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GLOBAL SPACE GOVERNANCE FOR ENSURING RESPONSIBLE USE OF OUTER SPACE, ITS SUSTAINABILITY AND ENVIRONMENTAL SECURITY: LEGAL PERSPECTIVE

Abstract

The paper will be focused on the dominant legal actions taken worldwide, more specifically at the regional and international level, towards responsible and secure use of outer space and ensuring of its sustainability. For this purpose the sufficiency of applicable legally binding norms elaborated at the beginning of the space era and extent of complementarity of the pertinent soft law provisions will be analyzed. It will also envisage legal grounds for regulating emerging space threats and a shaped framework for measures taken at all stages of space activities towards achieving of aforementioned objectives. The emphasis will be made on legal initiatives to manage the risks posed by dangerous space debris, destructive collisions, the crowding of satellites, the growing saturation of the radio-frequency spectrum, etc. In this line, the paper will provide an overview of such topical concepts as “space situational awareness”, “space traffic management” and “active debris removal”. Finally, the role of international cooperation through transparency and confidence-building measures designed to enhance coordinated actions in the context of concepts’ proper implementation will be examined.

INTRODUCTION AND PREREQUISITES FOR A SECURE AND SUSTAINABLE SPACE ENVIRONMENT AND RESPONSIBLE BEHAVIOUR THEREIN

Even though the grounds of responsible and secure use of outer space, and of its sustainability have been laid down at the beginning of the space era, the recognition of the need to develop them further adjusting to modern space challenges started about a decade ago.

As of today the legal regime governing responsible, secure and sustainable space environment is composed of two main blocks: legally binding norms (mainly international space treaties and national space legislation) and complementary soft law provisions (draft codes of conduct, GGE reports, policies, guidelines, principles etc.).

The very first fundamentals of secure space environment and responsible behavior therein have been enshrined in the Outer Space Treaty.[1]

In particular it provided for four categories of obligations towards ensuring the minimum level of transparency:

- To cooperate;
- To hold consultations;
- To inform;
- To afford the opportunity to observe the flight of space objects launched.

Elaborating further on those categories, we have to refer to some pertinent provisions:

- States shall be guided by the principle of cooperation and mutual assistance (art. IX);
- States shall undertake appropriate international consultations before proceeding with any activity or experiment that would cause potentially harmful interference with activities of other States (art. IX) / with a counter right to request consultations concerning such an activity or experiment (art. IX);
- States conducting activities in outer space agree to inform the UN Secretary-General as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the UN Secretary-General should be prepared to disseminate it immediately and effectively (art. XI);
- States shall consider on a basis of equality any requests by other States to be afforded an opportunity to observe the flight of space objects launched by those States (art. X).

The aforementioned provisions are the minimum requirements for a responsible public order in space, the optimum ones are found in soft law provisions thus not having any enforcement mechanisms – backing for implementation. In a perfect public order in space the optimum requirements should move towards the minimum ones and replace them leaving the niche to more up-to-date requirements - responses to current space threats and challenges. However taking into account the fast pace of changes occurring in a space sector, the niche of optimum requirements should be taken by the new ones adjusted to the congested and contested space environment.

LEGAL ACTIONS TAKEN WORLDWIDE

The first question that should be asked: why do we need to ensure security and sustainability of space environment, and responsible nature of space activities?

ITU and IADC indirectly responded to this question focusing on the importance of satellite orbits and protected regions of outer space. Namely, ITU specifies that satellite orbits constitute limited natural resources that are increasingly in demand. The IADC, in its turn, emphasized on the value of protected regions, stating that any activity taking place in outer space should be performed while recognising the unique nature of protected LEO and GEO regions of outer space, to ensure their future safe and sustainable use. It has been also highlighted that these regions should be protected with regard to the generation of space debris.

Highly vulnerable space assets provide us with enormous benefits that are threatened by risks from space debris, destructive collisions, the crowding of satellites, the growing saturation of the radio-frequency spectrum, etc. As correctly noted by the European External Action Service these challenges call for committed involvement by all space-faring and other countries to ensure greater safety, security, and long-term sustainability of outer space activities.[2]

The first relevant study dates back to 15 October 1993 entitled "Study on the application of confidence-building measures in outer space" (A/48/305 and Corr.1).[3] It was initiated based on the UNGA resolution 45/55 B of 4 December 1990 that requested the UN SG with a group of governmental experts to carry out a study on the specific aspects related to the application of different technologies available, possibilities for defining appropriate mechanisms of international cooperation in specific areas of interest. Even though at that time the main emphasis was made on "prevention of an arms race" still it was acknowledged that to avoid conflicts based on misperceptions and mistrust, it is imperative to promote transparency and other confidence-building measures.

The next topical study was requested almost 20 years later, namely on 8 December 2010, by the UNGA Resolution 65/68. Transparency and confidence-building measures in outer space activities.[4] This resolution provided for a mandate to establish the Group of Governmental Experts (GGE) to conduct a study, commencing in 2012, on outer space TCBMs. In 2013 the GGE Report on Transparency and Confidence-Building Measures in Outer Space Activities has been released. The GGE considered the TCBMs as a means by which Governments can share information with the aim of creating mutual understanding and trust, reducing misperceptions and miscalculations and thereby helping both to prevent military confrontation and to foster regional and global stability. TCBMs have been also seen as a facilitator in building confidence as to the peaceful intentions of States increasing understanding, enhancing clarity of intentions and creating conditions for establishing a predictable strategic situation in both the economic and security arenas.

In that Report the GGE defined two categories of TCBMs:

1) dealing with capabilities;
2) dealing with behaviors.

With focus on enhancing the transparency of outer space activities, the report provided for:

- Information exchange on space policies;
- Information exchange and notifications related to outer space activities;
- Risk reduction notifications;
- Contact and visits to space launch sites and facilities.

Another important soft law document entitled "International Code of Conduct for Outer Space Activities"[5], even though still a draft, is considered as one of the most promising and comprehensive documents of this nature that focus on security and sustainability of outer space.

Shaped as multilateral code of conduct, it is aimed at enhancing the safety, security, and sustainability of outer space activities and as recommended by the aforementioned GGE Report on TCBMs is perceived as a complement to international law.

Already in its preamble was acknowledged the need to safeguard the continued peaceful and sustainable use of outer space for current and future generations that should be performed in a spirit of greater international cooperation, collaboration, openness and transparency. The Code recognizes the necessity of a comprehensive approach to safety, security, and sustainability in outer space. It also notes that space debris affects the sustainable use of outer space, constitutes a hazard to outer space activities and potentially limits the effective deployment and utilisation of associated space capabilities. Therefore it is in the shared interest of all States to reinforce international norms for responsible behaviour in outer space.

Under this Code the States agree to establish and implement policies and procedures to minimise the risk of accidents in space, collisions between space objects, or any form of harmful interference with another State's peaceful exploration, and use, of outer space. In conducting outer space activities they also resolve to refrain

from any action which brings about, directly or indirectly, damage, or destruction, of space objects unless such action is justified by imperative safety considerations (in particular if human life or health is at risk or in order to reduce the creation of space debris) or by the UN Charter, including the inherent right of individual or collective self-defense. Where such exceptional action is necessary, it should be undertaken in a manner so as to minimize, to the greatest extent practicable, the creation of space debris and to take appropriate measures to minimize the risk of collision. The States, guided by the principle of cooperation and mutual assistance, consented to notify, in a timely manner, to the greatest extent practicable, all potentially affected States of any event related to the outer space activities they are conducting which are relevant for the purposes of this Code, including scheduled maneuvers that could pose a risk to the safety of flight of the space objects of other States; predicted conjunctions posing an apparent on-orbit collision risk, due to natural orbital motion, between space objects or between space objects and space debris; pre-notification of launch of space objects; collisions, break-ups in orbit, and any other destruction of a space object which has taken place generating measurable orbital debris; predicted high-risk re-entry events in which the re-entering space object or residual material from the re-entering space object potentially could cause significant damage or radioactive contamination; malfunctioning of space objects or loss of control that could result in a significantly increased probability of a high risk re-entry event or a collision between space objects. Moreover, the States shall provide the notifications on any event related to the outer space activities described above to all potentially affected States through the Central Point of Contact or through diplomatic channels; or by any other method as may be mutually determined by States. In notifying the Central Point of Contact, the States should identify, if applicable, the potentially affected States. A State that may be directly affected by certain outer space activities conducted by another State and has reason to believe that those activities are or may be contrary to this Code may request consultations with a view to achieving mutually acceptable solutions regarding measures to be adopted in order to prevent or minimize the potential significant risks of damage to persons or property, or of harmful interference to a State's outer space activities. The consultation process will be held through diplomatic channels or by other methods as may be mutually determined. It is worth noting that the States also agree to work jointly and cooperatively in a timeframe sufficiently urgent to mitigate or eliminate the identified risk initially triggering the consultations. Any other State which has reason to believe that its outer space activities would be directly affected by the identified risk may take part in the consultations if it requests so, with the consent of the State which requested consultations and the State which received the request. The States are given a right to propose the creation of, on a voluntary and case-by-case basis, missions to analyse specific incidents affecting space objects, based on objective information, with a view to draw lessons for the future. These missions, to be established by consensus by the Meeting of the States and carried out by a geographically representative group of experts, endorsed by the involved States, should utilise information provided on a voluntary basis by the States, subject to applicable laws and regulations.

One more legal initiative is held under the aegis of the UN Committee on the Peaceful Uses of Outer Space and is structured as the Working Group on the Long-Term Sustainability of Outer Space Activities.

It is tasked to examine and propose measures to ensure the safe and sustainable use of outer space for peaceful purposes and for the benefit of all countries. Within the WG 4 expert groups were created to discuss specific topics and develop draft guidelines:

A — Sustainable space utilization supporting sustainable development on Earth;

B — Space debris, space operations and tools to support space situational awareness sharing;

C — Space weather;

D — Regulatory regimes and guidance for new actors in the space arena.

The 33 draft guidelines have been consolidated in 18 draft guidelines. However the work is still ongoing.

SSA, STM and ADR

In the last decade three new concepts (SSA, STM and ADR) related to secure and sustainable space environment have been either developed, or enhanced. Understanding of their content is important for placing them within the global space governance system.

Space Situational Awareness permits to autonomously detect, predict and assess the risk to life and property due to man-made space debris objects, reentries, in-orbit explosions and release events, in-orbit collisions, disruption of missions and satellite-based service capabilities, potential impacts of Near-Earth Objects (NEOs), and the effects of space weather phenomena on space- and ground-based infrastructure. In addition, it enables to have understanding what is going on in space by acquiring the independent capability to watch

for objects and natural phenomena that could harm our infrastructure.[6]

Space Traffic Management is the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference. It provides appropriate means for conducting space activities without harmful interference; supports the universal freedom to use outer space as laid down in the Outer Space Treaty of 1967. For the purpose of achieving a common good, actors have to follow specific rules, which are also in their self-interest. [7]

Active Debris Removal involves removing objects from orbit above and beyond the currently-adopted mitigation measures. It foresees a satellite performing a rendezvous with the object targeted for removal, initiating contact with the object, controlling its attitude, reducing orbital altitude and then removing it from orbit. However as the most significant limitations of its implementation could be seen the lack of transparency, coordination and willingness to cooperate. Moreover, being mainly developed at the beginning of the space era, the pertinent international legal instruments do not consider recent trends, are sometimes too broad and do not provide for a differentiated approach on most issues.

SPACE DEBRIS MITIGATION and ADR

To present there is no explicit internationally binding obligation imposed on the launching states to remove the space object from orbit once it is no more functional or cooperative. However through the array of soft law documents, in particular space debris mitigation guidelines, planetary protection policies and codes of conduct, this implicit obligation can be distilled and introduced as an explicit commitment to remove space object from orbit upon completion of its efficient operation.

The IADC Space Debris Mitigation Guidelines[8] focus primarily on two main categories of non-functional man-made objects, namely spacecraft and launch vehicle orbital stages. They see spacecraft as an orbiting object designed to perform a specific function or mission and draw a clear distinction between those spacecrafts that are considered functional and non-functional. A spacecraft that can no longer fulfil its intended mission is considered non-functional if only it is not in reserve or standby modes awaiting possible reactivation. As regards launch vehicle orbital stages, the Guidelines view them as stages of a launch vehicle left in Earth orbit. Since they have already terminated their mission when deploying the spacecraft it is natural that such stages are treated as non-functional.

It is important to be proactive in facing space debris problem since it is not limited by danger posed to space objects, but also constitute threat to the environment in which they operate, services they provide and to the humans in space.

In addition, the space debris problem leaves an open item: who has to remove space debris and who actually will accomplish this?

This question is followed by many more questions, namely how can we oblige someone to remove non-functional space object, is there any legally binding obligations to remove it and are there any enforcement mechanisms for doing so?

The critical character of a space debris problem is also explained by its influence on what is happening on Earth (justified by our dependence on space applications).

In a situation where there is no mandatory obligation to remove the space object from orbit and preserve space environment, no enforcement mechanisms for implementation of space debris mitigation guidelines and no differentiated guidelines that would consider new trends, there is an explicit need to develop a clear ADR rules to deal with space debris problem if preventive actions failed to be efficient. However this is complicated by fact that there is no international acceptance and recognition of ADR and so far there were no cases / precedents of its implementation.

In IADC guidelines it is provided that operators should avoid the long term presence of launch vehicle orbital stages in the GEO region. As regards the spacecraft that have terminated their mission, they should be manoeuvred far enough away from GEO so as not to cause interference with spacecraft or orbital stage still in geostationary orbit. It is expected that such a manoeuvre should place the spacecraft in an orbit above the GEO protected region.Whenever possible spacecraft or orbital stages that are terminating their operational phases in orbits that pass through the LEO region, or have the potential to interfere with the LEO region, should be de-orbited or where appropriate manoeuvred into an orbit with a reduced lifetime. The Guidelines provide in particular for two relevant to the ADR mitigation measures: de-orbiting and re-orbiting. Both of them are interpreted through intentional changing of a spacecraft or orbital stage's orbit; however the first one, i.e. de-orbiting, focus on re-entry of a spacecraft or orbital stage into the Earth's atmosphere purported to eliminate the hazard it poses to other spacecraft and orbital

stages, by applying a retarding force, usually via a propulsion system.

It is worth noting that during an organisation's planning for and operation of a spacecraft and/or orbital stage, the systematic actions should be taken to reduce adverse effects on the orbital environment by introducing space debris mitigation measures into the spacecraft or orbital stage's lifecycle, from the mission requirement analysis and definition phases. More importantly, no program, project or experiment that will release objects in orbit should be planned unless an adequate assessment can verify that the effect on the orbital environment, and the hazard to other operating spacecraft and orbital stages, is acceptably low in the long-term.

However the space debris mitigation measures should focus on minimization of the potential for on-orbit break-ups, avoiding intentional destructions, which will generate long-lived orbital debris. This is one of the key limitations for the ADR implementation which specifies that mitigation measures should be carefully designed not to create other risks.

Thus when undertaking the ADR activities two main limitations should be kept in mind: 1) avoidance of intentional destruction and other harmful activities and 2) prevention of on-orbit collisions. It is specified that intentional destruction of a spacecraft or orbital stage and other harmful activities that may significantly increase collision risks to other space objects on-orbit should be avoided. In developing the design and mission profile of a spacecraft or orbital stage, a program or project should estimate and limit the probability of accidental collision with known objects during the spacecraft or orbital stage's orbital lifetime.

The most relevant to ADR guidelines, namely the ones that reflect situations having a high probability for implementation of this mechanism, are: 1) to limit the probability of accidental collision in orbit, 2) to avoid intentional destruction and other harmful activities, 3) to limit the long-term presence of spacecraft and launch vehicle orbital stages in the LEO region after the end of their mission and 4) to limit the long-term interference of spacecraft and launch vehicle orbital stages with the GEO region after the end of their mission.

The probability of accidental collision with known objects during the system's launch phase and orbital lifetime should be estimated and limited already at the time of developing the design and mission profile of spacecraft and launch vehicle stages. If available orbital data indicate a potential collision, adjustment of the launch time or an on-orbit avoidance manoeuvre should be considered. Some accidental collisions have already been identified. Numerous studies indicate that, as the number and mass of space debris increase, the primary source of new space debris is likely to be from collisions. Collision avoidance procedures have already been adopted by some member States and international organizations. Recognizing that an increased risk of collision could pose a threat to space operations, the intentional destruction of any on-orbit spacecraft and launch vehicle orbital stages or other harmful activities that generate long-lived debris should be avoided. When intentional break-ups are necessary, they should be conducted at sufficiently low altitudes to limit the orbital lifetime of resulting fragments. Spacecraft and launch vehicle orbital stages that have terminated their operational phases in orbits that pass through the LEO region should be removed from orbit in a controlled fashion. If this is not possible, they should be disposed of in orbits that avoid their long-term presence in the LEO region. When making determinations regarding potential solutions for removing objects from LEO, due consideration should be given to ensuring that debris that survives to reach the surface of the Earth does not pose an undue risk to people or property, including through environmental pollution caused by hazardous substances. Spacecraft and launch vehicle orbital stages that have terminated their operational phases in orbits that pass through the GEO region should be left in orbits that avoid their long-term interference with the GEO region. For space objects in or near the GEO region, the potential for future collisions can be reduced by leaving objects at the end of their mission in an orbit above the GEO region such that they will not interfere with, or return to, the GEO region.

Similar provisions have been enshrined in the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space.[9]

The high risk of damage posed by ADR activities also requires proper consideration of applicable liability regime. From the legal perspective, when applying ADR, one should think about possible differences in legal implications depending on contact vs. contactless removal. Deriving from the Liability Convention, launching state, when in outer space, is liable only if the damage is due to its fault or the fault of persons for whom it is responsible. Therefore, in case of contactless removal the fault will be less evident and therefore more challenging to prove.

Despite all possible justifications to apply the ADR, it cannot be implemented without reaching agreement with states related to non-functional / non-cooperative space object – target object to be removed. Two optional approaches could be suggested: to identify all objects in orbit

that can be impacted by ADR activities and to hold preliminary consultations with all concerned parties (mainly launching states) or to inform the UN Secretary-General about the planned ADR setting a deadline for concerned States to get in touch with "interested in ADR States" expressing their will to hold consultations.

Aside from this, the continuing legal relationship between the object and launching states together with extension of their jurisdiction over the object once launched in the outer space should be taken into account. In the context of hazardous nature of ADR activities, the issue of authorization, supervision and control should be considered to ensure that ADR falls under the legal scope and therefore cannot be interpreted as an "international wrongful act".

GLOBAL SPACE GOVERNANCE

The Montreal Declaration dated 31.05.2014 (McGill)[10] recognized that current global space governance system that was created during the 1960s and 1970s has not been comprehensively examined by the international community since its establishment. The concept of global governance is comprehensive and includes a wide range of codes of conduct, TCBMs, safety concepts, international institutions, international treaties and other agreements, regulations, procedures and standards. The Declaration drew attention to the numerous developments that have occurred in the world in general, and in space sector in particular, with serious implications for current and future space activities and for sustainable use of space for peaceful purposes for the benefit of all humankind.

Thus the Global Space Governance can be seen as a movement towards political integration of transnational actors aimed at negotiating responses to space-related problems that affect more than one state and tends to involve institutionalization. This raises questions as to the possibility for the UN to be considered as an institution of global space governance and the powers such institution (e.g. UN OOSA, ITU, UNIDIR, IAEA etc.) will have in relevant context. The consideration should go in parallel with understanding that the global space governance also provides for an acceleration of interdependence on a worldwide space arena and the term itself may also be used to name the process of designating space laws, rules, or regulations intended for a global scale. Therefore the Governance requires reflection on the issues: Who is governing? What is the focus area? What are its existing instruments and methods applied? What are the limitations?

UN COPUOS[11] is the only committee of the UNGA dealing exclusively with international cooperation in the peaceful uses of outer space. Its role as a forum to monitor and discuss developments related to the exploration and use of outer space has evolved alongside with the technical advancements in space exploration, geopolitical changes, and the evolving use of space science and technology for sustainable development. The overall mandate of the Committee and its two Subcommittees aims at strengthening the international legal regime governing outer space, resulting in improved conditions for expanding international cooperation in the peaceful uses of outer space. The mandate also specifies that the Committee should support efforts at the national, regional and global levels, including those of entities of the United Nations system and international space-related entities, to maximize the benefits of the use of space science and technology and their applications. It aims to increase coherence and synergy in international cooperation in space activities at all levels.

ITU[12] is the UN specialized agency for information and communication technologies – ICTs that allocates global radio spectrum and satellite orbits, develops the technical standards that ensure networks and technologies seamlessly interconnect and strives to improve access to ICTs to underserved communities worldwide.

In its turn the UNIDIR (UN Institute for Disarmament Research)[13] is an autonomous institute within the UN that generates ideas and promotes action on disarmament and security, assists the international community in developing the practical, innovative thinking needed to find solutions to the challenges of today and tomorrow and in finding and implementing solutions to disarmament and security challenges, seeks to contribute to conflict prevention and promote the development of a peaceful and prosperous world and strives to anticipate new security challenges and threats and to elaborate possible methods to address them before they become critical.

As regards the IAEA (International Atomic Energy Agency)[14] it is positioned as an independent intergovernmental, science and technology-based UN organization, in the United Nations family, that serves as the global focal point for nuclear cooperation; assists its Member States, in the context of promoting the safe, secure and peaceful use of nuclear technologies social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States; develops nuclear safety standards and, based on these

standards, promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation; verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes.

To the main focus areas of the global space governance refer space activities, space environment, space objects and human in space. The global space governance should also cover such emerging space threats as risks posed by dangerous space debris, nuclear power source applications in outer space, destructive collisions, crowding of satellites and growing saturation of the radiofrequency spectrum.

Existing legal instruments for space governance are binding and nonbinding, wherein the TCBMs are playing the growing role. Even though the TCBMs refer to the soft law, they have a potential to become a hard law.

Methods applied in space governance:

- Bottom – up approach for law-making (collection of best practices and development of recommendations, principles, rules of conducts etc.);
- Holding of fora;
- Establishment of working groups;
- Development of new cooperative actions and initiatives.

CONCLUDING REMARKS

Nowadays we can observe many parallel legal initiatives and other non-legal actions focusing on enhancing the secure, sustainable and responsible space. However their efficiency will be reduced if implemented in uncoordinated way not falling under the scope of global space governance. Even though this must cause many discussions as regards pros and cons of centralization vs. decentralization and the potential risk of usurpation of space authorities in “one hands”, we are of the view that the global space governance should be implemented for the purposes of coordination, avoiding useless duplications and hazardous contradictory actions.

To conclude, we are not talking about “governing” stricto sensu, creating a centralized space superpower, but rather about assisting space actors to cooperate and coordinate, having a holistic picture and understanding of what has already been done, what is happening and what is planned to be realized.

[1] Outer Space Treaty 1967 // http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

[2] European External Action Service // http://eeas.europa.eu/non-proliferation-and-disarmament/outer-space-activities/index_en.htm

[3] Study on the application of confidence-building measures in outer space // http://www.un.org/ga/search/view_doc.asp?symbol=A/48/305

[4] UNGA Resolution 65/68. Transparency and confidence-building measures in outer space activities // http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/65/68

[5] DRAFT International Code of Conduct for Outer Space Activities, version 31 March 2014 // http://www.eeas.europa.eu/non-proliferation-and-disarmament/pdf/space_code_conduct_draft_vers_31-march-2014_en.pdf

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[7] STM // https://iaaweb.org/iaa/Studies/spacetraffic.pdf

[8] IADC Space Debris Mitigation Guidelines 2002 // http://www.iadc-online.org/index.cgi?item=docs_pub

[9] Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space 2007 // http://www.unoosa.org/pdf/publications/st_space_49E.pdf

[10] Montreal Declaration 2014 // https://www.mcgill.ca/iasl/files/iasl/montreal-declaration-2nd-manfred-lachs-conference.pdf

[11] UN COPUOS // http://www.unoosa.org/oosa/en/ourwork/copuos/index.html

[12] ITU // http://www.itu.int/en/about/Pages/default.aspx

[13] UNIDIR // http://www.unidir.org/

[14] IAEA // https://www.iaea.org/