

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)	
)	IB Docket No. 18-313
Mitigation of Orbital Debris in the)	
New Space Age)	

To: Federal Communications Commission

COMMENTS OF LEOSAT MA, INC.

I. INTRODUCTION

LeoSat MA, Inc. (“LeoSat”) hereby responds to the notice of proposed rulemaking (“NPRM”) issued by the Federal Communications Commission (“Commission” or “FCC”) in connection with updating its rules relating to orbital debris mitigation.¹ LeoSat plans to operate a satellite system consisting of 78 non-geostationary satellite orbit (“NGSO”) Fixed-Satellite Service (“FSS”) satellites that will provide global broadband satellite services to enterprise and other customers. As a recipient of a grant of U.S. market access conditioned on future rules adopted by the Commission, including those related to orbital debris mitigation,² LeoSat is particularly interested in this proceeding and the impact it will have on its forthcoming satellite system.

¹ *Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rulemaking and Order on Reconsideration, 33 FCC Rcd 11352 (2018) (“NPRM”).

² *Petition for Declaratory Ruling Concerning U.S. Market Access for the LeoSat Ka-band Low-Earth Orbit Satellite System*, Order and Declaratory Ruling, 33 FCC Rcd 11486, 11492-93 ¶ 15, 11496 ¶ 22(q) (2018).

The Commission adopted this NPRM to improve and clarify its debris mitigation rules based on its experience with satellite licensing, improvements in debris mitigation guidelines and practices, and the various market developments since it first adopted debris mitigation rules.³ LeoSat appreciates the Commission's ongoing concern about orbital debris mitigation and supports many of the Commission's proposed rules. However, several of the Commission's proposals would impose significant and unnecessary burdens on the next generation of NGSO satellite systems and should not be adopted.

II. LEOSAT SUPPORTS MANY OF THE COMMISSION'S PROPOSALS

As a general matter, the Commission should not adopt rules that are likely to advantage one market competitor over another because such rules are likely to hinder the overall global development of satellite services in low-earth orbit ("LEO"). In addition, when the Commission adopts technical regulations, the Commission should make them as general and flexible as possible to prevent the Commission's requirements from mandating specific technological solutions and thereby suppressing innovation or supplanting the reasonable business judgements of providers.

LeoSat provides its views below regarding many of the Commission's specific NPRM proposals. Although LeoSat supports many of the Commission's proposals, in some instances LeoSat believes that the Commission should refrain from additional regulation or should adopt regulations that are less stringent than those proposed by the Commission.

³ NPRM, 33 FCC Rcd at 11354 ¶ 3.

A. The Commission Should Adopt its Proposals Related to the NASA Standards

The Commission should adopt its various proposals related to incorporation of the NASA standards into the Commission's rules.⁴ LeoSat believes that the standard for the probability of collision with a large object should be less than 0.001 and should apply separately to each spacecraft. Constellation operators are highly incentivized to meet this standard to avoid "polluting" the operational orbit of their own constellations. LeoSat also supports continuing the current case-by-case approach to determining what constitutes a "large object" rather than adopting a specific size.

LeoSat also believes that the NASA standard should be directly incorporated into the Commission's rules and should apply to each spacecraft in each orbit. While it's anticipated that LeoSat's satellite design will comply with this collision probability of 0.001, the current best estimate of this probability is 9.48 E-06. In addition, and in line with current spacecraft design principles, LeoSat will perform a micrometeoroid penetration analysis according to NASA NSS 1740.14.

However, LeoSat opposes the proposed extension of this rule to "planned" satellites.⁵ It is extremely difficult to determine the likelihood of a particular planned satellite ever actually being launched, and many planned satellites are proposed by companies that may not be sufficiently mature to participate productively in coordination discussions. LeoSat supports revising the rule to include all NGSO satellites, rather than only LEO NGSO satellites.

⁴ *Id.* at 11361-62 ¶¶ 26-27.

⁵ *Id.* at 11363 ¶ 28.

B. The Commission Should Adopt its Proposals Related to Orbit Selection

LeoSat supports several of the Commission's proposals related to orbit selection. It is appropriate for the Commission to seek a rationale from operators seeking to launch satellites into orbits with lifetimes more than two times their mission lifetime, if their satellites do not incorporate a propulsion system to facilitate deorbiting.⁶ Additionally, all NGSO satellites planning to operate above a certain altitude should be required to include propulsive capabilities.⁷ LeoSat also supports the proposal to limit maximum orbit variation above or below the operational orbit,⁸ but is not prepared at this time to propose outer bounds for such orbit variation.

C. The Commission Should Adopt its Proposals Related to Tracking and Data Sharing

LeoSat supports requiring operators to communicate ephemeris information to the Air Force's 18th Space Control Squadron or any successor civilian entity.⁹ LeoSat also supports the proposal to require applicants for NGSO systems to certify that, upon receipt of a conjunction warning, they will take all possible steps to assess mitigate collision risk if necessary.¹⁰ Such an approach to collision warnings is consistent with the public interest and will support effective and successful long-term exploitation of space by NGSOs.

⁶ *Id.* at 11365 ¶ 32.

⁷ *Id.* at 11365 ¶ 34.

⁸ *Id.* at 11365 ¶ 35.

⁹ *Id.* at 11366 ¶ 37.

¹⁰ *Id.* at 11366-67 ¶ 38.

D. The Commission Should Not Adopt its Proposal to Require a Description of Spacecraft Maneuverability

LeoSat does not support the Commission's proposal to require applicants to describe the extent of their satellites' maneuverability in their space station license or market access applications.¹¹ Specific information relating to satellite maneuverability is proprietary and competitive in nature. Public disclosure of this information as part of an application could prompt a "race to the bottom" among satellite operators. Moreover, any information initially disclosed in an application will become stale and inaccurate as the operator's satellites age and their propulsion capacity is consumed.

E. The Commission Should Reconsider its Proposals on Design Reliability

LeoSat has two primary concerns regarding the Commission's design reliability proposals.¹² First, although the Commission suggests that operators should be required to comply with design reliability standards, the Commission is unclear how the design reliability standards would be developed and who would be responsible for evaluating the compliance of applicants with such standards. These criteria are likely to be highly technical and industry best practices evolve very quickly. Consequently, it seems likely that only industry engineers will be capable of adequately developing and validating design and reliability standards, as well as evaluating and certifying compliance with such standards. For this reason, the Commission should refrain from imposing regulatory design reliability mandates at this time.

Second, if the Commission nevertheless adopts a design reliability standard, LeoSat believes that a reliability standard of 0.999 is far of what is appropriate. Such a stringent standard generally would require triple redundancy for many subsystems, which would greatly

¹¹ *Id.* at 11367 ¶ 39.

¹² *Id.* at 11368 ¶¶ 42-43.

increase the size, weight, and power needs of satellites (“SWaP”) and therefore also their cost. It is also unclear from the Commission’s proposal which systems would be subject to a 0.999 requirement. If the Commission ultimately adopts a reliability standard, LeoSat suggests that the reliability standard should be no more than 0.9 per satellite for constellations under 150 satellites and should apply only to systems required for de-orbiting.

F. The Commission Should Reconsider Some of its Proposals on Post-Mission Disposal

Although LeoSat supports several of the Commission’s proposals regarding post-mission disposal, some of the Commission’s proposals should be reconsidered. LeoSat supports the proposal that satellites have reliability of end-of-life disposal of 0.9 per satellite. This limit should be satisfactory to ensure successful decommissioning and deorbit of constellations under 150 satellites, and it is consistent with the Inter-Agency Space Debris Coordination Committee’s recommendations. LeoSat also supports the Commission’s proposal to require decommissioning and deorbit of satellites to orbits that will cause the satellites to achieve atmospheric reentry at end of life.¹³ LeoSat believes direct retrieval may eventually be a solution to orbital debris, but the current state of technology may cause such an activity to actually increase orbital debris due to the required high risk of “docking” with a non-functional satellite. A failed docking could potentially increase orbital debris due to damage to both the failed satellite and the retrieval satellite. Furthermore, LeoSat does not support permitting operators of LEO satellites to dispose of the satellites into “graveyard” orbits at altitudes above 2,000 km.

LeoSat also does not support the proposal to require operators to initially deploy at 650 km before moving to a higher orbit.¹⁴ This requirement would greatly increase the cost and

¹³ *Id.* at 11371 ¶ 52.

¹⁴ *Id.* at 11369-70 ¶ 48.

SWaP of a given satellite due to the extra propulsion needs, while greatly limiting an operator's early revenue generation due to the extended period of on-orbit testing that would be needed at a lower orbit prior to orbit raising, especially for operators planning to use orbits much higher than 650 km. In addition, satellites designed for operation at higher altitudes may require complex additional operational modes in order to be successfully tested at 650 km. Furthermore, when recovering from operational failures, the additional time required to boost a spare satellite from 650 km into its operational orbit, as opposed to direct injection, could greatly impact business operations. More fundamentally, the requirement to test at 650 km may encourage operators to choose to operate at this altitude as opposed to a higher altitude, thus increasing the risk of orbital debris. This requirement will also be redundant if the Commission imposes its proposed 0.999 design reliability requirement on the design, development, manufacturing, assembly, integration, testing, and qualification activities applicable to satellites. The likelihood of an “unforeseen flaw” compromising a complete constellation is exceptionally unlikely.

If the Commission nevertheless adopts this orbit-raising proposal, the requirement at most should only be applicable to constellations with more than 150 satellites, and even then, should only apply only to the first five or ten percent of a constellation’s satellites. Upon successful testing of these initially launched satellites, the satellite design should be considered mature, and no further low-orbit testing should be required. Instead, satellites of a mature and qualified design should be permitted to utilize direct insertion opportunities, especially for the launch of ground spares.

LeoSat also opposes the Commission’s proposal to require the automatic initiation of spacecraft deorbiting mechanisms if a satellite experiences a loss of power or contact with the

spacecraft.¹⁵ Such a proposal would require each satellite to maintain an excessive level of decision-making autonomy via its onboard algorithms. It also may unduly and prematurely risk the complete loss of a spacecraft that otherwise may have been able to be recovered. In practice, satellites are frequently recovered successfully from safe hold modes or other “free-wheel” conditions. Modern fault detection and isolation diagnostics algorithms coupled with critical subsystem redundancies make catastrophic failures right out of the box (i.e., infant mortality) highly unlikely, and the inherent costs of prematurely losing a spacecraft naturally encourage operators to err on the side of conservatism. These existing approaches are far less risky than requiring satellites to include significant automated de-orbiting systems. Furthermore, if this requirement is combined with a requirement to test a satellite at an altitude below 650 km before boosting it to its final orbit, it may take an excessively long time for a replacement satellite to replace an autonomously de-orbited one.

G. The Commission Should Adopt its Proposals Related to Maintaining Ephemeris Data and TT&C Encryption

LeoSat supports the Commission’s proposal to require sharing of ephemeris data with other operators.¹⁶ This requirement will be an effective path for promoting cooperation among operators and unambiguously requiring all operators to play by the rules. LeoSat also supports the requirement of encryption for all TT&C links for satellites with propulsion.¹⁷ An encryption requirement provides the minimum protection necessary to prevent unauthorized access to the command of the satellite and its movement.

¹⁵ *Id.* at 11370 ¶ 49.

¹⁶ *Id.* at 11377 ¶¶ 72-73.

¹⁷ *Id.* at 11378 ¶ 75.

H. The Commission Should Not Adopt its Proposal to Require Operators to Obtain Indemnification Within 30 Days of Grant

Although LeoSat generally supports the Commission's objective to require Commission-authorized operators to enter into indemnification agreements, LeoSat requires further information regarding the Commission's approach to such indemnification agreements to enable LeoSat to take a firm position regarding the matter. For example, LeoSat is concerned that the timing of the Commission's application of this requirement could have an unintended and unnecessarily adverse effects on the ability of new operators to enter the U.S. satellite market. Specifically, LeoSat does not support a requirement for an indemnification agreement within 30 days of a space station or market access license being granted by the Commission.¹⁸ Most new operators have not fully funded their proposed satellite systems prior to the Commission's grant of a license. As a result, due to the inherent cost of such indemnification, requiring operators to obtain the indemnification within 30 days of such grant may not be realistic and could chill new entry. Instead, it would be more appropriate for the Commission to require operators to complete an indemnification agreement no later than 90 days before launch. This approach is much more financially realistic for new licensees that are still involved with fundraising efforts.

III. CONCLUSION

Orbital debris mitigation remains an issue of critical concern to the future of satellite operations, and LeoSat supports the Commission's efforts to encourage good stewardship of the space environment. Nevertheless, the Commission should avoid adopting burdensome debris mitigation regulations that have the potential to stifle the deployment of innovative and new

¹⁸ *Id.* at 11379 ¶ 79.

satellite systems without providing sufficient concomitant benefits. LeoSat thanks the Commission for its consideration of these comments as it moves forward with this proceeding.

Respectfully submitted,

LeoSat MA, Inc.

By: /s/ Joseph C. Anders

Joseph C. Anders
CEO

LeoSat MA, Inc.
1245 S. Powerline Rd.
Pompano Beach, FL 33069

April 5, 2019