ESOA
EMEA SATELLITE OPERATORS ASSOCIATION

SPACE SUSTAINABILITY
The Time to Act is Now

The use of technology to drive solutions to social and environmental challenges has expanded beyond the Earth itself. The importance of these solutions is such that social and economic functioning and stability fundamentally rely on a host of space-based services for which there is often no alternative.

The increased interest in space and pace of launches in recent years highlights the need for action to deal with space debris and collisions and to ensure space remains sustainable, safe and accessible for all.

Global Challenges | Satellite Answers

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For satellites and space systems to function properly, access and use of the orbital environment needs to be safe and sustainable. Demand for orbits has increased significantly in the last decade driven by institutional and commercial actors. The introduction of multiple non-geostationary orbit ("NGSO") constellations, some of which will include thousands or even tens of thousands of satellites intended to support satellite broadband and other services, is accelerating at an unprecedented pace.

The safe and sustainable use of space is fundamental to enable the accelerated achievement of the Sustainable Development Goals.[1] ESOA members already follow best practices[2] to ensure space situational awareness ("SSA") and effective space traffic management ("STM"), including among others following relevant Inter-Agency Space Debris Coordination Committee ("IADC") guidelines and International Organization for Standardization ("ISO") voluntary standards. ESOA members are also leading voluntary efforts to share information and data to improve the space safety and cybersecurity environments, such as through participation in the Space Data Association[3] and the Space Information and Analysis Center, among others.[4]

ESOA members are committed to space sustainability and implement numerous measures to mitigate the generation of space debris.

Since the first 'Sputnik' satellite was launched in 1957, over 9,000 additional satellites flagged by approximately 40 different countries have been put into the low-Earth, medium-Earth, and geostationary orbits. Tens of thousands of more satellites are predicted to launch in the coming years, to meet user demands.

The innovative uses of space to solve issues on Earth is to be applauded, but the increased use of space has focused attention on issues that, while long known, must now be addressed. Diverse missions and satellite systems share the low-Earth orbits nearest to Earth. One of the unintended consequences of increased use of space, especially in low-Earth orbit, is the creation of additional orbital debris which increases risks for ongoing space operations. To prevent these risks from growing progressively worse, prompt action is required.

A transparent and flexible regulatory regime, implemented at national and international levels, is required to ensure that space can be accessed now and for future generations safely and sustainably. Whether for broadband connectivity or other communications services, weather forecasting, location-based services, Earth observation, or any number of other space-based services upon which the world relies, everyone should be able to benefit from advances in space technology.

Tens of thousands of satellites and other space objects may be launched in the next decade.

1 https://esoa.net/reports_and_studies/satellites-the-sdgs-making-a-difference/
2 https://sia.org/space_safety/; https://conference.sdo.esoc.esa.int/proceedings/ecsl19/paper/4/ECSL19-paper4.pdf
3 https://www.space-data.org/sda/
4 https://s-isac.org/

ESOA and its members are committed to working with governments around the world to develop and ensure appropriate policies to enable continued safe, reliable, and equitable access to all orbits, for all systems, from all nations.

A flexible technology-neutral regime will:

- Minimize the creation of more debris in space;
- Maximize orbital resources through appropriate space traffic management, including for launches; and
- Enable the development of responsible solutions to existing and future orbital debris.

Improving Space Sustainability Efforts

Recognizing the need for the long-term protection of outer space, governments and operators have taken ever-increasing actions towards greater space sustainability, including:

- The formation of the Inter-Agency Space Debris Coordination Committee (IADC) by the world's leading space agencies to co-ordinate efforts to deal with debris in orbit around the Earth, resulting in widely adopted space debris guidelines for all orbits[5];
- Europe's adoption of the European Code of Conduct for Space Debris Mitigation have reinforced the IADC's efforts; the Code of Conduct is consistent with the IADC guidelines while providing greater detail and rationale.
- The Long-Term Sustainability Guidelines published by the UN's Committee on the Peaceful Uses of Outer Space (COPUOS) in 2019[6].
- The International Standards Organization's collection of guidelines and best practices from the IADC, the United Nations, spacecraft operators and regulatory bodies into a comprehensive set of international standards on space debris mitigation under a single international family of standards, ISO 24113 (Space systems – space debris mitigation requirements), most recently updated in 2019;[7] and

- Voluntary and secure sharing of accurate orbital information by satellite operators about their spacecraft, such as the trusted third-party platform of the Space Data Association ("SDA"), for improved conjunction analysis.[8]

5 The IADC comprises 13 Government Space Agencies, including ESA, which represents 22 nations. The IADC Space Debris Guidelines were recently updated in June 2021, see https://www.iadc-home.org/documents_public/view/id/172#u.

6 https://www.unoosa.org/res/oosadoc/data/documents/2021/stspace/stspace79_0_html/st_space79E.pdf

7 See https://www.hou.usra.edu/meetings/orbitaldebris2019/orbital2019paper/pdf/6053.pdf

8 See, e.g., https://www.space-data.org/sda/ Since the SDA's establishment in 2009, more than 33 organizations are now involved in sharing data through the SDA.

In addition, new initiatives aiming to incentivize space sustainability include:

- A Space Sustainability Rating ("SSR")[9] being developed in tandem by the EPFL (École Polytechnique Fédérale de Lausanne) and the WEF (World Economic Forum);
- A Space Safety Coalition formed by operators affirming best practices for the sustainability of space operations.[10]

Advances in technology - such as reusable rockets, new propulsion systems, and emerging debris removal technologies - are also helping to improve the long-term sustainability of outer space.

These are important steps, but more can and should be done at the international and national levels to establish binding rules for responsible practices and behavior in space. Adopting basic rules like requiring satellite maneuverability and prohibiting the intentional creation of debris will go a long way towards promoting the long-term sustainability of space activities.

Momentum for international action is building

In October 2020, space agencies of the G20 countries noted *"the sustainability of the space domain itself was consistently identified as a strategic priority among the Space20 community.* [11] *"*

Around the same time, a number of countries signed the Artemis Accords, recognizing the need for meaningful cooperation and the need to *"use their experience under the Accords to contribute to multilateral efforts to develop international practices and rules applicable to preserve our outer space heritage*[12]*."*

In June 2021, the G7 countries issued a joint statement affirming their commitment to *"the safe and sustainable use of space to support humanity's ambition now and in the future"* and *"the importance of developing common standards, best practices and guidelines related to sustainable space operations alongside the need for a collaborative approach for space traffic management and coordination."*

In the same month, the U.S. and EU issued a joint statement[13] committed to strengthen cooperation in space, including *"exchanging on our respective approaches on space traffic management.* [14] *"*

All these multilateral efforts will require individual administrations to take decisive implementation actions at the national level.

9 https://www.weforum.org/projects/space-sustainability-rating
10 https://spacesafety.org/
11 https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/12/g20-voices-on-the-future-of-the-space-economy.pdf
12 https://spacenews.com/op-ed-building-on-the-artemis-accords-to-address-space-sustainability/
13 https://www.gov.uk/government/news/g7-nations-commit-to-the-safe-and-sustainable-use-of-space
14 https://www.consilium.europa.eu/media/50758/eu-us-summit-joint-statement-15-june-final-final.pdf

Action is Needed to Avoid a Possible Space Sustainability Crisis

The European Space Agency estimates[15] that the number of debris objects in Earth's orbits include:

- approximately 34,000 objects larger than 10 cm
- approximately 900,000 objects of between 1 cm and 10 cm in size
- approximately 128 million objects of between 1 mm and 1 cm in size

These objects are moving at speeds that could have dire consequences if they collide with other objects such as debris, an operational satellite, or manned objects such as the International Space Station.

Many worry that one collision, particularly in low Earth orbit, could cause a cascade of further collisions (the so-called "Kessler Syndrome") and render the use of some parts of space difficult. Debris of any type has safety implications for other missions and raises risk levels for years.

Without near-term harmonized international agreement, the problems inherent to shared orbital debris resources will grow, possibly leading to the point where some parts of space are no longer usable.

A failure to act now to develop and implement broadly accepted and a harmonised regime for space sustainability could render space substantially less accessible, threatening the delivery of critical services relied upon by those on Earth.

15 https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers (presenting data as of 20 May 2021)

Recommendations

ESOA recommends that industry and government promptly work together with all stakeholders to develop flexible, technology-neutral frameworks that protect the space environment while also protecting nation-states from liability. Such regulation should, at a minimum, address three main areas:

Space Debris Mitigation | **Space Situational Awareness** | **Remediation and Disposal**

Recommendations on Space Debris Mitigation

Space debris mitigation is critical to the continued use of space. There have been a number of multilateral efforts to develop standards and norms for the mitigation of space debris, the most prominent of which is the IADC consisting of the world's leading space agencies. Continued improvement of IADC and other international norms, as well as broader adoption by national administrations, would enhance space sustainability while avoiding the imposition of conflicting requirements on space actors.

Regulatory frameworks should
- *Set out requirements*
- *Be flexible as to how to achieve them and*
- *Be enforceable*

Some segments of the space-faring industry have already developed relevant best practices and participated in standards bodies to address the issues of space debris mitigation and space sustainability. However, more can be done to establish norms and practices for the long-term sustainability of outer space:

- Regulatory frameworks to govern commercial and non-commercial missions should incorporate requirements around space debris mitigation to proactively mitigate debris risks while giving operators flexibility to determine how to meet those requirements.
- Governments should make regulatory decisions based on pre-launch expected compliance and should measure compliance based on an operator's actual performance over time. Governments should enforce requirements and take remedial action if necessary.

More specifically, ESOA recommends that governments:

1. Incorporate aggregate (system-wide) collision probability limits on NGSO systems that minimize the intentional and unintentional creation of orbital debris;
2. Require space operators to demonstrate and maintain over time effective orbital tolerances in which they will operate to ensure adequate access to orbits by multiple entities;
3. Require space operators to be capable of and maintain the ability to maneuver to avoid collisions during the operational life of the space object while in orbit above a reasonable altitude such as 400 km. A non-maneuverable space object is indistinguishable from space debris;
4. Require space operators to choose designs/make changes that lessen the impact on other operators, hence reducing the risk of collision;
5. Require NGSO satellites to be retrievable or fully demisable[16] and re-orbited responsibly into the atmosphere or an appropriate disposal orbit before predicted loss of maneuverability;
6. Require GSO satellites to be disposed of to a post-mission disposal orbit in accordance with international standards;
7. Require frequent health checks to ensure NGSO satellites are working properly and, if not, require operators to address the root cause of the problem before launching additional new or replacement satellites that could endanger the orbital environment; and
8. Prohibit the intentional destruction of spacecraft and other harmful activities that may significantly increase debris and collision risks to other spacecraft;
9. Reduce the post mission disposal (PMD) timeframe for LEO constellations satellites from the current 25 years;
10. Improve effectiveness on the enforcement of current regulations for satellite disposal after end of life (graveyard or disposal orbit for GEO / MEO and natural decay for LEO).

16 The term fully demisable means that spacecraft components will burn-up on re-entry.

Recommendations on Space Situational Awareness ("SSA")

SSA is the ability to track objects in orbit and predict where they will be at any given time: it is critical for a safe space environment. For years, the US and Russia[17] have provided SSA information to the rest of the world.

Many other countries are now developing their own SSA systems in view of the increase in space objects. The key to effective SSA and STM remains cooperation. By cooperating with each other, multiple SSA systems can provide continuity and resilience of the monitoring system as well as working towards higher accuracy of space data thanks to so-called data fusion.

A single SSA system operating alone will not be sufficient; cooperation and cross-checking across multiple SSA systems is key.

ESOA recommends that:

1. Operators establish 24/7 points of contact and share relevant contact information as needed to coordinate collision avoidance activities;
2. Operators should be encouraged to construct GSO and NGSO satellites in a manner that facilitates active and/or passive tracking, as well as having knowledge and control of their trajectories;
3. Governments should ensure all missions are registered under the UN Registration Convention;
4. Governments should support research and development efforts nationally and internationally to improve space situational awareness;
5. Governments should support or setup an international governmental organization(s) to provide effective, free-of-charge, essential, SSA services that allow for effective implementation and monitoring of regulations.
6. As SSA services operate most effectively with accurate information, governments should collaborate to ensure complete and accurate space objects catalogues.[18]
7. Operators should demonstrate they have access to an up-to-date space object catalogue and that they have an efficient service in place for collision warning.

17 https://www.globalsecurity.org/space/world/russia/space-surveillance.htm

18 This information will be obtained from a variety of sources including on ground and space observations, and reliable information from satellite operators.

Recommendations on Remediation and Disposal

Many companies, including a number of ESOA members[19], are investing in technologies to assist in clearing large pieces of debris and defunct satellites from crowded orbits. Over time this will enable orbital debris mitigation. Some satellite operators are already building these functions into their satellite end-of-life plans. Examples include use by servicer spacecraft of magnetic capture of docking-plate-enabled prepared client satellites or robotic arm for capture of unprepared client satellites.

- Satellite operators are encouraged to implement remediation and disposal techniques for future NGSO and GSO satellite systems taking account of commercial, technical, regulatory, and space orbital environmental safeguarding objectives.

Developments in debris removal technology, are promising, but are several years away from being available at scale. Improved sustainability measures, besides debris removal,will continue to be needed.

Examples of such initiatives include:

- The Sunrise Project, which is a part of the ESA ARTES program, was created to develop technologies for future generation telecommunication satellite missions and to advance Active Debris Removal (ADR) capabilities in low Earth orbit.

- Some LEO operators have implemented or plan to implement magnetic plates or grappling plates to help with capture in the unlikely event that a satellite becomes unresponsive or fails in orbit.

With regards to use of capture technologies to facilitate disposal of uncontrolled objects, a certain degree of standardization should be encouraged. This could facilitate the creation of a healthy market of in orbit removal services.

19 For example Airbus, Thales Alenia Space and Astroscale are developing such In-Orbit-Servicing satellite systems.

Conclusions

ESOA fully supports the existing efforts of the international community to address space debris and calls upon governments to turn these efforts into concrete actions. These actions will go a long way to ensure the continued use and critical benefits of space for all humankind by:

Avoiding the creation of unnecessary debris in space & **Managing orbital resources through industry-led space traffic management** & **Cleaning-up existing debris**

- Satellite operators and the services they provide play a key role in making the world a better, safer and more inclusive place for humankind.
- In order to do so, ESOA and its members are committed to taking actions, individually and together with government partners, to ensure satellites can continue to operate in the safest possible manner.
- While operators are key players in ensuring the responsible use of space, they cannot do so alone – actions need to be taken by governments to enhance policies that commit to address these problems.
- The technologies available for space awareness and in-orbit-service operations are incredibly promising and beyond what was imaginable a few years ago. Government and institutions shall encourage the creation of a sustainable market for SSA/STM services as well as In Orbit Servicing/Active Debris Removal services.
- The risks associated with Space Sustainability are existential in view of the extreme reliance on space services and data whether for climate change, security, location-based communications or many other video and data communications services.

ESOA urges space-faring nations to work with industry to define the necessary steps and take action to implement the recommendations made above in a cooperative manner with one another.

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