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## FEDERAL COMMUNICATIONS COMMISSION

### 47 CFR Part 25

[IB Docket No. 21–456; FCC 24–117; FR ID 265639]

### Spectrum Sharing Rules for NGSO Fixed-Satellite Service Systems

**AGENCY:** Federal Communications Commission.

**ACTION:** Final rule; denial of reconsideration.

**SUMMARY:** In this document, the Federal Communications Commission (FCC or Commission) clarifies the methodology to be used in compatibility analyses by non-geostationary satellite orbit (NGSO) fixed-satellite service (FSS) system licensees. The *Second Report and Order* adopts specific degraded throughput methodology criteria that NGSO FSS systems licensed in a later processing round must include in compatibility analyses, in absence of a coordination agreement, to demonstrate that they can operate compatibly with and protect NGSO FSS systems authorized in earlier processing rounds. The *Second Report and Order* clarifies these methodologies to promote market entry, regulatory certainty, and spectrum efficiency through good-faith coordination. The Commission also adopts an *Order on Reconsideration* dismissing in part and, on alternative and independent grounds, denying a petition for reconsideration.

**DATES:** Effective on January 13, 2025.

**FOR FURTHER INFORMATION CONTACT:** For additional information on this proceeding, contact Carolyn Mahoney, Satellite Programs and Policy Division, Space Bureau, at (202) 418–7168 or [carolyn.mahoney@fcc.gov](mailto:carolyn.mahoney@fcc.gov).

**SUPPLEMENTARY INFORMATION:** This is a summary of the Commission’s *Second Report and Order and Order on Reconsideration*, in IB Docket No. 21–456, FCC 24–117, adopted on November 5, 2024 and released on November 15, 2024. The full text of this document is available at <https://docs.fcc.gov/public/attachments/FCC-24-117A1.pdf>.

#### Final 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 rulemakings, 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 a Final Regulatory Flexibility Analysis (FRFA) concerning the potential impact of the rule changes contained in the *Second Report and Order and Order on Reconsideration*. The FRFA is set forth in the appendix of the document available at <https://docs.fcc.gov/public/attachments/FCC-24-117A1.pdf> and a summary is included in the Procedural Matters section below.

#### Paperwork Reduction Act Analysis

The *Second Report and Order* contains modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104–13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, other Federal agencies, and the general public will be invited to comment on the modified information collection requirements contained in this document.

The Commission assessed the effects of requiring later-round NGSO FSS grantees to submit compatibility showings with respect to earlier-round grantees with whom coordination has not yet been reached. The Commission finds that doing so will serve the public interest and is unlikely to directly affect businesses with fewer than 25 employees.

#### Congressional Review Act

The Commission has determined, and the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, concurs that this rule is non-major under the Congressional Review Act, 5 U.S.C. 804(2). The Commission will send a copy of the *Second Report and Order and Order on Reconsideration* to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

#### Synopsis

##### I. Introduction

In the *Second Report and Order*, the Commission continues to refine the Commission’s rules governing spectrum sharing among a new generation of broadband satellite constellations to promote market entry, regulatory certainty, and spectrum efficiency through good-faith coordination. Specifically, the Commission clarifies certain details of the degraded

throughput methodology that, in the absence of a coordination agreement, must be used in compatibility analyses by non-geostationary satellite orbit, fixed-satellite service (NGSO FSS) system licensees authorized through later processing rounds to show they can operate compatibly with, and protect, NGSO FSS systems authorized through earlier processing rounds. The Commission adopts a 3 percent time-weighted average throughput degradation as a long-term interference protection criterion, a 0.4 percent absolute increase in link unavailability as a short-term interference protection criterion, and declines to adopt additional protection metrics or to adopt an aggregate limit on interference from later-round NGSO FSS systems into earlier-round NGSO FSS systems. In an accompanying *Order on Reconsideration*, the Commission denies a Petition for Reconsideration (88 FR 58540, August 28, 2023) of the *Report and Order* (88 FR 39783, June 30, 2023). These actions continue the Commission’s efforts to promote development and competition in broadband NGSO satellite services.

##### II. Background

The Commission is committed to updating and refining its rules governing NGSO FSS systems, at a time when these systems are being deployed at unprecedented scale. NGSO FSS satellites traveling in low- and medium-Earth orbit provide broadband services to industry, enterprise, and residential customers with lower latency and wider coverage than previously available by satellite.

*Processing Round Procedure Overview.* Applications for NGSO FSS system licenses and petitions for declaratory ruling seeking U.S. market access for non-U.S.-licensed NGSO FSS systems are considered in groups based on filing date, under a processing round procedure. Pursuant to the Commission’s rules, a license application for “NGSO-like” satellite operation, including operation of an NGSO FSS system, that satisfies the acceptability for filing requirements is reviewed to determine whether it is a “competing application” or a “lead application.” A competing application is one filed in response to a public notice initiating a processing round. Any other application is a lead application. The public notice for a lead application initiates a processing round and establishes a cut-off date for competing NGSO-like satellite system applications. After the close of the processing round, the Commission grants all the applications for which the

Commission finds that the applicant is legally, technically, and otherwise qualified, that the proposed facilities and operations comply with all applicable rules, regulations, and policies, and that grant of the application will serve the public interest, convenience and necessity.

**NGSO FSS System Spectrum Sharing Overview.** The Commission has adopted rules for spectrum sharing among NGSO FSS systems. NGSO FSS space station license applications granted with a condition to abide by these sharing rules are exempt from frequency band segmentation procedures that otherwise apply to applications for NGSO-like satellite operation. Instead, NGSO FSS operators must coordinate with one another in good faith the use of commonly authorized frequencies. If two or more NGSO FSS satellite systems fail to complete coordination, a default spectrum-splitting procedure using a  $\Delta T/T$  of 6 percent threshold applies, pursuant to § 25.261(c) of the Commission's rules. In the *NGSO FSS Report and Order* (82 FR 59972, December 18, 2017), the Commission stated that it would "initially limit" sharing under the  $\Delta T/T$  of 6 percent threshold to qualified applicants in a processing round. The Commission explained that treatment of applicants after a processing round would be on a case-by-case basis and would consider both the need to protect existing expectations and investments and the benefits of additional entry, as well as any comments filed by incumbent operators and reasoning presented by the new applicant.

**Notice of Proposed Rulemaking.** The *NPRM* (88 FR 39783, June 30, 2023) in this proceeding sought comment on potential rule changes to clarify the relative obligations between NGSO FSS systems approved in different processing rounds. Specifically, the Commission proposed to limit the existing NGSO FSS spectrum-splitting procedure in § 25.261(c) to those systems approved in the same processing round, and to require systems approved in a later processing round to coordinate with, or demonstrate they will protect, earlier-round systems. The Commission invited comment on how to quantify inter-round protection and whether it should sunset after a period of time. The Commission also proposed to require all NGSO FSS grantees, regardless of their processing round status, to coordinate with each other in good faith, and sought comment on specific information sharing obligations that could facilitate operator-to-operator coordination.

**Report and Order.** In response to the record developed through the *NPRM*, the *Report and Order* adopted rule changes designed to promote market entry, regulatory certainty, and spectrum efficiency of NGSO FSS systems. The Commission, for the first time, limited the default spectrum-splitting procedure in § 25.261(c) to NGSO FSS systems approved in the same processing round and required NGSO FSS systems approved in a later processing round to coordinate with, or demonstrate they will protect, earlier-round systems, subject to a sunset provision. The Commission also required all NGSO FSS grantees to coordinate with each other in good faith. Regarding the technical demonstrations of compatibility of later-round NGSO FSS systems with earlier-round systems, the Commission concluded that an interference analysis based on a degraded throughput methodology offered the most technically promising path for NGSO FSS inter-round sharing and required later-round systems to use such a methodology. In adopting a sunset provision for the inter-round protection requirement, the Commission concluded that protection of earlier-round NGSO FSS systems must ensure a stable environment for continued service and investment but should not hinder later-round systems indefinitely. The Commission decided that NGSO FSS systems will be entitled to protection from systems approved in a subsequent processing round until ten years after the first authorization or market access grant in that subsequent processing round. After that date, all systems in both processing rounds will be treated on an equal basis with respect to spectrum sharing in the absence of a coordination agreement, and the default spectrum-splitting procedure in § 25.261(c) will also apply between systems in the two rounds. In sum, prior to commencing operations, an NGSO FSS licensee or market access recipient must either certify it has completed a coordination agreement with any operational NGSO FSS system licensed or granted U.S. market access in an earlier processing round, or submit a showing for Commission approval that it will not cause harmful interference to any such system with which coordination has not been completed using a degraded throughput methodology.

**Further Notice.** In conjunction with the decision in the *Report and Order* to adopt an inter-round protection requirement described above, the Commission adopted the *Further Notice*

(88 FR 40142, June 21, 2023) to finalize the details of the degraded throughput methodology. The Commission invited specific comment on the appropriate values and assumptions to be used in this requirement, as well as on whether the Commission should adopt a rule limiting aggregate interference from later-round NGSO FSS systems into earlier-round systems. Ten comments, eight reply comments, and several *ex parte* presentations were filed in response to the *Further Notice*.

**Petition.** On July 20, 2023, OneWeb filed a Petition for Partial Reconsideration of the *Report and Order* concerning the sunset period adopted with the new inter-round protection requirement. Kuiper opposed the OneWeb Petition, SpaceX commented on it, and OneWeb replied to Kuiper's opposition.

### III. Discussion

#### 1. Second Report and Order

In this *Second Report and Order*, after review of the record, the Commission clarifies certain details of the degraded throughput methodology that, in the absence of a coordination agreement, must be used in compatibility analyses by NGSO FSS system grantees, authorized through later processing rounds, to show they can operate compatibly with, and protect, NGSO FSS systems, authorized through earlier processing rounds. Specifically, the Commission adopts a 3 percent time-weighted average throughput degradation as a long-term interference protection criterion and a 0.4 percent absolute increase in link unavailability as a short-term interference protection criterion. The Commission declines to adopt additional protection metrics or to adopt an aggregate limit on interference from later-round NGSO FSS systems into earlier-round NGSO FSS systems. The Commission's decisions in the *Second Report and Order* rely on its predictive judgment in the highly complex and dynamic area of spectrum sharing among a new generation of innovative NGSO FSS systems. The Commission's decisions strive to balance its competing goals of providing regulatory certainty for, and adequate protection of, earlier round systems vis-a-vis later entrants while encouraging new entry and coordination among NGSO FSS operators.

#### 1. Long-Term Interference Metric

**Further Notice.** In the *Further Notice*, the Commission outlined its expected steps in a degraded throughput analysis and sought comment on the proposed process. Specifically, noting that 3

percent had been suggested as an appropriate value for several aspects of the degraded throughput analysis, including a long-term interference limit based on reduction in time-weighted average throughput, the Commission invited comment on the appropriate values for such a limit, including technical justification.

*Comments.* Four out of the five commenters proposing a specific threshold value for degraded throughput support using the 3 percent value noted in the *Further Notice*. Kuiper, for example, observes that a 3 percent throughput-degradation threshold has been adopted internationally to protect V-band GSO networks from NGSO FSS systems and argues that it provides a conservative measure of protection for incumbent systems due, in part, to conservatism in the methodology a new entrant must use to estimate interference. Viasat agrees that use of the 3 percent threshold should adequately safeguard systems from adverse performance degradation experienced over an extended period of time. Telesat, while initially arguing that “[t]he long-term criterion is sufficiently stable and there is a sufficient record, including through recent ITU studies, to support adopting a 3 percent degradation limit,” more recently concludes that specific degraded throughput criteria should be left to coordination discussions among satellite operators to determine. Telesat now believes that the record is sufficiently complete to allow the Commission to adopt rules, endorsing the 3 percent degraded throughput value for the long-term protection criterion proposed by SpaceX. Intelsat initially indicated that further study would be required before concluding upon a degraded throughput value, but now supports the 3 percent value as well. TechFreedom argues it is premature to adopt protection criteria. Public Knowledge and New America Open Technology Institute also support adopting a 3 percent degraded throughput threshold.

SpaceX, which initially commented that a 3 percent degraded throughput value required further study, subsequently submitted its own spectrum sharing study evaluating the 3 percent limit. Using publicly available information and reference standard antenna patterns, SpaceX performed 123 dynamic (Monte Carlo) simulations of interference from various 2020 processing-round NGSO systems into various 2016 processing-round NGSO systems. In 112 of the 123 studied cases, degradation was below 3.12 percent, which SpaceX argues empirically

supports the Commission adopting a 3.0 percent degradation of average spectral efficiency as a single-entry long-term interference criterion for compatibility determinations.

Only OneWeb proposes a long-term interference metric other than 3 percent, arguing that a 3 percent time-weighted average degraded throughput limit will substantially harm NGSO FSS operators and disincentivize coordination. OneWeb asserts that an aggregate interference and rain fade criterion of no more than 10 percent degradation in average throughput is appropriate for an NGSO FSS system, that apportionment of this allowed percentage of interference to other NGSO systems should be no more than 2.5 to 3.85 percent, and that when accounting for the existence of multiple co-frequency NGSO systems, the single-entry average degraded throughput should be less than 1 percent for each individual NGSO system. OneWeb further claims that if a 3 percent limit were adopted per system and six NGSO FSS systems were operating co-frequency, then a 15 percent degradation in average throughput would occur from the 5 interfering systems to the victim system. No other commenter supports OneWeb’s proposal; SpaceX, Kuiper, and Telesat raise numerous technical concerns with it; and commenters suggest alternative explanations for the results of OneWeb’s analysis.

OneWeb also argues that SpaceX’s study purporting to affirm the 3 percent metric relies on flawed assumptions that undermine its conclusions. Specifically, OneWeb contends that the study fails to accurately model system-specific details that could impact whether a previous-round system may experience harmful interference. OneWeb’s analysis incorporating its revised assumptions argues that the 3 percent metric results in substantially higher levels of interference than projected by both SpaceX and Kuiper, which could exceed 5 percent when taking into account a small deployment of Kuiper customer terminals without adding any contribution from the Viasat system. Thus, OneWeb concludes that SpaceX’s study fails to adequately predict the interference levels prior-round NGSO systems would receive. OneWeb further highlighted its support for a 1 percent or less average degraded throughput as the long-term criterion that should be adopted.

*Decision.* The Commission adopts a 3 percent time-weighted average degraded throughput threshold as the long-term interference metric that must be complied with in any inter-round compatibility showing submitted by a

later-round NGSO FSS grantee. The 3 percent time-weighted average degraded throughput is calculated on a per link basis. The Commission concludes that adopting this value best furthers its goals of providing regulatory certainty for, and adequate protection of, earlier-round NGSO FSS systems while allowing for new entry and coordination among NGSO FSS operators. First, this value has been developed and adopted internationally as sufficient for the protection of GSO satellite networks using adaptive coding and modulation techniques, which are also used by NGSO FSS systems. Second, the 3 percent throughput-degradation threshold limits the interference allowed at any location, not the expected average of interference across all locations. Since the worst-case locations will likely drive the discussion of appropriate system parameters and any mitigation measures, actual interference should be less than 3 percent in many circumstances. Third, the Commission’s technical review of the SpaceX study on the record indicates that the study reliably supports the conclusion that a 3 percent threshold is achievable by later-round systems, and therefore encourages competitive new entry, by demonstrating that the simulated degradation was near or below 3 percent in 112 of the 123 studied cases of later-round systems protecting earlier-round systems.

The Commission disagrees with OneWeb that a 3 percent degraded throughput threshold would disincentivize coordination, for three reasons. First, not all links considered in the SpaceX study meet this degraded throughput threshold. Additional links or different assumed parameters might also not meet the threshold, and therefore the 3 percent degraded throughput threshold would incentivize coordination or require mitigation. Second, this protection requirement is unilateral, and later-round systems will have an incentive to coordinate to receive some accommodation, or protection from interference, from earlier-round systems. And third, the 10-year sunset period ensures that earlier-round systems and later-round systems will be treated on an equal basis after the sunset, and any compatibility analyses will no longer permit the later-round system to operate in cases where it would exceed the default spectrum-splitting mechanism in § 25.261(c).

In contrast, a criterion of 1 percent or lower has not been demonstrated to allow for competitive new entry by any study. The Commission also finds the technical basis for this criterion to be

flawed. The Commission agrees with Telesat that OneWeb is incorrect in claiming that Note 3 of Recommendation ITU-R S. 2131-1 provides a 10 percent limit on time-weighted average degraded throughput for an FSS link employing adaptive coding and modulation (ACM). In addition, the single-entry interference criterion proposed by OneWeb is based on an isolated scenario that does not represent the broad variation of throughput degradation that can occur due to rain fade. Further, the single-entry throughput degradation values suggested by OneWeb are based on arbitrary assumptions. And the idea conveyed by OneWeb that the allowable degradation from one interference source should simply be computed by considering the degradation allowance from all interference sources and then dividing by the number of interference sources is simply incorrect, because it does not take into account the manner in which ACM is implemented in modern satellite links.

On the other hand, declining to adopt any specific long-term interference protection criterion could invite unnecessary and lengthy debates among later-round operators submitting compatibility analyses and earlier-round operators subject to those analyses with whom a coordination agreement has not yet been reached. Instead, the Commission concludes that establishing a specific long-term interference protection metric, as technically supported on the record, will provide a clear benchmark for new entrants, around which parties may tailor any alternative long-term protections mutually agreed in coordination.

## 2. Short-Term Interference Metric

### i. Relative vs. Absolute Increase in Unavailability

*Further Notice.* In addition to seeking comment on defining a long-term interference metric in the degraded throughput analysis, the *Further Notice* sought comment on setting a short-term interference metric expressed as a change in the earlier-round system's link unavailability time percentage. The Commission invited comment on the appropriate value for this limit, including technical justification.

*Comments.* On the issue of defining a short-term interference metric, commenters differed on whether to use a relative change in link unavailability, an absolute change in link unavailability, or both. Ultimately, commenters on this issue support the use of an absolute metric; no commenter opposes use of an absolute metric or

only supports use of a relative metric. SpaceX, for example, explains that because next-generation satellite systems are designed to be resilient to signal degradation, these systems frequently maintain a high degree of link availability—typically in excess of 99 percent—despite varying environmental effects and interference from other NGSO systems. This equates to a typical baseline unavailability of less than 1 percent, but with such levels of unavailability as the baseline, SpaceX states that very small changes in link performance can trigger “wild swings” in a relative unavailability metric, even if the absolute level of link availability remains close to its baseline value. O3b and Intelsat each propose a formula to determine an absolute allowed increase in unavailability that changes with the baseline availability, reflecting concerns that a single value for increase in unavailability may not adequately protect high availability links. OneWeb supports an absolute increase in unavailability and supports O3b's proposal for a variable absolute increase in unavailability based on the service requirements of the link to cover a wider range of use cases.

*Decision.* The Commission agrees with the general consensus among commenters on this issue. The Commission concludes that the use of an absolute increase in link unavailability as the short-term interference metric provides a more reliable measure of short-term interference that is not as susceptible to significant fluctuations as a relative increase metric would be. The Commission therefore adopts an absolute increase in link unavailability as the sole short-term interference metric required in an inter-round compatibility showing submitted by a later-round grantee. As discussed in greater detail below, the Commission declines to adopt proposals for a formulaic approach for a variable absolute increase in unavailability in establishing a short-term interference metric.

### ii. Value

*Further Notice.* The *Further Notice* also invited specific comment on the appropriate value for the short-term interference metric, with accompanying technical justification.

*Comments.* Commenters are divided on the appropriate value for the short-term protection criterion. OneWeb asserts that if the Commission adopts an absolute change in link unavailability as the short-term metric, the single-entry limit should be “substantially lower than” 0.01 percent to account for uses

which may necessitate higher levels of availability, such as links designed to meet a 99.99 percent unavailability requirement. Viasat claims that a 0.05 percent tolerable packet loss rate from all sources “is the minimum necessary requirement” and states that a smaller value, such as 0.01 percent, would provide a margin to allow for other sources of short-term packet loss. Intelsat initially argued that further study would be required before determining protection criteria values, although now supports an absolute metric based on a sliding-scale formula, similar to O3b's, for the short-term protection criterion. Similarly, Telesat had also initially argued that no single short-term metric is appropriate for all links in all coordinations based on its own study, but now agrees that the SpaceX proposal strikes the right balance in protecting incumbent NGSO systems while supporting the entry of new NGSO systems and supports the 0.4 percent metric.

SpaceX argues that its study of several 2016 processing-round and 2020 processing-round systems using 123 dynamic (Monte Carlo) simulations establishes an “empirical zone of reasonableness” for the values of the absolute change in link availability. The values in the SpaceX study range from 0 to 0.382 percent at a carrier-to-noise (C/N) threshold of 0 dB, and SpaceX states that the upper end of this range is appropriate for both uplink and downlink. SpaceX therefore contends that its study provides empirical support for short-term interference up to approximately 0.4 percent absolute change in link availability at a C/N threshold of 0 dB. SpaceX further argues that its conservative use of a C/N threshold of 0 dB to assess changes in link availability further supports allowing short-term interference up to 0.4 percent absolute change. SpaceX suggests that setting such a value will incentivize a later-round system to try to limit inline events to an earlier-round system toward achieving this level of short-term interference or if it cannot, to coordinate with the earlier-round system to more efficiently use the shared spectrum. Telesat supports the proposed SpaceX approach, noting that it is the only approach that encourages coordination amongst operators by establishing a backstop value to protect incumbent operators while also supporting good faith coordination and promoting competition.

Kuiper supports the proposed SpaceX 0.4 percent absolute increase in unavailability metric as well. Kuiper initially proposed the Commission adopt a 0.1 percent absolute increase in

link unavailability as a threshold for short-term interference, which Kuiper argued would offer sufficient room for new entrants to bring their systems into operation, even in drier climates, while being highly protective to incumbents. Kuiper now urges the Commission to adopt an absolute threshold in the range of 0.1 to 0.4 percent for short-term protection as proposed by Kuiper and SpaceX, respectively, arguing that this would incentivize both new entrants and incumbents to negotiate in good faith while minimizing impacts on vulnerable links and operations in both systems. Kuiper also explains that arguments claiming that a short-term threshold in this range would discourage coordination between incumbents and new entrants ignore the realities of coordination, which occurs when both parties are incentivized to negotiate a more mutually beneficial outcome than an alternative compatibility showing scenario. Kuiper notes that even with interference thresholds tilted in favor of new entrants, rather than with a more balanced approach as proposed by Kuiper and SpaceX, new entrants would retain these incentives and continue to coordinate with incumbents. Regarding incumbents, Kuiper argues that while incumbents have incentives to minimize potential impacts of new entrants, an overly protective short-term threshold, like the O3b proposed formula, would incentivize incumbents to make unreasonable coordination demands and leverage those protections against new competition.

O3b proposes the Commission use a formula, rather than a fixed percentage value, to determine the allowed increase in unavailability of an earlier-round system link. O3b proposes that the permitted increase in unavailability =  $-0.12 * \text{baseline availability} + 12.02$ . O3b argues that its formula appropriately adjusts protection levels to service requirements and reflects a broad range of technical characteristics and protection requirements. OneWeb agrees and argues the SpaceX proposal would eliminate later round systems' incentive to coordinate, unacceptably undermine established operators' service quality, render it impossible for operators to guarantee a defined quality of service to their customers, and subvert the purpose of the processing round framework. OneWeb further asserts that a 0.4 percent absolute increase is "overly-relaxed" and risks undermining U.S. credibility as a stable investment environment and deterring international coordination with U.S. systems. Intelsat supports O3b's

proposed formula approach and proposes the Commission adopt a slightly modified version of the formula, increasing the minimum unavailability degradation value. Intelsat proposes that the permitted increase in unavailability =  $-0.12 * \text{baseline availability} + 12.05$ , modifying the minimum unavailability degradation factor from 12.02 to 12.05 which Intelsat argues allows for flexibility regarding the percent of link unavailability for high availability links. OneWeb also supports adopting O3b's proposed formula, should the Commission decline to issue a further notice and comment. SpaceX and Kuiper oppose this approach, arguing that O3b's formula is overly protective of earlier-round systems and would incentivize those incumbents to leverage strict limitations on later-round systems, thus discouraging market entry and innovation and leading to inefficient spectrum sharing. Telesat also raises concerns, flagging that the O3b formula has not been previously considered by the Commission or "related forums such as the ITU" and involves granular details that are better addressed in coordination between parties than by the Commission.

In the alternative, O3b and OneWeb suggest the Commission seek further comment on an appropriate short-term interference criterion and each of the corresponding proposals through a second further notice of proposed rulemaking. O3b argues that the SpaceX and Kuiper proposals are both untimely and warrant additional inquiry. SpaceX and Kuiper argue that the record is complete with detailed analyses, and demonstrates that parties have moved toward a consensus on values and methodology, and encourage the Commission to move forward with a final order. Telesat agrees, finding that the record is sufficiently complete to allow the Commission to finalize the rules for spectrum sharing and arguing that further delay will not lead to better rules, but rather, foster lingering uncertainty as to the framework in which NGSO operators coordinate their activities. Telesat additionally notes that the record demonstrates that there may never be a perfect formula that optimally addresses all possible NGSO system interactions which all parties agree upon, given the nature of the complex analyses and systems involved in developing specific metrics, and thus the Commission is justified in moving forward with a final order.

*Decision.* After review of the record, the Commission adopts a 0.4 percent absolute increase in link unavailability at a C/N threshold of 0 dB as the short-term interference metric to be used in

inter-round compatibility analyses. For the reasons discussed below, the Commission concludes that this 0.4 percent value, more so than the 0.1 percent value, 0.01 percent or less values, or the formulas proposed by O3b or Intelsat on the record, most closely aligns with the Commission's goals of providing regulatory certainty for and ensuring adequate protection of earlier-round incumbents while offering the best opportunities for later-round new entrants and competition and encouraging coordination.

First, the Commission finds that this criterion will adequately protect earlier-round NGSO FSS systems. Like the long-term interference metric adopted above, this short-term interference metric will limit the increase in link unavailability at any analyzed location. Since the worst-case locations will likely drive operators' determinations of appropriate system parameters and any mitigation measures, the actual increase in unavailability will be less than 0.4 percent in many circumstances. In addition, the use of a C/N threshold of 0 dB to assess changes in link availability is at the upper end of the  $-3$  dB to 0 dB range for C/N thresholds supported on the record for compatibility analyses, and renders the 0.4 percent value more conservative. Because the C/N threshold is intended to reflect the minimum carrier received signal, relative to noise, necessary to maintain a link, real values for the C/N threshold may be closer to  $-2$  dB or  $-3$  dB. At these lower C/N thresholds, the absolute change in link availability is typically lower than at the 0 dB threshold. Thus, using a 0 dB C/N threshold may overestimate the interference from a later-round system to an earlier-round system's link whose actual C/N threshold is lower. The Commission further concludes this value will be sufficiently protective of earlier-round systems because of the decisions below to use simplifying assumptions in the analysis—such as modeling 50 percent or 100 percent deployment of an incumbent system even if it has not yet deployed in those numbers, or using an assumed satellite selection strategy when the actual satellite selection strategy is not provided by the incumbent—that may also tend to overestimate the actual interference caused to an incumbent system by the later round system. These simplifying assumptions in the analysis itself tend to offer incumbents more protection. Therefore, the Commission considers the totality of the analysis when deciding upon the likely real-world interference caused by a later-

round system satisfying the 0.4 percent absolute increase in link unavailability metric at a C/N threshold of 0 dB.

Second, the Commission concludes that adopting a 0.4 percent absolute increase in unavailability metric will simultaneously support competitive new entry because it will accommodate several modeled second-round systems, both uplinks and downlinks, per the 123 dynamic (Monte Carlo) simulations in the SpaceX study, which the Commission notes are a better representation of the dynamic nature of NGSO systems than a static analysis would reflect. Further, the Commission has reviewed the SpaceX study and find that the data, assumptions, and methodology employed are reasonable for purposes of adopting a 0.4 percent short-term interference metric to be used in inter-round compatibility analyses. To be sure, O3b argues that the study is too limited in the operating metrics considered and is accordingly not reflective of real-world parameters. Such individualized parameters will be considered in individual compatibility analyses. In the event that other system combinations, or the use of different assumed parameters, result in exceedances of this short-term limit, this will require mitigation measures to be applied by the later-round operator or coordination with earlier round operators.

Third, the Commission concludes that adopting this short-term protection value will support competitive new entry while continuing to encourage good-faith coordination among both incumbents and new entrants, which offers the best avenue for efficient spectrum sharing among NGSO FSS systems. Unlike the requirement for later-round systems to protect earlier-round systems under the inter-round protection requirement prior to the sunset period, incumbents have no corresponding requirement to protect new entrants during this period, and therefore an overly conservative protection requirement for the benefit of incumbents may discourage incumbents from negotiating more lenient limits for new entrants. On the other hand, permitting new entrants to operate with an overly lenient limit may discourage them from negotiating with incumbents for more restrictive protections for the benefit of incumbents. The short-term interference metric the Commission adopts here strikes the right balance to encourage coordination among earlier and later-round systems. The Commission disagrees with assertions that the 0.4 percent absolute increase will risk investment in U.S. systems by discouraging international systems from

coordinating with U.S. systems. While it is unclear which specific circumstances are in reference, the Commission reminds both incumbents and new operators that coordination with the ITU is separate from coordination within the U.S. and is required of all international systems under the ITU Radio Regulations. The Commission's rules require both parties to engage in good faith coordination. Providing an avenue for meaningful competition by both incumbents and new entrants will encourage both sides to agree upon any more specific, mutual protection measures during coordination.

The Commission is not persuaded by alternative proposals. The Commission disagrees with the proposed 0.01 percent or lower threshold advocated by Viasat. Unlike the 0.4 percent absolute increase in unavailability metric, which the SpaceX Monte Carlo study in the record indicates is achievable for several modeled second-round systems, there is no evidence in the record from proponents of a 0.01 percent or lower threshold showing that it is achievable and provides for competitive new entry. And while a 0.1 percent limit would accommodate most second-round system links analyzed in the SpaceX study, a 0.4 percent limit will provide greater opportunities for new entry while still providing adequate protection of incumbent systems due to the conservative assumptions incorporated into the standard and the calculation of increase in unavailability and at the same time providing incentives for good faith coordination. Stricter limits for particular links can, of course, be agreed in coordination. The SpaceX study indicates 0.4 percent to be the upper limit in the studied cases in both uplink and downlink, and accommodates user terminals and gateway earth stations. Indeed, the Commission notes that Kuiper's initial study, which proposes the 0.1 percent limit, uses the SpaceX study as partial justification for its chosen interference limit and nonetheless acknowledges that "SpaceX's justification for a higher [0.4 percent] threshold has merit." Further, Kuiper has since advocated for the Commission to adopt a threshold within the 0.1 and 0.4 percent range as proposed by Kuiper and SpaceX, respectively, noting that these proposals represent a reasonable range that balances competing interests and incentives.

The Commission also does not agree with O3b and Intelsat that their proposals to create a variable, sliding-scale metric for absolute increase in unavailability would better serve the Commission's goals than the adoption of

a 0.4 percent absolute increase in link unavailability metric at a C/N threshold of 0 dB. As an initial matter, both the O3b and Intelsat formulae appear to be based on the protection of only a narrow set of systems. In addition, the Commission disagrees with O3b's claim that the proposed formula would not impose additional complications on operators compared to an established absolute threshold value. Incorporating a variable, sliding-scale short-term interference metric would be more burdensome for later round systems to implement considering that detailed information of the incumbent system, including the receiver characteristics, would be required in order to calculate the baseline availability required by the sliding-scale formula. Absent cooperation from the operator of the incumbent system, it would be difficult to obtain this information, particularly for new entrants. The Commission does not find the alleged benefits of this approach as compared to a non-variable metric outweigh these burdens. Given the conservative assumptions in the analysis itself, the Commission is also concerned that O3b and Intelsat's more stringent formulae may unnecessarily restrict competitive new entry. O3b and Intelsat's principal objection to the use of a single 0.4 percent absolute value is that it would create a more noticeable impact on customers served by higher availability links than on those served by lower availability links. However, it is precisely a concern about the overprotection of high availability links that has driven the general consensus on the record towards using an absolute metric of increase in unavailability, rather than a relative metric.

Moreover, O3b's assumed baseline availability rates of the incumbent system may be higher on paper than in reality, to the extent O3b excludes from the baseline the effects of other existing sources of interference, such as interference from GSO networks, other NGSO systems, and intra-system noise. Accordingly, the relative impact on high availability links may be overstated. In addition, while O3b argues that a 0.4 percent absolute increase in unavailability metric would "make it impossible for operators to guarantee a defined quality of service to their customers" because of the additive effect of short-term interference from multiple later-round systems, the potential for aggregate interference is not limited to the use of this value and would exist under O3b's formula as well. Further, just as the Commission expects the real-world impact of a later-round system complying with the 0.4

percent increase in unavailability limit to be less than 0.4 percent in many cases, given the conservative assumptions in the analysis noted above, the Commission similarly expects that any cumulative, real-world effects of two or more later-round systems will likely be less than a simple multiplication of the 0.4 percent limit by the number of later-round interferers that O3b assumes because it fails to account for mitigation techniques or other spectrum-sharing measures that may be applied by the NGSO FSS systems and reduce their overall aggregate impact.

While O3b also argues that a 0.4 percent increase in unavailability limit would “eliminate later round systems’ incentive to coordinate” because all links in the SpaceX study can be accommodated under this short-term limit, other links or parameters not included in the SpaceX study, some of which O3b points out, might exceed the 0.4 percent short-term limit. In any event, O3b itself notes that not all links in the SpaceX study meet the 3 percent degraded throughput long-term limit the Commission adopts above. Cases where a later-round system cannot meet either the short-term or long-term limit will encourage the later-round operator to complete coordination with the incumbent operator. Later-round operators will also be incentivized to coordinate in order to potentially receive some protection, or accommodation, from earlier-round operators. Further, the 10-year sunset period the Commission adopted in the *Report and Order* ensures that earlier-round systems and later-round systems will be treated on an equal basis after the sunset period, and any compatibility analyses will no longer permit the later-round system to operate in cases where it would exceed the default spectrum-splitting mechanism in § 25.261(c). Accordingly, later-round system operators will have several incentives to complete coordination with earlier-round operators. Moreover, § 25.261(b) of the Commission’s rules requires NGSO FSS licensees and market access recipients to coordinate in good faith the use of commonly authorized frequencies regardless of their processing round status.

To the extent an incumbent wishes to ensure the highest availability for particular use cases, such as when offering its services to government or enterprise customers, it may discuss such particular uses during coordination with new entrants and new entrants will have several incentives to complete the coordination. The Commission has expressly

recognized that the physical realities of interference in spectrum-based services should guide both system design and reasonable expectations of operation. The likelihood of harmful interference should be assessed under a range of operating conditions. Further, the Commission has encouraged operators, and specifically NGSO FSS operators, to design systems for a shared and dynamic operating environment and plan to manage potential interference in such dynamic environments. Operators providing important communications with 99.5 percent or greater service availability require systems equipped with redundancy to compensate for potential short-term impacts caused by inline events. The Commission has detailed best practices for satellite operator emergency planning and preparedness with specific recommendations to determine system resiliency and redundancy. To the extent operators have concerns about protecting particular types of links operating in the non-federal FSS, such as those they may be offering to government or enterprise customers, such concerns are best addressed in coordination agreements rather than in a non-federal spectrum sharing framework.

In addition, the Commission does not agree with O3b that a 0.4 percent value “subvert[s] the purpose of the processing round framework” because it is higher than the spectrum-splitting trigger, which O3b calculates for its system would be between 0.01 and 0.04 percent absolute increase in unavailability. Although it is possible for a very small number of links of the earlier-round systems in which the  $\Delta T/T$  of 6 percent ( $I/N$  of  $-12.2$  dB) (the trigger for coordination among systems in the same processing round) may be exceeded, such exceedance would be limited in terms of the number of links affected and the length of time. The Commission is not convinced that such short-term impact would be significant on the earlier round systems. The short-term protection criteria the Commission adopts here is a unilateral protection of earlier-round systems by later-round systems and does not require any reduction in spectrum usage or other operational changes by the earlier-round system. In contrast, exceeding the more sensitive trigger for spectrum-splitting in § 25.261(c) for systems approved in the same processing round creates a mutual obligation for both systems to split their commonly authorized frequencies for the duration of the potential interference event. Nevertheless, for links of an earlier-

round system in which the  $\Delta T/T$  is 6 percent or greater, later-round systems are required to coordinate with the earlier-round systems of these links prior to commencing operation.

The Commission is further not persuaded by calls to seek comment on the short-term interference metric through a second further notice of proposed rulemaking. The *Further Notice* sought comment on setting a short-term interference metric. In response to the *Further Notice*, interested parties have had ample opportunity to comment on all proposals, as illustrated by their record submissions. Adopting a specific limit for increase in unavailability, rather than adopting no limit or deferring the issue to a later time as some commenters advocate, will result in a more complete set of required interference metrics applicable to an inter-round compatibility analysis and therefore will provide greater regulatory certainty to earlier-round operators and later-round operators. Conversely, not adopting any specific acceptable short-term interference threshold or deferring the issue to a later time would deprive new entrants of the certainty that they can provide some level of service without the agreement of an earlier-round operator. The SpaceX study indicates 0.4 percent to be the upper limit in the studied cases in both uplink and downlink, and accommodates user terminals and gateway earth stations. Stricter limits for particular links can, of course, be agreed in coordination.

Therefore, the Commission concludes an absolute increase in unavailability value of 0.4 percent at a C/N threshold of 0 dB will appropriately balance the Commission’s goals of providing regulatory certainty for, and adequate protection of, incumbent systems while at the same time ensuring competitive new entry and encouraging coordination among NGSO FSS operators.

### 3. Minimum Link Availability

*Further Notice and Comments.* In conjunction with the Commission’s consideration of long-term and short-term interference criteria, SpaceX, on the basis of its study of several 2016 processing-round and 2020 processing-round systems, proposes that the Commission adopt a 99.0 percent link availability without the interferer at a C/N threshold of 0 dB as a minimum benchmark for an earlier-round system to show it merits the backstop levels of short-term and long-term interference protection from a later-round system that the Commission is considering. SpaceX states this minimum benchmark indicates a well-designed, efficient



earlier-round NGSO system with a robust signal-to-noise ratio and that all first-round links studied by SpaceX achieved this minimum benchmark, except one link at 98.7 percent. Requiring a minimum 99.0 percent link availability, SpaceX argues, would prevent an incumbent whose publicly-available information shows its link achieves a 99.9 percent link availability at a C/N threshold of 0 dB, for example, from claiming that it can actually achieve only a 90 percent link availability at that threshold. Such a claim would tend to exaggerate the extent to which the earlier round system is susceptible to interference from every second-round system. SpaceX also contends that a rule requiring a first-round system to show a 99.0 percent link availability without the interferer at a C/N threshold of 0 dB incentivizes efficient spectrum sharing through coordination, since “a first-round system that cannot achieve this minimum benchmark level of performance on a given link—indicating its inefficient use of spectrum—would have to coordinate with the second-round system to determine a more efficient spectrum sharing arrangement.” O3b, in proposing its increase in unavailability threshold formula, supports protection of links with baseline availabilities as low as 97 percent, and argues the SpaceX proposal would unfairly provide no protection for links with lower baseline availability levels that meet the needs of customers with a higher interference tolerance.

*Decision.* The Commission agrees with SpaceX that an inefficient incumbent system design should not unreasonably hamper future entry. Further, the Commission has reviewed the SpaceX study and finds that the data, assumptions, and methodology employed are reasonable and note that, although O3b has commented that the study could be expanded upon using different system parameters, no commenter objects to the data, assumptions, or methodology SpaceX used. While O3b’s formula shows protection of links with baseline availabilities as low as 97 percent, its formula inherently recognizes that lower performing links should receive less protection and does not specifically justify or technically support requiring protection of links below 99.0 percent availability. Rather, the Commission concurs with SpaceX that a 99.0 percent link availability without the interferer at a C/N threshold of 0 dB is a reasonable minimum benchmark to guard against the risk of low-performing incumbent links. The Commission therefore will

require this benchmark as a minimum value to be incorporated into an inter-round compatibility showing to demonstrate compliance with the long-term and short-term interference metrics adopted above.

#### 4. Additional Interference Metrics

##### i. Loss of Synchronization

*Further Notice.* The *Further Notice* also asked whether additional means are needed to protect earlier-round systems against loss of synchronization due to potentially high levels of short-term interference.

*Comments.* Most commenters on this issue oppose including additional criteria to protect against loss of synchronization. Telesat argues that doing so is unnecessary because in modern satellite systems the concept of link unavailability also protects against the loss of synchronization as long as an appropriate C/N objective is chosen. Kuiper states that including such a protection criteria would undermine incentives for a resilient design of modems and receivers and result in a less efficient spectrum sharing framework. Kuiper additionally maintains that any issues an incumbent may have regarding synchronization loss is best addressed in good-faith coordination with new entrants. Commenters also note that information on the particular modems used by incumbents, which is required to determine a protection criteria necessary to prevent loss of synchronization for a particular system, is not typically disclosed in domestic or international filings. Kuiper suggests the appropriate way to address particularized interference concerns of a given incumbent is not through systematic changes to the methodology but instead through operator-to-operator coordination.

Two commenters support requiring later-round operators to specifically protect against an incumbent’s loss of synchronization, arguing that consideration of loss of synchronization does not render analyses overly complex, and that when information has been shared pursuant to good-faith coordination, the consideration of these additional metrics is straightforward and can ensure protection of a variety of NGSO system designs and service characteristics. OneWeb also argues the Commission should account for short-term degraded throughput events where an operator may experience high levels of degradation causing a modem to lose synchronization or suffer other critical errors. OneWeb argues that loss of synchronization should be a required

metric in any compatibility showing to ensure that operators have a complete picture of the interference environment if operators cannot achieve a coordination agreement.

*Decision.* The Commission declines to mandate new entrants protect incumbent systems against loss of synchronization, or incorporate a short-term degraded throughput metric, beyond the protections afforded by the long-term and short-term interference protection criteria the Commission adopts above. The Commission agrees with commenters who argue that doing so would risk incentivizing inefficient system designs, including the choices of modems and receivers that are not capable of quickly re-establishing synchronization in a shared spectrum environment. The Commission also agrees with Telesat that doing so is unnecessary because a limit on the increase in link unavailability also protects against the loss of synchronization. In addition, requiring new entrants to meet such protection criteria that are defined solely by incumbents, to address particular interference sensitivities of incumbent systems, outside of protections mutually agreed in coordination, would create uncertainty for new entrants and could unduly restrain new entry and competition.

##### ii. Carrier-to-Noise Objectives

*Further Notice.* The *Further Notice* sought specific comment on whether an earlier-round operator should be able to specify two C/N objectives—one relative to the C/N level below which the victim modem would lose signal lock with the satellite and another relative to the C/N level below which the victim link would become unavailable because it is not able to offer the minimum wanted throughput.

*Comments.* Several commenters on this issue support the Commission adopting a single minimum C/N objective relative to link unavailability, rather than include multiple C/N objectives such as one below which the victim modem would lose lock. SpaceX proposes the Commission adopt a reference C/N threshold between  $-3$  dB and 0 dB, because this range accounts for both real modem performance and the modulation and coding rates of broadband satellite waveforms within a reasonable margin. O3b suggests the Commission specify 0 dB as the standard C/N level to account for the threshold performance that efficient modems should be capable of achieving. Noting that the commonly used adaptive coding and modulation (ACM) standard DVB-S2X can demodulate



signals with C/N levels as low as  $-3$  dB, Intelsat recommends the required minimum C/N value should align with ACM standards and should accurately reflect the earlier NGSO system's requirements.

Several commenters also oppose allowing an incumbent to specify an additional C/N level below which its modem would lose lock, because doing so could invite gamesmanship, or otherwise require information on all of the potential modems and receivers used by the incumbent system, details of which are not typically available through publicly available filings. Kuiper argues that accounting for this factor in interference analyses could undermine incentives for a resilient design of modems and receivers, whereas rejecting proposals to account for link loss will require operators that choose designs ill-suited for a shared-spectrum environment to "internalize the costs of their decisions."

O3b, however, argues the Commission should allow an earlier-round operator to justify a system-specific alternative minimum C/N threshold by identifying, subject to reasonable explanation and support, the required C/N level needed to maintain link usability. O3b argues these C/N values would typically be incorporated into coordination discussions, so later-round systems should be aware of the earlier-authorized operators' protection requirements.

*Decision.* The Commission agrees with the general consensus on the record that reference C/N threshold values of between  $-3$  dB and 0 dB are appropriate to account for the performance of efficient, modern modems and receivers. The Commission will adopt a C/N value of 0 dB that must be used in a compatibility showing with an earlier-round system as proposed by O3b and within the ranges supported by SpaceX and Intelsat as it reflects a reasonable, upper-limit for modern NGSO systems. The Commission also concludes that allowing an incumbent to specify an additional C/N level below which the victim modem would lose lock, if it is more sensitive than this range, could reward inefficient system designs at the expense of more competitive new entry. The Commission therefore declines O3b's proposal to require later-round grantees to demonstrate they will meet any alternative incumbent-specified C/N level needed to maintain lock. Nonetheless, operators in coordination will be free to discuss and agree upon the use of other C/N levels when concluding a coordination agreement that leaves both parties better off than

would operating under any submitted compatibility showing.

### iii. Aggregate Interference

*Further Notice.* The *Further Notice* also noted concerns about aggregate interference from multiple NGSO systems. The Commission invited comment on whether to set a limit on permissible aggregate interference from later-round systems into earlier-round systems. The Commission also asked whether the Commission should expect that there will be a maximum number of NGSO FSS systems that can be accommodated in a given frequency band and if so, how that should affect any inter-round protection criteria and the opening of additional processing rounds. Finally, the Commission inquired as to how the degraded throughput methodology should accommodate multiple NGSO systems that span multiple processing rounds.

*Comments.* Most commenters on the issue of aggregate interference limits oppose them as unworkable and unnecessary. Commenters argue that setting aggregate interference limits is unnecessary for several reasons. As an initial matter, Mangata argues that the primary concern with respect to interference between NGSO systems is the occurrence of inline interference events, and the probability of an inline event involving multiple NGSO systems, with all the varying constellation designs and the resulting look angles, is very low. As such, Mangata contends that per-system limits established in this proceeding will be sufficient to mitigate any such concerns. Second, commenters argue that both advances in technology and the use of increasingly higher-frequency bands should make it possible for more operators to coexist within a band than is otherwise possible today. Third, commenters argue that required coordination or spectrum-splitting among later-round operators should further reduce the expected aggregate interference.

Commenters also argue there is no demonstrated need on the record to adopt aggregate interference threshold for now. Kuiper notes that, given the long deployment timelines of NGSO FSS systems, such aggregate interference would not manifest for years—giving the Commission ample time to address this issue should it actually arise. Some commenters therefore recommend the Commission defer consideration of aggregate interference levels for protecting earlier round systems until there is more real-world data that can be evaluated to determine the effect of aggregate

interference on individual system operations.

Commenters further state that numerous implementation questions remain unsettled which would also make it difficult to enforce aggregate interference criteria, and this uncertainty raises the question of whether and how the Commission would administer an aggregate framework for NGSO sharing when the number of potential systems is perpetually in flux. Indeed, commenters state there is currently no known basis for any later-round applicant even to measure aggregate interference that might result from the combined operations of multiple systems.

Commenters also dispute that establishing aggregate interference limits is a prerequisite to establishing per-system limits, and further dispute that per-system limits should be derived by simply dividing the aggregate limit among the number of later-round systems, because doing so assumes that each system contributes equally to aggregate interference. They argue such an assumption "defies reality" and "would significantly overstate actual interference" because "cumulative interference could only result where multiple satellites communicate with earth stations at the same location, with the same frequency, and at the same time." Commenters further note that some authorized systems may not deploy.

Commenters also raise concerns with adopting an aggregate interference limit in the context of the Commission's licensing regime for NGSO FSS systems. SpaceX argues the Commission cannot adopt an aggregate interference cap under its current processing round framework because the number of NGSO systems that will deploy in a given processing round and spectrum band is uncertain and highly variable. Kuiper contends that, given the Commission has adopted a framework designed to promote coordination and efficient coexistence, it would be irrational to adopt an aggregate limit on the assumption that parties neither coordinate nor take measures to efficiently share spectrum. Kuiper also suggests that the same arguments raised in favor of an aggregate cap on interference could be made to cap the number of applicants in a single processing round, where more applicants in a processing round can mean reduced spectrum access for any given licensee required to share spectrum on equal terms with contemporaneously licensed systems. Intelsat warns that adopting an aggregate interference cap would be an

end-run around the purposes of the sunset framework the Commission just adopted, which are to promote competition and to encourage NGSO operators to innovate and use spectrum more efficiently.

Importantly, SpaceX warns that “an aggregate cap on interference would involve arbitrary line-drawing that risks stifling new NGSO system entry,” and numerous other commenters make similar statements. Instead, these commenters argue that NGSO systems can account for the total interference environment within their private negotiations, and that the Commission has determined in other contexts that operators themselves could account for aggregate interference concerns as a part of good-faith coordination.

A minority of commenters do express support for the adoption of aggregate interference limits. OneWeb argues the establishment of aggregate limits on interference into NGSO FSS systems is a prerequisite to establishing per-system limits, and that failing to adopt aggregate limits could result in more systems being authorized than can reasonably be accommodated. OneWeb suggests the Commission could accept operators in an initial processing round “up to” the established aggregate limit and, once those systems deploy, or fail to do so, the Commission could determine the number of additional systems that can be supported in later processing rounds. Considering degradation due to rain fade and other sources of interference, OneWeb argues that an aggregate limit of 2.5 to 3.85 percent time-weighted average degraded throughput should be given to all NGSO FSS systems.

Viasat suggests the Commission develop aggregate interference limits by defining the total amount of interference that any individual NGSO system should be expected to tolerate, then allocating this amount between different NGSO FSS systems and processing rounds, while ensuring adequate opportunities for additional market entry. Viasat argues an acceptable aggregate interference limit, including all interference sources (NGSO, GSO, and terrestrial), would be less than 0.05 percent. ViaSat notes that aggregate interference limits on NGSO FSS systems have been adopted to protect GSO networks, though there remains no mechanism for allocating the overall interference budget between different NGSO operators.

ITIF suggests the Commission could apply an aggregate limit to later-round systems, which would be divided equally among the later-round systems that actually deploy. TechFreedom also

argues the Commission should consider how many NGSO systems a given frequency band support, but states it is premature to do so based on the current record.

*Decision.* The Commission declines to adopt limits on aggregate interference into an NGSO FSS system. First, there has been no demonstration of a need for such limits at this time. No second-round system is required to deploy its full constellation until 2029 at the earliest. Indeed, some proposed systems may never deploy their authorized number of satellites, or deploy any satellites at all. Even if the Commission felt it appropriate to adopt aggregate interference limits from later-round systems at this time, the Commission agrees with Kuiper, among others, that unresolved questions remain as to the derivation of any aggregate limits. The Commission also disagrees with OneWeb that a simplistic, worst-case assumption of multiplying the single-entry limit by six operational NGSO FSS systems reflects a realistic assessment of the interference environment because it fails to account for mitigation techniques or other spectrum-sharing measures that may be applied by the NGSO FSS systems and reduce their overall aggregate impact. Nor does the Commission agree with OneWeb that the Commission should adopt aggregate interference limits to prevent “more operators being granted authorizations to operate in a given band than can reasonably be accommodated.” The Commission’s experience has shown that not all authorized systems deploy their fully planned constellations, if they deploy at all. The recent generation of NGSO FSS systems has shown to be iterative in nature, with companies filing for systems in the first and second processing rounds, and using techniques like adaptive coding and modulation to adapt to changing spectrum environments. Blocking new entry while the Commission waits to see which NGSO FSS systems will deploy, out of a fear of future aggregate interference that may never arise, would artificially and unreasonably inhibit competition to the benefit of some incumbents but contrary to the public interest. Should a demonstrated need arise in the future, the Commission may revisit the question of aggregate limits. And, of course, operators are free to discuss and agree upon ways to account for any aggregate interference effects during their good-faith coordination discussions.

5. Other Sources of Interference in Baseline

*Further Notice.* The *Further Notice* invited specific comment on how to determine the appropriate baseline for the earlier-round system, and whether it should include existing sources of interference, such as interference from GSO networks or intra-system interference. The Commission also inquired whether a degraded throughput methodology should compare an incumbent’s baseline level of performance given only natural degradation to that same incumbent’s expected performance given only a single new entrant’s operations, or whether the comparison should include the operations of multiple new entrants.

i. GSO Interference

*Comments.* Most commenters on this issue oppose including GSO interference in the baseline calculation. Commenters argue that including additional degradations in the baseline from interference due to GSO networks could overly complicate the analysis because there is no standardized model for such interference and no clear way to impute such interference across all systems given the different approaches NGSO systems employ to address GSO interference. Commenters also note that the Commission has set aside certain portions of the Ka-band in which GSO networks must protect NGSO systems, and argue that “[e]xisting NGSO operators should not be penalized for being subject to interference from secondary GSO networks.”

Intelsat, however, supports including GSO interference in the baseline calculation. Intelsat argues that failing to account for all noise sources that contribute to the overall noise an NGSO system experiences will ultimately lead to the overprotection of earlier-round systems and, as a result, artificially reduce competition among NGSO satellite services. Intelsat argues the specific level of existing noise to be accounted for in each frequency range should be as accurate as possible and based on services deployed in that frequency range, which will vary depending both on the Commission’s rules that apply in the bands and on the intensity with which the bands are used. While conceding that GSO noise still needs to be modeled and developed to ensure that it is accurately represented, Intelsat argues there are likely baseline metrics that can be used in all or most scenarios to simulate GSO interference for which NGSO operators must account. Intelsat suggests the Commission need not define the metric

for inter-system interference from existing GSO systems because the party conducting the analysis can determine whether to include this element and provide any necessary justification for that choice.

*Decision.* The Commission declines to incorporate GSO interference into the baseline. The Commission acknowledges that omitting existing sources of interference in the baseline, such as GSO interference, will tend to underestimate the interference experienced by an incumbent. However, the Commission disagrees with Intelsat that parties should be able to create and use their own metric for GSO interference affecting the incumbent's baseline in order to ease their burden of demonstrating compliance with the required interference limits. The Commission is concerned that Intelsat's proposal, in the absence of an agreed model or clear way to impute such interference across all NGSO FSS systems, and the need to carefully consider GSO deployments and regulatory frameworks in different frequency bands, would create unnecessary disputes that would be time-consuming for Commission staff to assess and strain the Commission's limited resources. Accordingly, the Commission concludes that any alleged benefit of incorporating GSO interference into the baseline does not outweigh the burdens on parties and Commission staff in determining the appropriate way to incorporate such interference at this time. Parties are free to explore such interference effects during the detailed information sharing and discussions that accompany good-faith coordination among NGSO FSS operators, and which, the Commission finds, ultimately lead to the most efficient use of spectrum by the concerned operators.

#### ii. Intra-System Interference

*Comments.* Most commenters on this issue also oppose including intra-system interference in the baseline. These commenters state that satellite operators do not routinely disclose how they mitigate intra-system interference because such mitigation techniques have little to no impact on the operations of other constellations, may be competitively sensitive, and change with user needs. Kuiper argues that requiring consideration of intra-system interference would either leave new entrants to guess how each incumbent addresses intra-system interference, inviting inaccuracy and dispute, or necessitate an unnecessary and potentially intrusive mandate to share such information. Kuiper suggests that

an administrable degraded throughput methodology is likely to omit several existing noise sources, such as intra-system interference and interference from other NGSO FSS operators, given the practical difficulties of faithfully incorporating such factors into the analysis.

Intelsat, however, again argues that the earlier-round system's performance baseline should consider all realistic sources of noise degradation, including intra-system degradations. Intelsat contends that intra-system interference and non-time-varying sources could be standardized to a single value, and notes that ITU Resolution 770 uses 1 dB of margin to account for these cases. Intelsat asserts that intra-system noise is a critical factor that should be included in compatibility analyses and argues there is no technical reason not to account for intra-system noise as a realistic assumption that would improve sharing among NGSOs.

*Decision.* The Commission declines to incorporate intra-system interference into the baseline. Given that information on intra-system interference changes with user needs, the Commission is concerned that incorporating such interference into the baseline would create additional disputes between parties, and burdens on the Commission's limited staff resources in resolving those disputes, in the absence of a clear way to incorporate such interference into the baseline. Further, the record is not sufficiently developed to determine whether the 1 dB margin used to account for intra-system interference and non-time-varying sources with respect to interference into GSO networks in V-band under ITU Resolution 770 would be appropriate to systems in other frequency bands. Accordingly, the Commission concludes that any alleged benefit of incorporating intra-system interference into the baseline does not outweigh the burdens on parties and Commission staff in determining the appropriate way to incorporate such interference at this time. Parties in coordination are free to explore such interference effects during their detailed information sharing and discussions.

#### iii. Interference From Other NGSO FSS Systems

*Comments.* The only specific comments on this issue supported comparing an incumbent's baseline against its expected performance given the operations of a single (rather than multiple) new entrant. In particular, Kuiper argues that, while accounting for the noise environment an incumbent faces because of other incumbent NGSO

FSS operators may make the analysis more accurate, the burden of increased complexity outweighs any benefit of this accuracy. Rather, Kuiper argues the Commission should follow the path taken by satellite operators in coordination—to model only the incumbent and new entrant's systems. Kuiper states that instead of ignoring interference from other NGSO FSS systems, the Commission can account for it when establishing an interference threshold and recognize that excluding this interference makes any threshold that it adopts more conservative and protective than it appears.

*Decision.* The Commission declines to require compatibility analyses to include effects of multiple NGSO FSS systems in the baseline interference of the incumbent system because doing so could create uncertainty and disputes, with accompanying strain on the Commission's limited staff resources to assess those disputes, as to which additional NGSO FSS systems should be considered in a given analysis and how their effects should be incorporated in the analysis. Accordingly, the Commission concludes that any alleged benefit of incorporating interference from multiple NGSO FSS systems into the baseline does not outweigh the burdens on parties and Commission staff in determining the appropriate way to incorporate such interference at this time. Although including this interference is not common in operator's own coordination discussions, parties in coordination are free to explore such interference effects during their detailed information sharing and discussions.

#### 6. Rain Attenuation

*Further Notice.* The Commission also asked how rain fade conditions in different locations should be incorporated into the degraded throughput analysis, how many locations should be evaluated, and whether any locations should include sites outside the United States.

*Comments.* Most commenters on this issue support using three geographically diverse locations within the United States for application of a rain attenuation standard, one for each of low, medium and high rain rates. These commenters assert that using three data points will provide sufficient scope for an interference assessment, while at the same time not demanding an analysis that could become unwieldy with an excessive number of data points. SpaceX contends that these locations should reflect the actual deployments of earlier-round systems and, where possible, rely on locations that operators

jointly establish in good-faith coordination.

Intelsat argues that four to five sites located within the United States in representative geographic areas with different rain rates “should suffice.” O3b proposes that the Commission require parties to employ at least four different latitudes between 10 degrees and 70 degrees North Latitude as test points in the analysis and consider a range of rain conditions at each latitude.

Additionally, several commenters recommend that the Commission require operators to use a common rain-attenuation model that references attenuation characteristics from the latest versions of Recommendations ITU-R P.618 and P.676.

SpaceX also argues that the Commission should standardize the rain fade conditions that represent the low, medium, and high rain attenuation conditions for NGSO system deployments, and proposes to define low rain areas as having  $\leq 30$  mm/hr, moderate rain areas as having 40–50 mm/hr, and high rain areas as having  $\geq 80$  mm/hr. O3b similarly suggests rain rates for 0.01 percent of an average year that vary between dry (20–30 millimeters/hour) to wet (up to 80 millimeters/hour).

Finally, Intelsat argues that, to account for other link losses, the Commission should either calculate the non-precipitation impairment values using the methodology specified in Recommendation ITU-R P.618 or use a standardized approach to these additional degradations.

*Decision.* The Commission declines to mandate specific rain fade assumptions to be used in an inter-round compatibility analysis. Rather, the Commission will assess rain fade assumptions on a case-by-case basis as to whether they are reliable and representative. While the Commission concludes based upon review of the record that inter-round compatibility analyses with three geographically diverse locations at various latitudes within the United States may be sufficient in many cases for application of a rain attenuation standard (one for each of low, medium and high rain rates), the Commission will assess rain fade assumptions, including the number of locations, on a case-by-case basis to determine whether they are reliable and representative.

The Commission agrees with the majority of commenters on this issue that three locations would typically provide sufficient scope for the analysis without overburdening it because three locations will allow for the selection of sites with each of low, medium, and

high rain rates. But regardless of the number of locations assumed (whether three or more or less than three), the operator submitting an inter-round compatibility analysis must demonstrate that the number of locations assumed is reliable and representative given the assumed operations of the earlier-round system. For example, if an earlier-round system operated only in a geographically limited area, such as at high latitudes, then a later-round operator might reasonably use location and rain fade assumptions that reflect the actual service area of the earlier-round system even if less than three locations. Similarly, to ensure the most accurate modeling, these locations can reflect the actual coverage of earlier-round systems and, where possible, rely on locations that operators jointly establish in good-faith coordination discussions.

The Commission will also assess the rain attenuation model used in an inter-round compatibility analysis on a case-by-case basis as to whether it is reliable and representative. As an illustrative example, a party preparing an inter-round protection showing may model rain attenuation as per the current versions of ITU-R Recommendations P.618–14 and P.676–13, as recommended by commenters, and specify the rain fade conditions that represent the low, medium, and high rain attenuation conditions for NGSO system deployments, with rain rates for 0.01 percent of an average year in low rain areas as  $\leq 30$  mm/hr, in moderate rain areas as 40–50 mm/hr, and in high rain areas as  $\geq 80$  mm/hr. The Commission will assess such rain fade assumptions on a case-by-case basis as to whether they are reliable and representative. Finally, as an illustrative example, a party might use Recommendation ITU-R P.618 to account for other link losses and will assess its appropriateness on a case-by-case basis, considering how these other link losses are treated in coordination and similar contexts and their particular applicability to the cases studied.

#### 7. Standardized Parameters

*Further Notice.* The *Further Notice* inquired as to whether the Commission should use standardized antenna patterns and noise temperatures for the computation of  $C/(I+N)$  in a degraded throughput method.

*Comments.* Commenters supporting standardized parameters argue that the Commission should allow later-round applicants to use certain default system parameters for earlier-round applicants that reflect a baseline of accepted system performance, below which the

earlier-round applicant should not be entitled to protection.

SpaceX argues that establishing default parameter values will ensure that compatibility showings uniformly implement the best practices of efficient NGSO systems when the parties and the Commission lack access to operational information. SpaceX also argues that default parameter values will give notice to operators that any sharing framework will not accommodate filings or system designs that are based on inefficiencies intended to block competition.

Intelsat also argues the Commission should also adopt or clarify the nominal or standard earth station parameters that should be used where the information is not provided in the operator's authorization and not already provided for in the Commission's rules.

Commenters propose specific operational assumptions the Commission could standardize, including: assuming earth stations from the victim and the interfering systems are collocated for both uplink and downlink cases; considering satellite beams of the selected satellites as pointing toward the earth station location in both uplink and downlink cases; for uplink cases, considering only one interferer location at each time step; and implementing one-second time step durations in the analysis.

Intelsat further proposes that, absent information on an incumbent's tracking strategy, later-round grantees should default to using random selection as the tracking strategy to determine the available satellites that meet other operational parameters such as minimum elevation angle, GSO exclusion angle, and Nco (the maximum number of beams which can be illuminated simultaneously in the polarization considered).

SpaceX recommends reference parameters for downlinks and uplinks that operators should use when operational information is missing or incomplete. As standardized downlink parameters, SpaceX proposes an earth station receive noise temperature of 200K and satellite antenna patterns contained in Recommendation ITU-R S.1528. As standardized uplink parameters, SpaceX proposes a satellite receive noise temperature of 500K, earth station antenna diameters of 2.4m (gateway) and 1.0m (user terminal), and earth station antenna patterns contained in the ITU Radio Regulations Appendix 8, Annex 3.

Intelsat also suggests the Commission should standardize the method and waveform used for the conversion from C/N values to spectral efficiency, and

suggests using the method defined in Section 2.3 of the Annex of Recommendation ITU-R S.2131-1, which considers a DVB-S2X waveform and is widely used in the satellite industry.

OneWeb, however, opposes making use of standardized parameters, arguing that the parameters for NGSO FSS systems vary widely and default NGSO system or earth station parameters are unlikely to effectively protect incumbent operators. In particular, OneWeb disagrees with considering only collocated earth stations. OneWeb asserts that this is an oversimplification and that aggregate interference of multiple stations within the same interfering system also needs to be addressed. Additionally, OneWeb opposes a standardized practice of considering only one interferer location at each time step, claiming that the interference potential could be underestimated if multiple earth stations are not accounted for and that earth station deployment models can be addressed in detailed coordination.

*Decision.* The Commission declines to mandate specific parameters and assumptions to be used in an inter-round compatibility analysis. Rather, the Commission will assess these parameters and assumptions on a case-by-case basis as to whether they are reliable and representative. To facilitate the work of new entrants in preparing the showings and Commission staff and incumbents in reviewing them, the Commission lists below illustrative examples of parameters and assumptions that operators might consider using in any necessary compatibility showings:

(1) assume earth stations from the victim and the interfering systems are collocated for both uplink and downlink cases;

(2) consider satellite beams of the selected satellites as pointing toward the earth station location in both uplink and downlink cases;

(3) for uplink cases, consider only one interferer location at each time step;

(4) implement one-second time step durations in the analysis;

(5) use of the method and waveform for the conversion from C/N values to spectral efficiency method defined in Section 2.3 of the Annex of Recommendation ITU-R S.2131-1;

(6) assume earth station antenna diameters of 2.4m (gateway) and 1.0m (user terminal);

(7) use the earth station antenna patterns contained in the ITU Radio Regulations Appendix 8, Annex 3;

(8) assume an earth station receive noise temperature of 200K;

(9) use the satellite antenna patterns contained in Recommendation ITU-R S.1528;

(10) assume a satellite receive noise temperature of 500K; and

(11) assume random selection as the tracking strategy to determine the available satellites that meet other operational parameters such as minimum elevation angle, GSO exclusion angle, and Nco.

The Commission concludes that providing these illustrative examples of parameters and methodological approaches could make the preparation and review of compatibility analyses less burdensome and could avert unnecessary disputes among operators. The Commission emphasizes, however, that the Commission will assess these parameters and assumptions on a case-by-case basis as to whether they are reliable and representative, including by considering any alternative publicly available information or information that the incumbent provides during operator-to-operator coordination and any justifications raised by the parties. For example, the Commission will assess on a case-by-case basis whether it is appropriate for parties to assume that earth stations are collocated and to consider only one interferer location at each time step, including as it may be necessary due to the absence of detailed earth station deployment models and satellite receiving beams layout. The Commission believes that a case-by-case approach, in combination with the list of illustrative example parameters above taken from the record, will provide parties appropriate flexibility in tailoring their analyses while facilitating the preparation of these analyses by new entrants.

#### 8. Use of Information Gained Through Coordination

*Further Notice.* The *Further Notice* sought comment on what other technical data is needed to appropriately evaluate degraded throughput effects, and how the Commission can ensure that any degraded throughput analysis appropriately protects the specific characteristics of an NGSO system's operations, including what role Schedule S information should play in the analysis.

*Comments.* Commenters agree that as part of the good faith coordination among NGSO FSS operators required by the Commission, operators share technical and operational information about their systems, which is a better reflection of their actual or planned operations than can be drawn solely from information in the public record.

Commenters therefore support the Commission allowing later-round operators to use operational information gained during coordination to enhance the accuracy of their compatibility showings with an earlier-round system, and to submit such showings to the Commission on a confidential basis, allowing the earlier-round operator to review the showing to ensure the information exchanged in good-faith coordination is properly represented and analyzed while preventing competing operators from viewing potentially commercially sensitive operational data.

Commenters disagree, however, on whether later-round operators should be required to use more realistic operational information gained during coordination in their compatibility showings whenever possible, or whether later-round operators should have the choice of using either public or private data on the earlier-round system. Both sides raise the prospect of gamesmanship—if there is a requirement to use private data, the earlier-round operator could selectively provide system details that make it appear more sensitive to interference while omitting details that could facilitate sharing; while if there is the option, but no requirement, a later-round could choose any combination of public or private information to ease its compatibility showing, even public information that, commenters agree, may not reflect actual operations. Kuiper argues that, if later-round systems are given the option of using public or private information, the earlier-round operator will still have the opportunity to review the showing and comment on the appropriateness of the parameters used. SpaceX also notes that later-round operators may need to disclose confidential parameters in any compatibility studies before the Commission to show compliance with backstop interference values, supporting the disclosure of parameters as needed to maximize efficient spectrum sharing.

*Decision.* The Commission agrees with commenters that the use of operational information shared during coordination should enhance the accuracy of compatibility showings, and will allow later-round operators to base their analyses on such information to the extent it is available and permitted by the incumbent operator to be reflected in a compatibility analysis submitted to the Commission. Analyses based on operational information shared during coordination may be submitted on a confidential basis when satisfying the requirements of the Commission's confidentiality rules (assuming the

incumbent operator has permitted this information to be reflected in a compatibility analysis). However, the Commission agrees with Kuiper that later-round operators should have the flexibility to use publicly available parameters of the earlier-round system, even if alternative parameters are provided in coordination, and to justify that decision when submitting a compatibility analysis. The Commission will assess the use of publicly available information in these instances on a case-by-case basis to determine if the analysis is adequately representative of the earlier-round system, considering as well any arguments that the later-round operator has selectively used publicly available information to its advantage to ease its protection showing. In addition, because the incumbent's privately shared operational data may be used in a compatibility analysis submitted to the Commission only if it consents to such use, the Commission does not believe that allowing use of such data will disincentivize information sharing during coordination, especially where the incumbent's consent may be contingent upon sharing the information on a confidential basis.

#### 9. Incorporation of Deployment Milestones Into Compatibility Analyses

*Comments.* Several commenters note that when the operator of a later-round NGSO FSS system is preparing a compatibility showing for an earlier-round system, the earlier-round system may not yet be fully deployed and, indeed, may never fully deploy or deploy at all. Commenters argue that later-round operators should be given the flexibility to provide compatibility analyses based either on the number of satellites at the 50 or 100 percent deployment milestones of the earlier-round system, whichever has yet to be achieved, or on the "number of satellites actually deployed" and operating. Commenters suggest that later-round operators should not be held to the parameters of such showings before the actual deployment of the earlier-round system, and that later-round operators should be able to update their showings to account for later deployments, if not accounted for in the initial analysis.

SpaceX, for example, argues that accounting for milestone requirements in compatibility analyses would better reflect the operational realities of NGSO systems and better calibrate the need for regulatory certainty with opportunities for new entry. SpaceX also argues that accounting for deployment milestones in compatibility showings better accommodates the interference risk to earlier-round systems as they grow and

change, given that NGSO operators frequently file modifications as they build out systems that differ from those initially authorized. SpaceX further asserts that by emphasizing the deployment milestone requirements, the Commission can encourage earlier-round systems to share higher-fidelity information about their near-term deployment plans for new satellite launches to ensure protection for those satellites.

*Decision.* The Commission agrees that later-round NGSO FSS operators should not be restrained by a requirement to protect not yet deployed earlier-round systems. At the same time, the Commission is cautious about permitting compatibility analyses considering solely the number of deployed satellites at a given time, which may need to be updated with each subsequent launch of an earlier-round system and consume unnecessary resources for the earlier-round operator, and Commission staff to review.

Therefore, the Commission will permit compatibility analyses to consider only the deployment configuration of the earlier-round system at the six-year, 50 percent milestone if this milestone has not yet been met. If the 50 percent deployment milestone has been met, compatibility analyses must consider the fully deployed system. In the event the earlier-round system misses a milestone and its authorization is automatically reduced to the number of satellites deployed on the date of the missed milestone, compatibility analyses need only consider the number of actually deployed satellites.

#### 10. Mitigation Techniques

*Further Notice.* The *Further Notice* also asked what mitigation techniques would be appropriate for a later-round system to implement in the event that any protection criteria were not otherwise satisfied in a compatibility showing.

*Comments.* Commenters on this issue agree that the Commission should not limit the mitigation techniques available to a new entrant where its constellation would otherwise exceed the interference thresholds, though some commenters specifically note that, once an operator commits to using certain mitigation techniques, it should be held to that commitment through licensing conditions.

*Decision.* The Commission concurs that elaborating a list of appropriate mitigation techniques could unnecessarily restrict operator flexibility and spectral efficiency, and therefore will not limit the potential mitigation techniques that can be

employed. Further, the Commission agrees that, when mitigation techniques are used as a basis for demonstrating compatibility with an earlier-round system, the later-round system will be required to employ those mitigation techniques to the extent necessary to protect the earlier-round system's actual operations.

#### 11. Timing of Acceptance of Compatibility Showings

*Comments.* Some commenters argue that the Commission should refuse to accept a compatibility showing from a later-round operator until the operator makes a "valid prior coordination attempt" with the earlier-round operator, or until "after coordination has failed." Mangata notes that the Commission's rules already require good faith coordination among all NGSO FSS grantees and argues the Commission "need not exclude valid degraded throughput analyses to enforce coordination since engaging in such coordination efforts is already required."

*Decision.* The Commission declines to adopt any limit on when a later-round NGSO FSS grantee may submit an inter-round compatibility analysis based on the state of its coordination with an earlier-round operator. Later-round grantees are under an obligation to coordinate in good faith with other NGSO FSS operators, before and after submission of any compatibility showings. The Commission does not believe it would be productive to codify, and potentially adjudicate, a requirement that later-round operators coordinate "enough" before the Commission will review a demonstration that their operations will be compatible with an earlier-round operator. Rather, to the extent earlier-round operators may be concerned that its operational data will not be used in the compatibility showing, they may affirmatively reach out to provide such information and, a later-round grantee may not refuse such an offer consistent with its obligation to coordinate in good faith.

#### 12. Post-Sunset Sharing Regime

*Further Notice.* When adopting a sunset period to accompany the new inter-round protection requirement in the *Report and Order*, the Commission determined that, after sunset, new entrants will be subject to co-equal spectrum sharing with incumbents. In the absence of a coordination agreement, this is accomplished through spectrum-splitting when the  $\Delta T/T$  of 6 percent threshold is exceeded. Nonetheless, the *Further Notice* sought

additional comment on what criteria should be applied among NGSO systems after the sunset period.

*Comments.* Most commenters on this issue support the Commission's initial decision in the *Report and Order* to apply the default spectrum-splitting procedure between earlier and later-round systems after sunset occurs. They argue that placing parties on an equal footing under the Commission's default spectrum-splitting rules represents the simplest and most reasonable approach to sunset, that alternatives to spectrum splitting do not have a similar ability to incentivize both sides to reach a coordination agreement, and that not applying the spectrum-splitting rules equally after sunset would perpetuate a stratified spectrum-sharing regime that gives incumbents a permanent advantage over later-round grantees.

SpaceX, which supports applying the Commission's default spectrum-splitting procedure after the sunset date, nonetheless argues that the Commission should ensure that systems with deployment milestones after the sunset date do not avoid good-faith coordination simply because their deployment commitments extend into the post-sunset regime. While SpaceX supports applying the Commission's default spectrum-splitting procedure after the sunset date, it proposes a revision to the procedure to reward the more efficient system with the first choice in a spectrum split, and to apply this backstop both to systems within the same processing round and to different-round systems after protections sunset.

Telesat asks the Commission to defer consideration of any revisions of the current regime until a later date, when the Commission has gained more experience in understanding how NGSO systems can coexist.

ViaSat, SpaceX, and OneWeb reiterate earlier arguments that the Commission should revise the default spectrum-splitting mechanism as it applies to systems authorized in the same processing round, but do not argue that a different sharing regime should apply between earlier and later-round systems following sunset. OneWeb also argues the Commission should lengthen the sunset period for later-round operators until they have deployed their full systems, and only after consider applying the same metrics between prior-round operators and later-round operators.

*Decision.* The Commission reaffirms the decision in the *Report and Order* to place earlier and later-round operators on an equal footing after the sunset date by applying the default, spectrum-

splitting mechanism to both sets of operators at that time. Doing so ensures that earlier-round advantages do not continue indefinitely, and simplifies the regulatory framework when systems authorized through multiple processing rounds may be operating. However, the Commission declines to adopt proposed changes to the default, spectrum-splitting mechanism itself, as applied to systems within a processing round, because such changes are beyond the scope of this proceeding. Further, the Commission notes that no commenter advocates different treatment of later-round operators post-sunset than among earlier-round operators. Indeed, the equality of treatment of later-round operators after the sunset date is a key component of the sunset provision. And while the proposal to lengthen the sunset period for certain operators is also beyond the scope of the *Further Notice's* inquiry, the Commission retains the authority to enforce its good-faith coordination requirement in cases where a later-round operator with deployment milestones after the sunset date is alleged to be avoiding good-faith coordination. The Commission expects any such cases to be rare, however, because operators receive benefits of reaching stable coordination agreements not only in operation but in securing the necessary funding for constellation deployments.

### 13. Digital Equity and Inclusion

The Commission, as part of its continuing effort to advance digital equity for all, including people of color, persons with disabilities, persons who live in rural or Tribal areas, and others who are or have been historically underserved, marginalized, or adversely affected by persistent poverty or inequality, invited comment on any equity-related considerations and benefits (if any) that may be associated with the proposals and issues discussed in the *Further Notice*.

The Commission did not receive specific comment on this topic. Nonetheless, the Commission finds that the rule changes in the *Second Report and Order* will continue to encourage a more stable and competitive environment for the development of NGSO FSS systems well suited to reaching underserved areas with new broadband capacity, and therefore that this rulemaking will enhance digital equity and inclusion.

#### A. Order on Reconsideration

*Petition.* OneWeb petitions for reconsideration (*OneWeb Petition*) of the sunset period adopted with the inter-round protection requirement in

the *Report and Order*. OneWeb specifically requests that the Commission partially reconsider the sunset period for first round operators because it believes that the Commission failed to consider the evidence in the record and applied an unjustifiable sunset period to them. In support of its petition, OneWeb makes three principal arguments.

First, OneWeb argues that the Commission effectively reduced the sunset period for first-round operators "by 30 percent" compared to operators in later processing rounds because the 10-year sunset period began on the date of the first authorization in a subsequent processing round, which occurred in 2020, leading to a sunset period ending in 2030, whereas the *Report and Order* that established the sunset date was not adopted and released until 2023. OneWeb states this creates an "effectively seven-year sunset period for interference protections" for first-round operators. OneWeb argues that such treatment undermines the benefit first-round operators should receive for their pioneering efforts and that, given the time required to implement technical changes in constellation designs and operations, the sunset period impairs first-round operators' ability to develop appropriate mechanisms to co-exist with later-arriving operators, potentially subjecting first-round operators to harmful interference. OneWeb further contends that, although the Commission stated in 2017 that it would consider NGSO FSS applications filed after the first processing round on a "case-by-case" basis, OneWeb had no prior reasonable expectation that all later-round operators would be entitled to operate on a co-equal basis with first-round systems eventually. OneWeb claims that the Commission's decision here is contrary to past precedent, where it denied Kuiper's waiver request to be treated on an equal basis with systems that filed applications within a previous processing round. OneWeb also argues that the Commission failed to consider relevant information in the record and failed to provide a sufficient explanation for its decision.

Second, OneWeb argues that the consideration of several questions in the *Further Notice* on the technical rules surrounding interference protections that affect the sunset period "further cuts into the already shorter sunset period for First Round operators." OneWeb states these questions include: what protection levels should be imposed during and after the sunset period; whether there is a maximum number of NGSO systems that can be accommodated in a given frequency



band; how the number of NGSO systems accommodated should affect inter-round protection criteria and the opening of different rounds; and what “co-equal” means when established operators are to operate a co-equal basis with newer entrants.

Finally, OneWeb notes that several second-round applications from the 2020 processing round remain pending. If granted, the operators would have up to nine years to deploy their full constellations under the Commission’s milestone rules. Therefore, OneWeb argues, the sunset of the inter-round protection requirement in 2030 will mean that “first-round operators would be protected from interference for little or no time after second-round grantees are fully deployed,” “effectively placing the later-arriving operators in the first processing round in the context of interference protections” and “remov[ing] any meaningful incentive for second-round operators to coordinate with First Round operators.” OneWeb now requests that the Commission specifically establish the sunset for first-round protections at ten years from adoption of the *Report and Order* consistent with the notice for subsequent rounds, or at ten years from final adoption of the spectrum sharing framework metrics under the *Further Notice*.

*Comments.* Kuiper opposed the OneWeb Petition. Kuiper contends that it fails to identify any material error in the *Report and Order* warranting reconsideration, and otherwise relies on arguments that the Commission has fully considered and rejected or that OneWeb could have but did not present earlier in this proceeding.

Kuiper argues the Commission specifically addressed the question of whether the sunset should apply to first-round operators and concluded that, as applied, it gave “incumbent NGSO FSS grantees sufficient time to evaluate and adapt to the eventual, equal sharing environment” and that not applying the sunset in this way “would substantially frustrate the purpose of sunset by locking in incumbent protections that are not assured under the current, case-by-case regime.” Kuiper also states that OneWeb has offered no evidence—either now or before the *Report and Order* was adopted—that a seven-year period would afford insufficient time to prepare for co-equal spectrum sharing with second-round systems, or evidence that the thirteen years OneWeb will have had between its market access grant in 2017 and the end of the sunset period in 2030 would be insufficient.

Kuiper states that OneWeb appears to misread the Commission’s reason for

discussing the full deployment milestone, stating that at no point does the Commission suggest that it is choosing that milestone as a means to protect incumbents—instead, the Commission chose it in recognition that once a new entrant has fully deployed its constellation, it should generally have the right to co-equal treatment. And Kuiper notes that, as the Commission explained in direct response to OneWeb’s argument, the fact that the full deployment milestone for some (or even many) later-round operators will not occur until after the 2030 sunset is irrelevant because “the speed of deployment of the later-round systems would not affect the overall time that the incumbents will be protected by systems approved in the later processing round.”

Kuiper further states that the *Report and Order* did not premise the adoption of the sunset period on providing inter-round protections after second-round systems have fully deployed and are providing service, instead reasoning that first-round operators would need some “period of time” after an application had been granted in a new processing round to plan for co-equal sharing, and that the ten-year period, which would run from the grant of the first license in the next processing round, “appropriately balance[d] the need for stability for incumbent operations and the possibility for new entrants to compete on an equal footing once they have built out their systems.”

Kuiper also argues that OneWeb incorrectly assumes that second-round operators will delay offering any service until they are fully deployed, but that even if later-licensed systems did delay offering service in this manner, such delay would have no impact on the time given to OneWeb to operate with special protections.

Kuiper further asserts that OneWeb’s claim that the decision removes “any meaningful incentive for second-round operators to coordinate” ignores the Commission’s thorough treatment of such incentives and record evidence that a sunset is likely to enhance the incentives for all parties to coordinate. And Kuiper argues that OneWeb’s argument that it has invested “billions of dollars” and “made significant financial investments in their next generation satellites based on the Commission’s framework existing prior to the adoption of a sunset period” ignores the billions of dollars that second-round operators have invested in their own systems.

Kuiper finally argues that none of the questions in the *Further Notice* implicate the length or application of

the sunset period to first-round operators, and notes that OneWeb itself explicitly told the Commission that the “proposed sunset schedule”—that is, a 2030 sunset for second-round operators—“affords the Commission time to further consider these issues.”

OneWeb replied to Kuiper’s opposition, arguing that the opposition fails to counter the issues raised in its petition and reiterating arguments in the petition. OneWeb maintains that neither the *Report and Order* nor Kuiper have addressed the disparate treatment of first-round operators who have insufficient time to prepare for co-equal spectrum sharing. OneWeb contends that Kuiper ignores that the outcome of the *Further Notice* further diminishes first-round operators’ time to prepare for the “fully defined regulatory framework” given that they will have to comply with the new rules.

SpaceX also responded to the *OneWeb Petition*, arguing that the ten-year sunset period adopted by the Commission “strikes the appropriate balance” between incumbents and new entrants but stating that careful consideration should be given when incorporating deployment milestones for later-round systems to minimize any advantages for operators that refuse to coordinate.

*Decision.* The Commission dismisses in part and, on alternative and independent grounds, deny the OneWeb Petition in full on the merits. Under § 1.429(l)(3) of the Commission rules, the Commission may dismiss a petition for reconsideration that presents arguments previously considered and rejected. OneWeb previously raised the issue that the 10-year sunset period would effectively eliminate advantages of first-round operators because of the timing of second-round grants, since first-round operators would be protected from interference for little or no time after some second-round grantees are fully deployed. The Commission fully considered and rejected this argument in the *Report and Order*, finding that while the sunset may occur before some later-round systems have reached the full deployment milestone at nine years, contrary to OneWeb’s argument, this would not “effectively eliminate” advantages for first-round operators, since the speed of deployment of the later-round systems would not affect the overall time that the incumbents will be protected by systems approved in the later processing round. Accordingly, the Commission dismisses this part of the *OneWeb Petition* pursuant to § 1.429(l)(3).

On alternative and independent grounds, the Commission denies the

*OneWeb Petition* on the merits. The *Report and Order* for the first time adopted an inter-round protection requirement to replace the Commission's explicit policy of case-by-case licensing of NGSO FSS systems after the cutoff date in an initial processing round. In doing so, the Commission considered numerous sunset proposals on the record, ranging from 6 years after the application cut-off date in a processing round to 15 years commencing from release of the *Report and Order* for the current Ku-/Ka-band processing rounds and 15 years from the first authorization or market access grant in a subsequent processing round for future processing rounds.

First, the *Report and Order* ensured all NGSO FSS operators authorized through a processing round the same 10-year period of time, following the first authorization in a subsequent processing round, during which they are protected by systems approved in that subsequent processing round under the newly adopted inter-round protection requirement. The 10-year period, tied to the first authorization in a later round, balances the Commission's goals to afford later-round systems equal spectrum sharing opportunities under the spectrum-splitting procedure once their full service constellations are operational, while providing earlier-round systems time to adjust to the constellations ultimately deployed by later-round grantees, with simplicity and regulatory clarity. While it is true that first-round operators effectively had notice of seven years of protection from all second-round grantees under the new inter-round protection requirement, applying a 10-year sunset provision from the date of the release of the *Report and Order* would result in an effective 13-year sunset period for the first system authorized in the second processing round, contrary to the Commission's rationales for adopting the 10-year inter-round protection period and its goal of promoting new entry.

Indeed, the basis for the adoption of a 10-year period was not because it was the minimum necessary period for earlier-round systems to adjust to new entrants. Rather, the Commission concentrated on the deployment timelines of later-round systems and reasoned that sunset period should "relieve earlier-round grantees of the uncertainty of near-term, equal sharing with new entrants" while giving later-round systems an equal opportunity to operate with their full service constellations, which may be completed at the nine-year final deployment

milestone. For OneWeb's first-round system approved in 2017, and for other first-round systems, the Commission continues to find that a sunset date in 2030 (ten years after the first grant in the subsequent processing round, which occurred in 2020) relieves them of the uncertainty of near-term, equal sharing with new entrants intended by the sunset period. The *Report and Order* further noted the iterative development of NGSO FSS systems and the fact that many earlier-round grantees, like OneWeb, have proposed updated, second-generation systems filed in a later processing round that will benefit from the sunset period applied to second-round systems. As Kuiper notes, OneWeb provided no specific evidence to support its assertion that the sunset period as adopted is in fact insufficient.

The *Report and Order* also determined that sunset will not upset existing expectations of interference protection because, under Commission policy in effect prior to the *Report and Order*, later-round applicants were considered on a case-by-case basis as to whether they will be entitled to share spectrum on an equal basis with earlier-round systems—as such there was never a guarantee that earlier-round grantees would be entitled to protection from later-round systems. OneWeb's citation to a grant condition in which a later-round licensee was required to protect NGSO FSS systems authorized through an earlier processing round does not create a reasonable expectation that OneWeb would be protected indefinitely from all later-round applicants. The *Report and Order* acknowledged the Commission's then-existing policy of case-by-case licensing of NGSO FSS systems filed after a processing round, including licensing conditions, and based on the record in the proceeding decided to adopt a generally applicable inter-round protection requirement with an accompanying sunset provision. While OneWeb argues the Commission "provided no notice that all such later-round operators would be entitled to co-equal operations," the policy of case-by-case licensing meant that any future applicant—or all future applicants—could be afforded co-equal status with earlier-round systems. The sunset period also does not effectively create an open-ended processing round because the sunset guarantees a period of time of unequal protection for earlier-round systems, during which earlier-round systems are not required to protect later-round systems, while an open-ended processing round would

immediately treat all NGSO FSS systems on an equal basis.

Second, the *Report and Order* tied the 10-year sunset date to the date of the first authorization in a later processing round. In doing so, the Commission acknowledged that "the sunset may occur before some later-round systems have reached the full deployment milestone at nine years" but reasoned, contrary to OneWeb's argument, this would not "effectively eliminate" advantages for first-round operators, since the speed of deployment of the later-round systems would not affect the overall time that the incumbents will be protected by systems approved in the later processing round. Similarly, the Commission does not share OneWeb's concern that some "second-round operators' fully-deployed systems would never have to protect First Round operators, effectively placing the later-arriving operators in the first processing round," "contrary to the Commission's acknowledgement that First Round operators should have some benefits, and remov[ing] any meaningful incentive for second-round operators to coordinate with First Round operators." The basis for the 10-year sunset period was not to lock in coordination advantages for earlier-round systems. Rather, the Commission determined that fully deployed later-round systems *should* be able to operate on an equal basis with earlier-round systems; not that they must protect earlier-round systems for a specific period of time after full deployment. Further, the benefit to earlier-round operators is that they are entitled to a 10-year period after the initial grant in a later processing round in which later-round systems must protect the earlier-round system while accepting any interference caused by the earlier-round system, unless a coordination agreement has been reached. And as explained in the *Report and Order*, the Commission does not expect the sunset period to introduce significant coordination delays because the period is long enough that a later-round grantee would not wish to operate for years without an agreement with earlier-round grantees.

Finally, the Commission disagrees that the exploration of issues in the *Further Notice*, some of which OneWeb itself requested, justifies changing the sunset provision. Specifically, OneWeb argues that having as open issues "what protection levels should be imposed during and after the sunset period" and "what 'co-equal' means when established operators are to operate a co-equal basis with newer entrants" shortens the time period for it to prepare for new entrants at the end of the sunset

period. In the *Second Report and Order* above, the Commission reaffirms the decision in the *Report and Order* to apply the default, spectrum-splitting mechanism between earlier and later-round systems after sunset. Therefore, there is no change in the post-sunset regime from what was adopted in the *Report and Order*. In addition, the *Second Report and Order* declines to adopt any cap on the number of NGSO FSS systems that can operate in a given frequency band, negating OneWeb's concern that doing so may render the sunset period superfluous. Similarly, the *Second Report and Order* does not place any restrictions on "the opening of different processing rounds," nor limit "the number of NGSO systems accommodated." The changes the Commission has adopted in the *Second Report and Order* to the inter-round protection requirement also do not "shorten" the sunset period for first-round systems because, while they will apply immediately upon the effective date of the rule changes, they will not apply between first and second-round systems after the sunset period.

#### IV. Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA), an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Further Notice* released in April 2023. The Commission sought written public comment on the proposals in the *Further Notice*, including comment on the IRFA. No comments were filed addressing the IRFA. The Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

##### A. Need for, and Objectives of, the *Second Report and Order*

The *Second Report and Order* continues to facilitate the deployment of non-geostationary satellite orbit, fixed-satellite service (NGSO FSS) systems capable of providing broadband and other services on a global basis, by refining the Commission's rules governing spectrum sharing among a new generation of broadband satellite constellations to promote market entry, regulatory certainty, and spectrum efficiency through good-faith coordination. The Commission amends its rules governing the treatment of NGSO FSS systems filed in different processing rounds clarifying certain details of the degraded throughput methodology that, in the absence of a coordination agreement, must be used in compatibility analyses by NGSO FSS system licensees authorized through later processing rounds to show they

can operate compatibly with, and protect, NGSO FSS systems authorized through earlier processing rounds.

Specifically, the *Second Report and Order* clarifies details regarding the implementation of a degraded throughput methodology by adopting a 3 percent throughput degradation as a long-term interference protection criterion, a 0.4 percent absolute increase in link unavailability as a short-term interference protection criterion, and declining to adopt additional protection metrics or to adopt an aggregate limit on interference from later-round NGSO FSS systems into earlier-round NGSO FSS systems. It also affirms that the default, spectrum-splitting mechanism will be applied among NGSO systems in different processing rounds after the sunset period. The actions the Commission takes in this proceeding further its efforts to promote development, and competition among broadband NGSO FSS system proponents, including the market entry of new competitors.

##### B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

There were no comments filed that specifically addressed the proposed rules and policies presented in the IRFA.

##### C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration

Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules.

##### D. Description and Estimate of the Number of Small Entities To Which the Rules Will Apply

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 rules adopted herein. 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.

*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. For purposes of this proceeding it is likely that there are very few entities meeting the SBA's definition of small satellite telecommunications providers that are small satellite system operators involved in designing, manufacturing, and launching a satellite due to the generally a high fixed cost of these activities.

*All Other Telecommunications.* This industry comprises firms "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.

#### *E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities*

The *Second Report and Order* amends rules that are applicable to space station operators requesting a license or grant of U.S. market access from the Commission. Specifically, the *Second Report and Order* adopts changes to the spectrum sharing requirements among NGSO FSS satellite systems approved in different processing rounds, and specifies details of the technical demonstration that space station licensees and market access grantees that were authorized through a later processing round must submit to show that they will not cause harmful interference to space station licensees and market access grantees that were authorized through an earlier processing round, prior to the sunset period, if the later-round grantees have not certified that they have reached a coordination agreement with the earlier-round grantees. The technical demonstration of compatibility between the later-round system and the earlier-round system is based on a degraded throughput methodology and assessing absolute increase in link unavailability.

The adopted metrics, values, and assumptions to finalize degraded throughput methodology will impact information later-round NGSO FSS system operators are required to report in compatibility analysis submissions. However, because of the costs involved in developing and deploying an NGSO FSS satellite constellation, the Commission anticipates that few NGSO FSS operators affected by this rulemaking would qualify under the SBA definition of “small entity,” and therefore small entities are not likely to have to hire professionals, or incur any compliance costs as a result of the *Second Report and Order*.

#### *F. Steps Taken To Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered*

The RFA requires an agency to provide, “a description of the steps the agency has taken to minimize the

significant economic impact on small entities . . . including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each one of the other significant alternatives to the rule considered by the agency which affect the impact on small entities was rejected.”

The *Second Report and Order* defines specific metrics for long-term interference and short-term interference that must be used in compatibility analyses demonstrating that a later-round NGSO FSS system will adequately protect an earlier-round system. Agreeing with the general consensus of commenters, the *Second Report and Order* adopts a 3 percent degraded throughput threshold as the long-term interference metric for inter-round compatibility analyses and a 0.4 percent absolute increase in link unavailability as the short-term interference metric based on the technical record developed in this proceeding. The Commission concludes that establishing a specific long-term interference protection metric consistent with the technical evidence in the record provides the benefit of a clear standard for new entrants, and a benchmark that parties can use to negotiate any alternative long-term protections mutually agreed to in coordination.

The Commission specifically considered, and declined, adopting additional protection metrics for loss of synchronization, multiple carrier-to-noise (C/N) objectives, or aggregate interference limits in part because of the additional complexities and costs that complying with such additional metrics could entail. Similarly, the Commission considered, and rejected, incorporating interference from additional sources in the baseline calculation, such as from GSO networks, other NGSO FSS systems, and intra-system noise, in part to simplify the analysis required of new entrants in the absence of a coordination agreement. Moreover, to lower burdens on later-round operators, the Commission provides illustrative examples of parameters that may be used when preparing compatibility analyses and which will be considered on a case-by-case basis as to whether they are reliable and representative. The Commission also considered and reaffirmed its decision from the *Report and Order* to apply the default, spectrum-splitting mechanism to earlier and later-round operators after the sunset date to place them on equal footing, noting that facilitating equal treatment of later-round operators after the sunset date was a key component of

the sunset provision. Additionally, by reaffirming this decision the Commission ensures that earlier-round advantages do not continue indefinitely, and simplifies the regulatory framework when systems authorized through multiple processing rounds may be operating.

#### *G. Report to Congress*

The Commission will send a copy of the *Second Report and Order*, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act. In addition, the Commission will send a copy of the *Second Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA.

#### **V. Ordering Clauses**

Accordingly, *it is ordered that*, pursuant to sections 4(i), 7(a), 10, 303, 308(b), and 316 of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 157(a), 160, 303, 308(b), 316, that is the *Second Report and Order and Order on Reconsideration is adopted*, the policies, rules, and requirements discussed herein *are adopted*, and Part 25 of the Commission’s rules *is amended*.

*It is further ordered that*, pursuant to sections 1, 4(i), 4(j), and 405 of the Communications Act of 1934, as amended, 47 U.S.C. 151, 154(i), 154(j), 405, and 47 CFR 1.429(b), (l)(3), that the petition for reconsideration filed by WorldVu Satellites Limited in IB Docket No. 21–456, is *dismissed in part* and, on alternative and independent grounds, *denied*.

*It is further ordered that the Second Report and Order and Order on Reconsideration shall be effective 30 days after publication in the Federal Register*, except that § 25.261(d), which may contain new or modified information collection requirements, will not become effective until the Office of Management and Budget completes review of any information collection requirements that the Space Bureau determines is required under the Paperwork Reduction Act. The Commission directs the Space Bureau to announce the effective date of § 25.261(d) by subsequent Public Notice.

*It is further ordered that the Commission’s Office of Secretary shall send a copy of the Second Report and Order and Order on Reconsideration, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.*

*It is further ordered that the Commission’s Office of the Managing Director, Performance Program*

Management, *shall send* a copy of the *Second Report and Order and Order on Reconsideration* in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

#### List of Subjects in 47 CFR Part 25

Satellites.

Federal Communications Commission.

**Marlene Dortch,**

*Secretary.*

#### Final Rules

For the reasons discussed in the preamble, the Federal Communications Commission amends 47 CFR part 25 as follows:

#### PART 25—SATELLITE COMMUNICATIONS

■ 1. The authority citation for part 25 continues to read as follows:

**Authority:** 47 U.S.C. 154, 301, 302, 303, 307, 309, 310, 319, 332, 605, and 721, unless otherwise noted.

■ 2. Amend § 25.261 by revising paragraphs (d) and (e) to read as follows:

#### § 25.261 Sharing among NGSO FSS space stations.

\* \* \* \* \*

(d) *Protection of earlier-round systems.* Prior to commencing operations, an NGSO FSS licensee or market access recipient must either certify that it has completed a coordination agreement with any operational NGSO FSS system licensed or granted U.S. market access in an earlier processing round, or submit for Commission approval a compatibility showing which demonstrates by use of a degraded throughput methodology that it will not cause harmful interference to any such system with which coordination has not been completed. If an earlier-round system becomes operational after a later-round system has commenced operations, the later-round licensee or market access recipient must submit a certification of coordination or a compatibility showing with respect to the earlier-round system no later than 60 days after the earlier-round system commences operations as notified pursuant to § 25.121(b) or otherwise.

(1) Compatibility showings must contain the following elements:

(A) A demonstration that the later-round system will cause no more than 3 percent time-weighted average degraded throughput of the link to the earlier-round system, for links with a baseline link availability of 99.0 percent or higher at a C/N threshold of 0 dB;

(B) A demonstration that the later-round system will cause no more than 0.4 percent absolute change in link availability to the earlier-round system using a C/N threshold value of 0 dB, for links with a baseline link availability of 99.0 percent link availability or higher; and

(C) With respect to an earlier-round system that has not yet satisfied its 50 percent deployment milestone pursuant to § 25.164(b)(1), the compatibility showing may consider only 50 percent deployment of the earlier-round system; if the 50 percent deployment milestone has been satisfied, the showing must consider 100 percent deployment of the authorized system.

(2) Compatibility showings will be placed on public notice pursuant to § 25.151(a)(13).

(3) While a compatibility showing remains pending before the Commission, the submitting NGSO FSS licensee or market access recipient may commence operations on an unprotected, non-interference basis with respect to the operations of the system that is the subject of the showing.

(4) A later-round NGSO FSS system will be required to conform its operations to its compatibility showing submitted for the protection of an earlier-round system to the extent necessary to protect the actual number of deployed and operating space stations of the earlier-round system.

(e) *Sunsetting.* Ten years after the first authorization or grant of market access in a processing round, the systems approved in that processing round will no longer be required to protect earlier-round systems under paragraph (d) of this section, and instead will be required to share spectrum with earlier-round systems under paragraph (c) of this section.

[FR Doc. 2024–28993 Filed 12–12–24; 8:45 am]

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#### DEPARTMENT OF COMMERCE

#### National Oceanic and Atmospheric Administration

#### 50 CFR Part 300

[RTID 0648–XE447]

#### Fraser River Sockeye Salmon Fisheries; In-Season Orders

**AGENCY:** National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

**ACTION:** Temporary rule; in-season orders.

**SUMMARY:** NMFS publishes in-season orders to regulate treaty tribal and non-tribal (all citizen) commercial salmon fisheries in United States (U.S.) waters of the Fraser River Panel (Panel) Area. In 2024, a single order was issued by the Panel of the Pacific Salmon Commission (Commission) and approved and issued by NMFS for fisheries within the U.S. Panel Area. This order relinquished regulatory control of U.S. treaty tribal and all citizen commercial fisheries in U.S. Panel Area waters.

**DATES:** The effective dates for the in-season order is set out in this document under the heading In-season Orders.

**FOR FURTHER INFORMATION CONTACT:** Anthony Siniscal at 971–322–8407, email: *Anthony.siniscal@noaa.gov*.

**SUPPLEMENTARY INFORMATION:** The Treaty between the Government of the United States of America and the Government of Canada concerning Pacific salmon was signed at Ottawa on January 28, 1985, and subsequently was given effect in the United States by the Pacific Salmon Treaty Act (Act) at 16 U.S.C. 3631–3644.

Under authority of the Act, Federal regulations at 50 CFR part 300, subpart F, provide a framework for the implementation of certain regulations of the Commission and in-season orders of the Commission's Panel for U.S. sockeye and pink salmon fisheries in the Fraser River Panel Area.

The regulations close the U.S. portion of the Panel Area to U.S. sockeye and pink salmon tribal and non-tribal commercial fishing unless opened by Panel regulations that are given effect by in-season orders issued by NMFS (50 CFR 300.94(a)(1)). During the fishing season, NMFS may issue in-season orders that establish fishing times and areas consistent with the Commission agreements and regulations of the Panel. Such orders must be consistent with domestic legal obligations and are issued by the Regional Administrator, West Coast Region, NMFS. Official notification of these in-season actions is provided by two telephone hotline numbers described at 50 CFR 300.97(b)(1) and in 89 FR 44553 (May 21, 2024). The in-season orders are published in the **Federal Register** as soon as practicable after they are issued. Due to the frequency with which in-season orders are generally issued, publication of orders during the fishing season is impracticable.

#### In-Season Orders

The Fraser Panel did not issue any orders opening fisheries on sockeye or pink salmon in 2024. NMFS issued the following in-season order for U.S.