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SOME LEGAL ASPECTS OF INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY MALFUNCTIONING OF SATELLITE NAVIGATION SYSTEMS

Abstract

International liability is one of the most difficult legal issues related to satellite navigation applications. The 1972 Liability Convention provides that a launching State shall be absolutely liable to pay compensation for damage caused by its space objects on the surface of the Earth or to aircraft flight, and liable for damage due to its fault in space. The legal situation of artificial satellites, including navigation satellites, is determined by their assignment to space objects. Unfortunately, the term "space object" is also not specifically defined in international space law. The main purpose of this article is to determine whether damage caused by satellite navigation systems can be covered by the Liability Convention, whether the Convention refers only to direct physical damage resulting from the fall or collision of space objects or whether it also encompasses damage resulting from the malfunctioning of a navigation space object and intangible electromagnetic waves. It seems that the present regulations of the Outer Space Treaty and the Liability Convention do not apply to satellite navigation and do not cover the damage caused by navigation's intangible signals. Unfortunately, it is rather clear that the international community is unlikely to adopt uniform rules on liability for satellite navigation signals in the near future. However, the United Nations and its Committee on the Peaceful Uses of Outer Space remain to be the best platform to work on establishing

the principles governing the issue of liability for damage caused by malfunctioning of satellite navigation systems and their signals.

KEY WORDS

satellite technologies, satellite navigation applications, international space law, international liability, space objects

SŁOWA KLUCZOWE

techniki satelitarne, zastosowania nawigacji satelitarnej, międzynarodowe prawo kosmiczne, odpowiedzialność międzynarodowa, obiekty kosmiczne

1. INTRODUCTION

International liability is one of the most difficult legal issues related to satellite navigation applications. The United Nations (UN), since the beginning of the Space Age, has been involved in work on establishing not only the legal status of outer space and celestial bodies but also the principles governing states' activities in space. One of these principles concerns the issue of international liability for the damage caused by space objects. International lawyers emphasize that "unlike responsibility for breach of law, which results from generally applicable rules of international law, liability does not have such a nature and as it relates to actions permitted by international law; it may only result from express treaty obligations between States, and apply only to those States which are parties to such international agreements".[1]

The first important document, although non-binding, which makes a reference to international liability for damage caused by space objects is the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space.[2] It was adopted by the Legal Subcommittee (LS) of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 1963. According to Point 8 of the Declaration "Each State that launches or procures the launching

[1] Z. Galicki, *Rozwój zasad odpowiedzialności międzynarodowej za działania kosmiczne,* (in:) A. Wasilkowski (ed.), *Działalność kosmiczna w świetle prawa międzynarodowego,* Warsaw 1991, p. 56.

[2] 13 December 1963, RES 1962(XVIII). The UN COPUOS was established on a permanent basis in 1959 and at the same time two main legal issues appeared – the matter of the return of astronauts and the issue of responsibility and liability.

of the object into outer space, and each State from whose territory or facility an object is launched, is internationally liable for damage to a foreign State or to its natural or juridical persons by such objects or its component parts on the earth, in air space, or in outer space". The first binding document regulating this issue is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967 (the Outer Space Treaty).[3] Point 8 of the 1963 Declaration is reflected in its Article VII, which also imposes international liability on launching States and international organizations for damage caused by space objects and their component parts, and thus for the negative consequences of their activities in space.[4] Article VII did not modify the provisions of the Declaration. However, the concept of "a space object" followed by the term "component parts" contained both in Point 8 of the Declaration and in Article VII of Outer Space Treaty has its consequences. According to Kerrest and Smith "…this cannot be seen as substantial improvement. If it achieved anything, it complicated rather than clarified the definition".[5] Unfortunately, Article VII of the Outer Space Treaty of 1967 (unlike Article VI which establishes the principle of responsibility for national activities in outer space and requires space activities by non-governmental entities to have state authorization and continuing supervision) was silent on the principles governing liability, so there was a need for supplementary rules. They were elaborated and introduced into the Convention on International Liability for Damage Caused by Space Objects of 1972 (the Liability Convention).[6] The drafting of its text was difficult, controversial and took the LS of the COPUOS nine years to complete. The Liability Convention constitutes *lex specialis* in relation to Article VII of the Outer Space Treaty.

The Liability Convention provides that a launching State shall be absolutely liable (except where the damage results from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant state or of

[3] The Outer Space Treaty was considered by the Legal Subcommittee in 1966 and agreement was reached in the General Assembly in the same year (Resolution 2222 (XXI)). The Treaty was opened for signature by the three depository Governments (the Russian Federation, the United Kingdom and the United States of America) in January 1967, and it entered into force in October 1967; At present 112 States are parties of the Treaty.

[4] Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies.

[5] A. Kerrest, L.J Smith, *Article VII,* (in:) S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds), *Cologne Commentary on Space Law,* Cologne 2009, p. 134.

[6] The Liability Convention was considered and negotiated by the Legal Subcommittee from 1963 to 1972. Agreement was reached in the General Assembly in 1971 (Resolution 2777 (XXVI)), and the Convention entered into force in September 1972. At present 98 States are parties of the Treaty.

natural or juridical persons it represents) to pay compensation for damage caused by its space objects on the surface of the earth or to aircraft flight (Article II and VI), and liable for damage due to its fault or the fault of persons for whom it is responsible in outer space (Article III). The Convention also provides for procedures for the settlement of claims for damages. As Rajski rightly notes, "[t]he subject of the legal regulation contained in the provisions of the said convention are specific types of property relations (compensatory type) of an international nature. These are relations between states, between states and international organizations and between such organizations. Therefore, the regime of liability for damage set out in the Convention has the nature of international liability, not civil law liability."[7] The same author also emphasizes that "[t]he international legal nature of the liability for damage regulated in the said convention results in certain consequences, which, among others, lead to the need to assess and interpret it in the light of international law, disregarding the rules and methods applicable in this respect in individual national civil law (or equivalent) systems, despite the ascertainable impact of certain civil constructions on a number of provisions of the Convention."[8] Czapliński and Wyrozumska even more strongly emphasize that "(...) liability for activities undertaken in outer space is the only undisputed case of introducing the construction of absolute liability, also known as risk-based liability, into international law".[9] Kerrest and Smith also add that "…Article VII contains the general liability provision on which the Liability Convention is based, acceptance of liability under one, or indeed, both treaties may be read as recognition of the binding force of the State liability rule as a customary rule of international law derived from a treaty obligation".[10]

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[7] J. Rajski, *Odpowiedzialność międzynarodowa za szkody wyrządzone przez obiekty kosmiczne*, Warsaw 1974, p. 33.

[8] *Ibidem,* pp. 33 – 34.

[9] W. Czapliński, A. Wyrozumska, *Prawo międzynarodowe publiczne,* Warsaw 2014, p. 617.

[10] A. Kerrest, L.J Smith, 2009, *op. cit.,* p. 136. During the session of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space in 2014, the catalogue of questions was amended by a fourth question relating to international customary law ("Are there any provisions of the five United Nations treaties on outer space that could be considered as forming part of international customary law and, if yes, which ones? Could you explain on which legal and/or factual elements your answer is based?"). The German delegation is of the opinion that the general principles of the Outer Space Treaty (OST) have become international customary law since almost all States conducting activities in outer space have ratified the OST and act according to its provisions. Furthermore, a dissenting practice of the States not having signed the OST is not identifiable. Germany is of the opinion that the general principles of the OST accepted as customary law are the following: the space freedoms (Art. I OST), the non-appropriation principle (Art. II OST), the applicability of public international law to space activities (Art. III OST), the responsibility and liability of States for national activities in outer space (Art. VI and VII OST) and the duty to authorize and supervise non-governmental activities in outer space (Art. VI OST) as well as the duty to register space objects (Art. VIII OST). The universal validity of these rules is of utmost importance for the peaceful use of outer space. COPUOS, Responses to the set of

Without any doubt – navigation satellites launched in outer space are under the rule of international space law, too. Such satellites are a part of satellite navigation systems which, apart from the space segment, also include ground and user segments.[11] The effectiveness of satellite navigation depends on an adequate number of satellites – constellations of 24 to 30 or more satellites – deployed on circular orbits at an altitude of about 20,000 kilometres. Nowadays satellite navigation systems can be divided into two groups: global (core-constellation) and regional (augmentation) systems. Global Navigation Satellite Systems (GNSS) provide three main services: Positioning, full global Navigation coverage, and precise Timing signals (PNT).[12] Regional (augmentation) systems are support systems that aim to provide greater precision and availability to existing GNSS.[13] The signals emitted by the systems can be used to provide different services, e.g. to determine the position of points and moving objects, along with the parameters of their movement, regardless of the environment in which they are (outer space, air space or the surface of the Earth: both territory under sovereign authority and outside it, such as on the high seas) and regardless of the weather and time of day.[14] The damage which may occur from the provision of such services is related to vulnerabilities of satellite signals to disruption and loss of signals.[15] The major

Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space, 10 April, A /AC.105/C.2/2015/CRP.11.

[11] The ground segment consists of surveillance stations that monitor each satellite continuously (they may be located in different countries). The user segment includes receivers which are placed in aircraft and marine vehicles, cars, and cell phones. The navigation receiver obtains signals from many satellites whose position is well known, compares those signals and calculates its own geographic location.

[12] At present there are the following functioning GNSS: US Global Positioning System (GPS); Russian Federation's GLONASS; European Union's 'Galileo'; and China's 'Compass' system. The concept of the GNSS was presented in K. Myszona-Kostrzewa, *Nawigacja satelitarna w świetle prawa międzynarodowego*, Warsaw 2011, p. 20 ff. and in K. Myszona-Kostrzewa (ed.), *Legal and Political Aspects of the Use of European Satellite Navigation Systems Galileo and Egnos*, Warsaw 2018, pp. 15 ff.

[13] Existing regional support systems include: WAAS (Wide Area Augmentation System), a US-based GPS support system in North America, providing greater accuracy, reliability and availability of GPS, especially in air transport; SDCM (System of Differential Correction and Monitoring), a Russian support system aiming to ensure greater accuracy and availability of GLONASS and GPS in Russia; IRNSS (Indian Regional Navigational Satellite System) is an Indian project intended to remain under civilian control, which covers India and an area of 1,000–2,000 km around it; MTSAT (Multi-functional Transport Satellite) and MSAS (Satellite-based Augmentation System) provide navigation services for all aircraft flying over Japan. QZSS (Quasi-Zenith Satellite System) is a Japanese regional GPS support system in Asia and Oceania; EGNOS is a joint project of the European Space Agency, the European Commission and the European Organisation for the Safety of Air Navigation (Eurocontrol). It was the European Union's first activity in the field of GNSS and a precursor to Galileo.

[14] More: K. Myszona-Kostrzewa, *Nawigacja satelitarna w świetle prawa międzynarodowego*, Warsaw 2011; K. Myszona-Kostrzewa (ed.), 2018, *op. cit*.

[15] K. Myszona-Kostrzewa, 2011, *op. cit*., pp. 234-235.

threats to proper signal functioning may be due to force majeure: increased solar activity, ionospheric effects (which affect propagation of the signal), but also due to interference from other electromagnetic waves (e.g. TV signals). Satellite navigation signals can be also spoofed – "captured", and retransmitted on the same frequency with much greater power, too (recipients will be provided with legitimate-looking false signals instead of the original ones – both GPS and other satellite navigation systems are vulnerable to misuse by hostile groups). It should also be stressed that the basic principle of the United States' policy is its ability to block the use of GPS in any area (by intensive jamming of the relevant frequencies). This means that provision of the navigation signal may be interrupted for reasons which are independent of the technical aspects of the GNSS operation – it may be a deliberate action dictated by a change in the political situation or conditions in international relations.

Clarifying the meaning of the terms: 'navigation satellite' and 'space object' and their 'component parts' and answering the question if intangible signals are covered by them seem to be crucial in this context. However, the main purpose of this article is to determine if the damage caused by such signals (their lack or malfunctioning) can be covered by two of the five UN treaties on outer space[16] – Article VII of the Outer Space Treaty and the Liability Convention. This paper also intends to investigate whether the Liability Convention refers only to direct physical damage resulting from the fall or collision of space objects or whether it also encompasses damage resulting from the malfunctioning of a navigation space object and intangible electromagnetic waves.

II. THE TERM 'SPACE OBJECT' – DEFINITION AND SCOPE

The space segment is the core segment of satellite navigation systems. It consists of artificial satellites launched into space (also known as navigation satellites). The concept of "artificial satellite" is not used in any of the five UN treaties on outer space. The definition of this term first of all can be found in dictionaries or encyclopaedias[17] but also in publications of international lawyers or national

[16] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968; Convention on International Liability for Damage Caused by Space Objects of 1972; Convention on Registration of Objects Launched into Outer Space of 1975; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979.

[17] According to Encyclopaedia Britannica "an artificial satellite" is "artificial object launched into a temporary or permanent orbit around Earth. Spacecraft of this type may be either crewed or uncrewed", https://www.britannica.com/technology/Earth-satellite (accessed 8.02.2023).

space agencies. According to the United States' National Aeronautics and Space Administration (NASA) – a satellite (as defined on its website) is "…a body that orbits around another body in space. There are two different types of satellites – *natural and man-made.* A man-made satellite is a machine that is launched into space and orbits around a body in space".[18]

The legal situation of artificial satellites, including navigation satellites, is determined by their assignment to space objects. Unfortunately, the term "space object" is also not specifically defined in international space law. According Lachs, "the lack of definition of the term "space object" justifies the necessity for the law to follow the development of technology and its achievements".[19] However, as Schmidt-Tedd and Mick rightly point out, "in practice, a common understanding of the term 'space object' exists. Accordingly, a space object is every object that was launched into space in order to explore or use outer space as well as every object that is intended to be launched".[20] Also, Hobe marks that "Space objects may be defined as artificial manmade objects that are brought into space and are designed for use in outer space".[21]

Further clarification of this term is given in Article I(d) of the Liability Convention. It reads that the term "space object" includes its component parts as well as its launch vehicle and parts thereof. It can be assumed that the provision of Article 1(d) constitutes an important interpretative guidance for this term. However, as Chatzipanagiotis and Liperi rightly point out, "[i]t is unclear whether intangible parts of a space object, such as signals, are included".[22]

The general rule of interpretation laid down in Article 31(1) of the Vienna Convention on the Law of Treaties of 1969[23] adopts a textual approach – "a treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose" – on which the UN International Law Commission was unanimous. The International Court of Justice has also emphasised that interpretation is not a matter of revising treaties or of reading into them what they do not expressly or

[18] *What it a satellite?,* NASA, 5.09.2018, https://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/txt_satellite.html (accessed 07.02.2023).

[19] M. Lachs, *Tendencje rozwojowe prawa kosmicznego,* 'Postępy Astronautyki' 1978, No. 3, p. 48.

[20] B. Schmidt-Tedd, S. Mick, *Article VIII*, (in:) S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds), *Cologne Commentary on Space Law,* Cologne 2009, p. 150.

[21] S. Hobe, *Article I*, (in:) S. Hobe, B. Schmidt-Tedd, K.-U. Schrogl (eds), *Cologne Commentary on Space Law,* Cologne 2009, p. 32.

[22] M. Chatzipanagiotis, K. Liperi, *Regulation of Global Navigation Satellite Systems*, (in:), R.S. Jakhu, P.S. Dempsey (eds), *Routledge Handbook of Space Law*, New York 2017, p. 165.

[23] Adopted on 23 May 1969, entered into force on 27 January 1980.

by necessary implication contain,[24] or of applying a rule of interpretation so as to produce a result contrary to the letter or spirit of the treaty's text.[25] According to Oppenhaim's International Law, "[t]he application of the basic rule of interpretation laid down in Article 31 of the Vienna Convention will usually establish a clear and reasonable meaning: if such is the case, there is no occasion to have recourse to other means of interpretation".[26] It should be stressed that terms and regulations contained in the Liability Convention are consistent with and reflect the world practice and technical knowledge of the times in which the Convention was concluded. In fact, only two states (the former Soviet Union and the United States) launched space objects at that time and scientists have only recently started to work on satellite navigation signals,[27] e.g. the American Global Positioning System – the world's most utilized satellite navigation system – became operational only in 1978 and globally available in 1994 (that is after the adoption of the Liability Convention). It would be rather difficult to prove that the member states of the COPUOS Legal Subcommittee and their representatives who were working on the draft of the Liability Convention were going to use the term "component parts as well as its launch vehicle and parts" of a space object in a sense other than the material parts of the object. Furthermore, according to Article 31(3)(b) of the Vienna Convention, "any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation" should be taken under consideration. Meanwhile, consistently with its stance, the US government (as the owner of one of the few fully functioning systems, i.e. GPS) disclaims liability for any damage caused as a consequence of its operation. The US authorities have repeatedly emphasized that civilian users of GPS signals use them voluntarily and free of charge, do not need any permits, and are not dependent on the intermediation of service providers. The open signal means that the providers do not accept any liability for its quality and worn users that they use it at their own risk.

The Cosmos 954 incident[28] (the first instance in the history of space exploration where a claim was made by one sovereign state against another on account of damage caused by a falling space object) has also proved that states engaged

[24] E.g. *Certain Expenses of the United Nations Case*, ICJ Rep (1962), p. 159; *South West Africa Cases*, ICJ Rep (1966), pp. 3, 48. See also: R. Jennings, A. Watts (eds), *Oppenheim's International Law*. 9th edition. Vol. I. Parts 2 to 4, Oxford 2008, p. 1271 ff.

[25] E.g. *Rights of United States Nationals in Morocco Case,* ICJ Rep (1952), pp. 196, 199.

[26] R. Jennings, A. Watts (eds), *op. cit.*, p. 1275.

[27] The first maritime navigation satellite system (NAVSAT, also called TRANSIT) was developed in the USA in 1958 by the Defense Advanced Research Projects Agency (DARPA) and the Applied Physics Laboratory of Johns Hopkins University to provide accurate location information to the US Navy in relation to its ballistic missile submarines. Subsequently, NAVSAT was also used as a navigation system by the US Navy's surface ships.

[28] On 24 January 1978, COSMOS 954, a Soviet nuclear-powered surveillance satellite, crashed in the Northwest Territories. The crash scattered an enormous amount of radioactivity

in space activities differ in the interpretation of terms used in the Liability Convention and in understanding the definitions contained therein. Canada's claim against the Soviet Union for compensation for damages caused by the re-entry and crash in 1978 of the Soviet satellite, Cosmos 954, was based primarily on the Liability Convention.[29] It gave rise to several legal issues concerning the interpretation of this convention, e.g. there were different views about the material scope of the concept of "damage" under Article I(a) of the Liability Convention,[30] although it was obvious that the Soviet satellite fell on to the territory of Canada and caused the immediate damage.

Most authors have no doubts that the Liability Convention applies only to direct physical damage resulting from the fall or collision of space objects and their material parts. According to Kerrest and Smith, "[t]here is no legal presumption as to the size and use of a space object…Whether a space object must be tangible or material is equally relevant. The growth of satellite technology dependent on signals and emissions, notably on the context of satellite navigation services, is a case in point. Liability for electromagnetic waves and laser beams are non-tangibles and their classification as space objects a pending issue"[31].

Although, there are also some authors who consider a broader interpretation of the term "parts of a space object". They suggest that damage caused by the signals (electromagnetic waves) submitted by the satellites is also ruled by the Liability Convention.[32] They rely on the *travaux préparatoires*[33] of the Liability Convention and "the victim-oriented character of the Convention as stated in its preamble".[34] According to Article 32 of the Vienna Convention the preparatory work of the treaty is one of the supplementary means of interpretation and it should be considered together with the circumstances of its conclusion, in order to confirm the meaning resulting from the application of Article 31 or to determine the meaning when the interpretation according to Article 31: (a) leaves the meaning ambiguous or obscure; or (b) leads to a result which is manifestly absurd or

over a 124,000 square kilometre area in Canada's north. The clean-up operation was a coordinated event between the United States and Canada.

[29] Protocol between the Government of Canada and the Government of the Union of Soviet Socialist Republics, Department of External Affairs Communiqué, No. 27, 2 April 1981. The settlement was based on a number of considerations including past lump sum settlements, the desirability of prolonging negotiations, and the various political considerations surrounding the negotiations.

[30] For the purpose of the Convention the term "damage" means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations.

[31] A. Kerrest, L.J. Smith, 2009, *op. cit*., p. 140.

[32] C. Q. Christol, *International Liability for Damage Caused by Space Objects*, 'The American Journal of International Law' 1980, Vol. 74(2), p. 362.

[33] It is the record of the negotiations preceding the conclusion of a treaty. The International Court of Justice has confirmed the usefulness of recourse to them.

[34] M. Chatzipanagiotis, K. Liperi, 2017, *op. cit.*, p. 165.

unreasonable. It seems that possibly Article 31(a) could be raised by those authors who underline that the term "parts of a space object" is "ambiguous".

On the other hand, as Chatzipanagiotis and Liperi note, "[i]n general, satellite signals are not considered products, but a form of service provision. Thus, there would be a case of improper service provision, which is usually a form of contractual liability, often subject to liability limitations and waivers. However, should the user present an extra-contractual claim against the satellite operator, the legal basis could be product liability, by analogy to liability for aeronautical charts".[35] It seems that that "a form of service provision" cannot be regarded as "parts of a space object".

However, in any case the nexus between the damage and the space object or its component parts must be established. Damage related to the operation of global satellite navigation systems can be caused by various reasons, e.g. as a result of the launch of a navigation satellite or satellites into space and their failure or collision with another space object (such accidents may also negatively affect the operation of the entire satellite navigation system). When it comes to damage in orbit it may be very difficult to obtain evidence of its causes, given that proof of fault is needed. The damage may be also due to "inadequacies" of the navigation technology in areas where stringent safety requirements play an important role, such as those in air transport or force majeure (as it has been stated above). A pilot, during the approach to landing and during the landing itself, must have the reliability of the signal guaranteed (i.e., confidence that it is error-free – GPS currently does not provide a sufficient level of reliability). The signal can be also "intercepted" and retransmitted on the same frequency with much greater power (satellite navigation systems are vulnerable to misuse by hostile groups). In such a situation the nexus will be even more difficult to establish.

III. FUTURE LEGISLATION

It should be stressed that, to date, no multilateral international law agreements have been developed which specifically regulate the numerous issues associated with satellite technologies and their applications[36], including satellite navigation.

However, the development of space activities resulted in attempts to regulate primarily the issue of responsibility for actions taken in connection with satellite technologies applications. Unfortunately, the results of these efforts are not satisfactory. The UN General Assembly has adopted sets of rules by way of

[35] *Ibidem,* p. 173.

[36] K. Karski, K. Myszona-Kostrzewa, *Space Activities: Economic and Legal Aspects*, 'Finance India' 2020, Vol. XXXIV, No. 1, p. 62.

resolutions (which are non-binding acts) concerning two specific types of space activities: direct satellite television and remote sensing of the Earth: Resolution 37/92 on Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting of 1982[37] and Resolution 41/65 on Principles Relating to Remote Sensing of the Earth from Outer Space of 1986.[38] They do not include any provisions relating to international liability there.

The crash of Cosmos 954 raised international policy questions. Soon after the satellite's crash, there was a call from the United States to prohibit satellites containing radioactive material from orbiting the earth. This was followed by similar calls from Canada and states in Europe. In November 1978, the UN authorized its COPUOS to set up a working group to study nuclear-powered satellites. The General Assembly adopted Resolution 47/68 on the Principles Relevant to the Use

[37] A/RES/37/92. According to principle F of Resolution 37/92, states should bear international responsibility for activities in the field of international direct television broadcasting by satellite carried out by them or under their jurisdiction and for the conformity of any such activities with the principles set forth in this document. This means that states should consistently bear responsibility for actions in the field of direct satellite television, not only of governmental institutions, but also of non-governmental legal persons (international responsibility for activities carried out in this area by international intergovernmental organizations should be borne both by the organization and by the states participating in it). It is a construction based on Art. VI of the Outer Space Treaty of 1967. The slow pace of work on Resolution 37/92 and the lack of unanimity in adopting it prompted international lawyers dealing with this subject to put forward the thesis that the above resolution has no chance of "becoming the basis for shaping common customary norms" (Z. Galicki, 1991, *op. cit.*, p. 47).

[38] A/RES/41/65. According to the Principle XIV of the Resolution 41/65 states operating remote-sensing satellites shall bear international responsibility for their activities and ensure that such activities are conducted in accordance with the principles contained in this resolution and the norms of international law, irrespective of whether such activities are carried out by governmental or non-governmental entities or through international organizations to which such states are parties. It was also confirmed at the beginning of this principle that it complies with Art. VI of the Outer Space Treaty of 1967, and it was emphasized in its conclusion that it does not prejudge the possibility of applying the norms of international law to the responsibility of states for remote sensing activities. However, it seems significant that immediately after reaching a consensus in the LS as to the content of principle XVI, the USSR delegation interpreted this principle in the spirit of Art. VI of the 1967 Outer Space Agreement recognizing that the state is responsible for all aspects of remote sensing activities. Representatives of Western countries, however, believed that it was unacceptable to transfer the regime of responsibility specified in Art. VI of the space system for typical terrestrial activities. The dispute concerned both the assessment of the scope of the state's responsibility based on Art. VI, as well as the principle of state responsibility itself. Nevertheless, it seems that the importance of this resolution is increased by the fact that it was adopted by *consensus*. It is worth recalling that the issue of responsibility for remote sensing activities was previously regulated at the regional level – in the Convention on the Transfer and Use of Data of the Earth from Outer Space, signed in Moscow on 19 May 1978. A/33/162. Art .VI of the Convention lays down that the Contracting Parties shall bear responsibility for national activities in the use of data of the remote sensing of the Earth from outer space relating to the territories of other Contracting Party.

of Nuclear Power Sources in Outer Space.[39] Its Principle 9, Liability and compensation, imposes the same international liability as that contained in Article VII of the Outer Space Treaty and in the Liability Convention, with a corresponding duty to compensate for damage caused by a space object or its component parts.[40] Although the UN General Assembly Resolution 47/68 does not apply to application of space technologies, it is worth mentioning because also, in relation to satellite navigation, a resolution of the UN General Assembly, including the issue of liability, would provide a proper introduction to further codification activities in this area. Skubiszewski even states that "usually a resolution is more appropriate than a treaty when it's about drawing a line of action. The next step is to implement the procedures in the form of binding legal norms".[41]

At this point, however, it cannot be overlooked that none of the resolutions mentioned above led to the creation of binding norms of international law. In the case of satellite navigation, there is some hope that, unlike other space activities, it has so many applications in various areas that states will have to address the issue of international liability. The above resolutions also indicate the goals that states will try to achieve in possible future legal regulations.

The international community, in search of proposals for legal regulations of space technologies' application may turn to international organizations (such as the UN's specialized agencies) which are interested in the development of GNSS. The UN's specialized agencies are also amongst bodies considered to be capable of preparing detailed legislation on the practical applications of satellite navigation in specific areas, such as air transport or maritime navigation. Such agencies

[39] RES 47/68, adopted with outvote.

[40] *Ibid*., 1. In accordance with Article VII 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, and the provisions of the Convention on International Liability for Damage Caused by Space Objects, each State which launches or procures the launching of a space object and each State from whose territory or facility a space object is launched shall be internationally liable for damage caused by such space objects or their component parts. This fully applies to the case of such a space object carrying a nuclear power source on board. Whenever two or more States jointly launch such a space object, they shall be jointly and severally liable for any damage caused, in accordance with article V of the above-mentioned Convention. 2. The compensation that such States shall be liable to pay under the aforesaid Convention for damage shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf a claim is presented to the condition which would have existed if the damage had not occurred. 3. For the purposes of this principle, compensation shall include reimbursement of the duly substantiated expenses for search, recovery and clean-up operations, including expenses for assistance received from third parties.

[41] K. Skubiszewski, *Non-binding Resolutions and the Law-Making Process*, 'Polish Yearbook of International Law' 1986, Vol. XV, p. 160.

are the International Civil Aviation Organization (ICAO)[42] and the International Maritime Organisation (IMO).[43]

The ICAO' Council establishes international standards and recommends good practices and other guidance applicable to the use of GNSS for civil aviation under Article 37 of the Chicago Convention on International Civil Aviation of 1944.[44] Specific provisions of Articles 15, 22 to 28 of the Chicago Convention may also apply to satellite navigation systems introduced into civil aviation transport. In 1995, the ICAO' Council established the Panel of Legal and Technical Experts on the Establishment of a Legal Framework with Regard to GNSS, which prepared a draft of the Charter on the Rights and Obligations of States Relating to GNSS Services.[45] In 2008, the ICAO's Legal Committee (during its 33rd Session) accepted a draft of a Framework Agreement between the Governments concerning the Implementation, Provision, Operation and Use of a Global Navigation Satellite System for Air Navigation Purposes.

In 1997, also the IMO Assembly adopted Resolution No. A.860(20)[46] defining the IMO's policy towards future global navigation satellite system. This Resolution was replaced by Assembly Resolution A.915(22) of 29 November 2001,[47] which stressed the need to introduce GNSS, under international control, to shipping worldwide. It was also noted that progress in the work carried out by the International Civil Aviation Organization on the requirements for the use of GNSS in air transport was to be monitored. The IMO was granted the right to monitor and control the adaptation of signals processed by users' receivers to operational requirements and was recognized as competent to assess GNSS, in relation to maritime navigation, in terms of the system's compliance with the requirements for positioning equipment. With regard to GNSS devices, a number of resolu-

[42] ICAO is funded and directed by 193 national governments to support their diplomacy and cooperation in air transport as signatory states to the Chicago Convention (1944). Annex 10: Aeronautical Telecommunications to the Chicago Convention on International Civil Aviation of 1944 defines a GNSS as "a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation."

[43] IMO was established in the Convention on the International Maritime Organization signed on 6 March 1948; it came into force on 17 March 1958. Currently, the IMO has 174 Member States and three Associate Members; *Member States, IGOs and NGOs*, IMO, http://www.imo.org/en/About/Membership/Pages/Default.aspx (accessed 10.06.2018).

[44] The Council gives continuing direction to the work of ICAO. In this regard, one of its major duties is to adopt international Standards and Recommended Practices (SARPs) and to incorporate these as Annexes to the Chicago Convention. The Council may also amend existing Annexes as necessary.

[45] The Assembly Resolution A32-19.

[46] Resolution A.860(20) adopted on 27 November 1997, Maritime Policy for a Future Global Navigation Satellite System (GNSS).

[47] Resolution A.915(22) Adopted on 29 November 2001, Revised Maritime Policy and Requirements for a Future Global Navigation Satellite System (GNSS).

tions have been adopted by one of the IMO's committees – the Maritime Safety Committee (MSC)[48] – which deals with all matters related to maritime safety and maritime security involving both passenger ships and all kinds of cargo ships.[49] MSC's Resolution 401(95) (adopted on 8 June 2015) on Performance Standards For Multi-System Shipborne Radio-navigation Receivers[50] recommended that Governments ensure that multi-system shipborne radio-navigation receivers installed on or after 31 December 2017 perform to standards not inferior to those specified in the Annex to the Resolution.

In 2009 the European Space Policy Institute issued a document titled "Policy Aspects of Third Party Liability in Satellite Navigation"[51] in which it was stated that third party liability regime must be based on the principles of strict liability (i.e. it is the duty of the operator to prove that it is not liable) and limited liability (i.e. liability is limited to a predetermined amount) in order to ensure a fair compensation to victims. It can constitute a valuable clue for future work on regulating the international liability for damage caused by satellite navigation signals.

IV. CONCLUSIONS

While at the beginning of the space age, activities in space were associated only with states, the development of space technology applications to a large extent changed this situation.

Satellite navigation systems and their application have become the basis for the functioning of many sectors of the global economy. However, there is still

[48] IMO Assembly Resolution No. A.819(19). Performance Standards for Shipborne Global Positioning System (GPS) Receiver Equipment, 23 November 1995, as amended by MSC Resolution No. 112(73) of 1 December 2001; MSC Resolution No. 53(66) of 30 May 1996. Performance Standards for Shipborne GLONASS Receiver Equipment, as amended by MS. C Resolution No. 113(73) of 1 December 2000; MSC Resolution No. 74(69) of May 12, 1998. Adoption of New and Amended Performance Standards, as amended by MSC Resolution No. 115(73) of 1 December 2000; MSC Resolution No. 64(67), Annex 2, of 4 December 1996, on Recommendation on Performance Standards for Shipborne DGPS and DGLONASS Maritime Radio Beacon Receiver Equipment (Annex 2); as amended by MSC Resolution No. 114(73) of 1 December 2000; MSC Resolution No. 233(82) of 5 December 2006. Adoption of the Performance Standards for Shipborne Galileo Receiver Equipment; MSC Resolution No. 379(93) adopted on 16 May 2014; Adoption of the Performance Standards for Shipborne BeiDou Satellite Navigation System (BDS) Receiver Equipment.

[49] *Maritime Safety Committee*, IMO, https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MSC-Default.aspx (accessed 20.01.2023).

[50] MSC Resolution No. 401(95), Annex 17, of 8 June 2015.

[51] A. Roma, K-U. Schrogl, M. Sanchez Aranzamendi (eds), *Policy Aspects of Third Party Liability in Satellite Navigation*, July 2009, ESPI, https://www.espi.or.at/wp-content/uploads/espidocs/Public%20ESPI%20Reports/espi_report_19.pdf (accessed 14.02.2023).

not an international binding obligation of the GNSS' owners preventing them from limiting or complete shutdown of signals available to civilian users. Indication as beneficiaries of space activities – all countries (the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind) contained in the Outer Space Treaty is not a viable obligation, but rather a general statement. Thus, in the event of discontinuation of the provision of satellite navigation services by their owners, international law does not actually provide the recipients of these services with any effective instrument enabling them to assert their rights. The jamming of the satellite navigation signal, accompanied by a violation of the provisions relating to the frequency band allocated to the states' providers may be considered illegal, but there are no sanctions corresponding to the frequency allocated to them.

It seems that the present regulations of the Outer Space Treaty and the Liability Convention do not apply to satellite navigation and do not cover the damage caused by navigation intangible signals. Unfortunately, it is rather clear that in the near future the international community is not likely to adopt uniform rules on satellite navigation signal liability. It causes great legal uncertainty.

The authors of the document "Policy Aspects of Third Party Liability in Satellite Navigation" rightly point out that "[f]rom the analysis of the premises of the possible solutions concerning the liability deriving from GNSS, it emerges that the proper legal framework for a uniform regime of GNSS TPL is an international convention of uniform law. The need of such instruments is mainly due to the fact that such regime implies mandatory rules and may not depend on acts of private autonomy not being capable: i) to protect victims of incidents in a specific field characterised by a high risk factor, and ii) to introduce an element of certainty in the discipline of compensation of huge damages". The United Nations and its Committee on the Peaceful Uses of Outer Space are the best platform to work on establishing the principles governing the issue of liability for damage caused by malfunctioning of satellite navigation systems and their signals.

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