Viasat

September 17, 2020

VIA ELECTRONIC FILING

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

Re: Viasat, Inc. Notice of *Ex Parte* Presentation, IBFS File No. SAT-MOD-20200417-00037

Dear Ms. Dortch:

On September 15, 2020, John Janka and Amy Mehlman of Viasat, Inc. spoke via teleconference with Nicholas Degani, Senior Counsel to Chairman Pai, and C. Sean Spivey, Wireless and International Advisor to Chairman Pai, regarding the modification application filed by Space Exploration Holdings, LLC ("SpaceX") in the above-referenced proceeding. At this meeting, we discussed SpaceX's claims regarding (1) satellite reliability, and (2) latency.

Satellite Reliability

SpaceX has long assured the Commission it would meet high levels of satellite reliability to ensure space safety, and would have a failure rate well below 1 percent.[1] We now know that its failure rates are increasing to about ***7 percent***.[2] And an actual failure rate this high, manifesting after such a small fraction of a Starlink satellite's design life has

[1] *See, e.g.*, 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 April 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.*

[2] *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) (citing Jonathan McDowell, "Reentered and Bad Starlinks," https://planet4589.org/space/stats/megacon/starbad.html (providing data as of Sep. 6, 2020) (last visited Sep. 13, 2020)).

passed, *optimistically* implies a staggering 22% failure rate over the duration of the Starlink mission.[3]

These failures are a clear and obvious threat to space safety. SpaceX satellites that cannot reliably maneuver cannot avoid collisions; they become additional, passive orbital debris objects that increase collision risk.[4] Collisions create large debris clouds extending hundreds of kilometers, polluting other orbits, endangering other satellites, and disrupting vital communications services, both near- and long-term.[5] These risks are what the Commission is seeking to manage in its ongoing proceeding on *Mitigation of Orbital Debris*.[6]

As Viasat's Chairman and CEO Mark Dankberg explained to Chairman Pai in April, if the Commission provides clear guidance about the importance of satellite reliability and space safety, the market will positively respond by fostering the mass-production of innovative, low-cost, and reliable satellites and satellite components.[7]

As to SpaceX's pending modification request, Viasat sees two options for the Commission:

- Require that SpaceX address its failure levels on the record, explaining what happened, how it is being resolved, and how a suitable reliability level will be achieved; *or*

- Do nothing and signal that operators may launch large LEO constellations without ensuring that their satellites can be maneuvered reliably or comply with commitments in FCC applications.

Latency

We also explained that the Commission should give little weight to SpaceX's recent assertions regarding the latency of its system—including its claimed ping times of 18 milliseconds and 19 milliseconds provided in a recent ex parte letter.[8]

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3 *See id.* at 52-53.

4 *See* Petition to Deny or Defer of Viasat, Inc., IBFS File No. SAT-MOD-20200417-00037, at 18-19 (filed July 13, 2020).

5 *See id.* at iii, 3, 7, 17, 36; Reply of Viasat, Inc. to Opposition of Space Exploration Holdings, LLC, IBFS File No. SAT-MOD-20200417-00037, at 11-15 (filed Aug. 7, 2020).

6 *See, e.g.*, *Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020), at ¶ 159 (proposing a 0.001 aggregate collision risk standard measured over the licensing period).

7 *See* Letter of John P. Janka, Viasat, Inc. to Marlene H. Dortch, Secretary, FCC, IB Docket No 18-313, at 1 (filed Apr. 17, 2020).

8 *See* Letter of David Goldman, Space Exploration Holdings, LLC, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-MOD-20200417-00037, Exhibit A, at 5 (filed Sep. 4, 2020).

As an initial matter, 18-19 milliseconds is ***not representative*** of expected round-trip ping times for all subscribers in all geographic locations, under peak busy hour network loading and terrestrial network conditions for a LEO system at 550 km. Indeed, approximately ***17 milliseconds of free space propagation delay alone*** exists at 550 km when both gateways and user terminals operate at lowest specified elevation angles. The satellite propagation component of end-to-end latency at a 25-degree angle is about ***2.3 times*** more than when operating directly overhead, due to the increased path length at that angle. Viasat is very concerned about using these *best case* latency measurements, on an extremely lightly loaded network, without regard to geographic location relative to terrestrial network components, as satisfactory evidence of meeting the Commission's 100 millisecond ping time requirement. That requirement is under peak busy hour conditions, for the 95th percentile, and for representative locations, to reflect the ability to generally provide that level of service.

As Viasat has pointed out previously, achieving 100 milliseconds of latency 95% of the time in the peak busy hour, for all subscribers, can be challenging for any complex nationwide network—satellite or terrestrial. Best engineering practice requires development of a thorough latency budget, incorporating all network components, queues, synchronization events, propagation delays, and other factors that can affect latency. Network beta test results, especially those that are clearly "best case possible" measurements, can help confirm many elements of such a budget, but they do not address the potentially very significant effects of peak busy hour loading, or geographic location.

Classic queuing theory tells us the relation between offered load and wait times (or latency) as a function of system, or network component, capacity. As illustrated in Figure 1 below, the wait time is small so long as the offered load is well below capacity (denoted on the graph as "1"), but it increases exponentially when the offered load approaches capacity and begins to congest the system.

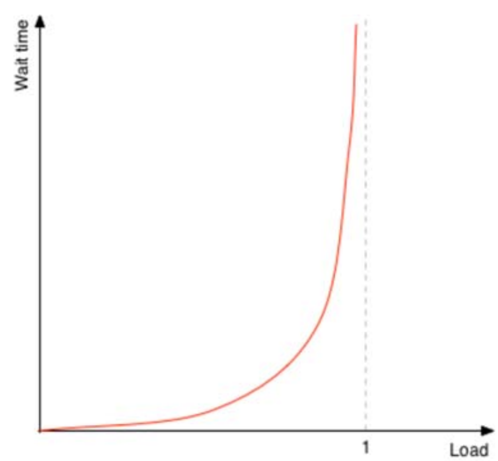

Figure 1: Queuing Delay vs. Load

This figure helps illustrate the peril of relying solely on selected ping testing of any network (LEO or otherwise) with little or no loading to determine whether the network can meet the low-latency requirement in which 95% of the round-trip measurements must be below 100 milliseconds for all locations. Such "beta" tests provide no insight into the performance of a LEO network under peak loading conditions, which can differ markedly from the early-phase testing of the network under light loading. Moreover, any of many elements of system design can greatly exacerbate these congestion-based impacts on latency—including, for instance, any processing, switching, and routing performed *on-board* the satellite, which can introduce potentially significant queueing delays during high congestion. Thus, the only way for a service provider to demonstrate its ability to comply with the low latency requirement is with a detailed element-by-element latency budget considering minimum, maximum, median, and 95^{th} percentile values of latency for every element in the communications path, supported by testing under load and across geographic locations. In a terrestrial network, testing under load may surface unanticipated bottlenecks that could be corrected. But, with a satellite network, if bottlenecks surface under loaded conditions *in the satellites already in space*, it is not at all clear that all of the satellites could even possibly be replaced in a timely fashion to meet latency obligations.

The Commission also should be wary of, and carefully scrutinize, beta ping testing measurements. A small sample size of measurements based on cherry-picked numbers is not statistically relevant to demonstrating compliance with the sub-100 millisecond latency requirement. Moreover, measurements that vary widely from test to test under the relatively uniform conditions of a lightly loaded beta network with limited geographic diversity indicate a high variance in the probabilistic components of network latency and thus an even wider range of possible measurement values in a statistically significant sample set under peak busy hour load, and in different geographic locations, possibly including values above 100 milliseconds with frequency greater than 5%. Geographical components to ping test measurements may be significant, as the path lengths between different locations will have a statistical distribution, including due to latency on the terrestrial network from different satellite gateways to a selected Internet Exchange Point. A high degree of statistical rigor may be necessary to evaluate such measurements when small sample sizes exhibit significant variance, and/or occasional values at or near the 100 millisecond requirement. At bottom, a detailed analysis, represented in a comprehensive latency budget, is the only way to determine whether a LEO network can meet the Commission's low-latency performance requirements, and the value of beta testing, if any, is to confirm that analysis, rather than as a replacement of that analysis.

Factoring in these real-world considerations, the Commission can and should expect that, if and when SpaceX begins commercially offering something other than a "beta" service, the 95th-percentile measurements of round-trip latency of SpaceX's Starlink network will quite likely be ***substantially higher*** than the 18 to 19 millisecond latency times SpaceX claims today. The only issue is exactly how much higher and at what likelihood.

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The Commission should carefully examine the serious issues raised in connection with SpaceX's pending modification application. In doing so, the Commission should require SpaceX to answer the difficult questions raised about its system, and rigorously validate SpaceX's responses *before* processing the modification application further—and even before allowing SpaceX to launch additional spacecraft. The Commission must not defer the issues related to SpaceX's failure rates and space safety for resolution in the *Mitigation of Orbital Debris* rulemaking. Given SpaceX's stated plan to launch 120 Starlink satellites per month,[9] waiting for that rulemaking to conclude would be too late.

Please contact me if you have any questions regarding this submission.

Respectfully submitted,

/s/

Amy R. Mehlman
Vice President
US Government Affairs and Policy
Viasat, Inc.

cc: Nicholas Degani
C. Sean Spivey

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9 *See* Letter of David Goldman, Space Exploration Holdings, LLC, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-MOD-20200417-00037, Attachment, at 2 (filed Sep. 14, 2020).