

1330 Connecticut Avenue, NW
Washington, DC 20036-1795
202 429 3000 main
www.steptoe.com

March 6, 2023

BY ELECTRONIC FILING

Marlene Dortch
Secretary
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, Call Sign S3069

Dear Ms. Dortch:

DISH Network Corporation (“DISH”) has analyzed the Equivalent Power Flux Density (“EPFD”) data files SpaceX provided to DISH for its combined second-generation (“Gen2”) system.¹ In short, SpaceX based its new power level calculations on an incorrect and non-compliant exclusion zone for the protection of geostationary (“GSO”) satellites in an attempt to manufacture a showing of compliance with the International Telecommunication Union’s (“ITU’s”) power limits. For these calculations, SpaceX used a zone of four degrees, rather than the 18-degree exclusion zone that is consistent with its mask. This violates the ITU’s rules, which define the exclusion zone angle as the “same” as the mask, contravenes SpaceX’s own prior representations to the Commission, and is inconsistent with its own system parameters. ITU Recommendation S.1503 provides that the border of an exclusion zone is the same as the border of an NGSO system’s PFD mask.² The border of SpaceX’s new mask is no less than 18 degrees, and may indeed be closer to 20 degrees. Likewise, SpaceX has repeatedly stated to the Commission that the reduction of power to protect NGSO satellites starts at 18 degrees from the GSO arc. The four-degree limit proffered by SpaceX in its Gen2 data is therefore not an accurate input with respect to EPFD limits. Rather, it is a sham.

It is only by arbitrarily shrinking the exclusion zones to an area materially smaller than the mask that SpaceX manufactures a showing of compliance with the ITU’s power limits. The reason is that the ITU software includes in the EPFD calculations all satellites in the exclusion

¹ SpaceX has still not submitted its combined files into the record of this proceeding.

² Recommendation ITU-R S.1503-2, *Functional Description to be Used in Developing Software Tools for Determining Conformity of Non-Geostationary-Satellite Orbit Fixed-Satellite System Networks With Limits Contained in Article 22 of the Radio Regulations*, Part C § 2.1 (Dec. 2013) (“ITU Recommendation S.1503-2”) (“Use of α or X angle pfd masks implies that the same definition of GSO angle is used for exclusion angle in the calculation of epfd”).

zone and only one, with an “Nco” of one, satellite *outside* the zone. Shrink the zone, and you automatically remove the contribution of many satellites to Starlink’s power level calculations.

This means that the violation of the ITU definition of the exclusion zone angle is far from a harmless technicality. It has a profound impact on the ground. The satellites whose power is removed by SpaceX’s improper shrinkage of the exclusion zone do not disappear from the real world. They still exist, still “rain” power down on the earth, and the ITU software correctly requires that they be counted in estimating the potential for interference into satellite television customers. SpaceX does not count them, defies the rules it claims to revere, and risks harming the millions of satellite television households these rules were designed to protect.

For the ITU’s software to produce valid results, it must be run on accurate inputs. The Commission should not tolerate this effort on the part of SpaceX to apply the software to an imaginary system that defines the exclusion zone as 4 degrees, but where power reduction supposedly starts at eighteen degrees, and which does not represent its own operations, to flout the ITU definition of exclusion zone while purporting to treat the ITU method as sacrosanct, and to revise the basis for its power level calculations when its original submission showed the entire system to clearly fail the limits.

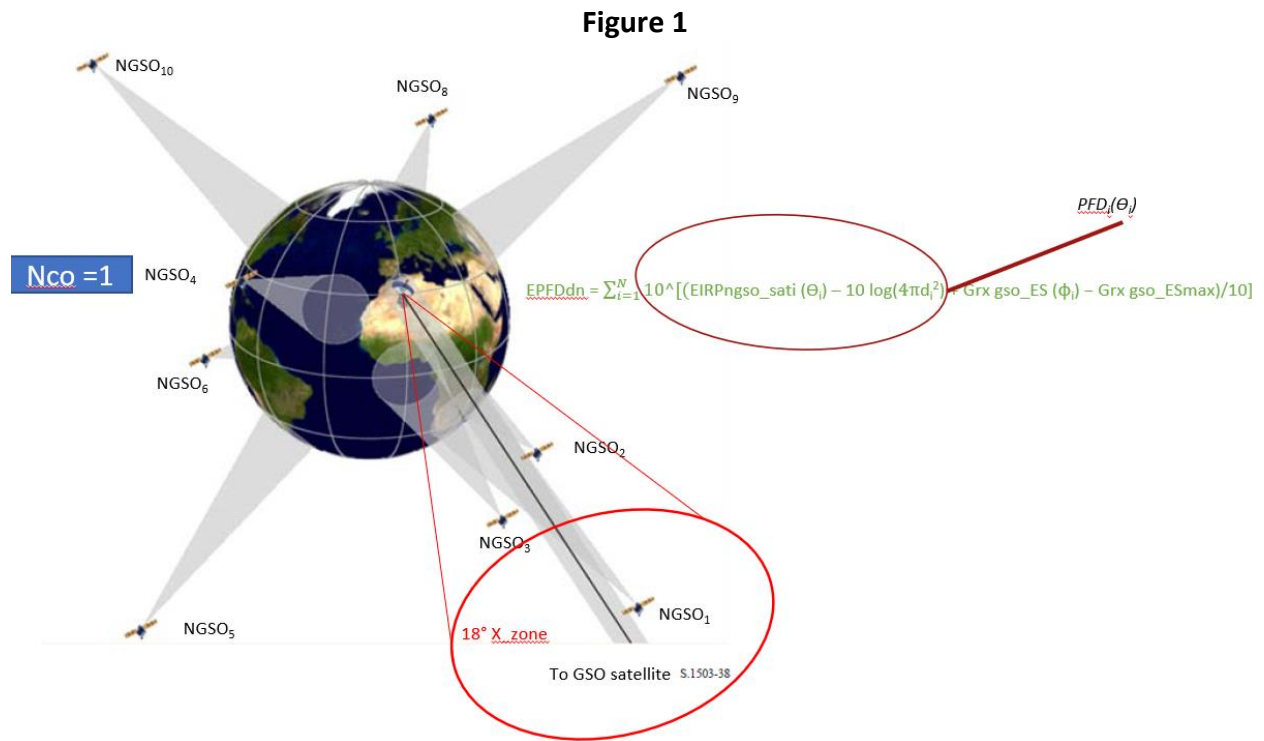
Nor is it enough for the agency to leave it up to the ITU to catch the violation of its own rules. The United States should not put itself in the position of making a non-compliant submission to an international body. DISH requests that the Commission not forward these files to the ITU. If the United States does forward the files, DISH requests that the United States, as the licensing administration for DISH’s own GSO satellites, advise the ITU Radiocommunication Bureau that the four-degree exclusion zone is inaccurate, and that it should be replaced with the 18-degree exclusion zone previously used by SpaceX in the data files it had prepared for forwarding to the ITU.³ The Commission should also ask SpaceX to produce its workpapers and other documents relating to its decision to use a four degree exclusion zone. These documents may prove what is already apparent—that this was a trial-and-error exercise aimed at picking the exclusion zone angle that attempts to display compliance with EPFD limits based on a fallacy.

I. Background

The exclusion zone is made up of the paths between any potential victim GSO earth station receiving satellite television and an area around the geostationary arc. This is a path in which that satellite television earth station is especially sensitive to NGSO transmissions, because these transmissions interfere directly with the victim dish’s main beam. Figure 1, based on ITU Recommendation S.1503-2, has been adapted to show the conical exclusion zone for a satellite television dish in Northern Africa, using an angle of 18 degrees. The concept applies equally well worldwide. Because satellite television dishes exist throughout the country, the

³ See Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Feb. 24, 2022), Exhibit 1, Demonstration of EPFD Compliance (“SpaceX Feb. 24, 2022 EPFD Files”).

exclusion zone for an NGSO system is anywhere in the path between the U.S. and a certain number of degrees on either side of the geostationary arc.



SpaceX provided two groups of power level files to DISH. The first group, provided on February 4, 2022, was based on the 18-degree zone illustrated in Figure 1.

The second group of files provided to DISH by SpaceX on December 30, 2022 showed a significant change: Suddenly, the exclusion zone had shrunk from 18 to 4 degrees, as illustrated by Figure 2.

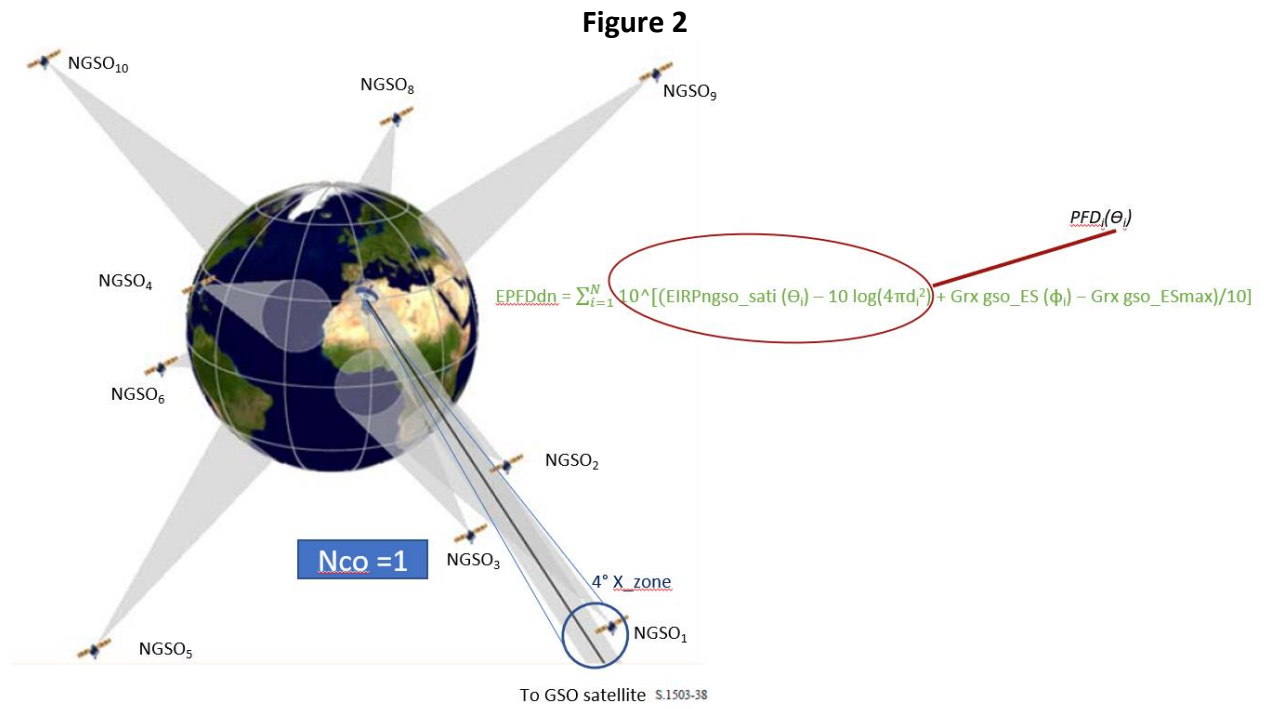
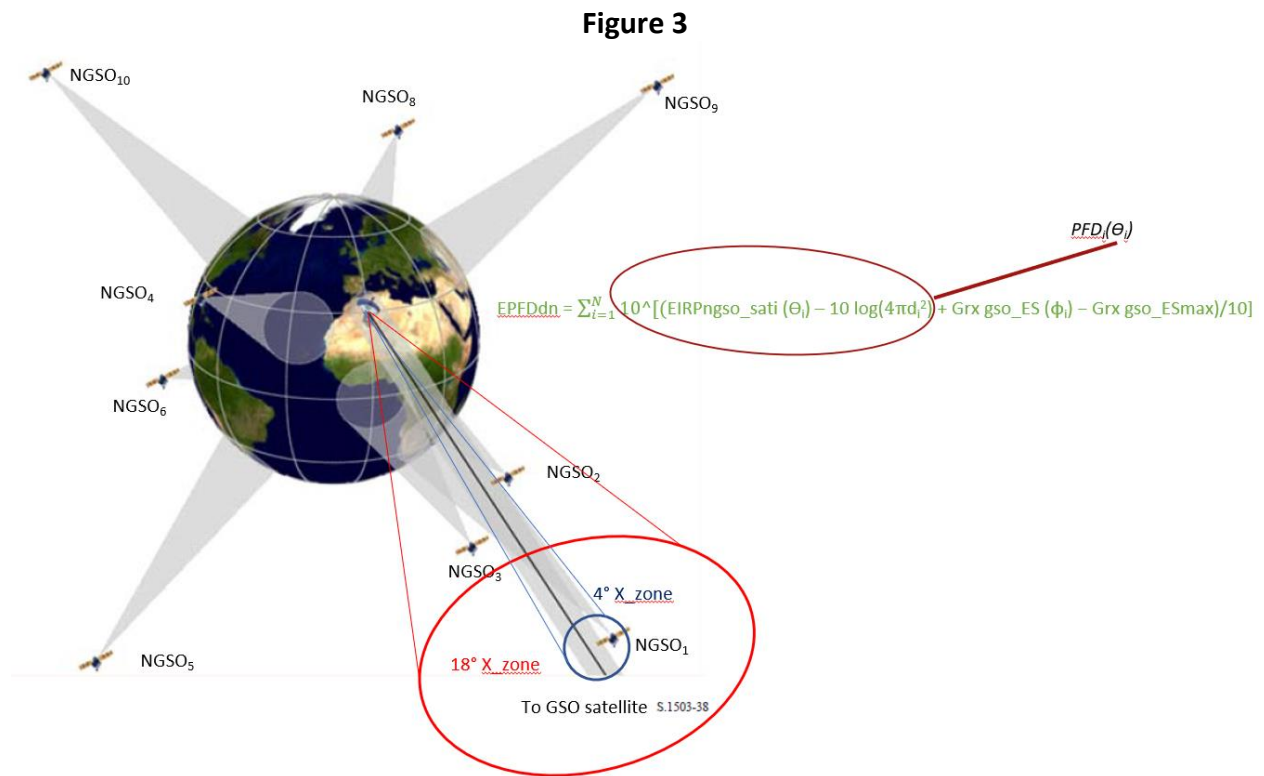


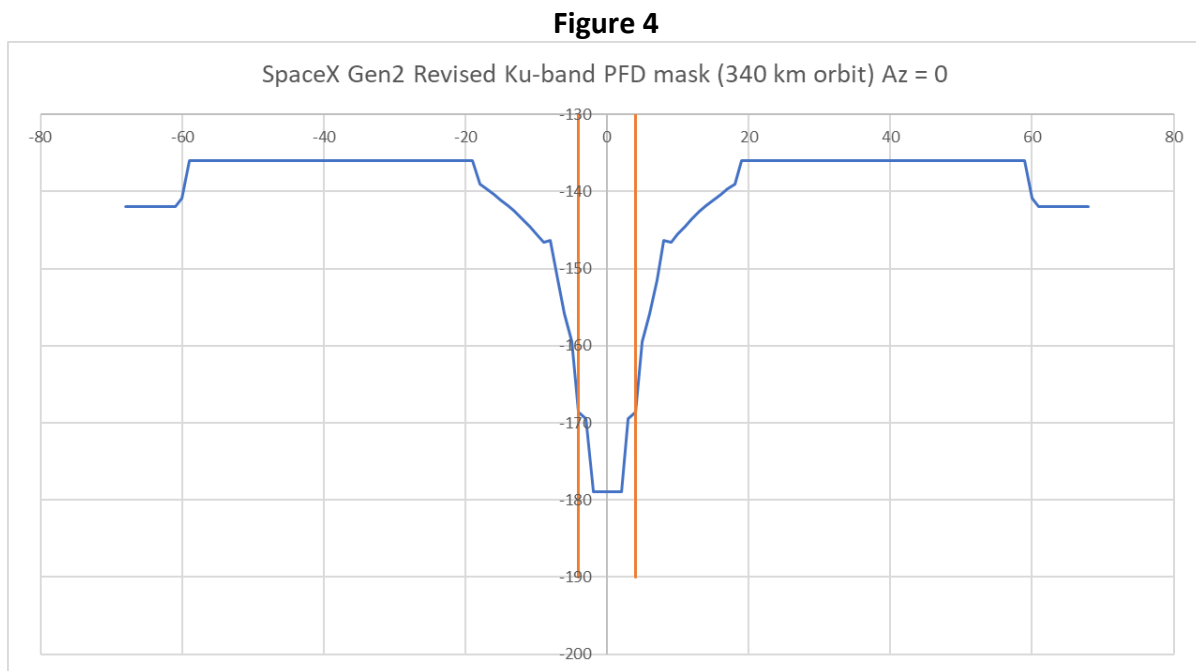
Figure 3 shows the two conical areas superimposed on one another.



II. The Exclusion Zone is Defined by the ITU

How is the border of the exclusion zone defined? SpaceX would apparently have us believe that it lies in the eye of the beholder, and that the proponent of an NGSO system can set it at whim and at such an angle that it can show compliance with the power limits. Not so. In Recommendation ITU-R S.1503, the authoritative document on the method for evaluating compliance with the EPFD limits, the ITU expressly provides that: “[u]se of α or X angle pfd masks implies that *the same definition* of GSO angle is used for exclusion angle in the calculation of epfd.”⁴ The rule could not be more clear. The exclusion zone angle for the purpose of calculating EPFD is the “same” as the angle of the PFD mask.

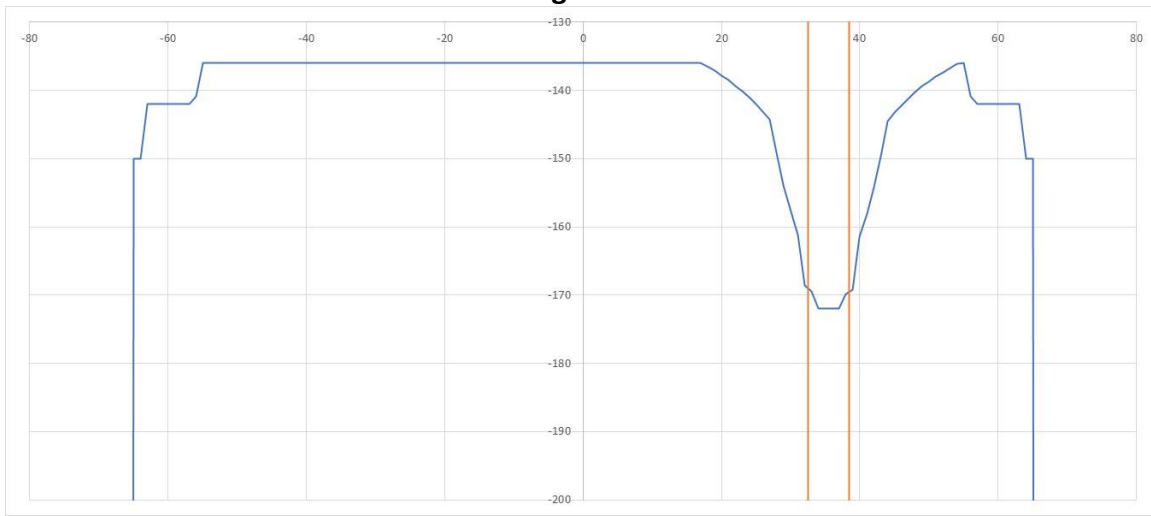
Let us now look at SpaceX’s PFD mask, which can be readily depicted based on the latest revised power level calculations provided by SpaceX to DISH. Figure 4 below shows the mask for a NGSO satellite located at the Equator, and another depicting a satellite at 30°N latitude, which could be in-line with the GSO arc for DBS terminals located in the southern United States.



Revised mask is consistent with a 20° exclusion zone: at its maximum, the PFD is -136 dBW/m² for angles greater than 20°, and starts falling off at that angle.

⁴ ITU Recommendation S.1503-2, Part C § 2.1 (emphasis added).

Figure 5



Revised mask is consistent with a 20° exclusion zone: at its maximum, the PFD is -136 dBW/m² for satellite off-axis angles below 18° and above 55° (which are 20° away from the in-line “ α_0 ” when converted to earth-based coordinates) and starts falling off at those angles.

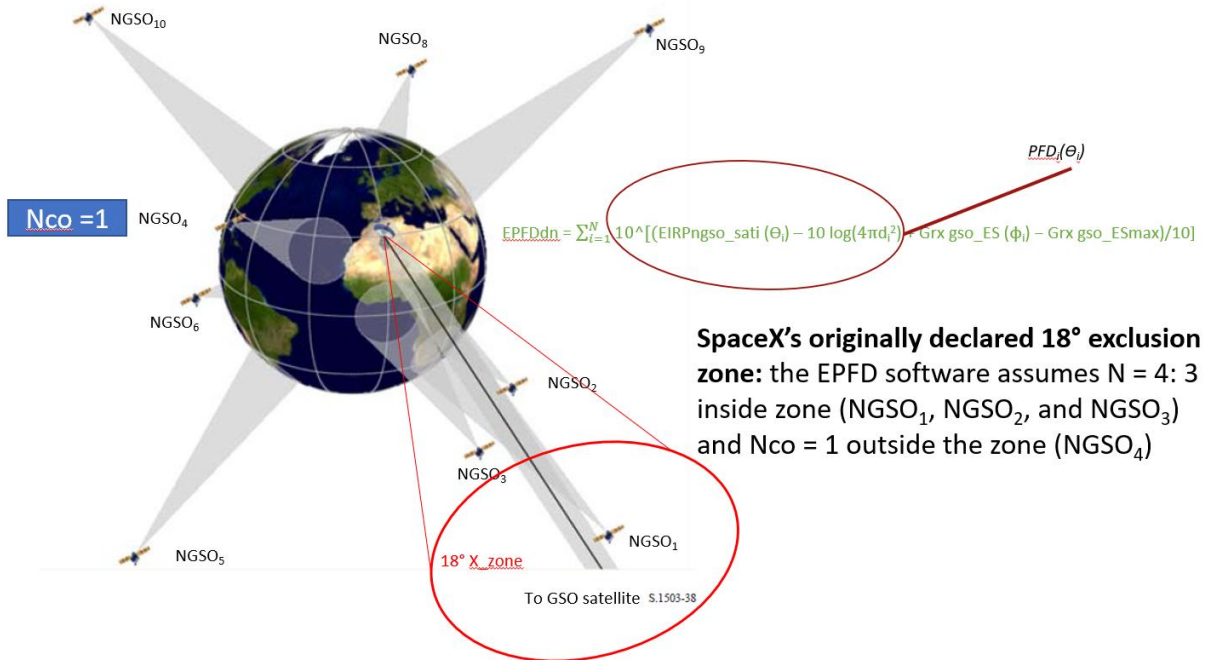
These depictions show that the mask angle is no less than 18 degrees (actually it appears to be closer to 20 degrees). This is where the power of the Starlink system has to start falling off to protect satellite television dishes in the 12 GHz band. It is nonsensical to argue that the power starts falling off at 4 degrees (the orange vertical lines in the graphs above). It is also notable that at no point is there a total switch-off of power; even below four degrees, the Starlink beam transmits at least -179 dBW/m² per 40-kHz band in the first case and -172 dBW/m² per 40-kHz band in the second. And so, even aside from the ITU’s definition of the exclusion zone angle as the “same” as the mask angle, SpaceX cannot argue that four degrees is some magical line that deserves to be the border of the new exclusion zone on the ground that satellites are totally switched off within that line: they are not. An exclusion zone does not mean that NGSO satellites may not orbit or may not transmit inside the zone at all. This is consistent with the ITU’s software, which recognizes that NGSO satellites can still transmit in that zone, and allows the user to set values for these transmissions. An exclusion zone means that the satellites within that zone must operate at reduced power consistent with the mask in light of the sensitivity of the victim dish’s boresight. The exclusion zone angle is the mask angle, and for the SpaceX Gen2 filing that is no less than 18 degrees.

III. The Arbitrary Definition of The Exclusion Zone as Different From SpaceX’s Mask Creates A False Impression of Compliance

The limits of the exclusion zone are significant inputs for the ITU’s software. The software considers only the satellites in the exclusion zone and, under an “Nco” of one; one satellite outside the zone (the one contributing the most power) in calculating a system’s power for purposes of comparing that power to the power limits.

Thus, in the illustrative example of Figure 6, the power of a total of four satellites will be included in the calculation.

Figure 6



By contrast, with the sham zone of four degrees, as seen in the illustrative example of Figure 7, only two satellites will be included.

Figure 7

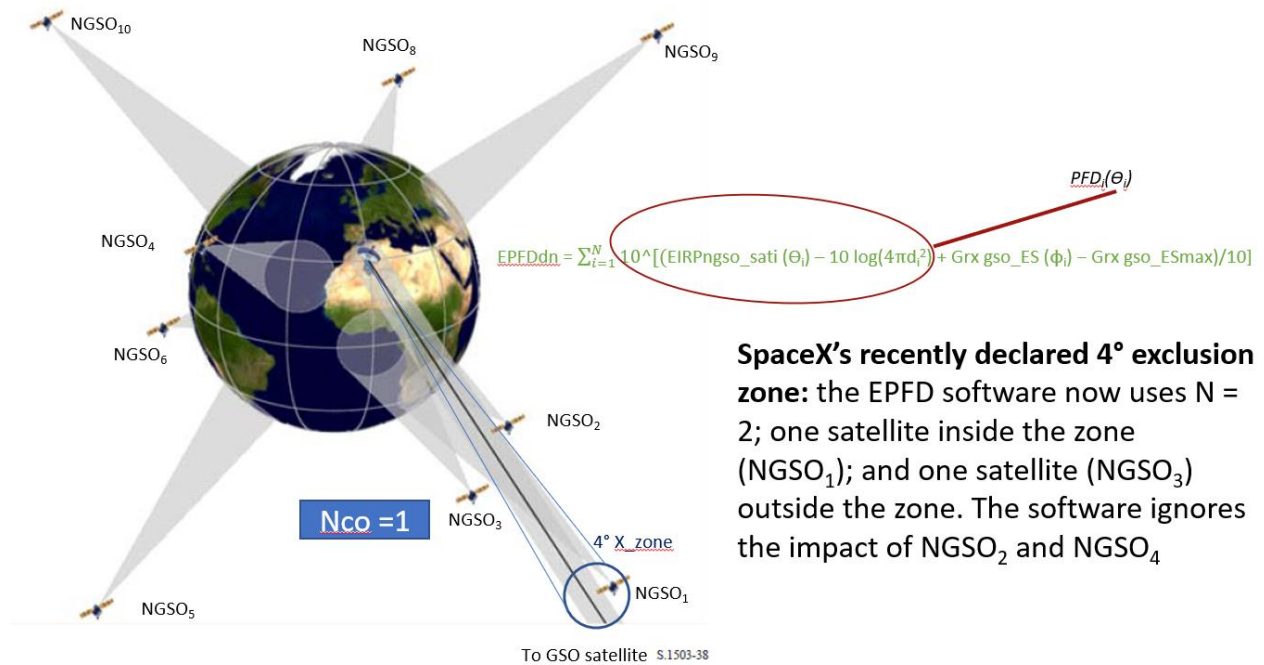
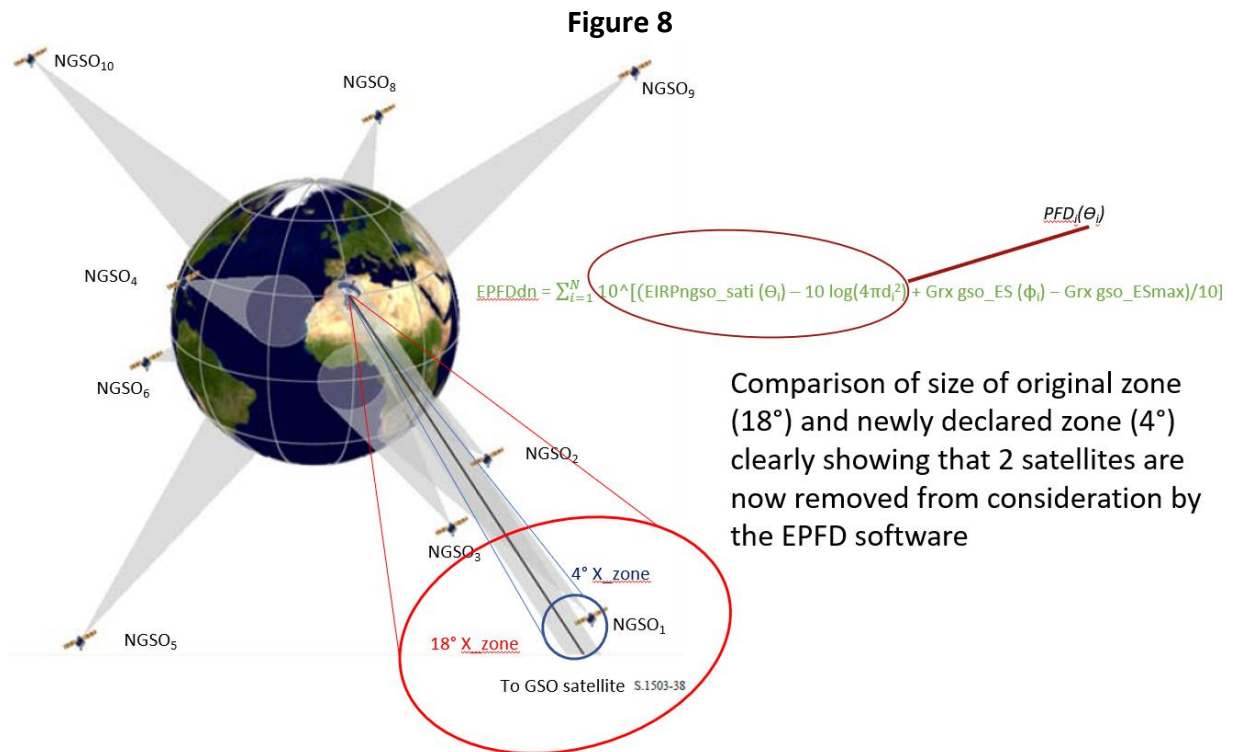


Figure 8 compares the previous exclusion zone with the shrunk one and illustrates vividly that the shrinkage removes two satellites from the calculation.

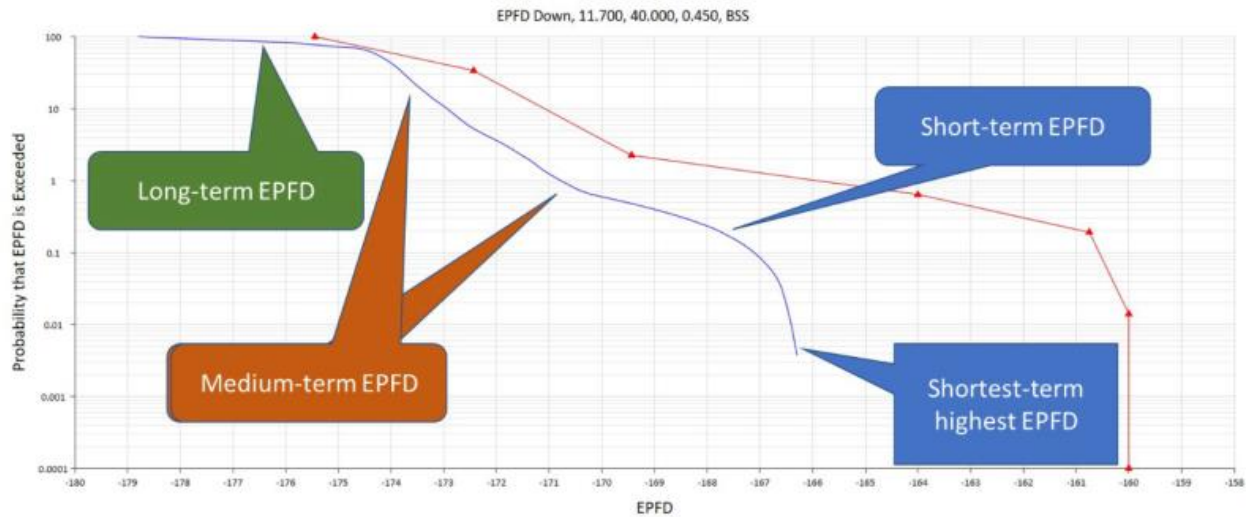


Note: the foregoing figures only show the GSO exclusion zone as a cone, which is the proper representation for a defined GSO link for a given satellite orbital slot. The ITU rules require the definition of the exclusion zone for the entire GSO arc as seen from any given point on the Earth’s surface. Therefore, the GSO exclusion zone is really a band around the GSO arc. This is for the protection of receivers communicating with any GSO satellite and ensures protection of DISH subscribers, as well as those of other DBS operators, no matter which satellites they receive service from.

In the case of SpaceX, due to its sheer size, an 18-degree exclusion zone would likely show dozens or even hundreds of satellites in the zone putting down lower sidelobe power into the GSO terminal, and a single “serving” NGSO satellite outside the zone putting down maximum power on that area. By contrast, a 4-degree zone would mask the power contributions of most of these satellites, and take into account only those of a limited number.

Therefore, the result of shrinking the exclusion zone is that there will be substantially fewer satellites inside the GSO exclusion zone at any one time. This is especially important because the satellites inside the exclusion zone are responsible for the majority of the short-term,

higher EPFD levels, as well as the medium term EPFD levels that are generated on the DBS subscriber antenna's main beam, as shown on the below diagram.⁵



Second Gen-2 Study Figure 32 – Example EPFDdown Cumulative Distribution Function (CDF) Curve

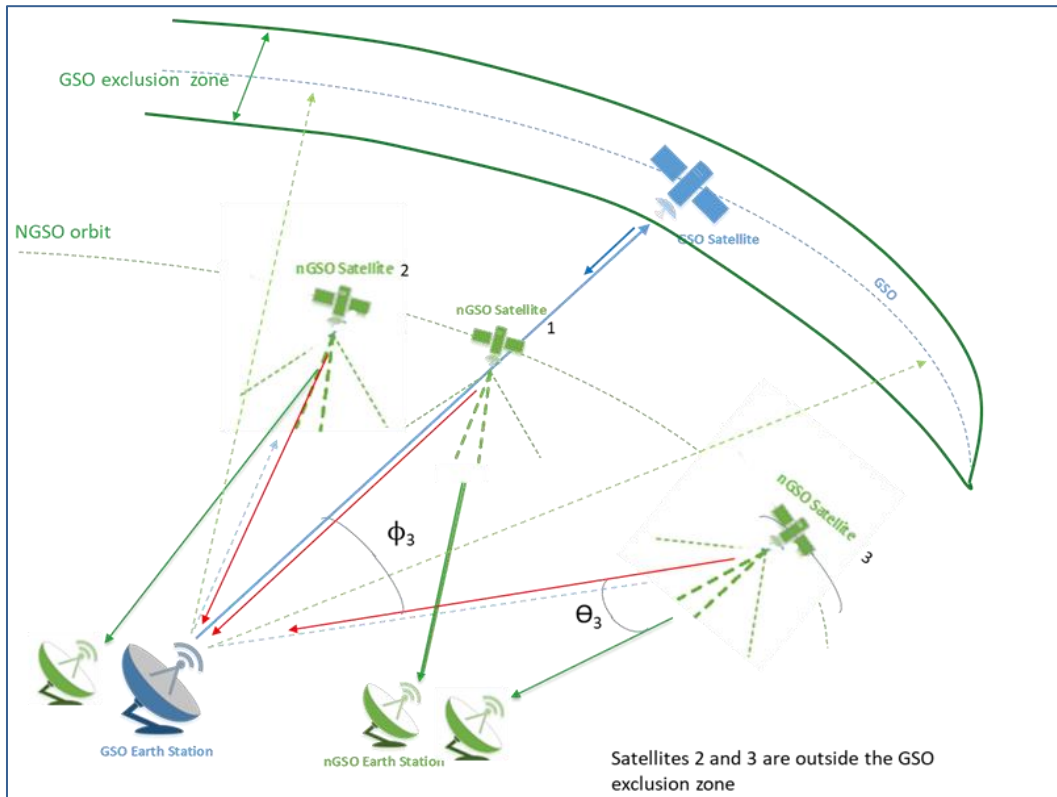
Thus, SpaceX's reduction in the GSO avoidance angle will have the greatest effect on short and medium-term EPFD, which originates from the aggregate of all NGSO satellites located within the GSO exclusion zone.

As shown below, there could be many NGSO satellites inside the GSO exclusion zone (between the blue and red lines), but typically only one will be exactly on the line between the GSO satellite and its earth station at any given time.

⁵ Maximum EPFD occurs when the interference originates from an NGSO satellite's sidelobes when a satellite is inside the GSO exclusion zone, close to its main pointing direction, but where the NGSO FSS satellite antenna points away from the interfered-with GSO location. For example, if the GSO interfered-with site is in Colorado, the NGSO satellites inside the exclusion zone may provide service to northern Mexico, California, Texas, Montana and Kansas, so that the GSO earth station would only receive low-power sidelobe emissions. With a reduced GSO arc avoidance angle, the number of such satellites will be greatly reduced.



When the exclusion zone is larger (such as SpaceX's original 18 degrees), there would be dozens or even hundreds of satellites operating inside the exclusion zone with much-reduced PFD levels but aggregating to a significant mid-term EPFD level when none of them is completely dominant, which is the case of Satellite 1 in the image below. In the example EPFD curves provided above, which were for a small subset of the Gen2 constellation from DISH's March 2022 submission, the portion of the EPFD interference between about -173 dBW/m² per 40-kHz (occurring less than 10% of the time) and -170 dBW/m² per 40 kHz (more than 0.5% of the time) is mostly caused by satellites located inside the exclusion zone, as these pass near, but just outside, the GSO earth station main beam (such as satellite 2 in the image below).



Shrink the exclusion zone, remove the power contributions of many satellites, and, *presto*, you achieve compliance. This would be unacceptably evasive even if the ITU rules did not define the exclusion zone angle as the same as the mask angle. But they do, making SpaceX's much-revised analysis a blatant violation.

IV. The Shrunk Exclusion Zone Is Also Inconsistent With SpaceX's Past Representations, As Well As Its Current System

Critically, SpaceX has repeatedly represented to the Commission that it implements at least an 18-degree exclusion zone:

- “[T]he SpaceX System will implement GSO arc avoidance to protect against interference into GSO systems. Specifically, SpaceX will turn off the transmit beam on the satellite and user terminal whenever the angle between the boresight of a GSO earth station (assumed to be collocated with the SpaceX user) and the direction of the SpaceX satellite transmit beam is 22 degrees or less . . . Because of the characteristics of the system, including suppression of potentially interfering satellite and earth station transmissions through the application of sidelobe nulling, the necessary GSO arc avoidance angle is 22 degrees.”⁶

⁶ Space Exploration Holdings LLC, File No. SAT-LOA-20161115-00118, Attachment A at 40-41.

- “SpaceX assumes that SpaceX satellites within 18 degrees of the GSO arc and O3b satellites within 2 degrees of the GSO arc are not eligible for communications.”⁷
- “[T]he EPFD data files that SpaceX provided to SES/O3b in connection with its 2019 modification specified an 18-degree avoidance angle for the NGSO system the Commission later approved.”⁸
- “[W]hile SpaceX previously determined that it could operate satellites in the Gen2 constellation within EPFD limits *at full power* while observing a GSO avoidance angle of approximately 18 degrees, by reducing power as its satellites approach the GSO arc, SpaceX can continue to operate at angles less than 10 degrees while still complying with EPFD limits.”⁹

In other words, a line on either side of the GSO arc is the limit within which SpaceX must *reduce* power in light of the sensitivity of victim GSO dishes. The power levels that SpaceX prepared initially for submission to the ITU and provided both to the parties and the ITU are consistent with that position: they were based on an exclusion zone of 18 degrees. Thus, the power level calculations included all satellites located in the conical area defined by 18 degrees on either side of the GSO arc.

In the Order granting in part the Gen2 application, the Commission likewise cited to SpaceX’s statement that it “intends to operate at full power when at an angle of 18 degrees or more with respect to the GSO arc, but it intends to continue operations at smaller angles, reducing power to comply with EPFD limits in accordance with our rules, down to angles less than 10 degrees with respect to the GSO arc.”¹⁰ Based on that statement, the Commission found “SpaceX’s proposed GSO avoidance angle plan would be sufficient to protect GSO operators from harmful interference,” and that SpaceX therefore needed to “operate its constellation with all technical parameters described in its application, as amended, and any supplemental

⁷ Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File No. SAT-MOD-20200417-00037, at 7 (Feb. 22, 2021) (“[T]he 18-degree GSO avoidance angle observed by SpaceX will preclude virtually any connection between a SpaceX earth station and SpaceX satellites that could have resulted in an inline geometry with an O3b satellite in equatorial orbit.”); *see also* Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, File No. SAT-MOD-20200417-00037 (July 27, 2020), App. A, at A-8 (“O3b’s analysis appears not to have accounted for the 18 degree GSO avoidance angle observed by the SpaceX system[.]”).

⁸ Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File No. SAT-MOD-20200417-00037, at 3 (Nov. 13, 2020).

⁹ Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, at 9 (Aug. 19, 2022) (emphasis added).

¹⁰ Space Exploration Holdings, LLC, *Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System*, Order and Authorization, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, FCC-22-91 ¶ 35 (Dec. 1, 2022) (“Gen2 Order”).

information submitted on the record” including the GSO avoidance angle.¹¹ These “technical parameters” include the power level submission made to the Commission on February 24, 2022. They do not include the revised submission provided to the Commission outside the record of the proceeding. All of this means that the 18-degree exclusion zone and the power level calculations based on that zone are made explicitly part of SpaceX’s license.

SpaceX also seems to still implement an exclusion zone of at least 18 degrees, despite its claim of a shrunk one. As mentioned, even under the revised power analysis sent to DISH on December 30, 2022, SpaceX reduced the power of its satellites at around 20 degrees. Certainly, SpaceX did not do this because the power reduction is beneficial to its customers—it is not, as it makes service difficult or impossible. Rather, SpaceX apparently did it for one reason only—because it is necessary to protect satellite television receivers within their sensitive main beam. The starting point for the power reduction is the starting point for the mask protecting satellite television. It is not an instance of a capricious SpaceX decision to reduce power without needing to implement a protective mask and at the expense of its customers. The area between 18 and 4 degrees is one of reduced power within the mask, not of high-power service outside it.

V. SpaceX Has Apparently Proceeded by Trial-and-Error to Obtain the Desired Result

Why did SpaceX revise its power level calculations and its exclusion zone? The reason appears to be simple—to create the appearance that the entire system’s power levels comply with the limits. SpaceX had initially tried to avoid a showing of non-compliance by arguing that its entire system does not matter and by artificially splitting it into 18 subsystems, each of which would—just—be shoehorned into the limit. DISH showed that, while each of these 18 divisions would barely meet the limits, the entire constellation would sharply exceed them.¹² To that, SpaceX said nothing except argue, again, that the entire system does not matter. But the Commission did not agree with SpaceX. As the Gen2 Order explained, “[w]e also require SpaceX to obtain a finding from the ITU that explicitly indicates the ITU has considered the joint effect of SpaceX’s multiple ITU filings.”¹³ Faced with the failure of that argument, SpaceX was unable to rebut DISH’s showing, and resorted to Plan B: remove the power contributions of many Starlink satellites by shrinking the exclusion zone. Of course, the initial power submission was not some draft workpaper that was rejected because it did not yield the desired result. It was the only submission made on the record of the proceeding in fact, the revisions never made it *to* the record. Just as important, achieving the desired result required violating the ITU’s definition of exclusion zone.

And this was not the first attempt in SpaceX’s campaign to fit a system that plainly exceeds the EPFD limits into these limits. While SpaceX has represented from its initial

¹¹ *Id.*

¹² Reply of DISH Network Corp. to Opposition and Response to Comments of Space Exploration Holdings, LLC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Mar. 8, 2022), Exhibit 1, *Second Technical Study on SpaceX Second-Generation System* at 25, Figure 17.

¹³ Gen2 Order ¶ 32.

application that the Gen2 system complied with the limits, it has had to reduce the system's power by 6 dB to improve its showing. Even then, compliance depended on the 18-way split. But the Commission foreclosed that attempt. Now SpaceX's exclusion zone shrinkage and attendant violation of the ITU method appears to be SpaceX's last resort.

Here is the chronology of SpaceX's results-oriented approach.

- May 26, 2020: SpaceX's application for its Gen2 System provides EPFD levels and certifies compliance with EPFD limits based on that information.¹⁴ SpaceX did not provide the PFD mask data files for review.
- August 18, 2021: SpaceX files an amendment to the application;¹⁵ SpaceX still certifies its compliance with EPFD limits, but does not correct the previously submitted maximum PFD levels, nor did it provide revised EPFD results.
- January 19, 2022: SpaceX admits that the May 26 EPFD levels are not accurate.¹⁶
- February 4, 2022: SpaceX supplies DISH with PFD input information;¹⁷ the maximum PFD levels are 6 dB lower than the PFD information in the August 18 amendment, which was never corrected.
- February 24, 2022: SpaceX submits the input information (SRS database, PFD masks) required for EPFD validation to the Commission.¹⁸
- October 27, 2022: SpaceX asserts in a throwaway sentence for the first time that "recently submitted combined EPFD data files . . . when analyzed with the ITU-approved validation software, comply with the applicable EPFD limits."¹⁹ No such data existed then, or exist now in the record.
- December 30, 2022: SpaceX provides the combined EPFD files to DISH four days before the deadline to file a notice of appeal of the Gen2 Order.

¹⁴ Space Exploration Holdings, LLC, Application for Satellite Space Station Authorizations, File No. SAT-LOA-20200526-00055, Attachment A at 26 (filed May 26, 2020).

¹⁵ Space Exploration Holdings, LLC, Application for Space and Earth Station Modification, File No. SAT-AMD-20210818-00105 (filed Aug. 18, 2021).

¹⁶ See Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Feb. 2, 2022) ("SpaceX explained that the original data sought was no longer relevant because the configuration of the Gen2 system had changed"); DISH Network Corp., Motion to Hold Proceeding in Abeyance Pending Development and Production of Information by the Applicant, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Jan. 27, 2022), Exhibit 1 (Letter from SpaceX counsel) (EPFD data used for the Gen2 application "is no longer relevant given SpaceX's decision to pursue a different orbital configuration for its Gen2 System.").

¹⁷ Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Feb. 4, 2022).

¹⁸ See SpaceX Feb. 24, 2022 EPFD Files.

¹⁹ Letter from David Goldman, SpaceX, to Marlene Dortch, FCC, File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, at 2 (Oct. 27, 2022).

In short, SpaceX originally submitted unsubstantiated EPFD results when it filed its Gen2 application in 2020; it did not even bother producing EPFD results with the 2021 amended application; no PFD data files were available to third parties until DISH and others insisted; and when DISH demonstrated the excess EPFD levels of the combined system, SpaceX performed its most recent manipulation to evade this result. But this latest attempt has brought SpaceX into a direct clash with the ITU method SpaceX supposedly considered inviolate²⁰ and with the interests of the millions of U.S. satellite television customers the rules are intended to protect.

For the foregoing reasons, the United States should not forward SpaceX's analysis to the ITU. If that analysis has been forwarded, the United States should inform the ITU of the violation of the exclusion zone definition, and should also represent DISH, since the effect of the Starlink system on DISH and its customers also makes the United States an affected administration under the ITU procedures.

Respectfully submitted,

/s/ Pantelis Michalopoulos
Pantelis Michalopoulos
Counsel to DISH Network Corporation

²⁰ See *Space Exploration Holdings, LLC's Final Resp. Br. as Intervenor for Resp't at 3, Viasat, Inc. v. FCC*, 47 F.4th 769 (D.C. Cir. 2022) (No. 21-1123) (“[T]he Commission made the expert decision in a notice-and-comment rulemaking to incorporate the ITU standards and methodologies into federal law. The Commission therefore did not act unreasonably—much less unlawfully or unconstitutionally—in crediting SpaceX's certification with ITU standards and requiring SpaceX to obtain ITU approval[.]”).

DECLARATION OF MARC DUPUIS

I, Marc Dupuis, being over 18 years of age, swear and affirm as follows:

1. I make this declaration using facts of which I have personal knowledge of, or based on information provided to me.

2. I joined Telecomm Strategies LLP in April 2020 after retiring from OneWeb, where I directed the spectrum team. Before joining OneWeb, I spent twelve years at Industry Canada, in progressively more senior roles, my last was Director General for the Spectrum Engineering Branch. I directed the regulatory planning and engineering of the radio spectrum and telecommunication for the benefit of Canadians. Before accepting a position in the federal government, I worked eighteen years in the private sector, first with Telesat Canada and then as the Director of the Canadian office for Teledesic, a start-up satellite company.

3. The foregoing has been prepared using facts of which I have personal knowledge or based upon information provided to me. I declare under penalty of perjury that the foregoing is true and correct to the best of my current information, knowledge, and belief.

/s/ Marc Dupuis
Marc Dupuis

Date: March 6, 2023