September 24, 2020

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Viasat, Inc. *Ex Parte* Letter, IBFS File Nos. SAT-MOD-20200417-00037, SAT-MPL-20200526-00056

Dear Ms. Dortch:

Viasat writes in response to the letter of Dr. Jonathan McDowell dated September 21, 2020.[1] Viasat greatly appreciates the work that Dr. McDowell and others have done in analyzing the SpaceX Starlink constellation. Viasat has followed Dr. McDowell's "Reentered and Bad Starlinks" web page with great interest, and especially his work on identifying non-maneuvering Starlink satellites. Viasat also admires Dr. McDowell's efforts in highlighting the impact of Starlink satellites on astronomy and his continuing work to address the impact of mega constellations.

As detailed below, Viasat has referenced Dr. McDowell's web page with respect to the underlying data, and we did not intend to imply that Dr. McDowell has expressed a specific view on the failure rate of SpaceX satellites. In fact, as we discuss more fully, given the lack of transparency from SpaceX regarding in-orbit failure analysis, we are integrating information and perspectives from multiple sources, in order to form reasonable interpretations from observable data. We encourage the Commission to request data from SpaceX that will provide greater clarity and certainty on this matter.

Viasat's estimate of SpaceX failures is based on (i) the significant and increasing number of satellites that SpaceX has reported as having lost or diminished maneuverability capabilities

[1] *See* Letter of Dr. Jonathan McDowell, IBFS File Nos. SAT-MOD-20200417-00037, SAT-MPL-20200526-00056 (filed Sep. 21, 2020) ("*McDowell Letter*").

above injection orbit,[2] (ii) its own analysis, and analysis by others (including Dr. McDowell) of Starlink orbits to identify satellites that are not being maneuvered, and (iii) the number of Starlink satellites that otherwise have failed to operate as intended beyond the initial portions of their five-year design lives, and that have been (or are being) deorbited.[3]

Viasat believes that data about all Starlink failures are relevant, more specifically:

- All but 60 of SpaceX's 700+ satellites have been operating for well less than a year, and those 60 were launched just 16 months ago.

- In May 2020, SpaceX disclosed that 12 of the 420 satellites it had launched since May 2019 had "lost maneuverability" above injection orbit.[4]

- In June 2020, SpaceX disclosed that of the 478 satellites launched "over the past year," nine "have since suffered diminished maneuvering capability."[5] Based on a comparison with the failure list provided in May, these nine apparently include only six of the same satellites previously described as having "lost maneuver capabilities above injection altitude."[6]

- The June disclosure thus reveals the existence of three additional failed satellites, which brought to 15 the total of Starlink satellites that SpaceX had reported with maneuverability problems earlier this year.

- The June disclosure does not (i) account for the 60 satellites SpaceX launched in May 2019 or the six failed satellites from that tranche, (ii) address whether more of those original 60 satellites have failed, or (iii) address maneuverability failures at injection orbit for any satellite from any tranche.

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[2] SpaceX has publicly informed the Commission twice about the loss of maneuverability capabilities on its spacecraft, but has addressed those spacecraft failures only with respect to satellites "at an altitude above injection." Letter from William M. Wiltshire, Counsel to SpaceX, to Jose P. Albuquerque, Chief, Satellite Division, FCC, IBFS File No. SAT-MOD-20200417-00037, at 4-5 (filed May 15, 2020) ("*SpaceX May 15 Letter*"); Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, at 1 (filed June 23, 2020) ("*SpaceX 2020 Annual Report*"). In other words, SpaceX has not reported those satellite failures that occurred at its launch altitudes.

[3] SpaceX indicated in June 2020 that it had deorbited spacecraft that were "not performing optimally," without identifying the root cause(s) of the failure(s) to achieve design specifications, or how that led to the need to deorbit satellites one year or less into their five-year design life. *SpaceX 2020 Annual Report* at 1.

[4] *SpaceX May 15 Letter* at 5.

[5] *SpaceX 2020 Annual Report* at 1.

[6] *SpaceX May 15 Letter* at 4-5.

- Dr. McDowell reports that 24 SpaceX satellites are not maneuvering and that such information supports an inference that such non-maneuvering satellites have failed.[7]

- Dr. McDowell also reports that half of the 60 satellites that SpaceX launched in May 2019 have deorbited—30 satellites—and that five of the satellites launched since November 2019 also have deorbited or "[r]eentered after fail."[8]

- In other words, a total of 35 satellites designed to last for 60 months decayed within 16 months or less.

- SpaceX has explained that its many failed satellites with lost or "diminished" maneuverability capability will passively deorbit over time because of gravity and drag, and not because SpaceX can effectuate a controlled disposal.[9]

- The number of failures of the Starlink satellites launched to date that Viasat has calculated is an absolute lower bound. A reasonable expectation is that more such satellites will fail as operational life extends further into the stated five-year design life.[10]

Viasat believes that all such failures occurring with SpaceX's currently-authorized system (whether from the original launch in May 2019 or later) are relevant in evaluating SpaceX's proposed third modification.[11] That is, failures as to the first 60 satellites, and failures of satellites that have been disposed of, cannot simply be wished away after the fact. All of the data needs to be considered, both (i) before one can consider what data is relevant, and (ii) to ultimately assess the scope and nature of the SpaceX failure problem.

In fact, all such failures inform two very relevant questions: (i) whether SpaceX's previous commitments as to the reliability of its currently-licensed system, in fact, *are being achieved*, and (ii) whether what SpaceX promised under its proposed third modification *can be achieved*. As the Commission said in April:

> In appropriate circumstances, the Commission could subsequently modify the license in accordance with Section 316 of the Communications Act *to address a rate of failure*

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7 *See McDowell Letter* at 1; Jonathan McDowell, "Reentered and Bad Starlinks," https://planet4589.org/space/stats/megacon/starbad.html (last visited Sep. 23, 2020) ("*McDowell Starlink Analysis*").

8 *See McDowell Starlink Analysis*.

9 *SpaceX 2020 Annual Report* at 1; *SpaceX May 15 Letter* at 4.

10 *See* Reply of Viasat, Inc. to Opposition of Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20200417-00037, at 20-21 (filed Aug. 7, 2020) ("*Viasat Reply re SpaceX Third Modification*").

11 *See* Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20200417-00037 (filed Apr. 17, 2020).

that departs materially from the expected reliability level, since that departure would affect the public interest assessment underlying grant of the license.[12]

Viasat's record position on the relevance of all of these types of failures has been clear on the record for months now. As Viasat previously explained:[13]

- Failure can manifest itself in a variety of ways, including at injection orbit or during orbit raising, spacecraft maneuvering and station-keeping anomalies, and spacecraft that do not achieve stated design life.
- Early failure may signal long-term reliability problems with other spacecraft in the constellation using similar designs or components, or those manufactured, tested, or launched in the same lot.
- Early failure can be a "red flag" that expectations are not being met, and that suitable adjustments are required before more spacecraft are launched.
- The failure of a spacecraft to achieve the five-year design life described in an application similarly is a sign that expectations are not being met.
- In this case, the SpaceX failures warrant further examination of the reliability level assured at the application stage.
- Simply deorbiting failed satellites does not excuse or explain the cause of anomalous failure rates or provide any assurance that other satellites of the same design will not fail later.

Because SpaceX has refused to address these issues with respect to its pending third modification application, we still do not know with certainty (i) why the 1% failure rate that SpaceX assured the Commission its system would be "nowhere near"[14] now is being significantly exceeded, or (ii) why SpaceX's failure rate, in fact, is increasing. Nor do we know the root causes of these failures.[15] Indeed, given SpaceX's refusal to address the many questions that have been raised about its failure rates, including addressing root causes and any remediation, all the public can do, as Dr. McDowell suggests, is draw inferences from the available data.

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[12] *Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020), at ¶ 99 (footnotes omitted) (emphasis supplied).

[13] *See, e.g.*, Petition to Deny or Defer of Viasat, Inc., IBFS File No. SAT-MOD-20200417-00037, at 34 (filed July 13, 2020) ("*Viasat Petition re SpaceX Third Modification*").

[14] *See* Letter from William M. Wiltshire, Counsel to SpaceX, to Jose P. Albuquerque, Chief, Satellite Division, FCC, IBFS File No. SAT-LOA-20161115-00118, at 4 (filed Apr. 20, 2017). In response to a request from the Commission that SpaceX "provide an analysis of collision risk, assuming rates of satellite failure resulting in the inability to perform collision avoidance procedures of 10, 5 and 1 percent," SpaceX represented: "SpaceX will construct its spacecraft to specifications and tolerances to ensure that failure rates are nowhere near the [1, 5 or 10 percent] levels postulated in this question." *Id*.

[15] *Viasat Petition re SpaceX Third Modification* at 14-16, 21-23, 31-32; *Viasat Reply re SpaceX Third Modification* at 2-3, 16-24.

Furthermore, any such failures that significantly impair spacecraft maneuverability could require that a satellite passively deorbit over a period of approximately five years.[16] And until they eventually deorbit, non-maneuverable SpaceX satellites pose a risk of collisions—the kinds of collisions that fragment spacecraft and send large debris clouds into orbits hundreds of kilometers above and below the point of impact, which can take decades or even more than a century to passively deorbit.[17]

Viasat's analysis using SpaceX's own data (which SpaceX does not rebut) reveals that SpaceX's experiential failure rates:

- Alter the collision risk analysis underlying its prior grants of authority.
- Materially depart from SpaceX's prior assurances to the Commission about the reliability of its satellites.
- Are getting worse over time, and not better.[18]

In response to SpaceX's claim that Viasat somehow "sought to impose" failure rates "on other NGSO systems," and SpaceX's suggestion that Viasat assume a 10% failure rate for its own LEO system, Viasat recently pointed out that SpaceX (not Viasat) had actually experienced a failure rate of nearly 7% of its constellation as of September 6, considering all of these types of failures.[19]

Notably, Dr. McDowell's own summary of "Deorbited, Malfunctioning and [A]nomalous Starlinks" *today* suggests that only 654 of the 713 Starlink satellites (v0.9 and v1.0) are "working."[20] With the reasonable characterization of all non-"working" satellites as failures (for the reasons above), this updated data[21] implies an 8.3% failure rate—a value that exceeds Viasat's previous 7% estimate.

In his letter, Dr. McDowell suggests that his analysis implies a current failure rate of "at most 3% (and possibly less)."[22] The disconnect between his interpretation of the data and Viasat's is due to the narrow definition of "failure" that Dr. McDowell uses in his letter. Specifically, in calculating that value, he appears to count as "failures" only the v1.0 satellites that his analysis has identified to be non-maneuverable.

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16 *See Viasat Reply re SpaceX Third Modification* at 9 (calculated at operational orbit).

17 *See id.* at ii, 2, 11, 21.

18 *See id.* at i, 22-24, 40-42.

19 *See* Consolidated Opposition to Petitions and Response to Comments of Viasat, Inc., IBFS File No. SAT-MPL-20200526-00056, at 52 (filed Sep. 15, 2020).

20 *McDowell Starlink Analysis*. (Several addition errors exist in that summary table. Corrected values are total deorbited equals 36, total still in orbit equals 678, and total working equals 654.)

21 Dr. McDowell's summary of Starlink satellites that have "[d]eorbited" or "[r]eentered after fail" though September 22 now includes 11 more Starlink satellites than it did on September 6.

22 *McDowell Letter* at 1.

Viasat is not aware of any valid basis for treating the v0.9 Starlink satellites (the first 60) as "early prototypes" and thus somehow "unrepresentative" of the Starlink system.[23] To the contrary, SpaceX's 2019 annual report to the Commission treats those initial 60 satellites as an integral part of its authorized system.[24] Moreover, for the purpose of evaluating whether SpaceX is achieving the reliability level that it represented to the Commission it would achieve, Viasat believes that all failures—including failures of satellites that have been disposed of—are relevant.

Even though Viasat respectfully disagrees with Dr. McDowell about which data is relevant to assessing SpaceX's failures, we note that Dr. McDowell also discusses other scenarios under which he calculates (using his own definition of failure) a SpaceX failure rate of 3-4%, which also is well above the 1% failure level that SpaceX previously assured the Commission it would design and manufacture the Starlink system to be "nowhere near."

Respectfully submitted,

/s/

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[23] *Id.*

[24] *See* Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-LOA-20161115-00118, at 1 (filed July 1, 2019) ("On May 24, 2019, SpaceX launched the first sixty satellites in its Starlink constellation. Fifty-seven Starlink satellites are communicating with SpaceX's earth stations using their broadband phased array antennas. . . . Two satellites are being intentionally deorbited to simulate an end of life disposal. Three satellites which initially communicated with the ground but are no longer in service, will passively deorbit."). In contrast, the two satellites licensed on an experimental basis appropriately may be considered prototypes. *See* Space Exploration Technologies Corp., Experimental Authorization, Call Sign WI2XTA, File No. 0298-EX-CN-2016 (granted Nov. 16, 2017) (authorizing Microsat-2a and Microsat-2b, also known as TinTin-1 and TinTin-2).