December 1, 2018

By electronic filing

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street S.W.
Washington, D.C. 20554

Re: Written Comment: IB Docket No. 18-313

Dear Ms. Dortch,

D-Orbit is a company with registered offices in Italy, the United States of America and Portugal, and is a service provider for the traditional and new space sectors, with capabilities in satellite manufacturing, launch, deployment, satellite operations, end-of-life strategies and solutions, space propulsion and related critical software. D-Orbit, as a certified Benefit Corporation, has the mission of stopping the systematic increase of concentration of uncontrolled objects in space. D-Orbit welcomes the Commission's initiative to comprehensively update its rules pertaining to orbital debris mitigation measures.

In the Annex *D-Orbit Comment* to this letter D-Orbit provides comments to some of the questions and requests for comment included in the Draft Notice *Mitigation of Orbital Debris in the New Space Age* with the hope to contribute to the thoughtful review of the Draft Notice and adoption of an effective regulatory mechanism addressing the ever-important issue of space debris mitigation and remediation. D-Orbit cites specific paragraphs in the text of the Draft Notice and provides answers highlighted in *italics*.

D-Orbit believes that the decommissioning of a satellite is a phase of a space mission of primary importance, and should be carried out by a dedicated and autonomous subsystem. This would greatly increase the success rate of the end-of-life manoeuvre, even in case of a critical malfunctioning of the satellite, reducing at the same time the impact on the existing satellite platform design. This technological measure, together with adequate financial instruments extended to compliant satellite operators, a reduction of the 25-year rule and the development towards active debris removal solutions, would reduce the proliferation of space debris in the orbital space around Earth.

D-Orbit's team is eager to provide any clarifications or additional information if necessary.

Sincerely yours,

Catherine Doldirina, Dr.
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Annex. D-Orbit Comment

Paragraph 9 Draft Notice: in lieu of an informational requirement, should we require all NGSO satellites planning to operate above a particular altitude to include propulsion capabilities reserved for stationkeeping and to enable collision avoidance maneuvers, regardless of whether propulsion is necessary to de-orbit within 25 years? If so, above what altitude?
Usually, satellites, the mission orbits of which are above circa 600km altitude, risk not to re-enter within 25 years. It is therefore suggested that satellites intended to be placed in such orbits, should be required to have both capabilities reserved for stationkeeping and to enable collision avoidance manoeuvres, and autonomous systems (i.e. propulsive modules) able to de-orbit in case of failure independently of whether the stationkeeping or manoeuvring capabilities are exhausted or not.

Paragraph 32 Draft Notice: A single deployment of a number of satellites from a launch vehicle or free-flying deployment device could result in some heightened risk of collision between objects, or on a longer-term basis due to the similarity of orbits for the released objects. We seek comment on whether we should include in our rules any additional informational requirements regarding such launches. Are there mitigation measures that are commonly employed that mitigate such risks, for example through use of powered flight during the deployment phase and/or through phasing of deployment, that we should consider adopting as requirements under some circumstances?
When a large number of satellites (i.e. > 3 satellites) are deployed in the same orbit, phasing between each satellite shall be required in order to avoid unwanted collisions between them. This is particularly relevant in case of deployment of nanosatellites (e.g. CubeSats) that normally occurs in a very short sequence, i.e. CubeSats are released with very short time between each released and following CubeSat. In this case, the phasing is critical, and use of free-flying deployer or of powered flight during the deployment phase can be used as alternatives.

Paragraph 38 Draft Notice: We propose to require that applicants provide information concerning the expected reliability of disposal measures involving atmospheric reentry, and the method by which that expected reliability was derived. We also seek comment on the metric by which such information should be evaluated. Adding a specific metric for reliability of disposal may help us to better evaluate the applicant's end-of-life disposal plan.
It is suggested to measure reliability based on the absolute capability of a satellite to perform decommissioning manoeuvre that is provided before the satellite is launched/placed in orbit. In addition, the reliability of such a capability shall be assessed dynamically during the space mission, e.g. the reliability can be re-assessed/re-measured after a critical event experienced by the satellite/spacecraft (failure, malfunctioning, getting hit by space debris, etc.). If after such re-assessment the reliability level is lower than the required threshold, the satellites shall be decommissioned even if the declare end-of-life is not yet reached.

It is furthermore suggested that use of autonomous decommissioning devices can greatly contribute to achieving and maintaining the threshold of reliability because use of such devices shifts the necessity to assess the reliability of the satellite itself to the assessment of the reliability of the device.

Paragraph 42 Draft Notice: we propose that applicants seeking to operate NGSO satellite systems provide a statement that spacecraft disposal will be automatically initiated in the event of loss of power or contact with the spacecraft, or describe other means to ensure that reliability of disposal will be achieved, such as internal redundancies, ongoing monitoring of the disposal function, or automatic initiation of disposal if communications with the spacecraft become limited. We recognize that these design features have some associated costs.
In order to lower the possible cost of ensuring that the reliability of disposal is achieved by design of the satellite platform itself, it is suggested to consider the possibility to equip the satellite with an autonomous decommissioning device that would duplicate, with degraded performance, most of the critical functions of a spacecraft (e.g. telecom, positioning, ADCS, etc.) so that in case of a critical malfunctioning of the spacecraft it can guarantee its diagnostic and perform the decommissioning manoeuvre. The obligation to ensure absolute capability to perform decommissioning manoeuvre will thereby be transferred from the satellite itself (i.e. its design) to such a device. Such an approach will avoid the investment in re-designing the satellite platform itself.

Paragraph 42 Draft Notice: We also ask whether we should simply require the design to include automatic disposal by a de-orbiting device in the event of loss of power, and on whether any such requirement would provide adequate flexibility for operators to react, for example, if the particular failure mode results in further propulsive manoeuvres running a high risk of explosive fragmentation.
Spacecraft operators would prefer to remain in control of their spacecraft notwithstanding their conditions. The use of an autonomous rather than automatic de-orbiting device provides the operator with the desired control over the spacecraft.

Paragraph 42 Draft Notice: Are there other technologies that can be used to ensure that satellite disposal is completed, even in the event of a major anomaly, and should we require use of those technologies for satellites that will operate in particular regions?
Use of autonomous decommissioning devices should be required in every orbital protected region. The key feature of such devices should be the autonomy from the spacecraft itself, to ensure the reliability of the EOL manoeuvre even in case of a critical failure of the spacecraft. The way the manoeuvre itself is performed would instead depend on the specific need of the mission and could be implemented through different propulsion systems, such as chemical propulsion (solid or liquid), drag augmentation devices, etc.

Paragraph 44 Draft Notice: we seek comment on whether there are other rule changes we should consider related to the disposal of spacecraft from the LEO region. Should we adopt a rule that disposal of spacecraft in the LEO region must be by either atmospheric reentry or direct retrieval? In assessing whether a post-mission disposal plan is sufficiently reliable, what weight, if any, and under what circumstances, should we give to proposals to directly retrieve the spacecraft from orbit at its end of life? Should direct retrieval be considered as a valid debris mitigation strategy, for example, only if the retrieval spacecraft are presented for licensing as part of or contemporaneously with the constellation license?
Current technological development with regard to retrieval devices is not yet at the stage of readiness for use as a reliable service. The additional risk associated with using retrieval devices is that of creating more debris in case of failed operations. Therefore, it is suggested not to consider it as a valid debris mitigation strategy short- to mid-term at the very least.

Paragraphs 49-50 Draft Notice: For example, the anticipated lifetime of a typical "CubeSat" operating in the Earth exploration-satellite service is only one or two years. Consistent with these shorter mission lifetimes, as well as the number of satellites planned for deployment, we ask whether the 25-year disposal guideline contained in the NASA Standard remains a relevant benchmark.
The 25-year rule does correspond to the current situation with regard to number of launches and of launched satellites, in particular if satellite constellations. It is suggested that the 25-year rule is shortened.

Paragraph 73 Draft Notice: We further invite comment generally on what economic approaches might be feasible and effective in creating incentives such that appropriate launch vehicle and satellite design choices are made, and appropriate decisions regarding the number of satellites launched are made as well. That is, recognizing debris creation as a negative externality, what approaches might induce private decisions on these design and launch choices to be consistent with the public interest in limiting the growth of orbital debris?
Several approaches could be considered for implementation

- *Ecotax: a tax payable for every launch/placing in orbit or for every year of satellite operations that would be used to foster development of space debris mitigation and remediation technologies and corresponding services;*
- *Deposit: a sum deposited with e.g. licensing authority and returned to the payer when end-of-life operations are successfully carried out;*
- *Eco-labelling: most compliant satellite operators and manufacturers should be distinguished by means of recognition that will incentivise best practices in this regard.*

Paragraph 85 Draft Notice: ***Changes in Satellite Design***. Another method of reducing orbital debris would be for the Commission to regulate how satellites or satellite system are designed. These regulations would limit the types of design features that increase the orbital debris population or increase the risk that such debris will be created. Some of the proposals above would potentially have the effect of changes in satellite design, for example, if more fuel was necessary onboard to perform orbit raising for satellites being deployed in an NGSO constellation. We recognize that there may be some costs associated with these types of proposals and seek comment on those potential cost in the discussion above. We do not propose to mandate particular designs for satellites and systems, however, such as use of a particular satellite bus design. While costs related to satellite design may be necessary to help achieve the goal of limiting creation of orbital debris, we believe such detailed mandates as specific satellite bus design would be too restrictive to cover the wide range of satellite systems and operations, would be difficult to develop and maintain, and could impose hardware and design costs on Commission-authorized satellites as well as costs related to limitations on innovation, that may be beyond what is necessary to achieve the desired ends.
A requirement to use a dedicated autonomous subsystem for the de-orbiting / EOL manoeuvre could be a good alternative to requirements with regard to spacecraft design that might be too costly or otherwise restrictive for satellite operators. Such a requirement would not compromise, but most likely improve achievement of the desired success rate of the decommissioning manoeuvre, without any substantial modifications in spacecraft design.

Paragraph 87 Draft Notice: ***Use of Economic Incentives***. In this NRPM, we ask whether there are other economic incentives available that the Commission could offer that would help achieve the public interest in this area. We seek comment on, for example, the possibility of requiring insurance for on-orbit and reentry liability. Given that debris creation is a negative externality, however, we believe that economic incentives alone may not be sufficient.

An economic incentive for operators to use dedicated and autonomous systems for deorbiting on their satellites could be that of eligibility of costs required to enable such use for tax reduction purposes or other similar financial instruments. Such an approach could result in that operators are motivated to install such systems thereby increasing the reliability of the EOL manoeuvres, and further incentivizing the market for decommissioning solutions with more competition and new and more efficient solutions.

Paragraph 89 Draft Notice: ***Active Debris Cleanup***. Another alternative to the rules proposed in this NPRM is for the Commission to consider requiring operators to engage in active debris removal. We ask questions about this disposal method in this NPRM.

Active debris removal is a service that will greatly help to maintain the orbital population under control. However, it should be considered as a debris remediation and not debris mitigation tool, for several reasons:

- *In the short term, the reliability and, in some cases, the feasibility, of active debris removal still needs to be demonstrated. While mitigation measures (e.g. deorbiting devices) can be implemented already with existing technology and a lot of heritage is being building up in these years.*
- *There is still a number of outstanding legal/regulatory issues related to active debris removal that would need to be cleared up before it can become a marketable service.*
- *Recognising active debris removal as a mandatory debris mitigation tool would be economically considerably more burdensome than e.g. use of autonomous decommissioning devices or changes in satellite design.*