PARIS PEACE FORUM de PARIS sur la PAIX

NET ZERO SPACE

Sustainable outer space by 2030

Fostering Better and More Interoperable Norms:

Comparing Existing Binding National Requirements Relating to Space Debris

Recommendations For Enhanced Regulations and Public Policy with Regard to Space Debris Mitigation and Remediation

WORKING GROUP 1

WHITE PAPER | November 2022

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Outer space is a shared environment offering important economic, scientific, and strategic benefits for all humankind. However, as activities in outer space have entered a new era of growth, the amount of orbital debris is increasing dangerously, jeopardizing key services of our daily lives and endangering the possibilities of exploiting and even accessing space in the medium term.

Since its launch in November 2021, the Net Zero Space initiative to protect the Earth's orbital environment has been calling for concrete actions commencing from 2021 onwards to tackle the pressing challenge of space debris, with the ultimate aim of achieving sustainable use of outer space by 2030. The Net Zero Space declaration especially states the following:

> *By launching the "Net Zero Space" initiative, we are calling for a global commitment to achieving sustainable use of outer space for the benefit of all humankind by 2030. We recommend urgent action from 2021 onwards to rapidly contain and then reduce the ongoing pollution of Earth's orbital environment:*
>
> - *by avoiding further generation of hazardous space debris, and*
> - *by remediating existing hazardous space debris.*

Over the past year, the Net Zero Space coalition has been looking into developing further policy recommendations in relation to the observation and commitments of the Net Zero Space declaration. This White Paper summarizes key conclusions of the discussions that took place in the framework of Working Group #1, focusing on studying existing binding requirements in national regulations and licensing processes around the globe. Ultimately, the recommendations of Working Group aim at paving the way for the establishment of common minimum requirements that allow for better international interoperability of the national legal frameworks.

All quotes, data and examples are from participants' contributions during the meetings and are anonymized in line with the agreed norms for the discussions.

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[1] *The Paris Peace Forum. Net Zero Space Declaration. Available here: Net Zero Space | Paris Peace Forum*

NET ZERO SPACE

Sustainable outer space by 2030

About the Net Zero Space initiative

Launched at the 2021 Paris Peace Forum, The Net Zero Space initiative aims at underlining the consensual assessment among the space industry that there is a need to urgently address rising orbital pollution. Its supporters call for political authorities, both nationally and internationally, to take urgent steps to protect the Earth's orbital environment in other to achieve a sustainable use of outer space by 2030.

It is now supported by 45 stakeholders, including 13 in-orbit services and SSA providers, 10 satellite operators, 6 civil society and academics, 5 space agencies and public authorities and 4 launchers. It gathers actors from 22 countries around the two core principles of avoiding further generation of hazardous space debris (mitigation) and remediating the existing ones (remediation).

About the Paris Peace Forum

In a world requiring more collective action, the Paris Peace Forum is a platform open to all seeking to develop coordination, rules, and capacities that answer global problems. Year-round support activities and an annual event in November help better organize our planet by convening the world, boosting projects, and incubating initiatives.

Composition of the Working Group

This Working Group gathered experts representing formal supporters of the Net Zero Space initiative. This White Paper summarizes the outputs of the year-long reflection and was agreed by consensus.

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NET ZERO SPACE

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I- Introduction

It has long been internationally recognized that the exploration and use of outer space are the province of all mankind"[2]. Consequently, ensuring equitable access to space for all nations regardless of their degree of economic or scientific *development* is a widely agreed upon principle that has been codified in international space law [3]. However, these general principles are currently threatened by the distressing reality of the decaying state of the Earth's orbits. The OECD recently conveyed that[4]:

> "Estimating the loss associated with excessive debris in Earth's orbit in monetary terms suggests more resources should be devoted to mitigating debris. An experimental model has been developed to assess the economic effects of a collision event through global value chains. It estimates worldwide monetary losses in the case of Kessler Syndrome to USD 191.3 billion. This is a large sum in proportion to the resources currently committed to debris mitigation and remediation globally."

The latest estimations assess the existence of over 36,500 space debris objects greater than 10 cm floating around through the Earth's orbits; one million between 1 cm and 10 cm, and 130 million space debris objects whose size ranges from greater than 1 mm to 1 cm[5]. Of the over 13,600 satellites successfully deployed since the advent of the Space Age, about 2,600 are derelict and yet still travelling through the Earth's orbits, thus increasing the probability of colliding into other space objects, either active or derelict[6].

Current government SSA capabilities alone cannot be expected to cover the millions of pieces of space debris that threaten operations and to scale the require accurate and comprehensive cataloguing and monitoring of space debris enabling modern mitigation and remediation[7]. Such capabilities are nevertheless necessary to manage the orbital environment in a sustainable way and preserve the benefits of a booming New Space economy. At this rate, and unless action is taken with the utmost urgency, the possibility for emerging spacefaring nations and current and future generations to benefit from orbital resources is greatly jeopardized.

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[2] This is notably contemplated in articles I-IV of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (or Outer Space Treaty); Articles 4 and 11 of the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement); Preamble of the Convention on International Liability for Damage Caused by Space Objects (or the Liability Convention); and Preamble of the Convention on Registration of Objects Launched into Outer Space (or the Registration Convention). These, along with the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (or the Rescue Agreement), are the five international treaties adopted in the framework of the UN Committee on the Peaceful Uses of Outer Space.

[3] Article I of the Outer Space Treaty; Article 4 of the Moon Agreement; Preamble of the Convention on International Liability for Damage Caused by Space Objects (or the Liability Convention); Preamble of the Convention on Registration of Objects Launched into Outer Space (or the Registration Convention).

[4] OCDE. (2022). *Earth's Orbits at Risk: The Economics of Space Sustainability*. Éditions OCDE, Paris. Available here: https://doi.org/10.1787/16543990-en.

[5] ESA. (11 August 2022). *Space Debris by the Numbers*. Accessible here: ESA - Space debris by the numbers [Accessed: 19 August 2022].

[6] Ibidem.

[7] "Space situational awareness can be defined as the "knowledge and characterisation of space objects and their operational environment to support safe, stable, and sustainable space activities" (The White House, 2018[38]). Effective space situational awareness and space traffic management rely on the co-ordinated efforts of military, civilian and commercial operators and space object trackers, all of which hold essential, but incomplete, data and information about the position of their own and others' space assets. Considering the size of the space environment, this is a daunting task". OCDE. (2022). *Earth's Orbits at Risk: The Economics of Space Sustainability*. Éditions OCDE, Paris. Available here: https://doi.org/10.1787/16543990-en.

The space sector is changing, the use of orbits has reached unprecedented intensity and the "orbital debris environment has reached the tipping point" according to NASA[8]. For decades, governments were the only organizations capable of having satellites in space as the financial and technological barriers-to-entry were too high. Today, the vast majority of spacecraft are coming from the private sector with important consequences. Space is congested, contested and competitive.

Statements to this effect are intrinsic to all reports on orbital debris by the main organizations and institutions of reference in the field[9]. For some time now, the industry and other stakeholders have also engaged in an important awareness raising effort on the urgency to deal with this issue but political mobilization at international level remains overall scarce. In this respect, it is worth to note the considerable efforts made in the development of the Long-Term Sustainability Guidelines (LTS Guidelines); however, their voluntary nature means that, in practice, there is still a long way to go in terms of effective and widespread implementation of the measures they propose.

Two main courses of action are available to states to meet this growing challenge. The first is to embark with other states on the process of drafting a new legally binding international treaty. While there are many advantages to binding international instruments, such as uniform international enforcement, they do not seem the most suitable option in cases like the present because consensual adoption stands in the way of rapid and decisive action needed to act upon the rapidly degrading state of the space environment, rapid technological advances fueling unprecedented activity on orbit. Thus, speed is an important success factor for space sustainability[10] and it is likely that, by the time a treaty is adopted, humanity will have reached a point of no return, that sustainably exploiting the Earth's orbits for the benefit of all mankind will no longer be an option or that the costs of launching to and operating in space will be prohibitively expensive, rendering space operations, space capabilities and services of all sort uneconomical.

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[8] Office of Inspector General, NASA. (27 January 2021). *NASA's efforts to mitigate the risks posed by orbital debris*. Available here: NASA's Efforts to Mitigate the Risks Posed by Orbital Debris | Oversight.gov

[9] For instance, see *ESA's Annual Space Environment Report* (22 April 2022). "Space debris poses a problem for the near Earth environment on a global scale, to which all spacefaring nations have contributed and for which only a globally supported solution can be the answer.", page 3. Available here: Space_Environment_Report_latest.pdf (esa.int); *ISRO's Space Situational Assessment 2021* (March 2022). "Growing collision threats of space objects including orbital debris with the operational space assets have become a perennial problem for the safe and sustainable use of outer space. These threats restrict the unhindered access to space and prompt all space actors to take appropriate measures to mitigate them." Available here: Space Situational Assessment 2021 - ISRO; *USA's National Orbital Debris Implementation Plan* (July 2022). "Earth's orbits, however, are finite resources and can be threatened by the rapid, uncontrolled increase in orbital debris. The challenges posed by orbital debris to the sustainability of outer space have inherent similarities to other human-made global environmental challenges. The consequences of not mitigating, tracking, or remediating orbital debris could render certain orbital regimes unsafe or unusable for satellites to operate.", page 5. Available here: 07-2022-National-Orbital-Debris-Implementation-Plan.pdf (whitehouse.gov).

[10] "We are in a critical window for ensuring space is a safe, sustainable, and accessible domain for all; without quick and decisive action, positive outcomes may not be realized. Space already plays a role in accelerating critical sustainability and security agendas. Our findings show it can play an even greater role in advancing these global priorities if the international community further adopts and accelerates the development of crucial space technologies." (...) "Success also depends on action at-pace: prioritizing space and furthering foundational governing principles for the sector, ideally in months, not years. By taking the right set of actions today, leaders believe the industry can chart a route for humanity to enjoy the myriad benefits of a peaceful, vibrant, and value-creating space sector." McKinsey & Company. (May 2022). *The role of space in driving sustainability, security, and development on Earth*. Available here: The role of space in driving sustainability, security and development on Earth

The second course of action takes this urgency into account and seeks to avoid the tediousness of the process in favor of quicker, more flexible mechanisms: that is, the adoption of space sustainability and debris-related norms at the national level. The underlying idea is that states taking individual actions aligned with a commonly defined goal of preserving space for future generations can lead to a similar result as an international treaty, should the main space-faring Nations coordinate their national reforms. If the main spacefaring nations voluntarily commit to a certain number of good practices today, not only will these have an direct and rapid impact on the core of the problem but will also naturally set the course for the potential adoption of an international instrument in the medium term through bilateral engagements. Furthermore, there already exists a number of internationally agreed guidelines[11] and recommendations from coalitions of members of the industry[12] that could serve as a basis for states to create converging national policies and/or binding regulations.

As such, the supporters of the Net Zero Space initiative and the Paris Peace Forum advocate that the priority should not be to focus on enacting an international treaty, but to ensure the proper implementation of existing industry best practices and recommendations by transposing them, where appropriate, into converging national laws and smart regulation.

In this context, this Working Group #1 on "**Fostering Better and More Interoperable Norms: Comparing Existing Binding National Requirements Relating to Space Debris"** was launched with the goal of studying the existing binding requirements concerning space debris within the national laws of 17 spacefaring/emerging spacefaring nations, as a starting point from which to elaborate concrete recommendations that could be adopted by all states at a national level. The choice of these countries was made in an attempt to have a representative sample of different space market sizes and maturity, with an extra effort in terms of geographical representation.

Josef Aschbacher, Director General of ESA. "Space debris have increasingly raised a general risk to all operating satellites in orbit. The intentional generation of space debris is significantly and irresponsibly endangering critical space-based services that Europe and the world rely on to save lives and to provide critical services for our present and future well-being. […] It is vital to immediately use an appropriate mechanism to secure a free, responsible, and safe access to space for all. As Director General of ESA, I am fully committed, in this context, to contribute to a globally acceptable solution and to support the actions of ESA Member states in the United Nations to guarantee the long-term sustainability of outer space. I shall now focus on working with ESA Member states to ensure continued safe space operations." ESA. (17 November 2021). *DG statement on the increasing risks of space debris*. Available here: ESA - DG statement on the increasing risks of space debris.

Kamala Harris, Vice President of the United States of America, and Chair of the National Space Council. "As we move forward, we will remain focused on writing new rules of the road to ensure all space activities are conducted in a responsible, peaceful, and sustainable manner.". The White House (18 April 2022). *Remarks by Vice President Harris on the Ongoing Work to Establish Norms in Space*. Available here: Remarks by Vice President Harris on the Ongoing Work to Establish Norms in Space - The White House.

[11] The Long-Term Sustainability Guidelines (LTS Guidelines, 2019). Long-term sustainability of outer space activities (unoosa.org); European Space Agency (ESA): Space Debris Mitigation Policy for Agency Projects (2014); Committee On the Peaceful Uses Of Outer Space (COPUOS, 2010): Space Debris Mitigation Guidelines. Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (unoosa.org); Inter-Agency Space Debris Coordination Committee (IADC): Space Debris Mitigation Guidelines. IADC Space Debris Mitigation Guidelines (nasa.gov); International Organization for Standardization (ISO): Standards and technical reports: ISO 24113:2019; ISO 23312:2022; ISO 20893:2021; ISO 11227:2012; ISO 14200:2012; ISO 16126:2014; ISO 27852:2016; ISO 27875:2019; ISO/TR 16158:2021; ISO/TR 18146:2020; ISO/TR 20590:2021; ISO 13541:2021; ISO 26900:2012; ISO 13526:2010; ISO 19389:2014; International Telecommunications Union (ITU): Recommendation ITU-R S.1003.2. RECOMMENDATION ITU-R S.1003-2* - Environmental protection of the geostationary-satellite orbit (unoosa.org); ESA *et al.* (28 June 2004). *European Code of Conduct for Space Debris Mitigation*. Available here: European Code of Conduct for Space Debris Mitigation

[12] Space Safety Coalition. (19 September 2019). *Best Practices for the Sustainability of Space Operations*. Available here: SSC Best Practices for Space Operations (spacesafety.org); Outer Space Institute. (2020). *Salt Spring Recommendations on Space Debris*. Available here: Salt Spring Recommendations (outerspaceinstitute.ca)

Given the two axes on which the Net Zero Space initiative is based – mitigation and remediation - the group decided to build the research questions around two categories: requirements that deal with space debris mitigation and those that deal with remediation.

II- Comparative analysis of national requirements

II.1 – State of the art

This section aims at providing a short overview of the state of the art of the existing binding sustainability requirements within the national legal frameworks of 17 countries when it comes to the performance of activities in outer space, as well as at putting forward a brief analysis of the main gaps and convergences found.

Within each of the two aforementioned categories, the following queries were retained for study:

1. MITIGATION
    a. Before launch: ***is it required when applying for a launching/operating permit or other domestic authorization to present a debris mitigation plan?***
    b. Before launch: ***is it required when applying for a launching/operating permit or other domestic authorization to present an end-of-life disposal strategy?***
    c. Once in orbit: ***is the space operator compelled by the license/by law/by contract to conduct its operations in a certain way (ex. in order to ensure the continuity of activities in outer space)?***
2. REMEDIATION:
    a. Once in orbit: ***is there an obligation to inform a specific national body in case of any alterations to the activity as described in the application form for permit?*** Ex. in case of partial or total destruction /malfunction of the spacecraft, undertaking of collision avoidance maneuvers, de-orbiting.
    b. End of life: ***is the actor obliged by the license/by law to safely dispose of the spacecraft once its mission is accomplished?***

For the study of national laws, the starting point was the Compendium of space debris mitigation standards adopted by states and international organizations in the framework of the production of the UN COPUOS Long-Term Sustainability Guidelines[13], which includes the current instruments and measures that have been implemented by states and international organizations.

[13] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations.* Available here: Space Debris Mitigation Standards Compendium - Update (unoosa.org)

The following matrix is a compilation of the results of the research. This form of representation has been chosen to facilitate visibility and understanding, but it is by no means exhaustive.

Fig. 1. Summary of the state of the art of the national legal frameworks when it comes to space debris.

	MITIGATION			REMEDIATION	
	1.a	1.b	1.c	2.a	2.b
Australia	YES	YES	-	YES	-
Brazil	-	-	-	YES	-
Canada	YES	YES	-	YES	YES
China	YES	*	*	YES	*
France	YES	YES	YES	YES	YES
Germany	-	-	-	-	-
India	-	-	-	-	-
Japan	YES	YES	YES	YES	YES
Luxembourg	-	-	-	-	-
The Netherlands	YES	YES	-	YES	-
New Zealand	YES	YES	-	YES	-
Nigeria	-	-	OPT	YES	OPT
Republic of Korea	-	-	-	YES	-
Russian Federation	-	-	YES	*	*
United Arab Emirates	-	-	YES	YES	YES
United Kingdom	YES	YES	OPT	YES	-
United States of America	YES	YES	YES	YES	YES

YES: the national legal framework expressly responds in a positive way to the question.
OPT: the national legal framework contemplates the question but leaves it to the regulator to decide whether to further develop the provision/to the actor to choose whether to include debris-related specifications in its contract.
"-": absence of an express reference to the debris-related question.
"*": lack of information.

II.2 – Analysis

The previous section gathers valuable information on the extent to which the issue of orbital debris is dealt with in different national regulations. In this section, that state of the art will be analyzed, with a view to finding possible points of convergence and improvement on which to formulate policy recommendations.

The first conclusion to be drawn from the matrix is the **low level of development of binding regulations specifically targeting space debris**. For instance, in Germany the only existing national mechanism is the Product Assurance and Safety Requirements for DLR Space Projects: December 2019 (Issue 8.2). However, "it is the policy of DLR that each contractor involved in the implementation of a particular space mission applies product assurance and safety requirements, including space debris mitigation, throughout all project phases"[14]. As it will be explained later, this becomes a *de facto* standard for public procurements, but there is no regulation governing missions where DLR is not involved. Other countries, as communicated to UNOOSA in the framework of the elaboration of the Space Debris Mitigation Standards Compendium, are in the process of either developing a national space-related legislation (such

[14] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. Germany*. Available here: Germany - Space_Debris_Compendium.

as Brazil)[15], or formally adopting a national mechanism on space debris mitigation (such as India)[16].

In some cases, the issue of space debris is addressed in multiple pieces of legislation and/or regulation, which complicates the task of understanding the state of the art of the requirements established by the national law. Such is the case of the United States, where obligations concerning space debris are spread throughout texts from NASA; the Federal Aviation Administration (FAA), the National Oceanic and Atmospheric Administration (NOAA), the Federal Communications Commission (FCC) and the Department of Defense (DoD) authorities, the U.S. Geological Survey and several National Policies[17].

Frameworks also mostly focus on formal requirements (such as having a debris mitigation plan) rather than a substantive obligation by dictate of the law. For instance, according to the Canadian Remote Sensing Space Systems Act[18]:

> An application to the Minister to issue, amend or renew a licence must be made in the prescribed form and manner, be supported by a proposed system disposal plan, proposed guarantee arrangements referred to in paragraph 9(1)(b) and any other prescribed information, documents and undertakings and be accompanied by any prescribed application fee.

No further provisions develop these formal requirements, which hampers the tracking of whether there has been an actual implementation of the disposal plan or the space debris mitigation strategy. The same goes for the Remote Sensing Space Systems Regulations (SOR/2007-66)[19] and the Canadian Client Procedures Circular (CPC) for Licensing of Space Stations – 2014/2017[20]. This rationale can also be applied to the Australian Space (Launches and Returns) Act 2018 and its Space (Launches and Returns) (General) Rules 2019.

The second conclusion worth pointing out is that **there are different traditions towards defining "binding" requirements**. As such, in practice norms to mitigate or remediate space debris can be binding by law (e.g., France), by license (e.g., the US or the UK), or by contract (e.g., Germany) – solutions which entail different regimes and meaning for the actors.

- The French Space Operations Act prescribes that all launch and orbital systems "must be designed, produced and implemented in such a way as to minimize the production of debris during nominal operations" [21] [including after the end-of-life of the launcher

[15] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. Brazil.* Available here: Brazil - Space_Debris_Compendium.
[16] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. India.* Available here: India - Space_Debris_Compendium.
[17] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. United States of America*. Available here: USA - Space_Debris_Compendium,
[18] Canada. (25 1November 2005). *Remote Sensing Space Systems Act*. Available here: Remote Sensing Space Systems Act (justice.gc.ca). Operation of Remote Sensing Space Systems > Applications, Licences and Related Matters > Applications regarding licences.
[19] Canada. (29 March 2007). *Remote Sensing Space Systems Regulations (SOR/2007-66).* Available here: Remote Sensing Space Systems Regulations (justice.gc.ca). Information and Documents To Support an Application: [...] Remote Sensing Satellite Disposal.
[20] Canada. (June 2017). *Canadian Client Procedures Circular (CPC) for Licensing of Space Stations – 2014/2017*. Available here: CPC-2-6-02 Licensing of Space Stations. 3.3.3 Space debris mitigation plan.
[21] République Française. Ministère de l'enseignement supérieur et de la recherche. (31 March 2011). *Arrêté du 31 mars 2011 relatif à la réglementation technique en application du décret n° 2009-643 du 9 juin 2009 relatif aux autorisations délivrées en application de la loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales.* Available here: Arrêté du 31 mars 2011 - (legifrance.gouv.fr)

and its component parts]. In this case, a specific behavior is directly mandated by the law, and thus noncompliance will entail a breach of law. As a consequence, the legal actions provided by law for such a case will be applicable.

- However, most national laws do not prescribe that activities in outer space be conducted in a specific way when it comes to space debris and spaceflight safety. Perhaps due to the lack of monitoring capabilities to enforce regulation, instead, they merely establish the need for a debris mitigation and remediation plan that meets certain specified requirements as a prerequisite for the granting or renewing of a permit or license. Such is the case of the US Code of Federal Regulations (Title 47, Chapter I). FCC licenses are typically granted subject to the requirement that operations under the grant must comply with the legal and technical specifications set forth by the licensee in its application and may include additional specific conditions relating to orbital debris/collision mitigation risk. As such, noncompliance in this case will qualify as regulatory noncompliance, which could result in the revocation or cancellation of the license to operate, alongside possibly other enforcement measures.
  Similarly, the UK 2018 Space Industry Act establishes[22]:

  > SCHEDULE 1 Section 13
  > PARTICULAR CONDITIONS THAT MAY BE INCLUDED IN LICENCES
  > 1 Conditions as to compliance with—
  > [...]
  > (g) space debris mitigation guidelines.

  Again, no obligation is imposed by law to behave in a certain way: it is rather considered as a condition for the maintenance of the license. In practice, it is the UKSA policy that applicants prove to be compliant with existing guidelines relating to space debris, such as IADC's or COPUOS's[23].

- Finally, if the mandate to deal with space debris is included as a condition for public procurement contracts, it becomes a *de facto* binding requirement for public-private contracts. Such is the case, among others, of the German DLR, whose policy is "that each contractor involved in the implementation of a particular space mission applies product assurance and safety requirements, including space debris mitigation, throughout all project phases"[24]. Similar efforts are being put forward by India's ISRO, whose Space Debris Mitigation Requirements "are being firmed up to evolve more effective implementation mechanisms to promote adherence by Indian entities"[25].

As a final observation, it should be noted that it is sometimes difficult to find some states' national regulation on outer space operations in an up-to-date UN working language version, which not only hinders visibility and prevents other states from potentially learning from their

[22] United Kingdom. (2018). *Space Industry Act 2018*. Available here: Space Industry Act 2018 (legislation.gov.uk)
[23] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. United Kingdom of Great Britain and Northern Ireland.* Available here: United Kingdom - Space_Debris_Compendium.
[24] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. Germany*. Available here: Germany - Space_Debris_Compendium.
[25] UNOOSA. *Compendium of space debris mitigation standards adopted by states and international organizations. India.* Available here: India - Space_Debris_Compendium.

best practices, but also in the long run hinders the process of convergence towards common minimum national requirements.

III- Recommendations

Government intervention is crucial to address the space debris issue[26]. The discussion in the previous sections provides a general view of the options open to states to meet the challenge of orbital debris mitigation and remediation. The Net Zero Space community and the Paris Peace Forum thus call on all heads of state and government to act now in favor of Earth's orbits. That said, global cooperation must be at the center of all strategy, for only a united action aligned towards the greater goal can successfully achieve the desired objectives. Otherwise, we will soon find ourselves with a scenario largely similar to that of the environment on Earth, where the international community only managed to take action when it was almost too late.

In order to facilitate its task, this Working Group has developed a series of recommendations which are described below. The logic that has guided their elaboration has been to devise both concrete measures that states can adopt in the short term in a direct and simple manner, and other longer-term measures that are a natural extension of the former.

General recommendations

1. **Fostering transparency around legislation**. States and all stakeholders would benefit from an enhanced visibility of existing legal frameworks. It would thus be useful to have a common platform where interested parties could find any current national regulation about space operations. This would also be a helpful way to promote accountability in case of lack of regulations or non-alignment with the mainstream standards.
    a. ***Short term***: states pledge to provide a central platform with their relevant national legal frameworks, in both their language of origin and in English. The central platform will translate them into all official UN languages.
    b. ***Long term***: states pledge to submit all legal amendments to or evolutions of their national regulation within 3 months following their adoption. The central platform will translate them into all official UN languages.
2. **Integrating relevant international frameworks**. Although not legally binding, international frameworks such as the IADC space debris mitigation guidelines or the UN guidelines for the long-term sustainability of outer space present consensual, concrete recommendations to protect Earth's orbital environment. States can unilaterally integrate them in their national regulation, thus making these guidelines or good practices binding in national law, which helps both in increasing the level of implementation and raising awareness about their importance.
    a. ***Short term***: states pledge to initiate procedures to translate existing international guidelines or good practices into national law or regulation, as appropriate.
    b. ***Long term***: states pledge to updating their national frameworks in a way that is coherent with the state of the orbital environment and the development of the

[26] OCDE. (2022). *Earth's Orbits at Risk: The Economics of Space Sustainability*. Éditions OCDE, Paris. Available here: https://doi.org/10.1787/16543990-en.

space sector, with internationally recognized norms and consensual good practices as minimum standards for national requirements.

3. **Increased cooperation**. Protecting Earth's orbital environment is a necessity for every actor to keep operating in orbit. Both in an intergovernmental and multi-actor format, states should develop cooperation to keep a sufficient international level of environmental awareness when it comes to the state of Earth's orbits.
    a. ***Short term***: states pledge to launch international, informal consultation directly involving the industry and other parties to confirm innovate and up-to-date best practice format for sharing SSA data.
    b. ***Long term***: states pledge to develop of a joint repository of SSA data in the agreed common/best practice format and to institute national points of contacts responsible for accessibility to such data.
4. **Private initiative**. In relation with the evolution of public regulations around the globe, private operators and financial actors could mobilize means of contract law to impose *de facto*, ambitious sustainability standards which could lead to more widespread adoption across the space value chain.
    a. ***Short term***: Developing a standard contract clause concerning space debris mitigation and space sustainability to be leveraged in contracts, and especially venture-capital agreements.
    b. ***Long term***: Systematize the use of the agreed standard contract clause.

<u>Specific Recommendations concerning Mitigation</u>

5. **Leading by example**. One way in which states could easily encourage their national actors to be transparent with information regarding their activities is if the state itself unilaterally decided to share information about government operations. This would set a precedent that could impact the culture of domestic industry, making it increasingly inclined to voluntary transparency:
    a. ***Short term***: states pledge to share more data on the position and trajectory of their public satellites, including military satellites with necessary adaptations regarding legitimate security interest.
    b. ***Long term***: states pledge to a transparency-by-design standard for government-supported operations and to agree before 2030 in the context of the United Nations on a clear framework clarifying possible exceptions to sustainability norms for legitimate security interest.
6. **Encouraging information sharing within the national commercial sector** by putting in place policies that encourage transparent and collaborative behavior among industry actors. Implementing this recommendation will indeed help in raising the standards of transparency of the domestic industry. Now, if carried out collectively (with the main spacefaring nations all agreeing to establish measures of this kind), it will also *de facto* increase the standards of the sector at the international level.
    a. ***Short term***: states pledge to incentivize the sharing of positional data, as well as details of planned maneuvers.
    b. ***Long term***: states pledge to make continuous data sharing a licensing requirement, subject to appropriate protections for such data.

7. **Leveraging public procurements**. Space agencies and other public contractors require that any actor entering into a contract with them meets a series of requirements regarding space debris. However, these provisions for public procurement often include exceptions that allow partial or total exemption from the requirements on a case-by-case basis, which often renders the initial good intention meaningless. Thus, states could choose to apply this measure, restricting the number of exceptions to very limited cases as much as possible:
    a. ***Short term***: Space agencies and other public actors will ensure the adoption of a specific, internationally recognized set of environmental standards (IADC, ISO, LTS, etc.) for its own activities, i.e., for data sharing.
    b. ***Long term***: Space agencies and other public actors will include in their public procurement contracts the aforementioned adopted set of standards for all actors that they enter into contracts with, without exception for environmental protection.
8. **Adopting stricter regulations concerning debris mitigation**. Apart from the aforementioned voluntary and incentive-driven recommendations, which may be useful at an early stage to prepare the industry for stronger change, the most effective measure to move towards better prevention of the creation and mitigation of the existence of orbital debris is undoubtedly the tightening of the obligations contained in the law or regulations.
    a. **Short term:** Building on the work undertaken at the UN COPUOS for the implementation of the 2019 Guidelines for the Long-Term Sustainability of Outer Space, states pledge to engage in the elaboration of a bill to establish or update their national authorization or licensing regulations for future newly launched LEO space systems in a way that defines stricter sustainability requirements (for application from 2023 onwards and with an appropriate phase-in period for industry actors to comply) for space debris mitigation, by consulting with industry and other interested spacefaring Nations, when relevant. Priority targets for such work could especially include:
        i. A post mission disposal (PMD) timeframe of no longer than 5 years for LEO satellites.
        ii. A post mission disposal (PMD) probability of at least 90%, 95% and 99% for LEO satellites in small scale, medium scale, and large scale LEO satellite systems. respectively.
        iii. iii. A capability for all LEO satellites operating above the ISS to perform in a timely manner collision avoidance maneuvers to significantly reduce the probability of collision with other space objects (active LEO satellites, derelict LEO satellites or space debris).
    b. ***Long term:*** State pledge to ensure the entering into force and proper enforcement of the conclusions of the aforementioned works and to regularly conduct updates of the main indicators and requirements in close cooperation with other interested space-faring Nations, as much as possible in the framework of the UN COPUOS.
9. **Leveraging and sustaining the space safety and sustainability innovation ecosystem.** Speed of action is a crucial factor to achieve sustainable use of outer space by 2030. As the private sector and commercial actors are now leading the innovation race at the

pace of relevance to support the growth of the space economy, states have a role to play as facilitator for the emergence and uptake of space sustainability solutions that address space debris mitigation (such as SSA services) and remediation (such as active debris removal services).

a. ***Short term***: states pledge to support the development of commercial space sustainability services and products as a complement to public capacities.
b. ***Long term***: states pledge to mandate public authorities and government entities to search for viable space sustainability services and products solution in the domestic or international market, as relevant to national policy, before developing government capacities.

Specific Recommendations concerning Remediation

Debris remediation is a rapidly evolving sector, for which common principles and norms still need to be defined. However, debris remediation will be necessary as even the immediate cessation of launches won't stop the increase of space debris – due to the number of derelict objects already orbiting Earth.

10. **Adopting stricter regulations concerning debris remediation**:
    a. ***Short term:*** states pledge to establish or update their national authorization or licensing systems for newly launched LEO space systems to define stricter sustainability requirements for application from 2023 onwards for space debris remediation by consulting with the industry and other interested spacefaring Nations, when relevant. The consultation process should especially focus on how national authority could request for authorized or licensed LEO satellite which cannot meet the above requirements defined in 8a for space debris mitigation as a result of partial or total failure which arises (or could arise) in orbit the following:
        i. A requirement for LEO satellite operators to reasonably engage with credible In-Orbit-Service (IOS) providers to implement means to perform viable active debris removal (ADR) or end of life (EOL) services to achieve decommissioning and deorbit of LEO satellites to meet the requirements given in 8a.
        ii. Application of relevant regulatory or financial measures for LEO satellite operators to implement remediation measures to achieve decommissioning and deorbit of LEO satellites consistent with the requirements given in 8a.
    b. ***Long term:*** states pledge to ensure implementation of the new decommissioning rule according to national preference.
11. **Collaborating toward ADR solutions**. Although still in a preliminary stage, ADR missions will become indispensable to ensure the future viability of Earth orbits when coping with the most dangerous debris orbiting Earth. For this reason, it is necessary for the states to engage with industry and other spacefaring Nations about establishing a regulatory and licensing framework from 2023 onwards for ADR missions.
    a. ***Short term***:
        i. States commit to engaging with the industry and other spacefaring Nations in further discussions to identify and solve overarching legal

issues concerning space debris remediation, such as the need for prior permission by the state of registry of the defunct object, liability rules, attribution of fault etc. There are quite critical for ADR to be successful.

ii. States pledge to review list of the 50 statistically-most-concerning derelict objects in LEO or, if preferred, elaborate their own.

b. ***Medium term***: states pledge to establish a dialogue with other states with a view to reaching deals that will allow for the collaborative de-orbiting of the designated most concerning derelict objects, with inclusion of relevant actors from the private sector.

c. ***Long term***: states pledge to maintain this dialogue and progressively increase it to include new spacefaring nations that may emerge and look to join the talks, until the process is systematized.

Annex 1. Relevant documents per country[27]

Australia

- Space Activities Act 1998 (No. 123, 1998) (as amended, taking into account amendments up to Act No. 8 of 2010);
- Space Activities Regulations 2001;
- Space (Launches and Returns) Act 2018;
- Space (Launches and Returns) (General) Rules 2019;
- Space (Launches and Returns) (Insurance) Rules 2019;
- Space (Launches and Returns) (High Power Rocket) Rules 2019;
- Flight Safety Code;
- Maximum Probable Loss Methodology;
- Australian Civil Space Strategy 2019-2028.

Brazil

- Law 8.854 of February 10, 1994, Law Establishing the Brazilian Space Agency;
- Law 9.112 of October 10, 1995, on sensitive goods
- Decree 1.953 of July 10, 1996 Creating the National System for the Development of Space Agencies;
- Law No. 9994 of 24 July, 2000;
- Resolution No. 51 of 26 January 2001 on Commercial Launch Activities from the Brazilian Territory;
- Administrative Edict No. 27 of June 20, 2001;
- Administrative Edict No. 5 of February 21, 2002;
- Administrative Edict No. 96 of 30 November, 2011;
- Administrative Edict No. 182 of 28 May, 2020.

Brazil has not adopted any national guidelines on space debris mitigation. Discussions are in progress with a view to developing. a national space-related legislation.

Canada

- Radiocommunications Act (R.S.C., 1985, c. R-2);
- Canadian Space Agency Act (1990, c. 13);
- Canadian Aviation Regulations: sections 602.43 and 602.44 (SOR/96-433);
- Civil International Space Station Agreement Implementation Act (S.C. 1999, c. 35);
- Remote Sensing Space Systems Act (S.C. 2005, c. 45);
- Remote Sensing Space Systems Regulations (SOR/2007-66)

China

- Measures for the Administration of Registration of Objects Launched into Outer Space of 8 February 2001;
- Interim Measures on the Administration of Permits for Civil Space Launch Projects of 21 December 2002;
- Interim measures on Administration of Mitigation of and Protection against Space Debris;

[27] UNOOSA. *National Space Law*. Available here: Space Law: National Space Law Database (unoosa.org); UNOOSA. (2022). *Schematic Overview of National Regulatory Framework for Space Activities*. AAC105_C2_2022_CRP09E.pdf (unoosa.org)

- China's Space Activities (White Paper of 2016). White Paper: China's Space Program: A 2021 Perspective

France

- Law No. 61-1382, 20 December 1961 Statute of the Centre National d'Etudes Spatiales (CNES);
- Decree 62-153, Regulations Relating to the CNES;
- French Space Operations Act, No. 2008-518 (2008);
- Decree No. 2009-643 of 9 June 2008;
- Decree No. 2009-643 of June 9, 2009 (Relating to the authorizations issued in application of law No. 2008-518 of June 3, 2008 relating to space operations);
- Decree No. 2009-644 of 9 June 2009, modifying Decree No. 84-510 of 28 June 1984, relating to CNES;
- Decree No. 2009-640 of 9 June 2009 (Implementing the provisions provided for in Title VII of Law No. 2008-518 of June 3, 2008 relating to space operations);
- Decree No. 2009-1657 of 24 December 2009 relating to the Defense and National Security Council and the General Secretariat for Defense and National Security;
- Order of March 31, 2011 relating to the technical regulations in application of Decree No. 2009-643 of June 9, 2009 relating to authorizations issued in application of Law No. 2008-518 of June 3, 2008 on space operations
- Order of 3 September 2019 on the creation and organization of the space command

Germany

- Law governing the transfer of responsibilities for space activities;
- Act to give Protection against the Security Risk to the Federal Republic of Germany by the Dissemination of High-Grade Earth Remote Sensing Data (Satellite Data Security Act – SatDSiG), 2007;
- Law governing the transfer of the administrative functions in the sector of outer space activities;
- Satellite Data Security Act- Terminology;
- Satellite Data Security Act.
- Product Assurance and Safety Requirements for DLR Space Projects: December 2019 (Issue 8.2)

India

- India is in the process of formally adopting a national mechanism on space debris mitigation.

Japan

- Law Concerning The National Space Development Agency Of Japan (Law No. 50 of June 23, 1969, as amended);
- The Law concerning Japan Aerospace Exploration Agency (Law No. 161 of 13th December 2002);
- Basic Space Law (Law No.43, 2008 of 28 May 2008);
- Act concerning Launch and Control of Satellites;
- Enforcement Order of the Act concerning the Launch and Control of Satellites
- Regulation for Enforcement of the Act concerning the Launch and Control of Satellites;
- Act concerning Adequate Handling of Satellite Remote Sensing Data;
- Enforcement Order of the Act concerning Ensuring Adequate Handing of Satellite Remote Sensing Data;
- Regulation for Enforcement of the Act concerning Ensuring Adequate Handing of Satellites Remote Sensing Data;

- Act on Securing Proper Handling of Satellite Remote Sensing Records (Remote Sensing Records Act, Act No. 77 of 2016);
- Act on Launching Artificial Satellites and Managing Satellites (Satellite Act, Act No. 76 of 2016)

Luxembourg

- Law of 27 July 1991 on Electronic Media;
- Law of 15 December, 2020 approving the Convention on the Registration of Objects Launched into Outer Space, adopted by the United Nations General Assembly, in New York, on 12th November 1974;
- Law of 15th December 2020 on Space Activities and amending: 1st the amended law of July 9, 1937 on the tax on insurance known as "Versicherungssteuergesetz"and 2nd the amended law of 4 December 1967 concerning income tax

Netherlands

- Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act) of 24 January 2007;
- Decree of 13 November 2007, containing rules with regard to a registry of information concerning space objects (Space Objects Registry Decree);
- Order of the Minister of Economic Affairs dated 7 February 2008, No. WJZ 7119929, containing rules governing licence applications for the performance of space activities and the registration of space objects;
- Form for registration of space objects (Annex 1 by article 4 of the "Regeling aanvraag vergunning ruimtevaartactiviteiten en registratie");
- Order of the Minister of Economic Affairs dated 16 April 2010, No. WJZ/10020347, containing amendments to rules governing licence applications for the performance of space activities and the registration of space objects;
- Decree of 19 January 2015 expanding the scope of the Space Activities Act to include the control of unguided satellites (Unguided Satellites Decree);
- Order by the Minister of Economic Affairs of 26 June 2015, No. WJZ/15055654, amending the Space Activities Licence Application and Registration Order, in connection with changes to the application form.

New Zealand

- Outer Space and High-altitude Activities Act 2017
- Outer Space and High-Altitude Activities (Licences and Permits) Regulations 2017

Nigeria

- National Space Research and Development Agency Act 2010 No.9 A 1255

Republic of Korea

- Space Development Promotion Act
- Space Liability Act
- Space Debris Mitigation Recommendations for the Development and Operation of Spacecraft

Russian Federation

- Federal legislation
    a. The Russian Federation Law "On space activity" dated August 20, 1993 N 5363-1 (revised 07.03.2018.);

    b. The Russian Federation Federal Law "On the State Corporation for Space Activities ROSCOSMOS" dated July 13, 2015 N 215-FZ;
    c. The Russian Federation Federal Law "On Standardization in the Russian Federation" dated June 29, 2015 N 162-FZ.
- Documents on strategic planning of space activities
    a. Federal Space Program of Russia for 2016-2025 (approved by the Russian Federation Government Decree of March 23, 2016 N 230);
    b. Fundamentals of the Russian Federation's State Policy in the Field of Space Activities for the Period up to 2030 and beyond (approved by the President of the Russian Federation on April 19, 2013 N Pr-906)
- Standard technical documentation
    a. GOST R 52925-2018 "Space Technology Items. General Requirements for Space Vehicles for Near-Earth Space Debris Mitigation" (developed by the Federal State Unitary Enterprise Central Research Institute for Machine Building, approved by Order of the Federal Agency for Technical Regulation and Metrology on September 21, 2018 N 632-st) effective date January 1, 2019, substitute GOST R 52925-2008.

United Arab Emirates

- Federal Law No. (12) of 2019 Issued on 19/12/2019 Corresponding to 22 Rabi' Al-Akhar 1441H. ON THE REGULATION OF THE SPACE SECTOR

United Kingdom of Great Britain and Northern Ireland

- Outer Space Act 1986 (OSA)
- Space Industry Act 2018
- The Space Industry Regulations 2021

United States of America

- Federal Aviation Administration Authorities:
    a. Space Launch Act of 1984, as codified and amended, Title 51 United States Code (U.S.C.), Commercial Space Transportation, chapter 509; Title 51 U.S.C., Commercial Space Launch Activities, Sections 50901-50923
    b. National and Commercial Space Programs Act (NCSPA) of 2010, Title 51 U.S.C., Subtitle VI
    c. Federal Aviation Administration (FAA) Regulations, Title 14, Code of Federal Regulations (CFR), Parts 415.39, 417.129, 431.43
- National Oceanic and Atmospheric Administration Authorities:
    a. Title 51, U.S.C., National and Commercial Space Programs, Subtitle VI, Earth Observations, Section 60122
    b. National Oceanic and Atmospheric Administration, Department of Commerce Regulations, Title 15, CFR, Part 960, Licensing of Private Land Remote-Sensing Space Systems; Final Rule
    c. NOAA Satellites: Per National Environmental Satellite, Data, and Information Service (NESDIS) Policy NQP-0304, NOAA follows NASA policy and best practices for decommissioning and disposal for the fleet of U.S. meteorological satellites NOAA operates.
- National Aeronautics and Space Administration Authorities:
    a. National Aeronautics and Space Act, Title 51 United States Code Sec. 10101, et seq.
    b. NASA Procedural Requirements for Limiting Orbital Debris, NPR 8715.6A, 2007; revised 2009
    c. NASA Process for Limiting Orbital Debris, NS 8719.14A, 2007; revised 2011

- Federal Communications Commission Authorities:
    a. Communications Act of 1934, as amended, Title 47 U.S.C., Section 301 et. seq.
    b. Federal Communications Commission (FCC) Regulations, Title 47, CFR, Parts 5, 25, and 97; initial publication at 69 Federal Register 54586 (September 9, 2004)
- Department of Defense Authorities:
    a. Title 10 United States Code
    b. DoD Directive 3100.10 (Space Policy), 2012; DoD Instruction 3100.12 (Space Support), 2000
- U.S. Geological Survey:
    a. The U.S. Geological Survey follows the U.S. best practices for operations and end of life disposal for the Landsat land remote sensing satellites.
- National Policies:
    a. U.S. National Space Policy, Presidential Policy Directive 4 (PPD-4), 2010
    b. U.S. Government Orbital Debris Mitigation Standard Practices, 2019
    c. National Orbital Debris implementation plan, 2022

Annex 2. Third party quotes and reports

- The United Nations General Assembly, is "*Deeply concerned* about the fragility of the space environment and the challenges to the long-term sustainability of outer space activities, in particular the impact of space debris, which is an issue of concern to all nations […] and […] considers that it is essential that Member States pay more attention to the problem of the gradually increasing probability of collisions of space objects[28]."
- in February 2022, the European Commission indicated that "In the race to establish a secure environment in space to guarantee security on the ground the EU must act now, swiftly, collectively and resolutely" with its EU Approach for Space Traffic Management[29]. This approach includes the EU's intention to impose, in the short term, that all satellite operators providing services within the EU should register with a collision avoidance service.
- The Space Foundation estimated that the global space economy is at $447B USD in 2020. Investment bank Morgan Stanley forecasts it will exceed $1,000B USD by 2040[30].
- The use of orbits has reached unprecedented intensity and the "orbital debris environment has reached the tipping point" according to NASA[31].
- A 2021 audit report by NASA's Inspector general confirmed that "Multiple studies by NASA and other space agencies have found that orbital debris has already reached critical mass, and collisional cascading will eventually happen even if no more objects are launched into orbit. **According to NASA, by 2005 the amount and mass of debris in LEO had grown to the point that even if no additional objects were launched into orbit, collisions would continue to occur, compounding the instability of the debris environment and increasing operational risk to spacecraft … the largest increases of new spacecraft and debris generation have occurred in LEO since 2006**[32]."
- **Audit report by NASA's Inspector general titled "NASA's efforts to mitigate the risks posed by orbital debris".**
  - "the growing volume of orbital debris threatens the loss of important space-based applications used in daily life, such as weather forecasting, telecommunications, and global positioning systems that are dependent on a stable space environment."
  - "Multiple studies by NASA and other space agencies have found that **orbital debris has already reached critical mass, and collisional cascading will eventually happen even if no more objects are launched into orbit."**
  - **"NASA does not have the ability to track debris smaller than 10 cm in the range of LEO where the ISS resides."**
  - **"Orbital debris has been identified as a major safety risk for the ISS with respect to loss of mission and crew." (…) "Therefore, the biggest threat to the U.S. modules is debris between 1 and 10 cm."**
  - **"both NASA and DOD officials** tasked with identifying potential collisions between spacecraft, performing conjunction assessments (the real-time process of assessing risk posed by close approaches), and working with spacecraft owners and operators to conduct collision avoidance maneuvers noted that the **rapid growth in the number and variety of both spacecraft and spacecraft owners has created an increasingly challenging, complex, and costly**

[28] United Nations General Assembly. (15 December 2021). *Resolution adopted by the General Assembly on 9 December 2021 on the report of the Special Political and Decolonization Committee (Fourth Committee).* Available here: ARES_76_076E.pdf (unoosa.org)

[29] European Commission. (15 February 2022). *Joint Communication to the European Parliament and the Council. An EU Approach for Space Traffic Management. An EU contribution addressing a global challenge.* Available here: Joint communication - STM

[30] Space Foundation. (2020). *The Space Report Online*. Available here: The Space Report

[31] Office of Inspector General, NASA. (27 January 2021). *NASA's efforts to mitigate the risks posed by orbital debris*. Available here: NASA's Efforts to Mitigate the Risks Posed by Orbital Debris | Oversight.gov

[32] Office of Inspector General, NASA. (27 January 2021). *NASA's efforts to mitigate the risks posed by orbital debris*. Available here: NASA's Efforts to Mitigate the Risks Posed by Orbital Debris | Oversight.gov

environment for conjunction assessment and collision avoidance. Specifically, both agencies have experienced an increase in the surveillance workload, necessitating a dedicated team for monitoring satellite constellations and preventing collisions in space."

- The report recommends to "**explore commercial alternatives to obtaining information on debris smaller than 10 cm"**.

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Fostering Better and More Interoperable Norms:

Comparing Existing Binding National Requirements Relating to Space Debris

Recommendations For Enhanced Regulations and Public Policy with Regard to Space Debris Mitigation and Remediation

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DISSENTING STATEMENT OF VIASAT REGARDING THE REPORT OF THE PARIS PEACE FORUM'S 'NET ZERO SPACE' INITIATIVE WORKING GROUP 1

When Viasat joined the "Net Zero Space" Initiative last year[1], we committed to address the growing space debris crisis in the shared orbits closest to Earth. As part of its contribution to the initiative, Viasat agreed to work on developing comprehensive models, employing best-in-class empirical measurements and modeling tools with new quantitative analyses to "forecast the evolution of debris in LEO so that regulators can set prudent limits on collision risk, and require responsible spacecraft and constellation design and operations."

Such an approach would help achieve the core ambition of the initiative: Contain the net rate of growth of orbital debris that the "Net Zero Space" Declaration recognizes as a threat to "humanity's ability to benefit from outer space by increasing the risk of collision for space assets, further affecting the safety and sustainability of space operations, and increasing the cost of access to the most useful orbits." Over the past year, we developed such models in collaboration with other experts and academic institutions and published a paper detailing our latest work.[2] We also explained the relevance of such modeling during our work with Working Groups 1 and 2 of the initiative.

However, we are disappointed to be unable to endorse the report from Working Group 1 (WG1) entitled "Fostering Better and More Effective Regulations and Public Policies: Comparing Existing Binding National Requirements Relating to Space Debris." The WG1 report fails to acknowledge that certain existing guidelines and practices were developed long before recent filings that cumulatively intend to place as many as one million satellites in LEO. Existing "norms" are inadequate to address the circumstances we face[3] and updated rules are needed to ensure LEO can safely support the very high rates of growth of larger and larger satellites being launched amidst the concurrent growth in orbital debris.

We believe it is essential to take a hard look at non-binding international guidelines, and then consider how to strengthen and expand those guidelines when adopting binding national policies that are applied by like-minded nations. We agree with those experts who urge that preventative action be taken *now* and *at the national level* because we just won't reach international consensus in the short term on a new framework for regulating large LEO constellations.[4]

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1 https://news.viasat.com/newsroom/press-releases/viasat-joins-the-paris-peace-forums-net-zero-space-initiative

2 M. Sturza, M. Dankberg, W. Blount, LEO Capacity Modeling for Sustainable Design, Advanced Maui Optical and Space Surveillance Technologies Conference, Sept. 27-30, 2022.

3 For example, the U.S. State Department has asked in a public consultation: "What might be missing from the current set of 21 [Long Term Sustainability] guidelines, and what are potential new and emerging challenges that could benefit from being discussed?" https://www.state.gov/remarks-and-releases-bureau-of-oceans-and-international-environmental-and-scientific-affairs/notice-11630-seeking-private-sector-written-input-on-implementation-of-the-21-guidelines-for-the-long-term-sustainability-of-outer-space-activities/.

4 *See, e.g.,* R. Buchs, Policy Options to Address Collision Risk from Space Debris, Lausanne: EPFL International Risk Governance Center (2021), at ii ("Given that the prospect of reaching consensus in the short term is very low, governments are advised to take unilateral but coordinated action by improving their national regulations.").

We also agree that certain mega-constellation operators currently are incentivized to prioritize their own short-term interest above the long-term interests in the use of space by all.[5] We cannot simply *hope* that voluntary compliance with existing "norms" by some portion of LEO system operators will avoid a long-anticipated tragedy of the commons.

Our latest model provides data demonstrating that certain proposed ways of mitigating the current crisis in LEO appear to be far less effective than hoped. That is why we disagree with WG1's recommendation, at this juncture, of some very specific remediations in the absence of quantitative analysis of their likely effectiveness and in an evolving environment with increasing debris growth in the orbits most at risk.

While each recommendation may "help" under some circumstances, there is no quantitative analytical basis to estimate the anticipated impact on total net growth of debris in the context of an environment that is forecast to consist of tens to hundreds of thousands of larger and larger satellites operating in increasingly congested orbits. And until we know where we stand, we risk merely treating the symptoms of the problem, and not addressing the root cause(s).

We therefore believe candidate recommendations should be analyzed in the context of a model that assesses the impact of existing and planned LEO systems and that also considers the implications of multiple large LEO constellations occupying neighboring, interleaving, and/or overlapping orbits. A sufficient set of recommendations should meet specific quantitative objectives of reversing, containing, or, at the very least, substantially slowing the net rate of growth of debris in vital LEO orbits.

Using suitable model(s) provides a quantitative alternative to the heuristics approach to mitigations and remediations currently being contemplated. Without employing such models, it is not possible to (i) understand, assess, or predict the extent of the steps needed to manage the current crisis in LEO and the likely efficacy of proposed mitigations and remediations, or (ii) make the cost/benefit analyses needed to determine where efforts should be focused.[6]

We look forward to working with our colleagues in the PPF over the coming year to provide demonstrably effective recommendations to address the growing space debris crisis in LEO.

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[5] *See, e.g.,* Mitigation of Orbital Debris in the New Space Age, Notice of Proposed Rulemaking and Order on Reconsideration, 33 FCC Rcd 11352, at ¶ 89 (2018).

[6] *See* Managing Mega-Constellation Risks in LEO (Nov. 2022), available at https://www.viasat.com/about/what-we-believe/space-policy/space-debris/.