Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Application of Space Exploration Holdings, LLC	)	File No. SAT-MOD-20181108-0008
For Modification of Authorization for the	)	
SpaceX NGSO Satellite System	)	

To: The International Bureau

COMMENTS AND PETITION TO DEFER

The Commercial Smallsat Spectrum Management Association ("CSSMA")[1] hereby submits these comments and petition to defer regarding the above-referenced application of Space Exploration Holdings, LLC ("SpaceX") seeking, *inter alia*, authorization to relocate 1,584 satellites from their currently authorized altitude of 1,150 km to the requested altitude of 550 km (the "Proposed LEO Orbit"),[2] which is at or near the operating orbital altitudes of many non-geostationary orbit satellite systems ("NGSOs"), including those of CSSMA members. The 400-600 km orbital altitude range is used by government, commercial, domestic and international operators, providing a wide range of valuable and critical services, including Earth remote sensing, meteorological, AIS and ADS-B signal tracking, and fixed-satellite services, as well as national security and safety operations. As a result, the SpaceX Modification raises significant policy issues regarding the sharing of valuable orbital resources, which are more appropriately addressed in the Commission's pending proceeding on the mitigation of orbital debris or

[1] CSSMA is one of the largest associations in the satellite industry, with thirty-nine members from eleven countries. CSSMA advocates and represents the members' views on spectrum management and other policy matters that affect the small satellite community. For more information on CSSMA, see https://cssma.space.

[2] Application of Space Exploration Holdings for Modification of Authorization for the SpaceX NGSO Satellite System, File No. SAT-MOD-20181108-0008 (filed Nov. 8, 2018) ("SpaceX Modification").

potential proceedings of other federal agencies.[3] Further, SpaceX has failed to provide any collision risk analysis with respect its proposed relocation and failed to recognize other incumbent operators in substantially the same orbits.[4]

Accordingly, CSSMA requests that the International Bureau ("Bureau") defer decision on SpaceX's Modification pending (i) the conclusion of the relevant rulemaking proceedings and (ii) SpaceX's provision of the collision risk analysis. In the alternative, CSSMA requests that the Bureau condition any grant of the SpaceX Modification upon the company's compliance with rules and policies adopted in applicable proceedings[5] and, pending completion of those proceedings, condition any grant of the application on the company's commitment to coordinate physical operations of its satellites in good faith with all satellite operators and current and future applicants operating or proposing to operate in orbital altitudes in the 400-600 km range, consistent with FCC precedent. Such conditions would ensure the continued ability for cubesat and other small satellite operators to have fair and reasonable access to critical low-Earth orbit resources without materially prejudicing SpaceX's proposed operations.[6]

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[3] *See, e.g., Mitigation of Orbital Debris in the New Space Age*, Notice of Proposed Rule Making, IB Docket No. 18-313, at ¶ 98 (Oct. 25, 2018) ("*Orbital Debris NPRM*"); *see also, id.*, Statements of Commissioners O'Reilly and Carr (seeking comment on the appropriate role of the Commission in regulating orbital debris and whether other agencies are better suited to do so); *see also Licensing Private Remote Sensing Space Systems*, Advance Notice of Proposed Rulemaking, 83 FR 30592, 30594 (June 29, 2018) (seeking comment on whether the Department of Commerce and the National Oceanic and Atmospheric Administration should establish debris mitigation requirements).

[4] The rules provide that a more detailed collision risk assessment is required where systems are operating in "identical" or "very similar" low-Earth orbits. 47 C.F.R. § 25.114(d)(14)(iii); *see also Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 ¶ 50 (2004).

[5] *See supra* n. 3.

[6] The CSSMA takes no position on whether the Bureau should grant the SpaceX Modification and/or consider the application within the relevant satellite processing round. *See OneWeb Petition Accepted for Filing and Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 10.7-12.7 GHz, 14.0-14.5 GHz, 17.8- 8.6 GHz,*

The 400-600 km orbital altitude range is the prime operating area for small satellite systems of varying mass and propulsive capabilities, particularly micro-satellite, nano-satellite, and cube satellite systems. For example, Planet, which operates a remote-sensing satellite system, is authorized to operate, over the term of its license, up to 600 satellites (200 satellites simultaneously operational) with the majority of those satellites operating at orbital altitudes between 350-550 km;[7] Spire Global, Inc. ("Spire"), which operates a weather forecasting and data collection satellite system, is authorized to operate, over the term of its license, 1000 satellites (175 satellites simultaneously operational) at orbital altitudes between 400-650 km;[8] Astro Digital U.S., Inc., which operates a remote-sensing satellite system, has requested authority to operate, over the term of its license, up to 100 satellites (with 30 satellites simultaneously operational) at altitudes between 475-625 km;[9] and Kepler Communications Inc., which operates a fixed-satellite service system, intends to deploy a constellation of 140 cubesats at altitudes between 500-600 km.[10]

18.8-19.3 GHz, 27.5-28.35 GHz, 28.35-29.1 GHz, and 29.5-30.0 GHz Bands, Public Notice, 31 FCC Rcd 7666 (IB 2016).

[7] *See* Stamp Grant, Planet Labs, Inc., IBFS File No. SAT-MOD-20170713-00103 (granted Aug. 25, 2017).

[8] *See* Stamp Grant, Spire Global, Inc., IBFS File No. SAT-AMD-20161114-00107 (granted in part and deferred in part Apr. 7, 2017); Stamp Grant, Spire Global, Inc., IBFS File No. SAT-AMD-20161114- 00107 (granted in part and deferred in part May 18, 2017); Stamp Grant, Spire Global, Inc., IBFS File No. SAT-AMD-20161114-00107 (granted in part and deferred in part July 13, 2017); Stamp Grant, Spire Global, Inc., IBFS File No. SAT-AMD-20180102-00001 (granted in part and deferred in part Nov. 28, 2018).

[9] *See* Application of Astro Digital U.S., Inc. for Authority to Launch and Operate an NGSO Satellite System, IBFS File No. SAT−LOA−20170508−00071, at 38 (May 8, 2017).

[10] *See Kepler Communications Inc., Petition for Declaratory Ruling to Grant Access to the U.S. Market for Kepler's NGSO FSS System*, Order and Declaratory Ruling, FCC 18-162 at ¶ 2 n. 4 (Nov. 19, 2018).

According to SpaceTrack, there are approximately 726 satellites, at least 300 of which are cubesats, in orbit between 400-600 km orbital altitude.[11] This orbital range is ideal for many cubesat systems and other similar-sized systems that do not have propulsion. At these altitudes, such systems would be able to operate for several years before naturally de-orbiting within NASA's recommended 25-year guideline.[12] The 400-600 km orbital altitude range is also desirable because of the greater availability of launches and the lower launch costs. The introduction of more than 1,500 SpaceX satellites, each of which is expected to have a mass of approximately 386 kg or approximately 80x the mass of a typical 3U cubesat,[13] would complicate the deployment and operations for micro-, nano-, and cubesat systems, particularly those without active propulsion systems, in their primary operating location.[14] For example, the increase in the number of satellites in the area and the larger mass and cross-sectional area of SpaceX's satellites may require that cubesat and other small satellite operators execute more differential drag maneuvers in response to potential conjunction events, resulting in a noticeable

[11] *See* Space-Track query function at https://www.space-track.org and UCS Satellite Database at https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.

[12] *See* NASA Technical Standard, Process for Limiting Orbital Debris, NASA-STD-8719.14A (with Change 1) (May 25, 2012).

[13] *See* Application of Space Exploration Holdings, LLC for Authority to Launch and Operate an NGSO Satellite System (call signs S3018 and S2983), File Nos. SAT-LOA-20161115-00118 and SAT-LOA-20170726-00110, Attachment A at 54 (Nov. 15, 2016).

[14] For example, in another proceeding, Planet and Spire encountered substantial objections to the deployment of cubesats in certain elliptical orbits that potentially crossed the authorized orbits of 17 satellites of another operator. In that proceeding, Planet was able to demonstrate the lack of any material burden to the complaining operator with respect to the number of collision avoidance maneuvers. However, such effort took considerable time and resources. In this case, SpaceX intends to deploy 1,584 satellites dramatically increasing the likelihood that the parties may need to execute collision avoidance maneuvers and will need to allocate the burden and responsibility for such maneuvers. *See* Stamp Grant, Planet Labs Inc., IBFS File No. SAT-MOD-20150802-00053 (granted Sep. 15, 2016); Stamp Grant, Spaceflight Inc., IBFS File No. SAT-STA-20150821-00060 (granted Oct. 25, 2016).

capacity loss because such satellites are not operational during those maneuvers.[15] The attached Technical Annex contains a more detailed analysis of the increase in risk to other operators in the 400-600 km orbital altitude range.

Fundamentally, the SpaceX Modification raises unanswered policy questions associated with the deployment of large constellations with unprecedented numbers of satellites and mass (aka "kilo-constellations"), including procedures for sharing orbital resources, the allocation of the burden of collision avoidance, the obligations of operators of satellites passing through orbits of others as part of orbit-raising and de-orbit maneuvers, and reasonable tolerances for orbital parameters, such as altitude and inclination.[16] These are all topics that will need to be addressed and resolved in appropriate orbital debris mitigation rulemaking proceedings.[17] Accordingly, any grant of the SpaceX Modification should be deferred until such other rulemaking

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[15] *See, e.g.,* Planet Labs Inc., Supplement to Aggregate Orbital Debris Assessment Report, IBFS File no. SAT-MOD-20170713-00103, at 3 n. 8 (explaining that differential drag maneuvers for the purpose of collision-avoidance require approximately 28 to 40 hours at an orbital altitude of 550 km, and approximately 19 to 28 hours at an orbital altitude of 500 km); Application of Astro Digital U.S. Inc., IBFS File No. SAT-LOA-20170508-00071, Attachment F to Exhibit 43 at 14-17 (May 8, 2017) (explaining the challenge of differential drag maneuvers and the substantial data loss incurred during those maneuvers); Application of Spire Global Inc., IBFS File No.SAT-LOA-20151123-00078, Exhibit A at 18 (Nov. 23, 2015) (explaining that differential drag maneuvers require approximately 24 hours' notice).

[16] *See* SpaceX Modification, Attachment A Technical Information to Supplement Schedule S at 3 (stating that orbital altitude will be maintained within 30 km).

[17] *See, e.g., Orbital Debris NPRM* ¶¶ 29, 32 (seeking comment on whether to require operators to provide their orbit-selection rationale); *id.* ¶ 26 (proposing that NGSO applicants demonstrate that the probability of a collision with a large object is no greater than 0.001, and seeking comment on whether to apply that metric on an individual or aggregate, system-wide basis); *id.* at 28 (proposing that applicants must indicate what steps have been (or will be) taken to coordinate with other spacecraft and avoid potential collisions); *id.* ¶ 34 (requesting comment on whether NGSO satellites operating above a particular altitude should be required to include propulsion capabilities to enable collision avoidance maneuvers); *id.* ¶ 71 (seeking comment on whether to require coordination of orbit raising maneuvers to avoid interference for both GSO and NGSO satellites); *id* ¶ 35 (seeking comment on whether the Commission should limit the extent to which NGSO systems can vary in orbital altitude from the operational orbit specified in their application).

proceedings are completed and thereafter be conditioned on the rules and policies adopted in such proceedings.[18]

Further, sharing of orbital resources is critical to the safe and harmonious use of low-Earth orbit, as SpaceX has recognized.[19] CSSMA agrees and, accordingly, requests that the Bureau condition any grant of the SpaceX Modification on the company's commitment to coordinate physical operations of its satellites in good faith with both current satellite operators and current and future applicants proposing to operate in the 400-600 km orbital altitude range, consistent with FCC precedent.[20] Such a requirement would ensure the continued ability for others to have fair and reasonable access to a critical shared orbital resource.

As part of the good faith requirement, SpaceX should be required to take active responsibility for collision avoidance during orbit raising and end-of-life de-orbiting through low-Earth orbit. Further, SpaceX should not be permitted to request that other parties assume the

[18] Moreover, because SpaceX does not adequately consider the orbital environment at the Proposed LEO Orbit, the International Bureau should not conclude that SpaceX has satisfied its license condition requirement to submit a revised orbital debris mitigation plan or grant a waiver of that requirement. *See* attached Technical Annex, Section D.

[19] *See* SpaceX Modification, Narrative at 44 (committing to coordinate with the Kepler Communications, Inc. and Spire systems, which operate in the vicinity of the Proposed LEO Orbit); *see also* Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, at 2-4, IBFS File Nos. SAT-LOA-20161115-00118 and SAT-LOA-20170301-00027 (filed Dec. 12, 2017) (requesting that the FCC require OneWeb to coordinate physical operations of its satellites with operators in similar orbits).

[20] *See, e.g., Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System*, Memorandum Opinion, Order, and Authorization, 33 FCC Rcd 3391, 3396, ¶ 11 (2018) (requiring SpaceX to "coordinate its physical operations with space stations of NGSO systems operating at similar orbital altitudes"); *Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, Order and Declaratory Ruling, 32 FCC Rcd 5366, 5378, ¶ 25(d) (2017) (requiring OneWeb to "coordinate physical operations of spacecraft with any operator using similar orbits, for the purpose of eliminating collision risk and minimizing operational impacts").

full burden of avoiding collision with SpaceX's 1,540 satellites.[21] Given SpaceX's proposed deployment, such requests would impose an extraordinary burden on satellite operators and potentially stifle use of low-Earth orbit by such operators.[22] If the FCC granted the SpaceX Modification without any conditions and concluded that subsequent applicants must assume the full burden of avoiding collisions with SpaceX's 1,540 satellites, SpaceX would be able to effectively exercise de facto regulatory veto power over the operations of any future system proposing to operate in the 400-600 km orbital altitude range.

For all of the above reasons, the CSSMA requests that the International Bureau take action consistent with these Comments and Petition to Defer.

Respectfully submitted,

CSSMA

/s/ Craig Scheffler

Craig Scheffler
President, Commercial Smallsat
Spectrum Management Association

Dated: January 29, 2019

[21] Indeed, given that the 400-600 km orbital altitude range is a prime area for deployment of cubesat systems without propulsion and executing a differential drag maneuver typically takes a cubesat operator one to two days, during which the cubesat is unable to perform regular mission operations, the Commission should strongly consider in the appropriate rulemaking proceeding imposing the burden of collision avoidance on others operating in the area.

[22] *See* Technical Annex, at Section B.

Technical Annex

ANALYSIS OF ORBITAL COLLISION RISK

SpaceX asserts that the proposed SpaceX Modification will reduce the overall orbital collision risk of the concerned shell, in part due to reduced re-entry lifetime afforded by a greater atmospheric density at the lower altitude, as well as an increased separation from other large constellations proposed in the 1,000 – 1,300 km region. The analysis below demonstrates that SpaceX's position is unsupported and its orbital debris mitigation plan is incomplete.

A. The Impact of Atmospheric Drag on Orbital Lifetime

SpaceX notes that the reduction of its altitude will improve its orbital debris risk as a result of accelerated re-entry.[1] Although true, individual orbital lifetimes are not meaningful in a collision-probability context if deorbited satellites are immediately replaced. This kind of active generational replenishment is a key feature of SpaceX's constellation[2] (and also with several aforementioned small satellite operators) and is understandably necessary to sustain a long-term orbital presence at 550 km, where atmospheric drag acts to passively decelerate orbital bodies. However, it completely negates the benefits that a shortening of orbital lifetimes would typically have on the overall risk of collision.

B. Failure to Address Other NGSO Operators in the 550 km Region

SpaceX states that by moving the constellation "shell" from 1,150 km to 550 km, it will increase its separation from the large systems proposed by OneWeb, Boeing, and Telesat and claims that by doing so it will "reduce potential conflict and improve the safety profile for its constellation as well as for other NGSO operators during nominal operations."[3] However, it is not enough to simply say that operating farther from OneWeb, Boeing, and Telesat will decrease the net risk of collision. By moving away from "large" constellations, SpaceX is moving toward the region in space occupied by numerous "small" constellations, and SpaceX fails to provide any analysis that the relative collision risk is better.

For example, notable constellations currently operating or planning to operate in this region include Kepler, Planet, Spire Global, Astro Digital, Hiber, Fleet Space, ICEYE, NASA (CYGNSS system), and others. It should be noted that many of the existing and prospective

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[1] Application of Space Exploration Holdings for Modification of Authorization for the SpaceX NGSO Satellite System, Attachment A Technical Information to Supplement Schedule S, File No. SAT-MOD-20181108-0008, at 43-44 (filed Nov. 8, 2018) ("SpaceX Modification").

[2] *See* SpaceX Modification at 10-11 ("The first-generation satellites are an initial application of the iterative process SpaceX has been planning since the inception of this constellation, and which will continue even after launch of its full constellation—constantly improving its technology on an ongoing basis *as it upgrades each generation of satellites with another.*") (emphasis added).

[3] *Id.* at 8.

small satellite systems in this orbital region are not equipped with propulsion and use differential atmospheric drag to execute avoidance and deorbiting maneuvers. They operate at a lower level of control authority than propulsive systems, such as those operating at higher orbits, are readily capable of.[4] Indeed, the sub-600 km region is uniquely valuable to systems that operate without propulsion due to their reliance on atmospheric drag. Granted that the movement of 1,584 satellites into any region of space will necessarily increase local collision risks, it will especially do so if placed into a region populated by spacecraft that require more time to manage their avoidance.[5] This risk will be particularly pronounced while SpaceX satellites undergo orbit-raising procedures, and the accuracy of their positional information is reduced.[6] For these reasons, the effects of the SpaceX Modification provide a salient concern for the safe operations of many small satellite operators.

CSSMA notes that SpaceX has previously discussed its requirements for safe operations in its response to a set of OneWeb *ex parte* letters,[7] requesting exclusive access to a 75-km radial buffer zone surrounding its own constellation. In its response,[8] SpaceX contested OneWeb's request in part on the grounds that it would be forced to change its own constellation design to accompany the restriction. SpaceX clarified that a smaller radial separation of 50 km would be sufficient for its system to maintain safe operations with respect to other NGSO constellations, including OneWeb's. By providing its own metrics for what it considers safe, SpaceX acknowledged that operating with some level of buffer would be necessary to ensure safe operations. In the concerned SpaceX Modification, SpaceX states that it expects its satellites to maintain their apogee and perigee to within 30 km. Not discussed, however, is the change in risk when other systems do operate within this safety margin. At the 550 km altitude, a 30-50 km buffer will overlap with the nominal altitudes of several non-propulsive systems, including those of Planet, Spire, Astro Digital, Kepler, and others. CSSMA reiterates that a careful study of these effects should be requisite for the approval of the SpaceX Modification.

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[4] Non-propulsive spacecraft require more time to alter course, as they are reliant on uncontrollable atmospheric conditions, which themselves are further dependent on solar activity, weather, etc.

[5] CSSMA notes that for several small satellite operators, reliance on passive maneuverability has been found to be compliant with the requirements of both the Commission and the Canadian national regulator ISED (the authority licensing Kepler's system).

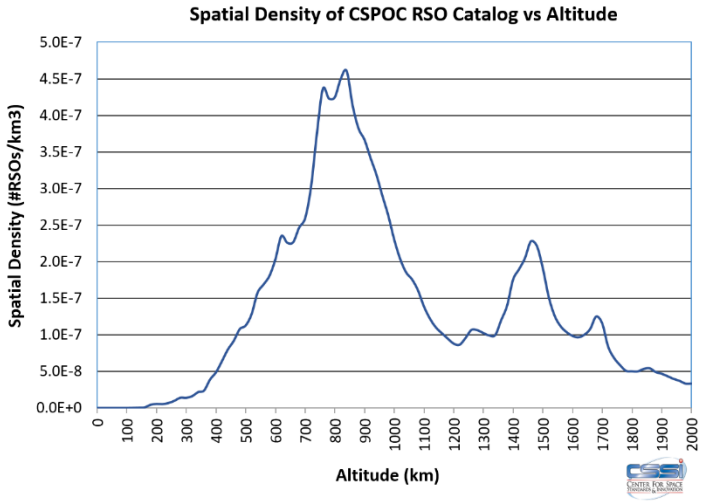
[6] *See infra* Section C.

[7] *See* Letters from Brian D. Weimer to Marlene H. Dortch, IBFS File Nos. SAT-LOA-20161115-00118 and SAT-LOA-20170301-00027 (Nov. 17, 2017).

[8] *See* Letter from William M. Wiltshire, Counsel to SpaceX, to Marlene H. Dortch, Secretary, FCC, at 2-4, IBFS File Nos. SAT-LOA-20161115-00118 and SAT-LOA-20170301-00027 (filed Dec. 12, 2017).

C. Failure to Consider Resident Space Object Environment in the 550 km Region

SpaceX claims that moving to 550 km would reduce the risk of collision with orbital debris.[9] This conclusion is overly simplistic and unsupported. The spatial density of Resident Space Objects (RSOs) is similar – if not slightly higher – in the 550 km region than in the 1,150 km region.



Further, SpaceX fails to acknowledge how the increased spatial density resulting from the proposed altitude reduction would serve to increase the overall risk of inter-constellation collisions. SpaceX provides the following information regarding the proposed change to the 1,150 km orbital shell.

Parameter	Original Authorization	Proposed SpaceX Modification
Orbital Planes	32	24
Satellites Per Plane	50	66
Total Satellites	1,600	1,584
Altitude	1,150 km	550 km
Inclination	53°	53°

Assuming an even distribution of satellites within the orbital planes, simple geometry dictates that satellites in the initial 1,150 km orbit would have a mean in-track separation distance of 945 km. After reduction to the 550 km altitude configuration, the mean per-satellite in-track separation distance would be reduced by approximately 30% to 660 km. Nowhere in the SpaceX Modification does SpaceX discuss the increased risk of inter-constellation collision that results from the greater spatial density in the proposed 550 km orbital shell.

[9] *See* SpaceX Modification at 8.

The SpaceX Modification poses an especially significant increase in risk to small satellite constellations in the vicinity, which when nominally operating above 550 km, will pass directly through the SpaceX shell when undergoing regular orbit degradation. Because many small satellites do not employ station-keeping, the operators have no ability to avoid this intersection. Worse yet, the rate of deceleration at this altitude is slow enough that the small satellite operators and SpaceX would likely occupy the same space for months, at which time the probability of inter-constellation collision will be at maximum. It is in this situation that the inter-constellation collision risk is the most sensitive to a high spatial density, a factor which SpaceX does not appear to have considered when choosing its modified orbital configuration.

D. Request to Waive the Commission's Orbital Debris Requirements

The International Bureau should not conclude that SpaceX has satisfied its license condition requirement to submit a revised orbital debris mitigation plan or grant a waiver of that requirement.[10] As discussed above, SpaceX's fundamental conclusion that fewer NGSO operators and/or constellations are affected by the modified SpaceX constellation is unsupported. Moreover, CSSMA questions the effectiveness of two other SpaceX statements:

- Reduced fuel requirements and thruster wear
- Benign ionizing radiation environment

Reduced fuel requirements and thruster wear at best only impact the *operational* life of the spacecraft and have no material impact on the total (operational plus non-operational) orbital lifetime, which is the metric associated with collision risk. Lastly, a more forgiving radiation environment will only slightly reduce the probability for critical electronics failure (and the loss of control of a spacecraft), which is already a highly unlikely event and thus offers only a marginal improvement to overall orbital collision risk.

E. Questions that Need to be Addressed

CSSMA urges the Bureau to consider these questions when evaluating the SpaceX Modification.

1. For the scenario of a kilo-constellation of satellites transiting quickly (using propulsion to change orbital altitude) through the orbits of other constellations of satellites without propulsion, where the dynamics of potential orbital conjunctions changes quickly and potentially faster than a propulsion-less satellite can respond to avoid a collision (using techniques such as differential-drag), what is the change in collision risk and who bears the burden to avoid the collision?

2. Current generations of small satellite (*i.e.*, cubesat) constellations (with 100-200 operational satellites) using differential-drag techniques for orbit maintenance and collision avoidance were not analyzed to account for the case of kilo-constellations of satellites (*i.e.*, 1500 satellites) passing through and/or co-existing in their orbits. Probabilities for collision risks for this

[10] *See* Space X Modification, Waiver Requests at 6.

scenario have not been analyzed and collision mitigation strategies, best practices, or policies have not been developed. Does such a scenario change the collision risk enough to now require more robust and comprehensive best practices and policies for space traffic management?

3. Without best practices and/or policies regarding space traffic management (STM) for the scenario above, what will be the STM responsibilities of future small satellite operators (without propulsion) in the same orbital regime with respect to SpaceX or other very kilo-constellations with propulsion? Will large incumbent constellation operators then become a significant impediment to the fair use of this orbit region by new small satellite operators in the future?

4. One analysis indicates that there are approximately fifteen conjunction warnings per year issued by Combined Space Operations Center (CSpOC) for cubesat class satellites in the vicinity of 550 km.[11] If needed, a differential drag maneuver requires approximately one to two days of maneuvering per spacecraft in order to avoid/eliminate each given conjunction. During these conjunction avoidance maneuvers, mission data collection (the revenue portion of the satellites' functionality) must be suspended. With an increase of 1,584 objects in the vicinity of 550 km, there is a significant increase in spatial density. How will the conjunction warning rate increase? How should the burden of conjunction avoidance and service loss be allocated?

[11] *See,* Application of Astro Digital U.S. Inc., IBFS File No. SAT-LOA-20170508-00071, Exhibit 43, Attachment F, (May 8, 2017) (explaining that differential drag maneuvers for the purpose of collision-avoidance require approximately two days' notice, during which time the satellite cannot collect imaging data or perform other normal operations)

CERTIFICATE OF SERVICE

I, Craig Scheffler, hereby certify that on January 29, 2019, a true and correct copy of the Comments and Petition to Defer was sent via U.S. Mail, first class postage prepaid, to the following:

William M. Wiltshire
Paul Caritj
Harris, Wiltshire, & Grannis LLP
1919 M Street NW
Suite 800
Washington, DC 20036

Counsel for SpaceX

Tim Hughes
Senior Vice President, Global Business and Government Affairs
Space Exploration Technologies Corp.
1155 F Street NW
Suite 475
Washington, DC 20004

Patricia Cooper
Vice President of Satellite Government Affairs
Space Exploration Technologies Corp.
1155 F Street NW
Suite 475
Washington, DC 20004

/s/ Craig Scheffler
Craig Scheffler