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FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 25

[SB Docket No. 25-157; FCC 25-23; FR ID 294294]

Modernizing Spectrum Sharing for Satellite Broadband

AGENCY: Federal Communications Commission.

ACTION: Proposed rule.

SUMMARY: In this document, the Federal Communications Commission (Commission or we) seeks comment on modernizing spectrum sharing between geostationary (GSO) and non-geostationary (NGSO) satellite systems operating in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz frequency bands in which equivalent power-flux density (EPFD) limits apply.

DATES: Comments are due **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Reply comments are due **[INSERT DATE 75 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: You may submit comments, identified by SB Docket No. 25-157, by any of the following methods:

- *FCC Website*: https://apps.fcc.gov/ecfs. Follow the instructions for submitting comments.

- *People with Disabilities*: Contact the FCC to request reasonable accommodations (accessible format documents, sign language interpreters, CART, etc.) by e-mail: FCC504@fcc.gov or phone: 202-418-0530 or TTY: 202-418-0432.

For detailed instructions for submitting comments and additional information on the rulemaking process, see the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: Clay DeCell, 202-418-0803, Clay.DeCell@fcc.gov.

SUPPLEMENTARY INFORMATION: This is a summary of the Commission's Notice of Proposed Rulemaking (NPRM), FCC 25-23, adopted April 28, 2025, and released April 29, 2025. The full text is available online at https://docs.fcc.gov/public/attachments/FCC-25-23A1.pdf. The document is also available for inspection and copying during business hours in the FCC Reference Center, 45 L Street NE, Washington, DC 20554. To request materials in accessible formats for people with disabilities, send an email to FCC504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

Procedural Matters

Comment Filing Requirements

Interested parties may file comments and reply comments on or before the dates indicated in the DATES section above. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS).

- *Electronic Filers*. Comments may be filed electronically using the Internet by accessing the ECFS: https://www.fcc.gov/ecfs.

- *Paper Filers*. Parties who file by paper must include an original and one copy of each filing.
    - Filings can be sent by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.
    - Hand-delivered or messenger-delivered paper filings for the Commission's Secretary are accepted between 8:00 a.m. and 4:00 p.m. by the FCC's mailing contractor at 9050 Junction Drive, Annapolis Junction, MD 20701. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
    - Commercial courier deliveries (any deliveries not by the U.S. Postal Service) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
    - Filings sent by U.S. Postal Service First-Class Mail, Priority Mail, and Priority Mail Express, must be sent to 45 L Street NE Washington, DC 20554.
- *People with Disabilities*. To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

***Ex Parte* Presentations**

Pursuant to 47 CFR 1.1200(a), this proceeding will be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules. Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with 47 CFR 1.1206(b). In proceedings governed by 47 CFR 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

Regulatory Flexibility Analysis

The Regulatory Flexibility Act of 1980, as amended (RFA), requires that an agency prepare a regulatory flexibility analysis for notice-and-comment rulemaking proceedings, unless the agency certifies that "the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities." Accordingly, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) concerning the possible impact of potential rule and policy changes contained in the NPRM on small entities. The IRFA is set forth in Appendix A of the Commission document, https://docs.fcc.gov/public/attachments/FCC-25-23A1.pdf. The Commission invites the general public, in particular small businesses, to comment on the IRFA. Comments must be filed by the deadlines for comments indicated on the first page of this document and must have a separate and distinct heading designating them as responses to the IRFA.

Paperwork Reduction Act

This document does not contain proposed information collections subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified information collection burden for small business concerns with fewer than 25 employees, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4).

Providing Accountability Through Transparency Act

Consistent with the Providing Accountability Through Transparency Act, Public Law 118-9, a summary of this document will be available on https://www.fcc.gov/proposed-rulemakings.

Synopsis

I. Introduction

1. The United States' pursuit of space leadership demands that the Commission's rules stay ahead of the rapidly unfolding space innovations that are providing massive consumer benefit to Americans. Our nation's commercial space industry is already delivering services that are changing lives, from connecting rural families with high-speed, low latency broadband to enabling life-saving communications in rural places as well as forests, mountains, and wilderness areas. And every indication is that this is only at the beginning. In a matter of years – with the right framework in place – the U.S. space industry will be delivering even faster high-speed services, will bring more competition and choice for consumers, and will support entirely new categories of innovation to keep America the strongest and safest nation on Earth. It is imperative the Commission does everything possible to clear the way for American innovation and investment in space excellence.

2. With this goal at the forefront, in the NPRM, we initiate a review of the decades-old spectrum sharing regime between geostationary (GSO) and non-geostationary (NGSO) satellite systems operating in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands that represents the single most constraining regulatory requirement on NGSO satellite systems currently deploying at breakneck speed. By taking a fresh look at today's satellite technology and operations, this proceeding will ensure highly efficient and effective use of the shared spectrum, and support a more efficient and competitive market for satellite broadband and other in-demand services while uncapping the potential of

satellite constellations that were unthinkable when the current regime was developed, to the ultimate benefit of American consumers.

II. Background

3. *Overview*. Recent years have witnessed unprecedented growth and innovation in the satellite marketplace. New NGSO satellite operators have launched thousands of satellites in the span of a few years, and have begun to offer high-speed, low-latency broadband services. Established GSO satellite operators continue to deploy powerful, new satellites with enhanced capabilities. By one estimate, the supply of high-throughput satellite capacity tripled between 2021 and 2023, with NGSO operators accounting for over 90% of the net supply. GSO and NGSO satellites are helping bridge the digital divide.

4. These services rely on a spectrum access system predicated on different systems – satellite as well as terrestrial – sharing the same spectrum bands and rules that enable them to coexist. In frequency bands between 10.7 GHz and 30 GHz, NGSO fixed-satellite service (FSS) systems share FSS allocations with GSO FSS networks, and must also operate compatibly with broadcasting-satellite service (BSS) networks and stations in other services, including terrestrial services. NGSO FSS systems must comply with power limits expressed in equivalent power-flux density (EPFD) to protect GSO FSS and BSS networks, and separate power limits expressed in power-flux density (PFD) to protect terrestrial services. Within the 10.7-30 GHz range, NGSO FSS EPFD downlink limits apply in the 10.7-12.7 GHz, 17.3-18.6 GHz, and 19.7-20.2 GHz bands in the United States. Applicants for NGSO FSS space station licenses, and non-U.S.-licensed satellite operators seeking access to the U.S. market, must certify that they will comply

with the specified EPFD limits. Prior to initiating service, NGSO FSS operators' EPFD showings submitted to the International Telecommunication Union (ITU) must receive a "favorable" or "qualified favorable" finding by the ITU Radiocommunication Bureau (BR).

5. *EPFD History*. Early proponents of NGSO FSS systems in the 1990s prompted the international community, and the Commission, to develop sharing criteria for NGSO FSS systems to share frequencies with incumbent GSO networks. In 1997, the ITU World Radiocommunication Conference (WRC) first adopted provisional EPFD limits for NGSO FSS systems operating in the Ku-band and Ka-band. These preliminary EPFD limits were studied during the 1998-2000 ITU-R study period. Final EPFD limits were adopted at WRC-2000. The Commission added the ITU's Ku-band EPFD limits to its rules in 2000, incorporated the Ka-band EPFD limits into its rules in 2017, and extended EPFD limits to new NGSO FSS operations in the 17.3-17.8 GHz band in 2024.

6. In 2019, the international community again considered sharing criteria among GSO and NGSO FSS systems, this time in the higher Q- and V-bands between 37.5 GHz and 51.4 GHz. WRC-19 did not adopt EPFD limits in these bands, however. Instead, it required NGSO FSS systems to protect GSO networks under specific short-term and long-term protection criteria that incorporate a degraded throughput methodology.

7. *Current ITU Work*. WRC-23 considered a proposal from the Inter-American Telecommunication Commission (CITEL) co-signed by ten member states, including the United States, to review the EPFD limits under a future agenda item for WRC-27. While the proposed agenda item was not adopted, WRC-23 invited ITU-R to conduct technical studies on the EPFD limits and to inform WRC-27 of the results of the studies, without

any regulatory consequences. These studies are being carried out in ITU-R Working Party (WP) 4A.

8. *Petition for Rulemaking*. On August 9, 2024, SpaceX filed a petition for rulemaking asking the Commission to revisit the NGSO-GSO sharing regime in downlink frequency bands between 10.7 GHz and 30 GHz that are subject to EPFD limits and to amend §§ 25.146 and 25.289 of the Commission's rules. SpaceX argues that the EPFD limits referenced in these rule sections are based on "flawed and outdated assumptions" that result in inefficient spectrum sharing between GSO and NGSO systems. SpaceX states that compliance with EPFD limits imposes "wide-ranging constraints and costs on virtually all aspects of next-generation" NGSO FSS systems. SpaceX asks that the Commission develop an updated sharing framework, with appropriate short-term and long-term GSO protection criteria and realistic GSO reference links, that NGSO FSS operators could use in the United States as an alternative to compliance with the current EPFD limits in these bands.

9. The Commission sought comment on the Petition on October 2, 2024. Seven comments, two oppositions, and eight reply comments were filed. Most parties support a review of the current EPFD limits. Several argue the Commission should initiate a rulemaking now, while others suggest the Commission postpone until further ITU developments. Viasat, which has previously urged the Commission to rethink the Ka-band EPFD limits, opposes the Petition and argues that current EPFD limits must be preserved. EchoStar cites particular concerns regarding the BSS and terrestrial operations in the 12.2-12.7 GHz band in its opposition to the Petition.

III. Discussion

A. SpaceX Petition for Rulemaking

10. Given the Commission's obligation "to make available, so far as possible, to all the people of the United States . . . world-wide wire and radio communication service" and given the slow pace of international progress relative to the rapid sprint at which the American space industry is operating, we recognize that now is the time for us to act to ensure America leads the way to the future of space. Therefore, after review of the Petition and the comments and oppositions filed, we conclude that the record on the Petition discloses sufficient reasons to justify initiating a rulemaking proceeding seeking further comment on the proposal. Indeed, the time is ripe to revisit the NGSO-GSO sharing regime in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz frequency bands developed a quarter century ago. Modern NGSO satellite constellations delivering high-speed broadband connectivity bear little resemblance to the theoretical NGSO systems considered in the 1990s. Satellite technologies and spectrum management techniques have evolved. NGSO modeling has improved. GSO networks have continued to innovate.

11. Despite the ongoing revolution in the FSS marketplace, compliance with EPFD limits based on 90s-era system designs significantly limits the services offered by NGSO broadband satellite constellations today. To comply with these limits, NGSO system designers state that they adjust four key operational parameters of their systems, each of which can affect the quality of service experienced by the end user. First, they limit radiated power levels (effective isotropic radiated power (EIRP)), reducing signal quality on the ground and making it harder to ensure a consistently high level of service. Second, they implement wide "avoidance angles" of the geostationary arc, which can reduce the

coverage of the entire system as other satellites are diverted to fill in the gap created by satellites that may not transmit because they fall within the "avoidance angle." Third, they restrict the number of satellites simultaneously serving a particular location on the ground (Nco), constraining the number of co-frequency beams that an NGSO system may place in one area and thereby limiting its ability to increase capacity resulting in less efficient spectrum sharing. And fourth, they employ higher earth station antenna minimum elevation angles, which, in combination with GSO avoidance angles, reduce the area of the sky above these earth stations that NGSO operators have available, affecting service as well as coordination options with other NGSO operators. Under current ITU regulations, EPFD limits must be met at every location on Earth, even locations in which a GSO network has no earth stations present. As a result, some percentage of NGSO satellites and their capacity cannot be utilized to serve consumers even where there is no risk of harmful downlink interference to GSO networks. Current NGSO systems, however, can be flexible in controlling the amount of power transmitted in each beam and precise in how those beams are directed to a particular location on the ground as the satellite traverses its orbit. In total, compliance with the current EPFD limits constrains NGSO systems and directly degrades the efficiency of spectrum use by these systems.

12. Beyond their significant impact on burgeoning NGSO systems, the particular EPFD limits themselves have raised questions as to whether they constitute the most efficient spectrum sharing regime for GSO and NGSO systems in the 10.7-12.7 GHz, 17.3-18.6 GHz, and 19.7-20.2 GHz bands. As an illustrative example in the Ku-band, one initial study has indicated that if GSO satellite operators were required to meet the current

NGSO FSS EPFD limits with respect to other GSO operators, it would require an orbital separation of between 25-30 degrees between GSO satellites, which is four-to-five times more restrictive than the six-degree separation that GSO operators have determined would lead to negligible interference internationally, and 12-to-15 times more restrictive than the longstanding two-degree spacing rules the Commission has determined promotes more efficient GSO FSS operations in the United States. Similarly, in the Ka-band, if the current NGSO FSS EPFD limits that apply in the 19.7-20.2 GHz band had to be met among GSO FSS operators, it could require GSO orbital separations of 46 degrees—more than five times the GSO separation of eight degrees used internationally, and 23 times the GSO separation used for service in the United States. Potential internal inconsistencies in the NGSO FSS EPFD limits also stand out. In the Ka-band, the NGSO FSS EPFD limit in the upper portion of the band is 15 dB (31.6 times) lower than the NGSO FSS EPFD limit in the lower portion of the band, despite only a 1.1 gigahertz separation between the two. And the overall methodology used to derive the current NGSO FSS EPFD limits, including whether it incorporated an appropriate long-term protection criteria, or used unrealistic GSO reference links, has also been questioned by parties.

13. Initiating a review of the current NGSO-GSO sharing regime in the 10.7-12.7 GHz, 17.3-18.6 GHz, and 19.7-20.2 GHz bands in the United States is consistent with longstanding Commission precedent and priorities. Indeed, the cornerstone of Commission policy on GSO-GSO FSS spectrum sharing, premised on two-degree orbital spacing between GSO satellites, resulted from independent Commission consideration and is a departure from more conservative spacings of six degrees or greater applied

internationally. Our closer-spacing allowances for GSO FSS satellites have enabled more satellites to serve the United States for decades, enhancing competition and service offerings for American consumers. More recently, the Commission has adopted clear rules for NGSO-NGSO FSS spectrum sharing while comparable international guidance remains long under development. Even when adopting the current Ka-band EPFD limits into our rules, the Commission noted that they "were not developed with the most advanced modern GSO networks in mind" but it concluded that, in the absence of any alternative limits proposed on the record, "it would not be advisable to remain without Ka-band EPFD limits in our rules pending such deliberations." Similarly, last year when the Commission adopted EPFD limits on new NGSO FSS operation in the 17.3-17.8 GHz band, consistent with decisions taken at WRC-23, the Commission noted international efforts to modernize EPFD limits and stated that it may reevaluate its rules considering international technical developments. This rulemaking will provide a dedicated forum for the Commission to reassess the complex technical issues associated with NGSO-GSO spectrum sharing in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands, including any international technical developments.

14. The status of international work in this area also supports a review by the Commission for services in the United States of the current NGSO-GSO sharing regime reflected in EPFD limits. ITU-R studies are ongoing, as they have been for years. There is no explicit item on the agenda for WRC-27 to review EPFD limits, and the invitation for ITU-R study of the matter during the current study period includes the phrase "without any regulatory consequences." Initiating our review of the NGSO-GSO sharing regime now will enable us to have a full record to make any needed changes to our rules

for the benefits of any revised NGSO-GSO sharing regime to American consumers in a timely manner. While we move forward on behalf of consumers in the United States, we will continue to monitor and participate in international studies and share our experience with other countries. We anticipate a Commission rulemaking may spur additional discussion and technical analyses that benefit international deliberations as well. We are happy to lead in this way and encourage the international community to modernize their domestic as well as international frameworks. As we start this proceeding, however, our primary focus will be on developing a domestic record that will enable the Commission to make an informed decision with the best interests of American consumers in mind. International updates can be done in due course.

15. While the suitability of existing NGSO FSS EPFD limits to the modern satellite environment is therefore in need of a fresh review, the fundamental importance of ensuring compatibility between NGSO FSS systems and GSO FSS and BSS networks remains unchanged. Modern satellites in GSO and NGSO orbits are helping bridge the digital divide across the United States, particularly in the most rural areas of the country where it may be uneconomical to build terrestrial networks. GSO and NGSO FSS satellites currently under construction are expected to offer broadband connectivity at fiber-like speeds. At the same time, GSO BSS satellites continue to serve millions of satellite television subscribers.

16. GSO and NGSO satellites also coexist in shared and adjacent spectrum environments with other services, including terrestrial and radio astronomy services. This proceeding will not change the existing PFD limits that apply to GSO and NGSO systems to protect terrestrial services. However, we will consider how any modifications to the

NGSO-GSO sharing regime might affect terrestrial and radio astronomy stations.

17. While NGSO-GSO spectrum sharing conditions vary in different portions of the 10.7-12.7 GHz, 17.3-18.6 GHz, and 19.7-20.2 GHz bands, this proceeding will provide a single U.S. forum for the complex technical discussions that underlie NGSO-GSO sharing in all of the bands, as well as flexibility to consider operations in different frequency segments individually. We believe that initiating multiple NGSO-GSO sharing proceedings based on different frequency bands would risk multiplication of the substantial technical work and discussions necessary to evaluate this difficult issue. Particular concerns associated with any potential alternative frameworks will be considered based on this record.

18. In light of the above, the oppositions to the Petition do not justify its dismissal or denial. Contrary to Viasat's claims, initiating a domestic review of the NGSO-GSO sharing regime is fully consistent with Commission precedent promoting efficient spectrum sharing in the United States. Echostar's objections do not counsel against initiating a rulemaking given that it would have an opportunity to submit comments and contribute to developing the technical record in this rulemaking. Domestic rulemaking will enhance, not "jeopardize," ongoing international discussions. Developing a technical record in this proceeding, without any proposed rules, also does not constitute "rash action." There is no inconsistency between the Commission's prior decision not to have its staff duplicate the time-consuming technical review of EPFD showings that is already performed by the staff of the ITU BR, using ITU-approved software, and our decision to revisit the sharing regime itself, which could substantially improve efficiency and competition. Nor will including the 12.2-12.7 GHz band in this rulemaking prejudge the

outcome of the separate 12 GHz band rulemaking; on the contrary, excluding the band here would forgo the important technical record to be developed in this proceeding. Finally, EchoStar's assertion that derogation from international EPFD limits "prior to an ITU consensus would also result in harmful interference and disruption of service" cannot simply be accepted. Such a claim must specify in detail what the change would be, and the Commission must analyze these claims. However, in any event, the concerns EchoStar raises can be fully evaluated in the context of this rulemaking prior to any decision on a potential alternative NGSO-GSO sharing framework. Accordingly, we deny the oppositions to initiating a rulemaking on these issues.

B. NPRM

19. *Overview*. The NPRM seeks to develop a substantial technical record concerning modern and efficient spectrum sharing among NGSO FSS systems and GSO FSS and BSS networks in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands, while ensuring that any rule changes do not affect the continued protection of co-frequency terrestrial services. We seek comment on how the satellite industry has changed since ITU EPFD limits were adopted in 2000; how the current limits protect GSO networks and impact NGSO systems; what a modern, realistic set of GSO reference links would be; what short-term and long-term GSO protection criteria would be appropriate; methodological considerations; alternative NGSO-GSO sharing frameworks; information sharing; aggregate interference; protection of terrestrial stations and radio astronomy; cross-border considerations; compliance; costs and benefits; NGSO-GSO sharing in additional frequency bands; and transitional measures. A robust record developed from these inquiries will assist the Commission in promoting a more competitive and efficient

marketplace for satellite broadband and other services in these bands.

20. *Changes since 2000*. As an initial matter, we invite comment on what relevant changes have taken place in the satellite industry since the adoption of EPFD limits by the ITU in 2000. How have the assumptions underlying this NGSO-GSO spectrum sharing regime changed? How have the capabilities and techniques of current and future GSO networks changed regarding their ability to share spectrum? How has NGSO system design changed? Are the modeling assumptions used in the verification of compliance with EPFD limits, such as continuous transmission at maximum power or the use of a worst-case geometry algorithm, realistic with respect to current NGSO operations? Are the protection criteria (e.g., interference-to-noise (I/N) ratios) assumptions still valid or do current satellite technology and design warrant different criteria?

21. *Current EPFD Protection of GSOs*. Next, we invite comment on whether the current NGSO EPFD limits may overprotect modern GSO networks. What levels of protection (short-term and long-term) do GSO networks reasonably require? Are the current EPFD limits appropriate for those requirements? What levels of protection do the current EPFD limits offer to GSO networks? If a modern NGSO system is compliant with the EPFD limits, what is the expected loss in throughput or increase in unavailability for a modern GSO satellite link that relies on Adaptive Coding and Modulation (ACM)? Does this expected level of degradation vary for gateways and user terminal earth stations? What is the level of short-term protection provided by current NGSO EPFD limits to GSO satellite links that do not rely on ACM? How do these levels of protection compare to other sources of interference, such as attenuation due to atmospheric conditions such as rain or interference from other GSO networks? How do these levels of

protection compare to any triggers for coordination? Are the protection criteria on which the EPFD limits are based (e.g., I/N ratios) still valid?

22. *Current Impact on NGSOs*. At the same time, do the current EPFD limits overly restrict modern NGSO operations? What are the impacts of the operational changes that NGSO FSS systems make to comply with the current EPFD limits on the quality or availability of service within the United States? To what extent would NGSO systems be able to offer higher capacity or better service in certain areas with less restrictive limits? We encourage commenters to submit studies showing the impact of less restrictive limits on capacity and other measures of service quality.

23. What GSO arc avoidance angles, or restrictions on where NGSO FSS systems can steer their antenna beams to prevent in-line interference events with GSO satellite networks, are NGSO operators adopting to comply with current EPFD limits, and how do those differ from the angles they could operate with under less restrictive limits? How do they differ from the equivalent separation angles used by GSO satellites for inter-arc sharing? How much must NGSO operators restrict their power levels to ensure compliance with EPFD limits and how do they implement such power level changes? Do they need to restrict their power levels differently in different bands given the EPFD limits? What Nco, representing the number of co-frequency, co-polarization satellite beams transmitting to a given point on the Earth's surface simultaneously, must NGSO operators adopt to comply with the EPFD limits? What Nco could NGSO operators adopt if these limits were not in place, and how would that change their available capacity? Given how the EPFD limits were designed, how well do modern NGSO operations map onto the EPFD limits? Is it plausible for a modern NGSO operator to take full advantage

of the required masks, or are the masks more restrictive than they appear? How do these levels of restriction differ in the Ku-band and the Ka-band?

24. *GSO Reference Links*. We also seek input on developing a set of modern GSO reference links to be used for analysis. What are the most representative GSO links used in the United States today? What is an appropriate set of GSO FSS reference links in these bands? What is an appropriate set of GSO BSS reference links in these bands? Which of these links use ACM, and which do not? What is the actual antenna pattern performance for these GSO earth stations? How many locations should be used in analyzing GSO reference links, and how can the Commission ensure that those analyzed appropriately reflect the impact of differing geographies on performance? What would be appropriate rain and interference margin for proposed links, and what would be their carrier-to-noise (C/N) below which the GSO link is lost? What is the receive system noise temperature of these reference links? What criteria should be used for evaluating the potential for harmful interference? What, if anything, should be apportioned for margin above that criteria? Are there any additional costs associated with developing the GSO reference links? If so, we seek estimates of these costs.

25. *Protection of GSOs that Use ACM*. What is the appropriate methodology for protecting GSO operations that use ACM? In the NGSO-NGSO sharing context, the Commission has made use of a degraded throughput methodology, with a long-term protection criterion representing a percentage of time-weighted average throughput degradation and a short-term protection criterion representing a percentage of absolute increase in link unavailability. A degraded throughput methodology could be implemented by requiring NGSO FSS operators to demonstrate that they will comply

with short-term and long-term protection criteria for GSO FSS and GSO BSS networks. We tentatively conclude that degraded throughput is a more appropriate methodology to use in the context of NGSO-GSO sharing when the GSO satellite uses ACM. What are the appropriate protection criteria? Is there any reason to think those criteria should be higher or lower, or should differ between gateways and user terminals or based on whether the earth station is using the Ku-band, the lower Ka-band, or the upper Ka-band? Is there a better methodology available to establish the actual impact an NGSO operator is likely to have on a GSO link that uses ACM? In establishing a methodology and thresholds, how should the Commission balance the need for protection of GSO incumbents with maximizing the benefits of NGSO systems? Should the Commission provide NGSO operators with the same flexibility it did in the NGSO-NGSO sharing context to adjust their operations to meet the new methodology and thresholds?

26. *Protection of GSOs that Do Not Use ACM*. What is the appropriate methodology for protecting GSO operations that do not use ACM? Is a degraded throughput methodology appropriate for such links, and if so, what changes would be needed to the methodology to account for the lack of ACM? Should the only criterion be a short-term protection criterion? If so, what would an appropriate short-term protection criterion be? Alternatively, would an I/N threshold be a more appropriate long-term protection criterion for GSO links that do not use ACM? If the Commission were to adopt an I/N threshold, what should it be and how can the Commission ensure that such a threshold reflects the necessary protection requirements of GSO operations? If the Commission were to adopt an I/N threshold, what should be the associated percentage of time? If the Commission were to adopt such a long-term threshold, what should the short-term

protection criterion be for such links, if any? Finally, what is the approximate number and percentage of FSS, BSS GSO satellites that currently do not use ACM?

27. *Methodology*. What modeling assumptions should underlie any methodology? For example, should the Commission adopt a minimum link availability threshold to guard against the risk of low-performing links? Should the Commission adopt standardized reference C/N threshold values to account for the performance of efficient, modern modems and receivers? Should the Commission adopt a minimum receiver performance standard, such as a limit on the receiver noise temperature? Should the Commission incorporate interference from other GSO operations into the baseline calculations for any methodology? What is the level of static interference that a GSO network should accept from its neighboring GSO satellites? Should the Commission require the use of particular rain-fade characteristics, such as those found in Recommendations ITU-R P.618 or P.676?

28. *Alternative NGSO-GSO Sharing Frameworks*. More generally, we seek comment on what NGSO-GSO spectrum sharing framework should apply in the 10.7-12.7 GHz, 17.3-18.6 GHz, and 19.7-20.2 GHz bands. In light of the Commission's recent decision to use a degraded throughput methodology when assessing inter-round interference among NGSO FSS systems, and international adoption of a degraded throughput methodology for the protection of GSO networks from NGSO systems in in bands between 37.5 GHz and 51.4 GHz, we tentatively conclude that a similar degraded throughput methodology would offer a more efficient alternative to spectrum sharing among NGSO and GSO systems that use ACM and operate in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands. To that end, we propose that the Commission ultimately adopt

backstop short-term and long-term interference protection criteria against which to assess interference into modern, realistic and validated GSO reference links. Consistent with the NGSO-NGSO sharing regime, we believe any short-term interference protection criterion should assess the absolute change in unavailability against a minimum availability threshold and any long-term interference protection criterion for GSO reference links using ACM should use a degraded throughput methodology. We also tentatively conclude that allowing NGSO systems to operate at a minimum avoidance angle from operational satellites in the GSO arc, such as four degrees, may provide a reasonable backstop in cases where realistic GSO reference links are unavailable for evaluating possible interference. We seek comment on the foregoing. In addition, should the Commission require GSO and NGSO operators to coordinate in good faith in these bands? Should the Commission continue to require NGSO operators not to cause unacceptable interference into GSO networks, absent coordination? Should the Commission instead require GSO operators to not cause unacceptable interference into NGSO systems in these bands, absent coordination, as the Commission requires in the 18.8-19.3 GHz downlink band, and what would be the benefits and costs of this alternative to both GSO and NGSO operations? Should any protections offered to GSO operations be uniform in scope, or should they be tailored to the actual usage in particular orbital slots? Should any protections offered to GSO operations be the same for earth stations in motion as those offered to fixed earth stations? Alternatively, should the Commission revise the current spectrum sharing methodology, which relies on EPFD limits?

29. *Information Sharing*. What information, if any, should GSO operators be required

to share to facilitate efficient spectrum use? Should GSO operators be required to share the actual antenna patterns of their deployed earth stations to the extent they differ from those in public records? Should GSO operators be required to share their actual power levels or other system characteristics that could impact their baseline operations? Should GSO operators be required to share the actual spectrum used or spectrum usage patterns of particular satellites to maximize spectral efficiency? Should GSO operators be required to identify links that require particular interference protection as well as the basis for any such heightened need? Should GSO operators be required to share whether their networks rely on ACM and, if not, the link budgets they use? To the extent a GSO network has blanket-authorized earth stations (such as user terminals), should a GSO operator be required to share whether any such stations are in a given area (so as to avoid protecting stations that do not exist)? What confidentiality measures may be needed to facilitate information sharing when viewing potentially commercially sensitive operational data? What are the estimated costs associated with information sharing?

30. *Aggregate Interference*. How should we address the potential for aggregate interference from multiple NGSO systems into a GSO network? Should we continue to rely on an approach similar to ITU-R Resolution 76 or ITU-R Resolution 769? How should we address any implementation issues regarding aggregate limits? Is an aggregate limit on NGSO-GSO interference in fact necessary to prevent harmful interference, or might the cost of such regulation outweigh its benefits and create an unjustified obstacle to NGSO deployment? In the context of NGSO-NGSO spectrum sharing, the Commission declined to create an aggregate interference threshold. Should we follow a similar approach here? Should we rely on coordination among NGSO and GSO operators

to resolve potential issues of aggregate interference?

31. *Protection of Terrestrial Operations*. How would any changes to the NGSO-GSO sharing regime affect co-frequency terrestrial operations? If current EPFD limits are not met, would any additional constraints on NGSO FSS operation be necessary to protect terrestrial wireless operations, beyond the existing PFD limits? How should the Commission ensure that terrestrial services in different portions of the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands are not adversely impacted?

32. *Radio Astronomy*. We note the extensive recent record of successful coordination and cooperation between radio astronomy systems and satellite systems, facilitated in part by previous FCC rulemakings. Would any additional considerations with respect to NGSO FSS operation be necessary to protect radio astronomy operations, beyond the existing PFD limits? How would any changes to the NGSO-GSO sharing regime affect co-frequency or adjacent-band radio astronomy operations, and how should the Commission ensure that successful coordination continue?

33. *Cross-Border Considerations*. We invite comments on cross-border considerations and any safeguards that may be needed to protect GSO operations in neighboring countries. We seek comment on any needed bilateral engagements to alleviate cross-border interference concerns in our region and share our experience, the record of this proceeding, and our findings. How should the Commission coordinate operations near the borders of Canada and Mexico, and how close to the border would NGSO operations need to be to qualify for such coordination? Are there any other jurisdictions that the Commission would need to coordinate with? We will continue to work with our regional and international partners and participate in international studies

in various venues. We believe that this rulemaking may spur additional discussion and technical analyses that benefit the international deliberations. With respect to cross-border considerations, commenters should identify the concerns and provide qualitative and quantitative analysis of their proposals.

34. *Compliance*. How should the Commission assess compliance with any new NGSO-GSO sharing framework? Would such a framework require additional monitoring and enforcement on the part of the Commission? What additional compliance costs would be associated with such monitoring and enforcement? Should NGSO operators be required to demonstrate compliance in their initial application or should authorization be conditional on later showings of compliance? Should NGSO operators be allowed to use information gathered through coordination discussions with other operators, or required to use public information? Are there any incremental costs that NGSO and GSO operators may incur with a new NGSO-GSO sharing framework that moves away from requiring NGSO operators receiving a "favorable" or "qualified favorable" finding by the ITU BR prior to initiating service? Are confidentiality protections needed for such filings, for example if they rely on proprietary or competitively sensitive information?

35. *Costs and Benefits*. We seek specific information on the benefits and costs associated with any proposals for alternative NGSO-GSO sharing frameworks. What are the economic benefits of less restrictive limits on NGSO operations for U.S. consumers and the aggregate economy of the United States? What costs could less restrictive limits potentially impose on GSO services provided to U.S. consumers or for terrestrial services in the United States? Would less restrictive limits lead to increased compliance and monitoring costs near the borders of Canada and Mexico? Would an alternative NGSO-

GSO sharing framework incur additional compliance and monitoring costs? We also seek comment on any additional costs or benefits not outlined above.

36. *Additional Frequency Bands*. Beyond seeking comment on revisions to the NGSO-GSO spectrum sharing regime in the FSS downlink frequency bands 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz, we also seek comment on whether the Commission should explore updates to the NGSO-GSO sharing regime in other frequency bands subject to ITU EPFD limits, as well as in V-band frequencies. How would the analyses for each of the categories of inquiry described above change for each additional frequency band? How would consideration of any additional frequency bands affect the timing of potential action on the request in the SpaceX Petition to revisit NGSO-GSO sharing in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands?

37. *Transition to New Rules*. Finally, we propose that the current GSO protections in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands must ultimately sunset to ensure they do not unduly limit competition, innovation, and spectral efficiency among next-generation NGSO systems that deliver high-speed, low-latency broadband to consumers. With that ultimate goal in mind, how should we transition to a new NGSO-GSO sharing framework in the United States? What time frame(s) would be reasonable? Under what circumstances would an immediate transition be appropriate? Are there any particular technologies or services that would require a longer period of protection under the current EPFD limits? How should we address existing license conditions that may conflict with any new rules we adopt? Should we offer current licensees and market access grantees a simple process to request modification of their authorizations to conform with any new rules, for example via letter request?

IV. Initial Regulatory Flexibility Analysis

38. As required by the Regulatory Flexibility Act (RFA), the Federal Communications Commission has prepared an IRFA of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in the NPRM. The Commission requests written public comments on the IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines provided on the first page of the NPRM. The Commission will send a copy of the NPRM, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA). In addition, the NPRM and IRFA (or summaries thereof) will be published in the Federal Register.

A. Need for, and Objectives of, the Proposed Rules

39. The NPRM launches a much needed review of the long-standing spectrum sharing regime between GSO and NGSO satellite systems operating in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands. The decades-old spectrum sharing regime constitutes the primary restrictive regulatory requirement on NGSO satellite systems currently deploying at breakneck speed. Innovation in the satellite industry has witnessed new NGSO satellite operators launching thousands of satellites in the short span of a few years, and these operators are beginning to offer high-speed, low-latency broadband services. The industry has also seen existing GSO satellite operators are continuing to deploy powerful, new satellites with enhanced capabilities. As innovation continues, the Commission's rules must be at the forefront of the quickly evolving space industry, encourage investment, and further the objectives of space leadership by the United States. By taking a fresh look at today's satellite technology and operations, the NPRM will

support a more efficient and competitive market for satellite broadband and other in-demand services while uncapping the potential of satellite constellations that were unthinkable when the current regime was developed, to the ultimate benefit of American consumers.

40. The NPRM seeks comment to develop a substantial technical record concerning modern and efficient spectrum sharing among NGSO FSS systems, GSO FSS, and BSS networks in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands, while ensuring that any rule changes continue to safeguard and maintain the protection of co-frequency terrestrial services. More specifically, the NPRM seeks comment on how the satellite industry has changed since ITU EPFD limits were adopted in 2000, how the current limits protect GSO networks and impact NGSO systems, what a modern, realistic set of GSO reference links would be, what short-term and long-term GSO protection criteria would be appropriate, methodological considerations, alternative NGSO-GSO sharing frameworks, information sharing, aggregate interference, compliance, protection of terrestrial stations, cross-border considerations, costs and benefits, and transitional measures. A robust record developed from these inquiries will assist the Commission in promoting a more competitive and efficient satellite marketplace that can deliver more high-speed broadband services and choices to the American public.

B. Legal Basis

41. The proposed action is authorized pursuant to sections 4(i), 7(a), 303, 308(b), and 316 of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 157(a), 303, 308(b), 316.

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules will Apply

42. The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted. The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction." In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act. A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.

43. *Satellite Telecommunications*. This industry comprises firms "primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications." Satellite telecommunications service providers include satellite and earth station operators. The SBA small business size standard for this industry classifies a business with $44 million or less in annual receipts as small. U.S. Census Bureau data for 2017 show that 275 firms in this industry operated for the entire year. Of this number, 242 firms had revenue of less than $25 million. Consequently, using the SBA's small business size standard most satellite telecommunications service providers can be considered small entities. The Commission notes however, that the SBA's revenue small business size standard is applicable to a broad scope of satellite telecommunications providers included in the U.S. Census Bureau's Satellite Telecommunications industry

definition. Additionally, the Commission neither requests nor collects annual revenue information from satellite telecommunications providers, and is therefore unable to more accurately estimate the number of satellite telecommunications providers that would be classified as a small business under the SBA size standard.

44. *All Other Telecommunications*. This industry is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Providers of Internet services (e.g. dial-up ISPs) or Voice over Internet Protocol (VoIP) services, via client-supplied telecommunications connections are also included in this industry. The SBA small business size standard for this industry classifies firms with annual receipts of $40 million or less as small. U.S. Census Bureau data for 2017 show that there were 1,079 firms in this industry that operated for the entire year. Of those firms, 1,039 had revenue of less than $25 million. Based on this data, the Commission estimates that the majority of "All Other Telecommunications" firms can be considered small.

D. Description of Economic Impact and Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

45. The RFA directs agencies to provide a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an

estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record.

46. The NPRM seeks to develop a robust technical record on the current NGSO-GSO spectrum sharing regime in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands, and how it might be updated or improved in light of modern satellite technologies and spectrum management techniques. The NPRM does not propose any reporting, recordkeeping, or other compliance requirements. However, matters upon which the NPRM seeks comment could result in new and/or modified reporting, recordkeeping, or other compliance requirements for small and other NGSO and GSO operators. For example, the NPRM seeks comment on what, if any, information GSO operators should be required to share to facilitate the efficient use of spectrum, and whether NGSO operators should be required to demonstrate compliance with any new NGSO-GSO sharing framework that may be adopted in their initial application or whether authorization should be conditional on later showings of compliance.

47. With regard to the compliance costs for small entities, the NPRM initiates a review to take a "fresh-look" at current technology and operations in the satellite industry, thus, at this time the record does not include sufficient cost and/or economic analyses to allow the Commission to quantify the costs of compliance for small entities, including whether it will be necessary for small entities to hire professionals to comply with any rules that may be adopted in this proceeding. Information the Commission receives in comments may include analyses of the costs and benefits of various alternative NGSO-GSO sharing frameworks and their associated requirements which should help the Commission assess any compliance costs for small entities. Industry

input should also allow the Commission to identify and evaluate additional matters and burdens relevant to small entities that may result from the inquiries we make in this proceeding.

E. Discussion of Significant Alternatives That Minimize the Significant Economic Impact on Small Entities

48. The RFA directs agencies to provide a description of any significant alternatives to the proposed rules that would accomplish the stated objectives of applicable statutes, and minimize any significant economic impact on small entities. The discussion is required to include alternatives such as: "(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rules for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities."

49. The NPRM seeks comment on various alternatives to develop the most efficient and effective use of the shared spectrum in the 10.7-12.7, 17.3-18.6, and 19.7-20.2 GHz bands, and to assess any alternative NGSO-GSO sharing framework in the these bands proposed by commenters on the NPRM. For example, the NPRM seeking input on the appropriate methodology for protecting GSO operations that use ACM inquires whether NGSO operators should be afforded the same flexibility to adjust their operations to meet any new methodology and thresholds similar to what the Commission provided in the NGSO-NGSO sharing context. The NPRM also seeks to explore the appropriate methodology for protecting GSO operations that do not use ACM and requests comment

on whether short-term protection criterion should be the only protection criterion, or alternatively, whether a long-term protection criterion such as an interference-to-noise (I/N) threshold may be a more appropriate threshold for GSO links that do not use ACM. Regarding what modeling assumptions should underlie any methodology, the NPRM raises alternatives such as whether the Commission should adopt a minimum link availability threshold to guard against risk of low-performing links; adopt standardized reference C/N threshold values to account for the performance of efficient, modern modems and receivers; adopt a minimum receiver performance standard, such as a limit on the receiver noise temperature; incorporate interference from other GSO operations into the baseline calculations for any methodology; or require the use of particular rain-fade characteristics, such as those found in Recommendations ITU-R P.618 or P.676.

50. The alternative NGSO-GSO spectrum sharing framework inquiry in the NPRM requests input on whether the Commission should continue to require NGSO operators not to cause unacceptable interference into GSO networks, absent coordination, or in the alternative require GSO operators to not cause unacceptable interference into NGSO systems, absent coordination. The NPRM also seeks comment on whether any protections offered to GSO operations should be uniform in scope, or should they be tailored to the actual usage in particular orbital slots. As part of the record the Commission seeks to develop on information sharing, and what if any, information GSO operators should be required to share to facilitate the efficient use of spectrum, the NPRM also inquires whether GSO operators should be required to share certain information including the actual antenna patterns of their deployed earth stations to the extent they differ from those in public records; their actual power levels or other system

characteristics that could impact their baseline operations; the actual spectrum used or spectrum usage patterns of particular satellites to maximize spectral efficiency; the identity of links that require particular interference protection as well as the basis for any such heightened need; and whether their networks rely on ACM and, if not, the link budgets they use.

51. Finally, the NPRM's request for comment involving compliance with, and the transition to, any new NGSO-GSO sharing framework seeks feedback on whether NGSO operators should be required to demonstrate compliance in their initial application, or instead should authorization be conditional on later showings of compliance; whether the Commission should sunset any protections for inefficient or outdated technologies or services; and whether to offer current licensees and market access grantees a simple process to request modification of their authorizations to conform with any new rules adopted, such as allowing requests to be made by letter. All of the above alternatives upon which comment is sought could result in requirements that have an economic impact on small entities.

52. The Commission expects to fully consider any proposals, and comments, including costs analyses submitted on the record in response to the NPRM, and assess whether they would have a significant economic impact on small entities. Information from industry stakeholders to create a robust technical record and provide responses to the inquiries in the NPRM will allow the Commission to better evaluate options and alternatives for minimization of any significant economic impact on small entities. The Commission's evaluation of this information will shape the final alternatives it considers

to minimize any significant economic impact that may occur on small entities, the final conclusions it reaches, and any final rules it promulgates in this proceeding.

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rules

53. None.

V. Ordering Clauses

54. Accordingly, IT IS ORDERED, pursuant to § 1.407 of the Commission's rules, 47 CFR 1.407, that the petition for rulemaking filed by Space Exploration Holdings, LLC, Revision of the Commission's Rules to Establish More Efficient Spectrum Sharing between NGSO and GSO Satellite Systems, RM-11990, IS GRANTED, and the oppositions filed by Viasat, Inc., and EchoStar Corporation ARE DENIED.

55. IT IS FURTHER ORDERED, pursuant to sections 4(i), 7(a), 303, 308(b), and 316 of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 157(a), 303, 308(b), 316, that this Notice of Proposed Rulemaking IS ADOPTED.

56. IT IS FURTHER ORDERED that the Commission's Office of the Secretary SHALL SEND a copy of the Notice of Proposed Rulemaking, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration

Federal Communications Commission.

Marlene Dortch,
Secretary.

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