ITU's") ITU-R Report M.2376[45] finds that, under ideal conditions (*i.e.*, free space path loss), a 12 GHz signal could travel more than twice as far as 28 GHz signal, as illustrated in Figure 5.

Figure 5: 12 GHz and 28 GHz Band Performance Comparison



[45] ITU-R M.2376-0, *Technical feasibility of IMT in bands above 6 GHz*, International Telecommunications Union (July 2015), https://bit.ly/2PSKNoy.

For operators seeking to provide high capacity, ubiquitous coverage, a five-fold coverage advantage could result in significant savings in deployment costs. Table 2 provides a comparison of the range and coverage area of the 12 GHz band versus millimeter-wave frequencies. It demonstrates how the deployment of a 28 GHz network would require at least *five times* as many base stations to provide the same coverage as a 12 GHz network.

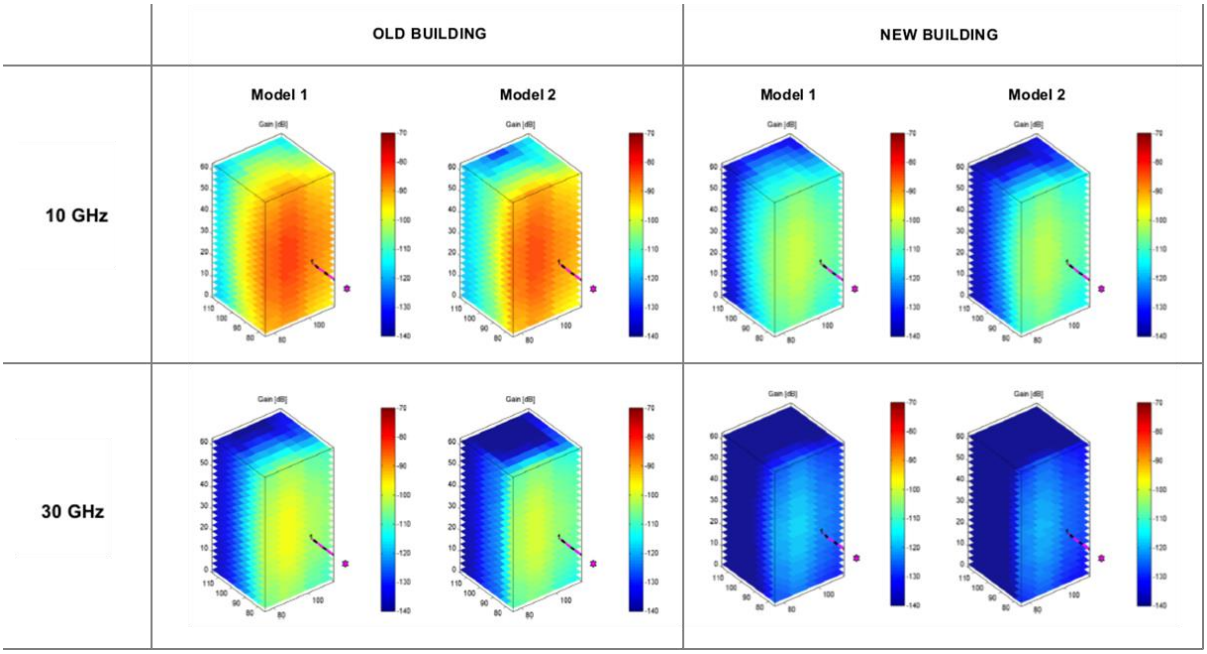
Table 2: Comparison of Range and Coverage Area of 12 GHz and Millimeter-wave Bands[46]

	24 GHz	28 GHz	39 GHz
12 GHz Signal Range Performance Compared to Millimeter-wave Bands	200%	233%	325%
12 GHz Coverage Area Compared to Millimeter-wave Bands	400%	544%	1,056%

The 12 GHz band has yet another compelling attribute. It has far less building entry and clutter loss, an issue that mobile broadband operators are currently experiencing in the millimeter-wave bands. As the image below illustrates, bands in the range of 12 GHz offer superior building penetration compared to the millimeter-wave frequencies the Commission recently auctioned.

[46] Calculations based upon reference values in ITU-R M.2376-0. Calculations performed by RAA. *See also supra* note 45.

Figure 6: Outdoor-to-Indoor Coverage in High-Frequency Bands[47]

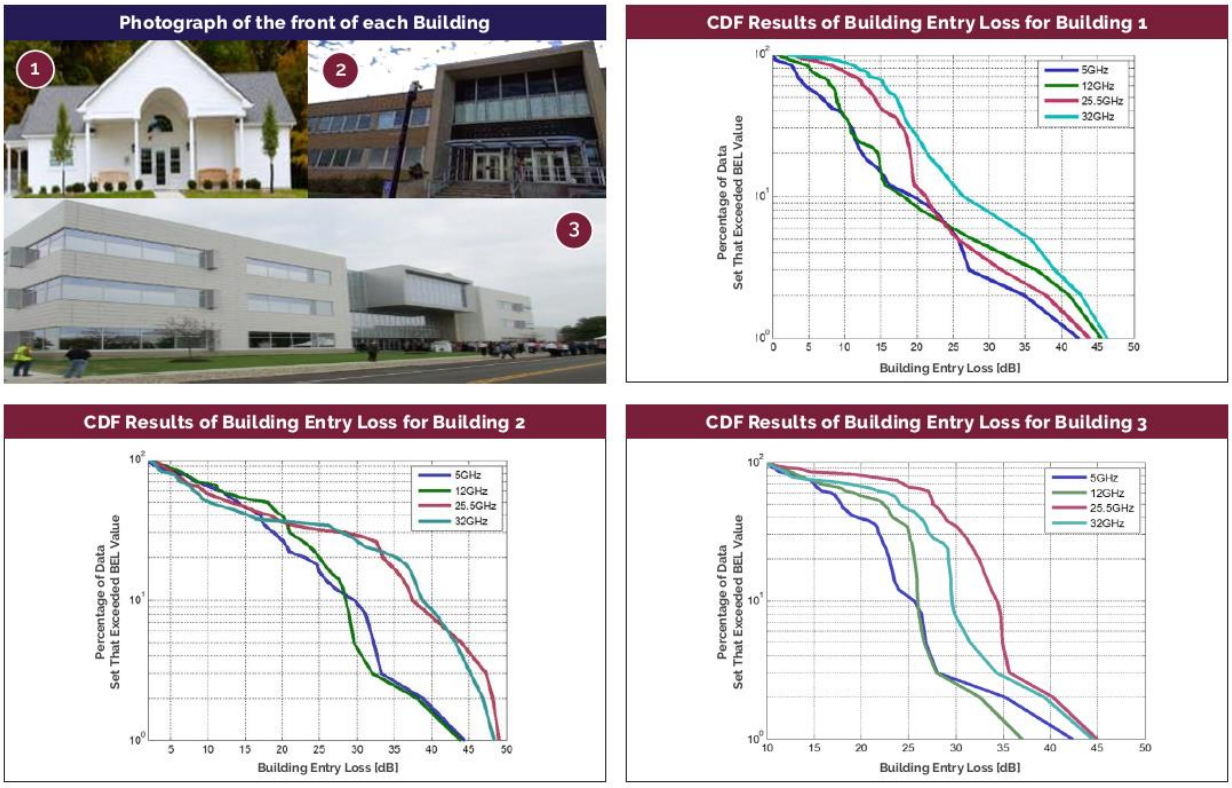


The building entry loss characteristics of 12 GHz are very similar to those of the 10 GHz band shown in the image and far superior to those at 28 GHz. For its part, the ITU has also studied the propagation characteristics of the 12 GHz band to assess building entry loss of terrestrial wireless signal transmissions. The ITU's 2019 Report P.2346-3, which compiles measurement data, found that the 12 GHz band tracks closely with the performance of 5 GHz spectrum and performs markedly better than millimeter-wave bands.[48] As shown in the figure below, transmissions in the 12 GHz band can penetrate buildings exceptionally well, especially the often-forbidding commercial office buildings made of brick and concrete block as well as newer commercial construction that use energy-efficient materials and low-E glass windows:

[47] *See* Eliane Semaan *et al.*, *Outdoor-to-indoor coverage in high frequency bands*, 2014 IEEE Globecom Workshops (2014), https://bit.ly/3b2dSVK. Propagation performance in the 10 GHz band is similar to that of the 12 GHz band.

[48] Report ITU-R P.2346-3, *Compilation of measurement data relating to building entry loss*, Int'l Telecomm. Union, at 79 (May 2019), https://bit.ly/3uiGuBK.

Figure 7: ITU Report P.2346-3: Identifying 12 GHz Cumulative Distribution Function of Building Entry Loss by Building Type[49]



Because the 12 GHz band is already licensed for terrestrial use on a geographically exclusive basis, rapid 5G deployment would not require the type of complicated transition mechanisms that the Commission was forced to undertake in other frequencies like the C-band. MVDDS licensees already possess licensed terrestrial rights exhaustively awarded through FCC-administered competitive bidding in Auctions 53 and 63, and FCC precedent amply supports the desirability and legality of expanding existing terrestrial rules to enable operators to offer flexible-use services.[50]

[49] *Id.* at 66, 78-79; *see also id.* at 71 (showing tabulated building loss results for three different buildings types at carrier frequencies 5, 12, 25.5, and 32 GHz).

[50] *See also infra* Section V (discussing how expanding terrestrial service rules in the 12 GHz band follows Commission precedent and the Communications Act).

Allowing two-way services in the 12 GHz band accords with recent standards-setting efforts and international rules. Until recently, 3GPP standards supported band classes in only two frequency ranges: (1) FR1 – 410 to 7,125 MHz; and (2) FR2 – 24.25 to 52.6 GHz. In June 2020, 3GPP approved a study item technical report for Release 16 that studied how 3GPP standards should treat bands that fall in the gap between the two ranges.[51] Work within 3GPP has begun on a new band class that will include the 10.0 to 10.5 GHz band for use outside of the United States. Based on the range of the band under consideration, this 3GPP report paves the way to develop a band class for 12.2-12.7 GHz in the United States and other countries seeking additional mid-band spectrum to promote 5G deployment.

Figure 8: 3GPP Frequency Ranges (Red Line Shows 12 GHz Band)

The 12 GHz band can also be easily implemented in consumer devices. The number of frequency bands supported in consumer devices has increased dramatically in the 4G and 5G eras. Because the 12 GHz band falls between bands supported by the latest devices, it can likely leverage components already used to support existing bands.[52] RS Access's conversations with multiple major equipment suppliers have confirmed the commercial feasibility of adding the 12 GHz band to consumer devices. As Table 3 illustrates, today's newer devices increasingly support a variety of mid-band frequencies.

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[51] *See 5G Frequency Bands*, Halberd Bastion, https://bit.ly/3upUppP (last visited May 6, 2021). 3GPP may elect to extend the FR1 and FR2 ranges to include the frequencies in between instead of specifying a new class.

[52] Several vendors successfully commercialized in the millimeter wave bands. Bevin Fletcher, *Verizon first to deploy Samsung's new 5G NR Access Unit*, FIERCE WIRELESS (Oct. 23, 2019), https://bit.ly/3vFqudg.

Table 3: Number of Frequency Bands Integrated into iPhones 5, 8, and 12

	LTE or LTE/5G Bands (Low)	LTE or LTE/5G Bands (Mid)	5G-Only Bands	Total
iPhone5 (2012)	2	4	-	6
iPhone8 (2017)	9	15	-	24
iPhone12 (2020)	13 (6 5G)	17 (9 5G)	5 (2 mmWave)	35

Two-way services in the 12 GHz band are also consistent with international frequency designations. The band is allocated internationally for multiple uses, including mobile (primary). The 12 GHz band is co-primary mobile in Regions 2 and 3.[53] The 12.2-12.5 GHz band is also co-primary mobile in Region 1, and the 12.5-12.7 GHz band is co-primary in many parts of Region 1.[54]

Finally, as a logistical matter, the small number of stakeholders in the 12 GHz band means that introducing flexible use rights into the band is relatively simple. Because the 12 GHz band has *no federal allocations or encumbrances* in the United States, expanded terrestrial operations will not interfere with sensitive governmental or national-security priorities. With its few stakeholders, the 12 GHz band can support a flexible regulatory framework that maximizes service options and allows for coexistence among all incumbent users. As discussed below, the 12 GHz band allows for 5G services while enabling sharing with incumbent satellite licensees.[55]

[53] *See* 47 C.F.R. § 2.106. The ITU's table of frequency allocations divides the earth into Regions 1, 2, and 3. Region 1 includes Europe, Africa, and most of the Middle East. Region 2 covers the Americas including Greenland. Region 3 contains most of Asia east of Iran, and most of Oceania.

[54] *See also* Section V.E (explaining how expanded terrestrial rules comports with international frameworks).

[55] *See generally* Section III.

C. Authorizing 5G Services in the 12 GHz Band Promotes the Public Interest by Modernizing MVDDS Rules to Best Serve Consumers.

Promoting the most intensive and efficient use of spectrum is a cornerstone of maximizing consumer welfare. If valuable spectrum bands remain fallow in some areas or inefficiently used in others, consumers lose the benefits of fast, accessible broadband. As SpaceX so aptly noted just this week, "the Commission should adopt an 'all-of-the-above' [spectrum] approach that allows multiple services to flourish and serve consumers."[56] Elsewhere, SpaceX explained that "increased efficiency leads to more sharing, which ultimately results in more competition and improved options for consumers."[57] That virtuous cycle of efficiency, competition, and choice is precisely what is at stake in this proceeding.

Due to insurmountable technical limitations in satellite frequency reuse, NGSO systems are capacity constrained in the 12 GHz band and NGSO operators are limited in how many customers they can serve using the band relative to terrestrial systems. SpaceX Chief Executive Officer Elon Musk succinctly captured a key tradeoff of satellite broadband: "[The o]nly limitation [for Starlink] is high density of users in urban areas."[58] Terrestrial broadband,

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[56] Letter from David Goldman, Director of Satellite Policy, SpaceX, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-133 (filed May 3, 2021).

[57] Letter from David Goldman, Director of Satellite Policy, SpaceX, to Marlene H. Dortch, Secretary, FCC, RM-11768, RM-11855, at 2 (filed July 8, 2020).

[58] Elon Musk (@elonmusk), TWITTER (May 4, 2021, 5:22 PM), https://bit.ly/3tmjtwz. On other occasions, Mr. Musk previously said that "[t]he challenge for anything that is space-based is that the size of the cell is gigantic . . . . it's 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." Karl Bode, *Space X's Starlink Won't Be The Broadband Disruption Play Many People Think*, TECHDIRT (Aug. 20, 2020), https://bit.ly/3euIpxT; *see also* Sascha Segan, *Who Needs Starlink Internet? These Rural US Counties Top the List*, PC MAGAZINE (Mar. 31, 2021), https://bit.ly/3a5z9gW; *see also* Anshu Goel, *Intelligence Brief: Is direct-to-consumer satellite broadband now viable?*, Mobile World Live (Mar. 10, 2021), https://bit.ly/3dVmTke ("Given the current prices for satellite broadband,

meanwhile, is capable of intensive spectrum reuse and can readily serve the millions of Americans that NGSO systems will not. Fortunately, the Commission is not faced with an either-or, zero-sum choice between terrestrial and satellite uses. Encouraging coexistence between terrestrial and NGSO systems would maximize public interest benefits for consumers by allowing for the greatest use (and reuse) of the 12 GHz band.

As measured by frequency reuse, NGSO FSS systems are relatively inefficient users of spectrum, especially in more densely populated areas. NGSO systems can cover large areas due to the way a beam propagates over long distances. What begins as a highly concentrated beam in space spreads into a miles-wide "spot" by the time it travels hundreds of miles to the earth's surface. Although these larger beams cover more ground, they necessarily dilute the NGSO system's ability to deliver available capacity. SpaceX's system illustrates the tradeoff between altitude, coverage, and capacity.[59] At an altitude of approximately 550 kilometers, where virtually the entirety of SpaceX's system will operate,[60] a Starlink satellite would create a spot beam of at least 135 square kilometers.

Each beam can support a very limited amount of spectrum reuse.[61] SpaceX has agreed to use only one co-frequency spot beam in the 12.2-12.7 GHz band in a given area at a given time

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it looks likely consumer uptake will probably be highest amongst rural households in developed countries.").

[59] Technical Attachment, Application of Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20170301-00027, at 3 (filed Mar. 1, 2017) (showing that a 1.5-degree spot beam at 340 km altitude covers an area of about 52 km^2 whereas a satellite at 1,110 km creates a 550 km^2 spot beam).

[60] *See* Application of SpaceX, IBFS File No. SAT-MOD-20200417-00037 (granted Apr. 27, 2021).

[61] Because satellite communications require line of sight between the satellite and the user terminal receiver, reusing the same spectrum to serve multiple sets of users within the area of the same spot beam is limited. Opposite polarizations can be used to double the bandwidth—and thus the capacity—of the user link spectrum, and co-frequency beams can be used from different

(*i.e.*, Nco=1).[62] The Starlink system has a maximum of 2,000 megahertz of Ku-band user downlink spectrum available in each spot beam,[63] and because the Commission has required Starlink's co-frequency spot beams not to overlap, the maximum amount of user downlink spectrum available at any given time in any given area is 2,000 megahertz. Assuming an NGSO FSS operator can achieve spectral efficiency of 10 bits per second/Hz, Starlink has a maximum capacity of 20 Gbps *in each non-overlapping 135-square-kilometer beam area* (a 4-mile radius).[64]

A Starlink spot beam of 135 square kilometers centered on Washington, DC, for example, would cover nearly the entire District and parts of Arlington, VA with a *total* of only 20 Gbps of connectivity. Using SpaceX's 100-Mbps Rural Digital Opportunity Fund ("RDOF") performance tier as the service baseline,[65] 20 Gbps per spot beam means only 200 simultaneous customers. Even accounting for periods of subscriber inactivity, SpaceX cannot overcome this

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satellites at different angles of arrival to the same location to provide limited reuse of spectrum (if Nco>1), but satellite systems fall far short of terrestrial systems in terms of spectral efficiency per square kilometer.

[62] *SpaceX Mod3 Order* ¶ 97(e) ("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.").

[63] The 12 GHz band is 500 megahertz, or one quarter, of Ku-band user downlink spectrum, which spans from 10.7-12.7 GHz. SpaceX is also authorized for user downlinks in another 2 gigahertz of spectrum between 40-42 GHz. *Space Exploration Holdings, LLC Application for Approval for Orbital Deployment and Operating Authority for the SpaceX V-band NGSO Satellite System*, Memorandum Opinion, Order, and Authorization, 33 FCC Rcd 11434 ¶ 31 (2018).

[64] *See* 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 OEA Docket No. 20-34, Attachment, at 3 (filed Feb. 8, 2021) (estimating "17-23 Gbps" per satellite).

[65] Application of Space Exploration Technologies Corp., ULS File No. 0009149922 (filed Oct. 23, 2020) (proposing to provide customers with 100+ Mbps broadband connectivity).

constraint and add more customers without reducing the performance available to other users.[66] Simply put, Starlink does not have nearly enough total capacity available to serve any meaningful portion of the Washington, DC market or those like it.

A terrestrial system would do much better. Terrestrial use of mid-band spectrum "presents wireless providers with the opportunity to deploy base stations using smaller cells to achieve higher spectrum reuse."[67] Terrestrial systems—especially when they employ mid-band frequencies—can deploy much smaller cell sizes than NGSO FSS systems can produce, which allows frequency use to be tailored to localized needs. These reuse efficiencies are particularly pronounced in higher density areas, where usage is high and smaller cell sizes are feasible. Terrestrial systems generally reuse spectrum more frequently due to comparatively small cell sizes and can adjust their frequency reuse by varying their cell size according to their need, whereas satellite systems are limited to relatively large cells. 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*.

The future of the 12 GHz band is not a zero-sum choice between satellite uses and terrestrial 5G. And the point of this proceeding is not to settle on either satellite or terrestrial infrastructure as the more efficient user of 12 GHz band resources, but rather to consider policies that will allow *both* satellite and terrestrial operators to employ the unique attributes of their networks to better serve the public at large. A modern coexistence framework can maximize the

[66] The bandwidth per customer could be reduced to serve more simultaneous users, but that would make the NGSO FSS operator's service even less competitive with terrestrial offerings. With an oversubscription rate of about 10x, SpaceX could serve just 2,000 customers in the Washington, DC area.

[67] *C-Band R&O* ¶ 5.

benefits of both terrestrial and satellite service platforms to ensure that the 12 GHz band is efficiently and intensively used (and reused) throughout the country regardless of population density.

D. The Public-Interest Benefits of Making 12 GHz Usable for 5G Far Outweigh Those of the Regulatory Status Quo.

Introducing flexible-use rights in the 12 GHz band will unlock tremendous value in what is otherwise an underutilized spectrum resource. An economic study from the Brattle Group accompanying these comments includes an analysis that demonstrates the value of terrestrial 5G in the 12 GHz band.[68] As the study shows, the incremental addition of terrestrial 5G spectrum will produce a net present value of social welfare benefit of an amount that could exceed $1 trillion.

The Brattle Study, conducted by economists Coleman Bazelon and Paroma Sanyal, develops a framework for dimensionalizing the value of the 12 GHz band when deployed for terrestrial 5G. The value of the 12 GHz band, like any other spectrum band, depends on various inputs, including its propagation characteristics, restrictions on its use, the relative supply and demand for spectrum, various impairments, cost of relocation of incumbents, and the timing and uncertainty regarding availability. The study finds that the 12 GHz band is uniquely valuable due to its coverage radius, use cases for small cells, fixed wireless, and backhaul, spectral efficiency, capacity, and potential channel size. The study uses the recently concluded C-band auction as a basis for comparison. Including relocation payments, the C-band auction generated a fully loaded net price of $1.10 per MHz-pop for 280 megahertz, for total costs of about $95

[68] *See* Brattle Study.

billion.[69] Applying conservative discount factors based on differences in the technical characteristics of the two bands, spectrum supply, population coverage, and other factors, the study estimates that the value of the 12 GHz band when employed for terrestrial 5G use ranges from **$27 to $54 billion**.

Having established a robust framework to quantify the value of expanding terrestrial use in the 12 GHz band, the Brattle Study finds that maintaining the regulatory status quo would leave the public worse off compared to a sharing arrangement. A coexistence solution would maximize the public interest and allow consumers to reap the benefits of 5G, DBS, and NGSO services in the 12 GHz band with a net present value of social welfare benefit of between $270 billion and $1,082 billion.

Ossifying the band in the regulatory status quo—that is, keeping the onerous terrestrial rules in place while allowing DBS and NGSO to operate as currently permitted—would deprive consumers of this value. A coexistence solution allows 5G, NGSO, and DBS services to be put to their highest and best use and maximizes the value of the band—the ultimate benefits of which consumers, operators, and the broader public stand to receive. Put simply, the public interest requires liberalizing the terrestrial service rules for the 12 GHz band to allow as much terrestrial use as possible.

As discussed in later sections, while NGSO FSS proponents have framed the decision facing the Commission as a choice between satellite and 5G, that characterization is a false dichotomy.[70] The Commission is not faced with an either-or proposition. The public can benefit

[69] *See* Sasha Javid, *Post-Auction Analysis for Auction 107 (3700-3980 MHz Band)*, sashajavid.com, https://bit.ly/3h0utx4 (last visited May 4, 2021).

[70] *See, e.g.*, Letter from David Goldman, Director of Satellite Policy, SpaceX, *et al.*, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443, at 1 (filed Mar. 12, 2021) ("As the 12 GHz Alliance has previously highlighted . . . ubiquitous two-way mobile services cannot successfully

from 5G *and* NGSO FSS operations by unlocking the MVDDS licenses for flexible terrestrial mobile use. Expanded terrestrial services, NGSO operations and DBS are compatible (as demonstrated below), and all available evidence indicates coexistence will be more feasible going forward.

A coexistence framework also helps account for changes in the demand for different use cases for mid-band spectrum. Whereas DBS service is declining in relevance as subscribers leave satellite television for streaming video, CTIA's 2020 Annual Survey reported that year-over-year U.S. wireless subscriptions increased by more than 20 million for a total of about 442.5 million subscriptions.[71] Establishing enhanced terrestrial service will help the Commission reorient its rules toward the future and will best serve the public interest as U.S. consumers increasingly rely on mobile broadband for their communications needs.

E. The Public Interest Is Served by Allowing Expanded Terrestrial Services in the 12 GHz Band as Rapidly as Possible.

Given the technologically evolving marketplace, expeditious action by the Commission in this proceeding is more important than ever to serve the public interest. As one economic study after another has shown, the faster that usable spectrum is made available, the greater the economic benefits to the consumer and the public at large. Indeed, one recent study determined that 400 megahertz of new mid-band spectrum would lead to more than $154 billion in

coexist with incumbent satellite operations . . . ."); Letter from Ruth Pritchard-Kelly, Senior Advisor, OneWeb, *et al.*, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443 (filed Mar. 12, 2021) (arguing "the record before the Commission demonstrates that ubiquitous two-way mobile services cannot successfully coexist with incumbent satellite operations that rely on co-primary access to the 12 GHz band to provide vital services to U.S. consumers").

[71] CTIA 2020 Annual Survey Highlights at 8.

infrastructure spending, 1.3 million new jobs, and $274 billion added to U.S. GDP.[72] By contrast, inaction creates a deadweight loss that keeps spectrum trapped in economically inefficient uses. That loss grows over time as deployment delays create foregone investment in downstream products and services.[73]

The Commission has repeatedly agreed with this bipartisan economic consensus about the value of speed and has emphasized the time-value of repurposing spectrum.[74] For example, in the C-band proceeding, mobile licensees are required to pay accelerated relocation payments to incumbent satellite operators who clear the band on the Commission-prescribed accelerated clearing timelines.[75] The basis for these payments was the Commission's estimate of the market value of accelerated access to the spectrum.[76]

Rapidly realizing the economic benefits of bringing spectrum to market and broadband to consumers is why the Commission has sought to conduct auctions as quickly as possible.[77] In

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[72] *See, e.g.*, David Sosa & Greg Rafert, *The Economic Impacts of Reallocating Mid-Band Spectrum to 5G in the United States*, Analysis Group, at 1 (Feb. 2019), https://bit.ly/37cXPCv.

[73] A seminal paper on the detrimental effects of delaying the introduction new services in the telecommunications space estimated that a 10-year delay in the introduction of cellular telephone services decreased consumer welfare by almost "$100 billion in total, with more than $25 billion lost in a single year." Jerry A. Hausman, *Valuing the Effect of Regulation on New Services in Telecommunications*, BROOKINGS PAPERS: MICROECONOMICS, at 3 (1997), https://bit.ly/3utlOqE.

[74] *See, e.g.*, Statement of Commissioner Jessica Rosenworcel, *Facilitating Shared Use in the 3100-3550 MHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 11078, 11169 (2020) ("[T]he United States is behind other countries in mid-band spectrum availability and quick delivery of these airwaves will help us close that gap.").

[75] 47 C.F.R. § 27.1422.

[76] *C-Band R&O* ¶ 216 ("So long as we set the accelerated relocation payment as a fraction of the bidder's expected incremental profits from deploying spectrum earlier, overlay licensees will themselves benefit even after making the accelerated relocation payment.").

[77] *Auctions of Upper Microwave Flexible Use Licenses for Next-Generation Wireless Services*, Public Notice, 33 FCC Rcd 7575 ¶ 17 (2018) ("Establishing concurrent filing windows will permit the Commission to proceed as quickly as possible to Auction 102 after the close of Auction 101, thus enabling prompt assignment of 24 GHz licenses and speedy deployment by

the C-band proceeding, for example, the Commission assigned a significant economic premium to early deployment. The Commission calculated $10.52 billion as the amount that wireless operators would be willing to pay to accelerate access to the spectrum and then, recognizing that the amount to pay satellite operators should be less than the amount that wireless licensees would be willing to pay, required that satellite operators be paid $9.7 billion for expedited clearing of the C-band.[78] Quickly capturing the benefit of licensing for the public is also why the Commission has *avoided* auctions where doing so would slow the deployment of spectrum. For example, when FiberTower and Straight Path defaulted for failure to meet deployment milestones, the Commission rejected calls to reauction the spectrum[79] and, instead, quickly approved sales to AT&T and Verizon on the grounds that a secondary-market transaction would allow for more rapid deployment.[80]

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auction winners."); *id.* ("[P]roceeding as quickly as possible to Auction 102 will expedite auctions of other spectrum bands, continuing to provide a spectrum pipeline for providers to offer new and innovative services to American consumers."); *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567 ¶ 13 (2014) ("We intend to conduct the broadcast television spectrum incentive auction as soon as possible.").

[78] *C-Band R&O* ¶¶ 211-19.

[79] *Application of AT&T Mobility Spectrum LLC and FiberTower Corporation For Consent to Transfer Control of 39 GHz Licenses*, Memorandum Opinion and Order, 33 FCC Rcd 1251 ¶ 16 (2018) ("*FiberTower Order*") (rejecting arguments that the Commission "should reclaim and auction the spectrum associated with FiberTower's unbuilt licenses."); *Application of Verizon Communications Inc. and Straight Path Communications, Inc. For Consent to Transfer Control of Local Multipoint Distribution Service, 39 GHz, Common Carrier Point-to-Point Microwave, and 3650-3700 MHz Service Licenses*, Memorandum Opinion and Order, 33 FCC Rcd 188 ¶ 16 (2018) ("*Straight Path Order*") (rejecting arguments that "the instant transaction should be denied and Straight Path's spectrum auctioned").

[80] *FiberTower Order* ¶ 22 ("[W]e find that consenting to the transfer of control of FiberTower's 39 GHz licenses to AT&T will most likely enable that spectrum to be used rapidly in 5G development and deployment, and that this would serve the public interest."); *Straight Path Order* ¶ 29 ("We find that, as a direct result of the transaction, Verizon likely will be better able to develop and deploy innovative 5G services to the benefit of American consumers.").

Expeditious deployment through an efficient, legal regulatory mechanism is critical to American consumers. Updating the MVDDS service rules as discussed below will produce the most meaningful economic gains for the benefit of the public possible.

III. 5G, NGSO FSS, AND DBS CAN SHARE THE 12 GHZ BAND WITH REASONABLE SAFEGUARDS.

The Commission adopted the MVDDS technical rules when the nation's bestselling phone was the Nokia 6100—a candy-bar phone with an LCD screen and a twelve-button keypad.

Figure 9: Nokia 6100

The severe limitations imposed on MVDDS reflected the technology and commercial needs of the time. But as wireless and satellite technology dramatically evolved in ways unforeseeable twenty years ago, the MVDDS service rules have remained static, a fossil of their era. To aid the Commission in evaluating the feasibility of introducing 5G service into the 12 GHz band, RS Access commissioned a study by RKF, an engineering consulting firm that has assisted the Commission in numerous spectrum proceedings.[81] The RKF Study demonstrates that mobile two-way 5G communications can readily coexist with NGSO operations. This is

[81] *See* RKF Study; *see also, 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).

precisely the type of win-win-win coexistence scenario envisioned by the conditions on 12 GHz NGSO FSS operators' authorizations, which provided grantees with ample notice that the Commission was considering further action in the 12 GHz band.[82]

A. Terrestrial 5G Systems with Liberalized Technical Rules Can Coexist with NGSO Systems.

To assess the feasibility of coexistence among 5G and NGSO services in the band, RS Access commissioned RKF to conduct a nationwide simulation of how NGSO and terrestrial 5G systems might interact at scale. The resulting model RKF constructed is systematic and comprehensive in its evaluation of multiple different paths for potential interference from terrestrial mobile operations into NGSO receivers.

RKF's terrestrial model assumed a 5G network of 49,997 terrestrial macro-cell base stations, 89,970 fixed small-cell base stations, 1,949,760 simultaneously active mobile devices, and 6,999 point-to-point backhaul links across the contiguous United States ("CONUS"). RKF's satellite model generously assumed that SpaceX would deploy 2,500,000 satellite terminals in both urban and rural areas—two and a half times the number of user terminals SpaceX is authorized to deploy.[83] This level of deployment is more than triple the upper-bound estimate of 800,000 Starlink terminals that analysts have projected for SpaceX in light of system capacity limitations and robust terrestrial competition.[84] Rather than choose locations in a way that might

[82] *See supra* notes 10-11.

[83] *See* Application of SpaceX Services, Inc., Call Sign E190066, SES-LIC-20190211-00151 (granted Mar. 13, 2020).

[84] The market analytics firm MoffettNathanson recently estimated SpaceX's total U.S. market penetration is unlikely to exceed 300,000 to 800,000 end users, assuming SpaceX fully deploys its presently authorized constellation of more than 12,000 space stations across multiple bands of frequency spectrum. Craig Moffett *et al.*, *Is Starlink a Substitute for, or a Supplement to, Wired Broadband?*, MoffettNathanson, at 25 (Apr. 5, 2021); Jeff Baumgartner, *Starlink's threat to wired broadband 'minimal' – analyst*, LIGHT READING (Apr. 5, 2021), https://bit.ly/3wM6abE.

mitigate risk, RKF used algorithms to site satellite and terrestrial equipment that were informed by both actual terrestrial deployment patterns and binding satellite performance obligations. Through a series of iterations, RKF modeling produced a cumulative distribution function to calculate a statistically significant finding that only 0.888% of the 2,500,000 Starlink earth terminals simulated nationwide would experience interference-to-noise ratio exceedances of -8.5 dB or greater from the simulated nationwide 5G deployment of macro-cell base stations, small-cell base stations, point-to-point backhaul links, and mobile devices. RKF's study shows that, with no coordination used or mitigation steps taken, a small percentage of about 0.888% of Starlink user terminals over CONUS could experience emissions that exceeded a nominal ITU threshold of -8.5 dB. Given the low level of risk, RKF concludes that "coexistence in the 12 GHz band between 5G and NGSO FSS is readily achievable."

RKF also pointedly noted that this low level of exceedance did not represent actual, much less, likely interference to satellite users for several reasons. *First*, the study used a variety of conservative assumptions that overstate the likelihood of exceeding nominal interference thresholds for the satellite terminals. *Second*, the model did not implement any of the case-by-case site coordination or mitigation measures that operators routinely employ to mitigate the potential for interference in the ordinary course of business. *Third*, the Starlink terminals would, in practice, have access to 1,500 megahertz of spectrum that is not co-frequency with the 5G equipment envisioned for the 12 GHz band.[85] For these reasons, the results of RKF's analysis

[85] Indeed, one such NGSO FSS operator made this point in its request to operate on an unprotected basis in the 10.7-11.7 GHz band:

> The OneWeb link to the user terminal can also use the 11.7-12.7 GHz band which is not shared with the [fixed service ("FS")]. So in the unlikely event of a case where the FS interference in the 10.7-11.7 GHz band is problematic, for that

show that NGSO and 5G systems can coexist with little, if any, negative effects on 5G or the NGSO operator. The small percentage of earth terminals calculated to exceed nominal ITU protection levels, to the extent they affect a consumer experience at all, can be easily addressed through mitigation or coordination. In RKF's words, "[t]he analysis confirms that the aggregate risk of harmful interference to NGSO satellite terminals is low."

The RKF Study focuses on coexistence between terrestrial 5G and Starlink's use of the 12 GHz band. Starlink is the least nascent of the Ku-band NGSO FSS systems authorized in the United States, and thus relatively more information about its expected design and operating parameters is available compared to other similarly situated NGSO licensees. OneWeb, for example, emerged from bankruptcy only last year with investments from the U.K. government and Bharti Global, and it remains to be seen whether the new owners will shift the company's operations, systems, and target markets.[86] Similarly, Kepler, a startup that originated at the University of Toronto, remains in the early stages of development and deployment.[87] Regardless of the relative scale or scope of any particular NGSO FSS licensee, however, the RKF study offers a high degree of confidence that operators can deploy 5G at scale in the 12 GHz band by working in good faith with any NGSO licensee that ultimately realizes its ambitions to deploy

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> specific location one option may instead be to use mostly the 11.7-12.7 GHz band for service to the user terminal.

Application of WorldVu Satellites Limited, IBFS File No. SAT-LOI-20160428-00041, Technical Narrative, at 38 (filed Apr. 28, 2016) ("OneWeb Application"). If frequency diversity can allow for coexistence outside the 10.7-11.7 GHz band it should equally allow for continuous services in the unlikely event of interference at 12.2-12.7 GHz.

[86] Rachel Jewett, *Will OneWeb Catch Up to Competitors After Emerging from Chapter 11?*, VIA SATELLITE (Nov. 20, 2020), https://bit.ly/2Rv4pj5.

[87] Jeff Foust, *Kepler launches first internally produced satellites*, SPACE NEWS (Sept. 29, 2020), https://bit.ly/3eSrvrC.

and sustain NGSO systems in the 12 GHz band so as to maximize consumer benefits for the American public.[88]

Consistent with the Commission's observation that any analysis regarding the feasibility of coexistence between terrestrial and satellite services should take into account reasonable operating parameters of today's NGSO systems, the RKF Study used real-world operating parameters and known deployment scenarios. The model did not rely on a simplistic rural-urban divide to position satellite and terrestrial terminals at distances, but rather used algorithms to capture satellite broadband commitments and use cases as well as real-world market patterns for 5G investment. The algorithmic models took care to distribute satellite and terrestrial activity across CONUS at random, but always in ways informed by actual and likely patterns of satellite and terrestrial deployment. For the satellite terminals, the model depicted an extensive, nationwide deployment of Starlink terminals to identify all manner of vulnerabilities to terrestrial emission paths. The model recognized that SpaceX has won ratepayer funding to offer broadband service to 643,000 locations across 35 states with a commitment to low-latency service at 100/20 Mbps. The model, therefore, weighted deployments to the RDOF areas, with the highest weighting to rural RDOF areas in which SpaceX secured funding, and additional deployments in areas outside of RDOF geographies in lower population density areas of the United States. However, the model did *not* confine Starlink terminals to areas of lower

[88] The nascent state of the NGSO FSS licensees' deployments as well as the satellite sector's shortened development cycle also allows satellite licensees a far greater capacity to adapt to "harness technological innovation" to avoid potential interference from terrestrial licensees in the band with much lower, if any, incremental costs to the enterprise. *See Satellite bankruptcies circa 2000 vs. 2020: We've come a long way!*, SPACE NEWS (April 15, 2021), https://bit.ly/3vPaAx2.

population density. Rather, the model situated large numbers of Starlink terminals in many of the most densely populated cities of the United States.[89]

For the terrestrial infrastructure, RKF identified census tracts with a population density greater than 7,500 people per square mile, which corresponds to the urban portions of many cities, and used those areas as likely sites for robust 12 GHz deployment. The model also recognized that 5G operators will deploy 12 GHz band transmitters in many less densely populated urban centers, too. Therefore, RKF used a methodology to ensure that if the "urban" density threshold did not result in an area that encompasses 10% of a market's population, then the most densely populated census tracts in the market were added until the area covered 10% of the market population. RKF chose Partial Economic Areas ("PEAs") as the geographic base unit to more closely track the FCC's prevailing approach to wireless broadband licensing and then distributed 5G infrastructure to ensure that 10% of the population in each PEA was covered with service. This textured deployment allowed RKF to depict 12 GHz 5G service in the most populous parts of many rural markets as well as large portions of the largest cities.

For each site, the RKF Study used standard, reference information for the azimuth, tilt, radiation pattern, and other base station design features to simulate the design of an actual 5G macro-cell network in the same area. This model resulted in a 12 GHz deployment area that includes smaller cities and towns as well as the largest and most populous cities in CONUS.

[89] RKF's methodology assumed such a dense deployment of satellite terminals in many metropolitan centers that the number of Starlink terminals may exceed the capacity of SpaceX's single co-frequency beam, and therefore SpaceX may be unable to provide the assumed urban users with a competitive level of service. This density of satellite terminals represents yet another of the numerous highly conservative assumptions RKF employed and ultimately increases the study's confidence in its conclusion that coexistence between NGSO and 5G is "readily feasible."

The RKF Study relied on similarly robust inputs to model the SpaceX network. Wherever possible, the RKF Study relied on parameters as expressed by SpaceX or as defined in 3GPP or the ITU. The RKF Study assumed the Starlink constellation was fully deployed and accounted the dynamic configuration of the SpaceX network infrastructure. Given that the SpaceX technical parameters are opaque[90] and seem to change frequently,[91] the RKF Study sought to undertake the most reasonable analysis based on public information. The RKF Study then assumed that SpaceX would have to apply differential penetration rates depending on whether: (1) the area is rural or urban; and (2) SpaceX won RDOF funding.

Several fundamental differences between terrestrial and NGSO deployment configurations explain why the RKF Study finds coexistence to be readily feasible. As an initial matter, differing elevation angles of NGSO systems and terrestrial wireless systems greatly improve the odds of coexistence. NGSO satellite constellations typically include thousands of satellites; therefore, user terminal operation is typically limited to comparatively high elevation angles. By contrast, the terrestrial base stations and user equipment are all relatively close to the

[90] SpaceX's system design as publicly revealed has several unknown characteristics. *See, e.g.*, Message from William Wiltshire, to Anthony Serafini, ELS File No. 0773-EX-CN-2020 (filed Jan. 15, 2021) (omitting submission of SpaceX's user terminal antenna pattern because, among other things, it is "complex [and] varies depending on steering angle"); Letter from Gardner Foster, Principal, Satellite Policy, SpaceX, IBFS File No. SAT-MOD-20200417-00037 (filed Jan. 5, 2021) (excluding information critical for modeling—right ascension and phase angles—for the 10 new satellites at 560 km, 97.6 degrees).

[91] SpaceX's system design also continues to radically evolve. *Compare, e.g.*, Application of Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20161115-00118 (filed Nov. 15, 2016) (proposing, in 2016, to deploy 4,425 satellites at 1,110 to 1,325 km) ("SpaceX Application") *with* Application of Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20181108-00083 (filed Nov. 8, 2018) (proposing, in 2018, to deploy 1,584 previously authorized satellites at 550 km, not 1,150 km, and to reduce system size from 4,425 to 4,409 satellites) *and* Application of Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20200417-00037 (filed Apr. 17, 2020) (proposing, in 2020, to deploy the entire previously authorized system at 540 to 570 km and reduce system size from 4,409 to 4,408 satellites) ("SpaceX Mod3 Application").

ground and therefore operate at low elevation angles. In 2016, planned low-earth orbit ("LEO") systems had small, sparse constellations and likely needed to have earth stations communicate across the full arc of the sky to operate. For those reasons, the 2016 study assumed elevation angles down to 5 degrees, which would not then have been compatible with terrestrial services.[92] Now in 2021, SpaceX plans an extensive constellation that allows consumer user terminal antennas to operate at elevation angles above 25 degrees,[93] enabling sharing with terrestrial 5G.[94] Today, NGSO FSS constellations include thousands of satellites, and therefore user terminal operation is predominantly at high elevation angles.

Moreover, NGSO terminals like Starlink's will be biased toward areas of lower population density areas, whereas terrestrial wireless services will be deployed primarily in areas of higher population density.[95] Of course, it is entirely possible that NGSO terminals will exist in higher density areas, and terrestrial base stations will exist in lower density ones—and the RKF Study took these possibilities into account by allowing for satellite and terrestrial infrastructure to occur at nearly any location suitable for deployment. Nevertheless, the model properly presumed that satellite systems will serve areas with lower population densities, which are less likely to have wireline alternatives, while 12 GHz terrestrial services will be deployed in higher population densities where additional capacity is required to support consumer demand for 5G.

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[92] *See* Comments of MVDDS 5G Coalition, RM-11768, Attach. 1, MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence, at 32-35 (filed June 8, 2016) ("Coexistence 1").

[93] SpaceX Mod3 Application, Technical Narrative, at 4.

[94] The RKF Study assumed a minimum elevation angle of 25° based on NGSO operators' declared specifications. RKF Study at 24.

[95] *See generally supra* Section II.C.

Terrestrial wireless base stations and NGSO user terminals operate at different heights such that the likelihood of interference would be minimal. In general, NGSO terminals operate closer to the ground, whereas terrestrial wireless base stations tend to sit on poles and rooftops. For its part, the RKF Study varied the antenna height to account for both the default, ground-mounted antennas recommended by SpaceX and its users for self-installation and the roof-mounted installations made possible with the purchase of additional hardware and professional installation. At each presumptive earth station site, the study assumes ground deployments 80 percent of the time and rooftop deployments 20 percent of the time.[96] The antennas also avoid the geostationary arc where DBS satellites are located.[97]

Apart from geographic and height-above-average terrain differences that make the likelihood of harmful interference remote, 5G equipment has other attributes that help to avoid interference with NGSO terminals. For example, 5G base stations in the 12 GHz band typically utilize antenna downtilt to avoid self-interference, which also further limits the risk of interference to NGSO user terminals. Likewise, 5G macro-cell base stations in the 12 GHz band will utilize beamforming, which further focuses radiated energy on the 5G user equipment being served and not on NGSO user terminals. And both NGSO systems and terrestrial 12 GHz systems can dynamically operate in an interference-prone environment by using software-defined radios to switch their channels flexibly when co-frequency transmissions from NGSO-based systems are present.

[96] Starlink kits come equipped with a tripod for ground-level installation by the consumer, and users are encouraged to find an unobstructed view of the open sky.

[97] Starlink indicates that its earth stations cannot operate when mounted in a horizontal position, such as the side of a building. SpaceX, *Starlink Volcano Mount Installation Instructions*, https://bit.ly/3abzBKp (last visited Apr. 14, 2021).

B. Terrestrial 5G Can Coexist with NGSO FSS Satellites Occupying Any Orbit, Not Only Highly Elliptical Orbits.

The Commission asks whether 12 GHz band mobile operations are compatible only with NGSO FSS satellites in a highly elliptical orbit ("HEO").[98] The answer is no. The viability of 5G uses in the 12 GHz band does *not* depend on limiting NGSO FSS systems to HEO orbits. All present-day NGSO FSS constellations provide some measure of antenna separation to terrestrial services and permit robust 5G deployment in the same band without the risk of harmful interference. The table below summarizes the differences between NGSO FSS and 5G performance considerations in 2016 and in 2021.

Table 4: Summary of NGSO FSS and Terrestrial Assumptions between 2016 vs. 2021

Assumption	2016	2021
Satellite Diversity	Non-Existent	Standard feature
Minimum Elevation Angle	5°	25°+
Antenna Performance	No phased arrays	Phased arrays
Satellite Beamforming	Large beams	Highly steerable spot beams
Terrestrial Adaptive Beamforming	Non-existent	Readily available for commercial operators
Beamsteering	Non-existent	Readily available for commercial operators
Multiple-Input and Multiple-Output ("MIMO")	MIMO available Massive MIMO not available	MIMO available Massive MIMO available

[98] *See NPRM* ¶¶ 28-29.

In a HEO configuration, satellites follow an elliptical pattern around the earth using a high apogee altitude and low perigee altitude.[99] Commenters explained in the MVDDS rulemaking docket that HEO satellites could prove compatible with co-frequency mobile operations if the satellites transmitted only at their perigee altitude.[100] This design enables HEO satellites to mimic geostationary ("GSO") satellites that only transmit to earth stations from one fixed point at higher elevations and ensures HEO earth stations are not susceptible to interference from co-channel terrestrial operations at lower elevations.[101]

Given architectural advances, however, NGSO satellites *can* coexist with mobile deployments in the 12 GHz band. Not until five months after the submission of the 12 GHz band petition for rulemaking and associated technical analyses did NGSO FSS operators reveal that their LEO deployment plans would result in consumer earth stations with beam-pointing ranges that use higher look angles.[102] The practical differences are significant. *First*, LEO systems will employ hundreds or thousands of satellites and, as a result, no longer need to secure and hold exceptionally low look angles to locate a satellite because several satellites are always overhead offering service.[103] In other words, today's LEO earth stations need not track satellites from

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[99] The apogee is the furthest point from earth, and the perigee is the closest point to the earth. *See id.* at n.84.

[100] *See, e.g.*, Letter from Jeffrey H. Blum, Executive Vice President, External and Legislative Affairs, DISH Network L.L.C., to Marlene H. Dortch, Secretary, FCC, RM-11768, at 4 (filed Nov. 12, 2020).

[101] *See* Coexistence 1 at 32, n.82.

[102] MVDDS Petitioners filed in Apr. 2016, but eleven of the twelve NGSO FSS processing round participants did not file their LEO constellation plans until Nov. 2016. *Compare, e.g.*, MVDDS 5G Coalition Petition (filed Apr. 26, 2016) *and* Coexistence 1 (filed June 8, 2016) *with* SpaceX Application (filed Nov. 15, 2016); Application of Kepler Communications Inc., IBFS File No. SAT-PDR-20161115-00114 (filed Nov. 15, 2016) ("Kepler Application").

[103] *See, e.g.*, SpaceX Application, Technical Narrative at 2 (stating that it will use 4,425 satellites and "employ optical inter-satellite links for seamless network management and continuity of service, which will also aid in complying with emissions constraints designed to facilitate

horizon to horizon. *Second*, LEO systems can deploy subscriber earth stations that use phased array antennas with excellent gain and sidelobe performance and support advanced antenna techniques, like beamforming and beamsteering, to narrowly control energy at desired locations.[104] *Third*, clutter absorption by buildings, vegetation, and other obstructions in urban and suburban areas further mitigates terrestrial signals' potential interference.[105]

SpaceX recognized the feasibility of coexistence between NGSO and terrestrial systems when it applied for its V-band authorization, which includes the 37.5-40.0 GHz band that is allocated on a co-primary basis to FSS, fixed, and mobile services. In seeking a waiver of the Commission's rules that limit FSS downlink operations in the 37.5-40.0 GHz band only to gateway earth stations, SpaceX told the Commission that the Starlink system has "a variety of attributes that facilitate spectrum sharing, including narrow, steerable spot beams, operations at high elevation angles, and the ability to provide service from multiple satellites with overlapping coverage contours."[106] Because "user terminals will only communicate with satellites at angles

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spectrum sharing with other systems"); Kepler Application, Technical Narrative, at 10 (stating that it will use 140 satellites and "antenna arrays on both the satellite and user terminals [to] allow for a seamless transition given the ability for a terminal to actively connect with more than one satellite at any given time"); OneWeb Application, Technical Narrative at 7-8 (stating that it will use 720 satellites and "[t]he movement of the satellites in their orbits [so] that a user will be progressively handed over from beam to beam within a OneWeb satellite and then handed off to the beams of the next satellite in the same orbital plane, or as required to a satellite in the adjacent orbital plane").

[104] *See Phased Array antennas are satellite's Holy Grail*, ADVANCED TELEVISION (Sept. 20, 2020), https://bit.ly/2LYmq6U; *see, e.g.*, SpaceX Application, Legal Narrative at 11 ("Technologies such as dynamic beam forming and phased array antennas both in space and on the ground, optical inter-satellite links, and more powerful computing and software capabilities will enable SpaceX to allocate broadband resources in real time, so that capacity can be placed where it is most needed and energy can be directed away from areas where it might cause interference to other systems.").

[105] *See NPRM* at n.31.

[106] *See* Application of Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20170301-00027, Waiver Requests, at 2 (filed Mar. 1, 2017).

of at least 35 degrees," SpaceX explained, "transmissions from satellites to user terminals would be far off-axis from terrestrial links, which tend to be pointed approximately tangent to the surface of the Earth."[107]

The circumstances in which SpaceX argued NGSO/terrestrial coexistence was feasible—whether it was the triple co-primary status of the band, the use of NGSO user downlinks, the presence of satellite diversity, or the elevation angles—are materially indistinguishable from the situation presented before the Commission in the 12 GHz band. The Commission ultimately denied SpaceX's request for blanket licensing of satellite user equipment, finding SpaceX's request repetitious of arguments previously raised and addressed by the Commission months earlier.[108] In that earlier decision, the Commission concluded that blanket licensing proponents "ha[d] not met their burden of demonstrating that allowing satellite end-user devices in 37.5-40 GHz is necessary and appropriate."[109] By contrast, the attached technical and economic studies, along with these comments, demonstrate precisely why a 5G/NGSO/DBS coexistence framework in the 12 GHz band is both "necessary" as a public policy matter and "appropriate" as a technical one.

In sum, a variety of technical developments that have transpired since the Commission's last review of the rules in 2002—including robust antenna discrimination helping to isolate

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[107] *Id.*

[108] *See Space Exploration Holdings, LLC Application for Approval for Orbital Deployment and Operating Authority for the SpaceX V-band NGSO Satellite System*, Memorandum Opinion, Order and Authorization, 33 FCC Rcd 11434 ¶ 20 (2018) ("In the *Spectrum Frontiers MO&O*, we fully considered the same arguments presented by SpaceX's Application in support of these waiver requests . . . .").

[109] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services et al.*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988 ¶ 220 (2017).

terrestrial transmissions from satellite transmissions and urban conditions that can block satellite earth station reception of terrestrial signals—have opened new sharing opportunities in the 12 GHz band.

C. Terrestrial 5G Services Can Coexist with DBS.

The coexistence studies submitted in the petition for rulemaking proceeding demonstrated that coexistence between DBS and terrestrial 5G is possible, even under a worst-case scenario.[110] And due to advances in technology, there are a variety of ways to implement terrestrial use without hindering DBS operations.

Current rules require MVDDS operators to survey the area around their proposed transmitting antenna site to determine the location of all DBS customers of record that may potentially be affected by the introduction of its MVDDS service. MVDDS licensees must use equivalent power flux density ("EPFD") calculations, terrain, building structure characteristics, and survey results to determine whether their signal levels will exceed the EPFD limit at the site of any DBS customer of record.[111] At least 90 days before the planned date of MVDDS commencement of operations, the MVDDS licensee must provide the following information to the DBS licensees: (i) geographic location (including NAD 83 coordinates) of its proposed station location; (ii) maximum equivalent isotropically radiated power ("EIRP") of each transmitting antenna system; (iii) height above ground level for each transmitting antenna; (iv) antenna type along with main beam azimuth and altitude orientation information, and description of the antenna radiation pattern; (v) a description of the proposed service area; and (vi) survey results along with a technical description of how it determined compliance with the appropriate

[110] Coexistence 1; Reply Comments of the MVDDS 5G Coalition, RM-11768, Appx. A, MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence II (filed June 23, 2016).

[111] 47 C.F.R. § 101.1440(b).

EPFD level at all DBS subscriber locations.[112] Before commencing operations, the MVDDS licensee must consider any new DBS customers or other relevant information provided by DBS licensees.[113] In reality, this coordination process does not involve sharing of DBS receiver locations. Instead, the MVDDS licensee proposes locations and receives a simple Yes or No without additional clarification.

What actually matters from a 5G/DBS coexistence standpoint is whether people can watch television—whether there is perceptible degradation of the signal. RS Access, for example, has deployed a "wide-area" commercial MVDDS deployment in Albuquerque, NM,[114] although that deployment required a permanent waiver of the MVDDS power limits. RS Access has not received a single complaint of harmful interference since the Commission allowed higher power limits in Albuquerque. In practical terms, interference protection is about not introducing excessive noise into a DBS receiver. This means that a reasonable interference limit, which could be stated in terms of EPFD, Interference/Noise, Carrier/Interference, or Signal/(Interference + Noise), could be coupled with modern coordination processes.

There is yet another factor limiting the potential for interference: satellite television is being eclipsed by streaming video.[115] Whereas the DBS industry served approximately 33 million subscribers in 2015, the service only retained 21.8 million subscribers by 2021.[116] In

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[112] 47 C.F.R. § 101.1440(d)(1).

[113] 47 C.F.R. § 101.1440(d)(3).

[114] *NPRM* ¶ 40 (citing RS Access, LLC, ULS File No. 0008742312, Required Notification for Call Sign WQAR561, Substantial Service Showing Supplement at 43-49 (filed July 26, 2019)).

[115] *See, e.g.*, Jon Brodkin, *AT&T's epic DirecTV losses mount as another 954,000 video customers flee*, ARS TECHNICA (July 23, 2020, 2:46 PM), https://bit.ly/3lfr3q9.

[116] Press Release, *Major Pay-TV Providers Lost About 5,120,000 Subscribers in 2020*, Leichtman Research Group (Mar. 4, 2021), https://bit.ly/3ejOqNt ("Satellite TV services lost

2018, AT&T announced in a presentation to analysts that "[w]e've launched our last satellite," and Randall Stephenson, AT&T's then-CEO, said that the company is "done" with satellite as it focuses on streaming video distribution.[117] Given the precipitous decline in DBS since the 2016 coexistence studies[118] (at least 8 million fewer subscribers and associated receiver-dish antennas than existed before), the already low likelihood of interference is now even smaller. Thus, the Commission has more flexibility to address DBS coexistence than it did when it adopted the original MVDDS rules, or even compared to just a few years ago.

IV. UPDATING THE MVDDS TECHNICAL AND SERVICE RULES WILL BETTER SERVE THE PUBLIC INTEREST THAN MAINTAINING THE ARCHAIC REGULATORY STATUS QUO.

Since the Commission established the MVDDS rules nearly two decades ago, technology has transformed dramatically, the market has evolved, and the demand for wireless broadband has exploded. Developing creative solutions for spectrum scarcity through rapidly advancing technical innovation represents the premise of the original order authorizing the MVDDS service in 2002:

> The Commission, as petitioners observe, has previously been reluctant to authorize multiple satellite and terrestrial services in the same bands due to the extremely complex engineering and interference concerns involved. However, the Commission noted in the *First R&O & Further Notice* the increasing demand for spectrum access necessitates that it consider more complicated and creative sharing arrangements.[119]

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about 3,440,000 subscribers in 2020 – compared to a loss of about 3,700,000 subscribers in 2019").

[117] Caleb Henry, *DirecTV owner AT&T says it's done buying satellites*, SPACE NEWS (Dec. 4, 2018), https://bit.ly/3lsJYOm.

[118] *See supra* note 110.

[119] *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range et al.*, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614 ¶ 35 (2002) ("*Second MVDDS R&O*") (citing *Amendment of Parts 2 and 25 of the Commission's*

That premise was true then and remains true now. By contrast, maintaining the regulatory status quo will bind licensees to aging, decades-old technologies, foreclose all but one-way data transmissions services in a two-way data world, and empower NGSO FSS licensees to pursue additional regulatory constraints on the band to foreclose competitive pressure from terrestrial broadband service providers. Absent decisive action, these trends will further constrain the Commission's ability to act when the need for a flexible 12 GHz framework may become even more urgent than it already is today.[120]

Updating the MVDDS service and technical rules will accelerate 5G deployment while also protecting DBS and NGSO FSS incumbents and minimize the costs and delays associated with relicensing. Existing rules allow MVDDS spectrum to be used for any digital, fixed, non-broadcast service. But mobile services are specifically banned, and two-way service is permitted only "by using other spectrum or media for the return or upstream path."[121] In adopting these restrictions nearly 20 years ago, the Commission concluded that both mobile and two-way operations would unnecessarily complicate the sharing environment among MVDDS, incumbent DBS, and future NGSO FSS.[122]

But technology has revolutionized wireless communications. Several technical advances that have facilitated spectrum sharing have gone from fiction to fact since the Commission adopted rules for 12 GHz terrestrial operations, including:

Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range et al., First Report and Order and Further Notice of Proposed Rulemaking, 16 FCC Rcd 4096 ¶ 224 (2000)).

[120] Despite an array of limitations and constraints on deployment, RS Access and other MVDDS licensees have deployed meaningful, substantial service to the public.

[121] 47 C.F.R. § 101.1407.

[122] *Second MVDDS R&O* ¶ 137.

- *Phased Array Antennas.* Phased array antennas can change the shape and direction of radiofrequency energy without physically moving the antenna. These systems enable beamforming and beamsteering that focus radiofrequency energy where it is wanted and minimize it where it is not wanted. These antennas have a practical form factor and excellent performance at higher frequencies, including in the 12 GHz band.[123]

- *Spectrum Access Systems.* In 2002, the Commission had no experience with real-time databases capable of managing interference according to specific rules. Since then, spectrum management databases with a range of capabilities have been successfully deployed in the TV White Spaces and the CBRS band, and databases will be soon deployed to ensure that unlicensed devices do not interfere with incumbent fixed services in the 5.925-7.125 GHz band. The database and cloud technology available today can transform spectrum access from a process that took months in 2002 to one that takes a fraction of a second in 2021. Today's technology supports dynamic frequency coordination and control.[124]

- *Software Defined Networks ("SDNs"), Self-Optimizing Networks ("SON") and Orchestration.* Today's networks are smarter and able to quickly adapt to changes in the radiofrequency environment, including via dynamic instructions from a spectrum management database to avoid or mitigate interference with another service in the same or adjacent band. SDNs manage networks and devices consistently, regardless of the complexity of the underlying network technology, in real-time. As one vendor described it, SDNs make bandwidth management, restoration, security, and other policies "highly intelligent and optimized" and allow "users to develop network-aware applications, intelligently monitor network conditions, and automatically adapt the network configuration as needed."[125]

- *Bandwidth and Carrier Aggregation.* Since 2002, much more broadband spectrum has become available, and operators can leverage large amounts of bandwidth in multiple bands to serve subscribers efficiently and effectively. Carrier aggregation expands capacity and increases resiliency: if one band is not available for any reason, other bands are available to provide service with minimal disruption to customers. In 2002 there were two bands, cellular and PCS, and devices could communicate with only one of those two bands at any given time. At that time, even if dynamic adjustments to support sharing had existed, those adjustments between bands would likely have had a dramatic negative effect on the user experience. Today, moving among bands is virtually imperceptible to the end user.[126]

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[123] *See, e.g.*, *What is a Phased Array Antenna?*, everythingRF, https://bit.ly/2QRVp7J (last visited May 6, 2021).

[124] *See, e.g.*, Michael Calabrese, *Dynamic Spectrum Access Databases – Getting Beyond the Myths*, Dynamic Spectrum Alliance 2018 Global Summit (May 3, 2018), https://bit.ly/3eXjamJ.

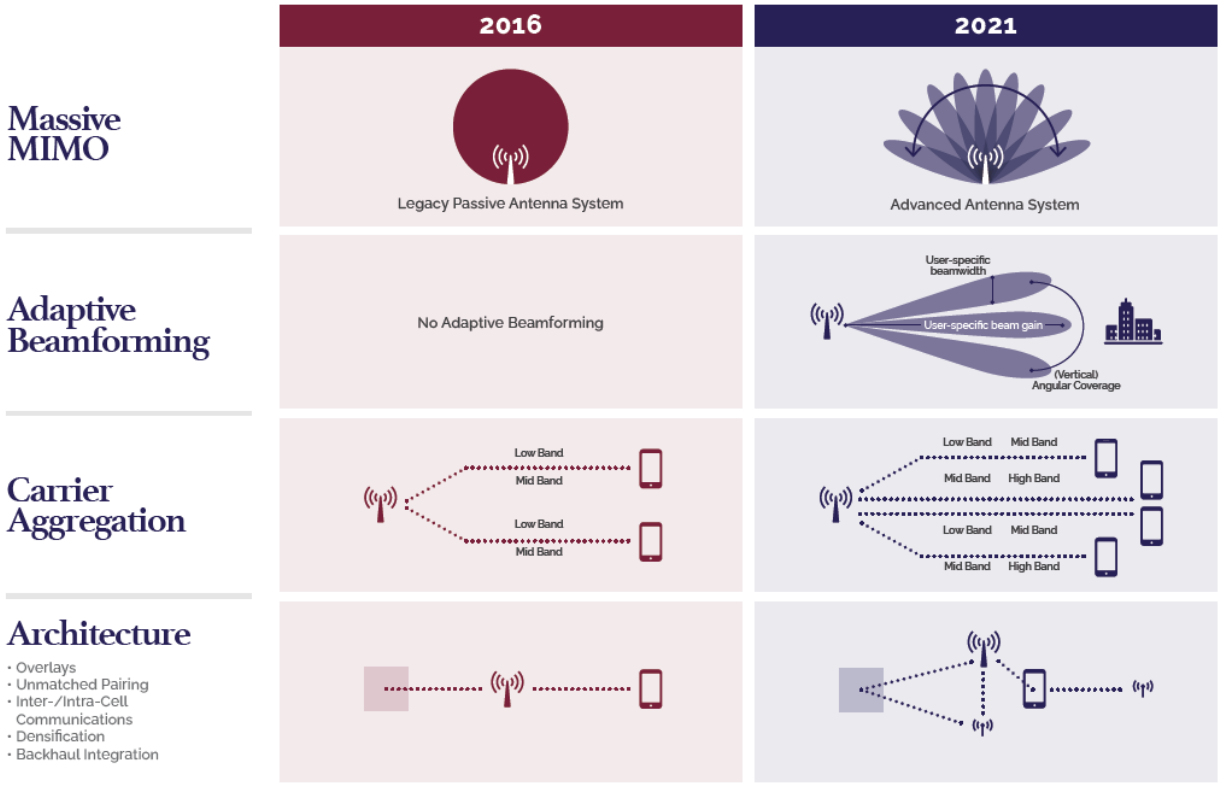
[125] *What is SDN?*, Ciena Corporation, https://bit.ly/3trnnnN (last visited May 6, 2021).

[126] *See, e.g.*, Carrier aggregation in 5G, Ericsson, https://bit.ly/2RswWWm (last visited May 6, 2021).

- *Small Cells.* The proliferation of small cells has provided operators with another tool in the toolbox to enable sharing. The types of interference caused by macro-cells and by small cells are different, and small cells can be a solution to facilitate sharing in areas where sharing with macro-cells is not feasible.[127]

And rapid technological advancement, as illustrated below in Figure 10, has continued apace since 2016 when MVDDS licensees from across the country petitioned for relief from the maze of operational limits and plodding document exchanges that govern the 12 GHz band:

Figure 10: Summary of Differences between Terrestrial Mobile Technologies in 2016 and 2021[128]



The preceding list and Figure 10 are some of the more prominent technical advances; however, this summary is far from exhaustive. But taken together, these and other innovations have made

[127] David A. Loeber, *Why small cells are a big part of 5G capacity (Reader Forum)*, RCR WIRELESS (May 13, 2020), https://bit.ly/3trNRFC.

spectrum sharing far more feasible today than it was in 2002 or even 2016 and underscores just how quickly the capacity for efficient, timely, cost-effective sharing has progressed. These transformative developments allow the Commission to authorize terrestrial mobile operations in the 12 GHz band with sufficient flexibility to provide a robust suite of 5G fixed and mobile service offerings.

Accordingly, the Commission should consider changes to the MVDDS technical rules to promote a viable 5G two-way mobile broadband service while protecting other services.[129] For example, MVDDS operators must contend with duplicative power restrictions intended to protect DBS receivers. The first restricts MVDDS transmit power and subjects MVDDS licensees to an EIRP limitation of 14 dBm per 24 MHz.[130] The second requires MVDDS licensees to meet specified EPFD levels that vary by U.S. region at each DBS subscriber location.[131] While the EPFD limits measured at DBS receivers provide protection to DBS reception, the EIRP limit measuring power at the output of the transmitter is unduly conservative. Imposing a power limit to protect DBS receivers provides no additional protection and serves only to limit the band's full and efficient use by precluding facilities that can be implemented without the threat of interference to DBS. By eliminating the duplicative 14 dBm per 24 MHz EIRP limit as a mechanism for mitigating interference from MVDDS to DBS, DBS receivers can still be fully protected without hampering 5G operations.

[129] 47 C.F.R. §§ 101.113(a), 101.147(p), 101.105(a)(4)(ii), 101.1440.

[130] 47 C.F.R. §§ 101.113 Note 11, 101.147(p).

[131] 47 C.F.R. § 101.105(a)(4)(ii)(B). The regions and corresponding EPFD limits are: East: -168.4 dBW/m^2 /4kHz, Midwest: -169.8 dBW/m^2 /4kHz, Southwest: -171.0 dBW/m^2 /4kHz, and Northwest: -172.1 dBW/m^2 /4kHz. *Id.*

Given the many technological advancements since 2002, the Commission also should adjust the maximum EPFD limit.[132] When the Commission adopted those thresholds nearly 20 years ago, it recognized that they were "very conservative."[133] The Commission explained, for example, that it "use[d] a conservative performance threshold value of DBS signal performance to calculate the EPFD."[134] Moreover, the Commission's underlying "analysis assumed worst-case operating conditions – a rain-faded DBS signal and a full-strength MVDDS signal."[135] Yet, the Commission has recognized that "[i]n practice rain will generally affect both the MVDDS and the DBS signals in an area"[136] and that because "a faded MVDDS signal would be received by the DBS system, the total increase in DBS unavailability due to MVDDS will be less than the amount calculated in our analysis."[137]

Similarly, the Commission should modify and streamline its EPFD compliance demonstration framework. Currently, an MVDDS provider cannot begin operation unless it can ensure that the EPFD from its transmitting antenna at all DBS "customer of record" locations is below the appropriate regional limit.[138] To do so, the MVDDS operator must identify every DBS "customer of record" that *could* be affected and must then assess whether the signal levels from its system would exceed the appropriate EPFD limit at any DBS customer of record

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[132] *Id*.

[133] *Second MVDDS R&O* ¶ 71 ("As a starting point, we applied the very conservative technical parameters and assumptions described below to derive EPFD values . . . .").

[134] *Id.* ¶ 79.

[135] *Id.*

[136] *Id.*

[137] *Id.*

[138] 47 C.F.R. § 101.1440.

location.[139] This process requires mapping all DBS customers in the MVDDS license area (and mapping changes every month based on normal but unpredictable movement within the subscriber base) and accommodating varying topologies.

Finally, the *NPRM* asks whether expanded terrestrial service rules should apply only indoor to protect satellite incumbents.[140] An indoor-only restriction is unnecessary and would be clearly detrimental to the public interest by severely limiting deployment use cases. As the RKF Study confirms, robust, diversified terrestrial use cases show that no need exists for such a draconian limitation on 5G deployments in the band.

V. ALLOWING TWO-WAY FLEXIBLE USE IN THE 12 GHZ BAND FOR EXISTING TERRESTRIAL LICENSEES IS CONSISTENT WITH COMMISSION PRECEDENT, THE COMMUNICATIONS ACT, AND INTERNATIONAL RULES.

Expanding flexible use of the 12 GHz band is most readily achievable by enhancing incumbent MVDDS licensees' authorizations. MVDDS licensees are the only incumbents in the band that have geographically exclusive, terrestrial authorizations purchased through competitive bidding.[141] These features make MVDDS licensees uniquely suited—as a matter of Commission precedent, sound spectrum policy, the Communications Act, and international agreements—to use their authorizations flexibly for the next generation of mobile broadband.

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[139] *Id.*

[140] *NPRM* ¶ 32.

[141] *See, e.g., NPRM* ¶ 36 ("While the DBS operators have exclusive rights to transmit from each of their orbital slots, they have non-exclusive rights in terms of geographic coverage (i.e., they jointly share the right to transmit across the United States using the 12.2-12.7 GHz band). In contrast, in order to encourage investment and innovation by terrestrial licensees, the Commission generally assigns new terrestrial use licenses on an exclusive geographic basis.").

A. FCC Precedent Supports Granting Two-Way, Mobile Rights to Existing Terrestrial Licensees.

The Commission has a long, successful record of expanding flexible-use rights to existing licensees like those holding MVDDS authorizations. Since at least as early as the mid-nineties, the Commission has adopted a clear policy of expanding flexible use to meet America's growing demand for mobile broadband. The Commission often accomplishes this task by expanding incumbent terrestrial operators' rights. Although the Commission has achieved similar results through overlay licensing[142] and assigning terrestrial rights to satellite operators, neither approach is workable here as detailed below.[143] Several case studies illustrate these points.

The Commission's 2016 *Spectrum Frontiers* proceeding shows why it serves the public interest to give MVDDS licensees greater flexible-use rights.[144] The Commission granted mobile operating rights to fixed Local Multipoint Distribution Service ("LMDS") and 39 GHz

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[142] The *Emerging Technologies* framework used in the PCS auctions relied on overlay licensing and, ultimately, involuntary relocation to transition the spectrum from Fixed Service to mobile use. *See, e.g.*, 47 C.F.R. § 101.75.

[143] *See, e.g., Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands, et al*., Report and Order and Order of Proposed Modification, 27 FCC Rcd 16102 (2012) (eliminating all the ancillary terrestrial component rules with respect to the 2 GHz band and awarding terrestrial licenses (AWS-4 licenses) to 2 GHz MSS licensees); *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567 (2014) (adopting licensing and service rules for the 600 MHz band); *Terrestrial Use of the 2473.5-2495 MHz Band for Low-Power Mobile Broadband Networks et al*., Report and Order, 31 FCC Rcd 13801 (2016) (authorizing Globalstar's proposed use of a terrestrial low-power service for use in the 2483.5-2495 MHz portion of the Big LEO band); *Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, Report and Order, Order of Proposed Modification, and Orders, 35 FCC Rcd 5183 (2020) (repurposing the 900 MHz band for broadband operations); *C-Band R&O* (reallocating the bottom 300 megahertz of the C-band for Part 27 operations, inclusive of a guard band).

[144] *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) ("*Spectrum Frontiers R&O*").

band licensees—licensees whose fixed service rights were initially acquired through competitive bidding. The Commission gave three reasons for expanding flexible use—all of which apply here.[145] *First*, granting incumbents mobile rights would minimize transaction costs and accelerate 5G deployment in the band to the benefit of consumers. According to the Commission, "it would be particularly important to take actions that expedite service because of the great benefits these new technologies could bring to consumers and because of the technical and logistical challenges licensees will face."[146] *Second*, the Commission found that, "given the technical characteristics of this band and the nature of the services that may be developed for it, the differences between fixed and mobile operation are increasingly blurred."[147] *Third*, "separate licenses for fixed and mobile operation[s] might create unusually large challenges related to interference."[148]

The 2016 *Spectrum Frontiers* proceeding also highlights why the Commission should reject proposals to conduct an overlay auction in the 12 GHz band. The Commission rejected AT&T's call for an overlay auction that would award mobile rights to non-incumbents on the same frequencies as LMDS fixed licensees because it "would lead to disputes between fixed and mobile licensees that could make it more difficult for both licensees to provide service."[149] Although the LMDS incumbents did not originally have mobile rights, the Commission reasoned that "the benefits of expediting service and ease of coordinating fixed and mobile service outweigh any foreseeable disadvantage of granting mobile rights to

[145] *Id.* ¶ 38.

[146] *Id.* ¶ 38.

[147] *Id.* ¶¶ 38, 83.

[148] *Id.*

[149] *Id.* ¶ 41.

incumbents."[150] Expedited treatment, the Commission noted, was "particularly important because of the need to make millimeter-wave spectrum available for innovative and novel uses."[151]

When overly restrictive rules hamper incumbent licensees' use of spectrum, the Commission's practice is to grant flexible-use rights rather than start from scratch. Recognizing that the 218-219 MHz service rules were too stringent and undermined the use of the band, the Commission added a mobile allocation[152] and then permitted common carrier operations (as opposed to a strictly private radio service).[153] Likewise, the Commission modified Nextel's 800 MHz licenses and allowed the company to operate on 10 megahertz of spectrum in the 1.9 GHz band, notwithstanding self-interested objections from rivals that Nextel would reap an undeserved advantage.[154] The Commission's actions to liberalize the 2.5 GHz band highlight how granting flexible use can yield long-term benefits.[155] In 1995, the Commission expanded

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[150] *Id.* ¶ 42.

[151] *Id.*

[152] *Amendment of Part 95 of the Commission's Rules to Allow Interactive Video and Data Service Licensees to Provide Mobile Service to Subscribers*, Report and Order, 11 FCC Rcd 6610 ¶ 9 (1996) ("*218-219 MHz Reform R&O*") ("[W]e believed that the primary use of the IVDS system should be for fixed operations. Now, however, in light of the development of the industry and the views of a majority of the commenters, we believe we should not limit IVDS licensees to providing a fixed service with only an ancillary mobile component. Rather, the public will be better served by giving the licensee the option of operating a fully mobile system . . . .").

[153] *Amendment of Part 95 of the Commission's Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999).

[154] *Improving Public Safety Communications in the 800 MHz Band*, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order, 19 FCC Rcd 14969 ¶ 12 (2004) ("*800 MHz R&O*").

[155] *See, e.g., Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands et al.*, Report and Order and Further Notice of

the protected service area contour for site-based Multichannel Multipoint Distribution Services ("MMDS") licensees from a 15-mile radius to 35 miles.[156] Subsequent advances in technology allowed Instructional Television Fixed Service ("ITFS") and MMDS licensees to provide multiple channels of video programming and high-speed data applications.[157] Two years later, the Commission authorized two-way operations on ITFS/MMDS frequencies, effectively enabling voice, video, and data services.[158] Noting that these and other regulatory changes led to more than "$2 billion dollars [invested] in the acquisition, by purchase or lease, of MMDS and ITFS channel rights covering 60 million households" since 1998, the Commission then added a mobile allocation to the band in 2001.[159] The Commission implemented geographic licensing[160]

Proposed Rulemaking, 19 FCC Rcd 14165 ¶ 30 (2004) ("*2004 2.5 GHz Order*") (reorganizing the 2.5 GHz band plan and permitting both Frequency Division Duplexing and Time Division Duplexing in the 2.5 GHz band to "resolve the incompatibility between high-power one-way services and low-power cellular services").

[156] *Amendment of Parts 21, 43, 74, 78, and 94 of the Commission's Rules Governing Use of the Frequencies in the 2.1 and 2.5 GHz Bands Affecting Private Operational Fixed Microwave Service, Multipoint Distribution Service, Multichannel Multipoint Distribution Service, Instructional Television Fixed Service, & Cable Television Relay Service,* Second Order on Reconsideration, 10 FCC Rcd 7074 (1995).

[157] *Request for Declaratory Ruling on the Use of Digital Modulation by Multipoint Distribution Service and Instructional Television Fixed Service Stations*, Declaratory Ruling and Order, 11 FCC Rcd 18839 (1996).

[158] *Amendment of Parts 21 and 74 to Enable Amendment of Parts 21 and 74 to Enable Instructional Television Fixed Service Licensees to Engage in Fixed Two-Way Transmissions*, Report and Order, 13 FCC Rcd 19112 ¶ 1 (1998) ("[W]e are: (1) permitting both [M]MDS and ITFS licensees to provide two-way services on a regular basis; (2) permitting increased flexibility on permissible modulation types; (3) permitting increased flexibility in spectrum use and channelization, including combining multiple channels to accommodate wider bandwidths . . . .").

[159] *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems,* First Report and Order and Memorandum Opinion and Order, 16 FCC Rcd 17222 ¶ 21 (2001).

[160] *2004 2.5 GHz Order* ¶ 54.

and permitted blanket licensing of mobile operations (which otherwise required separate authorization).[161] Fifteen years later, the band is now a core component of T-Mobile's multi-band 5G strategy.[162]

These examples show why granting two-way mobile rights to MVDDS incumbents serves the public interest and remains faithful to Commission precedent. In contrast to this precedent, RS Access is aware of no decision giving flexible-use rights to a satellite operator when terrestrial licensees already have geographically exclusive licenses.[163]

B. The Commission Has Broad Authority under Section 316 of the Communications Act to Modify MVDDS Licenses for More Intensive 5G Uses.

Expanding MVDDS licensees' spectrum rights is consistent with the Communications Act. Indeed, the Commission has broad authority to modify the terms and conditions of spectrum licenses to "promote the public interest, convenience, and necessity."[164] The Commission's statutory authority allows it to put spectrum to its highest and best use. The Commission has relied on its modification authority over the past two decades to expand or

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[161] *Id.* ¶ 111-12.

[162] *See Why multi-spectrum 5G networks matter for all businesses.*, T-Mobile, https://t-mo.co/3dgdBjY (last visited Feb. 14, 2021).

[163] To the extent there were terrestrial incumbents, they were site-based Fixed Service microwave licensees and Broadcast Auxiliary Service operators. *See, e.g., Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for use by the Mobile-Satellite Service et al.*, Third Report and Order and Third Memorandum Opinion and Order, 18 FCC Rcd 23638 (2003).

[164] 47 U.S.C. § 316; *see also Teledesic LLC v. FCC*, 275 F.3d 75, 84 (D.C. Cir. 2001) (citing *Telocator Network of Am. v. FCC*, 691 F.2d 525, 538 (D.C. Cir. 1982) (finding that when it is fostering innovative methods of exploiting the spectrum, the Commission "functions as a policymaker and, inevitably, a seer—roles in which it will be accorded the greatest deference by a reviewing court")).

introduce flexible-use rights, including in the 28 GHz and 39 GHz bands discussed above.[165] The Commission has taken similar action in other bands, too.[166]

An unbroken line of appellate court decisions defeats any argument the Commission lacks the authority to grant flexible use rights to MVDDS licensees.[167] These decisions expressly allow the Commission to enhance the intensity and efficiency of 12 GHz terrestrial operations.[168] At the same time, the Commission cannot rely on its modification authority to materially impair MVDDS licensees' rights. The Commission's modification authority is not unlimited and cannot be used to effect "fundamental changes" to existing licensees.[169] Auctioning overlay rights to a new class of licensees would materially impair MVDDS licensees' paid-for rights by introducing harmful co-channel interference and exceed the Commission's statutory authority under Section 316 of the Communications Act.[170] Indeed, the Commission has never auctioned overlay rights when existing incumbents held geographically exclusive terrestrial rights assigned through an auction. An overlay auction is not only legally dubious but also unnecessary because the Commission has many options to modernize the MVDDS service without materially impairing any licensee's rights.

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[165] *NPRM* ¶ 34; *see also Spectrum Frontiers R&O* ¶¶ 42, 87.

[166] *See, e.g., 218-219 MHz Reform R&O* ¶ 9 ("We believe that permitting unrestricted rather than ancillary mobile IVDS service, a measure supported by a majority of commenters, will enable IVDS providers to offer a broader array of services.").

[167] *See infra* note 169.

[168] *See, e.g., 2.5 GHz R&O* ¶ 13 ("[W]e also will replace the outdated regulatory regime for EBS with one of flexible use, thus making this valuable mid-band spectrum more available for advanced wireless services, including 5G.").

[169] *See Cmty. Television, Inc. v. FCC*, 216 F.3d 1133, 1140-41 (D.C. Cir. 2000) ("*Community Television*"); *California Metro Mobile Commc'ns v. FCC*, 365 F.3d 38, 46 (D.C. Cir. 2004); *Cellco P'ship v. FCC*, 700 F.3d 534 (D.C. Cir. 2012); *PSSI Servs. LLC v. FCC*, Docket Nos. 20-1142 *et al*. (D.C. Cir. Dec. 18, 2020) ("*PSSI Services*").

[170] 47 U.S.C. § 316.

C. No Reauction of Terrestrial Rights Is Required under Section 309(j) of the Communications Act.

The *NPRM* asks whether Section 309(j) requires a reauction of terrestrial licenses.[171] It does not. Section 309(j) of the Communications Act of 1934, as amended, requires the use of competitive bidding when the Commission accepts mutually exclusive applications. But Section 309(j) also creates an "obligation in the public interest" for the Commission to "*avoid* mutual exclusivity" through "engineering solutions, negotiation, [and] threshold qualifications."[172] Thus, where the Commission can avoid mutual exclusivity through negotiation, technical rules, or other means, an auction is not required under Section 309(j).[173]

The Commission's 2004 decision to repurpose the 800 MHz band is particularly instructive. Citing Section 309(j)(6)(E), Nextel's opponents argued that the Commission should auction off rights to the 1.9 GHz band instead of assigning it to Nextel through a license modification. The Commission rejected such arguments.[174] The Commission noted that Nextel

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[171] *NPRM* ¶¶ 36-37.

[172] 47 U.S.C. § 309(j)(6)(E) (emphasis added); *see 800 MHz R&O* ¶ 73 ("Thus, in Section 309(j)(6)(E), Congress recognized that the Commission can determine that its public interest obligation warrants action that avoids mutual exclusivity, and that this obligation extends to 'application and licensing proceedings' (which include license modifications), not just initial licensing matters.").

[173] *Benkelman Telephone Co. v. FCC*, 220 F.3d 601, 606 (D.C. Cir. 2000) (rejecting the argument that the FCC violated 309(j)(6)(E) by adopting a new licensing scheme (changing from site-specific licenses to geographic licenses) that produced mutually exclusive licenses); *Damsky v. FCC*, 199 F.3d 527, 535-36 (D.C. Cir. 2000) (upholding FCC approval of a settlement agreement to avoid mutual exclusivity that used financial disqualification (*i.e.*, threshold qualification) of another applicant as a precondition).

[174] *800 MHz R&O* ¶ 73 ("Although 309(j) generally requires auctions whenever mutually exclusive applications for initial licenses are filed, Section 309(j)(6)(E) provides that '[nothing in this subsection shall] be construed to relieve the Commission of the *obligation in the public interest* to continue to use engineering solutions, negotiation, threshold qualifications, service regulations, and other means in order to avoid mutual exclusivity *in application and licensing proceedings*.'") (quoting 47 U.S.C. §309(j)(6)(E)) (emphasis in original).

was uniquely situated to effectuate the repurposing plan (*i.e.*, a threshold qualification),[175] and the public interest supported the Commission taking this approach.[176] The Commission added that, so long as it did not authorize applications for the 1.9 GHz spectrum that would be received by Nextel, the modification of Nextel's licenses would not create a circumstance in which an "application is mutually exclusive with other major modifications or initial applications."[177]

For similar reasons, the Commission need not publicly auction off terrestrial mobile rights in the 12 GHz band. Section 309(j)'s competitive bidding requirement applies only when the Commission receives competing applications for new terrestrial licenses. Expanding the MVDDS service rules as proposed by RS Access would not involve any new applications, let alone competing applications.[178] Likewise, MVDDS licenses—as exclusive terrestrial authorizations assigned through competitive bidding—already provide a ready-made threshold qualification for issuance of new authorizations under Section 309(j)(6)(E). The same cannot be said for DBS or NGSO FSS licensees, whose rights are assigned on a nationwide (*i.e.*, geographically non-exclusive) basis. Otherwise, every satellite operator would have equal claim

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[175] *Id.* ¶ 74 ("[E]ligibility for the 1.9 GHz spectrum would have to be limited to Nextel for the restructuring plan to address satisfactorily the public interest imperatives that we have identified.").

[176] *Id.* ¶ 72 ("[W]e have found that the license modifications that we are ordering in this proceeding clearly promote the public interest, convenience, and necessity, as required by Section 316, and that an alternative process that does not assign the 1.9 GHz band for use in connection with the public safety rebanding would, at best, provide fewer and less effective public interest benefits[.]").

[177] *Id.* ¶¶ 70-71 (quoting *Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, Second Report and Order, 9 FCC Rcd 2348 ¶ 37 (1994)*; see also id.* ¶ 71 ("[W]e have not authorized the filing of applications for this spectrum, have never proposed to do so, and, for the reasons set forth herein relating to important public safety concerns, conclude that it is not in the public interest to open the spectrum for competitive applications.").

[178] For the very few MVDDS authorizations that remain in the Commission's inventory, a system of competitive bidding could be readily implemented to reauction those authorizations under the new 12 GHz rules.

to every terrestrial authorization, creating the very mutual exclusivity issue that a Section 309(j)(6)(E) qualification was intended to avoid.

D. Assignment of Flexible-Use Rights to Satellite Operators Is Not in the Public Interest and Would Undermine the Expectations of Wireless Licensees That Acquire Their Spectrum Rights at Auction.

The *NPRM* seeks comment on whether to grant flexible-use rights to DBS or NGSO operators.[179] At least five reasons counsel against assigning terrestrial rights to DBS or NGSO FSS satellite operators.

First, MVDDS licensees paid for their spectrum rights, which include protection from harmful interference; the Commission would unlawfully imperil those rights if it were to grant terrestrial rights to NGSO or DBS satellite authorizations. For example, RS Access, through its predecessor licensee, won 60 licenses in Auction 53 and 20 licenses in Auction 63. All told, auction winners spent more than $100 million to acquire their licenses between the 2004 and 2005 MVDDS spectrum auctions.[180] Since acquiring its MVDDS licenses, RS Access has made meaningful investments and deployments, delivering a variety of data-intensive applications to a diverse set of users, including rural and underserved communities.

To be sure, MVDDS licensees must protect DBS users.[181] But MVDDS authorizations are primary in the 12 GHz band on a *geographically exclusive* basis. Indeed, when the Commission adopted a geographic licensing framework, the Commission stated that it expected MVDDS authorizations would "require *ubiquitous* coverage" to deliver service.[182] In other

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[179] *NPRM* ¶¶ 36-37.

[180] *Multichannel Video Distribution and Data Service Spectrum Auction Closes*, Public Notice, 19 FCC Rcd 1834 (2004); *Multichannel Video Distribution and Data Service Spectrum Auction Closes*, Public Notice, 20 FCC Rcd 19807 (2005).

[181] *See* 47 C.F.R. § 101.1440.

[182] *Second MVDDS R&O* ¶ 130 (emphasis added).

words, MVDDS licensees have rights against harmful interference, which are "fundamentally related to spectrum rights" throughout the geographic area in which they are licensed.[183] In the recently adopted *C-Band R&O*, the Commission drew exactly this distinction between terrestrial and satellite licensees:

> [B]y their very nature, these incumbent space station licenses are fundamentally distinct, and easily distinguishable, from the exclusive geographic terrestrial licenses that the Commission issues through competitive bidding both in the rights conferred to the licensees and the method by which they are issued. Incumbent space station licensees have non-exclusive access to the band and did not obtain their current licenses through competitive bidding. . . . Thus, unlike terrestrial licensees, incumbent space station operators have no expectation of exclusive access to a particular spectrum band and incurred no appreciable costs for use of this valuable public resource beyond investment in their own network. These clear differences are more than sufficient to distinguish incumbent space station licenses from exclusive terrestrial licenses . . . .[184]

MVDDS *geographic* licensing in the United States is exhaustive—every area in CONUS has a licensed MVDDS operator.[185] Granting satellite operators flexible-use rights would interfere with MVDDS licensees' right to *exclusive* use of the band, subject to coordination

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[183] *Federal Communications Commission Spectrum Policy Task Force: Report of the Interference Protection Working Group*, FCC, at 1 (Nov. 15, 2002), https://bit.ly/3tog40k.

[184] *C-Band R&O* ¶ 143. While two orbital slots and accompanying DBS channel assignments were assigned through competitive bidding in Auctions 8 and 9, the Commission did not grant those authorizations with exclusive spectrum use nor geographically exclusive rights. *See generally Revision of Rules and Policies for the Direct Broadcast Satellite Service*, Report and Order, 11 FCC Rcd 9712 (1995). Moreover, the D.C. Circuit subsequently held that the FCC lacked the authority to assign DBS authorizations through competitive bidding so long as the service is used for international communications. *See Northpoint Tech., Ltd. v. FCC*, 412 F.3d 145 (D.C. Cir. 2005); *see also Direct Broadcast Satellite (DBS) Service Auction Nullified: Commission Sets Forth Refund Procedures for Auction No. 52 Winning Bidders and Adopts a Freeze on All New DBS Service Applications*, Public Notice, 20 FCC Rcd 20618 (2005).

[185] Since the initial issuances of MVDDS licenses, a small number of authorizations have been relinquished and a few others remain subject to review.

requirements. Likewise, conducting an overlay auction would impair MVDDS licensees' ubiquitous geographic rights.

Second, awarding terrestrial rights to multiple satellite operators is unnecessary. Satellite operators like SpaceX and OneWeb have not demonstrated that they need terrestrial rights for their networks nor have they expressed any interest or business purpose in developing terrestrial networks. Indeed, the NGSO mega-constellation model is meant to achieve global scale and bypass terrestrial deployment altogether.

Granting terrestrial rights to satellite operators is also logistically impossible. Satellite operators each have nationwide, non-exclusive rights to provide NGSO services across the entire 12 GHz band. Giving all satellite operators coterminous terrestrial rights in the band could lead to mutual exclusivity, holdout, and coordination problems and raise difficult questions about which operator should hold the rights to particular frequencies in particular geographic areas. The Commission rejected a similar proposal in the C-band proceeding; there, the Commission found that granting exclusive terrestrial rights to a consortium of satellite operators would introduce a "potential, and indeed likely, holdout problem that could undermine the success of such a transition" and "raise significant competitive concerns."[186] Indeed, even with Commission intervention and agreement from C-band operators representing essentially 100

[186] *C-Band R&O* ¶ 39; *see also Expanding Flexible Use of the 3.7 to 4.2 GHz Band et al.*, Order and Notice of Proposed Rulemaking, 33 FCC Rcd 6915 ¶ 59 (2018) ("*C-Band NPRM*") ("Repurposing of the 3.7-4.2 GHz spectrum bands allocated to FSS raises at least three economic problems . . . . First, because all FSS licensees have equal, nonexclusive rights to the entire band under Part 25 of our rules, they cannot compete in the same way that broadcast television licensees did in the broadcast incentive auction. Second, this nonexclusive licensing problem creates an incentive for an FSS licensee to overstate the value it assigns to the spectrum in order to increase the share of auction revenue it may receive. We will refer to this as the 'holdout' problem. Third, repurposing some of the 3.7-4.2 GHz spectrum band will reduce the amount of spectrum available for FSS, which lowers industry capacity and could lead to higher prices for downstream services, such as the transmission of video to cable head ends.").

percent of the U.S. C-band market share, certain satellite operators acted as holdouts and sought court intervention to overturn the C-band transition framework's fundamental structure.[187] Granting terrestrial rights to the six potential NGSO operators in the 12 GHz band would lead to the same infighting and logistical complications the Commission ultimately rejected in the C-band proceeding.

The same considerations apply to DBS operators. Both DBS operators are or are affiliated with nationwide wireless broadband providers.[188] Given the wireless industry's competitive dynamics, the DBS operators have the same incentives to act as holdouts and foreclose access to spectrum. Indeed, the *C-Band NPRM* identified these competition dynamics as a reason to not assign terrestrial rights to satellite operators.[189]

Third, the Commission grants NGSO authorizations free of charge to any entity that applies, both because they are satellite systems subject to the Open-market Reorganization for the Betterment of International Telecommunications Act (better known as the ORBIT Act) and because they are *non-exclusive*.[190] Granting *exclusive* terrestrial license rights in the 12 GHz band to NGSO authorizations would incentivize new applicants for NGSO authorizations

[187] *See PSSI Services*.

[188] AT&T will retain a large ownership and governance role even if the recently-proposed sale of DirecTV is approved.

[189] *C-Band NPRM* ¶ 59 ("We note that the first and last problems create opposite incentives for FSS licensees. The first provides an incentive to repurpose less than the efficient amount of spectrum while the last may create an incentive to repurpose more than the efficient amount.").

[190] 47 U.S.C. § 765f ("[T]he Commission shall not have the authority to assign by competitive bidding orbital locations or spectrum used for the provision of international or global satellite communications services.").

seeking exclusive terrestrial rights. This would violate Section 309(j)(1) of the Communications Act, which requires the Commission to auction mutually exclusive applications for licenses.[191]

Fourth, granting terrestrial rights that overrode MVDDS licensees' geographically exclusive terrestrial rights—which were already paid for through competitive bidding in FCC Auctions 53 and 63—would create perverse incentives and chilling effects in future licensing proceedings. It would send the unmistakable signal to the marketplace that spectrum rights sold at auction could be expropriated at any time even if the licensee greatly exceeds its substantial service obligations. This would create uncertainty for bidders in future auctions, reducing bidding participation and ultimately auction revenues. Increasing uncertainty and unpredictability in spectrum rights would concomitantly increase investment risk, distort investment decisions, lead to inefficiencies, and thus conflict with the broad public interest goals of the Communications Act.[192] It should come as no surprise to the Commission that regulatory uncertainty can discourage investment and should be avoided.[193]

Fifth, awarding terrestrial rights to satellite operators would violate the Communications Act. The Commission lacks statutory authority to inflict "fundamental changes" on MVDDS

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[191] 47 U.S.C. § 309(j)(1).

[192] *See, e.g.*, 47 U.S.C. § 157(a) ("It shall be the policy of the United States to encourage the provision of new technologies and services to the public.").

[193] *See, e.g.*, *Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities et al.*, Declaratory Ruling and Notice of Proposed Rulemaking, 17 FCC Rcd 4798 ¶ 5 (2002) ("[W]e seek to remove regulatory uncertainty that in itself may discourage investment and innovation."); *Appropriate Framework for Broadband Access to the Internet over Wireline Facilities et al.*, Notice of Proposed Rulemaking, 17 FCC Rcd 3019 ¶ 5 (2002) ("[O]ur policy and regulatory framework will work to foster investment and innovation in these networks by limiting regulatory uncertainty . . . ."); *Implementation of Sections 3(n) and 332 of the Communications Act, Regulatory Treatment of Mobile Services*, Second Report and Order, 9 FCC Rcd 1411 ¶ 25 (1994) ("Our definition of CMRS not only represents fidelity to congressional intent, but also establishes clear rules for the classification of mobile services, minimizing regulatory uncertainty and any consequent chilling of investment activity.").

licenses.[194] In *Community Television*, the D.C. Circuit reasoned that the licenses were not fundamentally changed because broadcasters would "provide essentially the same services" before, during, and after the transition.[195] Here, however, there is likely no greater difference in service types than those delivered from a terrestrial, geographically exclusive authorization and those from a fixed, non-exclusive satellite service. Grant of terrestrial rights here is distinguishable from the Commission's order on reconsideration affirming DISH's AWS-4 rights.[196] There, the modification involved expanded flexible-use rights for the "ancillary terrestrial component" rights that DISH already possessed (*i.e.*, the opportunity to challenge the underlying legal framework had already passed).[197] The fundamental change, in essence, had already occurred (and went unchallenged).[198] Indeed, the Commission noted in the *C-Band R&O* that satellite operators "have no terrestrial spectrum usage rights."[199]

For all of these reasons, assigning terrestrial rights to DBS or NGSO FSS satellite operators would be administratively and legally infeasible.

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[194] *PSSI Services* at 8 (citing *MCI Telecomms. Corp v. AT&T*, 512 U.S. 218, 227-29 (1994)); *see also Community Television*, 216 F.3d at 1140-41.

[195] *Community Television*, 216 F.3d at 1141.

[196] *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands et al.*, Order on Reconsideration, 33 FCC Rcd 8435 (2018).

[197] *Id.* ¶ 16 ("And both before and after the AWS-4 Order of Modification, the terms of DISH's 2 GHz licenses allowed it to provide terrestrial service in the 2000-2020 MHz and 2180-2200 MHz bands. Specifically, before the license modification at issue, the 2 GHz licenses had already allowed DISH to exercise terrestrial authority under the ATC rules.").

[198] The court in *NTCH, Inc. v. FCC* briefly addressed the issue but dismissed the argument as untimely. 950 F.3d 871, 882-83 (D.C. Cir. 2020).

[199] *C-Band R&O* ¶ 214.

E. Neither International Treaties nor ITU Regulations Counsel against 5G Services in the 12 GHz Band.

The *NPRM* seeks comment on the relevance that the "12 GHz band has not been proposed at the [ITU] for 5G or International Mobile Telecommunications (IMT) use at this time."[200] In fact, the 12 GHz band is already allocated internationally for multiple uses, including mobile.[201] Indeed, footnote 5.490 of the Commission's Table of Frequency Allocations recognizes the potential for terrestrial operations to coexist with the Broadcast-Satellite Service.[202] The 12.2-12.7 GHz band is co-primary mobile in Regions 2 and 3.[203] The 12.2-12.5 GHz band is co-primary mobile in Region 1 and regionally in Region 1 at 12.5-12.7 GHz.[204]

That the ITU has not yet proposed designating the 12 GHz band specifically for 5G or IMT use has little significance in this proceeding. The United States is the global policy and innovation leader in international spectrum affairs; it does not behoove the Commission to wait for the ITU to provide a worldwide mobile allocation in the 12 GHz band before acting in this proceeding. The world looks to the United States, and as much as any global institution, to the Commission itself, for leadership. The Commission has often acted before the ITU in facilitating

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[200] *NPRM* at n.66.

[201] *See* 47 C.F.R. § 2.106.

[202] 47 C.F.R. § 2.106, n.5.490 ("In Region 2, in the band 12.2-12.7 GHz, existing and future terrestrial radiocommunication services shall not cause harmful interference to the space services operating in conformity with the broadcasting-satellite Plan for Region 2 contained in Appendix 30").

[203] 47 C.F.R. § 2.106.

[204] 47 C.F.R. § 2.106, n.5.494.

mobile use in spectrum bands with latent potential. Examples include 600 MHz,[205] 700 MHz,[206] 2 GHz,[207] 3.7 GHz,[208] and 28 GHz.[209] The Commission adopted a reverse-band regime in 2000-2020 MHz even though no ITU agenda item had considered the issue.[210] Moreover, the Commission will likely act on the 17 GHz band before the ITU does at World Radiocommunication Conference ("WRC") 2023.[211]

The 28 GHz band is particularly instructive. There, the Commission granted incumbents flexible-use rights and noted: "Although WRC-15 omitted 27.5-28.35 GHz from a list of [millimeter-wave] bands that it invited ITU-R to study for mobile service, the record in this proceeding makes it abundantly clear that there are significant benefits to authorizing mobile use in the 28 GHz band regardless of that international decision."[212] Indeed, by the time the 24.25-27.5 GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2, and 66-71 GHz bands were identified for

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[205] *See Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567 ¶ 319 (2014).

[206] *See Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (relocating the lower 700 MHz for mobile use before the ITU designed the band for IMT at WRC-07).

[207] *See 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).

[208] *C-band R&O*; *see also* ITU Resolution 811 (WRC-19) (creating WRC-23 agenda item 1.2 to "consider identification of the frequency band[] . . . 3 600-3 800 MHz . . . for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis").

[209] *See Spectrum Frontiers R&O* ¶ 25.

[210] *See DISH Network Corporation*, Memorandum Opinion and Order, 28 FCC Rcd 16787 (2013).

[211] *Amendment of Parts 2 and 25 of the Commission's Rules to Enable GSO Fixed-Satellite Service (Space-to-Earth) Operations in the 17.3-17.8 GHz Band, to Modernize Certain Rules Applicable to 17/24 GHz BSS Space Stations, and to Establish Off-Axis Uplink Power Limits for Extended Ka-Band FSS Operations*, Notice of Proposed Rulemaking, 35 FCC Rcd 13239 (2020).

[212] *Spectrum Frontiers R&O* ¶ 25.

IMT-2020,[213] the Commission had already conducted two millimeter-wave spectrum auctions (Auctions 101 and 102),[214] with a third slated to begin shortly after the end of WRC-19 (Auction 103).[215] To reach that point in 2019, the Commission initiated its *Spectrum Frontiers* proceeding in 2014, adopting multiple notices of proposed rulemaking and orders along the way.[216]

Further underscoring that ITU allocations are not dispositive, the Commission allows NGSO FSS in the 12 GHz band, even though NGSO FSS does not have an exclusive worldwide allocation or the unfettered ability to trump mobile services in other regions. Many African and Middle Eastern countries require NGSO operators to share with mobile operators on a co-primary basis in the upper 200 megahertz of the 12 GHz band.[217] The same is true in Austria, Azerbaijan, Kyrgyzstan, and Turkmenistan.[218] And in Region 1, NGSO FSS enjoys primary status only in the lower 300 megahertz of the band.[219] In Region 3, none of the band is limited to NGSO FSS.[220] Rather, NGSO operators enjoy rights in the lower adjacent band, 11.7-12.2 GHz.

NGSO operators have neither a global NGSO FSS allocation in the 12 GHz band nor the ability to conduct 12 GHz operations in many important nations even where an allocation exists.

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[213] *WRC-19 identifies additional frequency bands for 5G*, ITU NEWS (Nov. 22, 2019), https://bit.ly/37bvhJB.

[214] Auction 101: Spectrum Frontiers – 28 GHz, FCC, https://bit.ly/3nULmup (last visited May 6, 2021); Auction 102: Spectrum Frontiers – 24 GHz, FCC, https://bit.ly/3eo6nuw (last visited May 6, 2021).

[215] Auction 103: Spectrum Frontiers – Upper 37 GHz, 39 GHz, and 47 GHz, FCC, https://bit.ly/3nULGcB (last visited May 6, 2021).

[216] *See, e.g.*, *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Notice of Inquiry, 29 FCC Rcd 13020, 13021, ¶ 2 (2014).

[217] *See* 47 C.F.R. § 2.106, n.5.494.

[218] *See* 47 C.F.R. § 2.106, n.5.496.

[219] *See* 47 C.F.R. § 2.106, n.5.487A.

[220] *See* 47 C.F.R. § 2.106, n.5.484A.

In fact, SpaceX's international authorizations do not uniformly provide two gigahertz of Ku-band user downlink spectrum. For example, it does not appear that Starlink is authorized to receive transmissions in the 12 GHz band in much of Australia[221] or any part of India[222] or Brazil.[223] Nor does Starlink appear to have interference protection in New Zealand.[224] And in Canada, SpaceX ostensibly may operate under an interim authorization, but operating conditions are not publicly available.[225] Starlink will operate with the same earth stations and with the same set of satellites over the United States as it does for other countries that do not permit Starlink to operate in or throughout the 12 GHz band in their territories at all, or only with significant geographic limitations. Indeed, Starlink is currently advertising in those regions and apparently will offer services in those countries using Ku-band spectrum. SpaceX's fragmented worldwide authorizations also belie its assertions that the 12 GHz band is "workhorse" spectrum necessary to offer Starlink service.[226]

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[221] Pantelis Michalopoulos and Andrew Golodny, Counsel, DISH Network Corporation, to Marlene H. Dortch, Secretary, FCC, WT Docket No. 20-443 *et al.*, at 3 (filed Apr. 23, 2021) ("In Australia, SpaceX is prohibited from using the 12 GHz band in most of the country's large metropolitan areas including Sydney, Melbourne, Perth, Adelaide, and others; it may only provide service in 'low density and remote areas.'").

[222] *Id.* at 5 ("India's telecom regulators . . . appear not to have licensed the Starlink system at all, and regulators are reportedly investigating reports that SpaceX is preselling beta service in India without authorization.").

[223] *Id.* at 6 ("[O]n March 9, 2021, Brazil's National Telecommunications Agency ('ANATEL') stated that there is no application in progress at ANATEL for a satellite landing right license, or for an authorization to operate associated telecommunications services for Starlink or its Brazil affiliates.").

[224] *Id.* at 5 ("SpaceX enjoys no protection from any authorized users of the [12 GHz] band.").

[225] *Id.* at 7 ("[T]he Department of Innovation, Science and Economic Development ('ISED') has given SpaceX approval under an interim approach for authorizing networks of identical earth stations using Ku-band frequencies . . . . [but t]hese approvals, and any additional conditions attached to them, have yet to be made public.").

[226] *See* Letter from David Goldman, Director of Satellite Policy, SpaceX, to Marlene Dortch, Secretary, FCC, RM-11768, at 1 (filed June 4, 2020).

F. Adding a Mobile Allocation to the 12 GHz Band to Allow Flexible, Terrestrial Use Complies with Section 303(y) of the Communications Act.

The *NPRM* asks whether adding a mobile allocation to the 12 GHz band would comply with Section 303(y) of the Communications Act.[227] It would, so long as those rights are conferred to MVDDS licensees to offer flexible-use services. Section 303(y) provides the Commission with authority to provide for flexible use operations if:

> (1) such use is consistent with international agreements to which the United States is a party; and (2) the Commission finds, after notice and opportunity for public comment, that (A) such an allocation would be in the public interest; (B) such use would not deter investment in communications services and systems, or technology development; and (C) such use would not result in harmful interference among users.[228]

Because, as discussed above, 5G deployment remains fully compatible with legacy DBS and NGSO services, the Commission could comfortably conclude that modifying the MVDDS service rules to allow for two-way, flexible-use services would comply with Section 303(y). The Commission's technical judgments to that end would receive great deference.[229]

By contrast, conducting an overlay auction and assigning mobile rights would harmfully interfere with MVDDS licensees' right to *exclusive* terrestrial use and violate Section 303(y).

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[227] *NPRM* ¶ 21.

[228] 47 U.S.C. § 303(y).

[229] *See, e.g., Teledesic LLC v. FCC*, 275 F.3d 75, 84 (D.C. Cir. 2001) ("The Commission is therefore entitled to the deference traditionally accorded decisions regarding spectrum management.") (citing *Telocator Network of Am. v. FCC*, 691 F.2d 525, 538 (D.C. Cir. 1982) (finding that when it is fostering innovative methods of exploiting the spectrum, the Commission "functions as a policymaker and, inevitably, a seer—roles in which it will be accorded the greatest deference by a reviewing court")); *FCC v. WNCN Listeners Guild*, 450 U.S. 582, 596 (1981) ("[T]he Commission's judgment regarding how the public interest is best served is entitled to substantial judicial deference."). More generally, federal courts defer to agencies' reasoned policy choices and predictive judgments within the scope of the agency's expertise. *See, e.g., Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) ("The scope of review under the 'arbitrary and capricious' standard is narrow and a court is not to substitute its judgment for that of the agency.").

The same would be true of any action to award terrestrial rights to NGSO or DBS operators. In sum, Section 303(y) provides only one path to mobile rights in the 12 GHz band—granting flexible-use rights to MVDDS licensees.

VI. CONCLUSION.

The public interest supports making the 12 GHz band the next significant platform for technologically innovative and economically vital 5G services. The public interest impels the Commission to release more mid-band spectrum for use by commercial wireless operators as quickly as possible. The 12 GHz band is the *only* large swath of mid-band spectrum that can be brought to the commercial mobile marketplace in the near term and offers all the characteristics required for valuable and robust 5G deployments. Coexistence among 12 GHz 5G, DBS, and NGSO FSS operators is feasible. By acting decisively and quickly, the Commission can establish a new win-win-win, "all of the above" coexistence paradigm before events constrain its policy flexibility. It can protect incumbent satellite services while respecting the geographically exclusive terrestrial rights of MVDDS licenses initially assigned through competitive bidding, consistent with tenets of basic fairness and legal precedent. The Commission can honor all these

objectives while delivering a historically important achievement on behalf of U.S. consumers, economic growth, and technological competitiveness.

Respectfully submitted,

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APPENDIX A – TECHNICAL STUDY BY RKF ENGINEERING SOLUTIONS, LLC

APPENDIX B – ECONOMIC STUDY BY THE BRATTLE GROUP