

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

In the Matter of)	
)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services)	GN Docket No. 14-177
)	
)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands)	IB Docket No. 15-256
)	
)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band)	RM-11664
)	
)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95 and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services)	WT Docket No. 10-112
)	
)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations)	IB Docket No. 97-95
)	

REPLY OF VIASAT, INC.

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Summary

The comments filed in response to the *Further Notice* illustrate the critical need to both maintain and expand opportunities for spectrum use by next-generation satellite networks in the 37.5-52.4 GHz frequency range, which has longstanding allocations for satellite services both in the U.S. and internationally. Specifically, broad consensus exists in the satellite industry that five gigahertz in each of the uplink (37.5-42.5 GHz) and downlink (47.2-50.2 GHz and 50.4-52.4 GHz) directions is required to provide the capacity necessary to meet consumer demand.

Within these five-gigahertz swaths, it is essential that a substantial portion remain available for the broadest possible satellite use. This “core” spectrum includes the 40-42 GHz and 48.2-50.2 GHz segments, which the Commission set aside long ago for this purpose, recognizing (i) the need for satellite networks to be able to operate in dedicated spectrum unimpeded by terrestrial operations, (ii) the need to provide certainty for business planning, and (iii) the need to be able to deploy all types of earth stations anywhere within the satellite coverage area, in an unfettered manner. The record confirms that new and advanced satellite broadband networks actively are being developed to provide service at 37.5-52.4 GHz in reliance on these core spectrum designations. Moreover, preserving the ability of satellite networks to use 40-42 GHz and 48.2-50.2 GHz in this manner is fundamental to facilitating satellite and terrestrial sharing in other portions of the 37.5-52.4 GHz spectrum.

In the other band segments addressed in the *Further Notice*—namely, the 42-42.5 GHz, 47.2-48.2 GHz and 50.4-52.4 GHz segments—sharing between satellite and terrestrial services may be feasible. However, the terms of any such sharing should be based on testing, simulations, and real-world assumptions. They should not be based on outdated spectrum use paradigms, *ex ante* restrictions, or yesterday’s technology. Because 5G technology still is in

development and propagation models for this portion of the radio spectrum still are being developed, ViaSat urges the Commission to conduct rigorous studies to establish an appropriate sharing framework for these band segments. Moreover, it is critical that any such sharing framework balances the needs and interests of satellite operators and wireless providers. Specifically, the terms for sharing must take into account (i) the large numbers of satellite interconnection and aggregation earth stations needed to provide tomorrow's broadband speeds and satisfy the ever-growing consumption of broadband capacity, (ii) the need to locate end user terminals at customer premises, and (iii) the fact that both types of earth stations can and will be located throughout the United States, including in urban and suburban areas.

Strong support exists for conforming the satellite downlink power levels at 37.5-40 GHz with the levels applicable to the 40-42 GHz band segment. Adopting a uniform downlink power level across these contiguous segments would provide a number of benefits, including a broader range of satellite services, and more choices for consumers. Notably, the analyses on the record show that this can be done without impeding 5G deployment.

Satellite commenters support the Commission's proposal to eliminate the prohibition on deploying satellite user terminals in the 37.5-40 GHz band segment, and allow satellite user terminals to operate in that band segment on a secondary, non-protected basis. Indeed, doing so would facilitate greater shared use of the spectrum resource without having any conceivable impact on 5G operations. Nor is there any reason this flexibility to enable the deployment of satellite user terminals also could not be employed in the 27.5-28.35 GHz segment, which actively has been used by satellite broadband systems for over five years, and which was opened up for 5G earlier this year.

A number of commenters request that use of the 29.1-29.25 GHz band segment be expanded beyond its current use for LMDS and feeder links to a single satellite network. The fixed-satellite-service allocation that exists in this band also supports much broader use of this band segment by the many satellite broadband networks that currently operate in the immediately adjacent spectrum on both sides of 29.1-29.25 GHz. Expanded satellite use of this spectrum can be fully compatible with the existing feeder link uses, as well as with any UMFU services that the Commission may authorize in this band segment. In addition, ViaSat supports those commenters who recommend accommodating satellite operations in the 70 GHz and 80 GHz and higher frequencies identified in the *Further Notice*.

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REPLY VIASAT, INC.

ViaSat, Inc. (“ViaSat”) submits this reply to the comments filed in response to the Further Notice of Proposed Rulemaking (“*Further Notice*”) in this proceeding.¹ ViaSat provides the perspective of (i) a leading communications solutions provider to U.S. businesses, consumers

¹ *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, *et al.*, Report and Order and Further Notice of Proposed Rulemaking, FCC 16-89 (rel. July 14, 2016) (“*Spectrum Frontiers Order*” or “*Further Notice*,” as appropriate).

and government users, and (ii) a leading developer and manufacturer of the satellite, Wi-Fi, and terrestrial wireless technologies used to provide those solutions.

I. THE RECORD DEMONSTRATES THE BENEFITS OF NEXT-GENERATION SATELLITE BROADBAND SERVICE IN THE 37.5-52.4 GHZ BAND

Since the inception of the Spectrum Frontiers proceeding, the Commission has recognized the important role that satellite services play in the broadband ecosystem. The opening comments to the *Further Notice* reinforce this view. Satellite networks play an important role in advancing broadband technology and expanding the availability of broadband services and high-speed, ubiquitous connectivity, both as a complement to and in competition with terrestrial services.² And satellite commenters reinforce what should be obvious by now: because satellite broadband serves all of the nation, satellite spectrum uses cannot be relegated to rural and remote areas.³ ViaSat agrees that “[s]atellite technology will be a key component to achieving the Commission’s next generation communication goals, not just in rural and remote areas, but also in the densest urban environments, in the air, and at sea.”⁴

Providing these service capabilities, enabling faster broadband speeds, and meeting the insatiable demand for broadband capacity require access to increasing amounts of

² See, e.g., Comments of Inmarsat, Inc., GN Docket No. 14-77, *et al.*, at 3, 6-7 (Sept. 30, 2016) (“Inmarsat Comments”); Comments of O3b Limited, GN Docket No. 14-77, *et al.*, at 3 (Sept. 30, 2016) (“O3b Comments”); Comments of the Satellite Industry Association, GN Docket No. 14-77, *et al.*, at 2-3 (Oct. 3, 2016) (“SIA Comments”); Comments of the Global VSAT Forum, GN Docket No. 14-77, *et al.* at 2 (Sept. 30, 2016) (“GVF Comments”).

³ See Inmarsat Comments at 5; SIA Comments at 2.

⁴ Inmarsat Comments at 5.

spectrum.⁵ Satellite industry commenters agree that an important aspect of preserving these capabilities is to both maintain and expand the existing satellite allocations and designations in the 37.5-52.4 GHz band, as well as in the 71-76 GHz, 81-86 GHz, and higher frequencies identified in the *Further Notice*.⁶ Indeed, satellite network technology in the 37.5-52.4 GHz band has been developed, and satellite systems are now actively being brought to fruition.⁷

Consensus exists that five gigahertz of uplink spectrum and five gigahertz of downlink spectrum is needed for satellite networks in the 37.5-52.4 GHz range⁸ in the following segments: 47.2-50.2 GHz and 50.4-52.4 GHz for uplinks and 37.5-42.5 GHz for downlinks, with 40-42 GHz and 48.2-50.2 GHz serving as “core” spectrum.

The Commission long ago established 40-42 GHz and 48.2-50.2 GHz for dedicated satellite use, recognizing (i) the need for satellite networks to be able to operate in certain spectrum without being impeded by terrestrial operations, (ii) the need to provide certainty for business planning, and (iii) the need to be able to widely-deploy all types of earth stations anywhere within the authorized satellite coverage area, in an unfettered manner.⁹

⁵ See Comments of The Boeing Company, GN Docket No. 14-177, *et al.*, at 7, 9 (Sept. 30, 2016) (“Boeing Comments”); GVF Comments at 2-3; Inmarsat Comments at 3; SIA Comments at 4.

⁶ See, e.g., SIA Comments at 6-7; Boeing Comments at 5; GVF Comments at 7; Inmarsat Comments at 15-19.

⁷ See, e.g., SIA Comments at 13; Boeing Comments at 3.

⁸ See, e.g., Boeing Comments at 7; Inmarsat Comments at 15-19.

⁹ See *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations*, Second Report and Order, 18 FCC Rcd 25428, ¶ 2 (2003) (“*V Band Second Report and Order*”); *Allocation and Designation of Spectrum for Fixed-Satellite Services*

With this 2 x 2 GHz designation of core satellite spectrum as a baseline, the satellite industry recognizes that significant potential exists for sharing with terrestrial services in the remaining three gigahertz of needed uplink and downlink bands; namely (i) 47.2-48.2 GHz and 50.4-52.4 GHz, and (ii) 37.5-40 GHz and 42-42.5 GHz.¹⁰

II. CORE SATELLITE SPECTRUM AT 40-42 GHZ AND 48.2-50.2 GHZ MUST BE PRESERVED

In its opening Comments, ViaSat emphasizes the need for “core” satellite spectrum in which satellite services can operate unimpeded by terrestrial services, and explained how access to such core spectrum facilitates sharing opportunities in other band segments.¹¹ As SIA emphasizes, over a decade ago, the Commission acknowledged the need for satellite networks to be able to operate in certain spectrum, unimpeded by terrestrial operations, and in order to provide certainty for business planning, designated “core” spectrum for the fixed satellite service in the 48.2-50.2 GHz segment for uplink communications and in the 40.0-42.0

in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations, Report and Order, 13 FCC Rcd 24649, ¶¶ 10, 18 (1998) (“V Band First Report and Order”).

¹⁰ See, e.g., O3b Comments at 6 (seeking to share 47.2-48.2 GHz with wireless); GVF Comments at 5 (supporting sharing of 47.2-48.2 GHz); Boeing Comments at 11, 18 (identifying the need for shared access to the 50.4-52.4 GHz for uplinks and 37.5-40 GHz and 42-42.5 GHz for downlinks).

¹¹ Comments of ViaSat, GN Docket No. 14-177, *et al.*, at 9 (Sept. 30, 2016) (“ViaSat Comments”).

GHz segment for downlink communications.¹² This is consistent with the ITU designation for high-density fixed-satellite operations at 48.2-50.2 GHz, paired with 40-42 GHz.¹³

Satellite commenters overwhelmingly agree that the 40-42 GHz and 48.2-50.2 GHz band segments must be maintained as “core” satellite spectrum, in which satellite operators have the ability to deploy large numbers of user terminals, as well as individually-licensed earth stations, in an unfettered manner.¹⁴ As SIA emphasizes, the satellite industry is beginning to deploy next-generation systems at 48.2-50.2 GHz and 40-42 GHz based on the long-standing U.S. and ITU designations for primary satellite use of these band segments.¹⁵ Notably, Inmarsat launched a network with 48 GHz capabilities in 2013,¹⁶ Boeing has filed an application with the Commission for a satellite network in these frequencies,¹⁷ and more such networks are likely to be announced in connection with the Commission’s upcoming NGSO processing round for these frequencies.¹⁸ Thus, maintaining primary access for satellite in the 40-42 GHz and 48.2-50.2 GHz band segments is critical to providing the certainty needed for existing business plans.¹⁹

¹² See SIA Comments at 12, citing *V Band First Report and Order* at ¶¶ 10, 17-18, and *V Band Second Report and Order*.

¹³ See ITU Footnote 5.516B; see also 47 C.F.R. § 2.106 n.5.516B.

¹⁴ See, e.g., GVF Comments at 4-5; O3b Comments at 6-7; Inmarsat Comments at 17; SIA Comments at 14.

¹⁵ SIA Comments at 12-13; see also GVF Comments at 2.

¹⁶ Inmarsat Comments at 18.

¹⁷ Boeing Comments at 3, citing *The Boeing Company Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service (S2966)*, File No. SAT-LOA-20160622-00058 (filed June 22, 2016).

¹⁸ See Boeing Comments at 3; GVF Comments at 2; Inmarsat Comments at 17; O3b Comments at 5; SIA Comments at 3.

¹⁹ See SIA Comments at 13; O3b Comments at 7.

Given the settled expectations of the satellite industry in these bands, ViaSat urges the Commission to reject requests by the wireless industry to relegate satellite use of 40-42 GHz and 48.2-50.2 GHz to secondary status, and instead repurpose these bands for terrestrial use.²⁰ If the Commission nevertheless considers accommodating some form of terrestrial operations in these core satellite bands, any terrestrial use should be limited to a secondary, non-interference basis to satellite. In other words, any terrestrial operations that the Commission may authorize in the 40-42 GHz or 48.2-50.2 GHz band segment should be required to work around satellite operations in the same way that the satellite industry proposes for satellite user terminal operations to work around terrestrial operations in the 37.5-40 GHz band segment. And in no event should satellite be limited in these or any other band segment considered in the *Further Notice* to either (i) one individually-licensed earth station site per PEA, as proposed in the *Further Notice*, or (ii) the restrictions adopted in the 27.5-28.35 GHz and 37.5-40 GHz band segments.²¹

III. REASONABLE AND EQUITABLE SHARING TERMS SHOULD BE EVALUATED FOR 47.2-48.2 GHZ, 50.4-52.4 GHZ AND 42-42.5 GHZ

Broad consensus exists among satellite commenters that access to spectrum in the 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz band segments for satellite broadband networks is essential to promote competition and facilitate faster broadband speeds and increased network

²⁰ See, e.g., Comments of Straight Path Inc., GN Docket No. 14-177, *et al.*, at 5, 7 (Sept. 30, 2016) (“Straight Path Comments”); Comments of CTIA, GN Docket No. 14-177, *et al.*, at 12-13 (Sept. 30, 2016) (“CTIA Comments”); Comments of T-Mobile USA, Inc., GN Docket No. 14-177, *et al.*, at 4-5 (Sept. 30, 2016) (“T-Mobile Comments”); Comments of Ericsson, GN Docket No. 14-177, *et al.*, at 11 (Sept. 30, 2016) (“Ericsson Comments”); Comments of Huawei Technologies, Inc. (USA) and Huawei Technologies Co., Ltd., GN Docket No. 14-177, *et al.*, at 6 (Sept. 30, 2016) (“Huawei Comments”).

²¹ See, e.g., O3b Comments at 7-8; Inmarsat Comments at 18; Boeing Comments at 19-20.

capacity.²² For these reasons, ViaSat proposed (i) that satellite access to the 47.2-48.2 GHz and 50.4-52.4 GHz uplink band segments include deployment of individually-licensed earth stations on a protected basis, as well as opportunistic access by satellite user terminals on a non-interference, non-protected basis,²³ and (ii) opening up the 42-42.5 GHz band segment for satellite downlinks, even if the Commission also allows terrestrial mobile services in this segment.²⁴

ViaSat urges the Commission to reject proposals by wireless interests to license all spectrum being considered in the *Further Notice* on an exclusive basis for terrestrial services.²⁵ Many wireless interests oppose sharing at the same time as they resist robust performance and buildout requirements that would ensure the spectrum is ever put to meaningful use.²⁶ They resist any sharing with the satellite industry, and seek rules that would allow terrestrial licensees to warehouse spectrum and stifle competition from satellite broadband providers. Significantly, wireless use of 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz is a greenfield, and, as at least one major wireless equipment manufacturer explains, the wireless technology that could be developed for these band segments would be highly conducive to sharing, including very low gain antennas and MIMO techniques with adaptive beam forming

²² See, e.g., SIA Comments at 6; Boeing Comments at 7; Inmarsat Comments at 15-19.

²³ ViaSat Comments at 12-13, 17.

²⁴ *Id.* at 15; see also SIA Comments at 12; Boeing Comments at 42-43; Inmarsat Comments at 16.

²⁵ See, e.g., Comments of AT&T, GN Docket No. 14-177, *et al.*, at 11 (Sept. 30, 2016) (“AT&T Comments”); CTIA Comments at 9-10.

²⁶ See, e.g., Comments of Competitive Carriers Association, GN Docket No. 14-177, *et al.*, at 6 (Sept. 30, 2016); CTIA Comments at 16, 19; Comments of the Telecommunications Industry Association, GN Docket No. 14-177, *et al.*, at 18-19 (Sept. 30, 2016) (“TIA Comments”).

and nulling capabilities.²⁷ Moreover, the propagation characteristics of these band segments are favorable for sharing given the relatively short distances that these signals travel. ViaSat therefore urges the Commission to reject requests for wireless exclusivity, and instead to establish sharing frameworks in the 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz band segments that allow the robust deployment of both wireless and satellite services.

In examining satellite and terrestrial sharing opportunities in the 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz band segments, a thorough examination of technological capabilities is warranted. Moreover, testing and simulations based on real-world assumptions about the actual operating environment are critical. Propagation studies and models for these frequencies still are being developed, and the technical work necessary to conduct appropriate studies will require measurement equipment and testing methodologies that have not yet been developed.²⁸ Therefore, ViaSat reiterates its request that the Commission conduct careful and rigorous studies before adopting sharing rules for the 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz band segments to enable the robust use of this spectrum by both terrestrial and satellite technologies.²⁹

For these reasons, ViaSat urges the Commission to reject calls for *ex ante* restrictions on the operation of satellite networks that are based on outdated paradigms of spectrum use, and that would unduly constrain the provision of service to the public. Other

²⁷ See, e.g., Huawei Comments at 9 (“The application of new technologies—beamforming, antennas and power-control, and dynamic operation, for example—will ensure the continuing enablement of new services and opportunities without a universal need for exclusivity in all spectrum assignments.”).

²⁸ See, e.g., AT&T Comments at 7 (acknowledging that “5G service remains undefined and standards have not been completed”).

²⁹ ViaSat Comments at 11.

satellite commenters echo ViaSat’s request not to impose the types of limitations on earth station siting that were adopted in the 28 GHz and 37.5-40 GHz band segments, or the draconian proposal in the *Further Notice* to limit interference protection for earth stations in the 47.2-50.2 GHz segment to one per PEA.³⁰

Notably, many satellite operators explain that next-generation satellite broadband systems need greater numbers of earth stations that serve gateway functions (*i.e.*, aggregation and interconnection) in order to provide faster speeds and more capacity to meet consumer demand.³¹ Therefore, in the 47.2-48.2 GHz, 50.4-52.4 GHz and 42-42.5 GHz band segments, any sharing rules between terrestrial and satellite uses must accommodate more than just a nominal level of earth station deployment.

For similar reasons, ViaSat requests that the Commission reject the proposals of Boeing³² and EchoStar³³ to relegate the deployment of satellite “gateway” facilities in the 47.2-50.2 GHz and 50.4-52.4 GHz band segments to rural and remote parts of the country. That simply is untenable if satellite broadband networks are to provide the ever-increasing speeds and capacity demanded by consumers, and if they are to continue to provide effective competition to terrestrial broadband networks. ViaSat previously has explained why flexibility is needed to site

³⁰ See O3b Comments at 8; Inmarsat Comments at 17-18; Boeing Comments at 20.

³¹ See Boeing Comments at 19 (indicating that it will need “several thousand gateways in the United States”); see also SIA Comments at 10.

³² See Boeing Comments at 19, 21 (advocating rural gateway siting to facilitate sharing in the 50.4-52.4 GHz band segment).

³³ See Comments of EchoStar Satellite Operating Corporation and Hughes Network Systems, LLC, GN Docket No. 14-177, *et al.*, at 6 (Sept. 30, 2016) (“EchoStar Comments”) (advocating rural gateway siting to facilitate sharing in the 47.2-50.2 GHz and 50.4-51.4 GHz band segments).

earth stations that serve critical aggregation and interconnection functions anywhere—even in urban areas.³⁴

As the Commission recognized in an earlier phase of this proceeding, the types of “gateway” facilities being employed on current broadband networks can be located in urban areas with only a *de minimis* impact on nearby terrestrial uses of the same spectrum.³⁵ The Commission allowed the continued deployment of satellite gateways in the 27.5-28.35 GHz band segment on a protected basis virtually anywhere in the nation (subject to certain limits) in order to provide predictability regarding the locations of future earth stations, and allow deployment near population centers when the deployment affects a small percentage (or even none) of the population.³⁶ That is why the Commission should also reject EchoStar’s resurrection of its prior proposal with AT&T to exclude earth station deployment from designated “urban core” areas, which the Commission found would undermine the need for predictability and preclude satellite use of spectrum that has no impact on nearby terrestrial operations.³⁷

³⁴ See, e.g., ViaSat, Inc., Notice of *Ex Parte* Presentation, GN Docket No. 14-177, *et al.* (Mar. 15, 2016) (explaining that higher capacity of state-of-the-art satellite broadband networks is achieved by employing larger numbers of gateway-type earth stations).

³⁵ See *Spectrum Frontiers Order* at ¶ 57 (subject to certain conditions, the Commission “do[es] not propose to designate the locations of any county’s satellite permitted interference zones in advance” instead “leav[ing] the choices of locations to the discretion of the satellite operators”).

³⁶ See *id.* at ¶ 60.

³⁷ See EchoStar Comments at 6; see also *Spectrum Frontiers Order* at ¶ 60.

IV. INCREASING SATELLITE DOWNLINK POWER LEVELS AT 37.5-40.0 GHZ WOULD EXPAND SATELLITE BROADBAND SERVICE WHILE STILL ENABLING INTENDED TERRESTRIAL USES

Satellite commenters urge the Commission to adopt its long-pending proposal³⁸ to bring the power flux density (“pfd”) levels for satellite downlinks in the 37.5-40 GHz in line with the levels that currently are allowed in the adjacent downlink band segment, 40-42 GHz, where satellite networks will also deploy.³⁹ Notably, the current pfd levels for 37.5-40 GHz were based on terrestrial antenna technology that is now well over 15 years old, and not on the types of new mobile wireless technology that the Commission promotes today—technology that should employ lower gain receive antennas and utilize MIMO techniques with adaptive beam forming and nulling capabilities.⁴⁰ ViaSat’s preliminary analysis demonstrates that the current pfd limits in the 37.5-40 GHz band segment—originally developed based on now-outmoded terrestrial antenna technologies—are significantly more stringent than necessary to protect 5G operations.⁴¹

Notably, conforming the pfd levels for 37.5-40 GHz with the levels permitted in the adjacent 40-42 GHz band segment would enable harmonious use of this contiguous downlink

³⁸ See *Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations*, Third Further Notice of Proposed Rulemaking, 25 FCC Rcd 15663, ¶ 17 (2010); see also *Further Notice* at ¶¶ 495, 499.

³⁹ See Boeing Comment at 24-25; Inmarsat Comments at 16.

⁴⁰ See ViaSat Comments at 22.

⁴¹ *Id.* at 22-23, Exhibit B.

band, facilitate a wider variety of service offerings, and thus facilitate more flexible spectrum use, all without constraining the deployment of terrestrial services at 37.5-40 GHz.⁴²

V. ALLOWING DEPLOYMENT OF SATELLITE END-USER TERMINALS AT 27.5-28.35 GHZ AND 37.5-40.0 GHZ WOULD FACILITATE IMPORTANT COMMISSION POLICIES

In the *Further Notice*, the Commission seeks comment on proposals to deploy satellite user terminals in the 37.5-40 GHz band segment, either on a secondary, non-interference basis or through a mechanism that uses a database of terrestrial operations that can be accessed by satellite operators to determine whether user terminals could operate without interference in a particular area.⁴³ The Commission acknowledged that because user equipment would simply receive signals from spacecraft in this band, such operations could not possibly cause interference to terrestrial operations.⁴⁴ Moreover, in the *Spectrum Frontiers Order*, the Commission indicated that it would consider allowing satellite user equipment to operate in the 27.5-28.35 GHz band segment in the future.⁴⁵

Satellite commenters strongly support allowing satellite user terminals to operate on a secondary, non-interference basis in the 37.5-40 GHz band segment, and also in other spectrum where satellite is secondary to terrestrial wireless uses.⁴⁶ Allowing secondary satellite user terminal operations would significantly expand the capacity and availability of satellite broadband networks, while at the same time ensuring that the primary services are protected.

⁴² See Inmarsat Comments at 16; ViaSat Comments at 23.

⁴³ *Further Notice* at ¶¶ 501, 502.

⁴⁴ *Id.* at ¶ 502.

⁴⁵ *Spectrum Frontiers Order* at ¶ 69 n.166.

⁴⁶ See Inmarsat Comments at 15; Boeing Comments at 23-24; SIA Comments at 11-12; GVF Comments at 4.

Moreover, these proposals would ensure efficient and intensive use of licensed spectrum, which is consistent with the aims of the Commission's proposals in the *Further Notice* to facilitate sharing of spectrum that is not actually being used by UMFU licensees.⁴⁷

The wireless commenters that oppose such secondary spectrum use appear to rely on a fundamental misunderstanding of the operating dynamic under which a satellite user terminal in the 37.5-40 GHz band segment could not possibly cause interference because it would receive, and would not transmit, in that band segment. In particular, Straight Path suggests that exclusion zones around satellite earth stations receiving in the 37.5-40 GHz would be needed to avoid interference from 5G services, and that even if satellite user terminals were operated on a secondary basis, investment in 5G services somehow would be threatened.⁴⁸ Similarly, T-Mobile opposes allowing satellite user terminal receivers in the 37.5-40 GHz band segment because “[d]eploying ubiquitous satellite user equipment means that the satellite beams would need to provide coverage wherever the user terminals are located, which would result in unpredictable interference to 5G base stations and mobile receivers.”⁴⁹ The proposals for secondary satellite user terminals in this band segment are for operations solely on a non-protected, non-interference basis, and the pfd limits established to protect 5G operations would ensure that those terrestrial operations would not suffer harmful interference. Thus, the number of earth stations receiving signals in this band segment on a non-interference basis could have no conceivable impact on terrestrial operations.⁵⁰

⁴⁷ *Further Notice* at ¶ 474.

⁴⁸ Straight Path Comments at 15.

⁴⁹ T-Mobile Comments at 30.

⁵⁰ See, e.g., *EchoStar Satellite LLC Application for Authority to Construct, Launch and Operate a Geostationary Satellite Using the Extended Ku-band Frequencies in the Fixed-*

In its Comments, ViaSat made a detailed proposal for a database solution to facilitate the operation of satellite user terminals on a non-interference, non-protected basis in any shared bands considered in the *Further Notice* proceeding that are not “core” satellite bands and that are not designated primarily for satellite services.⁵¹ This database framework would facilitate an objective determination of whether a satellite user terminal could “work around” terrestrial operations in a given location. Significantly, this database mechanism could be adapted for use by both transmitting and receiving satellite user terminal operations.⁵² ViaSat identified the 42.0-42.5 GHz and 37.5-40 GHz downlink band segments and the 27.5-28.35 GHz, 47.2-48.2 GHz and 50.4-52.4 GHz uplink band segments as spectrum in which the proposed database mechanism may be appropriate.⁵³ As discussed above, user terminals receiving satellite signals in downlink bands on a non-protected basis would not increase the interference potential for any terrestrial wireless service at 37.5-40 GHz, or for any terrestrial wireless service that may be designated at 42.0-42.5 GHz.

ViaSat’s proposed database mechanism also would facilitate the ability of satellite user terminal uplinks in the 27.5-28.35 GHz band segment to make opportunistic use of spectrum designated primarily for UMFU service at times and in locations where it is not then being used by the UMFU licensee. In proposing a sharing mechanism for UMFU bands, the Commission acknowledged that UMFU deployment in the 27.5-28.35 GHz band segment would be “targeted,

Satellite Service at the 109^o W.L. Orbital Location, Order and Authorization, 20 FCC Rcd 930 ¶ 13 (2004) (acknowledging that user terminal receive operations that “involve[] only passive receive-only earth stations that are not capable of causing interference into FS stations operating in [the same] band”).

⁵¹ ViaSat Comments at 17-18, Exhibit A.

⁵² *Id.* at 19-20.

⁵³ *Id.* at 17-18.

geographically-limited coverage” which would present significant opportunities for opportunistic use of spectrum that would otherwise lie fallow.⁵⁴ Wireless commenters confirm that UMFU deployment is more likely to serve as supplemental capacity, particularly in high-density, high-traffic areas, due to the extremely short distances that signals at these higher frequencies can travel.⁵⁵ Therefore, allowing satellite user terminal uplink operations in the 27.5-28.35 GHz segment, at times and in locations where UMFU is not deployed, on a secondary, non-interference basis, would significantly increase the utility and efficiency of this spectrum resource, and improve service to the public, all without hindering 5G deployment.

VI. OTHER SPECTRUM ISSUES

A. 29.1-29.25 GHz Also Should Be Made Available for Satellite Broadband Service

In their opening comments, Verizon and Nextlink ask the Commission to repurpose all other frequencies designated for LMDS and to make the 29.1-29.25 GHz band segment and certain 31 GHz frequencies available for 5G operations.⁵⁶ The 29.1-29.25 GHz band segment is allocated domestically and internationally for the fixed satellite service, in addition to fixed and mobile terrestrial services.⁵⁷ In the U.S., the Commission has designated

⁵⁴ See *Further Notice* at ¶¶ 473-474.

⁵⁵ See Qualcomm Comments at 13 (identifying that most deployments in millimeter wave bands are likely to be “densified collections of small cells”); see also CTIA Comments at 7 (“Bands above 24 GHz will serve as an important complement to lower-frequency channels” and “low-band spectrum, particularly the bands below 3 GHz, will be critical for macro network coverage and capacity”); AT&T Comments at 5-6.

⁵⁶ Comments of Verizon, GN Docket No. 14-177, *et al.*, at 4-5 (Sept. 30, 2016) (“Verizon Comments”); Comments of Nextlink Wireless, LLC, GN Docket No. 14-177, *et al.*, at 3 (Sept. 30, 2016). Straight Path concurs with this proposal and suggests converting the contiguous LMDS spectrum in the 31-31.3 GHz band segment to the UMFU framework. Straight Path Comments at 4.

⁵⁷ 47 C.F.R. § 2.106.

this band segment on a co-primary basis to feeder links for the mobile satellite service and LMDS.⁵⁸ This satellite designation currently is used by only a single satellite network: Iridium. ViaSat proposes that this band be made available for additional fixed satellite uses by additional satellite networks.

Use of the 29.1-29.25 GHz band segment for additional fixed satellite applications would be consistent with existing shared use of the adjacent 29.25-29.5 GHz band segment by both feeder uplinks to the Iridium system and uplinks for broadband satellite systems. Such successful co-primary sharing of the adjacent 29.25-29.5 GHz band segment has been going on for many years.⁵⁹ Extending such sharing between feeder uplinks to the Iridium system and uplinks for broadband satellite systems likewise could occur in the adjacent 29.1-29.25 GHz band segment. Notably, the original band plan for the Ka band contemplated multiple satellite operators using this band segment on a shared basis.⁶⁰ Allowing satellite broadband systems also to use the 29.1-29.25 GHz band segment for their uplinks is technically feasible and would improve the utility of this underutilized spectrum: increasing the capacity of satellite broadband networks, enabling faster speeds, and thereby facilitating better service to consumers.

⁵⁸ *Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, First Report and Order, 11 FCC Rcd 19005, ¶ 42 (1996) (“28 GHz First Report and Order”).

⁵⁹ *See, e.g.*, 47 C.F.R. § 25.258.

⁶⁰ 28 GHz First Report and Order at ¶ 66 (contemplating use of these band segments by three satellite systems).

B. The Technical Analysis Underlying the Existing Sharing Framework for 27.5-28.35 GHz Remains Sound

In the *Spectrum Frontiers Order*, the Commission established a sharing framework for the 27.5-28.35 GHz band segment under which up to three individually-licensed satellite earth stations deployed in a county may be entitled to protection from UMFU operations if, among other conditions, a specified level of unwanted energy emitted by those earth stations affects no more than 0.1 percent of the population in that county.⁶¹ The Commission established this condition based on record evidence that the individually-licensed earth stations associated with the satellite broadband networks being launched in early 2017 and afterward (such as ViaSat's) would be able to operate at much lower power levels, and thus would be much more compatible with nearby terrestrial spectrum uses, than legacy satellite gateways.⁶² The Commission determined that such earth station operations would have a *de minimis* effect, if they had any effect at all, on terrestrial services. On this basis, the Commission allowed certain satellite earth stations to operate on a protected basis along with terrestrial operations in the 27.5-28.35 GHz band segment.⁶³

In its comments, Nokia presents measurement data it claims to have gathered from existing Ka-band earth station facilities.⁶⁴ Effectively, Nokia seeks to relitigate the issues resolved in the *Spectrum Frontiers Order*, and its comments are therefore a thinly-veiled petition to reconsider that decision.

⁶¹ *Spectrum Frontiers Order* at ¶ 54.

⁶² *See id.* at ¶ 51 (citing the results of ViaSat's analysis, which were based on the latest satellite technology).

⁶³ *Id.* at ¶¶ 52, 60.

⁶⁴ *See* Comments of Nokia, GN Docket No. 14-177, *et al.*, at 16-19, Appendix 2 (Sept. 30, 2016).

The earth stations included in Nokia's data simply are not representative of the gateway earth stations associated with the satellite broadband networks that ViaSat is launching starting in early 2017. Thus, the legacy gateway facilities that were the subject of Nokia's measurements do not serve as a proxy for the types of earth station operations that formed the basis for the terms for spectrum sharing in the 27.5-28.35 GHz segment that were adopted in the *Spectrum Frontiers Order*.⁶⁵

Notably, Nokia contacted ViaSat during the first phase of this proceeding in June 2016 and indicated that Nokia planned to take field measurements of ViaSat's legacy gateway earth station in Salina, New York. ViaSat informed Nokia that the Salina facility was not representative of the earth stations that ViaSat would be deploying on a going-forward basis at 27.5-28.35 GHz, and invited Nokia to conduct measurements on a representative earth station in Carlsbad, California. Nokia never responded. Instead, it chose to place misleading information about the Salina facility on the record.

Nokia's data has no bearing on the Commission's determination in the *Spectrum Frontiers Order* about the ability of current earth station technology to peacefully coexist with UMFU operations. Nokia's data is wholly irrelevant to any issues in the *Further Notice*.

C. Service Rules for 37.0-37.6 GHz Must Factor in the Operation of Earth Stations Under the *Spectrum Frontiers Order*

In the *Spectrum Frontiers Order*, the Commission established a certain level of interference protection from terrestrial transmissions from individually-licensed earth stations in

⁶⁵ Moreover, the grandfathered earth stations in Nokia's data likely do not employ the types of RF shielding toward the horizon or other mitigation measures that will be used on a going-forward basis to ensure compliance with the terms of the *Spectrum Frontiers Order*.

the 37.5-40 GHz band segment.⁶⁶ The Commission intends to enable different uses of this spectrum, with the 38.6-40 GHz portion designated for UMFU, and the 37.0-38.6 GHz portion bifurcated into segments with different licensing frameworks to accommodate different wireless use cases and sharing with Federal uses.⁶⁷ Specifically, the 37.6-38.6 GHz portion will be geographically licensed, similar to the mechanism for UMFU at 38.6-40 GHz, and the 37.0-37.6 GHz segment will be available for coordinated uses between Federal and non-Federal users, with non-Federal rights granted by rule.⁶⁸ The details of Federal sharing in these band segments are addressed in the *Further Notice*, and several wireless interests have weighed in on these issues.⁶⁹

While ViaSat does not express any views on these terrestrial licensing regimes as they apply to the 37.6-38.6 GHz portion, ViaSat emphasizes that any rules adopted for terrestrial use of the 37.5-37.6 GHz portion must take into account the need to protect 37.5-40 GHz satellite earth stations under the terms of the *Spectrum Frontiers Order*. For instance, any tiered priority or SAS-type mechanism that may be adopted to enable terrestrial uses of 37.5-37.6 GHz must also include protected earth stations operating in this same band segment. Therefore, ViaSat urges the Commission to consider ways to ensure earth station protection under the terms of the *Spectrum Frontiers Order* as it evaluates ways to license the 37.5-37.6 GHz band segment for terrestrial wireless use.

⁶⁶ See *Spectrum Frontiers Order* at ¶ 93, Appendix A Final Rules § 25.136(b).

⁶⁷ *Id.* at ¶ 111.

⁶⁸ *Id.*

⁶⁹ See *Further Notice* ¶ 446; see, e.g., Comments of 5G Americas, GN Docket No. 14-177, *et al.*, at 13 (Sept. 30, 2016) (“5G Americas Comments”); T-Mobile Comments at 23; CTIA Comments at 22-24; Verizon Comments at 10-11; Ericsson Comments at 3, 16; Comments of Facebook, Inc., GN Docket No. 14-177, *et al.*, at 7 (Sept. 30, 2016).

D. Spectrum at 70/80 GHz and Above Is Critical for Satellite Service Growth and Expansion

Satellite commenters reinforce the importance of ensuring the continued availability for satellite services of the 70 GHz and 80 GHz bands, and also in the higher spectrum bands being considered in the *Further Notice*, consistent with the satellite allocations that current exist in these bands.⁷⁰ ViaSat agrees that “[t]here is no question that these bands will eventually become vital components of the high-speed, high-capacity FSS infrastructure.”⁷¹ Ensuring access for long-term satellite use in these bands will enable higher capacity broadband networks to meet consumer demand.

The 70 GHz and 80 GHz bands currently are used for highly directional point-to-point fixed service links. In addition, commenters describe a wide range of proposed uses for the 70 GHz and 80 GHz bands, including indoor operations,⁷² unlicensed operations⁷³ and shared access.⁷⁴ Although certain commenters are in favor of authorizing 5G and other mobile services in the 70 GHz and 80 GHz bands,⁷⁵ many recognize the difficulty in authorizing broadly deployed mobile services alongside the currently deployed non-exclusive fixed point-to-point

⁷⁰ See, e.g., SIA Comments at 19.

⁷¹ GVF Comments at 7.

⁷² See, e.g., Comments of Fixed Wireless Communications Coalition, GN Docket No. 14-177, *et al.*, at 3, 12 (Sept. 30, 2016); Comments of Micronet Communications, Inc., GN Docket No. 14-177, *et al.*, at 4 (Sept. 30, 2016).

⁷³ See, e.g., Comments of NCTA – The Internet & Television Association, GN Docket No. 14-177, *et al.*, at 8-9 (Sept. 30, 2016).

⁷⁴ See, e.g., Comments of Federated Wireless, Inc., GN Docket No. 14-177, *et al.*, at 12 (Sept. 30, 2016); Comments of Interdigital, Inc., GN Docket No. 14-177, *et al.*, at 3 (Sept. 30, 2016).

⁷⁵ See, e.g., 5G Americas Comments at 6; Comments of Comsearch, GN Docket No. 14-177, *et al.*, at 4-5 (Sept. 30, 2016).

links.⁷⁶ Given the broad nature of the proposals for these bands, ViaSat concurs with Boeing and SIA that sharing rules in the 70 GHz and 80 GHz bands should be informed by careful study of the anticipated uses in these bands and the technological developments occurring to enable such uses.⁷⁷ Other commenters also acknowledge the lead time that is needed to develop a better understanding of the ecosystem and technical issues in these bands before suitable service rules can be established.⁷⁸ For these reasons, ViaSat urges the Commission to take the time needed to conduct comprehensive studies of the potential uses for the 70 GHz and 80 GHz bands before any new designations are adopted.

VII. CONCLUSION

Broad consensus exists in the satellite industry that satellite access in the 37.5-42.5 GHz downlink band segment and the 47.2-50.2 GHz and 50.4-52.4 GHz uplink band segments is required to provide the capacity to meet consumer demand. The record reflects strong support to maintain primacy for satellite use of the 40-42 GHz and 48.2-50.2 GHz segments, which were set aside for unfettered satellite deployment, unimpeded by terrestrial operations. Moreover, preserving the ability of satellite networks to use 40-42 GHz and 48.2-50.2 GHz is fundamental to facilitating satellite and terrestrial sharing in other portions of the 37.5-52.4 GHz spectrum.

In the 42-42.5 GHz, 47.2-48.2 GHz and 50.4-52.4 GHz segments, sharing between satellite and terrestrial services may be feasible. However, the terms of any such sharing should be based on testing, simulations, and real-world assumptions. Strong support

⁷⁶ See, e.g., TIA Comments at 14; Huawei Comments at 9-10.

⁷⁷ See Boeing Comments at 44; SIA Comments at 20.

⁷⁸ See, e.g., GVF Comments at 7; see also Ericsson Comments at 13 (assigning lowest priority to the 70 GHz and 80 GHz bands).

exists for conforming the satellite downlink power levels at 37.5-40 GHz with the levels applicable in the adjacent 40-42 GHz downlink band segment. Adopting a uniform downlink power level across these contiguous segments would provide a number of benefits, including a broader range of satellite services, and more choices for consumers. Notably, the analyses on the record show that this can be done without impeding 5G deployment.

Furthermore, satellite commenters support the Commission's proposal to eliminate the prohibition on deploying satellite user terminals in the 37.5-40 GHz band segment, and to allow them to operate on a secondary, non-protected basis, because doing so would facilitate greater shared use of spectrum resources without impacting 5G operations. Flexibility to deploy satellite user terminals on an opportunistic basis should also be allowed in the 27.5-28.35 GHz band segment, on a secondary, non-interference basis.

The 29.1-29.25 GHz band segment should be expanded beyond its current use for LMDS and feeder links to a single satellite network. Expanded use of this spectrum by satellite broadband networks (which already share the adjacent 29.25-29.5 GHz segment with the system operating feeder links at 29.1-29.25 GHz) can be fully compatible with those existing feeder link uses, as well as with any UMFU services that the Commission may authorize in this band segment. In addition, ViaSat supports those comments who recommend ensuring the ability of satellite networks to continue to operate in the 70/80 GHz and higher frequencies identified in the *Further Notice*.

