HUMANITY, FROM PEACEFUL EXPLORATION OF OUTER SPACE TO ITS CONQUEST THROUGH SPACE FORCES, ANTI-SATELLITE WEAPONS AND STATE OF THE ART SPACE TECHNOLOGIES

Major-General Valentin BECHERU, PhD
Major Adrian STAN

MOTTO: *I believe that any domain that humans move into will be subject to conflict… conflict will move into space,* General JOHN HYTEN

Abstract: *For a long period of time, usage of outer space for humankind was limited to observing outer space constellations, navigation and prediction of meteorological phenomena. Currently our purpose has growing concerns either in the peaceful exploration of outer space or for military conquest or resources exploitation of its by developing spatial resilient networks with a wide variety in terms of the use of advanced technologies that are into continuous development.*

Worldwide, there are some states (US, Russia, China and more recently India) and organizations (UN, NATO, EU, ITU), which act as the important players in the outer space concern matters with high interest both in development complexes space infrastructure and by implementing sustainable policies, in order to explore peaceful outer space, protecting it, ensuring efficiency with fairness resources, space debris management, space security and control of military capabilities in outer space.

Since space is the prerogative of advanced technologies, its development entails development of other components of technical-economic and human society. Today, usage of complex space systems can be considered acting like a gate in order to improve actual purpose by implementing projects such as space situational awareness /terrestrial or extraterrestrial, telecommunications, imagery, security, Earth observation, meteorological and geoclimatic changes, or for the future by exploring other planets, the establishment of colonies, exploitation of extraterrestrial bodies, developing new technologies and even space tourism.

Taking into consideration cost-benefit, regional geopolitical environment, Euro-Atlantic membership, reducing dependency on space providers services and complexity of owning a space system, Romania is developing in the short and

medium term a project of National Satellite aiming at achieving military, government and civilian objectives.

Keywords: *outer space, peaceful exploration of outer space, conquest of outer space, militarization of outer space, resilience, UN, UNOOSA, ITU, space debris, space law, Romania's satellite project.*

I. Space, Cosmos, Universe – are subjects that represent controversial topics for researchers and beyond, ranging from mysticism to complex definitions. Outer space is an infinite territory for the mankind, but in spite of this man seeks to explore it and why not to conquer or to exploit it.

Over time, several science and methods of space analysis were invented: from observations of the sky (astronomy) to those in outer space adjacent to our planet or even the exploration of celestial bodies, or by people (such as the example of the moon, or in the near future exploiting the resources on asteroids), either using satellites and robots.

Over the time as the space field evolved from empirical to concrete, from simple to complex, from Conrad Haas, Isaac Newton and William Moore to Hermann Oberth, Wernher von Braun and Sergei Korolev, from the sniper observation devices and sextant to the missiles, constellations of satellites, orbital stations, space forces and why not space mining or space tourism, space exploration was a dream of mankind that became possible in the second part of the twentieth century, according with the evolution of propulsion elements, missile development, aviation, telecommunications, electronics and research projects.

Although the chronology of recent space events is well-known, as a eulogy of the evolution of this area, we emphatically point out the most important events. Thus, space flights begin with SPUTNIK1 on October 4, 1957, followed in the same year by Sputnik 2, when the puppet "Laika" was sent to space she became the first being on Earth ever to reach space. After this event, the first flight of man in space was executed by Russian major Yuri Gagarin on 12 April 1961, the duration of the flight being 108 minutes. On July 20, 1969, US Neil Armstrong and Buzz Aldrin in the Apollo 11 mission card, became the first people to step on the moon, the Earth's natural satellite. The only Romanian who has, till now, flown to outer space

was the retired lieutenant-general Dumitru Prunariu, who participated in the year 1981, in the mission of Soyuz 40 under the space program named "Intercosmos", spending a period of 7 days, 20 hours and 42 minutes in space.

The outer space is considered an endless expanse beyond the Earth's atmosphere, with a consistency and rules of composition and operation totally different from the laws of physics on Earth, with the following regions: Geospace, Interplanetary, Interstellar and Intergalactic[1].

Space may be consider the "Last Frontier", which man continuously explores to ensure its survival as a species, in the face of possible immediate dangers that can threaten our planet, such as global warming, resource consumptions in the context of overpopulation of the planet, but also of cosmic threats, such as gamma ray bursts, impact with asteroids or comets, and ultimately but most important in our opinion the death of the sun considered nuclear reactor that secures the energy of our solar system.

In addition, outer space can also represent a future theatre of confrontations between countries or changing organizations to ensure informational and rational supremacy, as well as testing technical capabilities in the field of advanced technologies. The emergence of outer space, by interacting with terrestrial space (earth, air and water) and cyberspace (cyber), requires the multi-domain implementation of state-of-the-art technologies in relation to growing needs at the changing level information, resources, propulsion solutions, multimedia technologies and weapon systems. New threats to commercial and military areas in space are emerging by increasing digital connectivity in all environments, business, governmental and military areas that are most often vulnerable, so during the conduct of conflicts, attacks on defense, governmental and civilian critical infrastructures must be anticipated and protected[2].

Globally, there are a number of states (USA, Russia, China and more recently India) and organizations (UN, NATO, EU, ITU), which as large players in the outer space market are dealing with high-interest space

[1] https://universulsispatiulcosmic.weebly.com/spatiul-cosmic.html
[2] US NATIONAL DEFENSE STRATEGY 2018 – summary

through the development of complex space infrastructures, and by implementing sustainable policies, with a view to the peaceful exploration of space, its protection, ensuring efficient use, with equidistant spatial resources, the management of space debris, the security of the space (Space Situational Awareness, Space Traffic Management and Space Weather) and full control of military capabilities in outer space environment.

At the global level, the United Nations (UN) organization through the UN Office for Space Affairs UNOOSA (Figure No. 1), pays particular attention to spatial activities undertaken by states and international organizations, in order to ensure that these activities are used in a peaceful way and the whole benefit of mankind. In this respect, at the organization level, a number of international instruments of a universal nature were developed and adopted, regulating the activity in space, which led to the development of a new area, that of international public law- international space law, the most significant are[3]:

- 1967 - Treaty on Principles Governing the Activities of States in the exploration and use of outer space, including the Moon and other celestial bodies – Outer Space Treaty[4];
- 1968 - Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space[5];
- 1972 - Convention on international liability for damage caused by space objects[6];
- 1976 - Convention on registration of objects launched into outer space[7];
- 1979 - Agreement Governing the Activities of States on the Moon and other celestial bodies[8].

[3] http://www2.rosa.ro/index.php/ro/cooperare/108-onu/449-onu, https://www.unov.org/-unov/en/unoosa.html and http://www.unoosa.org/oosa/oosadoc/data/documents/2019/aac.-105c.2l/aac.105c.2l.310_0.html
[4] United Nations, Treaty Series, vol. 610, Nr. 8843
[5] United Nations, Treaty Series, vol. 672, Nr. 9574
[6] United Nations, Treaty Series, vol. 961, Nr. 13810
[7] United Nations, Treaty Series, vol. 1023, Nr. 15020
[8] United Nations, Treaty Series, vol. 1363, Nr. 23002

Figure no. 1– United Nations Organization Chart for Spatial Activities

In the context of the increasingly prominent development of space exploration over the past 50 years, UNOOSA has begun the process of implementing a Space 2030 plan in order to streamline and strengthen UN principles / treaties in the field of space protection and peaceful exploitation of space, in a fair way for all states of the world. The objectives of this plan are structured on four pillars:

1. ***the space economy*** **-** increasing the economic benefits derived from space and strengthening the role of the space sector as a major factor for sustainable development;

2. ***spatial society (community)*** **-** advancing the social benefits of space-related activities and making use of space technologies, space services and applications for improving the quality of life;

3. ***accessibility of space*** **-** improving access to space for all and ensuring that all countries can benefit socio-economically from space, scientific, technological, spatial data, information and products, thus serving the objectives of sustainable development of the states;

4. ***space diplomacy*** **-** building partnerships and strengthening international cooperation in the peaceful use of space.

At the European Union level, space exploration policies are in line with those of the UN, and the Code of Conduct for Space Activities, which provides for the strengthening of security in outer space activities, was drafted in 2008. It is an important stake in the context of the expansion of space activities in favor of state development and security. The guiding principles of safety and security in space at European level are:

- freedom of access to space, its exploration, use and the use of space objects for non-interference peaceful purposes, with full respect for the security, safety and integrity of space objects in orbit;
- the right to legitimate defense, whether individual or collective, in accordance with the Charter of the United Nations;
- the responsibility of States to take all appropriate measures and to cooperate in good faith to prevent harmful interference in space activities;
- the responsibility of States, in the conduct of scientific, commercial and military activities, to promote the exploration and peaceful use of outer space and to take all appropriate measures to prevent the transformation of space into a conflict zone.

Space activities must be carried out by states / organizations in accordance with the observance and promotion of treaties, conventions and other commitments to peaceful exploitation of space by:

- respecting the existing legal framework for space activities;
- making progress towards joining and implementing the following instruments:
  - the existing framework governing activities in outer space, among others:
    - United Nations Treaties and Agreements governing the space;
    - Convention on International Liability for Spatial Objects (1972);
    - Convention on the Registration of Objects launched in the Extra-Mine Area (1975);
    - Establishment Act and Convention on the International Telecommunication Union and its Radio Regulations (2002);

- Treaty on the Prohibition of Experiences with Nuclear Weapons in the Atmosphere, Extra-Mammalian Space and Underwater (1963);
- The Comprehensive Nuclear Test Ban Treaty (1996);
- Code of conduct against proliferation of ballistic missiles (2002).

▪ declarations and principles, among others:

- Declaration on the legal principles governing the activities of states in the exploration and use of extra-atmospheric space, as set out in UN General Assembly Resolution 1962 (XVIII);
- Relevant principles for the use of nuclear energy sources in outer space as set out in United Nations General Assembly Resolution 47/68;
- Declaration on international cooperation in the exploration and use of space for the sake of and in the interests of all countries, taking particular account of the needs of developing countries as set out in United Nations General Assembly Resolution 51/122;
- Recommendations on the Practices of States and International Organizations on the Registration of Spatial Objects, as set out in United Nations General Assembly Resolution 62/101;
- Guidelines for the reduction of space debris developed by the UN Committee on the Peaceful Uses of Space, as set out in United Nations General Assembly Resolution 62/217.

Measures relating to space operations are established and implemented by national policies and procedures by States to minimize the possibility of space accidents, collisions between spatial objects or any form of interference, including the use of anti-satellite weapons (ASAT), which affects the right of other states to explore and peaceful use of space.

In the conduct of space activities, states apply the following rules:

- refrain from any intentional action that causes or is likely to cause, directly or indirectly, the degradation or destruction of space objects, unless such action is undertaken to reduce the creation of cosmic debris and / or is justified for imperative reasons of safety;
- take appropriate measures to minimize the risk of collision;

- observe and implement the recommendations and regulations of the International Telecommunication Union on the allocation of radio spectrum and geostationary orbit positions.

If it manages spatial objects in outer space - for example, to supply space stations, repair space objects, reduce debris, reposition spacecraft, signatory states take all reasonable steps to reduce the risk of collision[9].

Being in continuous expansion, space is increasingly congested by the large number of satellite networks and space sensors launched. Thus, by the end of 2018, approximately 1957 satellites (as detailed in Table 1) are operational on orbits (LEO - Low Earth Orbit, GEO - Geostationary Equatorial Orbit and Elliptic) by 80 states and organizations, providing coverage of multi-domain and multispectral satellite service needs for organizations. Both civilian and military actors use space capabilities for a large number of missions, including earth observation, weather monitoring, early warning, research, navigation and communications.

Satellite statistics (including registrations until 30.11.2018)			
Total number of operational satellites:1957			
SUA: 849	Russia: 152	China: 284	Others: 672
LEO: 1232	MEO: 126	Elliptical: 41	GEO: 558
Total number of US satellites: 849			
Civil: 24	Commercial: 488	Governmental: 170	Military: 167

Table no. 1 - Artificial satellites orbiting the Earth [10]

The control and mitigation of cosmic debris, one of the world's most important concerns to limit the creation and reduction of the impact of debris in outer space, requires states to refrain from deliberately destroying space objects in orbit and not to engage in other activities harmful

[9] European Code of Conduct for Activities in the Cosmic Space 17175/08 cc/CC/vp 7 DGE WMD RO

[10] UCS Satellite Database, https://www.ucsusa.org/nuclear-weapons/space-weapons/-satellite-database

substances that can generate long-lasting cosmic debris. It also adopts, in accordance with national legislative processes, appropriate policies and procedures for the implementation of the UN Cosmetics Guidelines on the peaceful use of space as adopted by UN General Assembly resolution 62/217.

Figure no. 2 - The evolution of space debris (greater than 10 cm) in LEO orbit

Taking into account the increasing number of incidents recorded in space, the collision of space launches from launch missiles, decommissioned satellites and the use of ASATs with operational satellites at European Union level through the European Space Agency, based on space research (Space Situational Awareness and Space Traffic Management) and statistical models were mapped and cataloged in January 2019, approximately 34,000 objects larger than 10 centimeters, approximately 900,000 objects with dimensions ranging from 1 centimeter to 10 centimeters and approximately 128 million objects with dimensions between 1 millimeter and 1 centimeter[11].

[11]https://www.esa.int/Our_Activities/Operations/Space_Safety_Security/Space_Debris/Space_debris_by_the_numbers

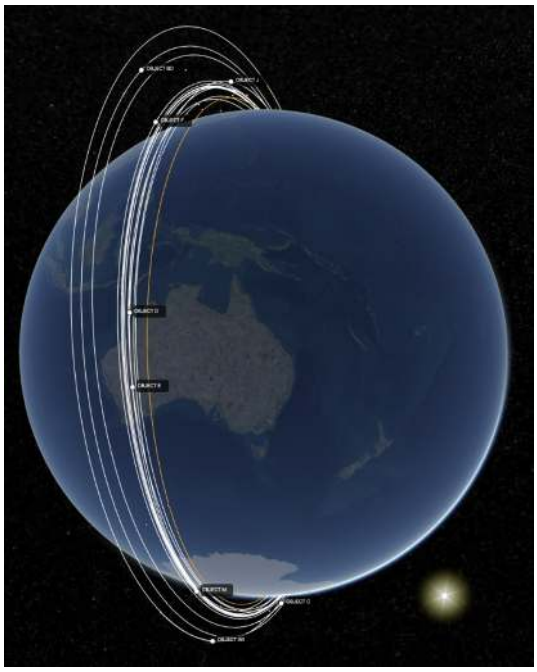

Figure no. 3 - the current displacement of space debris after India's testing of ASAT [12]

Contrary to the peaceful exploitation of cosmic space policies, permissive legislation and the lack of coercive measures at international level, more and more states are developing and testing ASAT capabilities, unnecessarily increasing the amount of cosmic debris and proliferating the relaunch of the arms race and the militarization of the cosmic saber.

The most recent global-like event was recorded at the end of March 2019 when India tested an anti-satellite ballistic missile by destroying its own proprietary satellite in LEO orbit at a height of 300 km above the Earth.

According to NASA's assessments, it was found that the test created 400 identifiable pieces of orbital material. Of these, 60 pieces are large enough to be monitored with a size of 10 centimeters or more and 24 pieces can pass in the vicinity of the International Space Station, increasing the risk

[12] https://breakingdefense.com/2019/04/indian-asat-debris-threatens-all-leo-sats

of hitting the station with pieces of orbital material for 44% over a period of ten days (figure no. 3).

Contrary to the actions of states to showcase the capabilities of the ASAT, taking advantage of permissive legislation and the lack of response of international organizations, concerns at the level of choice are to identify timely solutions and create capabilities to reduce and not limit as much as possible spatial debris. In this context, the European Space Agency, one of the most important players in the global market, has a series of projects involving several EU member states, including Romania, for the control and reduction of space debris.

On other ways, taking into account the complexity of space projects at international level, the following mechanisms for cooperation between states and organizations are needed to make space actions more efficient:

- Notification of activities in outer space, through which State / organizations commit themselves to timely, to the fullest extent possible and feasible, notify all potentially affected states / organizations of the activities in the cosmic space that are relevant, how It would be:
  - –Planned maneuvers that can generate a dangerous proximity to spatial objects;
  - –Orbital and reentry changes as well as relevant orbital parameters;
  - –collisions or accidents that occurred;
  - –Defects of space objects in orbit with significant risk of reentry or collision in orbit;
- Registration of spatial objects through which States / organizations commit themselves to recording spatial objects in accordance with the Convention on the Registration of Objects launched in the extra-mural space and to provide the Secretary-General of the United Nations with the relevant data set out in this Convention and the Recommendations on the Practices of States and Organizations on the Registration of Spatial Objectives as set out in UN General Assembly Resolution 62/101;
- Information on space activities through which States / organizations undertake to transmit, on an annual basis and where available, information on:
  - –national space policies and capabilities, including basic objectives for security and defence activities;

–national space policies and procedures to prevent and reduce the possibility of accidents, collisions or other forms of harmful interference;

–national space policies and procedures to reduce the production of space debris;

–Efforts to promote universal adherence to existing instruments of legal and political regulation of space activities[13].

From a military point of view, the actions of the great world powers are "militarizing the space" by launching on the orbit (LEO, MEO, GEO and elliptical orbit) military communications satellites, GPS, radar, imaging and research, or orbiting armament forces and systems, and last but not least by setting up specialized military structures such as "Space Forces" for the purpose of "conquering space". The most recent public initiative took place in 2018 when the US Presidential Administration declared the establishment and operationalization of the Space Force Command, the sixth component of the Force Structure until 2022, to lead missions and operations US military space.

According to the approved doctrine, the US Space Forces, will develop capabilities and processes for the following operations:

- knowledge of the spatial situation;
- global satellite operations;
- command and integrated control of space-based military forces;
- common space military operations and campaigns in a global theatre of operations;
- support from space forces or terrestrial, aerial, naval and cyber military structures;
- space transportation and testing operations;
- spatial detection and detonation of nuclear capabilities;
- prompt and defensive offensive and defensive space operations to achieve superiority in space[14].

Other states with a prominent military presence in space are Russia and China with capabilities (attack satellites, ballistic missiles, laser and

[13] European Code of Conduct for Activities in the Cosmic Space 17175/08 cc/CC/vp 7 DGE WMD RO.

[14] United Space Force, February 2019, p.4.

optical weapons) for deploying antisatellite, attack, and space defense operations, even if at the declarative level, support the ban on space weapons, the use of space-based military force and the threats to act against the destruction of space objects.

II. Romania, a state with membership in UN and Euro-Atlantic organizations has had several space initiatives over the years, the most important being a space mission in the 1980s by the Retired Lieutenant-General Dumitru Prunariu, GOLIAT the first Romanian nanosatellite built in on the CubeSat standard, as well as involvement in joint projects at the European Space Agency level for the development of space capabilities and Space Situational Awareness. In the current geopolitical context and through the multiplication of hybrid risks in the geographical area of Romania, affiliation in the North Atlantic Treaty Organization (NATO) and the European Union determines the adoption in the medium and long term at the politico-military level of a new strategy on the development of military capabilities for counteraction risks to national security, including through the implementation of advanced technology projects.

From the perspective of creating a scalable and interoperable platform for leadership, co-ordination and co-operation at national and allied level, in line with information exchange needs, it is necessary to develop national space capabilities capable of ensuring the active freedom of the actors involved to ensure connectivity, integrity and availability of information.

The plea for the necessity of developing a national space project, from the perspective of the unitary approach to defense, security and national security, makes it imperative for Romania to reduce its dependence on the major players of spatial communication services in the market, to ensure its spatial sovereignty, to ensure their own space-independent communications services, to increase the resilience of national critical communications infrastructure, to be able to meet the needs of long-term information exchange and even to become a provider of such services at national and international level within the pooling & sharing programs. The short- and medium-term implementation of a project on the first Romanian telecommunications satellite is circumscribed by Romania's efforts to strengthen its role both within NATO and within the EU / CSDP. Through

this project, Romania can contribute to stability in the Euro-Atlantic area, designing itself as a potential security provider in the region.

The immediate advantages resulting from the realization of a satellite capability have multidomain distribution, both at the military level specific to the national defense and the specific missions of the alliances Romania is part of, as well as the government in special situations, emergency, calamities and optimization of border and civil security through the development research and aerospace industry at national level. The fruition of this opportunity is to synchronize the activities and actions of the institutions at national and international level, which denotes the complexity of the implementation of a telecommunications satellite.

Thus, at national level, in addition to the substantial contribution given by the national defense and security structures as beneficiaries, the effort to achieve a spatial project of national strategically operational requires the unified efforts of the following key Actors**: Ministry of Foreign Affairs** (MAE) with a role in communicating to the UN the intention to achieve a spatial project, adherence (subscribes) to the international agreements on the management of space debris and negotiating international agreements with other states that could be included in the Romanian's strategic interest for the satellite coverage areas; **Ministry of Communications and Information Society** (MCSI) with a role in the efficient management of orbital geostationary slots allocated under Government Decision No. 36/2017, coordinating the process of activating an orbital GEO slot and coordinating together with the Ministry of Foreign Affairs the process of negotiating the coverage area of a geostationary satellite; The **National Authority for Administration and Regulation in Communications** (ANCOM) with the role of coordinating with the MCSI the process of activating an GEO orbital slot and the relationship on a specialized field with the International Telecommunications Union (ITU) in the process of allocating satellite frequency bands for planned and unplanned communication networks related to an GEO orbital slot; **Romania Outer Space Agency** (ROSA) with a role in the national coordinator of Space activities to promote the optimal conditions to coordinate of the research and development activity in the space field, insurance, mandated by MAE, representing Romania in the UN Committee on the peaceful use of extra-atmospheric space (UN-COPUOS) and leading

the working Group on the recovery of space surveillance services to develop and improve expertise, infrastructure, technologies and services (knowledge of Space Situational Awareness).

However, the emergence of actions undertaken by a State in the space field for bending of a GEO orbital slot involved a complex process for activation of an advantageous orbital position, so as to respond to the national strategic needs, missions of medium-and long-term information exchange and satellite coverage. International actors with responsibility for the peaceful exploitation of space are the United Nations (UN) as the supreme body and the area of space orbit assignment belongs to the International Telecommunication Union (ITU) as a specialized agency of the United Nations.

All the tasks and missions of this organization are described in the ITU Constitution and Convention, which defines how to organize and operate, including how to allocate the access of GEO orbital slots. At the national level, Romania official signed these constituent acts, along with other 192 states, through national Law No. 76/1993, for the ratification of the ITU Constitution and Convention, signed in Geneva in 1992.

Geostationary orbital slots (positions) for telecommunications satellites are managed according to the equity and efficiency principals. In this respect, in order to ensure equitable access to orbital positions, the ITU drew up two plans for the award of geostationary orbital positions for each member state, Appendix 30/30A (published in 1977) for satellite Broadcasting and 30/ 30B (published in 1988) for fixed radio communications, attributing of each member state to a geostationary orbital position of each appendix. Geostationary space orbit is situated at a distance of 32,000 kilometers from Earth in the equatorial plane, where the rotation speed of the earth equals the speed of rotation of a satellite.

Therefore, in accordance with ITU principle of equity, Romania benefits of a geostationary orbital position having a longitude of 50º for broadcasting services on satellite audiovisual programmers and a geostationary orbital position having longitude of 30,45º for fixed radio communication services, point-to-point or point-to-multipoint, satellite networks (Figure No. 4).

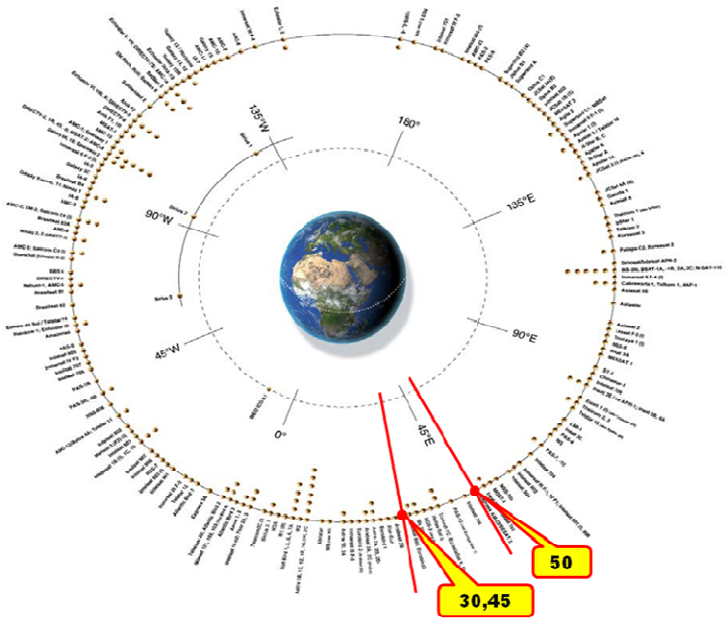

Figure No. 4 Graphical representation of the Geostationary orbital positions allocated to Romania

Last, but not least, at the European Union level, the European Space Agency (ESA) is working to ensure and develop cooperation, exclusively peacefully, between European States, including Romania starting with 2011, in the fields of space research and technology. Another part of the European Union is represented by the European Defense Agency (EDA) which supports the European Council and the Member States in their efforts to improve the defense capabilities of the European Union through space projects and cooperation programs. The type of projects specific to the space domain that they promote are "pooling & sharing", through "EU SATCOM MARKET" and "GOVSATOCOM" whereby member states jointly share their telecommunications satellite capabilities in military satellite bands (X, Ka, UHF – only allocated from NATO) for use, contractually, with states that do not have their own space infrastructure or which do not have satellite coverage on a given area at any given time.

BIBLIOGRAPHY

***, US NATIONAL STRATEGY FOR DEFENSE 2018;
***, US Doctrines for Space Forces, February 2019;
United Nations, Treaty Series, vol. 610, Nr. 8843;
United Nations, Treaty Series, vol. 672, Nr. 9574;
United Nations, Treaty Series, vol. 961, Nr. 13810;
United Nations, Treaty Series, vol. 1023, Nr. 15020;
United Nations, Treaty Series, vol. 1363, Nr. 23002;
UNOOSA - Working paper submitted by the Bureau of the Working Group on the "Space2030" Agenda;
The European Code of Conduct for Activities in the Cosmic Space 17175/08 cc/CC/vp 7 DGE WMD RO.
UCS Satellite Database, https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database
https://universulsispatiulcosmic.weebly.com/spatiul-cosmic.html
http://www2.rosa.ro/index.php/ro/cooperare/108-onu/449-onu
https://www.unov.org/unov/en/unoosa.html
http://www.unoosa.org/oosa/oosadoc/data/documents/2019/aac.105c.2l/aac.105c.2l.310_0.html
https://www.esa.int/Our_Activities/Operations/Space_Safety_Security/Space_Debris/Space_debris_by_the_numbers
https://breakingdefense.com/2019/04/indian-asat-debris-threatens-all-leo-sats