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AFTER EPFD

WHAT THE FCC'S 2026 SPECTRUM SHARING ORDER CHANGES FOR NGSO LINK DESIGN, AND WHAT IT DOES NOT

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Scope and method

Published by Apogee Ventures LLC in a series on the rules governing satellite spectrum and orbit. Each paper states the regulatory requirement, reviews the published work bearing on it, reproduces the governing calculation, and sets out the consequences for design, licensing, and diligence. Calculations use the models published on the Tools page at apogee-ventures.com: an exponential atmosphere with a solar-activity scaling factor, a circular-orbit drag integrator, Hohmann transfer delta-v, free-space path loss, and ITU-R P.838 rain coefficients with the P.618 path reduction. They are sized for decisions; a filing uses the full recommendation and the applicant's own parameters.

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ABSTRACT

On April 30, 2026 the FCC adopted FCC 26-26, retiring the equivalent power flux density limits that had governed how non-geostationary satellite systems protect geostationary networks in the Ku- and Ka-bands since the late 1990s, and replacing them with performance-based protection criteria, good-faith coordination, and technical backstops. This paper traces how EPFD shaped NGSO link and antenna design, summarizes what the interference literature found about the limits, explains what the new US framework changes and what it leaves in place, and works through the link-design consequences with the models published on this site. The central point is practical: a US-licensed system now runs two analyses, one for the FCC criteria and one for the ITU Article 22 limits that still apply everywhere else, and the hardware has to satisfy both until WRC-27 decides otherwise.

PRINCIPAL RESULTS

- FCC 26-26, adopted April 30, 2026 and effective July 13, 2026, replaces the equivalent power flux density limits with performance-based GSO protection criteria, good-faith coordination, and technical backstops.
- The ITU Article 22 limits still apply to market access abroad, to ITU filings, and to coordination with other administrations. A US-licensed system now runs two analyses, and the antenna has to satisfy both.
- Elevation is the lever the old rules constrained: from 550 km, moving a link from 30° to 45° is worth 2.4 dB in clear sky and 7.3 dB in rain at 20 GHz.
- The coordination agreement is a design input. Its throughput and availability criteria are the numbers the beam control software will be tuned to for the life of the system.

SECTION 1

The order and its status

FCC 26-26, adopted April 30, 2026 in SB Docket No. 25-157, revises the framework under which geostationary (GSO) and non-geostationary (NGSO) satellite systems share spectrum in the United States. The Commission found that the EPFD limits developed in the late 1990s, built on the NGSO designs of that era, required operators to overprotect GSO systems and in doing so held back the capacity of the constellations now in orbit. The order replaces those limits with performance-based GSO protection criteria, extends the good-faith coordination framework so that operators can negotiate interference protections privately, and adopts technical backstops that apply when coordination is not reached [1]. The rules were published on May 13, 2026 and took effect on July 13, 2026, with two sections held for a later effective-date notice [2]. Practitioner summaries describe the effect as removing the certification against ITU EPFD limits for NGSO fixed-satellite service operators in the affected Ku- and Ka-band segments and replacing it with an expectation of negotiated sharing arrangements [14].

SECTION 2

Effect of EPFD on NGSO design

Article 22 of the ITU Radio Regulations sets equivalent power flux density limits that an NGSO system may produce at a GSO earth station or space station in specified bands. The limits are statistical: they specify the power flux density that may not be exceeded for more than a stated percentage of time, and they are evaluated against reference GSO antenna patterns. Article 21, by contrast, sets fixed power flux density limits to protect terrestrial services [11]. Compliance is demonstrated with the ITU's validation software against the full constellation geometry, and NGSO applicants to the FCC certified compliance as part of their Part 25 showing.

For a link designer the limits translated into a handful of constraints that have shaped every NGSO system of the current generation. The most visible is the GSO arc avoidance angle: a satellite may not transmit toward an earth station when the geometry places it within some angular distance of the GSO arc as seen from that station, so the constellation must carry enough satellites that another is always available outside the exclusion zone. del Portillo, Cameron, and Crawley's comparison of the SpaceX, OneWeb, and Telesat architectures showed how the choice of altitude, plane count, and beam design followed from this requirement and from the capacity it cost [6]. A survey of NGSO systems from the communication perspective tabulates the Ku- and Ka-band segments in which GSO has priority and EPFD applies, and describes the second consequence: power and sidelobe control on every beam, because the limit is aggregate across the constellation and the reference antenna pattern penalizes sidelobe energy [12]. The third consequence is the one that FCC 26-26 addresses directly. Because the limits were fixed regardless of whether a GSO link was actually at risk at a given time and place, they constrained beam patterns, power levels, and orbital flexibility even where no interference would have occurred [13].

SECTION 3

Prior work on NGSO/GSO interference

The empirical question, how much interference NGSO systems actually cause, has been studied for a decade. Tonkin and de Vries performed the first public probabilistic risk assessment of NGSO-to-NGSO interference for multiple planned Ka- and V-band constellations, measuring impact as throughput degradation rather than as signal levels, and found the risk low even without mitigation: an increase in mean throughput degradation of three percentage points or less under reasonable assumptions [7]. Braun, Voicu, Simić, and Mähönen extended the analysis to dense constellations in the Ku-band downlink, including NGSO-to-GSO interference, and asked whether the concern was warranted at all; their answer was that it depends on constellation density and on the mitigation techniques in use, not on the presence of NGSO systems as such [8].

The mitigation literature is where the design choices live. Jalali et al. showed that joint control of transmit power and beam tilt across a constellation can hold interference to GSO ground stations within limits while preserving NGSO capacity, which is precisely the kind of adaptive behavior a fixed EPFD mask cannot credit [9]. Emiliani and Chatzinotas review the state of NGSO-GSO coexistence after WRC-23, which upheld the existing EPFD limits while launching studies on aggregate interference from multiple NGSO systems, and propose adaptive regulatory tools and probabilistic interference models as the way forward [10]. The FCC's order is, in effect, the first regulator adopting that agenda.

SECTION 4

Changes and continuing obligations

The US framework now has three layers. The first is the 2023 revision of NGSO-to-NGSO sharing, under which later-round systems must coordinate with or protect earlier-round systems, with that protection sunsetting ten years after the later system is authorized [3], and the December 2024 criteria that define protection as a 3 percent time-weighted throughput degradation and a 0.4 percent increase in link unavailability when no coordination agreement exists [4]. The second is FCC 26-26, which applies a performance-based approach to the GSO side of the problem [1]. The third is the Commission's allocation posture, illustrated by its May 2023 decision to keep the 12.2-12.7 GHz band with satellite downlinks rather than open it to terrestrial 5G, on the finding that ubiquitous mobile use could not coexist with DBS and NGSO operations [5].

What the order does not change is more important for hardware. The ITU Article 22 limits still apply to any system that needs market access outside the United States, to the ITU filings on which international priority depends, and to coordination with administrations that have not adopted a performance-based approach. WRC-23 kept the limits and set WRC-27, scheduled for Shanghai from October 18 to November 12, 2027, as the venue for the aggregate-interference studies now under way in ITU-R Working Party 4A [10][15]. A US-licensed NGSO system therefore runs two analyses: one against the FCC's criteria for domestic operations and coordination, and one against Article 22 for everything else. The antenna has to satisfy both.

SECTION 5

Consequences for link design

The most direct consequence of relaxing arc avoidance is that a terminal can be served by satellites at higher elevation more of the time, and elevation drives everything in a Ku- or Ka-band link. Table 3 shows slant range, free-space path loss at 12 and 20 GHz, and rain attenuation exceeded 0.01 percent of the year at a temperate site (42 mm/h) for a 550 km orbit, computed with the models on this site's Tools page, together with the resulting carrier-to-noise ratio for a representative 20 GHz downlink.

Table 3. Elevation angle versus slant range, free-space path loss, 0.01 percent rain attenuation (42 mm/h, circular polarization, 4 km rain height), and C/N for a 20 GHz downlink with 45 dBW EIRP, 18 dB/K receive G/T, 100 MHz bandwidth, and 4 dB other losses, from 550 km.

Elevation	Slant range	FSPL, 12 GHz	FSPL, 20 GHz	Rain, 12 GHz	Rain, 20 GHz	C/N clear sky	C/N at 0.01%
10°	1,815 km	179.2 dB	183.6 dB	18.0 dB	42.6 dB	24.0 dB	-18.6 dB
20°	1,294 km	176.3 dB	180.7 dB	12.5 dB	29.7 dB	26.9 dB	-2.8 dB
30°	993 km	174.0 dB	178.4 dB	9.9 dB	23.4 dB	29.2 dB	5.8 dB
45°	749 km	171.5 dB	176.0 dB	7.8 dB	18.5 dB	31.6 dB	13.1 dB
60°	627 km	170.0 dB	174.4 dB	6.9 dB	16.3 dB	33.2 dB	16.9 dB
90°	550 km	168.8 dB	173.3 dB	6.6 dB	15.7 dB	34.3 dB	18.6 dB

Two readings follow. In clear sky, raising the elevation angle from 30° to 45° reduces path loss by 2.4 dB. In rain at 20 GHz the reduction is 7.3 dB, because the slant path through the rain cell shortens with elevation, and the difference between a link that closes and one that does not at the 0.01 percent point falls entirely within that range. A system that was forced by arc avoidance to serve terminals from lower elevations paid this penalty in availability or in power. Under the new framework the constellation geometry can be optimized for elevation and capacity, and the coordination agreement, not a fixed mask, sets the protection the GSO operator receives.

The second consequence is the minimum elevation angle itself, which sets the constellation size. From 550 km, continuous single coverage requires a theoretical minimum of 59 satellites at a 10° mask, 184 at 25°, and 495 at 40°, before any margin for overlap and plane geometry. Higher masks buy availability and reduce interference geometry at the cost of satellites; the trade is now made against negotiated protection criteria rather than a fixed exclusion angle.

The third consequence is that the hardware requirements do not relax as much as the rules do. Sidelobe control, power management, and beam steering remain the tools by which any protection criterion is met, whether it is a throughput-based criterion negotiated with a GSO operator or an EPFD mask evaluated by the ITU. The measured interference the literature reports is low because those tools are already in use [7][9]. What changes is the accounting: a system designed to the Article 22 mask is likely to satisfy the FCC criteria with margin to spare; a system designed only to a domestic coordination agreement may not satisfy Article 22 when it files for market access abroad.

SECTION 6

Design and filing implications

For a hardware team the calendar is the issue. Decisions at WRC-27 arrive in November 2027; radios that will fly under them are being specified now. Three practices follow. Keep the ITU EPFD validation run in the design loop even for a US-first system, because the international requirement has not changed and the design freeze will come before the conference. Write the antenna and power specifications to the tighter of the two frameworks and record the margin against the other, so that a later coordination agreement can trade margin for capacity deliberately. And treat the coordination agreement as a design input: the throughput and availability criteria the parties agree to are the numbers the beam control software will be tuned to for the life of the system.

For a regulatory team, the framework rewards early, documented coordination and penalizes waiting for a backstop. The technical backstops in FCC 26-26 exist for the case where agreement is not reached; an operator whose business case depends on them has adopted the least favorable outcome as its baseline [1][14].

> **A system designed to the Article 22 mask is likely to satisfy the FCC criteria with margin to spare; a system designed only to a domestic coordination agreement may not satisfy Article 22 when it files for market access abroad.**

SECTION 7

Conclusion

FCC 26-26 replaces a fixed, geometry-based protection mask with negotiated, performance-based criteria for GSO protection in the United States. The interference literature supports the change: measured and modeled degradation to GSO links from modern NGSO systems is small, and the adaptive power and beam control that keeps it small is what a performance criterion can credit and a mask cannot. The order does not change Article 22, does not change the ITU filing process, and does not change WRC-27's agenda. Until it does, an NGSO system built for more than one market designs to both frameworks, runs both analyses, and carries the difference as margin.

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