

UiO : **Det juridiske fakultet**

The International Law on the Use of Force in Outer Space

Candidate number: 206

Submission deadline: 10.11.2023

Number of words: 36 538



Table of contents

1	INTRODUCTION	1
1.1	Subject and research questions	1
1.2	Background and relevance.....	2
1.3	Methodology	4
1.3.1	Sources of international law.....	5
1.3.2	Interpretation of treaties.....	7
1.3.3	Interpretation of customary international law.....	8
1.4	Circumscriptions	9
1.5	Overview of the thesis	10
2	INTERNATIONAL LAW BEYOND ORBIT – SCOPE, SOURCES AND DEFINITIONS	11
2.1	Sources of space law	11
2.1.1	Treaties on the use of outer space	11
2.1.2	Customary law	14
2.1.3	Legal expertise and manuals.....	15
2.1.4	Interpretation of the UN Charter.....	17
2.1.5	Analogies	19
2.2	Scope of space law and other definitions	21
2.2.1	Outer space.....	21
2.2.2	Non-hostile dangers.....	22
2.2.3	Hostile dangers.....	22
2.2.4	Weapons of mass destruction (WMD)	23
2.2.5	Multi-domain military operations	23
2.2.6	Dual-use objects	24
3	MAPPING THE LANDSCAPE – ACTIVITY AND ACTORS IN OUTER SPACE	24
3.1	The use of satellites	24
3.1.1	ISR Satellites.....	25
3.1.2	GNSS	25
3.1.3	SatComs – communication satellites.....	26
3.2	Weapons and weapon systems	26
3.2.1	Kinetic anti-satellite weapons (ASATS)	26
3.2.2	Electronic warfare	27
3.2.3	Laser weapons.....	28

3.3	States and their usage of outer space.....	29
3.3.1	The United States of America.....	29
3.3.2	NATO	30
3.3.3	Russia.....	31
3.3.4	China.....	32
3.3.5	Other states.....	32
4	PARTICULAR ELEMENTS PERTAINING TO REGULATING THE USE OF FORCE IN OUTER SPACE.....	33
4.1	No sovereignty in outer space.....	34
4.2	Jurisdiction in outer space	34
4.3	The use of outer space for “peaceful purposes”.....	36
4.3.1	Diverging interpretations of the term “peaceful purposes”	37
4.3.2	The legality of military installations in outer space	37
4.3.3	Implications for the use of force in self-defense.....	40
4.3.4	Other implications of the principle of peaceful purposes.....	41
5	THE UN CHARTER 2(4) AND THE PROHIBITION OF THE USE OF FORCE IN OUTER SPACE	43
5.1	The UN Charter article 2(4).....	43
5.2	Interpretation of “the use of force”	44
5.3	Scope of the prohibition in outer space	45
5.3.1	Objects in space – analogous to the territory of the state?	46
5.3.2	Commercial satellites	49
5.3.3	Electronic warfare	50
5.4	The lower threshold of the use of force.....	51
5.4.1	Determining the threshold for outer space.....	52
5.4.2	Jamming.....	54
5.4.3	Spoofing.....	56
5.4.4	Laser	56
5.5	Conclusion	57
6	THE UN CHARTER ARTICLE 51 AND THE RIGHT TO SELF-DEFENSE IN OUTER SPACE	58
6.1	The applicability of the right to self-defense in outer space.....	58
6.2	Interpretation of “an armed attack”.....	59
6.3	The threshold of an armed attack in space.....	61
6.3.1	The lower threshold of an armed attack	61
6.3.2	Analogy: ships on the high seas	64

6.3.3	Analogy: cyber operations	65
6.3.4	Accumulation of attacks	66
6.3.5	Hostile intent	67
6.3.6	Anti-satellite weapons	69
6.3.7	Electromagnetic weapons	70
6.3.8	Laser weapons	71
6.4	Permissible self-defense measures in space	71
6.4.1	Geographical scope	72
6.4.2	Necessity	74
6.4.3	Proportionality.....	75
6.4.4	The temporal element	76
6.4.5	Collective self-defense.....	80
6.5	Conclusion	81
7	IS THE REGULATION OF THE USE OF FORCE IN OUTER SPACE FIT FOR PURPOSE?.....	81
7.1	The lack of clarity regarding the “peaceful purposes principle”	82
7.2	The relationship between the satellite and the sending state	84
7.3	The threshold of the use of force and an armed attack.....	85
7.4	The regulation of permissible self-defense measures.....	87
7.5	The environmental ramifications of the use of force in outer space	87
7.6	Is space available to all?	88
	BIBLIOGRAPHY	90

1 Introduction

«In the future whoever has the capability to control space will likewise possess the capability to control the surface of the Earth»¹

US Air Force Chief of Staff General Thomas D. White, 1989

International law regulating the use of force and the right of self-defense was developed for a terrestrial reality, with the intent to allow states to protect their sovereignty and the exclusive rights of their territories.² Outer space is a completely different domain, without sovereignty and territorial claims.³ Nowadays, however, swift technological progress allows a growing number of states to deploy assets in space. An exploration race in search of precious materials is likewise in the making beyond orbit.⁴ Finally, multidomain terrestrial military capabilities increasingly rely on space assets.⁵ In short, space is becoming a crowded domain, filled with mighty competitors and of increasingly military significance. This thesis sets out to explore how international law regulates the use of force and self-defense in space.

1.1 Subject and research questions

In recent decades, space assets have become increasingly important to life on Earth, and the military sector is no exception. Modern militaries rely on space assets for navigation, intelligence, secure communication, and the employment of advanced technological weapon systems and the launch of missiles.⁶ Additionally, counter-space technologies, such as electronic warfare, have become an integral part of many militaries, integrating space in operations both in a defensive and offensive manner.⁷ In spite of decisions taken by major space powers during the Cold War to avoid the militarization of space, the spatial domain is becoming more integrated with other military domains on Earth and is increasingly a military domain in its own right.⁸

This thesis will explore how international law on the use of force applies to state activities in outer space. It will do so by examining three research questions pertaining to international law and military activity in outer space.

¹ US Air Force Chief of Staff General Thomas D. White, quoted in Futrell (1989) p. 550

² Koskenniemi 2017, p. 1368

³ Outer Space Treaty (OST) art. II

⁴ Pandya (2019), Harshberger (2023)

⁵ Schmitt (2006) p. 96, for a definition of “multi-domain”, see chapter 2.2.5

⁶ Jakhu et al. (2020) p. 29

⁷ Secure World Foundation (2023) p. xvi

⁸ Efforts taken to avoid militarization of space: Outer Space Treaty. Evidence of space as a military domain: NATO (NATO’s approach to space) (2022), United Kingdom Ministry of Defence (2022)

The first question is how the general prohibition of the use of force between states stipulated in the UN Charter article 2(4) applies to outer space. To answer this question, I will review the treaties applicable to outer space, and how these may influence the application of the prohibition of the use of force. Then, I will analyze the international regulation on the use of force in light of the nature of military activity in space, and examine to what extent current forms of military activity in this domain may be perceived to amount to the use of force under the UN Charter article 2(4).

The second question deals with the right to self-defense, the most important exception to the prohibition of the use of force. Is there a corresponding right to self-defense in space, and if so, what would constitute an “armed attack” in space, and which measures can be lawfully taken in response? To answer this question Chapter 4 will review whether the treaties regulating the use of outer space allow for forceful actions in self-defense, and Chapter 5 will analyze whether, and how the right to self-defense as enshrined in the UN Charter applies in outer space.

The final question relates to the adequacy of existing international law on the use of force in outer space. I will conduct a *lex ferenda* analysis of international treaties and customary law in view of recent space developments and assess whether the existing regulation is fit for purpose.

In the following, the evolution of the use of outer space and the development of the law regulating outer space are briefly laid out, demonstrating why the subject of this thesis is once again relevant.

1.2 Background and relevance

During the Cold War, the United States and the USSR competed for power and dominance by displaying their technological advancements.⁹ Both superpowers, aiming to attain the upper hand over their competitor, viewed space as the next frontier and considered space dominance a necessity in order to not lose ground, prompting the initiation of the space race.¹⁰

During this time, the United States and the USSR developed significant counter-space capabilities, some of which had nuclear capabilities.¹¹ With the consequences of the Second World War fresh in mind, non-space-faring states feared a nuclear catastrophe should such weapons be employed from or through space. Although the US and the USSR viewed space as a military frontier, states not taking part in the space race saw space as a possible peaceful domain. They

⁹ Jakhu et. Al (2020) p. 23

¹⁰ Jakhu et. Al (2020) p. 23

¹¹ Secure World Foundation (2023) p. xxxvi

wanted space to be free from weapons and military forces, and ideally for space to be available to all nations.¹²

The political effort to control the arms race in space intensified in parallel with both superpowers proving their intercontinental ballistic missile (ICBM) capacity.¹³ In response, the United Nations General Assembly (UNGA) successfully adopted its first resolution containing principles regarding the peaceful use of outer space in 1962.¹⁴ In 1964 two additional resolutions calling on countries to refrain from stationing weapons of mass destruction (WMD) in outer space, and stipulating the right of all states to explore space were adopted.¹⁵

In 1966 the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the Outer Space Treaty), was concluded. The Treaty was opened for signature in January 1967 and entered into force in October the same year.¹⁶ This signified the end of the arms race in outer space. The Treaty also stipulated that outer space would be used for peaceful purposes only.¹⁷ Outer space was to be free from issues relating to territorial disputes, or demonstrations of military might.¹⁸

The increased use of space for civilian purposes over the next decades nevertheless benefitted militaries, as they could utilize commercial technologies for military purposes.¹⁹ Moreover, the focus on commercial interests did not halt the expansion of the military use of outer space. An arms race between the United States and Russia was not considered a danger to the same extent as before, and the threat of a possible nuclear catastrophe was no longer looming over the international community, making military advancements in space seem less threatening. At the outset of this new era, space assets were primarily used in collective self-defense operations or asymmetric warfare against non-state actors. One of the most prominent examples was Operation Desert Storm during the first Gulf War in 1991.²⁰ The operation heavily relied on satellites for ground maneuvers and was coined the first “space war”.²¹

¹² Steinberg (1982) p. 388

¹³ Steinberg (1982) p. 388

¹⁴ UN General Assembly (1962)

¹⁵ UN General Assembly A/RES/1884, (1964) para 1-2, UN General Assembly A/RES/1962 (1964) para 1

¹⁶ The Outer Space Treaty (OST) as available on treaties.un.org

¹⁷ OST art. I, II, IX, preamble

¹⁸ OST art. I, II, IX, preamble

¹⁹ Steinberg (1982) p. 388

²⁰ See, for example, LTG Dodgen (2004)

²¹ Snyman (2015) p. 489, Vergun (2021)

Since then, there has been an increase in the weaponization and militarization of outer space. This is, in part, due to the fact that many states view it as a necessity to protect their assets in space from adversaries.²² In recent years, a significant shift has occurred on the global stage, characterized by a renewed great power competition involving China, Russia, and the United States. This competition has led some to describe the situation as a tripolar or multipolar world. Notably, this rivalry is highly pronounced in outer space, where the great powers' quest for dominance has increasingly adopted a more militarized dimension.²³

Space is also becoming more crowded. Although Russia, China, and the United States have considerable spatial assets, other states are increasing their investments in military space technology. As a result, space is no longer reserved for a minority of powerful states. Today, nearly 70 different nations are involved in space operations, and several are developing counter-space capabilities.²⁴ Additionally, multinational corporations, such as Starlink, have become prominent actors in space, creating new elements to consider when analyzing the law pertaining to the use of force in outer space.²⁵

Consequently, space today is not used exclusively for peaceful purposes. This new reality gives rise to numerous questions about the applicability of international law in space. The agreed point of departure is that international law applies to outer space.²⁶ However, the principles and rules of international law were made for an earthly reality, where territory and sovereignty are key components in how the rules on the use of force have been shaped and interpreted. International law on the use of force was not created with the realities of the space domain in mind. This is reflected in diverging state practice and a variety of different opinions among states, and here lies the subject matter of this thesis.²⁷ How do the rules regulating the use of force apply in space? The specific focus of the thesis is the prohibition of the use of force in the UN Charter article 2(4) and the right to self-defense in article 51.

1.3 Methodology

This thesis is written in the discipline of international law. It therefore relies on a strict methodological approach to international legal sources and methods of interpretation, presented in the following. The object of the thesis is to establish the international legal rules as they are

²² Jakhu et. Al (2020) p. 30, Vergun (2023), Ministry of Defence of the Russian Federation (2023), NATO Brussels Summit Communiqué (2022) para 33

²³ Congressional Research Service (2020) p. 15, Congressional Research Service (2023) p. 5, 22, 35, 42, Secure World Foundation (2023) p. xvii-xxii

²⁴ Dooley (2023)

²⁵ Birkeland (2022)

²⁶ OST art. III, UN General Assembly (1962) para 1(a)

²⁷ University of Adelaide (Woomera Manual) (2023)

perceived to be by states, the *lex lata* of the international law on the use of force in space. The last chapter deviates to some extent from this, offering an assessment and opening up to considerations about how the international law on the use of force ought to be, the *lex ferenda* perspective.

To the extent that the thesis refers to factual descriptions of the military development of states, it relies on publications by state organs, and authoritative and declassified descriptions, and reports available to the public. It also relies on press publications and a variety of academic publications on the subject. Most states do not make public the extent of their military capabilities in the space domain, due to the classified nature of military, and particularly counterspace capabilities. Especially, information regarding electronic warfare and blinding laser weapons has been difficult to gather. States are also reluctant to share how attacks from electronic weapons affect their militaries.²⁸ As a result, there has been limited information available.

An important source for the description of the military capacity of states has been the report created by the Secure World Foundation. The Secure World Foundation has created annual reports for the last five years of global counter-space capabilities. The foundation works with governments, the space industry, and international organizations to achieve a sustainable and peaceful use of outer space. The report is an open-source assessment.²⁹

The footnotes adhere to the Chicago Manual of Style, as directed by the faculty of law at the University of Oslo.³⁰ This citation style is minimal and differs from the usual citation style found in international law papers. To ensure clarity regarding the sources used, I've included supplementary information in the footnotes where needed.

1.3.1 Sources of international law

The sources of international law are identified by article 38(1) of the Statute of the International Court of Justice (ICJ). These are “international conventions, [...] international custom, as evidence of a general practice accepted as law”, and “the general principles of law recognized by civilized nations.” Additionally, “judicial decisions and the teachings of the most highly qualified publicists” are recognized as “subsidiary means for the determination of rules of law.” Article 38(1) is recognized as customary law and therefore has general application.³¹

²⁸ Secure World Foundation (2023) p. xxxiii, 01-18, 01-21

²⁹ Secure World Foundation (2023)

³⁰ University of Oslo, Universitetsbiblioteket (2023)

³¹ Shaw (2021) p. 59, Crawford et. al (2019) p. 19

A treaty is “an international agreement concluded between States in written form and governed by international law”.³² Treaties may also be concluded between international organizations and states.³³ Due to the fact that there are no independent law-making bodies, treaties are the most important method by which states create legal obligations with a more immediate effect than that of customary international law.³⁴ International conventions or treaties only impose obligations between the states party to the treaty.³⁵ This is due to the principle of sovereignty, where states are independent and equal, and their territorial integrity and political independence are inviolable.³⁶ In other words, a state cannot be bound to a treaty it is not party to. It can, however, be bound by a provision of a treaty if the content is considered to be declaratory of customary international law.³⁷

International custom, or international customary law, has both an objective and subjective element. The objective being that the rule is commonly accepted as evidenced by state practice, and the subjective being that the rule is regarded as binding by states (*opinio juris*).³⁸ Customary international law is binding on all states, save for customs with geographical limitations, or for states that are considered “persistent objectors”.³⁹ Customary law is often expressed in documents such as judgments by the ICJ, press releases, official manuals on legal questions, executive decisions, national rules of engagement, comments by governments on drafts by the International Law Commission (ILC), and reports by the ILC.⁴⁰

Judicial decisions and legal theory are subsidiary in nature as they often point to, or analyze primary sources of law, but they do not create new obligations.⁴¹ The sources may, however, influence the development of the law, be useful tools for the interpretation of primary sources, and provide evidence of customary international law.⁴²

³² VCLT art. 2(1) a)

³³ Aust et. Al (2023) para. 8, Note: Treaties between states and international organizations are regulated by the Vienna Convention on the Law of Treaties between States and International Organizations or between International Organizations (1986) (‘VCLT-IO’)

³⁴ Evans (2018) p. 91, 138

³⁵ The Vienna Convention on the Law of Treaties (VCLT) art. 34, Evans (2018) p. 91

³⁶ Besson (2011)

³⁷ ILC (2018) Conclusion 11

³⁸ Crawford et. Al (2019) p. 22-25

³⁹ Crawford et. Al (2019) p. 26

⁴⁰ Crawford et. Al (2019) p. 21-22

⁴¹ Evans (2018) p. 98-99

⁴² Evans (2018) p. 98-99

Although there is no formal hierarchy between the primary sources of law, the UN Charter takes precedence should the obligations under the Charter conflict with an obligation from any other treaty or international agreement.⁴³

1.3.2 Interpretation of treaties

The Vienna Convention on the Law of Treaties (VCLT) is the primary source for the interpretation of treaties. The Treaty's provisions regarding the interpretation of treaties are regarded as customary international law and thus are binding on all states, regardless of their ratification status.⁴⁴

According to VCLT Article 31(1), treaties “shall be interpreted in good faith in accordance with the ordinary meaning to be given to the treaty in their context and in the light of its object and purpose”. Interpreting treaties in accordance with the text and its purpose is of particular importance, as it is the treaty text the States have agreed on. The text itself is, therefore, better suited to determine the interpretation of a term, rather than “an investigation *ab initio* of the supposed intention of the parties.”⁴⁵ Hence, the interpretation of the wording of the treaty is to be given considerable weight. In some cases, the treaty makers choose a term that allows for an evolutive interpretation; thus, the wording creates a presumption for a dynamic interpretation of the term.⁴⁶

The interpretation of the wording is to be viewed in the treaty's context in light of the treaty's object and purpose.⁴⁷ Article 31 (2) specifies that the context of the treaty is comprised of agreements or instruments made by parties “in connection with the conclusion of the treaty,” in addition to the text, its preamble, and annexes. Furthermore, it is stated that subsequent agreements relating to the interpretation of the treaty, subsequent state practice, and rules of international law should be considered when interpreting the treaty.⁴⁸

The preamble of a treaty is regarded as an important source for interpreting the treaty because not only does it give light to the context of the treaty, it may also provide insight into its object and purpose. However, preambles do not create a binding legal effect upon the parties. They are generally formulated and not meant to establish substantive rules.⁴⁹

⁴³ UN Charter, Article 103

⁴⁴ ILC (2013) Conclusion 1

⁴⁵ ILC (1966) p. 223

⁴⁶ Ruys (2011) p. 21

⁴⁷ VCLT art. 31 (2)

⁴⁸ VCLT, article 31 (3)

⁴⁹ Mbengue (2006) para 11

According to article 31(3) litra c, “any relevant rules of international law applicable in the relations between the parties» shall also be taken into account in the interpretation of the treaty. “Any relevant rules” may also be customary law. The ILC has elaborated on this in their commentaries to the draft of the VCLT, stating that when the exact meaning of the treaty rule is difficult to establish, the recognized meaning in customary international law can be considered.⁵⁰

The VCLT lists preparatory works and circumstances of conclusion as “supplementary means of interpretation”.⁵¹ Preparatory works may be used to determine the meaning of the text in cases where other means of interpretation “leave[s] the meaning ambiguous” or lead to an unreasonable result.⁵² However, in their comments on the VCLT, the ILC clarified that preparatory works may also confirm the conclusions made about the “ordinary meaning of the text.”⁵³

1.3.3 Interpretation of customary international law

The starting point for determining the scope and content of customary law is the wording of the text, but contrary to the interpretation of treaties, the text is not as important. Other sources of international law, such as state practice, are equally important when establishing the scope of the rule.⁵⁴

For a rule of customary law to be established, the practice among states must be constant and uniform. It is not necessary that all states have adhered to the practice, but the uniformity must be substantial, with a degree of “generality” For the *opinio juris* element to be satisfied, the states have to follow the practice out of a sense of obligation, it is not sufficient that they do so out of practicality, or other motivations.⁵⁵

Opinio Juris, often ascertained through state expressions, occasionally necessitates the examination of the absence of states’ expressions, for example, in order to determine whether something is considered to be in breach of the rule. However, the determination of state *opinio juris*

⁵⁰ ILC (2004) para 347.

⁵¹ VCLT art. 32

⁵² VCLT art. 32 (a), (b)

⁵³ ILC (1966) p. 233

⁵⁴ ICJ North Sea Continental Shelf (1969) para 73

⁵⁵ Shaw (2021) p. 71

predicated upon the non-invocation of a particular legal principle, particularly in matters concerning the use of force, presents inherent complexities. States may choose silence as a strategic measure to mitigate tensions, or for other politico-strategic considerations.⁵⁶

In the areas of *jus ad bellum* and *jus in bello*, disparities exist between states' perceptions of the law and their actual conduct. In contrast to other areas of international law where breaches may lead to a modification of customary rules, within the domain of *jus ad bellum*, instances of state behavior deviating from established norms are viewed as violations, consequently reinforcing the notion that the rule remains in effect.⁵⁷

Elements such as the influence of “specially affected states”, must be determined according to the concrete area of the law. Hence, concrete aspects of the establishment of a rule of customary law will be discussed in Chapter 2, where international law in outer space will be examined.

1.4 Circumscriptions

The focus of this master is the prohibition and legality of the use of force in space. The treatment is limited to the material rules applicable to space. Questions related to responsibility for wrongful acts (state responsibility or individual responsibility), or issues that arise concerning attribution of wrongful acts will not be discussed. Although the space domain is becoming increasingly available to non-state actors, it is still mainly dominated by States and commercial actors. Consequently, complex questions arising from the use of force by non-state actors in space will not be treated.⁵⁸

The United States has announced plans to create a permanent base on the moon by 2025.⁵⁹ Although this may have implications for possible future military uses of outer space, this thesis will not examine the implications of colonization of celestial bodies for the question of the use of force in space.

Space operations are often dependent on cyberspace.⁶⁰ Space technologies are therefore vulnerable to cyberattacks.⁶¹ This may result in an overlap between the use of force in the space domain and the cyber domain. Therefore, there are frequent arguments that cyberattacks should be considered a part of *jus ad bellum* in space. However, the use of force in the cyber domain poses questions in and of itself and has been subject to many discussions. Conversely, other

⁵⁶ Ruys (2014) pp. 168-170

⁵⁷ Hellestveit et. Al (2020) p. 53

⁵⁸ Steer et al. (2021) p. 29, Snyman (2015) p. 501

⁵⁹ Hollingham (2023)

⁶⁰ Robinson (2021) p. 235

⁶¹ Snyman (2015) p. 501

types of weapons that directly target space assets have not received as much attention in these discussions. Therefore, this thesis will focus on weapons and issues primarily related to space and exclude discussions about the use of force in the cyber domain. However, it may be valuable to draw analogies from the cyber domain. This will be explored in 5.4, and 6.3.

1.5 Overview of the thesis

The use of force in outer space gives rise to rather unique legal challenges. This is reflected in the format and structure chosen for this thesis.

Chapter 2, titled “International Law Beyond Orbit – Scope, Sources, and Definitions” will present the sources and methodology of international law of the use of force. It will discuss some of the specific sources of the law of space and selected methodological challenges that arise for the general sources of international law when applied to the space domain.

Given the novelty and uncommon characteristics of both state infrastructure and the military utilization of outer space, chapter 3 called “Mapping the Landscape – Activity, and Actors in Outer Space” will provide an overview of current military uses of outer space. The section will place particular emphasis on the roles of satellites, the crucial military equipment, and weaponry designed for space, and will also provide a summary of states' assets and their stances on the deployment of weapons in outer space. The objective is to shed light on state practice and the potential ramifications the use of selected types of counter-space weapons may have. Part 3.2 and 3.3 will provide an overview of the depository of weapons of states in space, thereby establishing the factual premises for the subsequent discussion on the application of the use of force.

Chapter 4 will address the rules applicable to the use of force in space. It will start by analyzing the rules under the special regime stipulated in legally binding treaties applicable to space. It will then, in chapter 5, look at the scope of applicability to space of the general prohibition of the use of force in the UN Charter 2(4), and analyze the different positions taken on this question by states and legal authorities. Since all armed attacks inherently involve the use of force.⁶² I will examine the use of force prior to the question of self-defense. This subsequent discussion of armed attacks in space will build upon the foundation laid by the earlier exploration of force in the space domain.

Chapter 6 will look into one of the exceptions to the prohibition of the use of force, namely the right to self-defense codified in the UN Charter article 51. It will address the question of the scope of applicability of article 51 to space and analyze the current state of international law in

⁶² Tallinn Manual (2017) p. 333, para 8, Ruys (2014) p. 163

terms of state practice and *opinio juris* with respect to “armed attack” in space giving rise to the right of self-defense.

Chapter 7 will offer a *lex ferenda* analysis of the law regulating the use of force in outer space, based on the arguments, premises, and conclusions reached in the previous chapters. This chapter will also serve as a conclusion, with a final assessment of the adequacy of the state of international law on the use of force in this new technological era when space is becoming an integral part of our world, in peace and in war alike.

2 International Law Beyond Orbit – Scope, Sources and Definitions

2.1 Sources of space law

2.1.1 Treaties on the use of outer space

The treaty law regulating the use of outer space was created during and in the aftermath of the first space race, from the late 1950ies to the 1980ies. There have been subsequent attempts at creating new treaties, but none have resulted in binding treaty law.⁶³ Thus, there has been considerable technological progress and increased reliance on assets in space since the treaty law was created.

There are five treaties that regulate the use of outer space. The Outer Space Treaty (OST) provides the regulatory framework for the use of outer space. It has 110 state parties, including all the main space-faring nations, and another 89 states are signatories.⁶⁴ The Treaty contains principles relating to jurisdiction and liability.⁶⁵ Several of the provisions are, however, general in nature. Apart from rules regarding celestial bodies, and the placing of weapons of mass destruction in orbit, it contains no general rules regarding the use of force or the right to self-defense.⁶⁶ The interpretation of the treaty is nevertheless important when analyzing the regulatory framework for the use of force in outer space as it establishes principles regulating the conduct of states in this domain.

The other four treaties are the Rescue Agreement, the Liability Convention, The Registration Convention, and the Moon Treaty. The Rescue Agreement concerns the status of Astronauts and the obligation to aid astronauts.⁶⁷ Though important, it has little relevance in establishing

⁶³ For example, the Treaty to Prevent the Deployment of Weapons in Outer Space (PPWT) (2008)

⁶⁴ OST, as available on un.treaties.org

⁶⁵ OST art. VII, VIII

⁶⁶ OST art. IV, VI

⁶⁷ Rescue Agreement

rules relating to the use of force in outer space.⁶⁸ On the other hand, the Liability Convention and the Registration Convention may provide insight into the responsibility of States, and the administration of the use of outer space. Nevertheless, these treaties do not contain provisions that clarify the legal framework for the use of outer space for military purposes. The Liability Convention establishes that the launching states of space objects are liable for their space objects, and the damage they may create on the surface of the Earth, during aircraft, and in space.⁶⁹ The Registration Convention creates the obligation for states to register all objects launched into space.⁷⁰

Lastly, the Moon Treaty establishes that the moon and celestial bodies should be used exclusively for peaceful purposes and provides principles relating to the treatment of the environment of these bodies.⁷¹ This obligation could entail that any use of force on these bodies is prohibited, but the treaty only has eighteen parties, and none of these, apart from France, have considerable assets in outer space.⁷² The treaty's significance on the legal framework applicable to space must therefore be considered inconsequential.

The International Telecommunications Union (ITU) is the specialized agency of the UN which deals with information and communication technologies.⁷³ The ITU and its convention applies to the conduct of member states in space in so far it concerns radio services or communications. The constitution of the union forbids harmful interference with another country's radio installations, which will come into play with regards to several kinds of electronic warfare.⁷⁴ This will be discussed further in the subsequent chapter. However, the convention permits military radio installations.⁷⁵ It does not contain provisions relating to the use of force.

Another convention that expressly includes the use of outer space is the Environmental Modification Convention (ENMOD). The Treaty entered into force on the 5th of October 1978. It has 78 state parties, including the main space-faring nations.⁷⁶ The convention prohibits military or other hostile use of environmental modification techniques.⁷⁷ This might limit the available

⁶⁸ Rescue Agreement

⁶⁹ Liability Convention

⁷⁰ Registration Convention

⁷¹ Moon Agreement

⁷² Moon Agreement, as available on un.treaties.org

⁷³ International Telecommunications Union, itu.int (2023)

⁷⁴ ITU Convention art. 45, Secure World Foundation (2023) p. 01-17-18, Bamford et. Al (2021) p. 24-25 See the discussion of jamming and spoofing in chapter 3.2.2

⁷⁵ ITU Convention article 48 (1)

⁷⁶ United Nations Office for Disarmament Affairs (2023)

⁷⁷ United Nations Office for Disarmament Affairs (2023)

self-defense measures a state might take, and will therefore be relevant to the following analysis.

The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) is the principal multilateral body for the development of international space law. It was created by the General Assembly in 1958 and was key in developing the five space treaties.⁷⁸ The committee is tasked with identifying areas for international cooperation research on matters relating to the use of outer space and studying legal problems arising from such use.⁷⁹ Over time, as the number of members of the committee has grown, its impact has haltered. The committee appears to be deadlocked in the matter of decision making.⁸⁰

In 1988 the General Assembly passed a resolution containing the principles relating to the Prevention of an Arms Race in Outer Space (PAROS). The resolution reaffirmed the principles adopted in the OST and encourages a ban on the weaponization of space. The goal was to create a treaty with this obligation, but no such treaty has been created, and the resolution established no normative obligation for the UN member states.⁸¹

Several states and international organizations have attempted to create treaties to fill the lacunae of regulation relating to the military use of outer space, but none have entered into force. Some of the most noteworthy attempts were the propositions by Russia and China to the UN Conference on Disarmament. Russia and China have submitted three different drafts of a Proposal for a Treaty to Prevent the Deployment of Weapons in Outer Space (PPTW).⁸² The third draft treaty, submitted in 2014, was opposed by several states, and most strongly by the United States. It was opposed because it did not include a compliance verification, not defining what constitutes a weapon in outer space, and only regulated weapons placed into orbit, therefore omitting to mention anti-satellite weapons.⁸³

In 2019 the General Assembly established a Group of Governmental Experts (GGE) on the Prevention of an Arms Race in Outer Space tasked with discussing the possibility of a treaty, based on the PPTW.⁸⁴ The United States also opposed the creation of the GGE, as it would commence immediately on an international legally-binding instrument without first promoting

⁷⁸ Unoosa.org Committee on the Peaceful Uses of Outer Space (2023)

⁷⁹ Unoosa.org Committee on the Peaceful Uses of Outer Space (2023)

⁸⁰ Steer (2020) p. 736

⁸¹ Henderson (2020) p. 101

⁸² Moteshtar (2019) p. 11-12

⁸³ Mosteshtar (2019) p. 13, Wood (2017)

⁸⁴ Moteshtar (2019) p. 12

discussions on transparency and confidence-building measures.⁸⁵ The Group has yet to propose a treaty.

The European Union has created a proposal for an international Space Code of Conduct which goes further than the Outer Space Treaty in regulating the use of force in outer space. The draft has been used as a basis for negotiations open to all states. The goal of the treaty was to build a foundation for norms for space activities, and it is not legally binding.⁸⁶

In sum, the existing legal framework for outer space provides no general rules pertaining to the use of force or militarization of outer space. As of now, there is no established international customary law regarding the use of force in space, nor any judicial decisions relating to the use of force in space.

Given the lack of a legal framework on the use of force adjusted to the specific nature of space, the question arises about analogies from other fields with structural similarities to space. Analogies are addressed in 2.1.3.

2.1.2 Customary law

The doctrine of specially affected states

Determining the weight of different state practices is an important part of establishing a rule of customary international law. Due to the fact that the use of outer space for military purposes is a relatively new phenomenon, there is limited state practice, and a select few states have a longer history, and decidedly larger assets in space. The doctrine of “specially affected states” should therefore be given consideration when determining the existence and content of customary international law in outer space.

The doctrine of “specially affected states” originates from the North Sea Continental Shelf Case where the ICJ stated that the role of “States whose interests were specially affected” should be given weight.⁸⁷ The doctrine has since been criticized for giving a disproportionate role to dominant states in the formation of international law.⁸⁸ The ICJ has not provided further comments regarding the doctrine, but in the ILC’s commentary on the formation of customary international law, the commission concluded that “[d]ue regard should be given to the practice of ‘States whose interests [are] specially affected’, where such States may be identified”.⁸⁹ The

⁸⁵ Aho (2022)

⁸⁶ Johnson (2014)

⁸⁷ ICJ North Continental Shelf (1969) para 73

⁸⁸ Evans (2018) p. 95

⁸⁹ Wood (2018) para 54

special rapporteur clarified the meaning of this in his fifth report on the identification of customary international law, stating that “it does not imply that one only looks at the practice of specially affected states [...]; it simply means that their practice had to be taken into account.”⁹⁰

In outer space, countries possessing the most assets, such as the United States, Russia, and China, would be “specially affected”. Specifically, the practices of the United States and Russia hold significant importance due to their extensive history, in contrast to other states that have more recently entered the space domain. Nevertheless, all states possessing assets in space or depending on space assets could be considered as being particularly affected, as the regulations concerning the use of force in outer space will have a direct impact on their assets.

It is important to highlight that a limited number of states and organizations (such as the above-mentioned states, NATO, France, and the UK) have been notably outspoken in their interpretation of the Outer Space Treaty and in matters related to the general regulation of outer space.⁹¹ Since much of the information regarding the use of outer space and counter-space weapons is not accessible to the general public, one must rely on these statements to discern the applicable laws and regulations.

2.1.3 Legal expertise and manuals

Teachings of the most highly qualified publicists, or legal theory, are alongside judicial decisions a secondary source of law.⁹² Due to the lack of treaty regulation and clear customary law, considerations made by academics may bear more weight, as they may offer insights and analysis of state practice. Some legal theory regarding *jus ad bellum* in outer space also tries to analyze the lacunae in the law in order to encourage treaty-making.

Additionally, the lack of regulation has inspired attempts at collecting rules based on state practice, and general agreement among states. The manuals are intended as a starting point for a discussion of legal problems when it is unlikely that a treaty concerning the matter will be adopted. The manuals represent a collection of state practice with analysis by legal experts.⁹³ Such manuals have been created for both the cyber domain and for space. When there are few established customary rules, and no treaties in the areas of the military use of outer space and cyber warfare, general agreement among states and state practice should be given considerable weight. Insofar as the manuals represent such practice, they should be weighted accordingly in the analysis of the regulation.

⁹⁰ Wood (2018) para 70

⁹¹ See for example, NATO Brussels Summit Communiqué (2022) para 33, The French Ministry for the Armed Forces (2019), The United Kingdom Ministry of Defence (2022) p. 19

⁹² ICJ Statute art. 31 (1) d

⁹³ CCDCOE (2023), McGill (MILAMOS) (2023)

McGill University started the Milamos project, creating a Manual on International Law Applicable to Military uses of Outer Space. Their goal was to “develop a widely accepted manual clarifying the fundamental rules applicable to the military use of outer space in time of peace, including challenges to peace”⁹⁴ The project has published its first volume, containing the collected rules, and is currently developing its second volume, which will include commentaries.⁹⁵

There is an ongoing parallel project to develop a manual on international law applicable to military operations in outer space. The project, called Woomera, was started by the University of Adelaide and it seeks to develop a manual similar to the Tallinn Manual. It aims to cover “international laws applicable to military space operations, both during peacetime and during armed conflict.”⁹⁶ The project is said to be completed by the end of 2023.⁹⁷

The NATO Cooperative Cyber Defence Centre of Excellence (CCDCOE) created the Tallinn Manual which sought to analyze the existing rules and regulations in the area. It is an academic, non-binding study examining how international law regulates cyber warfare. Since its publication, it has become influential in the treatment of cyberattacks and may bring light to issues regarding the use of electronic warfare. In addition to a summary of rules on cyber-attacks, the manual’s second version includes commentaries by a group of experts that elaborate on the regulatory framework.⁹⁸ The CCDCOE are currently revising the Manual in order to create a third version.⁹⁹

The editors of the McGill Manual are Professor Steven Freeland and Professor Jakhu Ram.¹⁰⁰ Both are considered authorities on outer space law concerning the legalities of war. Professor Jakhu Ram has been awarded the “Distinguished Service Award” from the International Institute of Space Law for “his contribution to the development of space law.”¹⁰¹ Steven Freeland has been asked to advise several governments on space policies and has been party to the Space Law Committee of the London-based International Law Association and a member of the Space Law Committee.¹⁰²

⁹⁴ McGill (MILAMOS) (2023)

⁹⁵ McGill (MILAMOS) (2023)

⁹⁶ University of Adelaide (Woomera Manual) (2023)

⁹⁷ University of Adelaide (Woomera Manual) (2023)

⁹⁸ CCDCOE (2023)

⁹⁹ CCDCOE (2023)

¹⁰⁰ McGill Manual (2022) p. 7-8

¹⁰¹ McGill Manual (2022) p. 7

¹⁰² McGill Manual (2022) p. 8 Western Sydney University (2018)

Three of the experts on the Woomera Manual with considerable contributions to the academic discourse around the use of force in outer space are professor Michael N. Schmitt, professor Dale Stephens and professor Cassandra Steer. Professor Schmitt is an expert in the area of jus in bello (and more broadly on the international law on the use of force) and was one of the editors of the Tallinn Manual. He also served in the United States Air Force.¹⁰³ Professor Stephens is a professor at the University of Adelaide and a captain in the Royal Australian Navy Reserve.¹⁰⁴ Professor Steer is the Deputy Director of the Australian National University Institute for Space, with a focus on Mission Specialists.¹⁰⁵

The experts on space law generally agree on the most substantive parts of the regulation. Since the regulation of the use of force in outer space is still in the making, many scholars focus on highlighting the issues relevant to the development of the area of law. As the Woomera Manual has not yet been published, it is not yet ascertained whether the conclusions reached by the experts will be different from those of the McGill Manual.

However, there are disagreements regarding the interpretation of the general prohibition of the use of force and its exceptions. The disagreements concern the scope of the prohibition, particularly whether there exists a threshold for the use of force, and whether this threshold is lower than that of an armed attack.¹⁰⁶ These disagreements permeate the rules regarding the use of force. They will be discussed when necessary for the examination of jus ad bellum in space, but will not be subject to an in-depth examination, as this goes beyond the scope of the thesis.

2.1.4 Interpretation of the UN Charter

The Charter of the United Nations contains general rules pertaining to the prohibition of the use of force and its exceptions.¹⁰⁷ The Charter establishes basic norms binding on its states, and therefore many of its provisions do not detail the exact scope of the rule given. Moreover, as the charter was adopted in 1946, the world order and international law look decidedly different now compared to the situation 77 years ago. In turn, the rules will apply to situations that were non-existent at the time of the adoption. This is the case for the military use of outer space.

As the late Thomas Franck aptly put it, the UN Charter constitutes a “living, growing” system of rules—rules that are capable of adapting to the needs of the international community pursuant

¹⁰³ Harvard Law School (2023)

¹⁰⁴ University of Adelaide, Researchers (2023)

¹⁰⁵ Australian National University (2023)

¹⁰⁶ See for example Ruys (2014)

¹⁰⁷ UN Charter art. 2(4), Chapter VII

to the evolution of customary practice”.¹⁰⁸ As a result, both a dynamic interpretation of the wording of the Charter, as well as interpretation supplemented by customary law is important in establishing the exact content and scope. Additionally, the UN has organs tasked with the interpretation of the Charter, and organs that may give light to state practice. Therefore, in the interpretation of the Charter, the decisions of ICJ, resolutions by the General Assembly, and the Security Council are noteworthy sources for the interpretation of the prohibition of the use of force.

The UN Charter gives the ICJ responsibility for the interpretation of the charter, as the principal judicial organ of the UN.¹⁰⁹ Due to this, when using their judgments and opinions for the interpretation of the treaty text, there is no difference in weight between judgments and advisory opinions. The court has passed judgments in three cases and two advisory opinions relating to the use of force, namely, the Nicaragua case, the Oil Platforms case, the Armed Activities case, The Nuclear Weapons Case, and the Wall case.¹¹⁰

It is important to note that the judgment in the Oil Platforms case regarding the use of force was an obiter dictum. Obiter dicta are statements that are statements not directed to the principal matters in the case.¹¹¹ It is relevant to separate obiter dicta from ratio decidendi, which are statements about the law necessary to decide the issue before the court in order to establish the scope of the precedent.¹¹² However, in international law, there are no established rules relating to precedents, and as the ICJ is the principal judicial organ of the UN, even their obiter dicta statements should be considered. In Judge Fitzmaurice’s separate opinion in the Barcelona Traction Case, he remarked that obiter dicta statements by the ICJ should not be underestimated, as judicial pronouncements are “the principal method by which the law can find some concrete measure of clarification and development”.¹¹³

General Assembly resolutions are considered recommendations and thus are not binding for the members of the United Nations. However, they express the opinion of member states and must be adopted by a majority vote.¹¹⁴

¹⁰⁸ Ruys (2014) p. 163

¹⁰⁹ UN Charter art. 92

¹¹⁰ Delerue (2020) p. 279

¹¹¹ Brownlie (2003) p. 42

¹¹² Brownlie (2003) p. 42

¹¹³ ICJ Barcelona Traction, Judge Fitzmaurice’s separate Opinion (1970) p. 65 para 2

¹¹⁴ Un.org (2023)

Resolutions by the Security Council, on the other hand, are binding on all member states. The council has the “primary responsibility for the maintenance of international peace and security”, and determines existing threats to peace, providing insight into the assessment of international conflicts.¹¹⁵

Lastly, the General Assembly has established the International Law Commission, which shall “initiate studies and make recommendations for the purpose of ... encouraging the progressive development of international law and its codification”.¹¹⁶ Their interpretation of the charter and relevant rules to the Charter bears weight where the law is unclear or when the General Assembly, Security Council, and the ICJ disagrees or are silent on the matter.

2.1.5 Analogies

Due to the fact that outer space is characterized by the lack of sovereignty and territorial claims, the general rules relating to the use of force do not necessarily account for the particular scenarios of the use of force in outer space. Moreover, several of the weapons used in spatial warfare, such as electromagnetic weapons, are untraditional weapons that have not been subject to any practice yet. Therefore, the use of analogies to similar situations may provide a baseline for the discussions regarding the particularities of outer space. The use of analogies in law refers to the use of a rule covering a particular case on another similar case, but which is not itself regulated by the rule. It is based on the principle that similar cases should be ruled in a similar way and is an important part of closing lacunae in law.¹¹⁷

This thesis will draw on sources from two adjacent areas of international law. The first is regulation relating to ships and vessels, and particularly ships and vessels in the high seas. According to the United Nations Convention of the Law of the Sea (UNCLOS) article 87, the high seas “are open to all states”, and no state may “subject any part of the high seas to its sovereignty”. The situation regarding sovereignty and state territory is therefore similar to that of outer space. The main sources of law regulating the use of force against ships on the high seas are the UNCLOS, the Newport Manual, the ICJ’s judgments in the Oil Platforms Case, and the PCIJ’s judgment in the Lotus Case.¹¹⁸

It is important to note that the Lotus case dealt with a question of national criminal jurisdiction of states and did not relate to the use of force. The case revolved around a collision between

¹¹⁵ UN Charter art. 24

¹¹⁶ Legal.un.org (2023)

¹¹⁷ Vöneky (2008) para 1-6

¹¹⁸ Newport Manual (2023), UNCLOS, ICJ Oil Platforms (2003), PCIJ Lotus (1927)

two vessels, the French steamship S.S. Lotus, and the Turkish steamship Bozkurt, in the high seas. The French ship's officers were arrested and charged with manslaughter by Turkish authorities. The question before the court was whether Turkey had the jurisdiction to prosecute the French officers for actions that occurred on the high seas.¹¹⁹ However, it continues to be referenced in jus ad bellum discussions as it is regarded as confirming the principle that a ship on the high seas is considered an extension of the territory of the state whose flag it bears.¹²⁰

The Newport Manual on the Law of Naval Warfare is an attempt to compile the law of naval warfare. It is not regarded as customary law itself but provides one authoritative overview of the interpretation of the law as it is. It is published by the Stockton Center of International Law at the US Naval War Academy. It offers commentaries on the rules that elaborate on the interpretation of the rules of war at sea.¹²¹ Another manual on naval warfare is The San Remo Manual on International Law Applicable to Armed Conflicts at Sea. This manual is regarded as an expression of customary law, and therefore originally bore more weight than the Newport Manual.¹²² However, several of the provisions in the San Remo Manual are considered to be outdated, and it is currently being revised.¹²³ The Newport Manual offers a more updated compilation of the rules regarding naval warfare; hence it is the manual used in the following. It is important to note that there are diverging views among scholars and states on some of the rules regarding the use of force at sea. The Newport Manual refers to the diverging views but does not seek to provide an answer to the discussions.¹²⁴

Due to the similarities between cyber warfare and other non-kinetic warfare, such as electromagnetic warfare, the regulation regarding cyber operations will be useful in interpreting the use of force in outer space. Given that cyber operations frequently focus on assets that support intangible infrastructure, the principles and factors of cyber warfare may offer valuable perspectives when assessing the implications and categorization of attacks on satellites.¹²⁵ No binding treaties or international judicial practices relating to the use of force in the cyber domain are yet available. However, an increasing body of state practice, opinion juris, and legal theory concerning the rules regulating the use of force in cyberspace is emerging. The Tallinn Manual on cyber operations and its commentaries are important sources of law in this area. The Tallinn

¹¹⁹ PCIJ Lotus (1927)

¹²⁰ See for example Dörr (2019) para 23

¹²¹ Newport Manual (2023) p. xiii

¹²² International Institute of Humanitarian Law (iihl) (2023)

¹²³ Steele (2020)

¹²⁴ Newport Manual (2023) p. xiii

¹²⁵ Geiss et. Al (2021) pp. 1, 2, 7, 16

Manual and its commentaries often provide insight into space law, as they discuss cyber-operations in space.¹²⁶

Although analogies are valuable in the analysis of the law regulating the use of force in outer space, they are not necessarily fit to answer the questions. They may not address all the questions regarding the use of force in outer space. There may be lacunae in the law, or outer space may necessitate alternative approaches to address the regulation of force in this domain.

When analogies are relied on in the following, the differences between the analogies used and the situation in outer space will be addressed when relevant.

In conclusion, analogies from the rules regulating the use of force in other adjacent domains may bring light to lacunae or issues regarding the use of force in outer space.

2.2 Scope of space law and other definitions

In order to circumscribe the scope of space law, it is imperative to establish a clear definition of space itself. Additionally, other terms pertinent to the comprehension of space law will be defined in the following. Notably, certain terms may assume distinct interpretations within the context of outer space, underscoring the need for their clarification.

2.2.1 Outer space

The airspace above a state is a part of the territory of the state, but the territory of the state ends where outer space begins due to the fundamental principle of non-sovereignty in space law.¹²⁷ The rules regarding the use of force will therefore look decidedly different in outer space compared to rules applicable in the airspace of states. These boundaries define where the airspace above a state, regarded as a part of their territory, ends and where outer space begins.

There is no uniform agreement as to where outer space begins. The most common delimitation is known as the Kármán Line, which is situated 80-100 kilometers above sea level. The Kármán line is used by several states and organizations, such as the Fédération Aéronautique Internationale.¹²⁸ Another suggested delimitation is that outer space begins where ordinary planes can

¹²⁶ Tallinn Manual (2017)

¹²⁷ OST art. II

¹²⁸ Idrovo Romo (2020) p. 339

no longer operate. This definition may prove to be difficult to retain as there is no clear description of “ordinary planes”, and as aircraft technology continues to improve, the line may shift.¹²⁹ This thesis relies on the Kármán Line definition.¹³⁰

2.2.2 Non-hostile dangers

When objects in space are destroyed or collide, they create space debris, which causes a danger to the other objects stationed in orbit, as colliding space debris can damage satellites, and may have harmful effects on the spatial environment.¹³¹ Understanding what space debris is, and how it is classified is therefore valuable to understanding the effects kinetic attacks on a satellite may have.

The Outer Space Treaty does not define space debris, nor does any other legally binding instrument. However, in 2007 the Inter-Agency Space Debris Coordination Committee (IADC) submitted a draft containing, inter alia, a suggested definition of space debris, to the UNCOPOUS scientific and technical Subcommittee. The subcommittee elaborated on the draft, which was later adopted by the General Assembly. The adopted resolution defined space debris as “all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional». ¹³² In the following, this is the interpretation that will be used.

2.2.3 Hostile dangers

International law and international humanitarian law have focused on defining and prohibiting weapons of a particular nature, instead of defining the term “weapon”.¹³³ The International Committee of the Red Cross (ICRC) has, however, provided a definition. This has been done to define the concept of a “means or method of warfare” in the context of armed conflicts, which is crucial because International Humanitarian Law (IHL) imposes significant restrictions and prohibitions on such means and methods.¹³⁴ In the context of jus ad bellum, the definition is valuable because it helps identify actions or methods that can be considered a use of force.

According to this definition a weapon is “any item of equipment supplied by States or armed groups to their armed forces or members so that in an armed conflict they can take violent action against the enemy.”¹³⁵

¹²⁹ Idrovo Romo (2020) p. 339

¹³⁰ Most scientists and scholars rely on the Karman Line, see NASA (2019), COPOUS (2022) p. 3

¹³¹ As illustrated by the Russian ASAT test, Amos (2021)

¹³² Froehlich (2018) p. 74-75

¹³³ For example the Convention on the Prohibition of Anti-Personnel Mines and The Convention on Certain Conventional Weapons

¹³⁴ For example, AP I, and II

¹³⁵ ICRC (2023)

The ICRC definition encompasses non-kinetic weapons and highlights the effect of the weapon employed. This is in line with the acceptance of biological and chemical agents as weapons, and the growing acceptance of certain malware as cyber weapons. In the context of outer space, such a definition entails that electromagnetic and laser equipment may be regarded as weapons, despite their non-kinetic character. Thus, it is the definition that will be used in this paper.

In the space domain weapons based on the ICRC definition includes Earth-based weapons designed to target space assets, and space-based weapons designed to attack targets in space. Furthermore, it includes space-based weapons designed to attack targets on Earth, as well as earth-to-earth-via-space such as intercontinental ballistic missiles.¹³⁶

2.2.4 Weapons of mass destruction (WMD)

The Outer Space Treaty contains specific regulations for the use of weapons of mass destruction in outer space. The definitions and regulations for WMDs are primarily established through international treaties and agreements. This category includes nuclear weapons, and chemical and biological weapons.¹³⁷

However, The Commission of Conventional Armaments, established by the Security Council has established a broader definition, in order to encompass potential weapons that have not yet been invented. They defined WMD as “atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above”.¹³⁸ This was reiterated by the UNGA resolution in 1977.¹³⁹

2.2.5 Multi-domain military operations

The concept of multi-domain operations was first introduced by the United States Army in 2018.¹⁴⁰ It was originally referred to as an “air-land-battle”. It has since been adopted as a concept by several states and organizations, such as NATO. The term “domain” replaced the term “battle” and refers to what originally was considered battlefields.¹⁴¹ “Multi-domain” refers to an operation that includes an offensive or defensive in several, or all domains and environments.

¹³⁶ Pope (2021) p. 266

¹³⁷ Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Treaty on the Prohibition of Nuclear Weapons (TPNW), The Biological Weapons Convention (BWC) and the Chemical Weapons Convention (CWC).

¹³⁸ United Nations Security Council (1947)

¹³⁹ UN General Assembly (1977)

¹⁴⁰ Lieutenant-Colonel Leon (2021) p. 92

¹⁴¹ Lieutenant-Colonel Leon (2021) p. 92

Hence the use of one domain in order to assist an operation in another domain will not constitute a multi-domain operation.¹⁴² NATO recognizes five operational domains, land, air, maritime, cyber, and space.¹⁴³ In recent years, some countries have discussed the existence of a sixth domain, namely the “information domain”.¹⁴⁴ The number of operational domains, whether five or six, is not a key concern for this paper, as it will predominantly focus on the space and terrestrial domains, and not deal with questions relating to the information domain.

2.2.6 Dual-use objects

The term dual-use may have multiple meanings under international law. At the core is the idea that an object or a technology can be used for both civilian and military purposes. An important functional definition stems from the principle of distinction in international humanitarian law (IHL). IHL forbids the direct targeting of civilian objects – only military objectives can be directly targeted.¹⁴⁵ Military objectives are those objects which «by their nature, location, purpose or use make an effective contribution to military action and whose partial or total destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage». ¹⁴⁶ When a civilian object is used for military purposes, it takes on a *dual-use function*, and may hence lose immunity from direct attack. The majority of satellites currently in orbit are civilian or dual-use.

When there is no situation to which IHL applies, targeting rules of IHL do not apply to the use of force. For the sake of simplicity, this thesis will rely on the premise that a dual-use object is a lawful military objective when the use of force is involved.

3 Mapping the Landscape – Activity and Actors in Outer Space

3.1 The use of satellites

The use of satellites to collect raw data about the earth has increased both for civilian and military purposes in the last decades. Modern military operations are reliant on accurate satellite imagery and communications. The three main satellite functions indispensable to modern militaries are intelligence, reconnaissance, and surveillance satellites (ISR), Global Navigation Satellite systems (GNSS), and communication satellites.¹⁴⁷ The military function of these satellites is primarily to support operations at the terrestrial level. It is essential to remember that they

¹⁴² NATO (Multi-Domain Operations) (2023)

¹⁴³ NATO (Multi-Domain Operations) (2023)

¹⁴⁴ See for example Sgts. Maj. Aguilastratt et al. (2022)

¹⁴⁵ AP I Art. 48, 52(2), see also CIHL Rule 7,

¹⁴⁶ AP I Art. 52 see also CIHL Rule 8,

¹⁴⁷ Schmitt (2006) p. 96

also hold significance for civilian infrastructure. This means that infrastructure critical for both military and civilian purposes may be damaged if a state were to employ force towards it.

3.1.1 ISR Satellites

ISR systems collect and process imagery in order to provide both battle and situational awareness, inter alia monitoring enemy movement. Intelligence is the gathering of information, surveillance is the sustained observation of larger areas, and reconnaissance is the gathering of intelligence for a specific target for a specific time.¹⁴⁸ Thus, these satellites are crucial both for immediate operational support and tactical planning. In the last decade, ISR satellites have evolved to be used for immediate intelligence for rapid response.¹⁴⁹ Rapid response is important both for humanitarian relief, inter alia, a civilian purpose, and for rapid response military maneuvers. Militaries are reliant on purchasing data because the majority of satellites that provide imaging are owned by private, commercial entities, thus many satellites are dual-use.¹⁵⁰ The commercial uses of satellite imagery are important for weather forecasting and environmental monitoring.¹⁵¹ Hence, they are important for preventative measures in environmental disasters.

3.1.2 GNSS

GNSS stands for global navigation satellite system and provides positioning, navigation, and timing data through signals from a constellation of satellites. This data is received by GNSS receivers on Earth that use the data either for position, navigation, or timing.¹⁵² Positioning and navigation are used to determine the actual or desired location and to document position and orientation. The service of timing is used for essential systems for civilian infrastructure, such as mobile communication, the supply of electricity, financial systems, and weather radars.¹⁵³ Therefore incapacitating this would have huge effects for civilian infrastructure. The United Kingdom has estimated that a loss of GNSS signals for five days would result in an impact of 5.2 billion pounds.¹⁵⁴

¹⁴⁸ Taverney (2022)

¹⁴⁹ Taverney (2022)

¹⁵⁰ Taverney (2022)

¹⁵¹ U.S Department of Commerce (2022)

¹⁵² U.S Department of Transportation (2017)

¹⁵³ U.S Department of Transportation (2017), Bamford et. Al (2021) p. 26

¹⁵⁴ London Economics (2017)

The two main GNSS systems used are GPS, provided by the United States, and GLONASS provided by Russia.¹⁵⁵ The Chinese State has also developed its own GNSS system called Beidou.¹⁵⁶ The GPS system is the most prevalent and is used by NATO, including Norway.¹⁵⁷

The GPS satellites provide two services, one standard positioning service, available for civilian purposes, and a precise position service, only available to the US military and its allies. The latter supplies a more robust and encrypted signal with better protection from jamming.¹⁵⁸ The use of GPS has allowed military forces to rely on satellite signals instead of compasses, which is particularly useful at night.¹⁵⁹ Satellite navigation also allows the planning and tracking of convoys when rescuing injured soldiers which has reduced the response time.¹⁶⁰

3.1.3 SatComs – communication satellites

Communication satellites are used for both civilian and military purposes. Modern military communications rely on protected satellite communications (SatComs), with anti-jamming capabilities and nuclear disaster survivability. Military SatCom systems provide means of communication that have a low probability of detection, interference, and interception.¹⁶¹ The rapid technological evolution inflicts the speed of the development of communication satellites in the space industry. As an example – Norway has recently started a research program to provide a nanosatellite for military tactical communication in the Arctic.¹⁶²

3.2 Weapons and weapon systems

Due to the important functions of satellites, states have come to recognize that their assets in space needs to be protected. As a result, weapons have been developed in order to protect their assets in space, and to launch offensive attacks.¹⁶³ These weapons will be described in the following.

3.2.1 Kinetic anti-satellite weapons (ASATS)

One of the most destructive counter-space weapons that have been developed are kinetic ASATs, created to destroy or inhibit the functioning of satellites. Kinetic ASATs destroy or

¹⁵⁵ Navipedia, GMV, (2011), Navipedia, GMV, (2011)

¹⁵⁶ GPS.gov (2023)

¹⁵⁷ Lumiste, (2023)

¹⁵⁸ Navipedia GMV (2011)

¹⁵⁹ Navidpedia, GMV, (2011)

¹⁶⁰ Navipedia GMV (2011)

¹⁶¹ Wang et. Al (2021) p. 1-2

¹⁶² FFI (2020)

¹⁶³ Secure World Foundation (2023) p. xvi

damage the satellite by colliding at a very high velocity.¹⁶⁴ Kinetic ASATs can be co-orbital or direct ascent. Co-orbital ASATs are placed into orbit, to approach the target to attack it. Direct ascent kinetic ASATs are missiles launched from the ground, air, or sea.¹⁶⁵

Although the majority of states do not possess specific kinetic ASAT weapons, several have midcourse missile defense systems, developed to protect against long-range and intercontinental ballistic missiles. Because these missiles travel at a speed and an altitude comparable to satellites in LEO, missile defense systems are capable of being used as anti-satellite weapons.¹⁶⁶

Kinetic ASAT weapons have not yet been used in any armed conflicts according to open sources, but several states have displayed their ASAT capabilities.¹⁶⁷ There is therefore a probability that such use may take place in the future.¹⁶⁸

3.2.2 Electronic warfare

Electronic warfare is “weapons that use radiofrequency energy to interfere with or jam the communications to or from satellites”¹⁶⁹. Interference through jamming overwhelms the signal either directly from the satellite or the signal the users receive. The jammer uses a more powerful signal which overrides the original signal.¹⁷⁰ Jamming has become more sophisticated in recent years. “Smart-jamming” is designed specifically for the signal it is aimed at disrupting.¹⁷¹

Jamming can be both uplink and downlink. Uplink jamming targets the satellite directly and makes the signal the satellite supplies indecipherable. The impact of the jamming is widespread, affecting all users within the area of the targeted satellite. Downlink jamming does not target the satellite itself but disrupts the ground signal for the users in a specific area.¹⁷²

Both jamming and the use of lasers are often called *non-kinetic* ASAT weapons, as they are designed to inhibit the functioning of satellites.¹⁷³ Jamming is temporary. However, a Russian

¹⁶⁴ Blatt (2020) p. 30-32

¹⁶⁵ Steer et. Al (2021) p. 28

¹⁶⁶ Secure World Foundation (2022) p. 01-10

¹⁶⁷ For example, Russia: Amos (2021), The United States: Steer Et al. (2021) P. 27, India: Secure World Foundation (2023) p. xxii

¹⁶⁸ Secure World Foundation (2023) p. xvi

¹⁶⁹ Secure World Foundation (2023) p. 01-17-18

¹⁷⁰ Bamford et. Al (2021) p. 24-25

¹⁷¹ Bamford et. Al (2021) p. 25

¹⁷² Secure World Foundation (2023) p. 01-17-18

¹⁷³ Schreiber (2022) p. 168

military official has stated that Russia is developing a jammer that may cause permanent damage to communication systems reliant on satellites.¹⁷⁴

Spoofing is another form of electronic warfare. It is similar to jamming, but instead of making the signal indecipherable, it overrides the signal with a new, false signal.¹⁷⁵ Spoofing and jamming are often produced with the same equipment. The original signals are corrupted, and new, false signals are introduced.¹⁷⁶ During the course of the last years, several countries have been the victim of spoofing of automatic identification systems at sea (AIS). The system is used by most large ships: The signals are received by all ships near AIS base stations, as well as satellites and surveillance services. The ships may be displayed as appearing in a different place than their actual position or the ships may be given false positions causing them to navigate towards an undesired location.¹⁷⁷

Electromagnetic weapons target the service supplied by the satellite in the form of satellite signals, and like kinetic ASAT weapons, the effects of an attack will impact services on the terrestrial level.¹⁷⁸ Both spoofing and jamming can be conducted in a defensive manner in order to protect and ensure a state's use of the electromagnetic environment.¹⁷⁹

In an article in the Norwegian Military Journal, Norwegian military experts on electromagnetic warfare have classified the use of electronic warfare into five categories; non-intentional operations, operations with intentional lack of regard, signaling, political pressure, and preparation of the battlefield.¹⁸⁰ The categories are listed in ascending order to their level of severity. The category of "preparation of the battlefield" is described as acts done in order to weaken the enemy before the outbreak of an armed conflict. None of the categories are described as reaching the threshold of the use of force.¹⁸¹

3.2.3 Laser weapons

Laser weapons use concentrated beams of electromagnetic waves to either dazzle or damage the satellite bus or subsystems. They can be both ground-based and space-based.¹⁸² "Dazzling"

¹⁷⁴ Hendrickx (2020) p. 2

¹⁷⁵ Bamford et. Al (2021) p. 25

¹⁷⁶ Bamford et al (2021) p. 26

¹⁷⁷ Lied (2021)

¹⁷⁸ Secure World Foundation (2023) p. 01-17, Bamford et. Al (2021) p. 26

¹⁷⁹ Bamford et. Al (2021) p. 32

¹⁸⁰ Bamford et. Al (2021) p. 28

¹⁸¹ Bamford et. Al (2021) p. 28-29

¹⁸² Secure World Foundation (2023) p. 01-23

refers to when the laser impinges on the sensor detector array of the satellite, resulting in obscuring parts of the image the satellite provides. The damage is temporary but may affect an abundant amount of images, and therefore damaging the images provided by the satellite for a period of time.¹⁸³ Laser dazzling might serve as a defensive countermeasure to safeguard particular ground facilities from being visually captured by optical methods.¹⁸⁴

Laser weapons may also damage the image sensor of the laser, which will permanently damage a few pixels in the array indefinitely. This may be done intentionally, but it may also happen accidentally when the goal is to dazzle the satellite.¹⁸⁵ Lastly, very high-power lasers may cause damage to the satellite bus which will lead to a complete failure of the satellite.¹⁸⁶

3.3 States and their usage of outer space

The utilization of outer space by states is undergoing rapid changes, indicating the potential for further developments in this domain. Furthermore, the outer space domain is characterized by a multitude of actors, and a significant amount of information remains classified. The subsequent sections will provide a description of the most important states and prominent features in this context.

3.3.1 The United States of America

The United States has maintained its military dominance of space since the beginning of the space race, and as of 2021, there were 1,327 US-owned satellites in orbit. In 2019, the US created a space force, as a separate and individual branch of the military tasked with organizing training and equipping “space warfighters to maintain and enhance military advantage in space.”¹⁸⁷ The purpose of the space force is in line with the current general ideology of US presence in space – space is a warfighting domain, which needs offensive space control.¹⁸⁸

The United States has held that the right of self-defense extends to outer space, and that “purposeful interference with space systems, including supporting infrastructure, will be considered

¹⁸³ Secure World Foundation (2023) p. 01-23

¹⁸⁴ Secure World Foundation (2023) p. 01-23

¹⁸⁵ Secure World Foundation (2023) p. 01-24

¹⁸⁶ Secure World Foundation (2022) p. 01-23

¹⁸⁷ La Bella (2021) p. 757

¹⁸⁸ Secure World Foundation (2023) p. 01-35, Summary of the National Defense Strategy (2018) p. 6

an infringement of our sovereign rights.”¹⁸⁹ The US asserts that any such interference will warrant a response by the US, and the response will be “at a time, place, manner, and domain of our choosing.”¹⁹⁰

In 2008 the United States proved its ASAT capability by destroying a US satellite, that was said to be malfunctioning, with the explanation of avoidance of environmental damage.¹⁹¹ The United States has operational midcourse missile defense interceptors and has developed dedicated direct ascent ASATs in the past and possesses the ability to do so in the future.¹⁹² There is evidence that the US has nuclear-tipped ASAT weapons.¹⁹³ The Americans also possess technology that could lead to co-orbital ASAT capability.

3.3.2 NATO

NATO is not a subject in international law in the same way states are. The organization is a gathering of states. The stance and actions of NATO may therefore seem to reflect the opinion of a number of states.

NATO adopted a space policy in 2019, where the alliance recognized space as “a new operational domain alongside air, land, maritime and cyberspace”¹⁹⁴ The organization regards space as critical for their activities and states that their member’s space systems could be affected “even in cases where NATO is not involved in the conflict.”¹⁹⁵ More than half of the satellites in orbit are owned by members of NATO, but the organization maintains that their members retain jurisdiction over their own space assets.¹⁹⁶

At the 2021 Brussel Summit, the Alliance stated that space attacks could lead to an invocation of Article 5.¹⁹⁷ Article 5 of the NATO agreement states that “any armed attack on a NATO member in Europe or North America shall be considered an attack against them all”¹⁹⁸, meaning that attacks on space assets will be regarded in the same manner as terrestrial attacks under the treaty. Apart from specifying where such an attack may take place, the treaty does not further

¹⁸⁹ Department of Defence Directive (1999) p. 3

¹⁹⁰ National Security Strategy (NSS) (2017) p. 31, reiterated in JP 3-14, Space Operations (2020) p. I-1

¹⁹¹ Steer Et al. (2021) P. 27

¹⁹² Secure World Foundation (2023) p. 01-10

¹⁹³ Secure World Foundation (2023) p. xvii

¹⁹⁴ NATO (NATOS approach to space) (2022)

¹⁹⁵ NATO Space Policy (2022)

¹⁹⁶ NATO Space Policy (2022)

¹⁹⁷ NATO Brussels Summit Communiqué (2022) para 33

¹⁹⁸ North Atlantic Treaty Article 5

clarify what is regarded as an “armed attack”. Rather, article 5 makes reference to the UN Charter Article 51, indicating that the term “armed attack” refers to the same term as in the Charter.¹⁹⁹ This approach suggests that NATO takes the position that the rules of self-defense as expressed in the UN charter apply to outer space.

3.3.3 Russia

By the late 2010s Russia had regained its position as the second most powerful space nation. However, due to the economic sanctions imposed on the country following the Crimea-annexation in 2014 and the aggression against Ukraine in 2022, Russia is struggling to maintain its position of power in space.²⁰⁰ In 2021, Russia proved that it possesses direct ascent ASAT capabilities by destroying one of her own satellites.²⁰¹ The destruction of the satellite caused a massive field of space debris, which forced members of the International Space Station (ISS) to take shelter, as the debris intersected with the orbit of the station.²⁰² Russia has tested technologies that could lead or support potential co-orbital ASAT technology in both LEO and GEO. Russia is also developing laser systems and alleges that it has mobile, ground-based laser dazzlers.²⁰³

There are indications that Russia has enhanced its military control by employing electronic weapons for safeguarding their assets and disrupting potential threats. There have been reports that the Russian military has relied on these systems in the war against Ukraine, and in 2018 Russia allegedly disrupted GPS signals over northern Scandinavia during NATO’s exercise Trident Juncture.²⁰⁴

Russia's stance on the use of outer space is marked by conflicting statements. On one hand, Russia has promoted the peaceful utilization of outer space and supported the Prevention of Placement of Weapons in Outer Space (PPWT). However, more recently, Russia has declared that commercial space infrastructure "can become a legitimate target for retaliation."²⁰⁵ Moreover, Russian activities have increasingly focused on treating space as a military domain, leading Western states to interpret this as a declaration that Russia views outer space as a military domain.²⁰⁶

¹⁹⁹ North Atlantic Treaty Article 5, 6

²⁰⁰ Tarantola (2023)

²⁰¹ Schreiber (2022) p. 163

²⁰² Amos (2021)

²⁰³ CSIS (2023) p. 12-15

²⁰⁴ Secure World Foundation (2022) p. 02-23, Robinson (2021) p. 233

²⁰⁵ Roulette (2022)

²⁰⁶ U.S Space Command Public Affairs Office (2021), Aho (2022)

3.3.4 China

China has advocated for the peaceful use of outer space and has thus far not actively used counter-space capabilities in its military operations. Unofficially, however, China has increased investments into counterspace capabilities. China recognizes space as a military domain and has expressed a goal of achieving space superiority through military operations.²⁰⁷ There is evidence that China has doubled its number of satellites between 2019 and 2021, and according to the estimates by the American Center for Strategic and International Studies, China is the second most capable space nation.²⁰⁸ The United States estimates that China might surpass the U.S. as a space leader by 2045.

In 2007 China conducted a successful direct ascent ASAT test. The ASAT took down one of its aging weather satellites, creating a substantial number of debris.²⁰⁹ They have a “Strategic Support Force” (SSF), tasked with cyber and outer space, within the People’s Liberation Army.²¹⁰ China’s laser and electronic warfare capabilities are largely classified, but there is some evidence that the Chinese possess such technology, in addition to directed energy weapons, and they have combined glider and FOB technology with nuclear capabilities.²¹¹

3.3.5 Other states

Several other states have developed significant space and counter-space capabilities. France has stated that the state has the ambition to become the third largest military space power. France is currently developing remote sensing, electronic intelligence gathering, and communications satellites. The French have established a space command and announced that they wish to develop “space machine guns and lasers” to counter cyber-attacks.²¹² France views space as “an essential domain” for its armed forces.²¹³

As of now, India is the only country apart from China, Russia, and the U.S. that has proved their ASAT capabilities.²¹⁴ Australia has established a military space command, and Iran, the EU, North Korea, and South Korea are developing their counter-space capabilities.²¹⁵

²⁰⁷ Secure World Foundation (2023) p. xxii

²⁰⁸ CSIS (2023) p. 11

²⁰⁹ Steer et. Al (2021) p. 27

²¹⁰ CSIS (2023) p. 9

²¹¹ Secure World Foundation (2022) p. xvii-wviii, Zastrow (2021)

²¹² Secure World Foundation (2023) p. xxiii

²¹³ The French Ministry for the Armed Forces (2019) p. 13

²¹⁴ Secure World Foundation (2023) p. xxii

²¹⁵ Secure World Foundation (2023) chapter 08-12, and p. 07-02-07-03

The Gulf States have entered their own space race, but Saudi Arabia and the United Arab Emirates both stress the peaceful use of outer space and the peaceful uses of space industries.²¹⁶

The global landscape is witnessing a growing number of states actively advancing their space-related capabilities. In parallel, an increasing number of states are allocating resources and efforts to develop counter-space weapons, which collectively fuel a rising trend of militarization in outer space.

4 Particular Elements Pertaining to Regulating the Use of Force in Outer Space

There is general agreement among states and scholars that the UN Charter and the prohibition of the use of force apply in outer space.²¹⁷ Yet, the application is far from straightforward. As Manfred Lachs, former president of the ICJ, has stated, not all international law automatically extends to outer space. Parts of international law, including chapters of the UN Charter, apply to specific environments, and therefore will not have general application in outer space. Other rules will have general application, thus applying to outer space, but there is a need for modification to fit into the domain of outer space.²¹⁸

The prohibition of the use of force in article 2 (4) might be in need of such modifications. The prohibition was created at a time when space was beyond the reach of states and humankind, and the realities of such a potential theatre of war were not conceivable. Because of this, there are several aspects of the use of outer space which makes the prohibition hard to implement. Firstly, there is no national territory or sovereignty in space, meaning it is not possible to directly use force towards the territory of a state. The purpose of the UN Charter is to protect the sovereign rights of states and prevent the use of military force between them. The desire to prohibit the use of force stemmed partly from the fact that Earth no longer had unclaimed states, and military force towards another state's territory would be destabilizing.²¹⁹ The point of departure in space is the reverse – the basic point of departure is a principle of non-sovereignty. This basic structural difference has the consequence that the application of rights and prohibitions stemming from the UN charter and other terrestrial custom is complicated.

²¹⁶ United Arab Emirates Space Agency (2016), Saudi Space Agency (2023)

²¹⁷ See for example, McGill Manual rule 109, Tallinn Manual p. 273, UN General Assembly (1962 para 1(a))

²¹⁸ MA Xinmin (2014) p. 11

²¹⁹ Koskenniemi (2017) p. 1368

Secondly, the damage or disruption of a satellite or satellite signal will most likely not directly lead to the loss of life, instead, it will disrupt the functioning of services on Earth.²²⁰ Additionally, uses of force in space that create space debris have the possibility to impair objects in space that were not the original target of the attack.²²¹

The consequence is that important elements in the rules of international law on the use of force as developed and applied inside of orbit cannot simply be extended to outer space. In the following, these elements are presented and discussed, before delving into an analysis of the scope of applicability and content in space of the prohibition of the use of force in UN Charter 2(4) and its exception of self-defense as stipulated in the UN Charter article 51.

4.1 No sovereignty in outer space

The Outer Space Treaty, Article II stipulates that “outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” Rules regarding state sovereignty will therefore not be applicable in outer space. The Article was adopted to avoid the possibility of conflict stemming from territorial disputes or colonizing ambitions.²²² The principle of non-sovereignty is fundamental in space law and has thus far not been successfully disputed.²²³

4.2 Jurisdiction in outer space

As there is no sovereignty in outer space, the regulation of national jurisdiction over assets in space becomes the starting point for determining the relationship between the sending state and assets in space. It is particularly relevant to establish whether the sending state has a relationship with both governmental and non-governmental assets in space. It is necessary to ascertain such a connection in order to determine whether uses of force against spatial infrastructure will correspond to a use of force against the sending state, and by extension whether an armed attack against such assets will give rise to the right to self-defense.²²⁴

According to Article VIII of the OST, the states of registration “retains jurisdiction and control” over objects, and over any personnel they launch into space, “while in outer space or on a celestial body». The article does not specify whether such jurisdiction applies to both governmen-

²²⁰ Bamford et. Al (2021) p. 24-25

²²¹ Pope (2021) p. 265

²²² Freeland (2011) p. 78

²²³ Freeland (2011) p. 78

²²⁴ The need for such a connection is discussed in chapter 5.3

tal and commercial objects. It must therefore be interpreted in the light of the context and purpose of the treaty.²²⁵ Additionally, Article VII, asserts that the state from which the object is launched is “internationally liable for damage to another state party”²²⁶. The liability applies to any damage created on Earth, in air, or in outer space. Such responsibility, authorization, supervision, and liability are in line with the retention of jurisdiction of the objects.

“Relevant rules of international law” applicable between the state parties may be taken into account in the interpretation of the treaty.²²⁷ The jurisdiction of the OST applies to “a state [...] on whose registry an object is launched”, thus the Registration Convention brings light to what objects must be registered. According to the registration convention states are obliged to register space objects “by means of an entry in an appropriate registry.”²²⁸ The Registration Convention does not limit the obligation to register objects to governmental objects but applies to all objects launched from “the territory or facility” of the state.²²⁹ This reinforces the view that the jurisdiction of the state (under OST) also extends to non-governmental entities. The UN General Assembly has adopted a resolution in support of this view, asserting that states “should ascertain national jurisdiction over space activities carried out from territory under its jurisdiction/ and or control.”²³⁰

However, according to Article VI of the Treaty, State Parties bear international responsibility, including continued authorization and supervision of “national activities” in space. The responsibility extends to both governmental and non-governmental entities.²³¹ The wording indicates that states are not responsible for non-national activities. The question is therefore whether the non-governmental entity should operate on behalf of the state in order to be encompassed by the article. This depends on the interpretation of the term “national activities”.

The treaty does not provide a definition of the term, but the UNGA in its resolution stated that the national jurisdiction for space activities carried out from the territory of the state comes from taking into account “obligations as a launching State and as a State responsible for national activities in outer space.”²³² Although the resolution explicitly addresses the scope of activities subject to a state's jurisdiction, some authors interpret this as a delineation of what constitutes

²²⁵ VCLT art. 31 (1)

²²⁶ OST art. VII

²²⁷ VCLT art. 31 (3) litra c

²²⁸ Registration Convention art. II

²²⁹ Registration Convention art. I (ii)

²³⁰ UN General Assembly (2013)

²³¹ OST art. VI

²³² UN General Assembly (2013) para 2

"national" activities. This interpretation is also reinforced by various national space laws, which signify that the perspective is supported by "general practice accepted as law".²³³

The resolution further states that a state's obligation for authorization and supervision applies to space activities carried out by citizens or legal persons established or registered in their territory. This interpretation also garners support from state practice, as evidenced by the provisions within their respective national space laws. Therefore, "national activities" is interpreted as referring to activities undertaken from a state's territory or by individuals or legal entities based within the state's territory. Hence, the definition is broad and does not limit itself to activities of a certain character.

The Registration Convention and the Outer Space Treaty establish a clear connection between the sending state and the object in outer space, through jurisdiction, supervision, and liability, based solely on the launching of the object. Accordingly, the rules regarding jurisdiction and liability establish a strong nexus between the objects in space and the sender state. The Outer Space Treaty establishes such nexus both for governmental and non-governmental objects. The question is whether this connection is sufficient to offer the objects protection from the use of force. This must be determined according to the rules regulating the use of force, which will be examined in Chapter 5.3.

Certain commercial companies, like ViaSat, have intentions to establish a satellite system in which satellites are launched from multiple different territories, meaning there would be several "sending states."²³⁴ In such a scenario, the satellite would be owned by a company based in one state, but it would establish connections with several other states through the territories from which it was launched. Notably, neither the Outer Space Treaty (OST) nor the resolution issued by the United Nations General Assembly (UNGA) provide explicit guidance on the specific legal status of such satellites. While the UNGA resolution encourages cooperation, it does not address this situation in depth or offer comprehensive legal provisions regarding it, and none in relation to the potential use of force in outer space.²³⁵ Consequently, the status and legal framework for such satellites remains relatively uncharted territory in international space law.

4.3 The use of outer space for "peaceful purposes"

The term "peaceful" is essential to the international regulation of space and is relied on in all treaties on the use of outer space. In the Outer Space Treaty, the Preamble stipulates that outer

²³³ Zannoni (2021) p. 614, von der Dunk (2020) p. 5, ICJ Statute art. 38 (1) b

²³⁴ ViaSat (2023)

²³⁵ UN General Assembly (2013)

space should be used exclusively for “peaceful purposes.” Although preambles of treaties do not create legal obligations for the parties, they may enlighten the object and purpose of the treaty.²³⁶ The purpose of the Outer Space Treaty was to stop an arms race in space, and the preamble may be viewed as a reflection of this.²³⁷ Thus, the question is, if the object and purpose of the treaty were for outer space to be used for “peaceful purposes”, what does this entail?

4.3.1 Diverging interpretations of the term “peaceful purposes”

States express support for two diverging interpretations of “peaceful” in the context of outer space. One purports the view that “peaceful” means non-hostile, or non-aggressive, allowing outer space to be used for military purposes as long as it does not purport aggressive purposes.²³⁸ This view is held by most states.²³⁹ The other approach, long held by Russia, holds that “peaceful” corresponds to non-military, in essence banning all military uses of outer space.²⁴⁰ Under this wide interpretation of the term “peaceful purposes” as non-military, even military installations in outer space would be prohibited. The narrower interpretation of “peaceful purposes” as non-hostile activity, to the contrary, would allow such installations, and might also allow for military activities for “defensive purposes”.

For the purpose of the subject at hand, three questions need to be examined: Firstly, does the statement that space should be used for “peaceful purposes” entail an obligation of non-military use of outer space, also banning the use of military installations? This will be addressed in 4.3.2. Secondly, does the obligation to use space for “peaceful purposes” forbid states from developing military capabilities to protect their infrastructure, in other words, does it prohibit attacks on other states' military assets in self-defense? This question is examined in 4.3.3. And thirdly, may the obligation to use outer space for “peaceful purposes” have other relevant implications on military activities in outer space? This issue will be treated in 4.3.4.

4.3.2 The legality of military installations in outer space

The starting point of the interpretation of the treaty text is the wording of the text. There is no authoritative definition of “peaceful purposes” in any of the treaties on the use of outer space,

²³⁶ VCLT art. 31 (2)

²³⁷ Steinberg (1982) p. 388, Burns (1997)

²³⁸ Schmitt (2006) p. 101, Report of the Commission to Assess United States National Security Space Management and Organization (2001)

²³⁹ Schmitt (2006) p. 101

²⁴⁰ Schmitt (2006) p. 101

including the OST. Additionally, the term “peaceful” has been interpreted differently in different areas of international law.²⁴¹ The meaning must therefore be interpreted in light of the context and purpose of the treaty.²⁴²

Articles I, III, and IX stress the peaceful use of outer space. Article III of OST obliges state parties to use outer space in the “interest of maintaining international peace and security and promoting international cooperation and understanding.” Article I stresses that the use of outer space shall “be carried out for the benefit and in the interests of all countries», and article IX stipulates that the use of outer space “shall be guided by the principle of co-operation and mutual assistance.” The emphasis on promoting international peace and cooperation may be viewed as support for the view that outer space should be free from all military activities. Notably, it can be argued that military installations in outer space contributing to the conduct of hostilities in armed conflicts at the terrestrial level are contrary to the purpose of “maintaining international peace.”

For instance, in the case of Operation Desert Storm, ISR satellites were utilized to collect essential information required for the execution of military operations.²⁴³ Similarly, in the context of the Ukraine War, the importance of satellites cannot be overstated. Ukraine has effectively employed commercial radio frequency spectrum monitoring technology, which was implemented on lightweight 15 kg satellites by the U.S. company HawkEye 360. This technology has played a pivotal role in detecting troop movements and thwarting attempts to disrupt GPS signals.²⁴⁴ On the other hand, in the context of these operations, both the United States and Ukraine may assert that their actions were carried out with the objective of preserving or restoring peace.

However, article VI holds that the moon and celestial bodies can exclusively be used for peaceful purposes. The article also expressly forbids “military installations on celestial bodies”. Thus, on the moon and celestial bodies, the term must be interpreted as “non-military”, as it expressly forbids military activities. Similarly, article IV of the treaty expressly forbids the placement of nuclear weapons or other weapons of mass destruction both in orbit and on celestial bodies. An interpretation “a contrario” suggests that the utilization of outer space beyond celestial bodies

²⁴¹ Proelss (2021) para 1

²⁴² VCLT art. 31

²⁴³ Vergun (2021)

²⁴⁴ OECD (2022)

need not exclusively be non-military, that installations in various regions of outer space, including orbital installations, are not inherently prohibited, and that other military installations of weapons that are not weapons of mass destruction are permitted.

The peaceful purposes principle in the OST was based on the model of the Antarctic Treaty, which has been credited with the demilitarization of Antarctica.²⁴⁵ However, there are notable differences between the two treaties. Firstly, in the Antarctic Treaty the stipulation that Antarctica should be used exclusively for peaceful purposes is included in the substantive part of the treaty, unlike the OST where the use of outer space for “peaceful purposes” is only included in the preamble. Additionally, the Antarctic Treaty explicitly prohibits “any measure of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapon», on the entire continent.²⁴⁶ The OST, to the contrary, does not express such prohibitions that are clearly stated to apply to outer space as a whole. Such categorical prohibitions on military activities are in the OST reserved for the moon and celestial bodies.²⁴⁷ An analogy to the interpretation of “peaceful” in the Antarctic Treaty, is therefore not prudent.

Treaties may also be interpreted by subsequent state practice.²⁴⁸ The majority of states support the view that “peaceful” entails non-hostile, as illustrated by extensive practice by a large number of states with military, or dual-use infrastructure in space. Russia has expressed opposition towards such an interpretation, while simultaneously deploying considerable military assets in space.²⁴⁹ Moreover, states opposing the narrow interpretation of “peaceful” such as China and Russia have also had military installations in space for several decades, a practice that is relatively consistent.²⁵⁰ Thus, state practice seems to support the narrower interpretation of “peaceful purposes” as “non-hostile”.

This is also the interpretation relied on in the McGill Manual and the Tallinn Manual. Both interpret “peaceful” as non-hostile. The Tallinn Manual refers to state practice as the basis of this interpretation.²⁵¹ The McGill Manual rule 119 reiterates that the use of outer space should

²⁴⁵ Petras (2003) p. 187

²⁴⁶ Antarctic Treaty art. 1

²⁴⁷ OST art. VI

²⁴⁸ VCLT art. 31 (3) b

²⁴⁹ UN General Assembly First Committee (2022)

²⁵⁰ UN General Assembly First Committee (2022), see chapter 3.3.3, and 3.3.4 for the discussion on the Chinese and Russian use of outer space

²⁵¹ Tallinn Manual (2017) p. 275

be for peaceful purposes “in the common interest of all humankind”, but specifically states that “common interest” includes “military space activities”.²⁵²

In the following, the term “peaceful purposes” is therefore interpreted as “non-hostile”, allowing for military installations in outer space.

4.3.3 Implications for the use of force in self-defense

The next question is whether the term “peaceful purposes” prohibits states from using force in outer space in self-defense. The OST does not regulate the issue specifically. It must therefore be settled based on an interpretation in accordance with the context and purpose of the treaty.

Article I of the Treaty stipulates that outer space “shall be the province of all mankind”, “be free for exploration and use by all States”, and that all states shall have “free access to all areas of celestial bodies”. It also adds that there should be “freedom of scientific investigation.” On the one hand, any use of force in outer space might be viewed as contrary to these freedoms, as uses of force, particularly kinetic attacks, might create space debris, damaging the assets of states not involved in the conflict.²⁵³ On the other hand, the deterrence of harmful interference might be viewed as enhancing rather than hindering the free use of outer space.

Article IX imposes an obligation on state parties to undertake appropriate prior consultations, in the event they proceed with an activity that “would cause potentially harmful interference with activities of other States Parties.” Such prior consultations might be difficult in the event that states would employ self-defense measures.

However, if one were to interpret “peaceful” as not allowing the use of force in self-defense in outer space, this would entail that the use of outer space for peaceful purposes will supersede the right to self-defense in customary international law, and as enshrined in the UN Charter. Therefore, such an interpretation would be contrary to Article III of the Outer Space Treaty, which stipulates that the use of outer space should be in line with the Charter, and to Article 103 of the UN Charter, which states that the UN Charter takes precedence should the obligations under the Charter conflict with an obligation from any other treaty or international agreement.

State practice also unequivocally supports the interpretation of peaceful as allowing for states to use force in self-defense in outer space. The United States has, for example, long held the view that “any purposeful interference with or an attack upon the space systems of the United

²⁵² McGill Manual (2022)

²⁵³ As illustrated by the Russian ASAT test, Amos (2021)

States or its allies that directly affects national rights will be met with a deliberate response at a time, place, manner, and domain of our choosing.”²⁵⁴ France, the United Kingdom, and NATO, also support the view that self-defense measures may take place in outer space.²⁵⁵ Although Russia, and previously the Soviet Union, has long been the advocate for non-military use of outer space, it has expressed that “In [proposing additional international legal protection be provided to outer space objects], we are not at all seeking to detract from the significance of Article 51 of the UN Charter concerning the right to self-defense.”²⁵⁶ Thus, Russia expressly recognizes the right to self-defense also in outer space. Additionally, the McGill Manual also recognize the right of self-defense as enshrined in the UN Charter.²⁵⁷

Consequently, the current understanding shared by the community of states and the majority of legal experts is that the stipulation that outer space being used for “peaceful purposes” does not preclude states from taking self-defense measures in outer space.²⁵⁸ Provided sufficient connection can be established between a space object and a state, the state may resort to the use of force in order to defend their assets in space provided the criteria for the use of self-defense are met. Nevertheless, the state in question will have to consider specific procedural requirements arising from treaty provisions, such as prior consultations when conducting their operation.²⁵⁹ The effects such operations may have on the spatial environment must also be taken into account, as ENMOD forbids “any technique for changing -- through the deliberate manipulation of natural processes”, “the dynamics, composition or structure of [...] outer space.”²⁶⁰ These requirements apply irrespective of the applicability of the rules of IHL.

The conditions for self-defense, including whether self-defense actions may be taken in outer space, as a response to an attack on the terrestrial level, will be discussed under 6.4.

4.3.4 Other implications of the principle of peaceful purposes

The analysis above demonstrated that the use of outer space for “peaceful purposes” corresponds to non-hostile use of outer space. State practice shows that military installations and the use of force in self-defense are not regarded as “non-hostile”. It does not however show that the peaceful purposes principle is null and void. Several of the provisions of the Treaty stress the

²⁵⁴ The United States National Security Strategy (NSS) (2017) p. 31, reiterated in JP 3-14, Space Operations (2020) p. I-1

²⁵⁵ NATO Brussels Summit Communiqué (2022) para 33, The French Ministry for the Armed Forces (2019), United Kingdom Ministry of Defence (2022) p. 19

²⁵⁶ Skotnikov (2002)

²⁵⁷ McGill Manual rule 152

²⁵⁸ McGill Manual rule 152, ICOC art.4.2, Tallinn Manual (2017) p. 274 para. 4

²⁵⁹ OST art. XI

²⁶⁰ ENMOD art. II

peaceful use of outer space and encourage international cooperation. OST article III specifically requires states to “‘carry on activities in the exploration and use of outer space ... in the interest of maintaining international peace and security’». Any action that would be contrary to this would be in breach of the use of outer space for peaceful purposes. Thus, actions that are regarded as hostile will be prohibited even in the event that they do not reach the threshold of the use of force. This interpretation is also included in the Tallinn Manual.²⁶¹

When determining the legality of employment of counterspace weapons two questions arise; 1) is the action in breach of the UN Charter article 2(4) and 2) is the action “hostile” and therefore not in line with the use of outer space for peaceful purposes? The first question will be examined in chapter 5. The question at hand is which actions in outer space would constitute a violation of the principle of peaceful purposes.

Due to the lower threshold of “hostile” activities, all actions that amount to the use of force will entail a breach of the peaceful purposes principle. Chapter 5 will therefore include an analysis of specific incidents and whether these amount to a use of force, whereas the following discussion will center around whether the character of certain counter-space weapons entails that their employment is contrary to the peaceful purposes principle.

Utilizing kinetic ASAT weapons, whether they are based on the ground or in orbit, would clearly constitute a violation of the principle, unless it is carried out in self-defense and aligns with the criteria for self-defense measures.

The assessment of whether jamming violates the peaceful purposes principle will mainly apply to "uplink" jamming since it directly targets satellites and thus occurs within the space environment.²⁶² Jamming is conducted with the intention of disrupting signals or communication for a specific state, or its space assets could be seen as a “hostile”. This is because it implies an aggressive and intentional effort to interfere with the functioning of a country's space infrastructure. On the other hand, jamming to protect a state’s assets, will likely not be “hostile”, as the act is done for defensive purposes, which are allowed according to the interpretation of “peaceful purposes” in the Outer Space Treaty. The key distinction lies in the purpose behind the jamming. Ultimately, the interpretation and legal assessment would depend on the specific cases.

The question of whether spoofing would violate the "peaceful purposes" principle in the Outer Space Treaty will largely depend on similar factors as those applied to jamming, such as

²⁶¹ Tallinn Manual (2017) p. 276, para 9

²⁶² Secure World Foundation (2023) p. 01-17

whether it was conducted in order to maintain the security and integrity of a state's assets, or if it was conducted to disrupt or damage the space assets of other states. In the first case, the spoofing would not be considered “hostile” and therefore not in breach of the principle. In the second case, the spoofing may be considered hostile and could therefore be in breach of the peaceful purposes principle.

The employment of laser weapons to hinder the surveillance of an area by another state’s satellite would involve a "defensive" and non-hostile use of the weapon, making it unlikely to violate the "peaceful purposes" principle. However, in cases where the laser is employed in an effort to damage another state's satellite, the act can no longer be considered non-hostile. Instead, it qualifies as a potentially hostile action, which would likely be in violation of the "peaceful purposes" principle as stipulated in the Outer Space Treaty.²⁶³

Although specific uses of counter-space weapons should be evaluated on a case-by-case basis, it is likely that the utilization of specific counter-space weapons, not done for defensive purposes, may generally contravene the peaceful purposes principle. Nevertheless, the specific repercussions of violating this principle remain uncertain.

5 The UN Charter 2(4) and the Prohibition of the Use of Force in Outer Space

The analysis above demonstrates that the use of force is not specifically regulated in treaties addressing outer space. However, both OST article III and the UN Charter article 103 clarify that the provisions of the Charter apply in space. For this reason, the general prohibition of the use of force in the charter will, in theory, take precedence over any other obligation states may have regarding the use of outer space.

In the following, I will analyze to what extent current forms of military activity in this domain may be perceived to amount to the use of force under the UN Charter article 2(4). Firstly, I will interpret the prohibition, and then examine the scope, inter alia, if objects in outer space may be considered to be in the same category as the territory of the state. Lastly, I will analyze which acts in outer space will reach the threshold of the use of force.

5.1 The UN Charter article 2(4)

The United Nations Charter Article 2(4) contains the general prohibition of the use of force:

²⁶³ OST preamble, art. I

“All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations.”

The prohibition is regarded as customary international law, as recognized by the ICJ in the Nicaragua Case, where the court also referred to the rule as a “principle”.²⁶⁴ The prohibition is considered a peremptory norm in international law, known as *jus cogens*.²⁶⁵ This signifies that it is acknowledged and accepted by the entire community of States as a norm that cannot be derogated from, except by another general international law norm of the same character.²⁶⁶

In the Nicaragua case, the ICJ proceeded on the premise that the customary rule and article 2(4) have the same content.²⁶⁷ This presumption has been criticized in legal theory as states have diverging practices regarding the content and scope of the prohibition. However, as nearly all states are members of the UN and therefore parties to the UN Charter, the differing views concern the treaty rule as much as the customary rule. The fact that the prohibition is a customary rule means that the prohibition will apply to states even if they decide to withdraw from the Charter. Moreover, because the norm is customary in nature, it's important to recognize that not only can state practice supplement the interpretation of the prohibition's scope and content, but it can also introduce additional criteria.²⁶⁸

The Charter contains two exceptions to the use of force; forcible measures as authorized by the Security Council, acting under Chapter VII of the Charter, and the right of individual or collective self-defense following Article 51 of the Charter following an armed attack. Security Council authorization, will, as mentioned in the introduction, not be discussed, but the right to self-defense will be examined in chapter 6.

5.2 Interpretation of “the use of force”

In order to examine what actions in outer space will amount to “use of force”, it is necessary to determine the meaning of the term. The Charter does not provide a definition of the term “force”.²⁶⁹ The ordinary meaning of the term is “compulsion or coercion”.²⁷⁰ Its textual context nevertheless points to the fact that it only refers to “armed force”, contrary to economic or

²⁶⁴ ICJ The United States v Nicaragua (1986) para. 188 and 190

²⁶⁵ ILC (2019) p 163

²⁶⁶ ILC (2019) Conclusion 2

²⁶⁷ ICJ The United States v Nicaragua (1986)

²⁶⁸ VCLT art. 31(3) *litra c*,

²⁶⁹ VCLT art. 31(1)

²⁷⁰ Merriam-Webster, (definition of « force») (2023)

political force. Paragraph 7 of the preamble states that “armed force shall not be used”, and article 44 stipulates that “when the Security Council has decided to use force”, it calls upon Member states to employ “armed forces”. The commonly accepted view is that the prohibition pertains to the use of armed force, particularly military force.²⁷¹ This conclusion is supported by the Friendly Relations Declaration.²⁷²

Lastly, the understanding of “force” as “armed force” finds support in the *travaux préparatoires* of the charter, where the suggestion by the delegation from Brazil to include economic coercion was rejected.²⁷³ Preparatory works are only supplementary means of interpretation, but in this case, the works demonstrate the intended purpose of the Charter.²⁷⁴

In the Nuclear Weapons Advisory Opinion, the ICJ stated that “the prohibition appl[ies] to any use of force, regardless of the weapons employed”.²⁷⁵ The prohibition applies to both non-kinetic and kinetic weapons. Thus, the use of force in outer space includes military or armed force and is not restricted by the weapon used.

5.3 Scope of the prohibition in outer space

To identify which applications of force are restricted in outer space, the scope of the prohibition must be determined. Article 2(4) prohibits the use of force “against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations”. Thus, the question is whether territorial integrity and political independence were meant to be necessary requirements for the application of the prohibition, or whether the inclusion of “in any other manner inconsistent with purposes of the United Nations” is meant to include other uses of force.

The term “or” is used to link alternatives. Hence, the wording of the article indicates that the use of force is forbidden in all the events mentioned in the article, including in manners inconsistent with the purposes of the UN.²⁷⁶ A contextual interpretation points to the same conclusion.²⁷⁷ Paragraph 7 of the preamble of the charter states that armed force shall not be used save in the common interest of the states. Consequently, all uses of force are forbidden save for the specific exceptions in the Charter and in customary international law. In the commentary on the

²⁷¹ Simma (2002) p. 117, 119

²⁷² UN General Assembly (1970)

²⁷³ Dörr (2019) para 11

²⁷⁴ ILC (1966) p. 233

²⁷⁵ ICJ Nuclear Weapons (1996) para 39

²⁷⁶ VCLT art. 31(1)

²⁷⁷ VCLT art. 31 (2)

UN Charter, Simma concludes that the inclusion of the terms territorial integrity and political independence was not meant to “restrict the scope of the prohibition”, but they were included to “cover any possible kind of trans frontier use of armed force.”²⁷⁸ Thus, the addition of the term “or in any other manner”, was included to leave out any loopholes of the prohibition. The Tallinn Manual, and its commentaries, in a similar vein interpret the prohibition as encompassing the use of force that does not go against a state’s territorial integrity or political independence.²⁷⁹

However, even when the force is not directed against “territorial integrity” or “political independence”, it needs to be directed towards something associated with the state, in order to identify that a state has been a victim of the use of force. This is substantiated by numerous ICJ decisions. In the advisory opinion *The Wall*, the Court held that the concept of an armed attack involves attacks from outside the territory of a State that are imputable to another State.²⁸⁰ Consequently, even in the case that “territorial integrity and political independence” was not meant to be an exhaustive list of the prohibited targets of the use of force, the force needs to be directed at the territory of a state, or something assimilated, or analog to the territory of the state.

5.3.1 Objects in space – analogous to the territory of the state?

As demonstrated above in chapter 4.2, a link exists between the sending state and the objects it situates in space. In the following, it will be explored whether this connection is substantial enough to categorize these objects in a manner similar to territory, in the context of the prohibition of the use of force. In the context of discussing the application of force against objects in outer space, electromagnetic weapons fall into a distinct category since they do not inflict physical damage to the satellite but rather disrupt the signals it transmits, affecting the state's access to those signals.²⁸¹ It will therefore be examined separately in chapter 5.3.2.

Since there are no judicial rulings or treaties governing this issue, it is relevant to draw analogies from the use of force against ships on the high seas. Pursuant to UNCLOS articles 29-32 and 95-96, warships and government ships that are not operated for commercial purposes enjoy immunity from the jurisdiction of other states when in the Exclusive Economic Zone, Contiguous Zone, and on the High Seas. This is because “a ship on the high seas is assimilated to the territory of the State the flag of which it flies” and that “a ship is placed in the same position as

²⁷⁸ Simma (2002) p. 123

²⁷⁹ Tallinn Manual (2017) p. 329, para 2

²⁸⁰ ICJ *The Wall-Case* (2004) para. 13

²⁸¹ Secure World Foundation (2022) p. 01-17-18, Bamford et. Al (2021) p. 24-25

national territory”.²⁸² In the Oil Platforms case, the ICJ based their proceeding on the assumption that attacks on a State’s military vessel may amount to an armed attack when the vessel is flying the flag of the State.²⁸³ All armed attacks entail a use of force, thus the statement from the ICJ is applicable also to the situation of a use of force.²⁸⁴ State practice has shown that attacks against ships and aircrafts that have a non-commercial character amount to the use of force, and therefore are encompassed by the prohibition.²⁸⁵ Additionally, The Newport Manual states that such attacks against “sovereign immune platforms, that is, warships, auxiliaries, military aircraft, or other government ships” would qualify as a use of force.²⁸⁶

The act of registering a satellite to the sending state can be likened to "flying the flag" of that state. Moreover, states maintain jurisdiction over the objects they send into space, akin to the jurisdiction they have over their own ships. Nonetheless, there exist several distinctions between satellites and ships that could diminish the relevance of this analogy.

Firstly, ships, in many cases, return to their state of origin, unlike satellites, which are placed into orbit for an indefinite amount of time. This could imply a weaker link between the sending state and the satellite, than that between a ship and the state. Moreover, ships have a crew, thus the use of force towards a ship could also target the nationals of a state, unlike satellites, which are unmanned. This prompts consideration of whether an analogy to unmanned maritime vehicles might be more appropriate. The status of unmanned marine vehicles has been heavily debated in recent years.²⁸⁷ There is no general agreement as to whether they enjoy the same immunities as manned ships. Schmitt contends that if an Unmanned Maritime System (UMS) meets the criteria for being classified as a ship and is operated by a government solely for non-commercial purposes, it will essentially have the same sovereign immunity under the Law of the Sea Convention (UNCLOS) as a warship.²⁸⁸ Consequently, the status of UMS’s is influenced, at least in part, by their unsettled classification as "ships." This differs from the situation with satellites, where their legal status is, to some extent, established, as the OST specifies that sending states maintain jurisdiction and liability over them.²⁸⁹

²⁸² PCIJ Lotus (1927) para 25

²⁸³ ICJ Oil Platforms (2003) paras 64 and 72

²⁸⁴ UN General Assembly (1974)

²⁸⁵ Dörr (2019) para 23.

²⁸⁶ Newport Manual (2023) p. 24

²⁸⁷ See for example, Schmitt et al (2016)

²⁸⁸ Schmitt et. Al (2016) pp. 575-580

²⁸⁹ OST articles III, VI, VIII

Unlike ships, a use of force against a satellite would affect national infrastructure on the terrestrial level. Depending on what satellite would be destroyed it could hinder the delivery of humanitarian aid and ships, and aircraft could be cut off from their commanders, and pilots would struggle to reach air traffic controllers upon landing.²⁹⁰ Additionally, it could severely impact the financial market or telecommunications.²⁹¹ Historically, a state's infrastructure was typically located within its national borders. Therefore, safeguarding satellites, even when they are outside of a state's territory, would be a logical extension of this principle.

This poses the question as to whether attacks against objects in space that do not support terrestrial infrastructure must be placed in a category differing from those that do. On the one hand, the use of force towards the satellite might have a lesser impact on the terrestrial level, and thus the relationship may be seen as more remote. On the other hand, the legal relationship between the satellite and the state is the same irrespective of the degree of impact on the terrestrial level. Moreover, the regulations concerning the use of force against ships do not differentiate the legal status of the ships based on whether they transport cargo or personnel essential to the state, but it might influence the evaluation of whether the operation will surpass the threshold for the use of force.

Ships on the high seas have significant differences from satellites. What is similar is the fact that the state has jurisdiction over both ships and satellites. Ships are safeguarded, not due to the fact that they return to the state, or because they have crew, but because they are considered a representation of a state, and similarly, satellites are also regarded as a representation of a state. When force is employed directly against a ship, it is perceived as a direct hostility toward the state.²⁹² The use of force towards a satellite might be viewed in a similar manner.

This also finds support in state practice, as states have expressed that they believe that they have the right to protect “their” space assets, indicating that an attack (and likely therefore also a use of force) against their assets in space, is regarded as an attack against the state.²⁹³ Consequently, due to the legal relationship between the sending state and the satellite, the similarity between satellites and ships on the high seas, and as demonstrated through the opinion of states, satellites may be placed in the same category as the territory of a state.

²⁹⁰ ICRC (2020)

²⁹¹ Bamford et. Al (2021) p. 26

²⁹² PCIJ Lotus (1927) para 25, ICJ Oil Platforms (2003) paras 64 and 72, Newport Manual (2023) p. 24

²⁹³ The United States National Security Strategy (NSS) (2017) p. 31, reiterated in JP 3-14, Space Operations (2020) p. I-1, NATO Space Policy (2022), The French Ministry for the Armed Forces (2019), United Kingdom Ministry of Defence (2022) p. 19

5.3.2 Commercial satellites

The analogy from ships on the high seas might not be appropriate for commercial satellites, as the use of force towards commercial ships is normally not regarded as use of force against the state. This is because commercial ships are not regarded as an extension of the territory of the state, and do not enjoy the same immunities as governmental and warships.²⁹⁴ However, as established in chapter 4.2, the state's national responsibility, jurisdiction, and liability extends to both governmental and non-governmental satellites. Additionally, many satellites have a dual-use character, offering services for both military and commercial purposes.²⁹⁵ The differentiation established by the law of the sea may not necessarily be suitable for addressing the circumstances involving objects in outer space.

However, commercial satellites frequently offer services to multiple states.²⁹⁶ Thus, a disruption of the satellites of a commercial satellite will not only influence the state of register, but may disrupt the service for several states. This raises the question of the intended target of the operation. The Russian cyber-operation that disrupted ViaSat in the spring of 2022 is illustrative of this. Although the intended target of the attack was Ukraine, ViaSat is an American satellite system.²⁹⁷ Additionally, the cyber operation affected the internet service of several other European states.²⁹⁸

There are, however, differences between cyber-operations and electronic warfare and the use of laser weapons or kinetic ASATs. With these weapons, the satellite itself would be damaged.²⁹⁹ Even if other states experience disruption, it does not take away the fact that the targeted state may have been subject to the use of force. One possible approach to consider is to evaluate the intent of the state conducting the operation, and the impact the weapon has on both the satellite and its services. If the satellite targeted is destroyed or damaged, it might indicate that the sending state has been subject to the use of force. On the other hand, if a different state than the sending state suffers a disruption of services due to an attack against the satellite, it might indicate that this state would be the victim of a use of force.

This approach could be especially beneficial in a scenario involving a commercial satellite system, where multiple states might be considered "sending states".³⁰⁰ In such cases, a single state may not have a substantial connection with the system, making it necessary to identify the target

²⁹⁴ Dörr (2019) para 23

²⁹⁵ For example, Taverney (2022)

²⁹⁶ For example, ViaSat: Cyber Peace Institute (2022),

²⁹⁷ Cyber Peace Institute (2022), Viasat (2023)

²⁹⁸ Cyber Peace Institute (2022)

²⁹⁹ Blatt (2020) p. 30-32, Secure World Foundation (2022) p. 01-23

³⁰⁰ Registration Convention art. I (ii), II, OST art. VIII

based on the intent of the state using force, and which states experience the consequences of the operation. This approach takes into account both the intent behind the use of force and the practical effects it has on involved states.

Nevertheless, although this approach presents a possible solution, it contradicts the established criterion that the target of the use of force must be the territory of a state or objects closely linked to it. If these satellite systems lack a substantial connection to any state, it prompts the query of whether the satellite can genuinely be regarded as an extension of a state's territory, warranting protection from the use of force. The existing legal framework does not offer a definitive resolution to this issue.

5.3.3 Electronic warfare

When it comes to electronic warfare the situation is different. The main explanation is that the use of jamming or spoofing will not damage the satellite directly.³⁰¹ Secondly, electronic warfare happens in the electromagnetic environment, which encompasses the total amount of electromagnetic effects in a specific physical area. It covers the entire electromagnetic spectrum. The electromagnetic environment is not considered a separate operational domain, such as space or cyber, but it works as a connective line between different operational domains.³⁰² Due to the fact that the electromagnetic environment refers to the electromagnetic effects in a given physical area, it will materialize within a state's border. By jamming satellite signals, the operation directly targets services within the territory of a state. Consequently, depending on the nature of the attack, electromagnetic weapons may disrupt and interfere with the territorial integrity and sovereignty of a state.

However, not all operations will necessarily materialize within a state's border. Jamming may, for example, interfere with ships at sea. The Newport Manual concludes that cyber operations resulting in physical damage or destruction of a military vessel may rise to the level of the use of force.³⁰³ Unlike kinetic ASAT attacks, electromagnetic weapons do not damage or destroy the satellite. Thus, if the jamming or spoofing "only" targets a single vessel at sea, the satellite that provides the disrupted service is not damaged in and of itself. In this scenario, the nexus between the satellite and the territory of the state is more distant, both because the effects are not felt in the territory of the state, and because the satellite, which may be viewed as in the same category of the state territory is not targeted. Therefore, it is pertinent to analogize from the rules of naval warfare to assess whether this might entail the use of force.

³⁰¹ Bamford et. Al (2021) p. 24-25

³⁰² Bamford et. Al (2021) p. 32

³⁰³ Newport Manual (2023) p. 21

5.4 The lower threshold of the use of force

The prohibition in article 2(4) restricts (armed) force in a broad sense, yet the Charter does not explicitly specify the minimal level of force required, often referred to as the lower threshold. Consequently, there have been disputes among states regarding whether certain forms of force are so inconsequential that they do not violate the prohibition.³⁰⁴ Such a threshold will determine what operations in outer space will be encompassed by the prohibition.

The distinction is of importance because the use of force is a peremptory norm of international law. Therefore the usual exceptions that might apply to treaties or customary norms do not have apply.³⁰⁵ As an example, the "circumstances precluding wrongfulness" specified in the International Law Commission's Articles on 'Responsibility of States for Internationally Wrongful Acts,' like countermeasure, distress and necessity, do not apply in the case of jus cogens norms.³⁰⁶

Certain advocates of the threshold concept advocate for its existence to allow for greater flexibility. Scholars and states contend that the potential existence of such a threshold could help prevent an escalation of conflicts and promote amicable relations between states.³⁰⁷ Typically, these states support the idea that there should be no distinction in the threshold between an armed attack and the use of force. Conversely, other states, often those who may find themselves targeted, oppose the notion of a minimum threshold. They prefer the absence of any threshold, thereby creating a lower bar for categorizing something as a violation of the prohibition against the use of force.³⁰⁸

Some scholars and the ILC argue that these instances in which States refrained from asserting a breach of Article 2(4) do not inherently establish that an event fell below the threshold of the use of force; rather, it could signify a deliberate political choice not to invoke a violation of Article 2(4).

The ICJ has not explicitly expressed that there is a threshold of gravity for the prohibition of the use of force. However, the existence of a threshold may be inferred from several of the court's judgments.³⁰⁹ Such small-scale uses of force are, for example, minimal uses of force

³⁰⁴ See for example Ruys (2014)

³⁰⁵ Delerue (2020) p. 282

³⁰⁶ Delerue (2020) p. 282, ILC (2001) art. 22, 24, 25

³⁰⁷ Hellestveit et. Al (2020) p. 188-190

³⁰⁸ Hellestveit et. Al (2020) p. 188-190

³⁰⁹ Delerue (2020) p. 292

against foreign vessels at sea, or interception of a single aircraft.³¹⁰ These examples are not necessarily fitting for the extra-terrestrial domain, but the cases demonstrate that the differentiation of cases is the effect the use of force produces.

This is supported by The International Fact-Finding Commission on the Conflict in Georgia asserted that "the prohibition of the use of force applies to all physical force that exceeds a minimum threshold of intensity."³¹¹ Moreover, an interpretation in light of the purpose of the UN Charter would support the existence of a lower threshold, in order to repel international conflicts. This is particularly relevant considering the changing character of warfare where non-kinetic operations such as cyber and electronic warfare may be encompassed by the prohibition of the use of force. The use of such weapons is particularly prevalent in outer space. If every use of such weapons rises to the threshold of the prohibition, even minor actions would result in an escalation resulting in an international conflict. Hence, it is necessary to establish what this threshold is for outer space.

5.4.1 Determining the threshold for outer space

The destruction or damage of objects and loss of life is typically considered a use of force.³¹² Consequently, as deploying an anti-satellite weapon would result in significant damage or destruction of the satellite, it would surpass the use-of-force threshold. This would be the case for both satellites connected to terrestrial infrastructure and more "remote" satellites. However, the situation is not necessarily as straightforward when it comes to electronic and laser weapons, as they do not necessarily directly cause tangible damage to the satellite.³¹³ There are no established thresholds for the employment of these weapons. One must therefore rely on analogies to other areas of the law, and assessments of the consequences resulting from the deployment of these weapons. Given that cyber operations are non-kinetic, the considerations outlined in the Tallinn Manual may shed light on important factors to consider when assessing other non-kinetic operations, such as electronic and laser weapons.

According to the Tallinn Manual rule 69, "a cyber operation constitutes a use of force when its scale and effects are comparable to non-cyber operations rising to the level of a use of force."³¹⁴ In the corresponding analysis, the group of experts holds that acts always constitute a use of force when they injure or kill people or damage or destroy objects. Acts that fall short of this

³¹⁰ Delerue (2020) p. 292

³¹¹ Independent Fact Finding Commission on the Conflict in Georgia Report (2009) p. 242,

³¹² Tallinn Manual (2017) p. 333

³¹³ Bamford et. Al (2021) p. 24-25, Secure World Foundation (2023) p. 01-17-18

³¹⁴ Tallinn Manual (2017) p. 330

level of harm may still constitute a use of force if their effects are tantamount to such destructions.³¹⁵ The group of experts outlined a set of factors states are likely to emphasize when assessing the effects of cyber-operations that do not destroy or damage objects or people, in order to determine whether the operation constituted a use of force. It is important to note that the criteria from the Tallinn Manual were meant to assess attacks on a case-by-case basis.³¹⁶

The factors outlined in the manual are severity, immediacy, directness, and invasiveness.³¹⁷ Severity refers to the consequences of the operation, meaning how extensive the results of the concrete operation were. Consequences that only create inconvenience or irritation will be insufficient. But “the more consequences impinge on critical national interests” the more likely it is that the attack will be above the threshold of the use of force.³¹⁸ Directness refers to the link between the act and the consequences, and invasiveness refers to how intrusive the act is, where interference with more secure systems will be more invasive than open systems.³¹⁹ Invasiveness will be relevant in the context of electromagnetic weapons as well, as there are certain forms of GNSS and communication satellites (typically employed by the military) which are more protected than others.³²⁰ Other relevant factors are the duration and intensity of the attack.³²¹

An example of a cyber operation which reached the threshold of the use of force is the cyber-operation against Iran's Natanz nuclear facility.³²² In 2010 Iran suffered a cyber-operation by the Stuxnet malware worm that resulted in the destruction of 1000 of the 9000 IR-centrifuges of the reactor.³²³ The reactor was not operable until the IR-centrifuges had been replaced.³²⁴ Aside from the damage inflicted on the centrifuges, the extent of Stuxnet's success is subject to varying estimates. While some officials within the Obama administration contend that the cyber-attack delayed Iran's nuclear progress by 18 months to two years, other assessments take a more skeptical view of Stuxnet's importance, emphasizing the swift return of centrifuge operations at Natanz shortly after a brief facility shutdown.³²⁵ This operation demonstrates that

³¹⁵ Tallinn Manual (2017) p. 333

³¹⁶ Tallinn Manual (2017) p. 333

³¹⁷ Tallinn Manual (2017) p. 334

³¹⁸ Tallinn Manual (2017) p. 333-334

³¹⁹ Tallinn Manual (2017) p. 333-334

³²⁰ Navipedia GMV (2011), Wang et. Al (2021) p. 1-2

³²¹ Tallinn Manual (2017) p. 333-334

³²² Tallin Manual (2017) p. 342

³²³ NTI (2023)

³²⁴ NTI (2023)

³²⁵ NTI (2023)

causing damage to replaceable centrifuges is adequate for categorizing an operation as a use of force.

It is also worth noting, that although “hostile intent” is a criterion for the existence armed attack, (examined in chapter 6), it is relevant also when examining uses of force in order to distinguish uses of force from mere accidents.³²⁶

5.4.2 Jamming

Jamming operations should be assessed on a case-by-case basis because the severity of the effects of an operation may vary.³²⁷ The analysis of previous jamming operations may still be useful in determining whether the use of electronic weapons may reach the threshold of the use of force, and if so, provide insight into the character of the operations that reach the threshold. In light of this, this paper will examine the effects of two jamming operations.

In 2018 Russia allegedly interfered with GNSS signals in Norway during NATO’s Trident Juncture exercise.³²⁸ The operation affected the military exercise and civilian flights in northern Norway. Russia has denied all allegations, but Norway, NATO, and Finland have maintained that the Russian military was behind the operation, though the operation was never officially politically attributed to Russia³²⁹ The effects of the military exercise are not accessible to the public, hence it is difficult to assess how jamming impacted the secure systems. Determining the precise invasiveness of the operation is therefore not possible. However, as the civilian impacts of the operation are well-documented, it is possible to analyze the "immediacy" and "severity" of these effects.

The jamming caused the GPS service of civilian flights to malfunction and the pilots had to rely on less accurate backup systems.³³⁰ Additionally, the Medivac service was interrupted at an airport in northern Norway, which resulted in several canceled flights.³³¹ The jamming directly impacted the operation of civilian and medical operations, and its results were immediate, but the effects were neither long-lasting nor severe, as civilian flights were able to take off and land through other means of navigation. There are no reports stating that the cancellations had deadly

³²⁶ Ruys (2014) p. 173

³²⁷ Bamford et. Al (2021) p. 28-29

³²⁸ Secure World Foundation (2022) p. 02-23, Robinson (2021) p. 233

³²⁹ France-Presse (2018)

³³⁰ France-Presse (2018)

³³¹ Bellika (2019)

outcomes for the patients that Medivac was supposed to transport.³³² On the other hand, Medivac is a part of critical national interest, as it is essential to transport the sick and injured.³³³ Northern Norway is a vast area, with few hospitals, which makes the area more reliant on Medivacs, as opposed to regular ambulances.³³⁴

The jamming that disrupted the Trident Juncture exercise in 2018 was never called a “use of force” by Norway or NATO. The Norwegian State confronted Russian authorities with the incident, and a NATO spokesperson called the incident “dangerous, disruptive and irresponsible”.³³⁵ Norway and Russia have an increasingly tense relationship thus the political response to such incidents might be strategic.

Another example is the jamming done by North Korea against South Korea in 2016. South Korea was targeted by an operation that caused mobile phones to malfunction, disrupted the GPS signals of over 30 planes, and forced 70 fishing vessels to return to port due to malfunctioning navigation systems.³³⁶ The results were immediate, and the effects were a direct result of the disruption of the systems. Though the operation was extensive as it disrupted civilian life in South Korea, it did not cause lasting turmoil, nor was it reported that it damaged critical national interests.³³⁷

South Korea reported the jamming done by North Korea to the Security Council, reporting that they considered the GPS jamming to be in breach of their armistice agreement.³³⁸ Hence, South Korea officially attributed the operation to North Korea. The latter could entail that the state viewed the jamming as a use of force, but this was not explicitly stated, thus it is difficult to assert the state’s point of view regarding the prohibition.

These two incidents were disruptive, but they probably did not reach the threshold of the use of force. However, should, for example, the jamming conducted by Russia in Norway have persevered over a longer period of time, causing a sustained cancellation of Medivacs and aircraft collisions, the operation would have resulted in both loss of life and destruction of property, or consequences equal to this, thus the threshold would have been reached.

³³² Bellika (2019)

³³³ Bellika (2019)

³³⁴ Dimmen et. Al (2021)

³³⁵ Batchelor (2018)

³³⁶ Reuters Staff (2016)

³³⁷ Reuters Staff (2016)

³³⁸ Permanent Representative of the Republic of Korea (2016)

5.4.3 Spoofing

Similar to jamming operations, spoofing operations require a concrete assessment due to the varying degrees of harm they can cause. To better illustrate the potential consequences of a spoofing operation, it is beneficial to examine actual incidents of spoofing. In the subsequent discussion, the following section will examine spoofing operations targeting AIS systems.

Norway has been subject to the spoofing of AIS systems on several occasions. In 2021 the AIS systems showed that two Norwegian military ships were sailing into Russian territory, when in fact, they were headed for a Polish harbor.³³⁹ The year before, the Norwegian army reported that Russian military vessels appeared as Norwegian and Danish military vessels in the AIS system. The system showed that the Norwegian and Danish military vessels were in international waters outside of the Norwegian town, Tvedestrand, when in reality the ships were in their respective harbors.³⁴⁰ The harmful effects of the spoofing were mostly felt on a political level, as it is not reported that the spoofing resulted in damage or injury, or tantamount effects, this time.³⁴¹

In 2019 Iran spoofed civilian British ships which led them to navigate into Iranian waters where the ships were boarded by the Iranian Revolutionary Guard. The spoofing happened in an existing conflict of interest between Great Britain and Iran.³⁴² Although neither the people nor the ships suffered damage or injuries, the effects of the spoofing affected the political level and could have led to an escalation of the conflict.³⁴³

The incidents described above did not reach the threshold of the use of force. The spoofing of AIS systems appears to be conducted in order to aggravate existing tense political situations, which might lead to a use of force on a later occasion but would not constitute a use of force in and of itself. However, it is important to note that the spoofing may result in collisions at sea. If an electromagnetic operation targeting vessels at sea results in physical damage or destruction of a military or governmental vessel it may amount to a use of force.

5.4.4 Laser

Laser weapons have several levels of strength, and as a result, the varying degrees of dazzling produced will lead to different outcomes. To ascertain whether they qualify as a use of force,

³³⁹ Lied (2021)

³⁴⁰ Lied (2021)

³⁴¹ Lied (2021)

³⁴² Bamford et. al (2021) p. 30

³⁴³ Bamford et. al (2021) p. 30

the distinct levels of dazzling will have to be examined concretely in order to determine whether they entail a use of force.

“Dazzling” obscures a set of images the satellite provides. The damage is temporary, and the satellite itself remains undamaged.³⁴⁴ Although the use of dazzling may cause operational difficulties for a state or a military for a limited amount of time, it is unlikely that such employment will result in severe effects that are comparable to the loss of life or destruction of objects.

If the dazzling is conducted with a laser with sufficiently high power, the laser may permanently damage a few pixels in the array. This may be done intentionally, but it may also happen accidentally when the goal is to dazzle the satellite.³⁴⁵ If the intention was to damage the satellite, (and therefore not an accident) the issue becomes whether such damage reaches the threshold of the use of force. Although the effects of the laser will be immediate, they are not necessarily invasive, as they do not require the breach of a secure system. The damage will not affect the entirety of the image supplied by the satellite, and thus not be profound. It is therefore likely that such operations will not be above the threshold of the use of force.

With the use of a very high-power laser, the weapon could cause permanent damage to the satellite bus. This will result in a complete failure of the satellite. All satellites are susceptible to this type of damage, therefore it may be used to damage any satellite.³⁴⁶ This will result in the same effects as that of a kinetic anti-satellite weapon, as the satellite in both cases, will be inoperable. The difference in effects is mainly that the satellite will not explode, and therefore not cause space debris. The creation of space debris will, however, not be decisive as to whether the attack reaches the threshold of the use of force, but may be important in discussions of IHL, as the employment of laser weapons may have less damaging effects on the space environment.

5.5 Conclusion

Due to both the legal and factual relationship between a satellite and its sender state, and the satellites’ importance for national infrastructure, the use of force against satellites is prohibited. Yet, establishing this relationship with the state, and consequently identifying the state affected by a use of force, can be intricate, especially given that commercial satellites may have connections with multiple states. Presently, the regulations governing the use of force in outer space do not provide a clear answer to this issue.

³⁴⁴ Secure World Foundation (2023) p. 01-23

³⁴⁵ Secure World Foundation (2023) p. 01-24

³⁴⁶ Secure World Foundation (2023) p. 01-24

Ultimately, the determination of what constitutes a use of force in outer space is multifaceted and requires a case-by-case assessment, taking into account potential consequences and their impact on critical national interests.

Lastly, although certain uses of electronic weapons may not reach the threshold of the use of force, they may be in breach of other rules of international law such as the principle of sovereignty. Furthermore, interfering with communication satellites through jamming would contravene the prohibition on harmful interference set forth by the ITU.³⁴⁷

6 The UN Charter Article 51 and the Right to Self-Defense in Outer Space

6.1 The applicability of the right to self-defense in outer space

The right to self-defense by states follows both treaties and international custom and is an exception to the prohibition of the use of force. A state may resort to the use of force, including military force, in order to repel another state's use of force. The legal requirement for the right to resort to the use of military force in self-defense is that the state has been the target of an "armed attack" in violation of international law.³⁴⁸ The question posed here is the scope of the right to self-defense in space. Is there a right to self-defense in outer space? What would constitute an armed attack in space, and which measures can be lawfully taken in response?

According to the UN Charter article 103, and the OST article III, the UN Charter and international law apply in outer space. Consequently, the general prohibition of the right to self-defense, as stated in the Charter, is theoretically extended to apply in space. Additionally, numerous states and organizations have expressed the view that the right to self-defense extends to outer space, as presented in chapter 4.3.3. The right therefore seems to be supported by "general practice accepted as law".³⁴⁹

Nonetheless, similar to the challenge with the prohibition of the use of force, the unique characteristics of outer space make the straightforward application of these rights difficult, at least without any adjustments. Space technology evolves rapidly, and new capabilities can emerge suddenly.³⁵⁰ This makes it difficult to establish precise rules and thresholds for self-defense in space. Another significant factor to consider is that in outer space, machine dominance is expected to be more pronounced than on Earth, featuring autonomous systems equipped with

³⁴⁷ ITU Convention art. 45

³⁴⁸ UN Charter art. 51

³⁴⁹ See discussion under chapter 4, ICJ Statute Article 38(1)

³⁵⁰ NATO (NATOS approach to space) (2022)

preprogrammed indicators to identify potential attacks.³⁵¹ While the challenges associated with autonomous weapons are not exclusive to outer space, their potential issues may become more prominent in this environment, given the lack of human presence. Moreover, due to the vast distances involved, there can be significant delays in communication between space assets and ground control.³⁵² This delay can hinder timely decision-making and response. Lastly, attacks against satellites that do not support terrestrial infrastructure will not have any direct military or civilian effects on Earth. Any potential use of satellites, and actions taken in their defense will, most probably be part of the 'race for space,' colonization and the exploration of new planets and other conditions reminiscent of the early days on Earth when there was no general prohibition of the use of force between states.³⁵³

Some states have raised the issue that the distinctiveness of outer space could influence how the right to self-defense is applied in this domain. For example, the Russian delegation to UNCOPOUS has urged a clarification in regard to “the nature and characteristics (including severity) of a violent act that could be regarded as an armed attack.”³⁵⁴ The UNGA and the UNSC have yet to provide clarification to the questions posed by the Russian working paper. Consequently, the way in which the right to self-defense applies to outer space is, as of today, not completely settled. In the following, I will address which elements appear to be secure and which elements there is disagreement about, or which have not yet been clarified.

6.2 Interpretation of “an armed attack”

The UN Charter article 51 establishes that:

Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security.

In the Nicaragua case, the ICJ stated that the word “inherent” in the article is a reference to the right in its customary form.³⁵⁵ The court argued on the basis that the rules regarding the use of force and self-defense, were found both in the charter and customary law, and the right to self-defense is therefore a fusion between treaty and customary sources.

³⁵¹ Massingham (2022) p. 279, 291, 296, 298. 299, Van Esch et. Al (2017) p. 385

³⁵² Tripathi (2023)

³⁵³ ISECG (2013) p. 2, 4, Strickland et. Al (2023), Koskenniemi (2017) p. 1368

³⁵⁴ Russian Federation Working Paper (2015) para 18

³⁵⁵ ICJ The United States v. Nicaragua (1986) para. 176

The primary criterion for the right to self-defense is that the state has been subject to an armed attack, cf. “if an armed attack occurs”.³⁵⁶ Customary law stipulates additional criteria for the right to self-defense. Firstly, the attack must be conducted with “hostile intent” in order to be classified as an armed attack.³⁵⁷ Furthermore, customary international law imposes limitations on the acceptable actions a state can undertake in the exercise of self-defense.³⁵⁸

There are several different scenarios regarding the right to self-defense in outer space. Firstly, an attack from space to earth. The attack itself could be evaluated in the same way as terrestrial attacks because the effects would materialize on the terrestrial level. This is how attacks are regulated in international law applicable to armed conflict (*ius in bello*): attacks from sea to land or from air to land are regulated under the rules of armed conflict on land.³⁵⁹ In the following, therefore, attacks from space assets to Earth will not be discussed further. In this case, there would be the criterion for the employment of self-defense itself that would need to be discussed, including whether self-defense measures can be employed in outer space.

Another potential scenario involves the possibility of an attack on assets in space that are necessary for a state’s national infrastructure. These attacks can originate from Earth towards outer space or from one space location to another. Finally, there is the prospect that, in the foreseeable future, there may be attacks against space assets that lack a function on Earth but serve a purely space-related purpose. Currently, such infrastructure is relatively scarce, but it is probable that its presence will grow, as the United States, China and Russia race to explore and utilize space.³⁶⁰ Both types of attacks present challenges in relation to the application of the right to self-defense, including the evaluation of what uses of force would constitute an “armed attack” in this domain, and the which self-defense measures that can be lawfully taken in response.

In the following, I will initially address what types of force would qualify as armed attacks in space. This discussion will encompass both satellites that support terrestrial infrastructure and space assets dedicated solely to spatial functions. The discussion of satellites not linked to Earth will be concise, as it presently remains a relatively hypothetical scenario, with no official statements from states addressing this matter. In chapter 6.4, I will discuss the legalities of self-defense measures following such armed attacks, and the possibility of self-defense measures in space as a result of an armed attack on a terrestrial level.

³⁵⁶ UN Charter art.51

³⁵⁷ ICJ Oil Platform paras. 51, 63-64 and 72, Ruys (2010) p. 169

³⁵⁸ ICJ The United States v. Nicaragua (1986) para 176 , ICJ Nuclear Weapons (1996) para 41-43, ICJ Armed Activities on the Territory of the Congo (2005) para. 147

³⁵⁹ AP 1, art. 48, 51

³⁶⁰ ISECG (2013) pp. 4, 19-20 , Strickland et. Al (2023), and for example; the race to mine space: Pandya (2019), Harshberger (2023)

6.3 The threshold of an armed attack in space

The criteria of the threshold for an armed attack and the presence of hostile intent need to be assessed together when considering the actual effects of an attack. Therefore, the examination of the impacts of different space weapons will be addressed following the discussion of these criteria.

6.3.1 The lower threshold of an armed attack

As stated in Chapter 1.5, most states consider that the threshold of “use of force” is lower than that of “armed attack”. Neither Article 51 nor the UN charter elaborate on what an “armed attack” constitutes. According to the VCLT, the text of a treaty should be given considerable weight and should be interpreted in light of the object and purpose.³⁶¹ The term “armed attack” differs from the term “use of force” used in Article 2(4); thus the text suggests that the two concepts are distinct. Additionally, the term “attack” suggests a more severe operation than that of “force”, which linguistically has a broader scope.³⁶² The text of the Charter points to a difference in threshold between the use of force and an armed attack.³⁶³

The ICJ has affirmed this interpretation in their judgments. In the Nicaragua case, the ICJ distinguished “the most grave forms of the use of force (those constituting an armed attack) from other less grave forms»³⁶⁴ The court has upheld its distinction in the Oil Platforms Case.³⁶⁵

Despite the wording of the article and the clear stance of the ICJ, the existence of the threshold has been subject to debate. The opponents of the difference in threshold argue that a state is left defenseless against uses of force that do not qualify as an armed attack.³⁶⁶ In the dissenting opinion of Judge Schwebel in the Nicaragua case, the judge argued that a higher threshold for an armed attack would entail that stronger governments could more easily overthrow weaker governments by denying them the right of self-defense.³⁶⁷ Another argument that has been raised is that there is no difference in the threshold, but rather that less severe uses of force limit the available self-defense remedies by the proportionality criterion of the right to self-defense.³⁶⁸

³⁶¹ VCLT art. 31(1)

³⁶² Merriam Webster, (definition of “armed”) (2023), Merriam Webster (definition of “attack”) (2023), see chapter 5.2 for the definition of “force”

³⁶³ VCLT art. 31(1)

³⁶⁴ ICJ *The United States v. Nicaragua* (1986) para 191

³⁶⁵ ICJ *Oil Platforms* (2003) para 51, 61

³⁶⁶ Ruys (2010) p. 143-145

³⁶⁷ ICJ, *Nicaragua v. The United States*, Dissenting Opinion of Judge Schwebel (1986) para 166

³⁶⁸ Ruys (2010) p. 125

However, also the purpose of the Charter supports the existence of the difference in threshold. The Charter aims to reduce the dependence on military force as a means of asserting national authority, or as a means to solve disputes, as is stated in the preamble of the United Nations Charter; "to prevent future generations from experiencing the horrors of war and to establish principles and methods that ensure the use of armed force only for collective well-being."³⁶⁹ Thus the higher threshold required for an armed attack fits with the framework of the charter: the prohibition of the use of force is the starting point, and the use of force is a last resort, only available in certain circumstances, which limits the situations in which states may use force.³⁷⁰ The potential effects of the absence of a threshold were highlighted by Judge Singh in his separate opinion in the Nicaragua case. He stated if the use of force in the name of self-defense was made permissible for "minor provocations [...] the day would soon dawn when the world would have to face the major catastrophe of a third World War".³⁷¹

This interpretation is of particular relevance in outer space, which in principle should be reserved for peaceful purposes.³⁷² It is likely that space assets will be defended by autonomous weapon systems, maintaining a high threshold for these systems is essential to reduce the potential for machine-initiated armed conflicts between nations.³⁷³ Restricting the circumstances under which states can employ force in outer space will reduce the frequency of hostile actions in space, ultimately contributing to a more peaceful space environment, in line with the principle of peaceful purposes.

In the following, the majority interpretation will serve as *lex lata*. Due to the higher threshold, the employment of weapons in space determined in chapter 5 *not* to rise to the level of use of force, such as dazzling and certain jamming operations, will not be considered here. The operations discussed will not amount to an "armed attack" and consequently not occasion counter-measures under self-defense in the sense of the UN Charter article 51.

While an armed attack in outer space presents unique characteristics, there exists no established judicial precedent or treaty law specifically addressing this issue. Additionally, aside from a few state declarations, there is a lack of observable state practice in this regard. It is worth noting that there have been no documented armed attacks in outer space thus far.

³⁶⁹ UN Charter Preamble

³⁷⁰ Blank (2020) p. 256

³⁷¹ ICJ *The United States v Nicaragua Separate Opinion by Judge Singh*(1986) p. 141

³⁷² OST preamble

³⁷³ Massingham (2022) p. 279, 291, 296, 298. 299 Van Esch et. Al (2017) p. 385

Moreover, there is a scarcity of expressions of state *opinio juris*. States have to some extent expressed how they believe international law applies in space. For example, the United States has declared that any infringements on its infrastructure in space may lead to retaliatory measures.³⁷⁴ The use of the word “any”, indicates that the United States regards it as justifiable to employ force in response to any violations against their assets in space. This rationale aligns with the longstanding U.S. stance that there is no differentiation between the use of force and an armed attack.³⁷⁵ Hence the statement indicates that they hold the same view for outer space.

Other states have expressed that they have a right to defend their spatial assets, but do not provide additional clarification regarding the specific nature of infringements giving rise to this right.³⁷⁶ As a result, there is a notable lack of clear guidance on this issue. Consequently, the initial reference point for determining the threshold must rely on the interpretation of available sources made for a terrestrial reality.

Article 51 does not provide further clarification regarding the specific threshold of an armed attack. It is therefore necessary to analyze the interpretations made by the ICJ, and state practice. When the ICJ decides whether the threshold of an armed attack is surpassed the primary consideration seems to be the gravity of the “scale and effects”, particularly the physical effects of the attack.³⁷⁷ In the Nuclear Weapons case, the court noted that the gravity of an attack is not determined by the weapons employed.³⁷⁸ This has been supported in state practice, seen for example by the Security Council’s decision in relation to the 9/11 attacks on the United States, where the council recognized hijacked planes as weapons.³⁷⁹ This is of particular importance when it comes to outer space, as neither laser weapons nor electronic warfare are conventional kinetic weapons.

Loss of life is indicative of the gravity of an attack, but is not alone a criterion for the threshold to be reached. It is generally accepted that the destruction of objects may be regarded as an armed attack.³⁸⁰ In the context of the use of force in outer space, this distinction is pivotal be-

³⁷⁴ National Security Strategy (NSS) (2017) p. 31, reiterated in JP 3-14, Space Operations (2020) p. I-1

³⁷⁵ Goodman (2018)

³⁷⁶ NATO Space Policy (2022), The French Ministry for the Armed Forces (2019), United Kingdom Ministry of Defence (2022) p. 19 Ambassador Skotnikov (2002)

³⁷⁷ ICJ *The United States v. Nicaragua* (1986) para 195

³⁷⁸ ICJ *Nuclear Weapons* (1996) para 38-39

³⁷⁹ UN Security Council S/RES/1373 (2001) and UN Security Council S/RES/1373 (2001)

³⁸⁰ Ruys (2010) p. 152

cause the destruction of a satellite, though it may cause substantial effects, it will, in most instances, not directly result in physical harm to individuals. It becomes even more important when considering potential assets in space that do not support terrestrial infrastructure, as these may not have any effect on terrestrial life.

The baseline for determining the gravity threshold is therefore the “scale and effects” of the attack.³⁸¹ For further guidance regarding what would constitute an armed attack, it is necessary to rely on analogies. In the following, analogies to ships on the high seas and cyber operations will be used. Ships on the high seas might shed light on what uses of force against objects considered tantamount to the territory of a state constitute an armed attack. The regulations governing cyber operations may be more suitable for drawing analogies on the evaluation of the effects of a potential attack on a satellite, given that they target intangible infrastructure.

6.3.2 Analogy: ships on the high seas

It has been established that ships are protected from the use of force, as they “are placed in the same category as national territory.”³⁸² The question for this section is twofold: 1) what type of attacks against ships are sufficiently grave to be considered “armed attack” in the sense of the UN Charter article 51, and 2) can and should the same approach apply to satellites?

In the *Oil Platforms* case, the ICJ ruled on the basis that an attack against a single military vessel might constitute an armed attack.³⁸³ State practice also indicates that an attack against a governmental or military vessel or fleet may constitute an armed attack. Thus, attacks against a single military or governmental vessel may be sufficiently grave to be considered an “armed attack” in the sense of the UN Charter article 51.

As the discussion above demonstrated, loss of life may be indicative of the fact that the effects of the operation reach the threshold of an armed attack. When attacking a vessel, the state suffers both the destruction of an object and loss of life, whereas the attacks against satellites in the majority of cases would not directly constitute loss of life. It is possible to analogize from the discussion regarding Unmanned Maritime Vehicles, which indicates that if these Unmanned Maritime Vehicles (UMVs) were classified as warships in accordance with the United Nations Convention on the Law of the Sea (UNCLOS), they would be entitled to the same protections as conventional military vessels.³⁸⁴

³⁸¹ ICJ *The United States v. Nicaragua* (1986) para 195

³⁸² PCIJ *Lotus* (1927) para 25

³⁸³ ICJ *Oil Platforms* (2003) para 51, 63-64 and 72.

³⁸⁴ Schmitt et. Al (2016) p. p. 575-580

Nonetheless, satellites exhibit significant differences from both UUVs and traditional military vessels. Satellites that are vital for terrestrial infrastructure represent an indispensable element in safeguarding a nation's overall infrastructure.³⁸⁵ Therefore, when drawing analogies, it might be more relevant to consider comparisons with cyber operations.

On the other hand, potential satellites that provide services exclusively within the space domain share a closer resemblance to Unmanned Maritime Vehicles (UMVs). This similarity arises from their lack of human crew and their lack of involvement in supporting terrestrial infrastructure. However, while these space-based satellites contribute to spatial infrastructure, they differ notably from UUV's. The analogy implies that an attack on a single military asset beyond a state's territory could meet the criteria for being considered an armed attack. Nevertheless, these satellites operate in a domain that differs notably from the high seas, where the environment, functions, and potential consequences of attacks significantly differ from those of UUV's, which ultimately renders this comparison insufficient in addressing their specific status and vulnerabilities.

6.3.3 Analogy: cyber operations

The question for the following section is what types of cyber operations are sufficiently grave to be considered "an armed attack", and whether the same approach should apply to satellites.

According to the Tallinn Manual, "any use of force that injures or kills persons or damages or destroys property would satisfy the scale and effects requirement," but "cyber operations that involve brief or periodic interruption of non-essential cyber services, do not qualify as armed attacks»³⁸⁶ Critical infrastructure encompasses assets that are "essential for the functioning of society."³⁸⁷ This category includes services related to the provision of energy, water, transportation, financial systems, public health and safety, and telecommunications.³⁸⁸ Several of these infrastructures heavily rely on satellite-based support.³⁸⁹

Hence, by drawing parallels with the principles governing cyber operations, it becomes apparent that an attack in space may be classified as an armed attack even in the absence of physical destruction or loss of life, provided it leads to prolonged disruption of these critical services.

³⁸⁵ As seen through the importance of GNSS: Bamford et. Al (2021) p. 26, and ISR: Taverney (2022)

³⁸⁶ Tallinn Manual (2017) p. 341

³⁸⁷ National Cyber Security Centre (2023)

³⁸⁸ National Protective Security Authority (2023), National Cyber Security Centre (2023) America's Cyber Defence Agency (2023)

³⁸⁹ Bamford et. Al (2021) p. 26

State practice, has, however, established a significantly high threshold for an armed attack in the cyber context. For instance, the Stuxnet cyber operation against Iran was not classified as an armed attack due to the perception that the destruction of the centrifuges was not of a "considerable" magnitude. Despite the operation causing sustained issues for the Iranian power plant, Iran did not report any major disruptions in the country's energy supply.³⁹⁰ Thus it might not be regarded as leading to a prolonged disruption of critical infrastructure. This instance illustrates that even when a portion of a state's infrastructure is damaged, and parts of an object is destroyed, it may not meet the criteria to be deemed an armed attack.

The use of this analogy falls short when applied to the possible existence of satellites that exclusively offer services in outer space. These satellites cannot be classified as "critical infrastructure", as the definition of critical infrastructure only encompasses services on the terrestrial level. While it is plausible that this classification could change in the future, any such change remains speculative at this time. This implies that the applicable analogies do not provide a definite answer to what constitutes "an armed attack" on satellites exclusively serving outer space.

6.3.4 Accumulation of attacks

Due to the higher threshold of an armed attack, there has been a discussion about whether one can view the effects of several uses of force that all fall below the threshold of an armed attack cumulatively.³⁹¹ The concept of a series of attacks gains particular significance when considering laser and electromagnetic weapons. Individually, these attacks may not necessarily meet the threshold to qualify as an armed attack. However, when a state experiences a repeated and sustained pattern of such disruptions, it becomes conceivable that the cumulative impact could escalate to the level of an armed attack.

This "needle prick theory" has been met with skepticism as the UN Security Council apparently has rejected several invocations of self-defense in the event of cumulative attacks.³⁹² However, the Security Council has not explicitly rejected the theory itself but rather rejected the invocation due to their disproportionate responses or punitive nature.³⁹³ Other cases were rejected on

³⁹⁰ NTI (2023)

³⁹¹ Ruys (2010) p. 168

³⁹² Ruys (2010) p. 169

³⁹³ Ruys (201) p. 55, UN, see also UN Security Council (1956) para 33–93

the basis of colonialism.³⁹⁴ Additionally, although the ICJ has never explicitly accepted the theory, the court has in several cases implicitly stated that the cumulative effects of uses of force may constitute an armed attack. In the Nicaragua case, the Court noted that the lack of information about the attacks against Costa Rica and Honduras made it difficult to determine if the attacks could “singly or collectively” amount to an ‘armed attack’.³⁹⁵ In the Armed Activities case, the court stated that “even if this series of deplorable attacks could be regarded as cumulative in character, they still remained non-attributable to the DRC.”³⁹⁶

The purpose of the right to self-defense supports the existence of the accumulation of attacks. If the theory were to be rejected, a state would be left defenseless against a series of attacks that cumulatively amount to an armed attack, while the attacking state would be able to circumvent the right of self-defense by ensuring that each use of force was below the threshold of an armed attack.

6.3.5 Hostile intent

A separate requirement from the intensity of the use of force, relates to the intent behind the use of force. In order for an operation to be classified as an “armed attack” in the sense of article 51, the state conducting the operation needs to have the intention to attack. This is necessary in order to exclude harmless acts or accidental use of force.³⁹⁷ The ICJ, in the fisheries jurisdiction case, held that the arrest of the Spanish vessel by Canadian Coastguards was unproblematic in relation to the use of force, as Canada had no intention of attacking Spain. A similar position was taken in the Nicaragua case where the court held that “very little information is [...] available to the Court as to the circumstances of these incursions or their possible motivations, which renders it difficult to decide whether they may be treated [...] as amounting, singly or collectively, to an ‘armed attack.’”³⁹⁸

In the Oil Platforms case, the ICJ rejected the claim by the United States that it had been subject to an armed attack, partly due to the fact that they could not show that the attacks had been “specifically aimed” at the US or that Iran had “the specific intention” of harming US vessels.³⁹⁹ This could indicate that even in cases where the threshold is reached, it may not be regarded as

³⁹⁴ Ruys (2010) p. 171, see UN Security Council S/PV.1516 (1969) para, 61–6, 73, UN Security Council S/PV.1517 (1969) para 63–4, UN Security Council S/PV.1518 (1969) para, 58, 105 et seq. UN Security Council S/PV.1519 (1969)

³⁹⁵ ICJ, *Nicaragua v. The United States* (1986) para 231

³⁹⁶ ICJ *Armed Activities on the Territory of the Congo* (2005) para 146

³⁹⁷ Ruys (2010) p. 165-168

³⁹⁸ ICJ, *Nicaragua v. The United States* (1986) para 231

³⁹⁹ ICJ *Oil Platform* (2003) paras. 51, 63-64 and 72.

an armed attack if there was no hostile intent. State practice and *opinio juris* also indicate instances where uses of force were not considered armed attacks, primarily due to the absence of hostile intent.⁴⁰⁰ This raises the question of how one may ascertain or determine hostile intent in the context of space activities.

In cases involving greater complexity, one must consider the broader context in which the act was conducted. This evaluation encompasses an assessment of the general state of relations between the involved states. Are these states generally characterized by friendly relations, or is there a prevailing atmosphere of hostility? Has the state responsible for the actions extended diplomatic apologies or offered reparations? Has it taken punitive actions against those responsible for the incident? Another crucial factor to consider is whether the use of force is an isolated incident or part of a broader trend involving repeated deployments of armed force.⁴⁰¹ As a result, there will not be a universal guideline for the evaluation of hostile intent in outer space; instead, each case will necessitate a specific assessment.

When addressing more significant applications of armed force, such as the employment of missiles, the hostile intent is typically inherent in the action itself.⁴⁰² However, if there are compelling indications to the contrary, it can be concluded that there is no "armed attack" as defined in Article 51 of the UN Charter.

The particularities of outer space create new issues regarding the importance and the evaluation of hostile intent. Although the hostile intent could be considered to be inherent in the act itself when employing kinetic ASATs, it is likely that an ASAT attack causes space debris that will result in damage to the satellites of unintended third parties.⁴⁰³ Even if the destruction was considerable, the act would likely give rise to the right of self-defense to the third parties, due to the lack of hostile intent.

Jamming and spoofing may also create adverse effects that might not have been intended, although the jamming itself was intended. For similar cases in the cyber domain, The Tallinn Manuals hold that "all reasonably foreseeable consequences" should be considered when evaluating the scale and effects of the attack.⁴⁰⁴ The determination of whether such operations reach the threshold of an armed attack is therefore dependent on whether the foreseeable effects are sufficiently grave.

⁴⁰⁰ Ruys (2010) p. 165

⁴⁰¹ Ruys (2010) p. 167-168

⁴⁰² Ruys (2010) p. 167

⁴⁰³ Seen for example through the Russian ASAT test; Amos (2021)

⁴⁰⁴ Tallinn Manual (2017) p. 343

Furthermore, the assessment of hostile intent takes on particular significance when contemplating the potential utilization of autonomous weapons in outer space, a consideration that holds special relevance for possible remote satellites.⁴⁰⁵ Should these accidentally damage another state's satellite, it would not reach the level of an armed attack, even if the effects of the weapon reach the gravity threshold.

6.3.6 Anti-satellite weapons

The use of kinetic ASAT weapons, both co-orbital or ground-based, would destroy or damage a satellite to the point that it will no longer function. The question is whether the intended destruction would be grave enough to be considered an armed attack.

Given the Tallinn Manual's conclusion that cyber operations leading to the destruction of objects are considered as constituting an armed attack and the recognition that the use of force against a single military vessel at sea is similarly classified as an armed attack. This reasoning establishes an assumption that the deployment of a kinetic anti-satellite weapon, resulting in the destruction or significant damage to a satellite, would also be regarded as an employment of force. Nevertheless, each instance of force must be evaluated on a case-by-case basis. Hence, the forthcoming analysis will offer an assessment of the possible «scale and effects» of the employment of kinetic ASAT weapons.

Satellites utilized for terrestrial infrastructure and those exclusively employed for space operations may share certain commonalities in terms of scale and effects, but they will also exhibit notable differences. With regard to satellites used for terrestrial infrastructure, the severity of the effects resulting from a specific attack on a satellite would depend on the service it provides and how the destruction of the satellite would affect that service. If, for example, the satellite's destruction would disrupt essential services such as a GNSS system, telecommunications, or military functions, the impact would be severe, possibly targeting critical national infrastructure. The extent to which the service would be disrupted hinges on the availability of backup satellites within the system. Most states possess only 1-10 satellites in orbit, making it likely that the destruction of a satellite would significantly disrupt their services.⁴⁰⁶ Furthermore, the utilization of a kinetic ASAT weapon is expected to result in more substantial damage compared to the Stuxnet operation's impact on Iran's centrifuges.

⁴⁰⁵ Asaro (2020) P. 213, 219

⁴⁰⁶ Bamford et. Al (2021) p. 27

Determining the precise impacts and outcomes of actions targeting satellites only used for spatial purposes proves challenging, as their significance remains relatively uncertain. Nonetheless, the effects would likely be comparatively less severe than those affecting satellites crucial for terrestrial infrastructure. On the other hand, these space operation-focused satellites might be more challenging to replace, given their assumed remote locations compared to their terrestrial counterparts.⁴⁰⁷

What is true for both types of spatial assets is that satellites are expensive and require resources and technologies that may not be easily replaced by the majority of states.⁴⁰⁸ Consequently, even though the destruction of a singular satellite might not seem like a large-scale operation, the effects could be severe for the targeted state. Considering that an attack against a single vessel may constitute an armed attack, and the vessel is not part of a state's critical infrastructure, it might indicate that the destruction of a satellite would reach the threshold of an armed attack.⁴⁰⁹ Additionally, the employment of kinetic ASATs is of such clear hostile intent that it is hard to imagine that states would not regard such destruction as giving rise to the right of self-defense. Consequently, this would likely lead to the conclusion that the use of a kinetic ASAT constitutes an armed attack, given the extent of its destructive potential.

6.3.7 Electromagnetic weapons

The situations discussed in chapter 4 did not entail a use of force, and consequently would not amount to an armed attack. Nevertheless, jamming operations have the potential to target critical national infrastructure, as demonstrated by their disruption of essential services like medical evacuation (medivacs). It is conceivable that a scenario could arise where a state experiences a sequence of attacks that, when considered together, collectively reach the threshold of an armed attack. The challenging aspect is determining whether these consequences were predictable enough to establish hostile intent. On one hand, there is substantial evidence indicating that disruptions of Global Navigation Satellite Systems (GNSS) or communication satellites, initially intended to target military services, will also impact civilian services.⁴¹⁰ On the other hand, assessing the precise effects of a specific jamming operation might be challenging in advance.

Spoofing aimed at military or government ships at sea might be more likely to entail an armed attack should the spoofing result in collision or otherwise destruction of the vessel. The ICJ and

⁴⁰⁷ Strickland et. Al (2023), as an example of a possible remote space mission

⁴⁰⁸ Bamford et. Al (2021) p. 27

⁴⁰⁹ ICJ, Oil Platforms (2003) para 51, 63-64 and 72

⁴¹⁰ Seen for example through the jamming aimed at Trident Juncture, Secure World Foundation (2022) p. 02-23, France-Press (2018), Bellika (2019)

state practice shows that the use of force against a military vessel may constitute an armed attack.⁴¹¹ As the weapon used to exert force is inconsequential to the evaluation of an existence of an attack, spoofing could in these situations be above the threshold of an armed attack.⁴¹² Nevertheless, if the intention was to alter the course of a ship, and the collision was an unforeseeable consequence, it would probably not indicate hostile intent and thus would not be considered an armed attack.⁴¹³

Jamming or disrupting satellites that serve no terrestrial functions would not target critical national infrastructure, hence it is unlikely to meet the threshold outlined in the Tallinn Manual for constituting an armed attack. Again, it is challenging to provide a more detailed assessment because there is limited knowledge regarding the possible effects of such actions on these space-only satellites. If one assumes such jamming operations would not reach the level of an armed attack, due to the lack of damage to critical infrastructure, it means that these satellites, by being more remote, are less protected from certain uses of force.

6.3.8 Laser weapons

The utilization of high-power lasers capable of damaging the satellite bus and subsequently causing the satellite's failure, rendering it inoperable, mirrors the impact of anti-satellite weapons.⁴¹⁴ However, if it were feasible to repair or replace the satellite bus, it might not meet the criteria to be considered an armed attack. The Stuxnet operation set a considerably high threshold for categorizing partial destruction of objects as an armed attack.⁴¹⁵ Consequently, if one were to use the Stuxnet operation as an analogy, and the satellite bus could be restored or replaced, it might not qualify as an armed attack.

6.4 Permissible self-defense measures in space

The use of force in self-defense is the most important exception to the prohibition of the use of force. In the context of outer space, where the peaceful use of this domain is highly emphasized, clarity on the rules of self-defense becomes even more pertinent to maintaining international order and stability. What are the measures that can lawfully be taken in response to an armed attack in space?

⁴¹¹ ICJ, *Oil Platforms* (2003) para, 51, 63-64 and 72.

⁴¹² ICJ *Nuclear Weapons* (1996) para 38-39

⁴¹³ Ruys (2010) p. 167-168, Tallinn Manual (2017) p. 343

⁴¹⁴ Secure World Foundation (2022) p. 01-23

⁴¹⁵ NTI (2023)

It is established in customary law that in order for self-defense to be legal, the measures taken must be necessary and proportional to the armed attack.⁴¹⁶ The necessity and proportionality criteria exist to restrain the action to inhibit it from becoming other than defensive. In the Nuclear Advisory opinion, the ICJ stated that the requirements could have an impact on which weapons and methods the state is entitled to employ.⁴¹⁷ The criterion may also impact the geographical scope of operations.⁴¹⁸

The criterion of necessity and proportionality can be traced back to the Caroline incident in 1837, when, in the midst of an existing tumultuous relationship between Great Britain and Canada, British troops conducted an attack against a merchant ship used by Canadian rebels and American supporters in an attack against Canada. The attack took place in American territorial waters and sunk the ship. This led to a reaction by the United States, where the American Secretary of State, Webster, demanded that Britain “showed a necessity of self-defense, instant, overwhelming and leaving no choice of means and no moment of deliberation.” The criterion was later adopted by the UK foreign minister and was referenced both in the Nuremberg and Tokyo Tribunals.⁴¹⁹ The customary law regarding self-defense has evolved since then, but the “Webster formula” is still used to justify actions taken in self-defense.⁴²⁰

In the following, the geographical limitations to self-defense will be assessed in order to determine whether the employment of self-defense measures can take place in a different domain than the initial attack. Following that, an examination of the constraints dictated by the necessity and proportionality criteria will be presented, emphasizing their impact on the assessment of self-defense within the context of outer space. Lastly, the criteria pertaining to collective self-defense and intervention by invitation will be addressed.

6.4.1 Geographical scope

A question of particular importance for self-defense in outer space is the geographical scope of self-defense measures. Must possible self-defense measures be limited to outer space if the initial attack happened in space? Conversely, could an armed attack on the terrestrial level warrant an attack in outer space?

⁴¹⁶ ICJ *The United States v. Nicaragua* (1986) para 176, ICJ *Armed Activities on the Territory of the Congo* (2005) para. 147

⁴¹⁷ ICJ *Nuclear Weapons* (1996) para 41-43

⁴¹⁸ Greenwood (2011) para 29

⁴¹⁹ Ruys (2010) p. 256, Greenwood (2011) para 1

⁴²⁰ Ruys (2010) p. 92-94

The wording of Article 51 does not indicate a limit as to where the self-defense might take place. However, some scholars sustain that it is “generally accepted that forceful actions should be confined to the area of the attacks they are designed to repel.”⁴²¹ An example often put forward in this view is the case of the Falkland Islands, where Britain employed the use of force in self-defense on the Falkland Islands instead of against Argentine on Argentinian territory.⁴²² This was done in order to repel the attack. The attack was on the Falkland Islands; hence the self-defense measures were employed where the attack was taking place.

The ICJ has not specifically commented on the matter, but in the *Armed Activities* case they stated that “the taking of airports and towns many hundreds of kilometers from Uganda's border would not seem proportionate to the series of trans-border attacks it claimed had given rise to the right of self-defense, nor to be necessary to that end”⁴²³ In this case, what the ICJ seems to point out is that the attacks were not proportional, nor necessary in order to self-defend. Similarly, In the Falkland Islands case, it would not be necessary or proportional to attack the Argentinian Islands when the goal of the use of force was to stop the illegal occupation of the Falkland Islands.

Consequently, there is nothing precluding the use of force in self-defense as a response to an armed attack in space to take place in another place, or to use force in self-defense in outer space as a result of an attack on the terrestrial level, if it was aimed towards the force it sought to repel, and if it was otherwise proportional and necessary.

Although the rule, in theory, is clear these regulations were designed for a terrestrial context, and it is not evident that it should automatically extend to all domains. Particularly because the possibility of space as a war-fighting domain is relatively new. The complexity of this issue becomes especially pronounced when addressing attacks on objects in outer space that lack any connection to Earth. Theoretically, it might be justifiable to target such objects if the attack had its origins on Earth or was directed from Earth. However, even when taking into account the principles of necessity and proportionality, permitting defensive actions against such entities could potentially stretch the rule beyond what was intended.

⁴²¹ Ruys (2010) p. 118

⁴²² Ruys (2010) p. 119

⁴²³ ICJ *Armed Activities on the Territory of the Congo* (2005) para 147

6.4.2 Necessity

The necessity criterion refers to the fact that in the given circumstances, the state had no alternative means of preventing the attack aside from resorting to armed force”.⁴²⁴ The necessity criterion in jus ad bellum must be separated from the necessity criterion in international humanitarian law. Necessity in jus ad bellum requires an evaluation if an operation is necessary at all, in other words, if there is no practical non-military alternative, and if the target is necessary to repel the armed attack, whereas necessity in IHL refers to whether a concrete attack is “necessary to accomplish a legitimate military purpose». ⁴²⁵

For a self-defense measure to be necessary the measure must be “adequate for the repelling of an armed attack”, and the target must be “connected to the force to be repelled”.⁴²⁶ This is supported by consistent and uniform state practice.⁴²⁷ For example, in 1993, the US stressed that its military raid against Iraq ‘was aimed at a target directly linked to the operation against President Bush’.⁴²⁸

In the context of outer space, this would have several implications. Firstly, it would mean that if the satellite was targeted by a ground-stationed ASAT weapon, or by a laser weapon stationed on the ground, it would not be considered necessary to employ force towards the attacking state’s spatial assets. The use of force would have to be directed towards the origin of the attack, which in this case would be on the terrestrial level. Conversely, if a state suffered an attack on the terrestrial level, originating from outer space, it would be deemed necessary to use force against the attacking states’ spatial assets in order to repel the attack. If the attack originated from space and was directed against spatial assets, the use of force could be directed toward the state’s assets in space. However, in the scenario an attack is launched from space, it is possible that there may be a control center or a similar facility on the ground responsible for guiding the weapon launched from space. This can make it difficult to identify the true source of an attack. In such a scenario, both the control center and the source of the launch may be legitimate targets according to the necessity criterion.

If the state assets were protected with autonomous weapon systems, there would be no actual evaluation of the necessity criterion. In other words, the machine would most likely, and as of today’s technology, not be able to assess whether it would be better to employ diplomatic

⁴²⁴ Ruys (2010) p. 95

⁴²⁵ ICRC (2023)

⁴²⁶ Ruys (201) p. 108

⁴²⁷ ICJ statue art. 38(1)

⁴²⁸ UN Security Council (1993) p. 6.

measures instead of responding with the use of force.⁴²⁹ This lack of human judgment and discernment in autonomous systems raises concerns about their decision-making process, which is essential when considering the use of force in complex, real-world situations. This could increase the hostility in outer space.

The necessity criterion is often evaluated in terms of the temporal element of the self-defense action. This will be discussed under the “temporal element” of self-defense measures.

6.4.3 Proportionality

In order for the use of force in self-defense to be legal the force must be “proportional to the armed attack and necessary to respond to it.”⁴³⁰ Although the court here makes reference to the fact that the proportionality of self-defense must be measured “to the armed attack”, it is important to note that force as a punitive effort is not allowed.⁴³¹ A “tit for tat” approach to self-defense is not permitted. It is therefore important to see the proportionality criterion in conjunction with the criterion of necessity. For example, in the event of an attack by an ASAT weapon, it would be proportional to destroy one of the satellites of the aggressor state, but it would not necessarily be necessary if the weapon was not connected to the initial attack.

The proportionality of self-defense must be measured with the whole self-defense operation in mind, as it does not regulate specific targets or incidents, which is regulated by the proportionality principle in international humanitarian law. The ICJ referred to this in the *Oil Platforms Case*, stating that it “could not close its eyes to the scale of the whole operation.”⁴³² For outer space this means that if a state suffers an attack from outer space, which was aided by terrestrial means warranting a response in both domains, the operation in its entirety would be subject to the proportionality assessment.

The proportionality principle does not limit the kind of weapon used to respond to an attack. In the *Nuclear Weapons Case*, the ICJ stated that no weapon is excluded in the self-defense operation, but it must be evaluated according to the concrete circumstances of the case.⁴³³ The United States has for example reserved the right to respond to cyber-operations with conventional military means.⁴³⁴ In the context of outer space, this flexibility in choosing the means of self-defense implies that a state might respond to an attack on its space assets with a range of

⁴²⁹ Van Esch (2017) p. 384

⁴³⁰ ICJ, *Nicaragua v. The United States* (1986) para 176

⁴³¹ Ruys (2010) p. 95

⁴³² ICJ *Oil Platforms* (2003) para 77

⁴³³ ICJ *Nuclear Weapons* (1996) para 42-3, 97

⁴³⁴ Lynn (2011)

options, depending on the nature and severity of the attack. Thus, a state could respond with kinetic means to electronic warfare, or with electronic warfare toward an ASAT weapon.

Even if an attack were deemed necessary and proportional under the established criteria, the state would still need to take into account the specialized legal framework of outer space when contemplating the use of force. The persistent destruction of assets in space would result in a significant accumulation of space debris, with direct consequences for third parties. In this scenario, the state would be obligated to assess whether the application of force requires prior notification in accordance with Article IX of the Outer Space Treaty. Furthermore, the state would also need to take into consideration whether the selected use of force would lead to a "deliberate" alteration of the space environment, as outlined in the Environmental Modification Convention.⁴³⁵

6.4.4 The temporal element

Due to the fact that self-defense measures are meant to repel an attack in order for a state to defend itself, the use of force in self-defense, either after an attack has ceased or before it has been initiated, is typically prohibited.⁴³⁶ Nonetheless, there are exceptions to the former situation, while the latter has generated considerable debate.⁴³⁷ It becomes particularly relevant for outer space, as it might be difficult to respond to an ongoing attack due to the resources and time it takes to employ counter-space weapons. Moreover, space infrastructure remains a costly investment, and as illustrated earlier, its destruction can have profound consequences. Therefore, states would significantly benefit from the ability to prevent or halt an attack before it reaches its intended target.

For the use of force in self-defense to align with the necessity criterion, it typically needs to occur while the initial attack is still ongoing. The argument is that if the use of force in self-defense happens a long period of time after the attack has seized, there may be other remedies available, which would render the need for resorting to armed force unnecessary.⁴³⁸ In the Nicaragua case, the ICJ, in an obiter dictum, rejected that the US measures were necessary as they happened months "after the major offensive of the opposition against the government of El Salvador had been completely repulsed."⁴³⁹ However, state practice accepts that there are cases where states need time in order to prepare or consider the employment of self-defense measures.

⁴³⁵ ENMOD art. II

⁴³⁶ Ruys (2010) p. 101-102,

⁴³⁷ Ruys (2010) p. 341

⁴³⁸ Ruys (2010) p. 95

⁴³⁹ ICJ *The United States v Nicaragua* (1986) para. 237

For example, in the Falkland case, the response by Britain was 23 days after the attack by Argentina, but Britain's response was still deemed necessary. The delayed response was deemed necessary as there was a continued occupation of the islands, and a continued refusal by Argentina to comply, as well as due to the geographic distance between Britain and the islands.⁴⁴⁰

In order for a delayed response to be lawful the attack must be ongoing, or there must be a likelihood that there will be more attacks in the imminent future, they may resort to self-defense measures.⁴⁴¹ This was the case for example after the bombing of the Twin Towers in New York. In their letter to the Security Council, the US argued that "United States armed forces have initiated actions designed to prevent and deter further attacks on the United States."⁴⁴² Another example is the US strike against Iraqi intelligence headquarters in 1993, following the assassination attempt of former American president George W. Bush.⁴⁴³ Several of the members of the Security Council voiced support for the fact that the strike was justified on the grounds that it was necessary in order to prevent further attacks by Iraq.

Thus, if other attacks were imminent the state could respond in self-defense. This would allow a state to avoid any further damage after the initial attack, but, given the current state of technology, it can be assumed that the use of an Anti-Satellite (ASAT) weapon would likely be a one-time event. In such a scenario, without any additional imminent attacks, the state would have no legal basis for employing self-defense measures. This leaves the state with diplomatic or economic avenues as the primary means to respond to the attack. This raises the question of whether the state may act proactively in order to avoid the destruction of its satellite, in other words, would anticipatory self-defense be allowed?

The notion of anticipatory self-defense has been a topic of significant debate over the past few decades, with increased attention following the attacks on the Twin Towers in the United States on September 11, 2001. Anticipatory self-defense has been categorized into three main types: pre-emptive, preventive, and interceptive.⁴⁴⁴

In the 2004 report of the UN High-Level Panel on Threats Challenges and Change, and in the subsequent 2005 follow-up report of the UN Secretary-General, pre-emptive self-defense was described as "military action taken against an imminent or closely impending threat of attack,"

⁴⁴⁰ Ruys (2010) p. 101-102,

⁴⁴¹ Ruys (2010) p. 106

⁴⁴² Letter from the Permanent Representative of The U.S (2001) p. 1

⁴⁴³ Ruys (2010) p. 108-109

⁴⁴⁴ Ruys (2010) p. 108-109

while "preventive self-defense" was defined as addressing non-imminent or distant threats. The common denominator between these two concepts was identified as anticipatory self-defense.

In recent years, there has been a broader consensus among states and scholars in favor of self-defense against "imminent threats." The "High-Level Panel on Threats, Challenges and Security" presented its comprehensive report titled "A More Secure World: Our Shared Responsibility," in which the panel members endorsed the idea that a threatened state, in accordance with well-established international law, can engage in military action if the impending attack is imminent, no other means would prevent it, and the action is proportionate. Responding with self-defense to non-imminent threats was not considered legally permissible.⁴⁴⁵

Nonetheless, there has not been unanimous support among states for this stance, with opposition, particularly from some states in the global south. Due to this resistance, the position was ultimately excluded from the document of the 2005 World Summit of the UN General Assembly.⁴⁴⁶ Consequently, it remains highly speculative whether pre-emptive or anticipatory responses to attacks in space would be permissible.⁴⁴⁷

In the context of outer space, it is challenging to conceive a legal rationale for anticipatory self-defense concerning space assets that lack a function on Earth. This is due to the absence of immediate danger to human life, which is a fundamental consideration in the application of anticipatory self-defense.⁴⁴⁸ Therefore, there may be fewer compelling reasons to preemptively prevent actions against such assets, as the primary motivation for doing so, protecting human life, is not at stake in this scenario.⁴⁴⁹

The situation takes on a different dimension considering space infrastructure that intricately links with terrestrial infrastructure. In such instances, the destruction of space assets can have enduring and substantial repercussions for life on Earth, potentially impacting vital services, communications, and other essential functions. The imperative to prevent such destruction becomes paramount, and there may be a stronger legal basis for anticipatory self-defense in the pursuit of preserving human life.⁴⁵⁰

⁴⁴⁵ UN Secretary General (2004) para 188

⁴⁴⁶ Ruys (2010) p. 341

⁴⁴⁷ Ruys (2010) p. 271, UN General Assembly (2005) para 26

⁴⁴⁸ As seen through anticipatory self-defense actions taken and justified on humanitarian grounds: Ruys (2010) pp. 316-317, Whitman (2005) 265-266

⁴⁴⁹ As seen through anticipatory self-defense actions taken and justified on humanitarian grounds: Ruys (2010) pp. 316-317, Whitman (2005) 265-266

⁴⁵⁰ Ruys (2010) p. 257

Interceptive self-defense, on the other hand, has not met as much criticism. Interceptive self-defense pertains to an act of self-defense carried out after an attack has been initiated but before it has actually reached its intended target.⁴⁵¹ The primary goal of interceptive self-defense is to disrupt or neutralize the attacking force. Interceptive self-defense would, for example, permit states to stop a kinetic ASAT weapon before it has reached the satellite. The phrasing in the Charter, which states "if an armed attack occurs," may be interpreted as in support of interception. The article does not state "after an attack has occurred", or "if an armed attack has occurred," hence it leaves room for interpreting the article to allow for self-defense measures when the attack has been launched. Arguably, an attack is in progress once a missile has been launched.

Moreover, requiring a state to simply wait for an attack to occur and endure its consequences before taking action might seem counterintuitive from a security perspective. It could potentially place states in a vulnerable position and undermine their ability to protect their interests and security in a timely manner. This is often referred to as "the sitting duck" scenario.⁴⁵² However, the limitations on interceptive self-defense are often rooted in principles that aim to strike a balance between states' rights to defend themselves and the need to prevent the premature or unnecessary use of force, which can lead to instability and conflict. The challenge lies in defining the thresholds and conditions under which interceptive self-defense can be justified to protect a state's security interests without risking unnecessary escalations. Therefore, in order for interceptive self-defense to not become pre-emptive self-defense it would need to be obvious that the attack has been launched, and it was no way, or unlikely that it can be stopped.⁴⁵³

This might be the case for kinetic ASAT weapons; hence, the attacked state could employ force to stop the missile aimed at their satellite. However, this might be difficult to employ in practice. Both due to the fact that it might be challenging to ascertain the precise target of the missile, and because the actual stopping of the missile might prove problematic once it is launched. This holds particularly true for possible remote satellites that primarily support spatial infrastructure rather than terrestrial infrastructure.

As a result, this process might require the rapid decision-making and response capabilities that autonomous weapons can provide. These weapons could potentially offer the swiftness and accuracy necessary to counter threats in space effectively, as human intervention alone may not be fast or precise enough to prevent damage to valuable space assets. For the possible existence

⁴⁵¹ Ruys (2010) p. 253

⁴⁵² O'meara (2021) p. 285

⁴⁵³ Dinstein (2017) p. 204-205

of remote spatial assets, conceivably only supporting spatial operations, this would be particularly useful. Nonetheless, the complexities and drawbacks concerning autonomous weapons, as outlined earlier still hold true.

6.4.5 Collective self-defense

Article 51 of the UN Charter explicitly acknowledges the right to "collective self-defense" but provides no further clarification regarding possible criteria for this. Such criteria have been established in customary law. In the Nicaragua judgment, the International Court of Justice (ICJ) established a set of criteria that states must meet in order to exercise collective self-defense. The criteria established by the ICJ for collective self-defense include the following, the state must have been a victim of an armed attack, The state that is the victim of the armed attack must formally declare that it has been so attacked, The state must request assistance.⁴⁵⁴

The court has faced criticism for its determination that a declaration of collective self-defense is required, as long as it is requested by the victim state under attack. In the Oil Platform case, the court did stipulate that the attacked state must request support but did not mention the declaration criterion.⁴⁵⁵ This omission could be interpreted as a departure from that particular criterion.

The criteria for the use of collective self-defense do not inherently contain any restrictions or limitations that would prevent states from applying this principle in the context of outer space. Collective self-defense, like individual self-defense, must adhere to principles of proportionality and necessity.

However, in practice, only a limited number of states possess the capability to employ counter-space weapons effectively. As a result, many states would need to rely on collective self-defense mechanisms if they were to protect their space assets. This reliance would likely be placed on a select few states with the necessary capabilities, which as of today are the United States, Russia, and China.⁴⁵⁶

This situation can lead to the formation of alliances and contribute to the intensification of the great power competition. States without strong independent space defense capabilities may seek to align themselves with those possessing advanced counter-space technology to ensure the protection of their space assets. These alliances and partnerships can then become a part of

⁴⁵⁴ ICJ *The United States v Nicaragua* (1986) para 198, 199

⁴⁵⁵ ICJ *Oil Platforms* (2003) para 51

⁴⁵⁶ See chapter 3.3 for a description of the military capabilities of states

broader geopolitical rivalries and power struggles, which have become increasingly apparent in the context of space security.⁴⁵⁷

This also raises the question of whether it becomes “collective self-defense” in its true sense. In other words, the shared defense of space assets might be driven more by political and strategic considerations rather than a purely collective response to external threats, instead of being a response to a concrete attack, where the targeted states request assistance for a specific situation at hand.

6.5 Conclusion

In essence, the analysis points to the existence of a right to self-defense in outer space. However, the current legal framework regarding this right reveals a notable gap, particularly in addressing the intricate nature of remote satellites dedicated solely to space functions.

Concerning the use of weapons in space, the threshold for an armed attack would likely be surpassed by the use of anti-satellite weapons. However, the employment of laser weapons or electronic warfare presents a more ambiguous scenario. While actions such as jamming or spoofing that impede critical infrastructure might constitute an armed attack, these measures might not apply to satellites solely operating in space. This distinction highlights the necessity for a more specialized legal framework to address such nuances.

The customary law regulating permissible self-defense measures allows for responses in a different domain from where the attack took place, as long as it adheres to the principles of necessity and proportionality, but the necessity and proportionality criterion was not developed for the spatial domain. This lack of specificity may introduce a level of flexibility that could potentially heighten the risk of conflicts escalating. Conversely, the constraints imposed by the temporal criterion seem to render states vulnerable to incoming attacks on their spatial assets.

7 Is the Regulation of the Use of Force in Outer Space fit for Purpose?

As demonstrated in the thesis, the absence of judicial practice, the scarcity of binding treaties beyond the Outer Space Treaty, and the limited extent of state practice in the field of space law leads to a significant gap in the regulation regarding the use of force in outer space. This is exasperated by the fact that a portion of the *opinio juris*, the shared belief among states regarding the law, is classified and inaccessible to the public. Furthermore, the analogies fall short

⁴⁵⁷ Congressional Research Service (2020) p. 15, Congressional Research Service (2023) p. 5, 22, 35, 42, Secure World Foundation (2023) p. xvii-xxii

because the challenges posed by the outer space domain lack comparable scenarios in both the cyber and naval domains.

This situation results in a legal landscape where the regulation of a domain of increasing global importance is left largely to interpretation and guesswork. Such ambiguity leaves room for potentially perilous situations to arise, as will be demonstrated in the following. These omissions have become increasingly problematic as space activities evolve. As we witness the growing importance of space technologies and the sheer number of assets deployed in space; it becomes apparent that the regulations crafted nearly 80 years ago struggle to adapt to the realities of today.

Although one might have expectations that the Outer Space Treaty tackles these concerns and provides guidance, it fails to do so adequately. While the space treaties of the 1960s addressed concerns like preventing space colonization and nuclear weapon placement, they notably lack clarity in prohibiting the use of force and defining the right to self-defense. This issue is compounded by the reluctance of several states to ratify new treaties, leaving the development of rules heavily reliant on principles and analogies.⁴⁵⁸

In the following, this chapter will point out certain gaps in the law and examine the challenges that emerge when attempting to adapt regulations designed for a terrestrial environment to the context of space. It will also serve as a conclusion to the thesis by tying up loose ends and placing the effects of the regulation, or its absence, within a broader geopolitical context

7.1 The lack of clarity regarding the “peaceful purposes principle”

The Outer Space Treaty includes the notion of "peaceful purposes" in its preamble, indicating a general commitment to the peaceful use of outer space. However, this term is not defined or further elaborated on within the treaty's main body. The absence of clarification on peaceful purposes in the Outer Space Treaty results in significant ambiguity regarding permissible and prohibited actions in outer space. While the prevailing interpretation allows non-hostile military activities, the precise definition of "non-hostile" remains unclear.⁴⁵⁹ Consequently, states have considerable leeway to interpret the regulations according to their preferences, potentially leading to an expansion of permissible military activities. The interpretation as of now seems to allow for all military purposes as long as they do not constitute offenses or hostile operations directed at other states.

⁴⁵⁸ See for example by Wood (2017) in relation to the PPWT

⁴⁵⁹ As evidenced through the discussion in chapter 4.3

This ambiguity is in contrast with the explicit regulation of the peaceful use of celestial bodies.⁴⁶⁰ The explicit regulation seems successful because as of now, these celestial bodies have not witnessed military activities. This suggests that the OST could have benefited from a more explicit and detailed definition of what constitutes "peaceful purposes" in outer space within the main body of the treaty. This would have provided a clearer framework for determining acceptable activities in outer space and potentially addressing any potential gray areas.

The lack of impact of the peaceful purposes principle might also stem from the fact that it is unclear what effects the breach of the peaceful purposes principle may have. The Outer Space Treaty and related space agreements do not have robust enforcement mechanisms. While they provide a framework for responsible and peaceful behavior in outer space, they do not specify the consequences or procedures for dealing with breaches. This can create an impression that breaches may go unpunished or unaddressed and may therefore not have a deterrent effect. An illustrative example of this is the omission of the invocation of the "peaceful purposes" principle when certain jamming operations occurred. Neither Norway nor South Korea acknowledged that the operations they experienced violated this principle.⁴⁶¹

Due to the lack of clarity regarding the limits on military activities in space, the OST might not offer a more robust level of protection against such activities than what is already provided by the general prohibition of the use of force in the UN Charter.

However, this ambiguity regarding the exact boundaries may also stem from the fact that the existing situation concerning the use and militarization of outer space was vastly different from the reality at the time the Outer Space Treaty was drafted. This leads us to what permeates this thesis: how to interpret and apply regulations that were not originally designed to address the contemporary realities of our world. At the time of the treaty's creation, the world's reliance on assets in outer space was significantly lower, and the notion of "protecting" these assets may therefore not have been a central concern in the minds of those crafting the treaty.

Consequently, interpreting the treaty now requires striking a delicate balance between the imperative for states to safeguard their space assets and the overarching goal of maintaining outer space as a peaceful and unweaponized domain. This balance is challenging to achieve for several reasons. The current perspective on satellites and their role in global infrastructure makes it clear that they are not just peripheral assets; they are fundamental components of modern life, essential for, for example, communications, navigation, and weather forecasting. This centrality

⁴⁶⁰ OST art. VI

⁴⁶¹ Bellika (2019), Batchelor (2018), Permanent Representative of the Republic of Korea (2016)

of satellites in the modern world raises questions about whether it is feasible to ensure the protection of these assets and simultaneously preserve outer space as a peaceful environment.

7.2 The relationship between the satellite and the sending state

The Outer Space Treaty establishes that objects launched into space fall under the jurisdiction of the state responsible for their launch.⁴⁶² However, this provision doesn't directly address whether these objects can be considered an extension of the territory of the state merely by virtue of their connection to the sending state. This conclusion is reached by interpreting statements made by a select few states, who may not be representative of the international community, and by drawing analogies to the laws of naval warfare, which have inherent differences from spatial warfare.⁴⁶³ As a result, it fails to address a multitude of the issues that arise when attempting to establish that assets in space are analogous to the territory of the state.

Firstly, the Outer Space Treaty and the Registration Convention broadly subject non-governmental satellites to the same jurisdiction and liability as governmental satellites, even when they offer services to multiple states.⁴⁶⁴ This is problematic as they have a fundamentally distinct relationship with the sending state compared to governmental satellites, and because any armed attack directed toward one state's satellite impacts other states with vested interests in the satellite's operation. Paradoxically, even if these states are almost equally affected by the attack, they may lack the legal prerogative to respond with self-defense measures. However, an interpretation leaving room for the opposite might elevate a potential conflict. For example, if the effects of the Russian operation towards the ViaSat Satellite reached the threshold of an armed attack, all the affected European states could claim the right to respond in self-defense.⁴⁶⁵ This situation could lead to an unintended escalation of conflict, possibly sparking a much larger and more widespread war involving multiple nations.

An additional concern is that neither the OST nor analogies provide an answer to the question regarding satellite systems with several sending states. If one uses the principle that a satellite must be viewed as an extension of the territory of the state to warrant the right to protection from the use of force, such satellites could be viewed as an extension of several territories. This represents a novel issue where, in the event of an armed conflict, states utilizing or sharing responsibility for the same satellite systems could inadvertently form a *de facto* alliance, potentially implicating them in each other's conflicts or activities in outer space.

⁴⁶² OST art. VIII

⁴⁶³ See chapter 4.2, and 5.3.1

⁴⁶⁴ OST art. VIII, Registration Convention art. I (ii), II

⁴⁶⁵ Cyber Peace Institute (2022)

Another issue with viewing satellites as an extension of the territory of the state is that it can place stress on the principles of non-territoriality and non-sovereignty in outer space.⁴⁶⁶ When objects in space are treated as extensions of the territory of the sending state, it implies a form of territoriality in space, which can potentially challenge the non-territorial and non-sovereign nature of outer space.

Finding alternative solutions to this issue is a complex task. The "effects-based" approach proposed in Chapter 5.3.2 presents several challenges. In such a case, the link between the state and the satellite would not be fixed but rather fluid and dependent on the potential effects of the lack of access to the satellite. This results in a lack of predictability for states concerning their rights in potential conflicts. Furthermore, identifying which states have a sufficient link based on the effects they suffer from the attack becomes particularly challenging in the case of potential remote satellites. These satellites, which may lack a direct connection to terrestrial infrastructure, do not neatly fit into the traditional framework, as their effects do not manifest in the same manner as satellites closely integrated with terrestrial operations – they might not have any effect on the terrestrial level at all. Determining what effects are considered sufficient to establish a connection is therefore difficult.

Consequently, the perspective suggesting the necessity of a connection similar to the state's territory appears to be the most viable option. However, as evidenced by the current legal framework, this stance leaves numerous questions unanswered.

7.3 The threshold of the use of force and an armed attack

The thresholds for uses of force and armed attacks are established through customary law, demonstrated for example through the judgments from the ICJ. However, although the ICJ has the responsibility to interpret the UN Charter, the statements regarding the interpretation of particular provisions are made in the context of their judgments in specific cases. None of these have concerned the use of outer space. Therefore, the statements may not necessarily be fitting in the analysis of the use of force in outer space. An example of this is the terminology of "scale and effects."⁴⁶⁷ This phrase was originally used in the context of territorial intrusions, with "scale" referring to the scope of the attack.⁴⁶⁸ This concept works well on Earth, where an armed group's actions can be evaluated based on its size and concrete activities. However, this evaluation method may not be as suitable for space, particularly when considering kinetic anti-satellite (ASAT) weapons.

⁴⁶⁶ OST art. II

⁴⁶⁷ ICJ *The United States v. Nicaragua* (1986) para 195

⁴⁶⁸ ICJ *The United States v. Nicaragua* (1986) para 195

The way in which “effects” are evaluated might also not be fitting as the effects may not necessarily manifest in the same manner as we are accustomed to on Earth's terrestrial level. This is particularly relevant when considering potential remote satellites with no direct connection to terrestrial infrastructure. In cases where assessing the threshold for an armed attack hinges on the targeting of critical infrastructure, certain applications of counter-space weapons might never meet the criteria for an armed attack when used against these remote satellites. Even if the satellite itself is more impacted than a corresponding operation that might be considered an armed attack if directed against satellites that are integral to terrestrial infrastructure.

Moreover, as new weapon technologies, like lasers and electronic warfare, continue to evolve and do not always meet the traditional criteria for an armed attack, states often find themselves primarily reliant on diplomatic and economic pressure. While this approach seeks to prevent outright war, recent actions by Russia, for instance, indicate that it may not always yield the desired results.⁴⁶⁹ States may still be vulnerable to operations that inflict damage on their critical infrastructure and potentially disrupt the delivery of humanitarian assistance.

This is particularly evident and a pressing concern when it comes to jamming operations. While there has been a level of tolerance for jamming activities thus far, the incident in South Korea highlights the disruptive consequences, where ships had to reverse their course. In the event of prolonged jamming, the potential impact is far-reaching, even if it does not target “critical infrastructure” in a way that would reach the threshold of an armed attack.⁴⁷⁰ Although these systems are becoming more resilient, the weapons employed for jamming are also advancing in sophistication.⁴⁷¹

The gradual acceptance of jamming activities without corresponding retribution or significant diplomatic actions has contributed to the establishment of an increasingly high threshold for categorizing such actions as a use of force or an armed attack. This evolving dynamic raises concerns about the adequacy of current international frameworks in addressing and deterring such disruptions, particularly in an era when the consequences of these actions can have profound implications for various aspects of society and security.

⁴⁶⁹ For example the jamming operation against Trident Juncture: Secure World Foundation (2022) p. 02-23, France-Presse (2018). The cyber operation against ViaSat: Cyber Peace Institute (2022)

⁴⁷⁰ Reuters Staff (2016)

⁴⁷¹ Bamford et. Al (2021) p. 25

7.4 The regulation of permissible self-defense measures

The general principles regulating lawful self-defense measures are, as demonstrated, not easily transferred to the realities of outer space. The challenges stem, in part, from the complexities of providing effective satellite protection while adhering to the rules regulating the temporal element of self-defense, and the substantial discretion that states possess in deciding the domain in which they can take responsive actions.⁴⁷²

The character of the attack the state needs to protect itself from is different from that of a terrestrial reality, as terrestrial intrusions might be more “ongoing”, whereas attacks in space might be an isolated event. Given that anticipatory self-defense is not generally accepted in international law, once the attack has concluded, the state must rely on diplomatic measures.⁴⁷³ This might make the deterrent effect the threshold of an armed attack has, less effective, as it may seem like there are no tangible repercussions for the aggressor. This situation can embolden malicious actors, as they perceive that their actions will not be met with a significant response. However, the skepticism towards anticipatory self-defense exists for a purpose. Expanding this right to encompass retaliatory strikes or pre-emptive self-defense would foster a more hostile environment and could facilitate armed conflicts more readily. Conversely, the ineffectiveness of these laws in the context of outer space might increase the likelihood of states violating them.

Hence, the case for interceptive self-defense holds merit, particularly when considering the need for timely responses to satellite threats. This might only be possible with the employment of autonomous weapons, which would introduce a new dimension to the conflict. First, there is the inherent risk of machine error, which could result in unintended consequences or collateral damage. Additionally, the deployment of autonomous systems raises concerns regarding the absence of human oversight in evaluating whether a potential attack necessitates a forceful response.⁴⁷⁴

7.5 The environmental ramifications of the use of force in outer space

While ENMOD prohibits the intentional manipulation of the outer space environment, the use of force in self-defense may occur without an explicit intention to manipulate the space environment, yet still result in such manipulation.⁴⁷⁵ In these instances, there would be no breach of the ENMOD. For instance, launching a kinetic ASAT weapon against a target in outer space may lead to a significant amount of space debris as a consequence of the impact, even though

⁴⁷² See chapter 6.4 for a description of these issues

⁴⁷³ Ruys (2010) p. 341, UN General Assembly (2005) para 26

⁴⁷⁴ Asaro (2020) P. 213, 219

⁴⁷⁵ ENMOD art. II

the primary intent was self-defense rather than environmental manipulation. Consequently, the current framework may not provide adequate safeguards for the preservation of the space environment when it comes to the use of force in outer space.

The use of kinetic weapons against objects in space will create space debris, as demonstrated by the Russian ASAT test in 2021.⁴⁷⁶ The threat of space debris resulting from potential attacks in space has significant implications for the overall accessibility and usability of outer space. Space debris poses a considerable hazard to spacecraft and satellites because even small pieces of debris can travel at high velocities and potentially cause collisions.⁴⁷⁷

The proliferation of space debris not only increases the risk of accidental collisions but also complicates the planning and execution of space missions.⁴⁷⁸ Space debris mitigation measures, such as collision avoidance maneuvers, require additional resources and can limit the operational windows for space activities.⁴⁷⁹ Furthermore, the presence of space debris in key orbits can effectively reduce the available slots for new satellites and missions, making it more congested and crowded in those regions of space.⁴⁸⁰ This congestion can limit the opportunities for new space activities, satellite deployments, and scientific endeavors.⁴⁸¹ As a result, space activities become riskier and more challenging, which can hinder accessibility to and usability of outer space for all states.

7.6 Is space available to all?

Given the significance of space assets in national defense and security, some countries may seek alliances or partnerships with dominant space-faring states to ensure access to space infrastructure and for collective self-defense efforts. This reliance on more advanced space powers for protection and access to space capabilities can lead to a geopolitical shift where states without such allies may face disadvantages in space-related activities.

The idea of space being available to all is undermined when access to critical space infrastructure becomes contingent on alliances or partnerships with dominant space powers.⁴⁸² This can create a power imbalance and perpetuate inequalities in the use of outer space, where some states have more significant influence and control over space-related activities than others.

⁴⁷⁶ Amos (2021)

⁴⁷⁷ Pope p. 265, IADC (2021) p. 42

⁴⁷⁸ Colvin et. Al (2023) p. i, IADC (2021) p. 6

⁴⁷⁹ IADC (2021) p. 14, European Space Agency (2015) p. 42, European Space Agency (2023)

⁴⁸⁰ Ask (2022), European Commission (2023), European Commission (2022) p. 1

⁴⁸¹ Colvin et. Al (2023)

⁴⁸² OST art. I

The challenge of regulating the use of force in outer space therefore goes beyond its unique characteristics; it's compounded by the evolving technology landscape and the power dynamics surrounding it. States now heavily depend on major powers for access to critical space technology, introducing security concerns. Recent global tensions raise the question of what happens when essential space infrastructure, vital for financial markets and GNSS, relies on the protection and goodwill of a select few states with already strained relationships.

The power rivalries in space are not only evident in the competition for dominance but also in the attempts to develop new space laws. Notably, China and Russia have endorsed the Proposed Prevention of Placement of Weapons in Outer Space (PPWT), while the United States and the United Kingdom have exhibited reluctance toward such agreements.⁴⁸³ This divergence in approach is indicative of the geopolitical complexities in shaping the future of space law.

The skepticism of the United States, in particular, is influenced by concerns that Russia, in practice, may not align its actions with its stated intentions, which affects its willingness to engage in treaty negotiations.⁴⁸⁴ In situations where states are unable to reach consensus on new agreements, customary international law often comes into play. Currently, there is a trend toward custom in space law that seems to be favoring the militarization of outer space.⁴⁸⁵

Given these dynamics, there is hope that initiatives like the Woomera Manual or other academic efforts might provide valuable guidance and solutions. If the current trajectory continues, with more actions deviating from the peaceful purposes principle of outer space, there is a growing concern about the potential risks and consequences for terrestrial life, and for the continued exploration of space.

⁴⁸³ Aho (2022) Plath (2018)

⁴⁸⁴ Wood (2017)

⁴⁸⁵ Evidenced through the discussion in chapter 4.3

Bibliography

Treaties

- Antarctic Treaty *The Antarctic Treaty*, Washington DC, 1 December 1959
- AP I *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I)*, Geneva 8 June 1977
- AP II *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II)*, Geneva 8 June 1977
- Biological Weapons Convention *Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction*, London, Moscow, and Washington, D.C 10 April 1972
- Chemical Weapons Convention *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*, Geneva 29 april 1997
- Convention on Certain Conventional Weapons *The Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* Geneva, as amended on 21 December 2001
- Convention on the Prohibition of Anti-Personnel Mines *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction* Oslo, 18 September 1997
- ENMOD *Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques*, Geneva, 18 may 1977

ICOC	<i>Draft International Code of Conduct for Outer Space Activities</i> , 31 March 2014
ITU Convention	<i>Convention of the International Telecommunications Union</i> , Geneva 22 December 1992
Liability Convention	<i>Convention on International Liability for Damage Caused by Space Objects</i> , Washington DC, Moscow, London 29 March 1972
Moon Agreement	<i>Agreement Governing the Activities of States on the Moon and Other Celestial</i> New York December 18, 1984
North Atlantic Treaty	<i>The North Atlantic Treaty</i> , Washington D.C. - 4 April 1949
OST (Outer Space Treaty)	<i>The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies</i> , Washington DC, Moscow, London January 27 December 1966
Registration Convention	<i>Convention on Registration of Objects Launched into Outer Space</i> , New York 15 September 1976
Rescue Agreement	<i>Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space</i> , Washington DC, Moscow, London 22 April 1968
Statute of the ICJ	<i>Statute of the International Court of Justice</i> , San Francisco 26 June 1945
Treaty on the Non-Proliferation of Nuclear Weapons	<i>Treaty on the Non-Proliferation of Nuclear Weapons</i> , London, Moscow and Washington 1 July 1968
Treaty on the Prohibition of Nuclear Weapons	<i>Treaty on the Prohibition of Nuclear Weapons</i> New York July 2017

UN Charter	<i>Charter of the United Nations</i> , San Francisco 26. June 1945
UNCLOS	<i>United Nations Convention on the Law of the Sea</i> Montego Bay, 10 December 1982
VCLT	<i>The Vienna Convention on the Law of Treaties</i> , Vienna 23 May 1969
VCLT-IO	<i>Vienna Convention on the Law of Treaties between States and International Organizations or between International Organizations</i> Vienna 21 March 1986

Judgement, advisory opinions and separate opinions

ICJ Armed Activities on the Territory of the Congo (2005)	<i>Armed Activities on the Territory of the Congo (Democratic Republic of the Congo v. Uganda)</i> , International Court of Justice, Judgment, 19. December 2005
ICJ Barcelona Traction, Judge Fitzmaurice's separate Opinion (1970)	<i>Barcelona Traction, Light and Power Company, Limited (Belgium v. Spain)</i> International Court of Justice, separate Opinion of Judge Sir Gerald Fitzmaurice, Judgment of 5 February 1970
ICJ North Continental Shelf (1969)	<i>North Sea Continental Shelf Cases (Federal Republic of Germany/Denmark; Federal Republic of Germany/ Netherlands)</i> International Court of Justice, Judgement of 20 February 1969
ICJ Nuclear Weapons (1996)	<i>Legality of the Threat or Use of Nuclear Weapons</i> , International Court of Justice, Advisory Opinion of 8 July 1996
ICJ Oil Platforms (2003)	<i>Oil Platforms (Islamic Republic of Iran v. United States of America)</i> International Court of Justice, Judgement of 6 November 2003

ICJ The United States v Nicaragua
(1986)

Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), International Court of Justice, Judgment, 27. June 1986

ICJ The United States v. Nicaragua
Dissenting Opinion of Judge
Schwebel (1986)

Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), International Court of Justice, Dissenting Opinion by Judge Schwebel, Judgment, 27. June 1986

ICJ The United States v Nicaragua
Separate Opinion by Judge Singh
(1986)

Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), International Court of Justice, Separate Opinion by Judge Singh, Judgment, 27. June 1986

ICJ The Wall-Case (2004)

Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory, International Court of Justice, Advisory Opinion of 9 July 2004

PCIJ Lotus (1927)

The Case of the S.S. Lotus (France v. Turkey) Permanent Court of International Justice 7 September 1927

United Nations General Assembly resolutions and documents

UN General Assembly (1962)

United Nations General Assembly Resolution 1721 (1961) *International co-operation in the peaceful uses of outer space* A/Res/1721 (February 1962) <https://digitallibrary.un.org/record/665195>

UN General Assembly A/RES/1884
(1964)

United Nations General Assembly Resolution 1884 XVIII (1964) *Question of general and complete disarmament* A/RES/1884(XVIII) (1964) <https://digitallibrary.un.org/record/203960>

UN General Assembly A/RES1962
(1964)

United Nations General Assembly Resolution 1962 (XVIII) (1964) *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space* A/RES/1962(XVIII) (1964) <https://digitallibrary.un.org/record/203965>

- UN General Assembly (1970) United Nations General Assembly Resolution 265 XXV (1970) *Declaration on Principles of International Law concerning Friendly Relations and Cooperation among States in accordance with the Charter of the United Nations*, A/RES/2625/XXV (24 October 1970) https://treaties.un.org/doc/source/docs/A_RES_2625-Eng.pdf
- UN General Assembly (1974) United Nations General Assembly Resolution 3314 (XXIX) (1974) *Definition of Aggression*, A/RES/3314(XXIX) (14 December 1974) <https://digitallibrary.un.org/record/190983>
- UN General Assembly (1977) United Nations General Assembly Resolution 32/84/B *Prohibition of the development and manufacture of new types of weapons of mass destruction and new systems of such weapons* A/RES/32/84/B (12 December 1977) <https://digitallibrary.un.org/record/623117>
- UN General Assembly (2005) United Nations General Assembly Official Records 59, A/59/PV.88 (7 April 2005) <https://digitallibrary.un.org/record/545466>
- UN General Assembly (2013) United Nations General Assembly Resolution 68/74 *Recommendations on national legislation relevant to the peaceful exploration and use of outer space* A/RES/68/74 (11 December 2013) https://www.unoosa.org/pdf/gares/A_RES_68_074_E.pdf
- UN General Assembly First Committee (2022) UN General Assembly First Committee Meetings Coverage (2022) *We Have Not Passed the Point of No Return', Disarmament Committee Told, Weighing Chance Outer Space Could Become Next Battlefield*, GA/DIS/3698 (26 October 2022) <https://press.un.org/en/2022/gadis3698.doc.htm>

United Nations Security Council resolutions and documents

- UN Security Council (1947) United Nations Security Council *Resolution 18 on regulation and reduction of armaments (1947)* S/RES/18 (1947) (13 February 1947) <https://digitallibrary.un.org/record/111986>
- UN Security Council (1956) United Nations Security Council *Official Records (1956)*. S/PV.749 (30 October 1956) <https://digitallibrary.un.org/record/633318>
- UN Security Council S/PV.1516 (1969) United Nations Security Council *Official Records (1969)* S/PV.1516 (4 December 1969) https://digitallibrary.un.org/record/580414?ln=zh_CN
- UN Security Council S/PV.1517 (1969) United Nations Security Council *Official Records (1969)* S/PV.1517 (5 December 1969) <https://digitallibrary.un.org/record/580415>
- UN Security Council S/PV.1518 (1969) United Nations Security Council *Official Records (1969)* S/PV.1518 (8 December 1969) <https://digitallibrary.un.org/record/580559?ln=en>
- UN Security Council S/PV.1519 (1969) United Nations Security Council *Official Records (1969)* S/PV.1519 (8 December 1969) <https://documents-dds-ny.un.org/doc/UN-DOC/GEN/N72/822/80/PDF/N7282280.pdf?OpenElement>
- UN Security Council (1993) United Nations Security Council *Provisional Verbatim Record (S/PV.3245)* (27 June 1993) <https://digitallibrary.un.org/record/169096>
- UN Security Council S/RES/1373 (2001) United Nations Security Council *Resolution 1368 (2001) Condemning the terrorist attacks of 11 September 2001 in New York, Washington DC and Pennsylvania, United States of America,*(S/RES/1368(2001) (12 September 2001) <https://digitallibrary.un.org/record/448051>
- UN Security Council S/RES/1373 (2001) United Nations Security Council *Resolution 1373 (2001) On threats to international peace and security caused by terrorist acts,*(S/RES/1373(2001) (28 September 2001) <https://digitallibrary.un.org/record/449020>

Other official documents of the United Nations

- COPOUS (2022) Committee on the Peaceful Uses of Outer Space Legal Subcommittee, Sixty First Session, *Matters relating to the definition and delimitation of outer space*, A/AC.105/C.2/2022/CRP24 6 April 2022 https://www.unoosa.org/oosa/oosadoc/data/documents/2022/aac.105c.22022crp/aac.105c.22022crp.24_0.html
- Letter from the Permanent Representative of The U.S (2001) Permanent Representative of the United States of America, (2001) *Letter dated 7 October 2001 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security Council S/2001/946*, (7 October 2001) <https://digitallibrary.un.org/record/449476>
- Permanent Representative of the Republic of Korea (2016) Permanent Representative of the Republic of Korea Oh Joon (2016) *Letter dated 5 April 2016 from the Permanent Representative of the Republic of Korea to the United Nations addressed to the President of the Security Council, S/2016/315* <https://digitallibrary.un.org/record/825221>
- PPTW (2008) The Permanent Representative of the Russian Federation and the Permanent Representative of China, Letter to the Conference on Disarmament (2008) *Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT)* CD/1839, 12 February 2008 <https://digitallibrary.un.org/record/633470>
- Russian Federation Working Paper (2015) Working paper submitted by the Russian Federation to the United Nations Committee on the Peaceful Uses of Outer Space (COPOUS) (2015) *Achievement of a uniform interpretation of the right of self-defence in conformity with the Charter of the United Nations as applied to outer space as a factor in maintaining outer space as a safe and conflict-free environment and promoting the long-term sustainability of outer space activities* A/AC.105/L.294, 10 June 2015 https://www.unoosa.org/pdf/limited/c1/AC105_C1_2015_CRP22ER.pdf
- UN Secretary General (2004) United Nations Secretary General Note s (2004)“*transmitting report of the High-level Panel on Threats, Challenges and Change, entitled "A more secure world : our shared responsibility"* A/59/565 (2 Dec 2004) <https://digitallibrary.un.org/record/536113>

Gatherings of international customary law, manuals, and best practice

- CIHL rule 7 International Committee of the Red Cross (ICRC), Customary IHL Database, *The Principle of Distinction between Civilian Objects and Military Objectives*, Accessed: 06.04.2023 https://ihl-databases.icrc.org/customary-ihl/eng/docindex/v1_rul_rule7,
- CIHL Rule 8 International Committee of the Red Cross (ICRC), Customary IHL Database, *Definition of Military Objectives*. https://ihl-databases.icrc.org/customary-ihl/eng/docindex/v1_rul_rule8,
- ILC (1966) The International Law Commission, *Yearbook of the International Law Commission 1966 Volume II Documents of the second part of the seventeenth session and of the eighteenth session including the reports of the Commission to the General Assembly*, United Nations, New York, 1967 https://legal.un.org/ilc/publications/yearbooks/english/ilc_1966_v2.pdf
- ILC (2001) The International Law Commission, *Yearbook of the International Law Commission 2001, vol. II, Part Two, Report of the Commission to the General Assembly on the work of its fifty-third session* February 2008, <https://www.un-ilibrary.org/content/books/9789213621592>
- ILC (2004) The International Law Commission, *Report of the 56th session 2004*, UN Doc. A/59/10, (3 May-4 June and 5 July-6 August 2004) https://legal.un.org/ilc/documentation/english/reports/a_59_10.pdf
- ILC (2013) The International Law Commission, *Yearbook of the International Law Commission Report of the Commission to the General Assembly on the work of its sixty-fifth session, 2013 Volume II, Part Two*, United Nations, New York and Geneva 2018 https://legal.un.org/ilc/publications/yearbooks/english/ilc_2013_v2_p2.pdf
- ILC (2018) The International Law Commission, *Yearbook of the International Law Commission 2018, vol. II, Part Two, Report of the Commission to the General Assembly on the work of its seventieth session*, United Nations New York and Geneva 2022 <https://www.un-ilibrary.org/content/books/9789210014151>

- ILC (2019) The International Law Commission, *Report of the International Law Commission Seventy-first session 2019 (A/74/10)*, (29 April–7 June and 8 July–9 August 2019) https://legal.un.org/ilc/reports/2019/english/a_74_10_advance.pdf
- McGill Manual (2022) Jakhu, Ram S., and Steven Freeland, *McGill Manual on International Law Applicable to Military Uses of Outer Space: Volume I – Rules*. Montreal: Centre for Research in Air and Space Law, 2022
- Newport Manual (2023) Kraska, James., Raul “Pete” Pedrozo Wolff Heintschel von Heinegg, Rob McLaughlin, James Farrant Yurika Ishii, Gurpreet S. Khurana Koki Sato, *The Newport Manual on the Law of Naval Warfare*, Newport: Published by the Stockton Center for International Law 2023
- Tallinn Manual (2017) Schmitt, Michael N., and NATO Cooperative Cyber Defence Centre of Excellence. *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations. Second Edition* Cambridge: Cambridge University Press, 2017
- Literature**
- Bamford et. Al (2021) Bamford, Erik Alexander., Harald Hovland, Ragnhild Endresen Seidler, Tor Bukkvoll. “Elektronisk krigføring i gråsonoperasjoner» *Norsk Militært tidsskrift*, nr 4/2021, årgang 191, Oslo Militære Samfund, (2021) p- 23-33
- Blank (2020) Blank, Laurie R. "Irreconcilable Differences: The Thresholds for Armed Attack and International Armed Conflict." *The Notre Dame Law Review* 96, no. 5 (2021): p: 249-90. Read through: HeinOnline
- Blatt (2020) Blatt, Talia. “Anti-Satellite Weapons and the Emerging Space Arms Race” *Harvard International Review* 41, no. 3 (2020) p. 29-34 Read through: Gale Academic OneFile
- Brownlie (2003) Brownlie, Ian. *Principles of Public International Law*, Sixth Edition, Oxford University Press, 2003.
- Crawford et. al (2019) Crawford, James, and Ian Brownlie. *Brownlie's Principles of Public International Law*. 9th ed. Oxford: Oxford University Press, 2019.

- Delerue (2020) Delerue, François. "The Threshold of Cyber Warfare: from Use of Cyber Force to Cyber Armed Attack." Chapter in *Cyber Operations and International Law*, Cambridge Studies in International and Comparative Law. Cambridge: Cambridge University Press, 2020. doi:10.1017/9781108780605.009. pp. 273–342.
- Dinstein (2017) Dinstein, Yoram. *War, Aggression and Self-defence*. Sixth ed. Cambridge: Cambridge University Press, 2017.
- Evans (2018) Evans, Malcolm D. *International Law*. Fifth ed. Oxford: Oxford University Press, 2018.
- Freeland (2011) Freeland, Steven "In Heaven as on Earth - The International Legal Regulation of the Military Use of Outer Space," *US-China Law Review* 8, no. 3 (March 2011): 272-287 Read through: HeinOnline
- Froehlich (2018) Froehlich, Annette. "The Right to (Anticipatory) Self-Defence in Outer Space to Reduce Space Debris." In *Space Security and Legal Aspects of Active Debris Removal*, Vol. 16. Studies in Space Policy. Cham: Springer International Publishing, (2018). P 71-92. Read through: HeinOnline
- Geiss (2021) Geiss, Robin, and Henning Lahmann. "Protecting Societies: Anchoring A New Protection Dimension In International Law In Times Of Increased Cyber Threats." Geneva Academy ,Academy of International Humanitarian Law and Human Rights. Date Written: (February 01, 2021) <https://ssrn.com/abstract=3851137>
- Goodman (2018) Goodman, Ryan. "Cyber Operations and the U.S. Definition of 'Armed Attack.'" *Just Security*, March 8, 2018. <https://www.just-security.org/53495/cyber-operations-u-s-definition-armed-attack/>
- Hellestveit (2020) Hellestveit, Cecilie, and Gro Nystuen. *Krigens Folkerett : Norge Og Vår Tids Kriger*. Oslo: Universitetsforlaget, 2020.
- Henderson (2020) Henderson, S. (2020). Arms Control and Space Security. In: Schrogl, KU. (eds) *Handbook of Space Security*. Springer, Cham. p.95-110 https://doi-org.ezproxy.uio.no/10.1007/978-3-030-23210-8_135

- Idrovo Romo (2020) Idrovo Romo, Juan Felipe. "Armed Conflicts in Outer Space." *USFQ Law Review* 7, no. 1 (2020): pp. 335-57.
- Jakhu et. Al (2020) Jakhu, Chen, K.-W., & Goswami, B. "Threats to Peaceful Purposes of Outer Space: Politics and Law". *Astropolitics*, 18(1), (2020). p. 22–50.
<https://doi.org/10.1080/14777622.2020.1729061>
- Koskenniemi (2017) Koskenniemi, Martti "“A Trap for the Innocent ...”", Claus Kreß and Stefan Barriga (red), *The Crime of Aggression: A Commentary, Volume 2*, Cambridge University Pres 2017
- La Bella (2021) La Bella, Joshua. "Star Wars: Attack of the Anti-Satellite Weapons in Anticipatory Self-Defense." *The University of the Pacific Law Review* 52, no. 3 (2021): pp. 733-759: <https://scholarlycommons.pacific.edu/uoplawreview/vol52/iss3/15>
- Lieutenant Colonel Leon (2021) Leon, Lieutenant Colonel Jose Diaz de, «Understanding multi-domain operations in NATO” United States Air Force Transformation Delivery Division NATO Joint Warfare Centre, *The Three Swords Magazine* 37/2021 p 91-94 https://www.jwc.nato.int/application/files/1516/3281/0425/issue37_21.pdf
- Massingham (2022) Massingham, Eve, and Dale Stephens. "Autonomous Systems, Private Actors, Outer Space, and War: Lessons for Addressing Accountability Concerns in Uncertain Legal Environments" . *Melbourne Journal of International Law* 23, no. 2 (2022) :p. 276-305
Read through: HeinOnline
- O’meara (2021) O'Meara, Chris. *Necessity and Proportionality and the Right of Self-defence in International Law*. First ed. Oxford Monographs in International Law. Oxford, England: Oxford University Press, 2021.
- Pope (2021) Roxanne Pope, "Space Weapons and the Increasing Militarisation of Outer Space: Whether the Legal Framework Is Fit-for-Purpose," *Auckland University Law Review* 27, no. 1 (2021): pp. 263-301
Read through: HeinOnline
- Petras (2003) Petras , Christopher M., "The Debate Over the Weaponization of Space - A Military-Legal Conspectus" (2003) XXVIII Ann. Air & Sp. L. 171
Read through: HeinOnline

- Robinson (2021) Robinson, Jana. "Prominent Security Risks Stemming from Space Hybrid Operations." *In War and Peace in Outer Space: Law, Policy, and Ethics*, 2021. Pp. 244-59. DOI: 10.1093/oso/9780197548684.003.0010
- Ruys (2010) Ruys, Tom. "*Armed Attack*" and Article 51 of the UN Charter : *Evolutions in Customary Law and Practice*. Vol. 74. Cambridge Studies in International and Comparative Law (Cambridge, England : 1996) ;. Cambridge: Cambridge University Press, 2010.
- Ruys (2014) Ruys, Tom. "The Meaning of 'Force' and the Boundaries of the Jus ad Bellum: Are 'Minimal' Uses of Force Excluded from UN Charter Article 2(4)?" *The American Journal of International Law* 108, no. 2 (2014): pp. 159–210. <https://doi.org/10.5305/amerjintelaw.108.2.0159>
- Schmitt (2006) Schmitt, Michael. "International Law and Military Operations in Space." *Max Planck Yearbook of United Nations Law* 10, no. 1 (2006):pp. 89-125. DOI: 10.1163/138946306783559959
- Schmitt et. Al (2016) Schmitt, Michael N. and Goddard, David S, (2016) "International law and the military use of unmanned maritime systems" *International Review of the Red Cross* (2016), 98 (2), War and security at sea, pp. 567–592. doi:10.1017/S1816383117000339
- Schreiber (2022) Schreiber, Nils Holger. "Man, State, and War in Space: Neorealism and Russia's Counterbalancing Strategy Against the United States in Outer Space Security Politics." *Astropolitics* 20, no. 2-3 (2022): 151-74. DOI: 10.1080/14777622.2022.2143043
- Shaw (2021) Shaw, Malcolm N. *International Law*. Ninth ed. Cambridge: Cambridge University Press, 2021.
- Simma (2002) Simma, Bruno. *The Charter of the United Nations : A Commentary : Vol. 1. 2nd ed.* Vol. Vol. 1. Oxford: Oxford University Press, 2002
- Snyman (2015) Snyman, Ferreira A. "Selected Legal Challenges Relating to the Military Use of Outer Space, with Specific Reference to Article IV of the Outer Space Treaty." *Potchefstroom Electronic Law Journal* 18, no. 3 (2015):pp. 488-529. DOI: 10.4314/pelj.v18i3.02

- Steele (2020) Steele, Jeanette. "U.S. Naval War College Hosts Conference on Revisions to Legal Manual Regarding Armed Conflict at Sea." U.S. Naval War College Public Affairs, January 2, 2020. CHIPS: The Department of the Navy's Information Technology Magazine. <https://www.doncio.navy.mil/chips/ArticleDetails.aspx?ID=13078>.
- Steer (2020) Steer, Cassandra, "Who has the Power? A Critical Perspective on Space Governance and New Entrance to the Space Sector". " *The Georgia Journal of International and Comparative Law* 48, no. 3 (2020) p. 751 Read through: HeinOnline
- Steer et. Al (2021) Steer, Cassandra, and Dale Stephens. "International Humanitarian Law and Its Application in Outer Space." *In War and Peace in Outer Space: Law, Policy, and Ethics*, 2021. Pp 23-68 DOI: 10.1093/oso/9780197548684.003.0002
- Steinberg (1982) Steinberg, Gerald M. "The Militarization of Space: From Passive Support to Active Weapons Systems." *Futures : The Journal of Policy, Planning and Futures Studies* 14, no. 5 (1982): pp. 374-92. DOI: 10.1016/0016-3287(82)90057-X
- US Air Force Chief of Staff General Thomas D White Quoted in Futrell (1989) Futrell, Robert Frank. *Ideas, Concepts, Doctrine: Vol. II: Basic Thinking in the United States Air Force 1961-1984*. Place of Publication Not Identified: Air University Press, 1989.
- Van Esch (2017) Van Esch, Patrick, Gavin Northey, Magdalene Striluk, and Helen Wilson. "Autonomous Weapon Systems: Is a Space Warfare Manual Required?" *The Computer Law and Security Report* 33, no. 3 (2017): 382-389. doi: 10.1016/j.clsr.2017.03.004.
- von der Dunk (2020) von der Dunk, Frans G. "Scoping National Space Law: The True Meaning of 'National Activities in Outer Space' of Article VI of the Outer Space Treaty," in Blount, P. J., Tanja Masson-Zwaan, Rafael Moro-Aguilar, and Kai-Uwe Schrogl (eds.), *Proceedings of the International Institute of Space Law 2019*, The Hague, Netherlands: Eleven International Publishing, 2020, pp. 227–237
- Wang et. Al (2021) Wang, Changhong, Zhongshan Zhang, Jiayi Wu, Chaofan Chen, and Fei Gao. "An Overview of Protected Satellite Communications in Intelligent Age." *Information Sciences* 64, no. 6 (2021): Science China. Information Sciences, 2021, Vol.64 (6). DOI: 10.1007/s11432-019-2928-9

- Whitman (2005) Whitman, Jim. "Humanitarian Intervention in an Era of Pre-emptive Self-Defence." *Security Dialogue* 36, no. 3 (2005): 259-74. <https://www.jstor.org/stable/26298959>
- Zanonni (2021) Zanonni, Diego « The Responsibility for Private Activities in Outer Space: Where is the Clue to this Puzzle?» *Online magazine registered at the Court of Florence* (decree no. 5626 of 24 December 2007). *SaggiFascicoli2/2021* p. 600-625 <https://www.osservatoriosullefonti.it/mobile-saggi/mobile-fascicoli/2-2021/1639-the-responsibility-for-private-activities-in-outer-space-where-is-the-clue-to-this-puzzle>
- Reports**
- CSIS (2023) Bingen, Kari A., Kaitlyn Johnson, Makena Young, John Raymond *CSIS Space Threat Assessment Center for Strategic and International Studies: (2023)* <https://www.csis.org/analysis/space-threat-assessment-2023>
- ILA (2018) International Law Association, Sydney Report, *Final Report on the Use of Force*, (Sydney 2018) https://www.ila-hq.org/en_GB/documents/conference-report-sydney-2018-7
- Independent Fact-Finding Commission on the Conflict in Georgia (2009) Independent Fact-Finding Commission on the Conflict in Georgia *Report, Volume II* (2009) https://www.mpil.de/files/pdf4/IIFFMCG_Volume_III.pdf
- Secure World Foundation (2022) Secure World Foundation, Dr. Brian Weeden, Victoria Samson *Global Counterspace Capabilities*, (April 2022) https://swfound.org/media/207350/swf_global_counterspace_capabilities_2022_rev2.pdf
- Secure World Foundation (2023) Secure World Foundation, Dr. Brian Weeden, Victoria Samson *Global Counterspace Capabilities*, (April 2023) https://swfound.org/media/207567/swf_global_counterspace_capabilities_2023_v2.pdf
- Wood (2018) Wood, Michael, *Fifth report on identification of customary international law*, International Law Commission Seventieth Session, (2018) https://legal.un.org/ilc/documentation/english/a_cn4_717.pdf

Official Documents, Statements and Websites of States and Organizations

- America's Cyber Defence Agency (2023) America's Cyber Defence Agency. "Critical Infrastructure Sectors: CISA." Cybersecurity and Infrastructure Security Agency CISA. <https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors>. Accessed 09.07.2023
- Aho (2022) Aho, Michael. "U.S. Statement to the Conference on Disarmament - Subsidiary Body." U.S. Mission Geneva, (1 April 1, 2022) <https://geneva.usmission.gov/2022/04/01/u-s-statement-to-the-conference-on-disarmament-subsidiary-body-one/>. Accessed: 07.06.2023
- Burns (1997) Burns, Nicholas. "Press Statement by Nicholas Burns/Spokesman." U.S. Department of State. (25 April 1997). <https://1997-2001.state.gov/briefings/statements/970425a.html>
- CCDCOE (2023) CCDCOE. «Tallinn Manual." <https://ccdcoe.org/research/tallinn-manual/>. Accessed: 07.06.2023
- China National Space Administration. "China's Space Program: A 2021 Perspective." Published by The State Council Information Office of the People's Republic of China, (January 2022) https://english.www.gov.cn/archive/whitepaper/202201/28/content_WS61f35b3dc6d09c94e48a467a.html Accessed: 23.09.2023
- Colvin et. Al (2023) Colvin, Thomas J., John Karcz, and Grace Wusk. "Cost and Benefit Analysis of Orbital Debris Remediation." Office of Technology, Policy, and Strategy, (10 March 2023). NASA. https://www.nasa.gov/wp-content/uploads/2023/03/otps_-_cost_and_benefit_analysis_of_orbital_debris_remediation_-_final.pdf. Accessed: 08.10.2023
- Congressional Research Service (2020) Congressional Research Service. "U.S. Role in the World: Background and Issues for Congress." (April 6, 2020) Report No. R44891. <https://crsreports.congress.gov>,

- Congressional Research Service (2023) Congressional Research Service. "Great Power Competition: Implications for Defense—Issues for Congress." (3 October 2023) Congressional Research Service, Report No. R43838. <https://crs-reports.congress.gov>.
- Cyber Peace Institute (2023) Cyber Peace Institute. "Viasat Case Study." (June 202) <https://cyberconflicts.cyberpeaceinstitute.org/law-and-policy/cases/viasat>. Accessed: 09.08.2023
- Department of Defense Directive (1999) "Department of Defense Space Policy." (July 9, 1999) Memorandum for Secretaries of the Military Departments, Chairman of the Joint Chiefs of Staff, Under Secretaries of Defense, Director of Defense Research and Engineering, Assistant Secretaries of Defense, General Counsel of the Department of Defense, Inspector General of the Department of Defense, Assistants to the Secretary of Defense, Director of Defense Agencies. Washington, D.C., https://ocw.mit.edu/courses/16-891j-space-policy-seminar-spring-2003/7014725c53e69dc9f404b2a3d21c5374_dod-spacepol.pdf. Accessed: 06.06.2023
- European Commission (2022) European Commission, High Representative of the Union for Foreign Affairs and Security Policy, "Joint Communication to the European Parliament and the Council. An EU Approach for Space Traffic Management. An EU contribution addressing a global challenge.", Strasbourg, (15.2.2022) eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022JC0004
- European Commission (2023) The European Commission "Space Traffic Management", https://defence-industry-space.ec.europa.eu/eu-space-policy/space-traffic-management_en Accessed: 10.10.2023
- European Space Agency (2015) European Space Agency (ESA), "ESA Space Debris Mitigation Compliance Verification Guideline", European Space Research and Technology Centre (19 February 2015) <https://sdup.esoc.esa.int/documents/download/ESSB-HB-U-002-Issue214February2023.pdf> Accessed: 10.10.2023
- European Space Agency (2023) European Space Agency (ESA), "Space Safety, Mitigating space debris generation", https://www.esa.int/Space_Safety/Space_Debris/Mitigating_space_debris_generation Accessed: 10.10.2023

- FFI (2020) "Forsvarets Forskningsinstitutt. 'FFI Utvikler Ny Militær Kommunikasjonssatellitt for Nordområdene.' 2020.
<https://www.ffi.no/aktuelt/nyheter/ffi-utvikler-ny-militaer-kommunikasjonssatellitt-for-nordomradene>. Accessed: 03.02..2023
- IADC (2021) Inter-Agency Space Debris Coordination Committee, "IADC Space Debris Mitigation Guidelines", Issued by IADC Steering Group and Working Group 4, IADC-02-01 (3 June 2021)
<https://orbitaldebris.jsc.nasa.gov/library/iadc-space-debris-guidelines-revision-2.pdf> Accessed: 10.10.2023
- ICRC (2020) ICRC. "The Potential Human Cost of the Use of Weapons in Outer Space and the Protection Afforded by International Humanitarian Law." Position paper submitted by the International Committee of the Red Cross to the Secretary-General of the United Nations on the issues outlined in General Assembly Resolution 75/36, 8 April 2021. *International Review of the Red Cross* (2020), 102 (915), 1351–1356.
doi:10.1017/S1816383121000552.
- ICRC (2023) ICRC "Military Necessity." How Does Law Protect in War, ICRC Online Casebook.. https://casebook.icrc.org/a_to_z/glossary/military-necessity. Accessed 20.08.2023
- ICRC (2023) ICRC. "Weapons." *How Does Law Protect in War*, ICRC Online Casebook.. https://casebook.icrc.org/a_to_z/glossary/weapons. Accessed 20.08.2023
- International Institute of Humanitarian Law (IIHL). (2023) International Institute of Humanitarian Law (IIHL). "San Remo Manual on International Law Applicable to Armed Conflicts at Sea." <https://iihl.org/san-remo-manual-on-international-law-applicable-to-armed-conflicts-at-sea/>. Accessed 20.08.2023
- ISECG (203) International Space Exploration Coordination Group "Benefits Stemming from Space Exploration.", (September 2013)
<https://www.nasa.gov/wp-content/uploads/2015/01/benefits-stemming-from-space-exploration-2013-tagged.pdf>. Accessed 10.10.2023

- International Telecommunication Union, *itu.int*. "About International Telecommunication Union (ITU)." <https://www.itu.int/en/about/Pages/default.aspx>. Accessed :02.06.2023
- JP 3-14 (2020) *JP 3-14, Space Operations*. Joint Publication 3-14, Space Operations. 10 April 2018. Incorporating Change 1, (26 October 2020) Department of Defense. https://irp.fas.org/doddir/dod/jp3_14.pdf.
- Legal.un.org International Law Commission, "Home" <https://legal.un.org/ilc/>." Accessed 02.04.2023
- Lumiste (2023) Lumiste, Liina. "Chatham House report: Space – NATO cyber security's weak spot." NATO Cooperative Cyber Defence Centre of Excellence, (2023). <https://ccdcoe.org/incy-der-articles/chatham-house-report-space-nato-cyber-securitys-weak-spot/>. Accessed 10.10.2023
- Lynn (2011) Lynn, William. "Announcement of the Department of Defense Cyberspace Strategy at the National Defense University." (July 14, 2011) American Rhetoric, Online Speech Bank. <https://www.americanrhetoric.com/speeches/william-lynn-dod-cyberstrategy.htm>. Accessed 02.04.2023
- LTG Dodgen (2003) Dodgen, Lieutenant General Larry J. "Leveraging Space for Asymmetrical Advantage." *Army Space Journal*, (Fall 2004) Commanding General, U.S. Army Space and Missile Defense Command. <https://apps.dtic.mil/sti/tr/pdf/ADA523268.pdf>. Accessed 02.04.2023
- MA Xinmin (2014) MA Xinmin. 2014. "The Development of Space Law: Framework, Objectives and Orientations." Speech at United Nations/China/APSCO Workshop on Space Law. Deputy Director-General, Department of Treaty and Law, Ministry of Foreign Affairs, The People's Republic of China. Beijing, November 17, 2014. Accessed at <https://www.unoosa.org/documents/pdf/spacelaw/activities/2014/splaw2014-keynote.pdf>.

Ministry of Defence of the Russian Federation (2023)	<i>Ministry of Defence of the Russian Federation.</i> "Aerospace Defence Forces." 2023. https://eng.mil.ru/en/structure/forces/cosmic.htm . Accessed 08.08.2023
NASA (2019)	NASA, Buis, Alan. "Earth's Atmosphere: A Multi-layered Cake." NASA's Global Climate Change Website. (2 October 2019) https://climate.nasa.gov/news/2919/earths-atmosphere-a-multi-layered-cake/ . Accessed 20.04 2023
National Cyber Security Centre (2023)	"Critical National Infrastructure (CNI)" Advice & Guidance. Cybersecurity and Infrastructure Security Agency. URL: https://www.ncsc.gov.uk/section/advice-guidance/all-topics?topics=Critical%20National%20Infrastructure%20(CNI)&sort=date%2Bdesc Accessed 20.04 2023
National Protective Security Authority (2023)	National Protective Security Authority. "Critical National Infrastructure." (25 April 2023) https://www.npsa.gov.uk/critical-national-infrastructure/ . Accessed 20.04.2023
National Security Strategy (2017)	President Donald J. Trump. "National Security Strategy of the United States of America. (December 2017) The White House, Washington, D.C. https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf . Accessed 08.08.2023
NATO Brussels Summit Communiqué (2022)	NATO. "NATO Brussels Summit Communiqué (2022)." Brussels Summit Communiqué. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Brussels, June 14, 2021. (1 July 2022) https://www.nato.int/cps/en/natohq/news_185000.htm . Accessed 20.04.2023
NATO (Multi-Domain Operations) (2023)	Multi-Domain Operations in NATO – Explained (5 October 2023) https://www.act.nato.int/article/mdo-in-nato-explained/ Accessed 10.10.2023
NATO (NATOS approach to space) (2022)	“NATO's Approach to Space.” NATO, (October 7, 2022) https://www.nato.int/cps/en/natohq/topics_175419.htm . Accessed 20.04.2023

- NATO Space Policy (2023) NATO. "NATO's Overarching Space Policy." (17 January 2022) https://www.nato.int/cps/en/natohq/official_texts_190862.htm. Accessed 20.04.2023
- OECD (2022) OECD. "How the War in Ukraine Is Affecting Space Activities: New Challenges and Opportunities." (15 November 2022) <https://www.oecd.org/ukraine-hub/policy-responses/how-the-war-in-ukraine-is-affecting-space-activities-ab27ba94/>. Accessed 20.04.2023
- Plath (2018) Plath, Cynthia, U.S. Mission Geneva. "Remarks by Cynthia Plath, Deputy Permanent Representative to the Conference on Disarmament, United Nations, New York City, November 5, 2018. As Prepared for Delivery." (6 November 2018) <https://geneva.usmission.gov/2018/11/06/explanation-of-vote-in-the-first-committee-on-resolution-l-50-no-first-placement-of-weapons-in-outer-space/>. Accessed 20.04.2023
- Report of the Commission to Assess United States National Security Space Management and Organization (2001) Committee on Armed Services, "Report of the Commission to Assess United States National Security Space Management and Organization." Hearing before the Subcommittee on Strategic of the Committee on Armed Services, United States Senate, One Hundred Seventh Congress, First Session, March 28, 2001. U.S. Government Printing Office, (2002) <https://www.govinfo.gov/content/pkg/CHRG-107shrg81578/html/CHRG-107shrg81578.htm> Accessed 08.09.2023
- Saudi Space Agency (2023) Saudi Space Agency. "About Agency." <https://ssa.gov.sa/en/about-agency/>. Accessed 05.08.2023
- Secure World Foundation (2023) Secure World Foundation. "Global Counterspace Capabilities Report." <https://swfound.org/counterspace/>. Accessed 05.05.2023
- Sgts. Maj. Aguilastratt, et. al (2022) Sgts. Maj. Alexander Aguilastratt, Matthew Updike, & Montigo White. 2022. "The Information Domain and Social Media: Part 1." U.S. Army Training and Doctrine Command. *NCO Journal*, (1 January 2022). <https://www.armyupress.army.mil/Portals/7/nco-journal/images/2022/January/Social-Media/The-Info-Domain-Part%201.pdf>. Accessed 05.05.2023

- Skotnikov (2002) Skotnikov, Leonid A. "Statement by Ambassador Leonid A. Skotnikov to the Conference on Disarmament, June 28, 2002." Ministry of Foreign Affairs of the Russian Federation. https://www.mid.ru/es/foreign_policy/news/1717683/?lang=en. Accessed 09.09.2023
- Summary of the National Defense Strategy (2018) The Department of Defense. "Summary of the National Defense Strategy of The United States of America: Sharpening the American Military's Competence." <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>. Accessed 09.09.2023
- The French Ministry for the Armed Forces (2019) The French Ministry for the Armed Forces. "SPACE DEFENCE STRATEGY: Report of the 'Space' Working Group." (2019) https://www.gouvernement.fr/sites/default/files/locale/piece-jointe/2020/08/france_-_space_defence_strategy_2019.pdf. Accessed 09.09.2023
- United Arab Emirates Space Agency (2016) United Arab Emirates Space Agency. "National Space Policy of the United Arab Emirates.". (2016) https://space.gov.ae/Documents/PublicationPDFFiles/UAE_National_Space_Policy_English.pdf Accessed 09.09.2023
- United Kingdom Ministry of Defence (2022) United Kingdom Ministry of Defence, "Defence Space Strategy: Operationalising the Space Domain", (February 2022) https://assets.publishing.service.gov.uk/media/61f8fae7d3bf7f78e0ff669b/20220120-UK_Defence_Space_Strategy_Feb_22.pdf Accessed 09.09.2023
- Unoosa.org Committee on the Peaceful Uses of Outer Space (2023) UNOOSA (United Nations Office for Outer Space Affairs) Committee on the Peaceful Uses of Outer Space. 2023. "<https://www.unoosa.org/oosa/en/ourwork/copuos/index.html>." Accessed 09.09.2023
- UN.org United Nations "How Decisions Are Made at the UN.". <https://www.un.org/en/model-united-nations/how-decisions-are-made-un>. Accessed 20.04.2023

- United Nations Office for Disarmament Affairs (2023) United Nations Office for Disarmament Affairs, «Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD)» <https://disarmament.unoda.org/enmod/> Accessed 20.04.2023
- U.S Space Command Public Affairs Office (2021) U.S. Space Command Public Affairs Office. "Russian direct-ascent anti-satellite missile test creates significant, long-lasting space debris." Peterson Space Force Base, Colo, (15 November 2021) <https://www.spacecom.mil/Newsroom/News/Article-Display/Article/2842957/russian-direct-ascent-anti-satellite-missile-test-creates-significant-long-last/>. Accessed 04.06.2023
- U.S Department of Commerce (2022) US Department of Commerce, NOAA. "Satellites." National Weather Service, September 8, 2022. <https://www.weather.gov/ajk/OurOffice-Sat>. Accessed 04.04.2023
- US Department of Transportation (2017) "What Is Positioning, Navigation and Timing (PNT)?" U.S. Department of Transportation.. <https://www.transportation.gov/pnt/what-positioning-navigation-and-timing-pnt>. Accessed 09.03.2023
- Vergun (2021) Vergun, David. "Space Domain Critical to Combat Operations Since Desert Storm." (19 March 2021) US Department of Defense. <https://www.defense.gov/News/News-Stories/Article/Article/2543941/space-domain-critical-to-combat-operations-since-desert-storm/>. Accessed 09.03.2023
- Vergun (2023) Vergun, David. "U.S. Will Not Let China, Russia Deny Its Space Superiority, DOD Officials Say." U.S. Department of Defense. (27 February 2020) <https://www.defense.gov/News/News-Stories/Article/Article/2096883/us-will-not-let-china-russia-deny-its-space-superiority-dod-officials-say/>. Accessed 01.09.2023
- Wood (2017) Wood, Robert. 2017. "Explanation of Vote in the First Committee on Resolution L.54, Agenda Item 97(b): No First Placement of Weapons in Outer Space." U.S. Permanent Representative to the Conference on Disarmament. New York City. (30 October 2017) Accessed at <https://usun.usmission.gov/explanation-of-vote-in-the-first-committee-on-resolution-l-54-agenda-item-97b-no-first-placement-of-weapons-in-outer-space/>. Accessed 09.03.2023

News Articles

- Amos (2021) Amos, Jonathan “Russian Anti-Satellite Missile Test Draws Condemnation.” *BBC News*. BBC, 16 November 2021) <https://www.bbc.com/news/science-environment-59299101>.
- Batchelor (2018) Batchelor, Tom. “Russia ‘Deliberately Disrupted GPS Signals during NATO Drill.’” *The Independent*, (14 November 2018) <https://www.independent.co.uk/news/world/europe/russia-nato-gps-drill-military-exercise-trident-juncture-norway-finland-a8633301.html>.
- Bellika (2019) Bellika, Bjørg. “Ambulanseflyoppdrag Ble Kansellert På Grunn AV Russernes GPS-Jamming.” *Ambulanseforum*. (7 March 2019) <https://ambulanseforum.no/artikler/ambulanseflyoppdragble-kansellert-pa-grunn-av-russernes-gps-jamming>
- France-Presse (2018) France-Presse, Agence. “Russia Denies Disrupting GPS Signals during NATO Arctic Exercises.” *The Guardian*, (12 November 2018) <https://www.theguardian.com/world/2018/nov/12/russia-denies-blame-for-arctic-gps-interference>.
- Davenport (2023) Davenport, Christian. “U.S. Is Concerned about Rivals’ Space Threats, Leaked Documents Show.” *The Washington Post*, (27 April 2023) <https://www.washingtonpost.com/technology/2023/04/25/space-warfare-leaked-documents/>.
- Dimmen et. al (2021) Dimmen, Sofie Dege, and Eirik Hind Sveen. "Det er 'mission impossible' å overta luftambulansetjenesten." (Published 15 June , 2021, updated 16 June 202). *NRK Troms og Finnmark*. <https://www.nrk.no/tromsogfinnmark/helse-nord-mener-ambulansetjenesten-i-nord-norge-er-for-komplisert-til-eget-bruk-1.15537997>.
- Hendrickx (2020) Hendrickx, Bart. "Russia Gears Up for Electronic Warfare in Space." *The Space Review*, (26 October 2020) <https://www.thespacereview.com/article/4056/1>.
- Hollingham (2023) Hollingham, Richard. “The Epic Quest to Build a Permanent Moon Base.” *BBC Future*. BBC, (20 March 2023) <https://www.bbc.com/future/article/20230317-the-epic-quest-to-build-a-permanent-moon-base>.

- Lied (2021) Lied, Henrik. "Norske Marineskip Ble Manipulert Inn I Russisk Farvann." *NRKbeta*, (25 September 2021) <https://nrk-beta.no/2021/09/25/norske-marineskip-ble-manipulert-inn-i-russisk-farvann/>.
- Moteschar (2023) Mosteschar, Sa'id. "Space Law and Weapons in Space." *Oxford Research Encyclopedia of Planetary Science*. (23 May, 2019) <https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-74>.
- Pandya (2019) Pandya, Jayshree. "The Race To Mine Space." *Forbes*, (13 May 2019). <https://www.forbes.com/sites/cognitve-world/2019/05/13/the-race-to-mine-space/>.
- Reuters Staff (2016) Staff, Reuters. "South Korea Tells U.N. That North Korea GPS Jamming Threatens Boats, Planes." *Reuters*, (11 April 2016). <https://www.reuters.com/article/us-northkorea-southkorea-gps-idUSKCN0X81SN>.
- Roulette (2022) Roulette, Joey. "Russia's Anti-Satellite Threat Tests Laws of War in Space." *Reuters*. (28 October 2022) <https://www.reuters.com/article/ukraine-crisis-russia-satellites-idAFKBN2RN07K>.
- Strickland (2023) Strickland, Ashley, and Jackie Wattles. "New Space Missions Will Launch to the Moon, Jupiter, and a Metal World in 2023." *CNN*, (5 January 2023) <https://edition.cnn.com/2023/01/05/world/space-missions-2023-scn/index.html>.
- Taverney (2022) Taverney, D. Thomas "The Evolution of Space-Based ISR ." *Air & Space Forces Magazine*, (2 September 2022). <https://www.airandspaceforces.com/article/the-evolution-of-space-based-isr/>.
- Zastrow (2021) Zastrow, Mark. "How Does China's Hypersonic Glide Vehicle Work?" *Astronomy.com*. (November 4, 2021) <https://www.astronomy.com/space-exploration/how-does-chinas-hypersonic-glide-vehicle-work/>.

Dictionaries and encyclopedia entries

- Aust et. Al (2023) Aust, Anthony, Oliver Dörr “Vienna Convention on the Law of Treaties” (2023), The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019.
- Besson (2011) Besson, Samantha “Sovereignty” (April 2011),The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Birkeland (2022) Birkeland, Roger: “Starlink “ (28 December 2022) in Store norske leksikon på snl.no. <https://snl.no/Starlink>
- Dörr (2019) Dörr, Oliver, “Use of Force, Prohibition of” (August 2019) The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Mbengue (2006) Mbengue, Makane Moïse, “Preamble” (September 2006) The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Merriam Webster (definition of armed) (2023) Merriam-Webster.com Dictionary, s.v. “armed, <https://www.merriam-webster.com/dictionary/armed>. ,” Accessed 20.04 2023
- Merriam Webster (definition of attack) (2023) Merriam-Webster.com Dictionary, s.v. “attack,” <https://www.merriam-webster.com/dictionary/attack> Accessed 20.04.2023
- Merriam Webster (definition of force) (2023) Merriam-Webster .com Dictionary s.v. “force” <https://www.merriam-webster.com/dictionary/force>, Accessed 20.04.2023
- Greenwood (2011) Greenwood, Cristopher, “Self-Defence” (April 2011) The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Greenwood (2011) Greenwood, Cristopher “The Caroline Incident” , (April 2011) The Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Proelss (2021) Proelss, Alexander. “Peaceful Purposes” (May 2021) Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019
- Vöneky (2008) Vöneky, Silja. “Analogy” (February 2008) Max Planck Encyclopedias of Public International Law. Oxford University Press, 2019

Other sources

- Australian National University (2023) “Dr Cassandra Steer.” Researchers. <https://researchers.anu.edu.au/researchers/steer-c>. Accessed 08.08. 2023.
- Dooley (2023) Dooley, Hanna, and Landry Signé,. “How Space Exploration Is Fueling the Fourth Industrial Revolution.” Brookings. Brookings, (28March 2023) <https://www.brookings.edu/blog/techtank/2023/03/28/how-space-exploration-is-fueling-the-fourth-industrial-revolution/>. Accessed 08.08. 2023.
- GPS.gov (2023) GPS.gov (2023) Other Global Navigation Satellite Systems (GNSS).” GPS.gov: Other Global Navigation Satellite Systems (GNSS). <https://www.gps.gov/systems/gnss/>. Accessed 15.06.2023.
- London Economics (2017) London Economics, Economic impact to the UK of a disruption to GNSS Showcase Report (April 2017) <https://londoneconomics.co.uk/wp-content/uploads/2017/10/LE-IUK-Economic-impact-to-UK-of-a-disruption-to-GNSS-SHOWCASE-PUBLISH-S2C190517.pdf> Accessed 20.04.2023.
- Harshberger (2023) Harshberger, Caleb, “NASA Speeds Up Quest to Beat China to Mining Metals on the Moon” (22 February 2023) *Bloomberg Law* <https://news.bloomberglaw.com/federal-contracting/lunar-mining-dreams-prod-nasa-to-explore-space-tech-advancements> Accessed 20.10.2023.
- Harvard Law School (2023) “Michael N. Schmitt.” Harvard Law.. <https://pilac.law.harvard.edu/michael-n-schmitt>. Accessed 08.08. 2023.
- Johnson (2014) Johnson, Chris. "Draft International Code of Conduct for Outer Space Activities Fact Sheet." Secure World Foundation, (February 2014) https://swfound.org/media/166384/swf_draft_international_code_of_conduct_for_outer_space_activities_fact_sheet_february_2014.pdf. Accessed 20.04. 2023.

- McGill (MILAMOS) (2023) Manual on International Law Applicable to Military Uses of Outer Space. <https://www.mcgill.ca/milamos/>. Accessed 20.04. 2023.
- Navidepia , GMV 2011) GMV. “Beidou General Introduction.” BeiDou General Introduction - Navipedia, (2011) https://gssc.esa.int/navipedia/index.php?title=BeiDou_General_Introduction. Accessed 03.04.2023
- Navidepia, GMV (2011) GMV. “GLONASS General Introduction.” GLONASS General Introduction - Navipedia, (2011). https://gssc.esa.int/navipedia/index.php?title=GLONASS_General_Introduction. Accessed 03.04.2023
- Navidepia, GMV (2011) GMV. “GLONASS General Introduction.” GLONASS General Introduction - Navipedia, (2011) https://gssc.esa.int/navipedia/index.php?title=GLONASS_General_Introduction. Accessed 03.04.2023
- Navidepia, GMV (2011) GMV. “GPS General Introduction.” GPS General Introduction - Navipedia, (2011) https://gssc.esa.int/navipedia/index.php?title=GPS_General_Introduction. Accessed 03.04.2023
- Navidepia, GMV (2011) GMV. “Military Applications.” Military Applications - Navipedia, (2011). https://gssc.esa.int/navipedia/index.php?title=Military_Applications. Accessed 03.04.2023
- Navidepia, GMV (2011) GMV. “Military Navigation.” Military Navigation - Navipedia, (2011.) https://gssc.esa.int/navipedia/index.php/Military_Navigation. Accessed 03.04.2023
- NTI (2023) The Nuclear Threat Initiative (NTI) Natanz Enrichment Complex (13 June 2023) <https://www.nti.org/education-center/facilities/natanz-enrichment-complex/> Accessed 08.08.2023