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**Long-term sustainability of outer space activities**

## **Updated set of draft guidelines for the long-term sustainability of outer space activities**

### **Note by the Secretariat**

1. At its fifty-seventh session, the Committee on the Peaceful Uses of Outer Space noted that the Chair of the Working Group on the Long-term Sustainability of Outer Space Activities would prepare a draft report of the Working Group and an updated set of draft guidelines for the current session of the Scientific and Technical Subcommittee. The present document contains an updated set of draft consolidated guidelines, prepared taking into consideration all views expressed and inputs received before, during and following the fifty-seventh session of the Committee.

2. The sources of these draft guidelines are as follows: draft guidelines 1 to 33 are derived from document A/AC.105/C.1/L.339 and reflect the contributions of States members of the Committee to the first consolidated set of draft guidelines, contained in conference room paper A/AC.105/2014/CRP.5; guidelines 34 and 35 are drawn from a proposal by the Russian Federation, contained in paragraph 5 of document A/AC.105/L.290; and guideline 36 contains a proposal presented by Switzerland during the fifty-seventh session of the Committee.

3. This document is complemented by document A/AC.105/C.1/L.343, which contains a draft report of the Working Group on the Long-term Sustainability of Outer Space Activities.

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\* A/AC.105/C.1/L.341.



## I. The context of the guidelines for the long-term sustainability of outer space activities

### Background

4. In *The Space Millennium: Vienna Declaration on Space and Human Development*,<sup>1</sup> the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space recognized the importance of space science and space applications for improving our fundamental knowledge of the universe and for improving the daily lives of people worldwide through environmental monitoring, management of natural resources, early warning systems to help mitigate potential disasters and support disaster management, meteorological forecasting, climate modelling, satellite navigation and communications. Space science and technology make a major contribution to the well-being of humanity and, specifically, to achieving the objectives of global conferences of the United Nations that address various aspects of economic, social and cultural development. Space activities therefore play a vital role in supporting sustainable development on Earth and the achievement of the Millennium Development Goals and in contributing to the post-2015 development agenda process. Hence, the long-term sustainability of space activities is a matter of interest and importance not only for current and aspiring participants in space activities, but also for the international community as a whole.

5. The space environment is being used by more and more States, international intergovernmental organizations, non-governmental organizations and private sector entities. The proliferation of space debris and the increased possibilities of collisions and interference with the operation of space objects raise concerns about the long-term sustainability of space activities, particularly in the low-Earth orbit and geostationary orbit environments.

6. States, international organizations, national and international non-governmental organizations and private sector entities that are involved in space activities should take steps to ensure that their activities do not diminish the ability of others to carry out their own space activities, either now or in the future.

7. Over the years, the Committee on the Peaceful Uses of Outer Space has considered different aspects of the long-term sustainability of outer space activities from various perspectives. Building on those previous efforts and relevant related efforts by other entities, the Working Group on the Long-term Sustainability of Outer Space Activities of the Scientific and Technical Subcommittee has proposed a series of measures with a view to providing a holistic approach to promoting the long-term sustainability of outer space activities.

8. The proposed measures, compiled in a set of voluntary guidelines, provide a foundation for the development of national and international practices and safety frameworks for conducting outer space activities, while allowing for flexibility in adapting such frameworks to specific national circumstances and organizational

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<sup>1</sup> *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

structures. The guidelines address the policy, regulatory, organizational, scientific, technical, cooperation and capacity-building aspects of space activities.

9. The legal framework in which the set of guidelines contained in this document was developed consists of the existing United Nations treaties and principles on outer space. In addition, current practices, operating procedures, technical standards, policies and experiences gained through the conduct of space activities have also been taken into consideration in the compilation of this set of guidelines.

10. The guidelines contained in the present document reflect an international consensus on measures needed to enhance the long-term sustainability of outer space activities, based on current knowledge and established practices. As a deeper understanding of the various factors influencing the long-term sustainability of space activities develops, the guidelines should be reviewed, and could be revised in the light of new findings.

11. The implementation of national and international frameworks for the conduct of space activities not only provides assurance to users of the space environment but also facilitates bilateral and multilateral cooperation in the peaceful uses of outer space and thereby contributes to the safety and stability of outer space.

### **Scope and application**

12. The guidelines contained in this document are applicable to all space activities, whether planned or ongoing, and all phases of a mission life cycle, including launch, operation and end-of-life disposal. The guidelines relate to the policy, regulatory and organizational aspects, the scientific and technical aspects, and international cooperation and capacity-building aspects of the safe and sustainable conduct of outer space activities, and are based on a substantial body of knowledge and the experiences of States, international organizations, national and international non-governmental organizations and private sector entities. Therefore, the guidelines are relevant to both governmental and non-governmental entities.

13. The guidelines are voluntary and not legally binding under international law. They are intended to supplement guidance available in existing standards and regulatory requirements.

14. The implementation of the guidelines is considered a prudent and necessary step towards preserving the outer space environment for future generations. States, international intergovernmental organizations, national and international non-governmental organizations and private sector entities should voluntarily take measures, through their own applicable mechanisms, to ensure that the guidelines are implemented, to the greatest extent feasible and practicable.

## **II. Guidelines for the long-term sustainability of outer space activities**

*[Proposal by the Russian Federation, contained in A/AC.105/C.1/L.338, para. 8]*

15. [The following set of voluntary guidelines establishing the concept of and defining basic criteria and practices, domestic and international, for ensuring the

long-term sustainability of outer space activities is premised on the understanding that outer space continuously remains a stable, safe and conflict-free environment open for peaceful uses and international cooperation, as intrinsically interrelated with the making by the international community of full use of opportunities to steadily increase, through dedicated practical measures, the predictability and transparency of, and the building of confidence in, space activities, as those features are conducive to and instrumental in the application of the guidelines for the long-term sustainability of outer space activities.

16. In applying the guidelines in good faith, States and international organizations shall provide for the establishment and effectuation of an appropriate system for internal regulation (including the necessary procedures and requirements) and international cooperation mechanisms in order to execute relevant functions with the aim of performing tasks related to ensuring the long-term sustainability of outer space activities.

17. The guidelines, as applied by States and international organizations through the use of appropriate means that would neither neglect nor challenge in any formal or practical way the existing principles and norms of international law, are designed to provide an effective regulatory framework for addressing practical ways and means of achieving the more rational organization of activities in outer space so that States and international organizations are in a position to conduct such activities by making use of existing, and putting in place new, mechanisms that would reliably accommodate needs for the development, through cooperative endeavours, of space potential and assist in reducing to a minimum or, as feasible, avoiding serious harm to the outer space environment and the safety of space operations.

18. In achieving the goal of ensuring the long-term sustainability of outer space activities, States and international organizations should refrain from any acts and practices, as well as from the use of means or methods, that could, purposefully or inadvertently, affect in any way, in violation of the principles and norms of international law, and/or harm, in the same manner, assets in outer space and/or lead to the evolvment of circumstances which could render full and effective application of the guidelines impracticable on national security grounds.

19. Without prejudice to any of the constituent elements of the concept of and practices for ensuring the long-term sustainability of outer space activities, risk monitoring for the purpose of identifying factors influencing the nature and magnitude of risks in the various segments of outer space activity and potential hazardous situations and developments in the space environment should be perceived as the most challenging task in terms of providing the context for creating incentives with regard to putting into effect and observing operational procedures whereby States and international organizations could, considering applicable legislative and conventional regulations, effectively cooperate, advising and assisting each other in all practical ways possible.]

20. The guidelines are grouped into three categories to facilitate their implementation by various governmental and non-governmental space actors: policy, regulatory and organizational; scientific and technical; international cooperation and capacity-building.

## Policy, regulatory and organizational

21. Guidelines [...] to [...] provide guidance on the development of policies, regulatory frameworks and practices that support the long-term sustainability of outer space activities for Governments and relevant international intergovernmental organizations authorizing or conducting space activities. The guidance addresses the adoption of national regulatory frameworks and the promotion of recommended voluntary measures by entities conducting outer space activities to promote the safety and sustainability of such activities. This guidance also includes measures to facilitate sharing of information on space objects and orbital events and sharing of contact information for entities responsible for spacecraft operations.

### Supervising national space activities (guidelines 14 + 32 + 33)

**States should ensure that entities under their jurisdiction and/or control that conduct outer space activities have the appropriate structures and procedures for planning and conducting space activities in a manner that supports the objective of enhancing the long-term sustainability of outer space activities, and that they have the means to comply with relevant national and international regulatory frameworks, requirements, policies and processes in this regard. States are encouraged to ensure that appropriate communication and consultation mechanisms are in place within and among the competent bodies that oversee or conduct space activities.**

States bear international responsibility for national activities in outer space and for the authorization and continuing supervision of such activities, which are to be carried out in conformity with international law. However, the direct responsibility for ensuring that a given space activity does not jeopardize the long-term sustainability of outer space activities in general lies with the entity conducting that activity. In this regard, States should ensure that the management of such entities takes steps to:

- (a) Establish and maintain all the necessary technical competencies required to conduct outer space activities in a safe and responsible manner and to enable it to comply with the relevant governmental and intergovernmental regulatory frameworks, requirements, policies and processes;
- (b) Develop specific requirements and procedures to address the safety and reliability of outer space activities under the entity's control, during all phases of a mission life cycle;
- (c) Assess all risks to the long-term sustainability of outer space activities associated with the space activities conducted by the entity, in all phases of the mission life cycle, and take steps to mitigate such risks.

The management of an entity that conducts outer space activities should ensure that the entity's structures and procedures for planning and conducting space activities support the objective of promoting the long-term sustainability of outer space activities. Appropriate measures to be taken by management in this regard should include:

- (a) A commitment at the highest levels of the entity to promoting the long-term sustainability of outer space activities;

(b) Establishing and fostering an organizational commitment to promoting the long-term sustainability of outer space activities within the entity, as well as in relevant interactions with other entities;

(c) Ensuring that the entity's commitment to the long-term sustainability of outer space activities is reflected in its management structure and procedures for planning, developing and conducting outer space activities;

(d) Encouraging, as appropriate, the sharing of the experiences of the entity in the conduct of safe and sustainable outer space activities as a contribution by the entity to enhancing the long-term sustainability of outer space activities;

(e) Designating a contact point within the entity responsible for communication with relevant authorities to facilitate efficient and timely sharing of information and coordination of potentially urgent measures to promote the safety and sustainability of outer space activities.

States are encouraged to ensure that appropriate communication and consultation mechanisms are in place within and among the competent bodies that oversee or conduct space activities. Communication within and among relevant regulatory bodies can promote regulations that are consistent, predictable and transparent so as to ensure that regulatory outcomes are as intended.

#### **Registration information on space objects (guideline 6)**

**States and international intergovernmental organizations are encouraged to provide registration information as soon as practicable to assist in the identification of space objects.**

States and international intergovernmental organizations should provide registration information on space objects in accordance with the Convention on Registration of Objects Launched into Outer Space. States and international intergovernmental organizations should provide such registration information to the Secretary-General of the United Nations as soon as practicable to assist in the identification of space objects and of the State of registry that supervises the owner or operator of those space objects. States and international intergovernmental organizations should consider furnishing enhanced registration information, as recommended by the General Assembly in its resolution 62/101.

#### **Contact information and information on space objects and orbital events (guideline 20)**

**States and international intergovernmental organizations are encouraged to provide regularly updated contact information for entities authorized to engage in appropriate information exchanges and/or responsible for spacecraft operations and conjunction assessment and to develop [a mechanism][procedures] for the exchange of appropriate information relating to actual or potential situations in near-Earth space.**

States and international intergovernmental organizations are encouraged to exchange regularly updated contact information on appropriate entities responsible for spacecraft operations and conjunction assessment and to establish appropriate procedures to enable timely coordination to reduce the probability of, and facilitate

effective responses to, orbital collisions, orbital break-ups and other events that might increase the probability of accidental collisions.

In order to enable information exchange in contingency situations, States and international organizations are encouraged to designate, and make publicly available contact information for, entities with the authority and capability to engage in information exchanges, process incoming incident reports and forecasts and serve as contact points with regard to adopting precautionary and response measures, thus supporting crisis warning and management mechanisms.

*[Third paragraph, alternative 1]*

[States and international intergovernmental organizations are encouraged to develop, implement and use an international mechanism, open for broad participation, for exchanging data on all functioning and non-functioning objects in near-Earth space.]

*[Third paragraph, alternative 2]*

[States and international intergovernmental organizations are encouraged to develop and implement appropriate procedures for exchanging information related to actual or potential situations in near-Earth space that may affect the safety and security of outer space operations.]

[This mechanism][These procedures] can be used to exchange relevant information on space objects, as mutually agreed. The providing entity should ensure that such information exchanged is reliable, sufficiently complete and accurate, and its time reference and period of applicability should be noted. [This mechanism][These procedures] should allow information to be exchanged in a timely manner to enable pre-emptive actions.

A unified centre for information on near-Earth space monitoring is to be established and operated under the auspices of the United Nations to serve as a core element of a distributed international information system and an information platform for multilateral cooperation in sharing and disseminating multi-source information on objects and events in near-Earth space. The organizational arrangement and statutory tasks and responsibilities of the Centre shall be elaborated through the Committee on the Peaceful Uses of Outer Space and endorsed by the General Assembly.

#### **Spectrum protection (guideline 4)**

**States and international intergovernmental organizations should ensure that all space activities under their jurisdiction and/or control are carried out in accordance with the Convention of the International Telecommunication Union and the Constitution and the Radio Regulations of the International Telecommunication Union (ITU), in order to enhance the long-term sustainability of space activities and in support of sustainable development on Earth. In accordance with the ITU Radio Regulations and Recommendations, States should facilitate prompt resolution of identified harmful radio frequency interference.**

The radio-frequency spectrum is a limited natural resource that should be used rationally, efficiently and economically so that countries or groups of countries may

have equitable access to radio frequencies for the conduct of their space activities, taking into account the special needs of developing countries and the geographical situation of particular countries. States and international intergovernmental organizations should ensure that their space activities are conducted in conformity with the Radio Regulations of the International Telecommunication Union, in order to avoid harmful interference with reception and transmission of radio signals related to the space activities of other States and international intergovernmental organizations, and as one of the means of promoting the long-term sustainability of outer space activities.

In their use of the electromagnetic spectrum, States and international intergovernmental organizations should consider the requirements for space-based Earth observation systems and other space-based systems and services in support of sustainable development on Earth, in accordance with the Radio Regulations and recommendations of the International Telecommunication Union.

States and international intergovernmental organizations should facilitate the implementation of the radio regulation procedures established by ITU for space radio links. Moreover, States and international intergovernmental organizations should encourage and support regional and international cooperation aimed at improving efficiency in decision-making and implementation of practical measures to eliminate identified harmful radio frequency interference in space radio links.

#### **Adoption of national regulatory frameworks (guidelines 9 + 12)**

**States should adopt national regulatory frameworks for space activities that provide clear guidance to governmental and non-governmental entities under their jurisdiction and/or control. When adopting or implementing national regulatory frameworks, States should consider the long-term sustainability of outer space activities.**

With the globalization and generalization of space activities, in particular the emergence of non-governmental entities providing services and carrying out operations, States should adopt regulatory frameworks to ensure the effective application of international norms, considering the specificities of non-governmental entities, for which States bear international responsibility. States are encouraged to consider the application of relevant, generally accepted standards and practices for the safe conduct of outer space activities.

When developing and adopting national regulatory frameworks, States are encouraged to consider the provisions of General Assembly resolution 68/74 on recommendations on national legislation relevant to the peaceful exploration and use of outer space. In particular, States are encouraged to consider not only existing space projects and activities but also the potential development of their national space sector, and to envisage appropriate timely regulation in order to avoid legal lacunae. It is important for national regulations to address the specific nature and characteristics of the State's space sector, as well as its general economic framework, which provides the context in which the space sector may further expand.

States, in enacting new regulations, should bear in mind their obligations under article VI 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. Traditionally, national regulations have been concerned with issues such as safety, liability, reliability and cost. As new regulations are developed, States should consider regulations that enhance the long-term sustainability of outer space activities. At the same time, regulations should not be so prescriptive as to prevent initiatives addressing the long-term sustainability of outer space activities.

**Elements to be taken into consideration when developing national regulatory frameworks (guidelines 10 + 11 + 13 + 22 + 23)**

**In developing regulatory measures applicable to the long-term sustainability of outer space activities, States should:**

- (a) Consider the five United Nations treaties regarding the exploration and use of outer space;**
- (b) Implement space debris mitigation measures;**
- (c) Address risks to people, property, public health and the environment associated with the launch, in-orbit operation and re-entry of space objects;**
- (d) Consider the potential benefits of using existing international technical standards;**
- (e) Weigh the costs, benefits, disadvantages and risks of a range of alternatives;**
- (f) Encourage advisory input from affected national entities.**

When developing national regulatory frameworks, States should ensure that the obligations under international law are implemented, including those specifically contained in the United Nations treaties on the exploration and use of outer space.

In accordance with the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, States and international intergovernmental organizations should address, establish and implement space debris mitigation measures through applicable mechanisms.

When creating regulatory frameworks, States should address risks to public health, safety and potential injury to persons or damage to property, taking into consideration the potential risks of space operations and the different liability regimes for damage occurring on Earth versus in space. Reducing risks to public health and safety should be considered as part of national regulations applicable to the launch, in-orbit operations and controlled re-entry of space objects. In this regard, States should consider the provisions of General Assembly resolution 68/74 on recommendations on national legislation relevant to the peaceful exploration and use of outer space. In cases of controlled re-entries of spacecraft or launch vehicle orbital and/or suborbital stages, States and international intergovernmental organizations should consider furnishing notices to aviators and mariners using already established procedures.

Due consideration should be given to international practices of spacefaring States and the development of new practices as a result of new technologies and capabilities. Ways to manage risks to public health and safety can include: quality assurance and risk management techniques; methodologies to assess probabilities of injury to people or damage to property from objects reaching the surface of the

Earth from space or as a result of launch attempts; probabilistic risk assessments, hazard analyses and environmental impact studies that address the complete life cycle of space missions; implementation of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space for space operations using nuclear power; and measures for planetary protection.

When creating regulatory frameworks, States should also consider the potential benefits of using existing international technical standards, such as those published by the International Organization for Standardization (ISO), the Consultative Committee for Space Data Systems and national standardization bodies. In addition, States should consider the utilization of recommended practices and voluntary guidelines proposed by the Inter-Agency Space Debris Coordination Committee and the Committee on Space Research.

In developing regulatory measures applicable to the long-term sustainability of outer space activities, States should ensure that such measures are implementable and practicable in terms of the technical, legal and management capacities of the State imposing the regulation, as a regulation should not require a technical innovation or exceed the current state of practice for the space activity being regulated. Regulations should also be efficient in terms of limiting the cost for compliance (e.g., in terms of money, time or risk) compared with feasible alternatives, and be effective in that they have a clear intended purpose and accomplish their intended purpose. States should share with other States regulations and experience resulting from their implementation and consider information available on other States' regulatory frameworks when creating their own regulatory frameworks.

States should encourage advisory input from affected national entities during the process of developing regulatory frameworks governing space activities. The entities may include private sector entities, universities, research organizations and non-governmental organizations operating under the jurisdiction of the State, agencies of the State or other bodies that play a role in space activities and that will be affected by the proposed regulatory initiative. By allowing early advisory input, the State can avoid unintended consequences of regulation that might be more restrictive than necessary or that conflicts with other legal obligations.

In developing or refining national regulatory frameworks, States should consider the need for appropriate transition periods and milestones for the implementation of measures to enhance the long-term sustainability of space activities.

**States and international intergovernmental organizations should develop and implement criteria and procedures for the preparation and conduct of space activities aimed at the active removal of space objects from orbit (guideline 34)**

States and international organizations considering or initiating execution of, or involvement in, operations for active removal of space debris, functioning space objects and/or non-functioning space objects, should, in the process of making their judgements with regard to feasibility and safety of such operations and throughout their preparation and execution stages, thoroughly review and effectively implement a coherent set of stringent requirements and measures aimed at ensuring identification, analysis, evaluation and prevention of risks, as well as employing

appropriate means and methods that would make such operations safe and fully consistent with the principles and norms of international law.

Decisions on risk mitigation methods and the choice of tools and techniques to implement active removal operations should reckon with the overriding task associated with the preclusion of any actions or omissions that could create vulnerability of, a threat to, and/or result in the loss of other State-, international organization- or foreign entity-owned or operated orbital systems, complexes and means, including operational malfunction, degradation or loss of integrity thereof, in part or whole, and thus impair or circumscribe rights and interests of the said States, international organizations or foreign entities. It should be commonly understood that any active removal operations:

(a) Rule out coercive technological impacts on the above-mentioned space assets in the absence of appropriately authenticated concurrence of, and authority explicitly conferred by, the State (including the State of registry), international organization and/or entity concerned;

(b) May not lead to any jurisdiction and/or control functions irregularities with regard to such foreign assets.

#### **Respect the security of foreign space-related ground and information infrastructures (guideline 35)**

States and international organizations should be encouraged to consider the concept of and practices for ensuring the long-term sustainability of outer space activities as forming an integral whole with the issues of safety and security of ground infrastructure that provides the proper operation of, and receiving and processing of data from, orbital systems, complexes and means. Following the line of responsible and peaceful conduct of space activities, States and international organizations should, as part of providing overall institutional support for the concept of and practices for ensuring the long-term sustainability of outer space activities, adopt decisions that are reasoned and effectively formalized at policy and doctrine levels so as to exclude any actions that could impair or adversely affect the serviceability of such ground infrastructure under foreign jurisdiction and/or control.

Such a comprehensive approach requires collective acceptance of responsibilities by States and international organizations to establish and pursue, within the framework of their information security doctrines and strategies, including cybersecurity, and through active efforts at the international level, an information security policy that would appropriately address the need for, and modalities of, effective cooperation in preventing, identifying, investigating and deterring malicious usage of information and communications technologies and/or any other activities incompatible with the task of mitigating vulnerabilities of, and precluding disruptions to, critical national, foreign and international information infrastructures, that may be directly associated with ensuring safe and secure operation of orbital systems, complexes and means under national or foreign jurisdiction. Consequently, States and international organizations should, whenever needed and/or as requested, establish liaisons and engage in practical interaction with each other in response to relevant real-time, emerging and potential threats and incidents in the segment under consideration.

**Awareness of space activities (guidelines 7 + 8 + 15)**

**States and international intergovernmental organizations are encouraged to raise general public awareness of the important societal benefits of space activities and of the consequent importance of enhancing the long-term sustainability of outer space activities. To this end, States and international intergovernmental organizations are encouraged to:**

**(a) Promote institutional and public awareness of space activities and their applications for sustainable development, disaster management and emergency response;**

**(b) Conduct outreach, capacity-building and education on regulations and established practices relevant to the long-term sustainability of space activities;**

**(c) Promote activities of non-governmental entities that will enhance the long-term sustainability of outer space activities.**

States and international intergovernmental organizations should promote public awareness of space applications for sustainable development, disaster management and emergency response through information-sharing and joint efforts with public institutions, private sector entities and civil society, taking into account the needs of current and future generations. In designing space education programmes, States, international intergovernmental organizations and non-governmental entities should pay special attention to courses on enhancing knowledge and practice of the utilization of space applications to support sustainable development. States and international intergovernmental organizations should initiate the voluntary collection of information on public awareness and education tools and programmes with a view to facilitating the development and implementation of other initiatives with similar objectives.

States and international intergovernmental organizations are encouraged to foster outreach activities by or with industry, academia and other relevant non-governmental entities. Outreach, capacity-building and educational initiatives could take the form of seminars (in person or broadcast over the Internet), published guidelines to complement national and international regulations or an Internet website with basic information on a regulatory framework and/or a contact point within the Government for regulatory information. Appropriately targeted outreach and education can assist all space actors in gaining a better appreciation and understanding of the nature of their obligations, in particular relating to implementation, which can lead to improved compliance with the existing regulatory framework and the practices currently being employed to enhance the long-term sustainability of outer space activities. This is particularly valuable where the regulatory framework has been changed or updated, resulting in new obligations for participants in space activities.

Cooperation between Governments and non-governmental entities should be encouraged and fostered. Non-governmental entities, including professional and industry associations and academic institutions, can play important roles in increasing international awareness of issues associated with space sustainability, as well as promoting practical measures to enhance space sustainability. Such measures could include adoption of the Space Debris Mitigation Guidelines of the

Committee on the Peaceful Uses of Outer Space; compliance with the Radio Regulations of the International Telecommunication Union related to space services; and the development of open, transparent standards for the exchange of data necessary to avoid collisions, harmful radio frequency interference or other harmful events in outer space. Non-governmental entities can also play important roles in bringing stakeholders together to develop common approaches to certain aspects of space activities that can collectively enhance the long-term sustainability of space activities.

## **Scientific and technical**

22. Guidelines [...] to [...] provide guidance of a scientific and technical nature for Governments, international intergovernmental organizations, national and international non-governmental organizations and private sector entities that conduct space activities. They encompass, among other things, the collection, archiving, sharing and dissemination of information on space objects and space weather, and the use of standards for information exchange. These guidelines also address research and development of ways to support the sustainable use and exploration of outer space.

### **Research on and development of ways to support sustainable exploration and use of outer space (guidelines 3 + 5)**

**States and international intergovernmental organizations should promote and support research and development of sustainable space technologies, processes and services and other initiatives for the sustainable exploration and use of outer space, including celestial bodies.**

In their conduct of space activities for the peaceful exploration and use of outer space, including celestial bodies, States and international intergovernmental organizations should take into account, with reference to the outcome document of the United Nations Conference on Sustainable Development (General Assembly resolution 66/288, annex), the social, economic and environmental dimensions of sustainable development on Earth.

States and international intergovernmental organizations should promote the development of technologies that minimize the environmental impact of [manufacturing and] launching space assets and that maximize the use of renewable resources and the reusability or repurposing of space assets to enhance the long-term sustainability of those activities.

States and international intergovernmental organizations should consider appropriate safety measures to protect the Earth and the space environment from harmful contamination, taking advantage of existing measures, practices and guidelines that may apply to those activities, and developing new measures as appropriate.

States and international intergovernmental organizations conducting research and development activities to support the sustainable exploration and use of outer space should also encourage the participation of developing countries in such activities.

**Data on space objects (guidelines 24 + 26)**

**States and international intergovernmental organizations are encouraged to promote the development and use of techniques and methods to improve the accuracy of orbital data for spaceflight safety and the use of common, internationally recognized standards when sharing orbital information on space objects.**

Recognizing that spaceflight safety strongly depends upon the accuracy of orbital and other relevant data, States and international intergovernmental organizations are encouraged to promote techniques and the investigation of new methods to improve such accuracy. Those methods could include national and international activities to improve the capabilities and geographical distribution of existing and new sensors, use of passive and active on-orbit tracking aids, and combining and validating data from different sources. Special attention should be paid to encouraging the participation and capacity-building of developing countries with emerging space capabilities in this domain.

When sharing orbital information on space objects, operators and other appropriate entities should be encouraged to use common, internationally recognized standards to enable collaboration and information exchange. Facilitating greater shared awareness of the current and predicted location of space objects would enable timely prediction and prevention of potential collisions.

**Perform conjunction assessment during orbital phases of controlled flight (guideline 25)**

**States and international intergovernmental organizations should encourage entities under their jurisdiction and/or control that conduct space activities to perform conjunction assessment during orbital phases of controlled flight.**

Conjunction assessment with other space objects should be performed for all spacecraft capable of adjusting trajectories during orbital phases of controlled flight for current and planned spacecraft trajectories.

Appropriate steps of the conjunction assessment process include improving the orbit determination of relevant space objects, screening current and planned trajectories of relevant space objects for potential collisions, and determining whether an adjustment of trajectory is required to reduce the risk of collision, in coordination with other operators and/or organizations responsible for conjunction assessment, as appropriate.

States and international intergovernmental organizations are encouraged to develop and implement common approaches to conjunction assessment.

Spacecraft operators, including those of the private sector, that are unable to perform conjunction assessments, should be encouraged to seek support, via State authorities, as necessary and in accordance with relevant applicable regulations, from appropriate around-the-clock conjunction assessment entities.

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**Promotion of research on orbital debris and sharing of space debris monitoring information (guideline 21)**

**States and international intergovernmental organizations are encouraged to promote the collection, sharing and dissemination of space debris monitoring information and to promote international scientific cooperation in this area.**

States and international intergovernmental organizations should encourage the development and use of relevant technologies for the measurement, monitoring and characterization of the orbital and physical properties of space debris. States and international intergovernmental organizations should also promote the sharing and dissemination of derived data products and methodologies in support of research and international scientific cooperation on the evolution of the orbital debris population.

States and international intergovernmental organizations with experience in space activities should also encourage and support capacity-building in developing countries with emerging space programmes to improve their expertise on spacecraft design and knowledge of flight dynamics and orbits through the performance of joint orbital calculations, conjunction assessments and collision avoidance procedures. This will require access to precise orbital data and appropriate tools for the monitoring of space objects. In this regard, consideration should be given to the development, on a mutually acceptable basis, of appropriate collaborative activities in space situational awareness and to arranging financing of projects in this regard.

**Development of space weather models and tools and collection of established practices on the mitigation of space weather effects (guidelines 28 + 30)**

**States and international intergovernmental organizations should support and promote the development of advanced space weather models and forecasting tools and the collection, sharing and dissemination of, and access to, information relating to established practices for mitigating the effects of space weather on terrestrial and space-based systems, as a means of enhancing the long-term sustainability of space activities.**

States and international intergovernmental organizations should undertake a coordinated approach to identifying and filling gaps in research and operational models and forecasting tools required to meet the needs of the scientific community and of the providers and users of space weather information services. Where necessary, this should include coordinated efforts to support and promote research and development to further advance space weather models and forecasting tools, incorporating the effects of the changing solar environment and evolving terrestrial magnetic field as appropriate, including within the context of the Committee on the Peaceful Uses of Outer Space and its Subcommittees, as well as in collaboration with other entities such as the World Meteorological Organization and the International Space Environment Service.

States and international intergovernmental organizations should support and promote cooperation and coordination on ground- and space-based space weather observations, forecast modelling, satellite anomalies and reporting of space weather effects in order to safeguard space activities. Practical measures in this regard could include:

(a) Incorporating current and forecast space weather thresholds into space launch criteria;

(b) Encouraging satellite operators to cooperate with space weather service providers to identify the information that would be most useful to mitigate anomalies and to derive recommended specific guidelines for on-orbit operations. For example, if the radiation environment is hazardous, this might include actions to delay the uploading of software, implementation of manoeuvres, etc.;

(c) Encouraging the collection, collation and sharing of information relating to ground- and space-based space weather-related impacts and system anomalies, including spacecraft anomalies;

(d) Encouraging the use of a common format for reporting space weather information. In relation to the reporting of spacecraft anomalies, satellite operators are encouraged to take note of the template proposed by the Coordination Group for Meteorological Satellites;

(e) Encouraging policies promoting the sharing of satellite anomaly data;

(f) Encouraging training on and knowledge transfer relating to the use of space weather data, taking into account the participation of [developing] countries with emerging space capabilities.

It is acknowledged that some data may be subject to legal restrictions and/or measures for the protection of proprietary or confidential information.

States and international intergovernmental organizations should work towards the development of international standards and collection of established practices applicable for the mitigation of space weather effects in satellite design. This could include sharing of information on design practices, guidelines and lessons learned relating to mitigation of the effects of space weather on operational space systems, as well as documentation and reports relating to space weather user needs, measurement requirements, gap analyses, cost-benefit analyses and related space weather assessments.

States should encourage entities under their jurisdiction and/or control to:

(a) Incorporate in satellite designs the capability to recover from a debilitating space weather effect, such as by including a safe mode;

(b) Incorporate space weather effects into satellite designs and mission planning for end-of-life disposal in order to ensure that the spacecraft either reach their intended graveyard orbit or de-orbit appropriately, in accordance with the Space Debris Mitigation Guidelines of the Committee. This should include appropriate margin analysis.

International intergovernmental organizations should also promote such measures among their member States.

States should undertake an assessment of the risk and socioeconomic impacts of adverse space weather effects on the technological systems in their respective countries. The results from such studies should be published and made available to all States and used to inform decision-making relating to the long-term sustainability of outer space activities, particularly with regard to mitigating the adverse impacts of space weather on operational space systems.

**Sharing operational space weather data and forecasts (guidelines 27 + 29)**

**States and international intergovernmental organizations should support and promote the collection, archiving, sharing, intercalibration, long-term continuity and dissemination of critical space weather data and space weather model outputs and forecasts, where appropriate in real time, as a means of enhancing the long-term sustainability of outer space activities.**

States and international intergovernmental organizations should support the identification of data sets critical for space weather services and research and should consider adopting policies for the free and unrestricted sharing of critical space weather data from their space- and ground-based assets. All governmental, civilian and commercial space weather data owners are urged to allow free and unrestricted access to, and archival of, such data for mutual benefit.

States and international intergovernmental organizations should also consider sharing real-time and near-real-time critical space weather data and data products in a common format, promote and adopt common access protocols for their critical space weather data and data products, and promote the interoperability of space weather data portals, thus promoting ease of data access for users and researchers. The real-time sharing of these data could provide a valuable experience for sharing in real time other kinds of data relevant to the long-term sustainability of outer space activities.

States and international intergovernmental organizations should further undertake a coordinated approach to maintaining the long-term continuity of space weather observations and identifying and filling key measurement gaps, so as to meet critical needs for space weather information and/or data. Consideration should be given to flying small and low-power integrated payloads for space weather science and monitoring whenever and wherever possible (e.g., radiation monitors on Earth-orbiting satellite missions).

States and international intergovernmental organizations should identify high-priority needs for space weather models, space weather model outputs and space weather forecasts and adopt policies for free and unrestricted sharing of space weather model outputs and forecasts. All governmental, civilian and commercial space weather model developers and forecast providers are urged to allow free and unrestricted access to and archival of space weather model outputs and forecasts for mutual benefit, which will promote research and development in this domain.

States and international intergovernmental organizations should also encourage their space weather service providers to:

- (a) Undertake comparisons of space weather model and forecast outputs with the goal of improved model performance and forecast accuracy;

(b) Openly share and disseminate historical and future critical space weather model outputs and forecast products in a common format;

(c) Adopt common access protocols for their space weather model outputs and forecast products to the extent possible, to promote their ease of use by users and researchers, including through interoperability of space weather portals; and

(d) Undertake coordinated dissemination of space weather forecasts among space weather service providers and to operational end users.

**Investigation and consideration of new measures to promote the sustainability of outer space activities in the medium and long term (guideline 36)**

**States and international intergovernmental organizations are encouraged to investigate and consider new measures, including technological solutions, with a long-term effect on the sustainability of outer space activities.**

Although improved sharing of data on space objects and the implementation of collision avoidance measures will make a significant contribution to promoting the sustainability of outer space activities in the short term, such collision avoidance measures are applicable only to a very small fraction of the total number of space objects in orbit that have the capability to change their trajectory. For the large majority of space objects, collisions are unavoidable and will contribute to the steady increase of orbital debris over time, thus jeopardizing the long-term sustainability of outer space activities.

States and international intergovernmental organizations are therefore encouraged to investigate and consider a number of possible new measures to address the sustainability of space activities in the medium to long term. Such new measures to be investigated could include, inter alia, on-orbit servicing and other methods for operational lifetime extension, active debris removal, “just-in-time” collision avoidance measures for debris or objects with no means of changing their trajectory, novel techniques for spacecraft passivation and end-of-life disposal, and a possible reduction in the currently recommended 25-year orbital lifetime for spacecraft in low-Earth orbit after the end of orbital operations.

Investigation of new measures to ensure the sustainability of space activities that involve either controlled or uncontrolled re-entries should not increase risks of injury to people, or damage to property or the environment. In this regard, States and international intergovernmental organizations are encouraged to share knowledge and experience gained from a “design-for-demise” philosophy whereby space systems are intentionally designed to completely ablate during uncontrolled atmospheric re-entry as a means of end-of-life disposal.

Policy and legal issues, such as ensuring that these new measures are compliant with the provisions of the Outer Space Treaty, the Convention on International Liability for Damage Caused by Space Objects and other applicable international law, will also need to be addressed.

**International cooperation and capacity-building**

23. Guidelines [...] to [...] provide guidance on international cooperation measures aimed at promoting the long-term sustainability of outer space activities for

Governments and relevant international intergovernmental organizations authorizing or conducting space activities. The guidance includes measures to promote technical cooperation and capacity-building to improve the ability of developing countries to establish their own national capacities, in accordance with national legislation, multilateral commitments, non-proliferation norms and international law.

**International cooperation in support of the long-term sustainability of outer space activities (guidelines 16 + 18)**

**States and international intergovernmental organizations should promote and facilitate international cooperation in the peaceful uses of outer space on a mutually acceptable basis, without infringing intellectual property rights and in accordance with relevant international non-proliferation obligations and national legislation and regulations, as a means of enhancing the long-term sustainability of outer space activities.**

*[Two alternative formulations for the supporting text of this guideline are given below for the consideration of delegations.]*

*[Alternative 1]*

[All States, particularly those with relevant space capabilities and with programmes for the exploration and use of outer space, should contribute to promoting and fostering international cooperation in the long-term sustainability of space activities on a mutually acceptable basis. In this context, particular attention should be given to the benefits for and interests of developing countries and countries with incipient space programmes. States are free to determine all aspects of participation in the exploration and use of outer space on a mutually acceptable basis. The terms of such cooperative ventures, for example in contracts and other legally binding mechanisms, should be fair and reasonable.

States undertaking, authorizing or intending to undertake or authorize international space activities involving the use of controlled items (objects, materials, manufactured items, equipment, software or technology) whose unauthorized disclosure and onward transfer are prohibited and thus warrant appropriate levels of control should ensure that such activities are conducted in accordance with multilateral commitments, non-proliferation norms and principles and international law, and respect intellectual property rights, irrespective of whether such activities are carried out by governmental or non-governmental entities or through international intergovernmental organizations to which such States belong.

States concerned should establish appropriate legal and administrative regulations relating to cooperation in cases where such controlled items are exported or imported, and seek to forge collaborative relationships based on mutual benefits and equal advantages with regard to safeguarding controlled items. States are encouraged to ensure, by means of agreements or other arrangements which are properly institutionalized under national legislation, the safety and security of imported controlled items while they are in the territory of the importing State. In particular, States should enter into consultations to reach agreement in relation to:

(a) Post-sale monitoring and verification to ascertain that controlled items are not at risk of unauthorized use or onward transfer;

(b) Strengthening end-use certification and authentication procedures at the State level;

(c) Providing legal supervision of contracts and contract-based activities in order to effectively facilitate the proper application of agreed measures on end use and to prevent any circumstances in which exported controlled items, when located in the territory of the importing State, could become the subject of disputed jurisdiction or be used for illicit purposes;

(d) Ensuring that the relevant State bodies have the power and capacity to monitor the end use of controlled items and to take appropriate measures where there is a presumption of non-compliance with non-proliferation norms and principles regarding end use.]

[*Alternative 2*]

[This guideline applies to all modes of cooperation, including governmental and non-governmental, commercial and scientific; global, multilateral, regional or bilateral; and among countries at all levels of development. All States, particularly those with relevant space capabilities and with programmes for the exploration and use of outer space, should contribute to promoting and fostering international cooperation in the long-term sustainability of space activities on a mutually acceptable basis. In this context, particular attention should be given to the benefits for and interests of developing countries and countries with incipient space programmes stemming from such international cooperation conducted with countries with more advanced space capabilities. States are free to determine all aspects of participation in the exploration and use of outer space on a mutually acceptable basis. The terms of such cooperative ventures, for example through contracts and other legally binding mechanisms, should be fair and reasonable.

States and international intergovernmental organizations should consider promoting international technical cooperation to enhance the long-term sustainability of outer space activities and support sustainable development on Earth. States and international intergovernmental organizations should support current initiatives and consider new forms of regional and international collaboration to promote space capacity-building, taking into account the needs and interests of developing countries and in accordance with relevant international non-proliferation obligations and national legislation and regulations. States and international intergovernmental organizations should also promote technology safeguard arrangements that may facilitate space capacity-building, while respecting intellectual property rights and relevant requirements for long-term sustainability.

States concerned should establish stronger legal and administrative regulation relating to such cooperation. States should seek to forge collaborative relationships based on equality and mutual benefits. To maximize the potential benefits of such collaboration, States are also encouraged to provide, by means of agreements or arrangements, for the implementation of measures, institutionalized appropriately under their national legislation.]

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**Sharing of experience related to the long-term sustainability of outer space activities and procedures for information exchange (guidelines 1 + 2)**

**States and international intergovernmental organizations are encouraged to share experience and expertise relating to the long-term sustainability of outer space activities and to develop and adopt procedures to facilitate the compilation and effective dissemination of information that will enhance the long-term sustainability of space activities.**

The experience and expertise acquired by those engaged in space activities are instrumental in the development of effective measures to enhance the long-term sustainability of outer space activities. States and international intergovernmental organizations are therefore encouraged to share relevant experience and expertise in order to facilitate and enhance the development of guidelines, rules, regulations and practices to enhance the long-term sustainability of space activities. New participants and those with very little experience in space activities will benefit from the experience and expertise of other space actors, and established actors will also find value in developing new partnerships and sharing experiences more widely.

In developing their procedures for sharing information to enhance the long-term sustainability of space activities, States and international intergovernmental organizations are encouraged to adopt procedures that permit sharing information with non-governmental entities, in addition to sharing information between States, national regulatory authorities, government agencies, and international intergovernmental organizations. In further developing their information-sharing procedures, States and international intergovernmental organizations could take note of effective data-sharing mechanisms applied by private sector entities.

**Capacity-building (guidelines 17 + 19 + 31)**

**States and international intergovernmental organizations are encouraged to support and promote capacity-building in scientific, technical and legal capabilities and improved data accessibility as means of promoting the long-term sustainability of outer space activities.**

States and international intergovernmental organizations should support current capacity-building initiatives and promote new forms of regional and international cooperation and capacity-building that are in accordance with national and international law to assist countries in gathering human and financial resources and achieving efficient technical capabilities, standards, regulatory frameworks and governance methods that support the long-term sustainability of outer space activities and sustainable development on Earth.

Capacity-building activities include education, training and sharing of appropriate experience, information, data, tools, and management methodologies and techniques, as well as the transfer of technology. States and international intergovernmental organizations are encouraged to coordinate their efforts in space-related capacity-building and data accessibility in order to ensure efficiency in the use of available resources and, to the extent that it is reasonable and relevant, avoid unnecessary duplication of functions and efforts, taking into account the needs and interests of developing countries.

States and international intergovernmental organizations should also undertake efforts to make relevant space-based information and data accessible to countries affected by natural disasters or other catastrophes, applying the principles of humanity, neutrality and impartiality, and to support capacity-building activities aimed at enabling the receiving countries to make optimal use of such data and information.

Capacity-building activities can make a significant contribution to enhancing the long-term sustainability of outer space activities by building on the knowledge gained by States and international intergovernmental organizations over many years in the conduct of space activities. In particular, sharing of such experience can enhance the safety of space activities and benefit all users of outer space. Therefore, States and international intergovernmental organizations with experience in space activities should encourage and support capacity-building in developing countries with emerging space programmes, on a mutually acceptable basis, through measures such as improving their expertise and knowledge on spacecraft design, flight dynamics and orbits, performing joint orbital calculations and conjunction assessments, and providing access to precise orbital data and appropriate tools for monitoring of space objects, as well as through the arranging of financing for projects on those subjects.

### **III. Implementation and updating**

#### **Implementation**

24. Without prejudice to the sovereign right of States to determine and establish their own control mechanisms for implementing their international obligations under existing treaties and principles governing the activities of States in the exploration and use of outer space, States are encouraged to implement the guidelines presented above to the greatest extent practicable and in accordance with their national law.

25. International cooperation is essential for promoting the long-term sustainability of outer space activities. Existing information-sharing mechanisms established by the United Nations treaties and principles on outer space, further supplemented by the present guidelines, provide a basis for collecting and exchanging information, knowledge and experience with respect to the progress being made in the protection of the outer space environment. States are encouraged to provide information on their experiences of implementing these guidelines to the Committee on the Peaceful Uses of Outer Space on a regular basis.

#### **Updates**

26. The guidelines presented above are based on the substantial body of knowledge that exists for conducting space activities in a safe and sustainable manner. However, the development of the guidelines has also revealed areas for which the current state of scientific and technical knowledge, or the levels of experience gained, are not yet adequate to provide a sound basis for recommending a guideline. Research by States and international organizations on the sustainable

use of outer space and on the development of sustainable space technologies, processes and services should continue, as recommended in the guidelines, in order to address those open questions. As the conduct of space activities evolves, which it is doing rapidly, and as more knowledge is gained, the guidelines should be reviewed and revised periodically to ensure that they continue to provide effective guidance to States and to all space actors to promote the long-term sustainability of outer space activities.

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