Safety and Security Zones (SSZs): How Developing Clear SSZs can Establish "Rules of the Road" in Outer Space

By

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ABSTRACT

From the beginning of the Space Age, scholars have recognized the need for rules pertaining to zones around space objects to protect them from other space actors' close approaches. Until now, States have not recognized a need to implement such rules. Recent and ongoing developments in space technologies producing highly maneuverable satellites have raised significant concerns about securing space assets. On-orbit servicing techniques stand ready to breathe new life into old satellites, yet simultaneously have the potential to stealthily degrade, deny, damage, or destroy another's space assets. The proliferation of commercial micro-satellites increasingly congests Low Earth Orbit (LEO), making the need for clear rules for managing space traffic even more important. Furthermore, the competing programs to return to the Moon, Artemis and the International Lunar Research Station (ILRS), will soon lead to having two crewed space stations on the Moon, seeking to explore the viability of commercial resource extraction. Multiple States have passed domestic laws to pave the way for these activities, and commercial companies are heavily investing in developing technologies to make space resource extraction possible and profitable. These developments increase the risks to States' national security assets and highlight the need to establish rules to ensure safety and security for satellites and installations on celestial bodies. With the current geopolitical climate, it is unlikely that States will agree to binding rules in this regime. Therefore, States must consider their options to protect their interests in outer space in accordance with international law. This thesis analyzes the legal viability of safety and security zones for satellites in LEO, geosynchronous orbit (GEO), and on the Moon and other celestial bodies. This thesis will address some of the limitations of these options related to Space Domain Awareness, Space Traffic Management, and how States should determine what is or is not a threat. The time has come for clear rules for these activities to prevent misunderstandings and potential collisions in outer space. I propose a

regime of Safety and Security Zones (SSZs) in LEO, GEO, and on celestial bodies as a mechanism to increase transparency, reduce misconceptions, and provide for a more orderly use of outer space.

RÉSUMÉ

Depuis le début de l'ère spatiale, les spécialistes ont reconnu la nécessité d'établir des règles concernant les zones entourant les objets spatiaux afin de les protéger des approches de d'autres acteurs de l'espace. Jusqu'à présent, les États n'ont pas reconnu la nécessité de mettre en œuvre de telles règles. Les développements récents et continus des technologies spatiales, qui produisent des satellites hautement manœuvrables, ont soulevé d'importantes préoccupations quant à la sécurisation des biens spatiaux. Les techniques d'entretien en orbite sont prêtes à donner une nouvelle vie aux vieux satellites, mais elles peuvent aussi permettre de dégrader, d'empêcher, d'endommager ou de détruire furtivement les biens spatiaux d'autrui.

La prolifération des microsatellites commerciaux congestionne de plus en plus l'orbite terrestre basse (LEO), ce qui rend encore plus importante la nécessité d'établir des règles claires pour la gestion du trafic spatial. En outre, les programmes concurrents du retour sur la Lune, Artemis et la station internationale de recherche lunaire (ILRS), conduiront bientôt à l'installation de deux stations spatiales avec un équipage chacun sur la Lune, afin d'explorer la viabilité de l'extraction commerciale des ressources. De nombreux États ont adopté des lois nationales pour ouvrir la voie à ces activités, et des entreprises commerciales investissent massivement dans le développement de technologies visant à rendre l'extraction des ressources spatiales possible et rentable.

Ces développements augmentent les risques pour les actifs de sécurité nationale des États et soulignent la nécessité d'établir des règles pour assurer la sûreté et la sécurité des satellites et des installations sur les corps célestes. Dans le climat géopolitique actuel, il est peu probable que les États acceptent des règles contraignantes dans ce domaine. Par conséquent, les États doivent examiner les options qui s'offrent à eux pour protéger leurs intérêts dans l'espace extra-atmosphérique conformément au droit international. Cette thèse analyse la viabilité juridique des

zones de sûreté et de sécurité pour les satellites en orbite terrestre basse (LEO), en orbite géosynchrone (GEO), sur la Lune et sur d'autres corps célestes.

Cette thèse abordera certaines des limites de ces options en ce qui concerne la sensibilisation au domaine spatial, la gestion du trafic spatial et la manière dont les États devraient déterminer ce qui est ou n'est pas une menace. Le temps est venu d'établir des règles claires pour ces activités afin d'éviter les malentendus et les collisions potentielles dans l'espace extra-atmosphérique. Je propose un régime de zones de sûreté et de sécurité (SSZ) en orbite basse (LEO), en orbite géostationnaire (GEO) et sur les corps célestes, afin d'accroître la transparence, de réduire les fausses idées et de permettre une utilisation plus ordonnée de l'espace extra-atmosphérique.

ACRONYMS AND ABBREVIATIONS

ADIZ	Air Defense Identification Zone
AKM	Apogee Kick Motor
ASAT	Anti-Satellite
ATC	Air Traffic Controllers
EEZ	Exclusive Economic Zone
GEO	Geostationary Orbit
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
ICBM	Intercontinental Ballistic Missile
ICJ	International Court of Justice
ILRS	International Lunar Research Station
ISS	International Space Station
ITU	International Telecommunications Union
LEO	Low Earth Orbit
LOAC	Law of Armed Conflict
NASA	National Aeronautics and Space Administration
OST	Outer Space Treaty
OTA	US Congress Office of Technology Assessment
RPO	Rendezvous and Proximity Operations
SDA	Space Domain Awareness
SDI	Strategic Defense Initiative

SSZ	Safety and Security Zone
STM	Space Traffic Management
TCBM	Transparency and Confidence Building Measures
UNOOSA	United Nations Office for Outer Space Affairs
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
US	United States
USSPACECOM	United States Space Command
USSR	Soviet Union
VCLT	Vienna Convention on the Law of Treaties

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

Whenever there is a law on the books, one's immediate suspicion should be that the law is there because not everyone would behave according to the law's specifications. – Dr. Walter E. Williams[1]

In the 1980s, the US was concerned with the USSR's intercontinental ballistic missiles (ICBMs), in which nuclear warheads had global reach. There was also a fear of the Soviets using nuclear or conventional warheads on maneuverable satellites that acted as "space mines" which could potentially explode, damaging US critical satellites.[2] President Ronald Reagan instituted the Strategic Defense Initiative (SDI) to counter these vulnerabilities.[3] The goal was to shift the geopolitical game from one of mutually assured destruction, in which the greatest deterrent to nuclear war was the ability to retaliate before the first missiles hit, to one of "mutually assured survival," by attempting to neutralize the threat of nuclear missiles in the first place.[4] This was to be achieved through the deployment of new space technologies.

Amid this development, scholars identified that technological developments in space required updated "rules of the road" to encourage "safe and orderly … uses of space."[5] During the Cold War, tensions ran high, and Reagan's SDI caused concern about escalation. The early warning systems that the USSR and the US used reduced the likelihood of miscalculation, misinterpretation, and mistake which in turn reduced the risk of unintended escalation.[6] Anti-

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[1] "Discrimination and Segregation, by Walter E.Williams," (5 October 2016), online: <https://www.creators.com/read/walter-williams/10/16/discrimination-and-segregation>.
[2] Office of Technology Assessment et al, "Anti-Satellte Weapons, Countermeasures, and Arms Control" (1985) OTA-ISC-281 at x [*OTA Assessment*].
[3] Office of Technology Assessment, "SDI: Technology, Survivability, and Software" (1988) OTA-ISC-353 at 3 [*SDI: Technology, Survivability, and Software*].
[4] *Ibid* at 21.
[5] Richard DalBello, "Rules of the Road: Legal Measures to Strengthen the Peaceful Uses of Outer Space Legal Aspects of Maintaining Outer Space for Peaceful Purposes" (1985) 28:1 Proc on L Outer Space 8 at 8 [*Rules of the Road*].
[6] US, *East-West cooperation in outer space: hearing before the Committee on Foreign Relations, United States Senate, Ninety-eighth Congress, second session, on S.J. Res. 236 ... September 13, 1984. Note* 1984) at 48 [*East-West cooperation in outer space*].

satellite (ASAT) weaponry, such as "space mines" that threatened those capabilities and was a serious destabilizing threat.[7]

In 1985, the US Congress Office of Technology Assessment (OTA) published a study entitled "Anti-Satellite Weapons, Countermeasures, and Arms Control."[8] The report highlights the threats that technological advancements of the US and USSR, particularly in anti-satellite (ASAT) technologies.[9] One proposal, among others outside the scope of this thesis, was to develop some general rules to "reduce suspicion and encourage the orderly use of space."[10] The report suggested the negotiation of rules with the Soviet Union regarding "keep-out zones" or, in the absence of such an agreement, that the United States should declare them unilaterally and be prepared to defend them.[11] The authors recognized that "keep out zones" "would have to be reconciled with Article II" of the OST. Therefore, the OTA authors provided a not-very-convincing-counter-argument by analogy with international practice with commercial satellites in GEO, in which the International Telecommunication Union (ITU) requires separation of a few degrees to avoid frequency interference.[12] This argument is weak because the ITU at least is an international body implementing agreements to which spacefaring States adhere.

The authors of the OTA report provide a model of some potential "rules of the road" regarding "keep-out zones":

- Keep 100 kilometers and three degrees out-of-plane from foreign satellites below 5000 kilometers.
- Keep 500 kilometers from foreign satellites above 5000 kilometers except those within 500 kilometers of geosynchronous altitude.
- One pre-announced close approach at a time is allowed.

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[7] *Ibid*.
[8] Office of Technology Assessment et al, *supra* note 2.
[9] *Ibid* at 3.
[10] *Ibid* at 8–9, 17.
[11] *Ibid* at 117.
[12] *Ibid* at 118.

- In the event of a violation of the rules above, the nation of registry of the satellite which most recently initiated a maneuver "burn" is at fault and guilty of trespass.
- Satellites trespassing upon keep-out zones may be forcibly prevented from continued trespass.[13]

These rules recognized the then-existing practice of satellites in GEO, which were already too close together to implement a "keep-out zone" large enough to protect the satellites without displacing satellites already in place.[14] The authors also considered that there were too many satellites in LEO to justify a "keep-out zone" spanning hundreds of kilometers radius around individual satellites.[15] The proposed rule permits one close approach at a time to allow for treaty verification or verify that the target satellite is not carrying fissionable material contrary to Article IV of the OST.[16] The authors acknowledge that for these rules to be binding, the US and Soviet Union "might have to modify their commitment to the [OST]" because Article II "could be interpreted as prohibiting establishment of such keep-out zones."[17] The OTA report and its proposals spurred considerable discussion amongst space scholars regarding the legality of "keep-out zones" and other exclusionary regimes in space.[18]

With the collapse of the Soviet Union at the end of the 20th Century, the world shifted from a bipolar world with competing superpowers, to one of a more multilateral conflict between the US and Islamic terrorists.[19] Although the conflict used space assets, the conflict between outer space assets of belligerents was minimal.[20] The space race was over, at least between the US and

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[13] *Ibid* at 136.
[14] *Ibid*.
[15] *Ibid* at 137 The proposal of a keep-out zone that spans hundreds of kilometers was untenable in the 1980s, it is even less tenable now with thousands of satellites now in LEO. .
[16] *Ibid* at 137.
[17] *Ibid* at 136.
[18] See Chapter 3, below.
[19] Giorgio Petroni & Davide Gianluca Bianchi, "New patterns of space policy in the post-Cold War world" (2016) 37:1 Space Policy (Special Issue: Developing Countries) 12 at 12.
[20] Larry Greenemeier, "GPS and the World's First 'Space War,'" (8 February 2016), online: *Scientific American* <https://www.scientificamerican.com/article/gps-and-the-world-s-first-space-war/>.

USSR. The space policy focus in the US shifted from that of great power competition to liberalization of space, encouraging commercial development in the space sector.[21] In 1992, US Congress passed the Land Remote Sensing Act, which established a licensing regime for commercial operators to sell satellite imagery data that previously was only available to government intelligence agencies, with restrictions of course.[22] National security was still an important consideration, and commercial providers had to comply with strict licensing requirements, but there was a shift toward allowing more commercialization. The success of using space capabilities in Operation Desert Storm, however, led to the US military emphasizing investment in military space technologies.[23] When President George W. Bush became President, he started a push to go to the Moon and then to Mars, until the terror attack of 11 September 2001.[24]

In the aftermath of 9/11, national security interests remained a major focus of outer space activities, but funding for developing space technologies was deemphasized because of the conflicts in Afghanistan and Iraq.[25] The original USSPACECOM was dissolved and the space capabilities once housed there were transferred to STRATCOM. It was during this time that China's development in space technologies was beginning to be seem a potential threat to US national security. At first, US leaders discounted China's initial tests, because China was still far behind American capabilities. In 2007, during the height of the war on terror, China destroyed

[21] Everett C Dolman, "War, Policy, and Spacepower: US Space Security Priorities" in Kai-Uwe Schrogl, ed, *Handbook of Space Security: Policies, Applications and Programs*, second (Cham: Springer International Publishing, 2020), 367 at 377 [*War, Policy, and Spacepower*].
[22] *Land Remote Sensing Policy Act of 1992*, Pub L No 102-555, 106 Stat 4163 (1992).
[23] Dolman, *supra* note 21 at 377.
[24] *Ibid* at 378.
[25] For instance, in 2003, one month after the US began its campaign in Iraq, President Bush signed an updated policy on commercial remote sensing that emphasized national security over commercial interests. See *US Commercial Remote Sensing Space Policy 2003 Fact Sheet,* US Office of Space Commerce, [*CRSSP*]; Dolman, *supra* note 21 at 378.

one of its own weather satellites with a direct-ascent ASAT weapon.[26] The incident caused more than 3,000 trackable pieces of debris, which was concerning by itself, but it also showed that China was capable of targeting satellites with kinetic direct-ascent weapons, meaning they now must be taken seriously as a space power.[27]

Between 2008 and 2021, India and Russia also conducted ASAT tests.[28] India tested its ASAT in March 2019.[29] In 2021, Russia tested a direct-ascent ASAT weapon that destroyed its own satellite.[30] These direct ascent ASAT tests caused a lot of debris and were denounced in a UN General Assembly Resolution in December 2022.[31] The US and other countries also committed to no longer conduct destructive direct-ascent ASAT tests.[32]

In December 2007, the US noticed that an NRO satellite was hurtling uncontrolled, falling out of orbit.[33] The bus-sized satellite had a fuel tank with 1,000 pounds of hydrazine fuel, which is very toxic.[34] NASA scientists calculated that the heat of reentry would be insufficient to melt the frozen hydrazine and would likely remain intact and potentially pose a significant risk to human life on Earth.[35] President Bush ordered that if something could be done to mitigate the risk, that it must be done.[36] The US announced Operation Burnt Frost and the justification for it

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[26] Dolman, *supra* note 21 at 378.
[27] *Ibid* at 381.
[28] Ajey Lele, "India in Space: A Strategic Overview" in Kai-Uwe Schrogl, ed, *Handbook of Space Security: Policies, Applications and Programs* (Cham: Springer International Publishing, 2020), 571 at 583–84 [*India in Space*].
[29] *Ibid* at 583.
[30] Chelsea Gould, "Russian anti-satellite missile test was the first of its kind," (17 November 2021), online: *Space.com* <https://www.space.com/russia-anti-satellite-missile-test-first-of-its-kind>.
[31] Jeff Foust, "More countries encouraged to commit to halt destructive ASAT tests," (15 June 2023), online: *SpaceNews* <https://spacenews.com/more-countries-encouraged-to-commit-to-halt-destructive-asat-tests/>.
[32] *Ibid*.
[33] Lucas Steinhauser & Scott Thon, "Operation Burnt Frost: The Power of Social Networks," (1 June 2008), online: *NASA Appel Knowledge Services* <https://appel.nasa.gov/2008/06/01/operation-burnt-frost-the-power-of-social-networks/> [*Operation Burnt Frost*].
[34] *Ibid*.
[35] James Oberg, "U.S. Satellite Shootdown: The Inside Story," (1 August 2008), online: *IEEE Spectrum* <https://spectrum.ieee.org/us-satellite-shootdown-the-inside-story> [*U.S. Satellite Shootdown*].
[36] *Ibid*.

before the launch of the ASAT in an effort to be transparent about the mission.[37] In February 2008, an ASAT missile was launched from the naval vessel USS Lake Erie and successfully destroyed the satellite.[38] This example differs from direct-ascent ASAT tests of other States, primarily because it was not a test or a demonstration of a capability, rather it was a decision to minimize real harm to human life because of an uncontrolled deorbit carrying the toxic hydrazine could have landed anywhere.[39] Its destruction ensured that the hydrazine would not pose a threat, and it was in a low enough orbit that it did not cause lasting debris.[40] Of course, although not the official reason for launching the ASAT, the US demonstrated the operational, not merely experimental, capability of the US.

Another threat on-orbit is the development of highly maneuverable satellites. The US, China, Russia, and others are developing satellites that could approach closely to other satellites, some of which have capabilities to repair, refuel, maintain, dock with, grapple with nets, or shoot harpoons and other kinetic projectiles. [41] These capabilities pose a serious threat to satellites in orbit, both in LEO and GEO. The increasing congestion only exacerbates the problem.

On 31 January 2014, approximately 1,167 active satellites were in orbit.[42] Less than ten years later, that number grew to approximately 7,560 active satellites in orbit.[43] This expansion

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[37] Dwayne A Day, "Burning Frost, the view from the ground: shooting down a spy satellite in 2008," (21 June 2021), online: *The Space Review* <https://www.thespacereview.com/article/4198/1> [*Burning Frost, the view from the ground*].
[38] *Operation Burnt Frost*, *supra* note 33.
[39] *Burning Frost, the view from the ground*, *supra* note 37.
[40] *Ibid*.
[41] Manny Shar, "How orbital refueling will unlock humanity's potential in space," (2 October 2023), online: *The Space Review* <thespacereview.com/article/4660/1>; "Global Counterspace Capabilities: An Open Source Assessment," (April 2024), online: <https://swfound.org/media/207826/swf_global_counterspace_capabilities_2024.pdf> at xix–xxii [*Global Counterspace Capabilities*].
[42] Union of Concerned Scientists, *Changes to the Satellite Database* Union of Concerned Scientists, 2023) at 138 As of 20 April 2024, the database only contains data on launches up to 1 May 2023.
[43] *Ibid* at 1.

of new satellites is largely driven by constellations of small satellites in LEO such as OneWeb,[44] Starlink[45], and Planet[46] satellites. According to the United Nations Office for Outer Space Affairs (UNOOSA) data, there were never more than 250 objects launched in a single year worldwide between the years 1957 and 2016.[47] In 2017, the US launched 286 satellites. That number decreased slightly in 2018, but then continued climbing every year until over 2,000 satellites were launched in 2023.[48] This rapid proliferation of satellites in space, especially in LEO, creates a greater risk of collision. The risk of collision is aggravated by the developments of Rendezvous and Proximity Operations (RPO) technologies, in which highly maneuverable satellites can approach close enough to a target satellite to repair or observe it.[49]

Furthermore, the Artemis Program and the International Lunar Research Station (ILRS) are competing programs to return to the Moon, with a goal of establishing a permanent presence there, for conducting research and potentially using the Moon as a jumping off point for missions to Mars with both programs eyeing the same potential locations on the south pole of the Moon, because of the advantages those locations hold. These two competing programs with similar goals, the US with the Artemis Program on one side and China and Russia with the ILRS on the other, has a potential to increase geopolitical tensions on Earth, through misunderstanding,

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[44] OneWeb has launched 634 satellites in 19 launches. OneWeb, "Our Story," (9 April 2024), online: *OneWeb* <http://oneweb.net/about-us/our-story>.
[45] As of February 2024, Starlink has more than 5,500 satellites in orbit. Elizabeth Howell & Tereza Pultarova, "Starlink satellites: Facts, tracking and impact on astronomy," (20 February 2024), online: *Space.com* <https://www.space.com/spacex-starlink-satellites.html> [*Starlink satellites*].
[46] As of March 2024, Planet labs had over 450 satellites in orbit. GISGeography, "Planet Labs Imagery: The Entire Earth, Everyday," (17 January 2018), online: *GIS Geography* <https://gisgeography.com/planet-labs-imagery/> [*Planet Labs Imagery*].
[47] Our World in Data, "Annual number of objects launched into space - UNOOSA [dataset]. United Nations Office for Outer Space Affairs, 'Online Index of Objects Launched into Outer Space' [original data]," (22 April 2024), online: *Our World in Data* <https://ourworldindata.org/grapher/yearly-number-of-objects-launched-into-outer-space> [*Annual number of objects launched into space - UNOOSA*].
[48] *Ibid*.
[49] Ashish Mehra, "On-Orbit Satellite Servicing Market Growth, Opportunities, Trends, Forecast 2030," (8/16/23), online: *SBWire* <http://www.sbwire.com/press-releases/on-orbit-satellite-servicing-market-growth-opportunities-trends-forecast-2030-1377035.htm>.

miscommunication, or lack of trust.[50] Though there is hope that the ever-expanding number of countries signing on to the Artemis Accords will lead to increased understanding, communication, and trust internationally, the friction between the US and China will not likely be smoothed in the short term.[51] There is now a great need to clarify the rules in LOE, GEO, and on Celestial Bodies.

Many scholars have proposed zones to mitigate these problems. Scholars have called them many names: keep-out zones, exclusionary zones, safety zones, security zones, identification zones, and others. The proposed purposes for these zones may or may not run afoul of space law. For example, keep-out or exclusionary zones, by their nature of limiting certain areas of space, potentially violate the non-appropriation principle. Safety, security, or identification zones can also be problematic, depending on implementation and the rules governing them. I propose establishing a safety and security zone (SSZ). I argue that safety and security are inseparable in outer space. A breach of security has implications for safety and vice versa. Therefore, the justification for my proposed zone is both safety and security.

This thesis proposes that establishing Safety and Security Zones in GEO, LEO, and on Celestial Bodies is one way to mitigate some of the risks associated with RPO operations and operations on the Moon and other celestial bodies. There is an argument that current space law already allows for these Zones,[52] however, a multilateral treaty would be the strongest way to proceed.

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[50] Andrew Jones, "China seeks its own Apollo moment – and more," (6 June 2024), online: *SpaceNews* <https://spacenews.com/china-seeks-its-own-apollo-moment-and-more/>.
[51] Jeff Foust, "Artemis Accords lift off," (17 June 2024), online: *The Space Review* <https://www.thespacereview.com/article/4812/1>.
[52] See Chapters 2 and 4 below.

A. SOVEREIGNTY AND JURISDICTION IN SPACE

The preliminary legal issue is what jurisdiction States can exercise in outer space. The general international rule is that States, as sovereigns, may act in their interests unless they agree through treaty or custom to prohibit certain activities.[53] In outer space, the OST puts limits on sovereign claims, but leave open others. Bin Cheng's breakdown of jurisdiction is helpful to conceptualize what authority a state may exert in outer space, where territorial sovereignty does not exist. Cheng explains that States have three types of jurisdiction: 1) territorial jurisdiction over their sovereign territory; 2) quasi-territorial jurisdiction, which exists on board ships, aircraft, and spacecraft; and 3) personal jurisdiction over their nationals, natural or juridical.[54] Each type of jurisdiction also has two elements: jurisfaction, the ability to make laws related to the subject matter, and jurisaction, the ability to enforce laws.[55]

Each State's jurisfaction is "on par" with every other State's. However, there is a priority of jurisaction depending on the type of jurisdiction at issue. Territorial jurisdiction has the first priority, quasi-territorial jurisdiction has the second, and personal jurisdiction has the third. In outer space, there is no territorial jurisdiction, which leaves the possibility of applying only quasi-territorial jurisdiction and personal jurisdiction.[56] This distinction is important to note because in implementing "keep-out zones" of whatever kind, a State may exert some influence over its registered space objects and, as I argue, the space immediately surrounding it through its jurisdiction and control over the object.

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[53] *SS Lotus (France v Turkey)* (1927), PJIC (Ser A) No 10 at 18 [*Lotus Case*].
[54] Bin Cheng, *Studies in International Space Law* (Oxford: Oxford University Press, 1997) at 387.
[55] *Ibid*.
[56] *Ibid* at 86–7.

1. LEGAL STATUS OF OUTER SPACE AND CELESTIAL BODIES

Scholars have noted many possible ways to characterize the legal status of outer space, but many use the following three: *res nullius, res communes omnium,* or *res extra commercium*.[57] Some care must be taken in discussing these terms, because they do not actually appear in the OST or other space treaties.[58] Nevertheless, the concepts are useful to determine the types of jurisdiction States may exercise in outer space.

These concepts originate in Roman law and refer to property rights and the extent of sovereignty over non-territorial areas.[59] *Res nullius*, "the thing belongs to no one," is a theory that, as applied to outer space, implies that outer space and celestial bodies belong to no one, but States may exercise territorial jurisdiction over that area and make it their own.[60] *Res extra commercium* is a type of property that belongs to no one and where States may not exercise territorial jurisdiction.[61] *Res communes omnium* is a type of property that no one owns exclusively, but that multiple parties could use for their own purposes, in "common."[62]

Bin Cheng, writing before the Outer Space Treaty's entry into force, was of the opinion that "void" space consisted of *res extra commercium*, and celestial bodies constituted *res nullius*.[63] He later observed that the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (OST) converted the "whole of outer space," including the moon and other celestial bodies, into *res*

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[57] Bin Cheng, "The Extraterrestrial Application of International Law" in Bin Cheng, ed, *Studies in International Space Law* (Oxford: Oxford University Press, 1997), 70 at 80.
[58] Henry R Hertzfeld, *How Simple Terms Mislead Us: The Pitfalls of Thinking about Outer Space as a Commons* Secure World Foundation, 2019) at 2.
[59] Andrea Capurso, "The Non-Appropriation Principle: A Roman Interpretation" (2018) 61:1 Proc Int'l Inst Space L 111 at 112 [*The Non-Appropriation Principle*].
[60] Cheng, *supra* note 57 at 87.
[61] Bin Cheng, "Outer Space: The International Legal Framework—the International Legal Status of Outer Space, Space Objects, and Spacemen" in Bin Cheng, ed, *Studies in International Space Law* (Oxford: Oxford University Press, 1997), 382 at 400 [*Outer Space*].
[62] Capurso, *supra* note 59 at 112.
[63] Cheng, *supra* note 57 at 87.

extra commercium.[64] After the treaty, he argues, as for the contracting States, Article II transformed the Moon and celestial bodies "from *res nullius* (their status under general international law) to *res extra commercium*."[65] The effect of this designation by the OST, is that outer space and the Moon and other celestial bodies cannot be owned or claimed—at least, not by the OST's parties. In other words, neither States, nor their nationals, may exert territorial jurisdiction over those areas.

However, as discussed in more detail below, Article VIII of the OST recognizes that States retain "jurisdiction" over space objects on their registry, and personnel thereof.[66] Therefore, a State may exercise jurisfaction for quasi-territorial and personal jurisdictions, i.e., they may pass laws and regulations regarding registered space objects and their personnel. This rule also means that States enjoy the jurisaction of quasi-territorial and personal jurisdictions, i.e., the authority to enforce such laws. In addition to jurisdiction, Article VIII says that States retain "control" over their space objects and personnel. Control is a broader term than jurisdiction's authorities of jurisaction and jurisfaction. Control implies an ability to limit activities that could interfere with or endanger a space object or its personnel. Control is exclusive, by definition.[67]

This argument may seem obvious and not particularly helpful at first. Clearly, a State may regulate its own nationals' space activities, as is clear from the authorization and supervision requirements of Article VI. However, whereas Article VI assigns responsibility for a State's internal regime to authorize and supervise its non-governmental actors' space activities, Article VIII deals with international relationships by recognizing States' jurisdiction and control over

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[64] Cheng, *supra* note 61 at 400.
[65] *Ibid*.
[66] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, 10 October 1967, 610 UNTS 205 at art VIII [*The Outer Space Treaty*].
[67] "control, n.," (7 May 2024), online: *Oxford English Dictionary* <https://www.oed.com/dictionary/control_n>.

their objects and personnel. This means that no other State has the right to exercise jurisdiction or control over another State's space objects or personnel..

Thus, a State may create rules, laws, and regulations regarding its registered space objects and personnel that affect other States, if there is a nexus between the regulation and maintaining jurisdiction and control over the space object or its personnel. One area this may arise in when one State procures a launch from another State. The launching State has liabilities and responsibilities under international law, and clearly has the right to mitigate those liabilities through regulation.

B. KEY PROVISIONS OF THE OUTER SPACE TREATY (OST)

To fully analyze the legality of safety and security zones in outer space, there are six key Articles of the OST that must be addressed: Articles I, II, III, VIII, IX, and (for celestial bodies) XII. Taking any one of these Articles alone, without considering them together, would give a misleading view of the state of the law in outer space. The general rule of treaty interpretation, as codified in Article 31 of the Vienna Convention on the Law of Treaties (VCLT), is that a treaty must be "interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in light of its object and purpose."[68] Although the US has not ratified the VCLT, it considers many of its provisions, including Article 31, to reflect customary international law.[69] The ICJ has also ruled that Article 31 and 32 of the VCLT "may in many respects be considered as a codification of existing customary international law on the

[68] *Vienna Convention on the Law of Treaties*, 23 May 1969, 1155 UNTS 331 at Art 31 [*VCLT*].
[69] US Department of State, "FAQ - Vienna Convention on the Law of Treaties," (17 May 2024), online: *U.S. Department of State Archive* <//2009-2017.state.gov/s/l/treaty/faqs/70139.htm>.

point."[70] Therefore, the VCLT provisions are useful as an expression of generally accepted principles of treaty interpretation as practiced by States.[71]

1. ARTICLE I: FREEDOM OF USE OF OUTER SPACE AND THE PROVINCE OF MANKIND

Article I of the OST establishes the freedom of use of outer space. The freedom of exploration and use of space is not absolute and is qualified in several ways in Article I itself, as well as in other Articles of the Treaty. The first paragraph of Article I states the "exploration and use of outer space … shall be carried out for the benefit and in the interests of all countries... and shall be the province of all mankind."[72] During negotiations of the OST, some of the developing nations proposed strengthening the language to give the phrase "province of all mankind" legal weight.[73] In the US Senate hearings regarding the OST, one Senator asked if the provision gave noncontributing countries "all the benefits of those who put up the money and expense… giving them a complete fee simple title to all results that come out?"[74] The US delegate explained that the phrase is a "goal" but does not give a "free ride" to developing countries and is limited by "self-executing provisions," such as the retention of ownership of space vehicles in Article VIII.[75] Because the "province of all mankind" is not self-executing, it has no legally binding force. The phrase captures the desirable goal for nations to cooperate with each other in outer space.

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[70] *Case Concerning the Arbitral Award of 31 July 1989 (Guinea-Bissau v Senegal),* [1991] ICJ Rep 53 at 69–70.
[71] *FAQ - Vienna Convention on the Law of Treaties*, *supra* note 69.
[72] *The Outer Space Treaty*, *supra* note 66 at art 1.
[73] Luca Follis, "The Province and Heritage of Humankind: Space Law's Imaginary of Outer Space, 1967–79" in Alexander CT Geppert, ed, *Limiting Outer Space: Astroculture After Apollo* (London: Palgrave Macmillan UK, 2018), 183 at 187–88 [*The Province and Heritage of Humankind*].
[74] US, *Treaty on Outer Space: Hearings Before the Senate Committee on Foreign Relations,* 90th Cong (1967) at 10 [*US Senate Hearings: OST*].
[75] *Ibid*.

Paragraph 2 recognizes that "[o]uter space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."[76] The language of the treaty is very specific. "Shall be free" conveys a meaning that the signatories to the Treaty are bound to abide by the language and does not appear to be merely aspirational. Not only that, all States, regardless of whether they ratified the Treaty or not, enjoy the freedom of exploration and use. However, the terms "without discrimination of any kind," and "on a basis of equality and in accordance with international law" are not precise and do not clearly indicate how States should implement those provisions.

The US delegate testified to the US Senate that the freedom of use principle "encompasses the same concept that applies to the high seas."[77] The freedom to explore and use outer space is of fundamental importance for all outer space activities. This right, however, is not absolute. Paragraph 2 limits the principle, in theory, by forbidding discrimination and requiring a basis of equality. More importantly, the treaty later restricts the freedom to use outer space in some ways in some of the other Articles of the treaty. For example, Article IV forbids placing weapons of mass destruction in orbit or on celestial bodies, Article IX requires "due regard," and Article XII requires visits to installations on celestial bodies to provide notice and be reciprocal.

In US practice on treaty interpretation, Article VI, clause 2 of the US Constitution, the Supremacy Clause, states that in addition to the Constitution and US laws, Treaties shall be the "supreme law of the land."[78] If the treaty is clear and specific enough, US Courts will apply the treaty, even without any laws passed by the legislature implementing it. This is referred to as a

[76] *The Outer Space Treaty*, *supra* note 66 at art 1.
[77] *US Senate Hearings: OST*, *supra* note 74 at 10.
[78] US Const art VI, cl 2.

"self-executing" treaty. However, in practice, not all treaties, or portions thereof, are self-executing, meaning that the legislature must carry into effect the provisions before they can be implemented.[79] In the 1829 US Supreme Court case, *Foster v. Neilson*, Chief Justice John Marshall held that treaties are equivalent to an act of the legislature only when it "operates of itself without the aid of any legislative provision."[80]

In 2008, the US Supreme Court held in *Medellín v. Texas* that Article 94 of the UN Charter was non-self-executing, in part, because it used the language "undertakes to comply" instead of "shall" or "must" comply, although the Court also avoided requiring the use of certain words.[81] The *Medellín* Court held that self-executing provisions must be a "directive to domestic courts," and that the ultimate question is whether the President or Congress intended for the treaty provisions to be self-executing.[82]

The doctrine of self-executing or non-self-executing treaty provisions only applies to domestic law and has no effect on the international obligation of the US.[83] The *Medellín* court's dicta regarding the language of the treaty are important because it is necessary to identify the legal obligation at stake. Article I says that the exploration and use of space "*shall* be carried out for the benefit and in the interests of all countries," space "*shall* be free for exploration and use by all States without discrimination of any kind," "there *shall* be freedom of scientific investigation," and "States *shall* facilitate and encourage international co-operation."[84] Article I mixes freedoms and obligations using the directive "shall." It is important to note precisely what

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[79] Congressional Research Service, *Self-Executing and Non-Self-Executing Treaties,* Constitution of the United States: Analysis and Interpretation (last visited 17 May 2024) online: <constitution.congress.gov/browse/essay/artII-S2-C2-1-4/ALDE_00012955/> [*Self-Executing and Non-Self-Executing Treaties*].
[80] *Foster v Neilson*, at 314; cited in *Self-Executing and Non-Self-Executing Treaties*, *supra* note 79.
[81] *Medellín v Texas*, at 508–09 cited in, *Self-Executing and Non-Self-Executing Treaties*, *supra* note 79
[82] *Medellín v. Texas*, *supra* note 81 at 523.
[83] *Self-Executing and Non-Self-Executing Treaties*, *supra* note 79.
[84] *The Outer Space Treaty*, *supra* note 66 at art I emphasis added.

a State "shall" do. The US may not, however, act in a way consistent with international law, but inconsistent with the Constitution.[85]

Therefore, freedom of use must be interpreted as the ability of a State to use and explore space in a way that does not interfere with the use or exploration of other States and to be free to conduct scientific investigation. State practice bears out this interpretation as recognized by the International Court of Justice (ICJ).[86]

2. ARTICLE II: NON-APPROPRIATION PRINCIPLE

Since the early days of using outer space, scholars have debated the legal and philosophical status of outer space and celestial bodies before and after the ratification of the treaty. As early as 1961, the UN unanimously adopted Resolution 1721(XVI) which called on States to abide by the principles that outer space and celestial bodies are "free for exploration and use by all States in conformity with international law and are not subject to national appropriation."[87] As described above, scholars attempted to determine what the legal status of outer space and celestial bodies were, and should be, before the OST was signed.[88] There is nothing inherent about outer space, including celestial bodies, which would preclude the ability of States to claim portions of it for themselves.[89] However, beginning with Resolution 1721(XVI), then the

[85] Benjamin Perlman, "Grounding U.S. Commercial Space Regulation in the Constitution" (2012) 100:1 Geo L J 929 at 951.
[86] *Case Concerning the Arbitral Award of 31 July 1989 (Guinea-Bissau v. Senegal), supra* note 70 at 69–70.
[87] *International Cooperation in the Peaceful Uses of Outer Space,* UNGA, 16th Sess, UN Doc A/RES/1721(XVI) (1961) at 6.
[88] See generally, Everett C Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London: Routledge, 2001) at 84–95 [*Astropolitik*]; Cheng, *supra* note 57 at 80–84; Sylvia Maureen Williams, "The Law of Outer Space and Natural Resources" (1987) 36:1 The International and Comparative Law Quarterly 142 at 146–150.
[89] Cheng, *supra* note 57 at 84.

unanimous Resolution 1962 (XVIII), and ultimately Article II of the OST, States' rights to lay claim to outer space or celestial bodies as sovereign territory were nullified.[90]

Of the Articles of the OST, Article II is the most relevant to the discussion on safety and security zones. Known as the "non-appropriation principle," it forbids States from "national appropriation" of outer space for themselves or their nationals by "claim of sovereignty, by means of use or occupation, or by any other means."[91] This provision appears to be in direct conflict with Article I's principle of freedom of exploration and use, and would be unworkable without taking these provisions in the proper context. Obviously, the limitation is not absolute, for any use of space at all is technically a form of appropriation. A fairer reading would be that the non-appropriation principle protects the freedom of others to use outer space by preventing the first-comer from excluding future space actors from using outer space. The modifier "national" is important.[92] National appropriation seems to suggest that space or celestial bodies cannot be reserved for the exclusive, permanent use of particular by a State. Article VI's provision that States are responsible for non-State actors extends the prohibition of national appropriation to non-State actors as well.[93]

The recent surge in interest in resource extraction in outer space has led to some States passing laws on the matter. In 2015, the US passed the Commercial Space Launch Competitiveness Act, which recognizes the rights of US citizens to "any asteroid resource or space resource obtained, including to possess, own transport, use, and sell the asteroid or space

[90] Cheng, *supra* note 61 at 400. Bin Cheng argues that "void space" has always been *res extra commercium* and Article II only confirmed that status. However, for celestial bodies, Article II of the Outer Space Treaty changed it from *res nullius* to *res extra commercium*.
[91] *The Outer Space Treaty*, *supra* note 66 at art II; Anne-Sophie Martin & Steven Freeland, "From One to Many: 'Mega' (Constellation) Challenges to the Legal Framework for Outer Space Part II: Space Law Articles" (2021) 46 Annals Air & Space L 131 at 141 [*From One to Many*].
[92] *The Outer Space Treaty*, *supra* note 66 at art 2.
[93] *Ibid* at art VI.

resource obtained in accordance with applicable law, including the international obligations of the United States."[94] In section 403 of the Act, Congress acknowledged that the US "does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body."[95] The US position is, based on this law, that a State may not claim exclusive ownership over celestial bodies, but utilizing the resources thereon is not a "national appropriation" of the celestial body. This position balances the freedom to use space with the limitation that a State cannot nationally appropriate space or a celestial body.

3. ARTICLE III: UN CHARTER AND INTERNATIONAL LAW

Article III specifically recognizes that the UN Charter and principles of international law are applicable to outer space.[96] Manfred Lachs, a former judge on the ICJ, observes that it is important to direct the development of international space law with the most recent developments in international law.[97] He argues that there is no implication from Article III, that applies international law, including the UN Charter, *in toto* to outer space and celestial bodies.[98] Many of the principles of the Charter and other international law principles are specific to situations that are not applicable in outer space.[99] Article III, according to Lachs, "reflects the very essence of international law" and it removed any doubt as to the applicability of international law principles to outer space, which extends *erga omnes*, even to those States who have not ratified the Outer Space Treaty.[100] Article III invites the use of analogies with other

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[94] 51 USC §51303.
[95] *Commercial Space Launch Competitiveness Act*, Pub L No 114-90 §403, 129 Stat 704 at 722.
[96] *The Outer Space Treaty*, *supra* note 66 at art III.
[97] Manfred Lachs, "The International Law of Outer Space (Volume 113)" in, *The Hague Academy Collected Courses Online / Recueil des cours de l'Académie de La Haye en ligne* (Leiden: Brill | Nijhoff, 1964) at 21.
[98] Manfred Lachs, *The Law of Outer Space: An Experience in Contemporary Law-Making*, reissued on the occasion of the 50th anniversary of the international institute of space law (Leiden: Martinus Nijhoff Publishers, 2010) at 13 [*The Law of Outer Space*].
[99] *Ibid* at 14.
[100] *Ibid* at 14–15.

areas of law as a guide to solve problems that arise in the outer space context. However, as Lachs warned, analogies "must be used creatively," considering "the most recent developments in international law as a whole."[101]

In the context of safety and security zones, it is logical to look to existing practices in international law regarding safety and security zones to examine how States resolved similar issues in similar contexts. Chapter 3 analyzes several international zones that may be used as analogies for safety and security zones in outer space. The analogies are not a perfect match. They are nevertheless useful in exploring possibilities of establishing such zones in outer space. Weighing how past solutions were implemented could help States develop the law and practice in ways that use appropriate pieces of analogous legal regimes to create a new regime that addresses these problems.

4. ARTICLE VIII: JURISDICTION AND CONTROL

Article VIII recognizes the right of States retain jurisdiction and control over space objects on their registry and any personnel thereof.[102] In the US Senate hearing's discussion about Article I, a question arose about whether the clause "irrespective of their degree of economic or scientific development" and reference to the province of mankind gave non-contributing states title to American objects sent into space.[103] The US delegate referred to Article VIII to address this concern, stating that the treaty does not transfer title of space objects to another State or all States collectively.[104] The question is, what type of jurisdiction does a State have over a space object and its crew, if there is no sovereignty in outer space? It is obvious that the jurisdiction

[101] *Ibid* at 21.
[102] *The Outer Space Treaty*, *supra* note 66 at art VIII.
[103] *US Senate Hearings: OST*, *supra* note 74 at 10.
[104] *Ibid*.

referred to in Article VIII cannot be territorial jurisdiction, considering Article II's non-appropriation principle. Therefore, quasi-territorial jurisdiction would apply to the object, and personal jurisdiction to the crew.

The International Space Station (ISS) agreement provides an example of how States have agreed to the specific exercise of jurisdiction on the ISS. Article 5 of the agreement requires each participating State to register its flight element, and each Partner retains jurisdiction and control over its flight element and its nationals, wherever those nationals may be located.[105] Furthermore, Article 22 of the Agreement states that criminal jurisdiction over personnel is retained by States over their respective nationals.[106] This agreement thereby reduces the exposure of criminal jurisdictions of other ISS Partners if an astronaut is accused of a crime committed in a flight element which is not registered to that astronaut's State of citizenship. The default rule would be if an astronaut went into another State's facility of the space station, the astronaut would be under the quasi-territorial jurisdiction, and potential criminal jurisdiction, of that State.

There is an open question on whether jurisdiction and control can extend beyond the physical limits of the space object. The Russians seem to believe so. Article 17, paragraph 5 of the Russian Space Law states that "[i]n the immediate vicinity of a space object of the Russian Federation within the bounds of a zone minimally necessary for the guarantee of security [or safety] of space activity, rules may be established, which are obligatory for Russian and foreign organizations and citizens."[107] It seems, therefore, at least in the view of the Russians, as well as

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[105] *Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, The Government of Japan, The Government of the Russian Federation, the Government of the United States of America Concerning Cooperation on the Civil International Space Station*, T.I.A.S. 12927 (1998) at Art 5.
[106] *Ibid* at art 22 There is a mechanism to extradite personnel to another country for prosecution if certain conditions are met.
[107] Michelle LD Hanlon, *Due Regard and Safety Zones: Understanding the Commercial Implications of Recent Policy and Legislation* (The University of Mississippi School of Law Center for Air and Space Law: 2021) citing

some other scholars, that control of space objects, logically, extends a reasonable distance beyond the physical limits of the space object.[108] Otherwise, control would be a meaningless concept if any other space actor could come close enough to dock with a satellite without permission. This point is especially relevant for crewed spacecraft or installations on the Moon or celestial bodies.

5. ARTICLE IX: DUE REGARD, HARMFUL INTERFERENCE, AND CONSULTATIONS

Article IX establishes the "due regard" principle in outer space. It states that States:

> …shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.[109]

Law of the Russian Federation on Space Activity, No. 5663-1 as amended by Federal Law No. 54-ФЗ, (2019) art 17(5).

[108] Martin A Rothblatt, "State Jurisdiction and Control in Outer Space Responsibility for Space Activities" (1983) 26:1 Proc on L Outer Space 135 at 135.

[109] *The Outer Space Treaty*, *supra* note 66 at art IX.

Article IX's due regard principle is one that is familiar in maritime and aviation law and requires States to act in a responsible manner vis-à-vis others.[110] Article IX captures the spirit of what many hope to be a peaceful outer space. The precise meaning of "due regard" has proven to be difficult to nail down. A plain reading of the phrase suggests that it is "proper care, fair consideration, or sufficient attention," however, the Treaty does not require a "total or complete regard."[111] A Tribunal constituted under Annex VII of the United Nations Convention on the Law of the Sea (UNCLOS) addressed the definition of due regard on the high seas, declaring that the

> Convention does not impose a uniform obligation to avoid any impairment of [a State's] rights; nor does it uniformly permit [another State] to proceed as it wishes, merely noting such rights. Rather the extent of due regard required by the Convention will depend on the nature of rights held by [the State], their importance, the extent of the anticipated impairment, the nature and importance of all the activities contemplated by [the other State], and the availability of alternative approaches.[112]

The due regard principle is essentially a balancing test of rights and interests, and the requirement to attempt to minimize harmful interference to other States.[113] In addition to the due regard principle, Article IX also requires consulting with other States if there is reason to believe that "potentially harmful interference" would occur, seeks to foster cooperation in space. However, since Article IX consultations have never been formally initiated, there is no state practice to define what constitutes harmful interference that would require consultations.[114]

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[110] See *United Nations Convention on the Law of the Sea*, 16 November 1994, 1833 UNTS 3 at art 60 [*UNCLOS*]; see also *Convention on International Civil Aviation,* 7 December 1944, 15 UNTS 295 at art 3 [*Chicago Convention*].
[111] Andrea J Harrington, "Due Regard as the Prime Directive for Responsible Behavior in Space" (2023) 20:1 Loy U Chi Int'l L Rev 57 at 69.
[112] *Awarded in the Arbitration regarding the Chago Marine Protected Area between Mauritius and the United Kingdom of Great Britain and Northern Ireland* (2015), Volume XXXI Reports of International Arbitral Awards 359 at 571.
[113] Harrington, *supra* note 111 at 69.
[114] Michael Listner, "China, Article V, Starlink, and hybrid warfare: An assessment of a lawfare operation," (11 September 2021), online: *The Space Review* <https://www.thespacereview.com/article/4650/1> [*China, Article V, Starlink, and hybrid warfare*].

There seems to be reluctance to do so, because that could potentially limit a State's future options.[115]

Article IX is relevant for safety and security zones because it can be used as a justification for identification or exclusion for objects on a path to enter such a zone. A State could argue that a sensitive satellite or installation requires a zone and that the State considers noncompliance with the rules of such a zone is indicative of a lack of due regard. It is significant that the Artemis Accords, in putting forth the safety zone concept in Section 11, justifies the safety zone under the due regard and harmful interference provisions of Article IX of the OST.[116]

6. ARTICLE XII: RIGHT OF INSPECTION?

Article XII only applies to the Moon and other celestial bodies, not to satellites in orbit. The principles here will only apply to the proposed safety and security zone as it relates to the Moon. Art XII of the OST states,

> All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited. [117]

The requirement that states "give reasonable advance notice of a projected visit" is a limitation on the freedom of use. Article XII is interesting in that the justifications for the restriction are 1) safety and 2) avoiding interference with operations. One could argue that the latter reflects the concept of security. Implicit is the right of States to prevent entry of its facilities if 1) advance

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[115] *Ibid*.
[116] *The Artemis Accords – Principles for a Safe, Peaceful, and Prosperous Future*, s 11 (entered into force 2020, accession by) [*Artemis Accords*].
[117] *The Outer Space Treaty*, *supra* note 66 at Art XII.

notice is not given, 2) reciprocal visitation of facilities is not arranged, or 3) a State determines that it is not possible to assure safety or avoid interference with operations if a visit takes place.[118] This right to enter is limited, however, by a requirement that the representative of the inspecting State make reasonable advance notice of a visit, on the basis of reciprocity. [119]

During the US Senate hearings, the US delegate pointed out that this arrangement is similar to the Antarctic Treaty, which requires complete freedom of all parts of Antarctica at any time.[120] He noted that the Russians had proposed additional language that the visit would be "subject to agreement," which the US rejected as essentially a right to veto.[121] The Japanese suggested that there should not be a veto, but because of the austere nature of the Moon reasonable advance notice would be required because any facilities there would require arranging oxygen and other safety measures to ensure the safety of the facility's crew.[122]

Although the drafters may have sought to avoid the right of a "veto," and the plain meaning of the text of the treaty does not permit a veto, as long as the conditions (reciprocity and reasonable advance notice) are met, it appears that a State could veto an attempt to enter a facility on a celestial body by claiming a lack of reciprocity, insufficient advance notice, or claim that the visit would reasonably put the safety of the crew at risk. The adequate timing, at least initially, may be served by arranging the visit before the astronauts launch. The journey would be too expensive and risky to attempt otherwise. The real concerns will be when there are permanent facilities with permanent personnel, who could potentially request an inspection at any time.

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[118] *Ibid.*
[119] *The Outer Space Treaty*, *supra* note 66 at art XII.
[120] *US Senate Hearings: OST*, *supra* note 74 at 44–45.
[121] *Ibid*.
[122] *Ibid*.

Article XII also has a connection with paragraph 2 of Article I's requirement of free access to all areas of celestial bodies. Article XII qualifies "free access" to celestial bodies by limiting access to facilities or vehicles on celestial bodies on the basis of reciprocity and with reasonable notice. If those conditions are not met, Article XII could arguably permit a State to refuse entry to representatives from other States who deny reciprocity. Article VIII further vests jurisdiction over registered space objects and facilities, including on celestial bodies. This quasi-territorial jurisdiction would allow the host some measure of ground rules within the facility, especially to ensure safety of the crew.

CHAPTER 2: LITERATURE REVIEW

A. LITERATURE REVIEW – 1980S, SDI, AND SCHOLARS' OPINIONS ON KEEP-OUT ZONES

President Ronald Reagan's announcement of the Strategic Defense Initiative (SDI) changed the direction of discourse for how outer space law should develop. Space law scholars examined the proposed "keep-out zones" intended to protect SDI assets and analyzed the issue from many sides. The idea of "keep-out" zones was not only an American idea. Burdunov, a Soviet scholar, argued that,

> …[t]he development of rapidly manoeuvrable space objects brings to the fore the problem of insuring [sic] the necessary conditions for the safe and effective functioning of space objects, especially those carrying a crew on board. For this purpose, the state involved may establish around them zones of security within the bounds of which all the activities of space objects finding themselves in such zones must proceed in keeping with previously agreed stipulations. In the case of a threat to one space object from another stemming from the breach of rules of manoeuvering in a

> zone of this kind, the state concerned has a right to take protective measures to remove this threat. [123]

Burdunov does not cite any legal authority for his claim, but he does specifically mention safety and security as justifications for a zone. He further argues that Article VIII of the OST not only retains jurisdiction of space objects and their personnel, but also control over them.[124] He asserts that "jurisdiction" and "control" do not carry the same meaning, although it may be understood that way from reading the Treaty.[125] Control is not the same as jurisdiction, and has more of a technical meaning of what a State may do with a Space object, separate and apart from the legalistic meaning of jurisdiction.[126]

Burdunov explains that the right of ownership of space objects consists of three elements: the rights of 1) possession, 2) use, and 3) disposal.[127] According to Burdunov, possession means that the object belongs to the owner, exclusively, whether the owner is a State, international organization, or a juridical person. He defines the right of use as "the exploitation of a space object, putting it to profit in accordance with its technical design."[128] The right of disposal is the changing of the status of the object from one owner to another. Burdunov concludes his paper with the observation that State ownership of space objects is straightforward, but that "[m]any questions arise in connection with ownership rights of international bodies … as well as juridical persons."[129] He does not elaborate what those questions might be.

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[123] V D Burdunov, "Rights of States as Regards Outer Space Objects Legal Status of Artificial Space Objects" (1981) 24:1 Proc on L Outer Space 89 at 90.
[124] *Ibid*.
[125] *Ibid* at 90.
[126] *Ibid* at 90–91.
[127] *Ibid* at 91.
[128] *Ibid* at 91.
[129] *Ibid* at 92.

During the Cold War, American leaders were concerned with Soviet "space mines" being placed near the anti-ballistic missile capabilities.[130] Space mines are a satellite that "would trail another satellite and explode lethally either on command or when itself attacked" and is a type of co-orbital ASAT weapon. They are essentially suicide-bomber satellites.[131] DalBello, who worked on the OTA report and echoes many of the ideas expressed therein, proposes six potential "rules of the road" to provide transparency to outer space actions, preventing miscommunication. The six proposed rules are: 1) "keep-out" zones; 2) Limits on minimum separation distance between satellites; 3) right of inspection; 4) restrictions on low-orbit overflight; 5) advance notice of launch activities; and 6) "hot line" for space activities.[132]

DalBello argues that of the six proposals, "keep-out zones" have the strongest legal hurdle because it runs afoul of the non-appropriation principle.[133] He points out that in GEO, since the ITU allocates orbital slots for telecommunication satellites, there is a type of "keep-out" area to prevent frequency interference, although the ITU regime is based on an internationally agreed upon set of rules whereas other "keep-out zones" in space are not.[134]

A unilateral "keep-out zone," on the other hand, would not have the same legal status. He admits that it is unclear whether international law would permit a State to establish a security zone around a satellite, much less to enforce it. Although Article 51 of the UN Charter and the customary international law principle of self-defense allow for preemptive defensive action, a mere violation of a security zone, by itself does not seem to rise to the level to which self-

[130] Office of Technology Assessment, *supra* note 3 at 276.
[131] *Ibid* at 15; See also, F Kenneth Schwetje, "Protecting Space Assets: A Legal Analysis of Keep-Out Zones" (1987) 15:2 J Space L 131 at 131 [*Protecting Space Assets*].
[132] DalBello, *supra* note 5 at 9–12.
[133] *Ibid* at 10.
[134] *Ibid*.

defense would be applicable, unless there is evidence to suggest that the use of force or an armed attack in imminent.[135]

DalBello's second proposal is a limitation on minimum separation distance between satellites.[136] This proposal differs from "keep-out zones" by necessitating an agreement to adopt general guidelines regarding satellite spacing, similar to how the ITU regulates geosynchronous communication satellites except applied to all of outer space.[137] His remaining proposals involve limited exceptions to "keep-out zones" and increasing communication between nations to deconflict outer space activities and increase transparency to reduce the risk of miscommunication.[138]

Rothblatt makes a highly technical argument highlighting the tension between ownership, jurisdiction, and control of space objects under Article VIII of the OST and the non-appropriation principle under Article II.[139] He points out that every

> space object occupies some volume of space. The State to whom this object is registered retains jurisdiction and control over the object itself and over its personnel. But no state may appropriate outer space, including the space within or adjacent to a space object. Now, the important question is what property rights do states or non-governmental entities have over the spatial volumes encompassed by or adjacent to their space objects? ...A dilemma exists because space objects and space itself constitute a system of interdependent elements; rules cannot affect space objects without affecting the space they encompass or adjoin, and rules cannot affect spatial volume without affecting the objects placed therein by states or non-governmental entities.[140]

[135] *Ibid* at 10.
[136] *Ibid* at 11.
[137] *Ibid*.
[138] *Ibid*.
[139] Rothblatt, *supra* note 108 at 135.
[140] *Ibid* at 135.

Rothblatt uses concrete examples to support his argument. A space station in a well-defined orbit does not appropriate the orbit itself, but a State can control what goes on inside its space station, as well as prevent others from interfering or destroying the space station.[141] Likewise if a State builds an inhabited facility on the Moon, the State could prevent other States from endangering the facility's structural integrity to ensure life support systems remain online.[142] He believes that there is no true conflict between the non-appropriation principle and jurisdictional rights of States over space objects "so long as it is recognized that neither 'space' nor 'object' are immutable concepts."[143] He uses the term "object-space" to define the area over which a State may exercise jurisdiction and control: to exclude others and allow conditional admission into the area, which could extend out further than the object itself.[144]

Schwetje argued that although protective zones in space had been a topic of academic interest among space law scholars since the early days of space exploration, there had been no genuine need to implement such a regime.[145] He observed that the SDI initiative had "renewed interest in 'Keep-out Zones,' 'Safety Zones,' 'Zones of Exclusivity,' and a host of other names" of similar zones in order to neutralize Soviet threats to critical assets in outer space.[146] Schwetje gives a handful of examples of proposals of how scholars believe a zone regime could work, including the "keep-out zone" proposed by the OTA assessment, cited above. Schwetje briefly lists several other proposals such as "exclusionary zones" in which a State would consider a breach of the zone to indicate hostile intent; a two-tiered zone of a temporary safety zone around a crewed object with a Space Defense Identification Zone (SPADIZ) around that which would require an

[141] *Ibid* at 136.
[142] *Ibid*.
[143] *Ibid*.
[144] *Ibid* at 137.
[145] Schwetje, *supra* note 131 at 131.
[146] *Ibid*.

approaching craft to identify itself prior to approaching; and a "Space Defense Zone" (SDZ) that establishes a keep-out zone for an entire sector on the basis of security .[147] One analogy in support of some of these ideas was the concept of the Air Defense Identification Zone (ADIZ) in international air law, in which a State unilaterally declares a zone around its sovereign territory to protect its national security.[148]

Schwetje compares US and Soviet opinions on the legality of these zones and determines that US scholars are more reluctant to opine that such security zones are legally valid than the Soviets.[149] In fact, many of the Soviet scholars express a "need for" exclusionary zones to prevent "cosmic piracy."[150] These Soviet scholars are concerned with the necessity of protecting crewed spaceships and facilities, in light of highly maneuverable space objects.[151] Another concern of Soviet scholars was the loitering of satellites in the vicinity of the target, including stationing close by "without any activities on the part of the pirate" because the mere presence could result in interference with the satellite's performance.[152] Schwetje observes that not a single Russian lawyer "ever denied the possibility of a unilateral declaration of exclusionary zones.[153] Schwetje observed that Soviet scholars viewed the question in realistic terms of practicality while many US scholars viewed Article II and the non-appropriation principle in a more legalistic light.[154]

Dr. Horst Bittlinger responds to many of the above authors in 1988 to address their arguments regarding "keep-out zones" with regard to the non-appropriation principle of Article II

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[147] *Ibid* at 132–33.
[148] *Ibid* at 131.
[149] *Ibid* at 137.
[150] *Ibid* at 138.
[151] Schwetje, *supra* note 131 citing; Burdunov, *supra* note 123 at 90.
[152] Schwetje, *supra* note 131 citing; B G Dudakov, "On International Legal Status of Artificial Earth Satellites and the Zone Adjacent to Them Legal Status of Artificial Space Objects" (1981) 24:1 Proc on L Outer Space 97 at 97.
[153] Schwetje, *supra* note 131 at 139.
[154] *Ibid* at 139.

of the OST.[155] Bittlinger admits that there is no definite interpretation of what constitutes a prohibited appropriation under Article II, despite many scholars attempting to provide a definitive definition.[156] He responds directly to Schwetje's article, arguing that unilateral keep-out zones contravene Article II of the Outer Space Treaty, and are not possible under international law, but he seems mostly concerned about the enforcement of such zones.[157] He concedes that there may be acceptable ways to set up zones, by limiting the enforcement measures, or to establish binding instruments, either global or between states engaged in space activities, although the latter approach would only be binding on the signatories and not to those who "do not want to accept 'keep-out zones.'"[158] The Cold War ended a couple years later without any resolution of the question in international law, as ultimately there was no incident that led to a need to address the issue.

B. LITERATURE REVIEW – 21ST CENTURY SPACE RACE, THE ARTEMIS ACCORDS AND THE NEED TO PROTECT SATELLITES IN AN INCREASINGLY CROWDED SPACE

After the Cold War, the US enjoyed a brief period of hegemony, which then shifted to a multi-polar world with China and Russia asserting their capabilities in space, as well as other countries, such as India, seeking to become major players in space. This, along with the commercialization of space, has led scholars to take another look at safety and security zones considering these, and anticipated, developments. During this time, the International Space Station (ISS) established a permanent, multinational human presence in outer space. NASA

[155] Horst Bittlinger, "Keep-Out Zones and the Non-Appropriation Principle of International Space Law Legal Aspects of Maintaining Outer Space for Peaceful Purposes" (1988) 31 Proc on L Outer Space 6 at 7.
[156] *Ibid* at 8.
[157] *Ibid* at 9.
[158] *Ibid* at 10.

implemented a 200 km keep out zone to protect the astronauts on board.[159] The necessity of safety zones to protect human life in space has not been challenged, however, scholars have debated the need for safety or security zones to protect non-human critical space assets.

Hays discusses the role that transparency and confidence-building measures (TCBMs) could play in providing stability in outer space, in light of national security threats.[160] The question of how to regulate space weapons is a "thorny" problem, whether these should be negotiated between the major spacefaring nations or more broadly; Hays also discusses what method of TCBM would work best.[161] He suggest that rules of the road or "keep-out zones" could be one of these potential TCBMs to provide transparency in space.[162]

Newsome's thesis recognized the risks that highly maneuverable satellites pose to safety and security in space and proposed a three-part test to determine the legality of safety and security zones.[163] He argued that a safety and security zone must pass a three part test: it must 1) be transparent, 2) cannot grant sovereign rights over the area, and 3) the law that applies outside the zone also applies inside the zone. According to Newsome, Article IX's requirement to consult with other states extends the responsibility to a State to consult with others in relation to establishing a safety and security zone to ensure transparency.[164] Furthermore, the spirit of the Registration Convention requires transparency, by requiring space objects be publicly registered on the State registries.[165] Article VIII of the OST gives jurisdiction over satellites that are

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[159] Melissa de Zwart, "To the Moon and Beyond: The Artemis Accords and the Evolution of Space Law" in, *Commercial and Military Uses of Outer Space* at 75.
[160] Peter L Hays, "Space Law and the Advancement of Spacepower" in, *Toward a Theory of Spacepower: Selected Essays (Charles D Lutes, et al, eds)* (Washington DC: National Defense University Press, 2011), 299 at 305 [*Space Law and the Advancement of Spacepower*].
[161] *Ibid* at 305.
[162] *Ibid*.
[163] See generally, Ted Newsome, *The legality of safety and security zones in outer space: a look to other domains and past proposals* McGill University Institute of Air and Space Law, 2016) [unpublished] [*The legality of safety and security zones in outer space*].
[164] *Ibid* at 58–59.
[165] *Ibid* at 60–62.

registered on a State registry. Therefore, a State could register the safety and security zone parameters in the State registry along with the space object. These SSZs could also be filed with the UN Secretary General for registration to provide transparency of the zone in question.[166]

Newsome also recognized that the non-appropriation principle does not give States a right to exercise sovereignty over space objects.[167] He analyzed the assertions of the Bogotá Declaration, in which several equatorial States claimed sovereignty over the geostationary orbit above their territory, and the individual appellant's unsuccessful claim in *Gregory Nemitz v. US,* in which a man claimed he registered title to an asteroid on which NASA subsequently landed a spacecraft and he sent NASA a parking ticket.[168] These claims of sovereignty and personal property rights of orbits and celestial bodies have not found legal acceptance internationally or domestically. However, Newsome argued that safety and security zones do not amount to a national appropriation because they are limited in scope and are not exclusive to the State.[169] The practicalities of operating a space object, especially an object moving at tens of thousands of kilometers an hour, of necessity, needs a buffer zone to prevent accidental collisions. In the case of highly maneuverable objects, drawing close to another satellite creates a great risk of a collision. One such example is the International Space Station (ISS), which has designated a large safety zone in which if a close encounter is anticipated, the ISS can take evasive action to

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[166] *Ibid*.
[167] *Ibid* at 64–65 The Bogota Declaration was a multinational instrument drafted by equatorial States, asserting sovereignty over the Geostationary orbit above the equator, and thus over their territories. The declaration did not gain support. The Nemitz case involved a man who claimed he registered title to an asteroid on which NASA subsequently landed a spacecraft. Mr. Nemitz sent NASA a parking charge. NASA denied the claim and the District Court and the Ninth Circuit Court of Appeals dismissed the claim. *Nemitz v US*, [2004] 2004 WL 3167042 [*Nemitz*].
[168] *The legality of safety and security zones in outer space*, *supra* note 163 at 64–65 The Bogota Declaration was a multinational instrument drafted by equatorial States, asserting sovereignty over the Geostationary orbit above the equator, and thus over their territories. The declaration did not gain support. The Nemitz case involved a man who claimed he registered title to an asteroid on which NASA subsequently landed a spacecraft. Mr. Nemitz sent NASA a parking charge. NASA denied the claim and the District Court and the Ninth Circuit Court of Appeals dismissed the claim. *Nemitz*, *supra* note 167.
[169] *The legality of safety and security zones in outer space*, *supra* note 163 at 68.

prevent a collision.[170] As long as a State does not claim sovereignty, then, Newsome argues, the safety and security zones would not run afoul of the non-appropriation principle.[171]

Based on maritime law's safety and security zones, Newsome argues that the law that applies outside a safety and security zone, also applies inside it.[172] A safety and security zone may not restrict the freedom of use and exploration, duty of due regard, and other legal principles inside the zone.[173] Newsome concludes that unilateral establishment of safety and security zones does not violate international law as long as they comply with his three part test.[174]

Mallowan, Rapp, and Topka compare many of the conceptual approaches to safety zones and separate them into three categories: 1) asset-dependent exclusionary zones, 2) self-defense zones, and 3) functional/non-interference zones.[175] The first zone is designed to protect assets by defining a geographical and special zone which is "mostly off-limits to other spacecraft."[176] They argue that this approach would require international agreement through either binding or non-binding instruments with detailed guidelines for delimitation. The second zone is a protective zone that, instead of a permanent radius around all spacecraft, is a temporary limited zone to protect a State's critical mission. It borrows its functionality from the concept of the EEZ in maritime law.[177] Since this approach is based on sovereign rights, it would also necessitate binding international agreements in order to survive the non-appropriation principle. The third zone is based on the concept of long-term sustainability by implementing an allocation of positions in orbital space or on celestial bodies, including temporary access exclusion based

[170] *Ibid* at 68.
[171] *Ibid* at 69.
[172] *Ibid* at 69–71.
[173] *Ibid* at 70–71.
[174] *Ibid* at 76.
[175] Lucas Mallowan, Lucien Rapp & Maria Topka, "Reinventing treaty compliant '"safety zones"' in the context of space sustainability" (2021) 8:2 Journal of Space Safety Engineering 155 at 164–65.
[176] *Ibid* at 165.
[177] *Ibid*.

on mission requirements. This third zone, however, relies on an international body to govern the zones, similar to how the ITU governs orbital slots and frequencies.[178]

Stubbs explored the legal justifications for outer space keep-out zones, operational zones, and safety zones.[179] His analysis includes what he argues are some zones that, through Article III of the OST which incorporates general international law, would undoubtedly be valid but are of limited application: UN Security Council authority and the belligerent right to control immediate area of operations during international armed conflict.[180] He argues that under current international law, the UN Security Council can authorize a keep-out zone in outer space, much like they can currently declare no-fly zones and maritime sanctions and interdiction regimes.[181] The UN Security Council has authority under Articles 41 and 42 of the Charter to authorize restrictive zones and to authorize the use of force, and there is no reason why that authority would not extend to outer space. Further, he argues that under customary international law, States are entitled to control the immediate area of naval and air operations, which has its legal underpinning from the right of self-defense.[182]

Stubbs argues for other types of zones in space whose legality is more dubious. One such zone is a more extensive exclusion zone in an armed conflict based on customary maritime and air law. After reviewing several States' military manuals on the law of war, he concludes that since this type of zone does not arise from any treaty, it is not clear whether it would apply in outer space, but as long as it is based on the right of self-defense and is properly balanced by

[178] *Ibid* at 164.
[179] Matthew Stubbs, "The Legality of Keep-Out, Operational, and Safety Zones in Outer Space" in Cassandra Steer & Matthew Hersch, ed, *War and Peace in Outer Space: Law, Policy, and Ethics*Oxford University Press, 2020), 201. *Ibid*.
[180] Stubbs, *supra* note 179 at 206–07.
[181] *Ibid* at 209.
[182] *Ibid* at 209–12.

necessity and proportionality, it could work.[183] He also analyzes the possibility of a space object identification zone analogized from the Air Defense Identification Zone (ADIZ) regime in air law.[184] He concedes that there is no clear legal basis for the ADIZ in the air law context in the first place, but state practice has tended to acquiesce to them. The ADIZ itself does not extend territorial sovereignty over international airspace; it is designed to provide advance notice of aircraft planning to enter territorial airspace. Stubbs argues that the legal justification for the ADIZ is based on an extension of national sovereignty over airspace and would run afoul of the non-appropriation principle if applied to space objects.[185] Stubbs nevertheless leaves open the possibility that an identification zone with a different legal justification could be developed and applied to space objects.[186]

Stubbs closes by reviewing the possibility of safety zones on celestial bodies in the context of resource extraction.[187] He points out in his text that there was little development in the legality of safety zones on celestial bodies and suggests that perhaps the safety zones in UNCLOS could be used as a model. In an appendix to his publication, Stubbs notes that while the paper was preparing for publication, the Artemis Accords were released, which proposed recognition of "safety zones" on celestial bodies relying on both "harmful interference" and "due regard" under Article IX of the OST. Stubbs concludes that international recognition of safety zones on celestial bodies through the Artemis Accords may lead to a development of state practice in this area.[188]

[183] *Ibid* at 218–22.
[184] *Ibid* at 222–24 The ADIZ concept is more fully reviewed in Chapter 2(b) below.
[185] *Ibid* at 224.
[186] *Ibid*.
[187] *Ibid* at 224–27.
[188] *Ibid* at 228.

In 2020, the NASA led an effort to promote international cooperation in a project to return to the Moon through the Artemis Accords.[189] As of 26 June 2024, there are 43 signatories to the Artemis Accords.[190] The Artemis Accords are not a binding treaty, but are a "soft-law" instrument outlining a set of agreed-upon "principles, guidelines, and best practices" and interpretations of the treaties regarding outer space, except for the Moon Agreement.[191]

In Section 11 of the Accords, Deconfliction of Space Activities, the Signatories reaffirm their commitment to the OST, especially the due regard and harmful interference principles.[192] Section 11.6 says that Signatories intend to "develop international practices, criteria, and rules applicable to the definition and determination of safety zones and harmful interference."[193] Section 11.7 further describes the intent of the Signatories regarding the safety zone: to develop a notification process to coordinate with other space actors to avoid harmful interference.[194] The Signatories established four principles related to safety zones: 1) the size and scope should reflect the nature of the operations; 2) the size and scope should be determined in a reasonable manner leveraging scientific and engineering principles; 3) the nature and existence of safety zones is expected to change over time, possibly changing size and scope as appropriate; and 4) Signatories should notify each other and the UN Secretary-General, in accordance with Article XI of the OST, of any changes to the safety zones.[195]

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[189] *Artemis Accords*, *supra* note 116.
[190] Robert Lea, "Artemis Accords: What are they & which countries are involved?," (12 June 2024), online: *Space.com* <https://www.space.com/artemis-accords-explained> [*Artemis Accords*] The signatories include: Angola, Argentina, Armenia, Australia, Bahrain, Belgium, Brazil, Bulgaria, Canada, Colombia, Czech Republic, Ecuador, France, Germany, Greece, Iceland, India, Israel, Italy, Japan, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Nigeria, Peru, Poland, the Republic of Korea, Romania, Rwanda, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, the United Arab Emirates, the United Kingdom, the United States, and Uruguay.
[191] *Artemis Accords*, *supra* note 116 s 1.
[192] *Ibid* s 11.1.
[193] *Ibid* s 11.6.
[194] *Ibid* s 11.7.
[195] *Ibid*.

The States' mere signatures to the Accords are not sufficient to constitute State practice, and likely is also not sufficient to establish *opinio juris*. However, the fact that States are signing the Accords without objecting to the proposed possibility of safety zones may indicate that if a Signatory does seek to establish a safety zone it will likely not be met with resistance.

The Artemis Accords also encourage Signatories to establish, maintain, or end safety zones in a manner that "protects public and private personnel, equipment, and operations from harmful interference."[196] To do this, States must publicly share information regarding the safety zones that are established, as well as the general nature of the activities taking place inside, with caveats for export-control or proprietary information.[197]

While the Artemis Accords represent a set a principles to guide behavior in outer space, the Artemis Program seeks to return to the Moon and eventually establish a permanent presence there, with China leading its own lunar program, the International Lunar Research Station (ILRS).[198] The goal of the ILRS is to place a permanent research station on the south pole of the Moon by the 2030s.[199] This is a direct competitor with the Artemis Program and will run essentially in parallel with the Artemis efforts.[200] The ILRS currently has ten signatory countries and ten non-governmental organizations.[201] The stated research goals of the ILRS include:

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[196] *Ibid* s 11.9.
[197] *Ibid*.
[198] Andrew Jones, "Serbia becomes latest country to join China's ILRS moon base project," (10 May 2024), online: *SpaceNews* <https://spacenews.com/serbia-becomes-latest-country-to-join-chinas-ilrs-moon-base-project/>.
[199] *Ibid*.
[200] Namrata Goswami, "The Strategic Implications of the China-Russia Lunar Base Cooperation Agreement," (19 March 2021), online: *The Diplomat* <https://thediplomat.com/2021/03/the-strategic-implications-of-the-china-russia-lunar-base-cooperation-agreement/>.
[201] *Serbia becomes latest country to join China's ILRS moon base project*, *supra* note 198 Serbia becomes latest country to join China's ILRS moon base project, supra note 162 These signatories include: China, Russia, Belarus, Pakistan, Azerbaijan, Venezuela, South Africa, Egypt, Nicaragua, Serbia, Asia-Pacific Space Cooperation Organization (APSCO), nanoSPACE AG (Switzerland), International Lunar Observatory Association (ILOA, Hawaii), National Astronomical Research Institute of Thailand (NARIT), University of Sharjah (UAE), Adriatic Aerospace Association (A3, Croatia), Asociación de Astronomía de Colombia (ASASAC), Arabeav Kyrgyz State University (Kyrgyzstan), PT Universal Satelit Indonesia (UniSat), Arab Union for Astronomy and Space Sciences.

Lunar topography, Lunar physics, Lunar chemistry, Cislunar space environment, Lunar-based astronomical observation, Lunar-based Earth Observation, Lunar-based biological and medical experiments, and Lunar resources in-situ utilization.[202] It appears to be primarily designed to be a "long-term unmanned operation," at least at first, with "the prospect of subsequent human presence."[203]

C. RENDEZVOUS AND PROXIMITY OPERATIONS

The development of Rendezvous and Proximity Operations (RPO) has highlighted a particular vulnerability of national space objects. Rendezvous operations are when two or more satellites "match their altitude, plane, and phasing."[204] Proximity operations are when two or more satellites move near each other.[205] This could include mutual or coordinated operations, where all the satellites are intentionally working together, or not, in which one or more satellites approaches another satellite without the latter operator's consent. Active Debris Removal (ADR) is one type of RPO which is essentially a satellite tug-boat that approaches space debris and is able to latch onto it and drag it either into an orbit that will decay and burn up in the atmosphere or pull it out into a graveyard orbit, e.g., above GEO.[206] On-orbit satellite servicing (OOS) is another form of RPO in which servicing satellites are able to approach another satellite and service, refuel, or repair it.[207] This technology has the potential to extend the lifespan of

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[202] CNSA & ROSCOSMOS, *International Lunar Research Station: Guide for Partnership (V1.0)* (UNOOSA: 2021) at 4.
[203] *Ibid* at 2.
[204] Rebecca Reesman & James R Wilson, "Physics of War in Space: How Orbital Dynamics Constrain Space-to-Space Engagements," (October 2020), online: *Aerospace Center for Space Policy and Strategy* <csps.aerospace.org/papers/physics-war-space-how-orbital-dynamics-constrain-space-space-engagements> at 9.
[205] *Ibid*; Matthew Jenkins, "To catch a star: the technical and geopolitical arguments for autonomous on-orbit satellite servicing," (10 May 2021), online: *The Space Review* <thespacereview.com/article/4172/1> [Jenkins].
[206] Benjamin Staats, "Mitigating Security Risks and Potential Threats of Emerging Rendezvous and Proximity Operations" (2022) 20:1 Astropolitics 64 at 64.
[207] *Ibid*.

satellites in orbit, reducing the frequency of replacing satellites, potentially mitigating the amount of space debris, and many other benefits.[208] The problem is that the same technology to enable RPOs to provide maintenance can also be used for perverse purposes.[209]

The physics of orbital mechanics makes craft move in outer space differently from on land, at sea, or in the air. Satellites move quickly, albeit predictably, in a plane that bisects the middle of the Earth.[210] They do not move in a straight line, but in an elliptical path in constant freefall toward the Earth.[211] The satellite's momentum carries it in the same direction around the Earth and it will continue on the same path unless it expends fuel to change direction. The larger the change in direction, the higher the cost of fuel.[212]

The physics of this is important to understand in the case of RPOs because to get a satellite close to another and keep it there does not happen by accident. It is a mission in which the timing must be coordinated precisely.[213] Getting a satellite into the same orbit is not enough; a satellite travelling the same orbital path could still be very far apart. To get close to the target, such a satellite would need to go into a transfer orbit, either going to a higher orbit (slowing down relative to the target in that orbit) or a lower one (speeding up relative to the target). This means that any sort of co-orbital RPO mission in which a satellite closely approaches another in the same or similar orbit is intentional. Unless an accident occurs that causes damage to a satellite which could trigger OST Article VII and the Liability Convention, there is no legal

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[208] *How orbital refueling will unlock humanity's potential in space*, *supra* note 41.
[209] Jenkins, *supra* note 205.
[210] *Physics of War in Space: How Orbital Dynamics Constrain Space-to-Space Engagements*, *supra* note 204 at 3.
[211] *Ibid* at 7.
[212] *Ibid* at 3, 5 The mass of the object also is an important consideration.
[213] The same orbital mechanics apply to missions to Mars, only the orbital reference is the sun. See Dave Doody, "Chapter 4: Trajectories - NASA Science," (10 May 2024), online: *Basics of Spaceflight* <https://science.nasa.gov/learn/basics-of-space-flight/chapter4-1/> [*NASA Basics of Spaceflight*]"The task might be compared to throwing a dart at a moving target. You have to lead the aim point by just the right amount to hit the target. The opportunity to launch a spacecraft on a minimum-energy transfer orbit to Mars occurs about every 25 months."

recourse for a foreign satellite approaching close to another satellite. In cases where this has occurred, the States have decried the behavior, calling it irresponsible, but have fallen short of claiming that the behavior violates international law.

On 28 September 2014, Russia launched a Proton-M space launch vehicle (SLV) into outer space.[214] The Russian state media called the satellite it launched "Luch," which is usually reserved for a constellation of data relay satellites in GEO, but some documents designated the satellite as "Olymp" or "Olymp-K."[215] After getting into a geostationary orbit, it began to move in an abnormal way.

First, Luch loitered next to Russian-owned Express-AM22. A few months later, it moved close to Russian-owned Express-AM33.[216] After spending a few months next to those two Russian satellites, Luch maneuvered close to more than two dozen commercial telecommunications satellites, including several operated by Intelsat, for periods lasting from a few weeks to months.[217] This raised concerns that Luch is attempting to intercept communications carried by these telecommunications satellites because it remains within the beamwidth transmissions from the ground terminal.[218] This is a real concern because a Russian insider confirmed that the Russian space intelligence agency intercepted secure communications of combatants in Syria and decrypted them, providing real-time intelligence on enemy movements, weapons, and battle plans.[219] It is not clear if Luch was the asset that did so, but

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[214] Brian Weeden, "Dancing in the dark redux: Recent Russian rendezvous and proximity operations in space," (5 October 2015), online: *The Space Review* <https://www.thespacereview.com/article/2839/1> [*Dancing in the dark redux*]; Bart Hendrickx, "Olimp and Yenisei-2: Russia's secretive eavesdropping satellites," (20 November 2023), online: *The Space Review* <https://www.thespacereview.com/article/4696/1> [*Olimp and Yenisei-2*].
[215] *Dancing in the dark redux*, *supra* note 214; *Olimp and Yenisei-2*, *supra* note 214.
[216] *Olimp and Yenisei-2*, *supra* note 214.
[217] *Ibid*.
[218] *LUCH Space Activities—Spacecast 14* (YouTube.com: 2019) loc. 9:15.
[219] Nikolai Litovkin, "Space is not enough: Are US and Russian satellites really spying on each other?," (14 February 2020), online: *Russia Beyond* <rbth.com/science-and-tech/331693-space-is-not-enough> [*Space is not enough*].

Russia clearly has the capability to engage in such an operation. One month before the launch of the conflict in Ukraine, Luch moved close to Intelsat 39, a communications satellite with European coverage.[220] Intelsat 39 transmits frequencies that are often used for secure military communications, although it is not known if that satellite was supporting military operations in Ukraine.[221]

In GEO, more than 90% of satellites are more than 25 kilometers from their neighbors, with 75% of them more than 500 kilometers apart.[222] On at least three occasions, Luch has come within 5 kilometers of other satellites.[223] Luch's closest approach to another satellite was 1.7 kilometers from Paksat-1R.[224] At a proximity of less than 5 kilometers there is a high risk of collision, and usually requires operators to closely coordinate to prevent a collision, however, according to Intelsat representatives, Russian operators refused to collaborate with other operators to ensure no collisions happen.[225] Interestingly, although Luch has closely approached more than two dozen commercial satellites registered to many States, only two entities publicly objected to the practice: Intelsat and France's defense minister.[226] Intelsat called the maneuvers "irresponsible."[227] The French defense minister, Florence Parly, said of Luch's approach to the Athena-Fidus, a French-Italian satellite which relays secure military communications, "[t]rying to listen to one's neighbor is not only unfriendly. It's called an act of espionage."[228] It is worth

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[220] Kari A Bingen et al, *Space Threat Assessment 2023* Center for Strategic & International Studies, 2023) at 19–20.
[221] *Ibid* at 20.
[222] Thomas G Roberts, "Unusual Behavior in GEO: Luch (Olymp-K)—Aerospace Security Project," (1 September 2022), online: *Aerospace Security* <aerospace.csis.org/data/unusual-behavior-in-geo-olymp-k/>.
[223] Mike Gruss, "Russian Satellite Maneuvers, Silence Worry Intelsat," (9 October 2015), online: *SpaceNews* <https://spacenews.com/russian-satellite-maneuvers-silence-worry-intelsat/>.
[224] *Olimp and Yenisei-2*, *supra* note 214.
[225] *Russian Satellite Maneuvers, Silence Worry Intelsat*, *supra* note 223.
[226] *Olimp and Yenisei-2*, *supra* note 214.
[227] *Russian Satellite Maneuvers, Silence Worry Intelsat*, *supra* note 223.
[228] John Leicester, Sylvie Corbet & Aaron Mehta, "'Espionage:' French defense head charges Russia of dangerous games in space," (10 September 2018), online: *Defense News* <defensenews.com/space/2018/09/07/espionage-french-defense-head-charges-russia-of-dangerous-games-in-space/> [*'Espionage*].

noting here that espionage is permitted under international law.[229] So although the act may be unfriendly, it is not *per se* illegal, although it could contribute to escalation of political conflict.

So far, all the satellites that Luch has co-located with have been commercial satellites. There was one incident between November 2018 and February 2019 where Luch parked west of satellite NSS-12, which is a broadcast satellite.[230] Just to the west of Luch, was a satellite that was not in the public catalogue until 5 December 2018, when the US Air Force released orbital information for several Department of Defense (DoD) satellites.[231] One of the satellites on the list was WGS-9, which was just to the west of Luch. Luch was in the broadcast cone of WGS-9. On 7 December 2018, Luch moved away from the US military satellite to the east side of NSS-12.[232] It is unknown whether Russia knew of WGS-9 before the publication of the list, but it seems a stretch to say it was a coincidence.[233]

Other Russian satellites have also approached US government satellites. In 2019, Russia launched Cosmos-2542, which later ejected a sub-satellite, Cosmos-2543, which was identified as an "inspector" satellite.[234] Cosmos-2543 then actively maneuvered near USA 245, which was believed to be a multibillion-dollar US government spy satellite.[235] USA 245 maneuvered away from Cosmos-2543 a few days after its approach.[236] The orbit of Cosmos-2543 was such that it could likely determine where USA 245 was pointing, thereby ascertaining potential ground targets, as well as listening in on radio emissions to try and intercept communications or

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[229] Geoffrey B Demarest, "Espionage in International Law" (1996) 24:2 Denv J Int'l L & Pol'y 321 at 331.
[230] *LUCH Space Activities—Spacecast 14*, *supra* note 218 loc. 23:49.
[231] *Ibid*.
[232] *Ibid*.
[233] *Ibid* loc. 24:15.
[234] Sandra Erwin, "Raymond calls out Russia for 'threatening behavior' in outer space," (10 February 2020), online: *Space News* <spacenews.com/raymond-calls-out-russia-for-threatening-behavior-in-outer-space/>.
[235] *Ibid*; W J Hennigan, "Exclusive: Russian Craft Shadowing U.S. Spy Satellite, Space Force Commander Says," (10 February 2020), online: *TIME* <https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/> [*Russian Craft Shadowing U.S. Spy Satellite*] Noting that this is the "first time the US military has publicly identified a direct threat to a specific American satellite by an adversary."
[236] *Raymond calls out Russia for 'threatening behavior' in outer space*, *supra* note 234.

determine where the ground stations are located.[237] Cosmos-2543 also demonstrated a co-orbital ASAT capability by launching a projectile into space.[238] Fortunately it did not strike another satellite, but nevertheless, it demonstrated that the satellite could approach very close to another and destroy it with a kinetic projectile.[239]

The close approach of Cosmos-2543 with USA 245 highlights a problem with these operations. It is difficult to track two space objects that are so close in outer space, potentially resulting in confusion of what object is being tracked or mixing observations.[240] This could have serious implications for attribution in the event of a collision.

China has also demonstrated the capabilities of highly maneuverable satellites. China launched Shijian-21 (SJ-21) in October 2021.[241] After settling into its orbital slot in GEO, SJ-21 separated from what is believed to be an Apogee Kick Motor (AKM), a thruster module used to place a satellite in a specific orbit.[242] SJ-21 conducted several RPO maneuvers around the AKM, then left it to approach a defunct Chinese GNSS satellite, Compass G2, which had been drifting uncontrolled since 2009.[243] SJ-21 performed RPO maneuvers with Compass G2 for several days before docking with it and dragging it to a graveyard orbit 3,000 kilometers above GEO, where it has very little risk of interfering with future outer space activities.[244]

This capability to dock with defunct satellites and remove them from usable orbits is important for debris mitigation efforts in orbit. However, this technology poses a threat to

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[237] *Russian Craft Shadowing U.S. Spy Satellite*, *supra* note 235.
[238] Sandra Erwin, "U.S. Space Command again condemns Russia for anti-satellite weapon test," (23 July 2020), online: *SpaceNews* <https://spacenews.com/u-s-space-command-again-condemns-russia-for-anti-satellite-weapon-test/>.
[239] *Raymond calls out Russia for 'threatening behavior' in outer space*, *supra* note 234.
[240] *Ibid*.
[241] *Space Threat Assessment 2023*, *supra* note 220 at 11.
[242] Alyssa Goessler et al, "Space Threat Assessment 2022," (4 April 2022), online: *Aerospace Center for Space Policy and Strategy* <https://aerospace.csis.org/space-threat-assessment-2022/> at 24.
[243] *Ibid*.
[244] *Ibid* at 24.

critical space assets, because it could be used to forcibly drag the asset out of position, rendering it useless, at least temporarily, if not permanently.

Russia and China are not the only countries with satellites that engage in close approaches with others. The US has a program called the Geostationary Space Situational Awareness Program (GSSAP).[245] These satellites use optical cameras to take detailed pictures of satellites in GEO.[246] To do so, the GSSAP satellites must approach closely as well. In fact, one of the GSSAP satellites reportedly drew as close as 10 kilometers of the Luch satellite discussed above.[247]

China has also been experimenting with RPO satellite technologies in GEO. The Shijian 21 (SJ-21) satellite was launched in 2021 as an experimental space debris mitigation satellite.[248] It managed to rendezvous with a defunct Chinese GNSS satellite and drag it to an orbit 3,000 km higher than GEO, and then returned to GEO.[249] While these satellites have great potential for debris removal, there are concerns that they could be used for intelligence collections or as latent counterspace weapons.[250]

Proposals abound on how to mitigate the risks that this technology pose, with some sort of zone being a main one.[251] Other proposals include increasing Space Domain Awareness, increased transparency measures, and employing guardian satellites to protect sensitive assets.[252]

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[245] *Olimp and Yenisei-2*, *supra* note 214.
[246] *Ibid*.
[247] *Ibid*.
[248] *Space Threat Assessment 2023*, *supra* note 220 at 11.
[249] Andrew Jones, "China's Shijian-21 towed dead satellite to a high graveyard orbit," (27 January 2022), online: *SpaceNews* <https://spacenews.com/chinas-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite/>.
[250] Clayton Swope et al, *Space Threat Assessment 2024* Center for Strategic & International Studies, 2024) at 10.
[251] Kaitlyn Johnson, Thomas G Roberts & Brian Weeden, "Mitigating Noncooperative RPOs in Geosynchronous Orbit" (2022) 1:4 Æther 79 at 91–92.
[252] *Ibid* at 87–93.

Although the satellites are moving very fast, because space is so big, it takes a long time to maneuver satellites into position, giving time to operators to understand where space objects are going, even highly maneuverable ones.

D. PROPOSED SOLUTION: SAFETY AND SECURITY ZONES (SSZ)

This thesis proposes a Safety and Security Zone (SSZ) as a solution to some of the safety and security risks that arise from highly maneuverable RPO satellites, and operations on the Moon and other celestial bodies. Chapter 3 of this thesis examines the historic use of international zones to determine whether these may be used as an inspiration for implementation of SSZs. Chapter 4 describes the concept of safety and security and how these twin justifications for the zone should be applied in GEO, LEO, and on Celestial bodies. Chapter 5 identifies barriers to implementation of SSZs and potential methods to mitigate these concerns.

CHAPTER 3: REVIEW OF TERRESTRIAL KEEP-OUT ZONES REGIMES AND THEIR JUSTIFICATIONS

"Law can be perhaps the single most important means of providing structure and predictability to humanity's interactions with the cosmos. Justice, reason, and law are nowhere more needed than in the boundless, anarchic, and self-help environment of the final frontier." – Peter L. Hays[253]

Analogies in international law may be helpful to determine what a legal regime should be but are not helpful to determine what the law is, and if the analogy is fallacious, it should be discarded.[254] Manfred Lachs observed that outer space is different from other domains, which is a good reason to limit the use of analogies, considering their pitfalls, but analogies remain "an indispensable method in the law-creating and law-shaping processes."[255] They may "be helpful

[253] Hays, *supra* note 160 at 299.
[254] Author's notes from a lecture at McGill University, Professor Ram Jakhu, 13 September 2023.
[255] Lachs, *supra* note 97 at 21.

to some extent by paving the way for a new rule," therefore, outer space law must reflect the most "up-to-date tendencies" of international law.[256] The goal of this paper is to review potential analogies that may provide instructive lessons that may be used to create new rules in outer space. Perhaps none of the analogies in this paper are perfect matches because outer space is different from both the high seas and airspace. Nevertheless, many of these international law developments in air and sea domains have occurred after the OST was ratified. Therefore, it is not impossible that legal and political norms could develop using similar principles and mechanisms as the analogies set forth below. In some cases, perhaps the analogous principle should be discarded or heavily modified to make it work in the unique domain of outer space.

A note on customary international law. Customary international law requires consistent State practice which is performed out of a sense of legal obligation, referred to as *opinio juris*.[257] The problem with relying on customary international law is being able to define state practice, as well as identifying *opinio juris*.[258] There is a scholarly debate on whether it is only the positive actions of a State that can be considered, or whether omissions or inaction of States may also be considered State practice.[259]

In the following sections, this thesis analyzes several analogies, the Air Defense Identification Zone (ADIZ) and Maritime zones. Although these analogies are not perfect, there are many aspects which are helpful for determining potential rules for safety and security zones in outer space.

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[256] *Ibid*.
[257] Jack L Goldsmith & Eric A Posner, *The Limits of International Law* (Oxford: Oxford University Press, 2005) at 23.
[258] *Ibid* at 23; Brian D Lepard, ed, "The Role of Consistent State Practice" in, *Customary International Law: A New Theory with Practical Applications* (Cambridge: Cambridge University Press, 2010), 218 at 219.
[259] Lepard, *supra* note 258 at 219 Noting that the *S.S. "Lotus" Case* appeared to decide that absence of State objection against the exercise of criminal jurisdiction of other states demonstrated a belief that customary international law permitted the exercise of jurisdiction. The dissent, however, asserted that only the positive actions of States may crystallize a customary rule.

A. ADIZS

One of the most proposed analogies for safety and security zones in outer space is the Air Defense Identification Zone (ADIZ). An ADIZ is a "specially designated airspace of defined dimensions within which aircraft are required to comply with special identification and/or reporting procedures additional to those related to the provision of air traffic services."[260] It is a unilateral declaration by a State, which exerts control over well-defined airspace. States have implemented various permutations of rules of boundaries, some only within sovereign airspace, while other States establish ADIZs over non-sovereign airspace over the high seas.[261] ADIZs arose shortly after World War II as a mechanism to protect national security.[262]

The first ADIZ was established by the US in 1950, extending for hundreds of nautical miles over international waters off the US coastline.[263] The distance was calculated as the distance that an aircraft could travel in one hour.[264] There are now more than 20 States with established ADIZs that vary across four characteristics: 1) they are either temporary or permanent, 2) they apply either to civil aircraft, or to both civil and military aircraft, 3) they either apply only to "inbound" flights to the sovereign airspace of the State or to all flights entering the ADIZ, and 4) they can cover sovereign airspace or extend over international airspace.[265]

States that implement ADIZs do so unilaterally. There is no international law mechanism to justify or enforce them. They are only enforceable domestically.

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[260] International Civil Aviation Organization, *Annex 15 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation* at 1–2 [*Annex 15, Chicago Convention*].
[261] Zoltán Papp, "Air Defense Identification Zone (ADIZ) in the light of Public International Law" (2015) 2015:2 PJIEL 28 at 30.
[262] The current US regulation states that that the "identification, location, and control of all aircraft (except for Department of Defense and law enforcement aircraft) is required in the interest of national security." *Security Control of Air Traffic*—14 CFR Part 99 s 99.3.
[263] Congressional Research Service, *China's Air Defense Identification Zone (ADIZ)*, by Ian E. Rinehart, Elias Bart (Washington DC: Congressional Research Service, 2015) at 2.
[264] Merinda E Stewart, *Freedom of Overflight: A Study of Coastal State Jurisdiction in International Airspace* (The Netherlands: Wolters Kluwer, 2021) at 185.
[265] Papp, *supra* note 261 at 30.

B. LEGAL JUSTIFICATIONS FOR ADIZS

There is an academic debate over whether an ADIZ is enforceable in international law.[266] One side argues that there is no international law basis for jurisdiction in the air space over the contiguous zone and EEZ.[267] The other side argues that there is no prohibition in international law, therefore, according to the Lotus principle, States may establish and enforce an ADIZ, even if it exercises jurisdiction over an area over the high seas. [268] Bin Cheng argued that ADIZs are only lawful to the extent that they do not violate the freedom of the high seas, and their legality rests more "on comity and tolerance by other States than on strict law."[269] As there are no treaties establishing the right of a state to establish an ADIZ, some have explored whether they have crystallized into customary international law.[270] This search is in vain. Although there is an abundance of state practice, spanning more than 70 years now, the practice is not consistent.

Not every State that establishes an ADIZ uses the same parameters. The US ADIZ, officially, only applies to aircraft intending to enter its airspace, although if a foreign military aircraft enters the ADIZ, the US will escort them with its own.[271] By contrast, the Canadian ADIZ (CADIZ) requires any aircraft entering the ADIZ to comply with the identification procedures.[272] The Chinese ADIZ in the East China Sea was widely criticized because it, like the CADIZ, extends to all aircraft entering the zone, whether or not the aircraft intends to enter Chinese sovereign

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[266] Stewart, *supra* note 264 at 188 citing Elizabeth Cuadra, 'Air Defense Identification Zones: Creeping Jurisdiction in the Airspace' (1978) 18 Va J Int'l L 485.
[267] *Ibid*.; *Lotus Case*, *supra* note 53 at 18.
[268] Stewart, *supra* note 264 at 188.
[269] Cheng, *supra* note 54 at 83; Bin Cheng, "The Right to Fly" (1956) 42:1 Transactions of the Grotius Society 99 at 102.
[270] Stefan A Kaiser, "The Legal Status of Air Defense Identification Zones: Tensions over the East China Sea" (2014) 63:4 ZLW 527 at 537 [*The Legal Status of Air Defense Identification Zones*].
[271] North American Aerospace Defense Command, "US and Canadian jets intercepted Russian reconnaissance planes near Alaska," (10 March 2020), online: *Business Insider* <businessinsider.com/us-canadian-jets-intercept-russian-reconnaissance-planes-near-alaska-2020-3>.
[272] Schwetje, *supra* note 131 at 136–37.

airspace.[273] Following the implementation of China's ADIZ, even though the US and South Korea complained and declared that the ADIZ is not valid, they both recommended their civilian airlines comply with the procedures, although military aircraft do not comply with the Chinese ADIZ.[274]

There is no clear *opinio juris* due to the nature of ADIZ. Civil aircraft will comply with an ADIZ to enter the airspace of another country, because they are likely carrying paying customers and/or valuable cargo and would take a financial and reputational hit if they were unable to complete the flight. This acquiescence to ADIZs is not necessarily out of a sense of a legal duty, as the *opinio juris* prong requires, but because acquiescence makes good business sense. Furthermore, the actions of commercial airlines do not really establish state practice, unless a State directs to encourages a particular course of action. When China established their ADIZ in the East China Sea, the US decried the action and argued that the Chinese ADIZ was not legal in international law, but quietly recommended that commercial carriers comply with China's ADIZ procedures.[275] Therefore, ADIZs should not be considered as being crystallized as a customary international law concept.

Although not internationally binding, the widespread acquiescence to ADIZs is of note, especially considering whether ADIZ, as a concept, has any valid application in outer space. Much ink has been spilt in the last few years about how the current geopolitical tension means

[273] Kaiser, *supra* note 270 at 529.
[274] Daniel Connolly & Alexander M Hynd, "The construction and enforcement of East Asia's air defence identification zones: Grey volumes in the sky?" (2023) 41:5 Environment and Planning C: Politics and Space 1029 at 1038 [*The construction and enforcement of East Asia's air defence identification zones*]; *China's Air Defense Identification Zone (ADIZ)*, *supra* note 263 at 16 Although some Japanese airlines in some instances refuse to follow China's ADIZ procedures.
[275] *China's Air Defense Identification Zone (ADIZ)*, *supra* note 263 at 16.

that new binding treaties are impossible to pass.[276] Regardless of whether binding solutions are possible, the safety and security threats remain and any solution, whether it is internationally enforceable or not, is beneficial if it can improve the situation.

The strongest legal argument for ADIZs over international waters is rooted in the principle of self-defense.[277] The early limits of the ADIZ boundaries, the distance an aircraft could fly in one hour, was to give a buffer around the sovereign airspace to give time for military aircraft to respond to threats by air.[278] The ADIZ is strongly rooted as a security concept, not safety. In practice, however, by requiring an aircraft to provide information to the authorities before entering the ADIZ, the State is able screen for potential threats, and confirm the flightpath and identity of the aircraft, crew, and passengers. These procedures serve as a deterrent for bad actors, if they may be identified on a flight list, which, in turn, increases the safety of the passengers.

C. ADAPTABILITY OF ADIZ TO OUTER SPACE

There are many aspects of ADIZs that are helpful in conceptualizing potential rules of the road for safety and security zones in outer space. The aspects that could be implemented are:

- The unilateral declaration by a State;
- Requiring identification information;
- The underlying purpose is for security reasons

The unilateral nature of an ADIZ declaration, which could also be applied to a Safety and Security Zone, has the benefit that it requires no international negotiation to implement it. A State could declare that such a zone exists, establish its parameters, and work at a diplomatic

[276] Jack Beard, "Soft Law's Failure on the Horizon: The International Code of Conduct for Outer Space Activities" (2016) at 342–43 [*Soft Law's Failure on the Horizon*]. *Ibid*; Johnson, Roberts & Weeden, *supra* note 251 at 94.
[277] See generally 531-36 Kaiser, *supra* note 270.
[278] Stewart, *supra* note 264 at 185.

level to seek compliance. There are risks to this, however. A unilateral declaration would not be binding, and there is a risk that actors in outer space may simply flout the imposed rules and ignore the unilaterally declared zone.

Another aspect of a unilateral declaration of a safety and security zone is whether States would accept them with reciprocity. If a State declares a safety and security zone that is in excess of what other States think is reasonable, how is that to be resolved? If the implementing State declares that violations are considered a threat of the use of force, a violation could lead to escalatory behavior. Requiring identification of a space object that approaches within the Safety and Security Zone does not, in itself, violate the non-appropriation or freedom of use principles because there is no exclusion, in a similar way that an ADIZ does not violate the principle of freedom of flight because it allows aircraft to continue to fly, subject to certain conditions over which the implementing State has *control*. Indeed, this requirement to provide information of a close-flying satellite could be justified by the requirement under Article IX of the OST for States to consult one another in instances which would cause "potentially harmful interference."[279]

D. MARITIME LAW

Maritime law has a rich history of customs and practice that goes back hundreds of years. Maritime law is often used as an analogy for space law because the two domains are similar in many ways. The high seas and the airspace above them are outside the sovereign control of any country. There is a freedom to navigate through international waters free from the interference of other States as long as that use does not preclude other States' use of them. Over time, States have developed rules unique to different aspects of the sea, such as the continental shelf, archipelagic waters, territorial seas, contiguous zones, and exclusive economic zones.

[279] *The Outer Space Treaty*, *supra* note 66 at art IX.

International law recognizes the interests States have in those areas and expands certain rights for States to exercise jurisdiction over those areas in a limited manner, even though some of those areas are outside sovereign seas. Outer space has no such legal regime, however, there are areas that may require slightly different rules. LEO, GEO, and celestial bodies could develop independent rules, similar to the legal regimes established in international waters. Those areas of outer space are also outside the sovereign control of States and States may currently freely use and navigate through them free from the interference of other States, if that use does not preclude other States' use of space.

During the Twentieth Century, there were several efforts to modernize international maritime law. The first of these were the Geneva Conventions on the Law of the Sea, which were a series of five conventions: 1) on the territorial sea and contiguous zone; 2) on the high seas; 3) on fishing and conservation of living resources on the high seas; 4) on the continental shelf; and 5) optional protocol concerning compulsory settlement of disputes.[280] These conventions codified some of the maritime practices that had developed in response to the technological developments of the first half of the Twentieth Century. The conventions had the novel feature of giving States control over portions of the high seas.[281] Around the time of the entry into force of the 1958 Geneva Conventions, a number of States became independent and did not ratify those treaties.[282] There were also technological advancements enabling the exploration and extraction of valuable natural resources in the seabed.[283] The 1958 Conventions, therefore were practically obsolete as

[280] United Nations, "1958 Geneva Conventions on the Law of the Sea—Main Page," (26 April 2024), online: *Audiovisual Library of International Law* <https://legal.un.org/avl/ha/gclos/gclos.html>. *Ibid*.
[281] R Y Jennings, "A Changing International Law of the Sea" (1972) 31:1 The Cambridge Law Journal 32 at 36.
[282] Tullio Treves, "United Nations Convention on the Law of the Sea," (July 2008), online: *UN Audiovisual Library of International Law* <https://legal.un.org/avl/ha/uncls/uncls.html> at 1.
[283] *Ibid* at 1–2. *Ibid*.

before the ink was dry. In 1967, negotiations began again for a treaty on the law of the sea, which culminated int the 1982 UN Convention on the Law of the Sea (UNCLOS).[284]

UNCLOS introduced several new concepts into maritime law that are relevant to our discussion: fixing the territorial sea to 12 miles and the contiguous zone to 24 miles; a 200-mile exclusive economic zone including the seabed granting sovereign rights over resources, artificial islands, installations, scientific research, and environmental protection; and a principle of reciprocal "due regard" in the exclusive economic zone (EEZ).[285]

Article 24 of the Convention on Territorial Waters and Contiguous Zone recognized the rights of coastal States to exercise "control" over a "zone of the high seas" necessary to: prevent infringement of customs, fiscal, immigration, or sanitary regulations and punish infringement of violations committed in territory or territorial waters.[286] The contiguous zone was limited to twelve miles from which the breadth of the territorial sea is measured.[287]

In addition to the Maritime Treaties there is also the San Remo Manual on International Law Applicable to Armed Conflict at Sea, which was prepared between 1988 and 1994 by a group of experts convened by the International Institute of Humanitarian Law.[288] Although not binding, it represents an articulation of the law of war at sea which is applicable to the discussion here. The manual has some analysis of the conditions for creating safety and security zones at sea during times of armed conflict.

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[284] *United Nations Convention on the Law of the Sea*, *supra* note 282 at 1–2. *Ibid*.
[285] *United Nations Convention on the Law of the Sea*, *supra* note 282 at 3–4.
[286] *Convention on the Territorial Sea and the Contiguous Zone*, 29 April 1958, 516 UNTS 205 at Art 24. *Convention on the Territorial Sea and the Contiguous Zone*, *supra* note at Art 24.
[287] *Convention on the Territorial Sea and the Contiguous Zone*, *supra* note 286 at Art 24. *Convention on the Territorial Sea and the Contiguous Zone*, *supra* note 286 at Art 24.
[288] International Committee of the Red Cross, "San Remo Manual on International Law Applicable to Armed Conflicts at Sea, 12 June 1994," (17 July 2024), online: *International Humanitarian Law Database* <https://ihl-databases.icrc.org/en/ihl-treaties/san-remo-manual-1994>.

1. LOAC ZONES

International maritime law has long been concerned with warfare at sea. Customary international law recognizes the rights of belligerents to exercise control within areas of operations, although many States differ slightly on exactly which rights are afforded.[289] Most agree that belligerents can exclude neutral ships or aircraft, or civilian craft of an opposing belligerent; however, targeting these craft must take into account the appropriate principles under the law of war, regardless of whether the zone is violated.[290] The legal justification for these "exclusion zones" is self-defense during hostilities.[291] There is also a justification rooted in the idea that by controlling access to the area of operations, neutral craft are kept at a safe distance from actual or potential hostilities, which is a desirable feature of such exclusion zones.[292] The San Remo Manual also stipulates certain criteria that apply to these zones:

1) The same body of law applies inside and outside the zone;
2) The extent, location, and duration of the zone shall not exceed what is strictly required by military necessity and principles of proportionality;
3) Due regard shall be given to neutral States to legitimate uses of the sea;
4) Necessary safe passage through the zone for neutral vessels and aircraft shall be provided;
5) The commencement, duration, location, and extent of the zone, and the restrictions, shall be publicly declared and appropriately notified.[293]

These zones in times of conflict serve to protect the safety and security of the ships and crew inside the zone. Warships in an operation must be able to ascertain the vessels and aircraft in the area, and any unidentified craft poses a risk, and so the belligerent may presume that any craft in

[289] United States Naval War College, *Maritime Operational Zones,* Center for Naval Warfare Studies International Law Department (2013), at 4–2.
[290] *Ibid* at 4–3.
[291] *Ibid* at 4–5.
[292] *Ibid* at 4–6.
[293] "San Remo Manual on International Law Applicable to Armed Conflicts at Sea—ICRC," (14 May 2024), online: *International Review of the Red Cross* <https://www.icrc.org/en/doc/resources/documents/article/other/57jmsu.htm> at para 106 [*San Remo Manual*]; *Maritime Operational Zones, supra* note 289 at 4–7.

the area without permission "were there for hostile purposes."[294] The restrictions prevent miscommunication and undue escalation, as long as the zones are respected and honored.

While these zones in maritime law only exist during times of conflict, in which the law of war applies, the presumption that a violation of the zone is *per se* a hostile act may serve a valuable purpose in a zone regime in outer space. Some care must be taken not to carry the analogy too far, because these maritime zones only exist after armed conflict has already begun, whereas no international armed conflict has yet taken place in outer space. RPO operations in which highly maneuverable satellites draw close to critical space assets, such as early warning systems for missile defense or military telecommunication satellites, do not by themselves, under the current regime, rise to the level of a hostile act. US military publications define a hostile act as "an attack or other use of force against the United States, United States forces, or other designated persons or property to preclude or impede the mission and/or duties of United States forces."[295] In other words, a hostile act is the threat or use of force.

In 2021, the North Atlantic Treaty Organization (NATO) put forth a statement in which it considers "that attacks to, from, or within space present a clear challenge to the security of the Alliance, the impact of which could threaten national and Euro-Atlantic prosperity, security, and stability and could be as harmful to modern societies as a conventional attack."[296] The NATO Alliance signaled that the Member States are paying attention to threatening space activities and will act in collective self-defense in accordance with Article 5 of the Washington Treaty on a case-by-case basis.[297]

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[294] *Maritime Operational Zones, supra* note 289 at 4–6.
[295] *Joint Publication 3-28, Defense Support of Civil Authorities* US Joint Chiefs of Staff, at GL-7 [*JP 3-28*].
[296] NATO, "Brussels Summit Communiqué issued by NATO Heads of State and Government," (1 July 2021), online: *NATO* <https://www.nato.int/cps/en/natohq/news_185000.htm> at para 33.
[297] *Ibid*.

The nature of some critical satellites in orbit, such as early warning systems, are so important that merely approaching them is indicative of a hostile act. Such an act could potentially fit the definition of JP 3-28 as impeding a mission of US forces, if the proximity of the other satellite interferes or blocks the signal collection for the critical asset. Thus far, States have not claimed that such operations amount to hostile acts, but during a time of crisis, such an act could be interpreted as threatening. Therefore, establishing a regime to handle these potential issues is imperative.

2. SAFETY ZONES

The 1958 Convention on the Continental Shelf introduced the concept of "safety zones." Article 5 of the Convention entitles the coastal State to construct installations within the continental shelf in international waters for exploring and exploiting natural resources.[298] Coastal States were allowed to establish "safety zones" around these structures which could extend up to 500 meters around the installations.[299] Neither the installations nor the safety zones are permitted to interfere with recognized sea lanes.[300] In other words, a coastal state may not use installations as a way to interfere with or block shipping lanes that have already been established, but on the other hand, the ships of all nations are obligated to respect the safety zone. [301]

Following the entry into force of the 1958 Conventions, there were additional technological advancements enabling the exploration and extraction of valuable natural resources in the deep seabed beyond coastal States' territorial seas, granting sovereign rights over resources, artificial islands, installations, scientific research, and environmental protection. These developments led

[298] *Convention on the Continental Shelf*, 10 June 1964, 499 UNTS 311 at Art 5.
[299] *Ibid*.
[300] *Ibid*.
[301] *Ibid*.

to a push to revisit certain maritime law principles, including reciprocal "due regard" in what became the exclusive economic zone (EEZ).[302] In 1983, UNCLOS replaced the continental shelf regime with the EEZ of 200 nautical miles from the coast.[303] UNCLOS expands the applicability of safety zones in Article 60 to include artificial islands and other structures as well.[304] Articles 56, 58, and 60 require that coastal States have "due regard" for the rights of other States, while other States have "due regard" for coastal States in the EEZ.[305] Savvy space lawyers' ears perk up upon mention of due regard.

It is not hard to draw similarities of this concept of safety zones in the ocean with a proposed safety zone in outer space. The continental shelf and EEZ are areas outside the sovereign control of any State, yet the coastal State has a right to occupy portions of it for valuable purposes, *e.g.*, resource extraction, scientific research, or environmental protection. UNCLOS recognizes the importance of safeguarding these sites, acknowledging that ships passing too closely poses a risk to the safety of the operation and personnel on those facilities, hence the safety zone of 500 meters and requirement for "due regard." By analogy, every State is a "coastal" state with outer space and has the right to occupy portions of it for valuable purposes. Satellites engaged in telecommunications, remote sensing, or other activities provide value to the operators. These satellites are also vulnerable to objects passing too close. Article IX of the OST requires due regard from space actors just as UNCLOS requires due regard at sea.[306] Therefore, it is logical that a safety zone around a satellite would be a desirable rule.

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[302] *United Nations Convention on the Law of the Sea*, *supra* note 282 at 3–4.
[303] *Ibid* at 4 This is an oversimplification. UNCLOS provides a mechanism to expand claims on continental shelves beyond 200 miles if certain geomorphologic, distance, and depth conditions are met, and the Commission on the limits of the continental shelf concurs.
[304] *UNCLOS*, *supra* note 110 at Art 60.
[305] *Ibid* at Arts 56, 58, 60.
[306] *Ibid* at art 60.

Conceptually, one may argue that placing an oil rig in international waters and extending a zone of 500 meters would violate the freedom of the high seas. The same argument is used against proposed zones in outer space. In some ways, it does restrict the freedom of others from using that space. However, no right is absolute.[307] By not excluding others from this safety zone weighs against the freedom of use because it would increase costs of operations, impose a greater risk to personnel on the facility as well as vessels that approach too close. The freedom to use either the high seas or outer space will, in some small way, exclude every other act that could take place in that space at that time.

To be clear, just because the law of the sea allows safety zones does not mean one can read safety zones into outer space. As Jakhu taught, analogies may be helpful to determine what the law should be but "they are not helpful to determine what the law *is*. Fallacious analogies should be discarded."[308] One obvious difference between this proposal for safety and security zones and the safety zone in the sea is that the latter came about through negotiation and was included in a binding treaty specifically applied to the high seas and confirmed through consistent state practice. There is a possibility that States will one day recognize the importance of such a regime in outer space to protect their interests and enter into binding agreements implementing a regime of safety and security zones.

[307] Helmut Tuerk, "The legal regime of maritime areas and the waning freedom of the seas," (14 November 2016), online: *The legal regime of maritime areas and the waning freedom of the seas* <http://www.maritimeissues.com/working-papers/the-legal-regime-of-maritime-areas-and-the-waning-freedom-of-the-seas.html>.

[308] Ram Jakhu, Author's notes from a lecture, *Foundations of International Space Law* (Faculty of Law, McGill University, 13 September 2023). "While an analogy may be useful in determining what the law in outer space should be, they are not helpful to determine what the law *is*. Fallacious analogies should be discarded."

3. INCIDENTS ON THE HIGH SEAS AGREEMENT

During the height of the Cold War, the Navies and Air Forces of the US and Soviet Union engaged in several incidents in which ships and aircraft passed close by each other; in some cases the ships bumped into each other.[309] The two sides recognized that these incidents could lead to undesired escalation through accident, miscalculation, or miscommunication.[310] After four years of negotiation, the US and USSR signed the Incidents on the High Seas Agreement. The agreement is credited for a great reduction in incidents at sea between the two countries, even though both navies were "much expanded."[311] Article II of the agreement recognized the existing freedom to conduct operations in international waters under international law, specifically referencing the 1958 Geneva Convention on the High Seas, which the agreement referred to as the "Rules of the Road."[312] The Bilateral Agreement provided for:

- Remaining well clear to avoid risk of collision;[313]
- Avoiding hindering formations;[314]
- Avoiding maneuvers in heavy traffic areas;[315]
- Requiring surveillance ships to keep a safe distance to avoid embarrassing the ship under surveillance;[316]
- Requiring the use of signals as proscribed in the Rules of the Road;[317]
- Restriction from simulating attacks by aiming weapons, launching object, or using illumination devices to illuminate the navigation bridges of the other party;[318]
- Requiring the use of International Code of Signals to warn of presence of submarines during exercises; and[319]

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[309] "Narrative of Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas," (14 March 2024), online: *US Department of State Archive* <https://2009-2017.state.gov/t/isn/4791.htm#protocol>.
[310] *Ibid*.
[311] *Ibid*.
[312] *Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas*, 25 May 1972, 852 UNTS 152 at Art II [*Incidents at Sea Agreement*].
[313] *Ibid* at Art III(1).
[314] *Ibid* at Art III(2).
[315] *Ibid* at Art III(3).
[316] *Ibid* at Art III(4).
[317] *Ibid* at Art III(5).
[318] *Ibid* at Art III(6) This restriction was expanded to non-military ships in a subsequent protocol.
[319] *Ibid* at Art III(7).

- Requiring commanders of aircraft to use caution and prudence in approaching aircraft and ships of the other Party, forbidding simulated attacks or dropping objects near enough to ships to constitute a hazard to navigation.[320]

It is clear that there are also some similarities with the risks present in outer space compared to the problems that confronted the US and USSR at the time they entered into this agreement. RPO satellites have the ability draw close to the target satellite, potentially close enough to dock with it, which creates a risk of collision. It is one thing to conduct such an operation with one's own satellite where there is coordination and collaboration on the operation. It is quite another to do so to another operator's satellite without their knowledge or permission. If the operator does not know that the RPO satellite is there, it could conduct a burn to reposition the satellite, resulting in a collision. Article III(4) of Incidents at Sea Agreement required surveillance ships to keep a safe distance.[321] Article IV required aircraft to use prudence in approaching other aircraft or ships.[322] These principles in the Incidents at Sea Agreement have direct applicability. For example, one rule could be that an RPO satellite may not approach another satellite without prior coordination. Most of the requirements in the Agreement have a strong parallel with the due regard principle of Article IX of the OST and the requirement to prevent harmful interference.

As discussed above, UNCLOS likewise requires due regard for ships at sea, and like the OST due regard principle, it is vague. The Incidents at Sea Agreement, however, restricts specific actions and scenarios. The specificity of the Agreement is what allowed these rules of the sea to deescalate tensions between US and Soviet navy vessels during the Cold War. Likewise, establishing "rules of the road" for space, whether through SSZs or some other set of rules, with

[320] *Ibid* at Art IV.
[321] *Ibid* at Art III(4).
[322] *Ibid* at Art IV.

specific limitations on types of behavior, would do much to increase transparency, and prevent miscommunication.

Without establishing some "Rules of the Road" for RPO operations, it is possible that an RPO operation during a time of geopolitical turmoil could be seen as an aggressive maneuver and could result in the same type of escalation that was feared during the Cold War at sea, namely, through accident, miscalculation, or miscommunication. The Incidents at Sea Agreement was cited as a potential model for safety and security zones in space in the OTA assessment in 1985.[323] There was very little analysis regarding how that Agreement would be applicable to outer space, apart from using it as a model to generate an agreement for rules of the road in implementing safety and security zones in outer space.[324] The reference to the Incidents at Sea Agreement in the OTA assessment seems to be in the spirit of what Ambassador Goldberg meant in the US Senate hearings on the OST when he testified that the OST "is a treaty of general principles recognizing that we must develop specific uses arrangements for specific uses, on what terms this should be done."[325] More recently, one space law commentator once proposed the US use the Incidents at Sea Agreement as a model to enter into bilateral or multilateral agreements with China and Russia to prevent some of these concerns.[326] Thirteen years later, he argued that the idea is no longer viable because of the geopolitical developments between the US, China, and Russia.[327]

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[323] Office of Technology Assessment et al, *supra* note 2 at 116.
[324] *Ibid* at 116.
[325] *US Senate Hearings: OST*, *supra* note 74 at 12 Responding to a question from Senator Gore regarding the meaning of the language of Article I "exploration and use of outer space shall be carried out for the benefit and in the interests of all countries."
[326] Michael Listner, "A bilateral approach from maritime law to prevent incidents in space," (16 February 2009), online: *The Space Review* <https://www.thespacereview.com/article/1309/1>; Interestingly, this Agreement has also been proposed as a model for agreements to de-escalate tensions in cyberspace. See Center for Strategic & International Studies, *Of Ships and Cyber: Transposing the Incidents at Sea Agreement*, by Alexander Klimburg (Washington DC: Center for Strategic & International Studies, 2022) at 3–4 [*Of Ships and Cyber*].
[327] Michael Listner, "Reconsidering the efficacy of an 'Incidents in [Outer] Space Agreement' for outer space security," (31 January 2022), online: *The Space Review* <https://www.thespacereview.com/article/4322/1>.

The validity of a bilateral or multilateral agreement relies on all parties agreeing to the terms.[328] The likelihood of reaching such an agreement relies on whether the risk of harm outweighs the being bound. During the Cold War, the naval incidents had a risk of escalating to nuclear war. Therefore, there was the awesome risk of nuclear holocaust versus the burden of not getting too close to the other side's ships. When the risks are not so great, States will be less willing to curtail their options through a binding agreement. For example, China has been increasingly aggressive in the South China Sea as it seeks to enforce its view of its sovereignty over certain islands in the area. In 2023, Chinese navy vessels blocked attempts by the Philippine Navy to resupply a beached ship.[329] Chinese Coast Guard ships also fired water cannons and rammed into Philippine ships, injuring sailors.[330] The risks of these activities, limited in scope as they are, do risk escalating, but all out warfare is not yet likely. Therefore, there is little incentive for China to compromise its position by making concessions through a treaty.

Listner's skepticism regarding the present utility of such bilateral or multilateral instruments is valid; although the geopolitical situation is tense, the situation has not yet escalated to the point that the major space powers would go to war over these incidents. Therefore, the danger is not yet clear and present enough to justify entering into a treaty. There are, however, principles that the Incidents at Sea address that can be used as a model for SSZs in space.

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[328] Although the world order is multi-polar, bilateral agreements, especially between two of the major world powers would have a strong impact on state practice even among non-signatories to the agreement.
[329] Carlyle Thayer, "Chinese aggression ramps up in the South China Sea," (12 March 2024), online: *East Asia Forum* <eastasiaforum.org/2024/03/13/chinese-aggression-ramps-up-in-the-south-china-sea/>.
[330] *Ibid*; John Victor D Ordoñez, "Stop harassing Philippine vessels in waterway, US envoy tells China," (26 June 2024), online: *BusinessWorld Online* <https://www.bworldonline.com/the-nation/2024/06/26/604482/stop-harassing-philippine-vessels-in-waterway-us-envoy-tells-china/>.

E. ADDRESSING TYPES OF ASSETS

Like the air and maritime zones, the status of the craft entering the zone is significant. For example, many military aircraft ignore some ADIZ requirements. Certain maritime zones only apply to certain ships and aircraft. In like manner, safety and security zones in outer space will need to consider the implications for different types of spacecrafts. Crewed assets have different considerations than autonomous because there is human life involved. Also, there is a difference between military and civil purposes, with dual use posing additional challenges.

1. CREWED ASSETS

Crewed assets, such as space stations, spacecraft, and facilities on celestial bodies are of most concern for protection, because of the threat to human life. Any mishap on a crewed asset, whether a spacecraft or a facility on a celestial body, is potentially life-threatening because of the vacuum of space, extreme temperatures, and lack of oxygen, in addition to the dangers of being isolated and far from swift help in the event of an emergency.[331] Therefore, the strongest argument for safety and security zones is to protect crewed assets, both in orbit and on celestial bodies.

The International Space Station (ISS), for example, has a 4 kilometer by 2 kilometer "Approach Ellipsoid (AE)" around it in which a spacecraft may not enter unless the ISS control center takes over.[332] The AE is used for cargo deliveries to the ISS and is designed to protect the crew of the ISS, similar to some port cities requiring local pilots to navigate ships through difficult places in the harbor. Additionally, there is a 200 meter "keep-out sphere" which has

[331] Andrea J Harrington, "US State Spaceflight Liability and Immunity Acts in context" in, *Commercial Uses of Space and Space Tourism* (Cheltenham: Edward Elgar Publishing Limited, 2017), 115 at 123.
[332] Wigbert Fehse, *Automated Rendezvous and Docking of Spacecraft* (Cambridge: Cambridge University Press, 2003) at 143–44.

specific approach and departure corridors for docking with the station.[333] These restrictions, established by NASA with the expectation that these rules will be followed by anyone approaching the station. These clear restrictions provide certainty and a technical means to minimize the risk of collision during docking procedures.[334] There has been widespread acceptance of the safety zone for the ISS.

On 6 December 2021, China invoked Article V of the OST, filing a notification with the UN Secretary-General claiming that on two occasions Starlink satellites had close encounters with the crewed China Space Station, which forced the station to perform maneuvers to avoid colliding with the satellites.[335] It is curious that China invoked Article V, which requires Parties to inform the Secretary-General when they discover "any phenomena … which could constitute a danger to the life or health of astronauts."[336] The intent of Article V seems to refer to report previously unknown hazardous conditions discovered in space or on celestial bodies, not the likelihood of a conjunction. Article IX would have been more applicable, by undertaking international consultations with the US regarding SpaceX's activities.[337] Listner observes that since Article IX consultations have not yet been invoked, there is no state practice as to what "due regard" and "harmful interference" mean, which could limit China's options in the future, or open itself up to a claim from other States on similar grounds.[338] The US responded to China's notification and stated that US Space Command tracked potential conjunctions and did not estimate a significant probability of collision on the dates of the alleged close approaches, and accordingly did not issue conjunction notifications on those dates.[339]

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[333] *Ibid* at 144.
[334] For a technical description of approach strategies for docking at the ISS, see *ibid* at 144–70.
[335] *China, Article V, Starlink, and hybrid warfare*, *supra* note 114.
[336] *The Outer Space Treaty*, *supra* note 66 at art V.
[337] *Ibid* at art IX; *China, Article V, Starlink, and hybrid warfare*, *supra* note 114.
[338] *China, Article V, Starlink, and hybrid warfare*, *supra* note 114.
[339] *Ibid*.

This episode with the China Space Station highlights the importance of protecting human life in outer space. Although it is not clear whether the China Space Station was actually in danger of a collision, due to conflicting reports between the US and China, what is certain is that protecting human life on board space craft is of utmost importance. A safety and security zone, even if declared unilaterally, for crewed spacecraft and facilities likely would not face strenuous objection, except perhaps in terms of size.

2. STATUS OF SPACE OBJECTS

The purpose and use of space objects is of critical importance in determining the rules of a safety and security zone. In some cases, like crewed assets, there may need to be a universal approach to ensure the safety of a crew. However, for autonomous objects, where human life is not at risk (at least on the craft, setting aside for the moment the potentially deadly indirect effects of interfering with a satellite's operations) it may be desirable to have different rules for different types of space objects. This analysis is complicated in comparison to aviation law and practice where Article 3 of the Chicago Convention places a clear distinction between civil aircraft and state aircraft.[340] For space objects, there is no clear distinction. There are three generally recognized categories: military, civil, and commercial.[341] Military objects are owned and operated by government and engage in national security operations. Civil objects are government-owned non-military objects, and commercial objects are owned and operated by commercial enterprises.

[340] *Chicago Convention*, *supra* note 110 at art 3.
[341] Almudena Azcárate Ortega, "Not a Rose by Any Other Name: Dual-Use and Dual-Purpose Space Systems," (5 June 2023), online: *Lawfare* <https://www.lawfaremedia.org/article/not-a-rose-by-any-other-name-dual-use-and-dual-purpose-space-systems> [*Not a Rose by Any Other Name*].

Military objects include classified military spacecraft, National Technical Means of Verification (NTMs), early warning missile defense systems, communications, position, navigation, timing, and weather satellites, and some remote Earth Observation systems. Many of these systems are critical for national security, commerce, banking, command and control, and other essential activities. Under international humanitarian law, these satellites operating with a military purpose are valid military targets.[342] There are also civil satellites which are government owned and operated, but do not have a dedicated military purpose. These include the ISS, scientific, environmental monitoring, and weather satellites, remote sensing satellites, communication satellites, navigation satellites, and others. Many of these technologies are provided to the public, or operated in conjunction with civil agencies which renders them dual-use in international humanitarian law.[343]

Commercial satellites are those that are owned and operated by commercial companies. Although the "appropriate State" under Article VI of the OST is required to authorize and supervise private space activities, the State does not own and operate the satellites, whose owners may, subject to export control laws and other restrictions, provide services to those willing to buy them.[344] These assets represent a growing part of the economy with incredible potential for future growth. They include telecommunications, remote sensing, micro-gravity manufacturing, broadcasting, space tourism and transportation, and eventually resource extraction.[345]

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[342] *Ibid*.
[343] *Ibid*.
[344] Article VIII of the OST says that States retain control over their registered space objects, although commercial owners operate the satellites in a practical sense.
[345] Dakota Cary, "The Biden Administration Must Designate Civilian Satellites Critical Infrastructure," (9 August 2022), online: *Scientific American* <https://www.scientificamerican.com/article/the-biden-administration-must-designate-civilian-satellites-critical-infrastructure/>; In-Space Servicing, Assembly, and Manufacturing Interagency Working Group of the National Science & Technology Council, *In-Space Servicing, Assembly, and Manufacturing National Strategy (USA)* National Science and Technology Council, 2022).

The civilian nature of these assets has important implications for the law of war in space. Both dual-use commercial and state-owned national security assets are valid targets in the law of war, whereas a wholly commercial asset likely would not be.[346] The principle of distinction requires belligerents to distinguish between the armed forces and civilian populations and protected and unprotected objects.[347] The difficulty here is that many of the commercial assets in space have potential (or actual) military applications, which likely renders them a valid military objective.[348]

Any civil or commercial space objects could be classified as dual-use assets if they are space objects that have a military or security function, but also civilian or commercial functions, either alternating or simultaneously.[349] Since launching a satellite is very expensive, at least until very recently it was prohibitively so, there is an incentive to put as many capabilities as possible on each satellite. This practice causes some potential issues in international law because dual-use satellites, which serve both a military and civilian purpose, can become lawful military objectives under international humanitarian law.[350] For example, the Global Positioning System (GPS) is military-operated but it provides navigation and timing capabilities to civilians as well as military operations.[351] If this service were to be disrupted, it could have devastating effects on the economy, as well as safety for passengers, personnel, and cargo on ships and aircraft.[352]

Protecting critical assets, whether they be clandestine national security satellites or commercial telecommunications satellites, can be accomplished with clear rules through

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[346] Tara Brown, "Can Starlink Satellites Be Lawfully Targeted?," (5 August 2022), online: *Lieber Institute West Point* <lieber.westpoint.edu/can-starlink-satellites-be-lawfully-targeted/>.
[347] *US Law of War Manual* (Office of General Counsel Department of Defense, 2023) at para 2.5.
[348] *Ibid* at para 2.5.4; Linda Slapakova, Theodora Ogden & James Black, "Strategic and Legal Implications of Emerging Dual-Use ASAT Systems" (2022) 42 NATO Legal Gazette 178 at 179.
[349] *Not a Rose by Any Other Name*, *supra* note 341.
[350] *Ibid*.
[351] *Ibid*.
[352] *The Biden Administration Must Designate Civilian Satellites Critical Infrastructure*, *supra* note 345.

establishing SSZs and would minimize the risk of misunderstanding or unnecessary escalation. One major risk of establishing a SSZ on a classified space object would be to call attention to it. As space monitoring technology and tracking capabilities, both commercially and governmentally, it will be increasingly difficult for States to field clandestine satellites. States are reluctant to call attention to clandestine satellites, however, it may be that these objects are an open secret. When an observer notices an object that does not appear on a registry, or its registration is extremely vague, this leads to an assumption that the object is a classified object. Some may argue that putting a SSZ on critical satellites would alert adversaries to which objects are high-value.[353] In some cases, this may be true. There may be some circumstances in which it is known that adversaries already know, or at least suspect the status of the satellite. If this is the case, then a State loses nothing by declaring the SSZ around the object. Nothing would prevent the State from declaring an SSZ around dummy satellites, or satellites that are not critical assets. A State could also choose not to establish an SSZ to not call attention to its critical assets. The SSZ is not a one-size-fits-all solution, but rather it is a tool that can be used in certain situations. There are other tools that could be used in conjunction with SSZs to further protect critical assets.

Some States, France and the US for instance, are developing bodyguard satellites.[354] A bodyguard satellite is a highly maneuverable RPO satellite that can "track, rendezvous, block or interpose itself between the satellite it is guarding and an attacking enemy spacecraft."[355] Other

[353] Brian D Green, "Space situational awareness data sharing: safety tool or security threat?" (2016) 75:1 75 AF L Rev 39 39 at 80.
[354] Thomas Harding, "'Satellite bodyguards' prepared for space protection," (25 January 2023), online: *The National* <https://www.thenationalnews.com/world/uk-news/2023/01/25/satellite-bodyguards-prepared-for-space-protection/>; Brian G Chow, "Op-ed | A new mission for DARPA's RSGS robotic spacecraft: satellite bodyguard," (1 February 2019), online: *SpaceNews* <https://spacenews.com/op-ed-a-new-mission-for-darpas-rsgs-robotic-spacecraft-satellite-bodyguards/> [*Op-ed | A new mission for DARPA's RSGS robotic spacecraft*].
[355] *"Satellite bodyguards" prepared for space protection*, *supra* note 354.

capabilities being developed include lasers, robotic arms, nets, and harpoons to neutralize threatening satellites.[356] In May 2024, the European Defense Fund (EDF) approved funding for an "Autonomous SSA Bodyguard Onboard Satellite," called Bodyguard that can track potential co-orbital ASATs and disable or destroy them.[357] These bodyguard satellites could be an effective capability to mitigate the risk of RPO ASATs.

As Harding notes, some scholars have already proposed "space safety zones" of 50 km around satellites, and these guardian devices could operate within the allotted zone.[358] This mix of SSZ and bodyguard satellites could serve as both a deterrent to harden potential targets, making it less likely someone will try something, but it could also actually protect the critical asset. It would be important, though, to clearly communicate the purpose of the satellites to prevent escalation. States are reluctant to share their national security assets' capabilities out of fear that others could develop countermeasures to overcome those capabilities. The State would not necessarily have to reveal all its cards, it may be sufficient to declare that space object X has bodyguard satellites Y and Z and that the State will interpret any unapproved approach within the safety and security zone to be a hostile threat and reserve the right to respond appropriately. Obviously, this could be escalatory. Communication would be key, which was one of the main proposals during the SDI days. DalBello, who is now with the US Department of Commerce, proposed a "Hot Line" for space activities in the 1980s as a way for States to clarify their actions in response to what may appear to be threatening behavior.[359]

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[356] *Ibid*; Theresa Hitchens, "European Defense Fund invests in 'Bodyguard' satellite development to 'counteract' orbital threats," (30 May 2024), online: *Breaking Defense* <https://breakingdefense.sites.breakingmedia.com/2024/05/european-defense-fund-invests-in-bodyguard-satellite-development-to-counteract-orbital-threats/>.
[357] *European Defense Fund invests in "Bodyguard" satellite development to "counteract" orbital threats*, *supra* note 356.
[358] *"Satellite bodyguards" prepared for space protection*, *supra* note 354.
[359] DalBello, *supra* note 5 at 12.

Clearly, the status of the space object matters. These implications for the law of armed conflict and national security need to be considered when crafting a regime for safety and security zones in space.

CHAPTER 4: PROPOSED SAFETY AND SECURITY ZONE REGIMES

The Archduke Francis Ferdinand of World War III may very well be a critical … satellite hit by a piece of space debris during a time of crisis. – Lt Col Schwetje[360]

Geosynchronous Orbits (GEO), Low Earth Orbit (LEO), and Celestial Bodies each have unique characteristics that warrant a separate examination of the proposed rules for the SSZ. There is a third orbit, Medium Earth Orbit (MEO) which lies between LEO and GEO. This paper does not analyze a regime for MEO because the same congestion problems that are currently occurring in LEO and GEO are not yet occurring in MEO. MEO is primarily used for GNSS satellites, such as GPS, Galileo, and Beidou. While MEO may well benefit from an SSZ, this paper does not examine such a regime. Many of the principles for SSZs in LEO and GEO would be applicable in MEO, however.

The proposed SSZ regime seems to work best in GEO/GSO due to its relation to the Earth, that it is already somewhat regulated by the ITU, and that most of the satellites in that orbit are in the same plane and orbital direction. LEO has unique challenges that would affect how a SSZ would operate. There are a lot of satellites congesting a much smaller area. Furthermore, the higher orbital velocities and diversity in orbital planes in LEO mean that tracking the satellites is much more difficult. This will make enforcing rules for SSZs more difficult; nevertheless, it highlights the need for clear rules of the road. Finally, efforts to establish permanent bases with

[360] Schwetje, *supra* note 131 at 144.

the goal of extracting resources from the Moon and other celestial bodies will require implementation of a SSZ consistent with Art XII of the OST.

The first section will explore the principles upon which a Safety and Security Zone may be established, using the principles discussed in Chapter 2 as a guide. The following three sections will examine how the SSZ could work in LEO, GEO, and on celestial bodies, respectively, due to their unique physical properties.

The clearest and cleanest way to establish rules for SSZs would be a binding treaty that sets out the way they are to work. The Artemis Accords include an attempt to form multilateral agreements, if not a consensus, on how "safety zones" will work. However, there is an argument to be made that existing international space law allows for the declaration and enforcement of unilaterally declared safety and security zones.

A. CONCEPTS OF SAFETY AND SECURITY

Safety and security are concepts relating to protecting activities from harm or danger.[361] In many languages, safety and security are the same word, where the distinction discussed here must be made clear from the context.[362] The distinction in English between these words is that security is protecting from intentional or reckless acts that create the danger of harm whereas safety is protecting from accidents which danger is created from unintentional risks.[363] In an international air law context, for comparison, safety is concerned with protecting human life and preventing accidents that could lead to injury or death.[364]

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[361] Marjolein B A van Asselt, "Safety in international security: a view point from the practice of accident investigation" (2018) 39:4 CSP 590 at 590 [*Safety in international security*]. *Ibid*.
[362] Asselt, *supra* note 361 at 590, fn 1. Marjolein B.A. van Asselt, a member of the Dutch Safety Board, observed in in the air law context, many non-English speakers will switch to the English words "safety" or "security" to remove ambiguity. *Ibid* Marjolein B.A. van Asselt, a member of the Dutch Safety Board, observed in in the air law context, many non-English speakers will switch to the English words "safety" or "security" to remove ambiguity.
[363] Asselt, *supra* note 361 at 590. *Ibid*.
[364] Asselt, *supra* note 361 at 590–91. *Ibid*.

In outer space, most space objects do not carry human life on board. There is a difference between the crash of a remotely piloted aircraft where no human life is harmed and a satellite collision in orbit. The aircraft's debris will fall to the Earth, and unless it hits someone or something on its way down, will not cause further damage. A satellite collision, however, could produce a debris cloud that remains in orbit for years, creating hazards to other satellites, or to spacecraft with human life on board. With the proliferation and commercialization of private space flight, the risk that someone could be harmed in the future by the debris resulting from a collision becomes ever higher. Therefore, it is not sufficient to look at "safety" in outer space in a narrow way only focusing on injury or death to a human. The safety of the entire outer space organism relies on responsible use of space and an active effort to avoid collisions.

Security issues, however, typically involve risks stemming from intentional actors intending to cause harm, as in the case of acts of terror or war. These two ideas are often treated separate, for example, Annex 13 to the Chicago Convention deals with safety investigations.[365] The sole purpose of investigations under Annex 13 are to determine the cause of accidents to prevent them from happening again, and specifically *not* to apportion blame or liability.[366] Furthermore, Annex 13 requires investigators to contact security authorities of the concerned State(s) immediately when evidence of unlawful interference becomes known.[367] These rules apply to international air operations where there is a very clear distinction between state and civil aircraft, and safety and security able to be demarcated in a conceptual way, although occasionally it is difficult to separate these concepts in practice.

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[365] Asselt, *supra* note 361 at 592–93. *Ibid*.
[366] International Civil Aviation Organization, *Annex 13 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation* (2016), s 3.1 [*Annex 13, Chicago Convention*]. *Annex 13, Chicago Convention*, *supra* note s 3.1.
[367] *Annex 13, Chicago Convention*, *supra* note 366 s 5.11. *Annex 13, Chicago Convention*, *supra* note 366 s 5.11.

One such example was the downing of flight MH17 over Ukraine. Early in the investigation, the investigators concluded that the incident was "no 'ordinary' aviation accident," and reported that the forward section of the aircraft was penetrated by a warhead.[368] The investigation board in that case did not have the legal authority to answer the question of who was to blame for the crash because that aspect was related to a security issue outside of the scope of the authorities of the investigation under Annex 13.[369]

Scholars have noted that studies in the fields of safety and security are generally separate, without much overlap in their research.[370] This separation remains to be true, although as van Asselt shows in her analysis of MH17, safety and security issues are often difficult to separate in practice.[371] A safety issue may not necessarily implicate security, but security issues almost always threaten safety.

It is not only intentional actions that can implicate safety and security. The effects of collisions in space, whether on purpose or not, pose a serious risk to both security and safety. One incident that highlights the risk of was the collision of Cosmos 2251 and Iridium 33.[372] On 10 February 2009, CelesTrak's SOCRATES predicted a close approach between Cosmos 2251 and Iridium 33, however it was not the top predicted close approach. [373] This is not surprising considering that there are hundreds and sometimes thousands of conjunction notifications every day, meaning that the collision avoidance service has a lot of false positives.[374]

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[368] Asselt, *supra* note 361 at 592–93. *Ibid*.
[369] Asselt, *supra* note 361 at 593–94. *Ibid*.
[370] Hylke Dijkstra, Petar Petrov & Esther Versluis, "Governing risks in international security" (2018) 39:4 CSP 537 at 540. *Ibid*.
[371] Dijkstra, Petrov & Versluis, *supra* note 370 at 540 citing, Asselt, *supra* note 361 at 597–98 Dijkstra, Petrov & Versluis, *supra* note 370 at 540 citing, Asselt, *supra* note 361 at 597–98
[372] Ram S Jakhu, "Iridium-Cosmos collision and its implications for space operations" in Kai-Uwe Schrogl et al, ed, *Yearbook on Space Policy 2008/2009: Setting New Trends* (Vienna: Springer, 2010), 254 at 263–64.
[373] CelesTrak, "CelesTrak: Iridium 33/Cosmos 2251 Collision," (22 June 2012), online: *CelesTrak* <https://celestrak.org/events/collision/>.
[374] Brian Weeden, "Billiards in space," (23 February 2009), online: *The Space Review* <https://www.thespacereview.com/article/1314/1>.

Some scholars have noted that the security issues with RPOs limit the space for consensus, and perhaps mitigating these risks by focusing on safety instead of only security may find more success, since "safety and security go hand in hand."[375] Once civil and commercial RPOs become more widespread, the ability to repair or remove defunct satellites will do much to increase both the safety and security of outer space by reducing space debris, and preventing inactive satellites from remaining in orbit indefinitely.[376] This proliferation is a two-edged sword, however, because the proliferation of these small maneuverable satellites will enable dual-use ASATS to be deployed among the benign satellites and be difficult to detect.[377]

B. IS THERE A NEED FOR A SAFETY AND SECURITY ZONE (SSZ)?

This proposal is to establish a zone with the dual justifications of safety and security. Previous proposals usually focus on either safety or security. However, the two concepts are so related that it is impractical to separate them. Although the Artemis Accords calls the zone a "safety zone," there is more of an emphasis on "harmful interference" than safety.[378] In Section 11, the phrase "harmful interference" appears ten times while the word safety, when not part of the phrase "safety zone," appears only once.[379] The phrase "harmful interference" is not defined, but subsection 1 ties the idea to the due regard principle of Article IX of the OST. The phrase evokes the idea that if one space actor's activities would interfere with another's, such that the latter's use would be curtailed, this is harmful interference, and should accordingly trigger the consultation requirement of Article IX. It includes the safety risk, but also the security of the

[375] Johnson, Roberts & Weeden, *supra* note 251 at 94.
[376] *Ibid* at 94.
[377] Peter L Hays, "Spacepower Theory and Organizational Structures" in Kai-Uwe Schrogl et al, ed, *Handbook of Space Security: Policies, Applications and Programs*, second edition (Cham: Springer Nature, 2020), 49 at 62.
[378] *Artemis Accords*, *supra* note 116 s 11.
[379] *Ibid*.

operation. In other words, security, as I am defining it, is the ability to continue with the operation without interference. Safety prevents harm to people or property. Security prevents interfering with the activity itself.

The threat to safety and security in orbit is highlighted by events that cause massive debris, such as ASAT tests or collisions.[380] Thousands of pieces of debris from these incidents continue to orbit the Earth, potentially creating a collision risk to many of the satellites, as well as crewed space stations, in LEO for decades.[381] A careless mistake by an RPO satellite, an accident, or worse, intentional destruction of another satellite is a safety and security risk, not only for the target satellite, but for all future satellites the debris may strike in the future.

C. WHAT IS THE LEGAL BASIS FOR A SSZ?

One of the most common legal objections to any type of jurisdictional zone in outer space is the non-appropriation principle of Article II of the OST.[382] However, the treaty must be interpreted in light of the context of the terms in light of the object and purpose of it.[383] The purpose of the OST is to establish rules on the exploration and use of outer space.[384] The concern that Article II addresses is that early spacefaring States could have potentially claimed sovereign rights in space, on the Moon, and on celestial bodies, thereby creating a regime that would have encouraged conflict with later spacefarers who want a piece of the pie. By forbidding permanent and exclusive sovereignty rights over space from the beginning, it eliminates the ability to claim, and later to contest, territory in space.

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[380] Jakhu, *supra* note 372 at 263–64.
[381] Loren Grush, "Visualizations show the extensive cloud of debris Russia's anti-satellite test created," (19 November 2021), online: *The Verge* <https://www.theverge.com/2021/11/19/22791176/russia-asat-satellite-test-space-debris-visualizations>.
[382] Bittlinger, *supra* note 155 at 7–9.
[383] *VCLT*, *supra* note 68 at art 31.
[384] *The Outer Space Treaty*, *supra* note 66 at Preamble.

What, then, are the limits to the non-appropriation principle? Any use at all could be considered an appropriation of the space being used. Article VIII gives the most teeth to the argument that States may exert control over areas in space, as long as that space is in relation to a registered space object. While Article II takes away sovereignty, Article VIII restores jurisdiction, which is, albeit, a lesser authority, it nevertheless means something. It appears to be a quasi-territorial jurisdiction, similar to ships in the sea.[385] As Bin Cheng taught, jurisdiction includes both jurisfaction, the ability to make laws, and jurisaction, the ability to enforce them.

States have the legal right to pass laws, regulations, and rules regarding their spacecraft. These spacecrafts are also afforded certain duties from other craft, like ships in maritime law, through Article IX which establishes the due regard principle and the principle that States' outer space activities should consult if they expect harmful interference with other activities. These laws, however, are only enforceable by the State which passes them. For example, if a Luxembourgish RPO satellite gets too close to a Belgian satellite, the jurisdiction of Belgium applies to its craft and the personnel on its craft, if any. Belgium has no legal claim of jurisdiction over the Luxembourgish craft. Therefore, jurisdiction alone is not enough to solve this problem.

The other operative term in Article VIII is "control," which, as Rothblatt argues, is similar to but different from jurisdiction.[386] Control denotes a power of regulating the object and personnel, of managing, possessing, and disposing of it.[387] Logically, control could extend to a reasonable area outside the space object or facility in order to prevent harm to it. The Russian

[385] Jennings, *supra* note 281 at 41.
[386] Rothblatt, *supra* note 108 at 136–37.
[387] *control, n.*, *supra* note 67.

Space Law recognizes this and specifically claims the authority to make binding rules on the area in "the immediate vicinity of a space object."[388]

D. THE RULES OF THE SSZ

Since there is a significant difference between operations in GEO, LEO, and on the Moon and other celestial bodies, the rules governing the SSZ in each should be slightly different. These are addressed in turn.

1. GEO/GSO

Geostationary orbit (GEO) is unique in that there is already an international organization that manages orbital slots for telecommunication satellites in GEO. The International Telecommunications Union (ITU) allocates orbital slots for communications satellites to prevent over-crowding and avoid harmful interference.[389] The "harmful interference" referred to in the Annex to Constitution of the ITU is narrower than the concept referred to in Article IX of the OST. The ITU defines harmful interference as "interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations."[390] An action that causes harmful interference in outer space under the ITU definition would also likely be considered harmful interference under Article IX of the OST. However, there are many other activities in outer space that are not related to telecommunications which could also run afoul of

[388] *Due Regard and Safety Zones: Understanding the Commercial Implications of Recent Policy and Legislation*, *supra* note 107 at 26.
[389] *Constitution of the International Telecommunications Union,* cited in *Collection of the basic texts of the International Telecommunication Union adopted by the Plenipotentiary Conference, <i>2023 ed (Geneva:2023)*, at art 1(2)(a) The ITU also allocates bands of the radio-frequency spectrum and radio frequencies.
[390] *Ibid* at 91.

Article IX. For example, an RPO satellite that intercepts telecommunications may not rise to the level of harmful interference in the ITU, since it does not endanger or interrupt the service.

Although the ITU states that Member States "retain their entire freedom with regard to miliary radio installations," the military installations, "must, so far as possible, observe statutory provisions relative to … prevent harmful interference."[391] So although military spacecraft are not bound by the ITU, it is in their interests to prevent harmful interference as a matter of policy. As was seen with Luch and the Chinese satellites, highly maneuverable satellites can approach satellites in GEO and linger nearby, potentially listening in on the communications. The ITU's rules do not address this issue, therefore, an SSZ is one way for States to safeguard their assets in GEO.

The security zones proposed in the 1980s were designed to prevent the detonation of a conventional or nuclear warhead on a co-orbital ASAT.[392] The OTA report referred to these ASATs as space mines because they would approach the target and then lay dormant but could be detonated at any time. If enough of these "space mines" were close to enough targets and simultaneously detonated, there was a potential that it could wipe out critical national security assets. The proposed "keep-out zones" attempted to take into account the size of the potential blasts and sized the proposal accordingly. The OTA proposal was for 100 km and three degrees out of plane in LEO, 500 km for satellites above 5000 km in altitude, except for those within 500 km of geosynchronous orbit.[393] However, the proposed security zone would have overlapped satellites in GEO, rendering such a zone useless.

[391] *Ibid* at art 48.
[392] Office of Technology Assessment et al, *supra* note 2 at 64.
[393] *Ibid* at 136.

A Safety and Security Zone in GEO would need to take into account the close proximity satellites have with each other as permitted by ITU orbital slot registrations. Approximately 90% of satellites in GEO are more than 25 kilometers away from their neighbor.[394] There has not yet been a security threat from a satellite registered with the ITU in its slot. This is a potential risk, but one aspect of the SSZ could be to exempt objects that are in their orbital slots as designated by the ITU. After all, it is the other satellites drawing near that pose the greatest risk of safety and security. Developments in technology may lead to capabilities that do not need to approach another satellite so closely. For example, developments in quantum communications may render satellite eavesdroppers obsolete, by creating communications that are practically impossible to intercept, which would remove one line of potential operations.[395] That is not to say that the SSZ would be obsolete, rather by creating additional pressures, through the SSZ, to keep unauthorized satellites away from critical space assets States may develop ways to achieve some of their goals without needing to draw as close, which would decrease the risk of collision. Then, if a satellite does intend to enter the zone, it is more likely to be for antagonistic purposes.

2. LEO

There is no legal definition of Low Earth Orbit (LEO), but it is generally considered to be between about 160 kilometers and 1,600 kilometers above the Earth.[396] The need for rules of the road in LEO is becoming ever more important as commercial satellite companies launch thousands of small satellites into mega-constellations. The OTA report from 1985 said then that

[394] *Unusual Behavior in GEO: Luch (Olymp-K)—Aerospace Security Project*, *supra* note 222.
[395] Scott Buchholz et al, "The realist's guide to quantum technology and national security | Deloitte," (27 May 2024), online: *Deloitte* <https://www.deloitte.com/conf/modern/settings/wcm/templates/modern--di-research-template/initial.html> at 8; *ibid*.
[396] Ken Stewart, "Low Earth orbit (LEO) | Definition, Distance, & Facts | Britannica," (2 May 2024), online: <https://www.britannica.com/technology/low-Earth-orbit>.

there "are too many satellites in low-Earth orbit to accommodate large keep-out zones.[397] However, it might be feasible to establish smaller keep-out zones around such satellites and, in addition, to specify a minimum angular separation between orbital planes to prevent continuous trailing."[398] Obviously, the congestion in LEO is now much higher than it was in the 1980s, especially with SpaceX and OneWeb having more than 6,000 satellites in orbit between them.[399]

It is only within the last few years that these have really taken off. To illustrate, in 1985, there were fewer than 400 active satellites in all orbits, including LEO.[400] As of 1 May 2023, there were approximately 6,700 satellites in LEO.[401] As LEO becomes more crowded, the risk of collision will continue to increase, as multiple orbits in multiple planes increase the risk of conjunctions. Highly maneuverable satellites would exacerbate this problem, because although the least the majority of the objects in LEO are in a more-or-less predictable orbit, RPO satellites can rapidly change their orbit to conduct their operations. These maneuvers would make them unpredictable and could lead to an increased number of conjunctions. The number of these types of satellites is expected to grow. The US Air Force Research Laboratory found that if an on-orbit servicing was successful twice, it would more than pay for itself.[402] With a constellation of thousands of satellites, it is not unreasonable to assume that a significant number of these could be repair satellites tasked with repairing satellites in the constellation, which means they will move around, creating additional complexity in tracking these satellites and ensuring no collisions occur.

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[397] Office of Technology Assessment et al, *supra* note 2 at 18.
[398] *Ibid*.
[399] As of April 2024, Starlink has over 5,800 satellites in orbit. *Starlink satellites*, *supra* note 45; *Our Story*, *supra* note 44 at As of April 2024, OneWeb has more than 600 satellites in orbit.
[400] "Number of active satellites by year 1957-2022," (7 May 2024), online: *Statista* <https://www.statista.com/statistics/897719/number-of-active-satellites-by-year/> This data is provided by Jonathan's Space Report (JSR).
[401] *Changes to the Satellite Database*, *supra* note 42.
[402] Jenkins, *supra* note 205.

The nature of LEO makes keeping track of space objects more complicated than GEO. As the satellite orbits the Earth, it loses contact with the ground stations, unless there are ground stations around the world or relays in space that provide continuous connectivity. This provides a potential target of opportunity for an adversary to bring in a highly maneuverable asset when the target satellite is incommunicado. Some of the more developed space countries have agreements with countries around the world to place ground stations that monitor space objects and debris and can continuously track objects as they circle the globe. Many technological advancements, backed up by commercial augmentation and international agreements, have mitigated this risk for some countries, but developing countries may not yet have the infrastructure in place to continuously monitor their satellites. A SSZ in LEO would be prudent to mitigate these risks.

The security and safety risks in LEO are like those in GEO, but whereas the majority of satellites in GEO are in the essentially same plane, and moving in the same direction, this is not true of LEO. A collision or destruction of a satellite in LEO could create a considerable amount of debris. Although the debris could deorbit sooner than debris in a GEO collision, there are more satellites in a smaller volume, and the risk of causing a cascading event in LEO is much higher than in GEO. This is partly because, unlike most satellites in GEO, satellites in LEO go in many different directions, not just equatorial, but also polar orbits and sun-synchronous orbits, as well as retrograde orbits. The SSZ's purpose in LEO, therefore, is to prevent unauthorized approach to other satellites.[403]

[403] *Physics of War in Space: How Orbital Dynamics Constrain Space-to-Space Engagements*, *supra* note 204 at 6.

3. CELESTIAL BODIES

Exclusionary zones on the Moon and celestial bodies may be the easiest to conceptually understand because the location of such zones is like locations on Earth, that is, they are stationary relative to the surface of the celestial body, compared to the zones analyzed above, which (at least in LEO) move very rapidly relative to the perspective of the Earth. There have also been much more recent proposals for zones on celestial bodies, such as the safety zones included in Section 11 of the Artemis Accords.[404]

The need for Rules of the Road[405] on celestial bodies is highlighted by the fact that there are many entities seeking to go to the Moon and other celestial bodies for scientific research, as well as potential resource extraction.[406] Some estimate the potential value of resources extracted and brought back to Earth (or used in situ as rocket fuel or to build facilities) to be quadrillions of dollars.[407] While this figure may rely on faulty assumptions, it is indicative of a desire to be one of the first to engage in these activities because of the business advantage that would be gained.[408] States have passed domestic laws to protect the property rights of those engaging in resource extraction in space.[409] The legality of those efforts is outside the scope of this paper; however, these efforts will lead to resource extraction in the near future on the Moon or other celestial bodies.

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[404] *Artemis Accords*, *supra* note 116 s 11.
[405] It should be noted that this reference to "Rules of the Road" is metaphorical. However, as a permanent presence is established on the Moon and other celestial bodies, there may one day be actual roads on them. There may need to be considered additional rules for the physical roads, which is outside the scope of this paper.
[406] The Artemis and ILRS programs are the two biggest programs seeking to establish a permanent presence on the Moon. See Andrew Jones, "China attracts moon base partners, outlines project timelines," (19 June 2023), online: *SpaceNews* <https://spacenews.com/china-attracts-moon-base-partners-outlines-project-timelines/>.
[407] Filip De Mott, "The race to the moon is heating up as lunar resources could top $1 quadrillion in value," (1 June 2024), online: *Markets Insider* <https://markets.businessinsider.com/news/commodities/moon-mining-space-race-helium-metals-india-chandrayaan-russia-luna-2023-8>.
[408] David Rich, Joshua Schertz & Adam Hugo, "The Space Resource Report: 2020," (1 October 2021), online: *The Space Resource* <thespaceresource.com/news/2020/the-space-resource-report> [*The Space Resource Report*].
[409] 51 USC §51303, *supra* note 94.

On 25 June 2024, China's Chang'e-6 mission returned with dust and rock samples from the far side of the Moon.[410] As scientists from around the world analyze these samples, if there are significant levels of valuable materials, this will lead to increased efforts to commercially extract them. When these activities begin in earnest, there will be a need to protect the safety of any crew members that may be involved. Additionally, there may be proprietary capabilities or processes that companies and states may wish to prevent others from observing, copying, or intercepting, which under the current regime is perfectly legal to do.

Both the Artemis and ILRS programs are actively developing technologies and capabilities to establish a permanent presence near the South Pole the Moon.[411] Therefore, it is possible that the first activation Article XII of the OST is only a few years away because both stations will likely be close to each other. It does not take a great stretch of the imagination to think of several scenarios where a request to inspect the other station may come up. For example, the ILRS could establish a Moon base on the south pole of the Moon, as planned, and the US may be concerned that China is using that base to develop weapons and requests to inspect the facilities under Article XII.

There is currently a strong push for humans to return to the Moon, with the Artemis Missions, led by the US and now including 43 other countries, and the International Lunar Research Station (ILRS), led by China and Russia including eighteen other signatories (eight other countries and ten organizations). These rival efforts will lead to permanent installations on the Moon, simultaneously. In the near term, these installations will be autonomous, but both

[410] Kristin Fisher, "NASA administrator weighs in on China's historic lunar far side samples—and potential US access," (1 July 2024), online: *CNN* <https://www.cnn.com/2024/07/01/science/nasa-bill-nelson-china-change-6-samples-scn/index.html>.
[411] William Steigerwald, "NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation," (27 January 2021), online: *NASA* <https://www.nasa.gov/humans-in-space/nasas-artemis-base-camp-on-the-moon-will-need-light-water-elevation/>.

groups are planning to have a human presence as early as the 2030s and are researching technologies to make this possible, such as using regolith to 3D print habitats on the Moon and on Mars.[412]

Both the Artemis Base Camp and the ILRS are planning to establish facilities near the South Pole of the Moon because it enjoys almost continuous sunlight, which is important for power generation and because it will mitigate extreme temperature changes, and it is close enough to areas of complete darkness, such as in deep craters or close to the far side of the Moon, which are believed to have water-ice.[413] These stations are going to need to have certain geographic features to make them viable. They need to be on the Earth-side of the Moon and away from geological features to ensure reliable communications with Earth.[414] The base camp facilities and solar panels will also need to be located at least 1 kilometer from the landing zone because the thrust from landing and launching spacecraft will kick up lunar debris in all directions and could damage facilities or obscure solar panels.[415] Launches and landings would also effect telescopes by kicking up dust and debris that could interfere with those sensors, and the vibrations would also effect seismographs. These facilities have the potential to become somewhat sprawling overtime, especially as both groups begin resource extraction operations.[416]

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[412] NASA, "NASA Outlines Lunar Surface Sustainability Concept—NASA," (14 September 2024), online: <https://www.nasa.gov/general/nasa-outlines-lunar-surface-sustainability-concept/>; *International Lunar Research Station: Guide for Partnership (V1.0)*, *supra* note 202; Lee Mohon, "NASA Looks to Advance 3D Printing Construction Systems for the Moon and Mars," (1 October 2020), online: *NASA* <https://www.nasa.gov/technology/manufacturing-materials-3-d-printing/nasa-looks-to-advance-3d-printing-construction-systems-for-the-moon-and-mars/>.
[413] *NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation*, *supra* note 411; *International Lunar Research Station: Guide for Partnership (V1.0)*, *supra* note 202.
[414] *NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation*, *supra* note 411.
[415] *Ibid*.
[416] *China seeks its own Apollo moment – and more*, *supra* note 50.

The Artemis program has identified 13 possible landing zones to establish its facilities, and China has identified ten possible locations for the ILRS, with considerable overlap.[417] All of the potential sites are within a geographic area of approximately 30km squared.[418] Setting aside the issue that the US and China do not seem to be coordinating potential landing sites, assuming both groups can agree on separate landing sites, the research operations of the two groups will be in relatively close proximity to each other.[419] Over time, these initially small stations could grow as resource extraction technologies become viable, which could lead to tensions if the facilities encroach each other.[420]

Mere operations on crewed research stations pose safety and security risks for the other station. The launch and landing of spacecraft will cause debris which could damage or interfere with the other station.[421] Resource extraction could also potentially kick up regolith and debris which could damage or interfere with the operations of the other station. If a spacecraft flies over the other station, there is a risk that an accident could occur, such as crashing the spacecraft into the other station. As resource extraction becomes viable, the two stations would not only be direct competitors, but also close neighbors, meaning that there would also be a threat of sabotage to interfere with the operations. Thus, States need to establish clear rules on how to govern these interactions, and if the two groups cannot come to an agreement, a unilateral declaration of an SSZ would provide at least set transparent expectations.

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[417] Andrew Jones, "NASA and China are eyeing the same landing sites near the lunar south pole," (31 August 2022), online: *SpaceNews* <https://spacenews.com/nasa-and-china-are-eyeing-the-same-landing-sites-near-the-lunar-south-pole/>.
[418] Antonino Salmeri & Peter Weis, "The Apple of Discord or the Fruit of Salvation? A Dialogue on the Practical and Legal Aspects of Safety Zones on the Lunar South Pole Section 5: Safety Zones Celestial Bodies and in Outer Space" (2022) 65 Proc Int'l Inst Space L 345 at 349 [*The Apple of Discord or the Fruit of Salvation?*].
[419] *NASA and China are eyeing the same landing sites near the lunar south pole*, *supra* note 417.
[420] *China seeks its own Apollo moment – and more*, *supra* note 50.
[421] Salmeri & Weis, *supra* note 418 at 346.

The principles of freedom of use, non-appropriation, cooperation and mutual assistance, and due regard are particularly relevant to such a scenario. While each group has the right to "free access to all areas of celestial bodies," as discussed in Chapter 1 above, this right is not absolute. Articles VIII and XII recognize that States retain jurisdiction and control over their facilities and require coordination and reciprocity before permitting a visit.[422]

E. UNILATERAL VERSUS BILATERAL/MULTILATERAL APPROACHES

One of the consistent questions of whether SSZs are legally viable in space rests on whether a State declares the zone declared unilaterally or establishes it through through an international agreement. For example, Newsome argues that unilateral safety and security zones are valid in international law as long as they are 1) transparent, 2) do not claim sovereignty, and 3) the same law applies inside the zone as outside the zone.[423] The unilateral approach for safety or security zones has never been tested in space, yet has a lot of merit as long as the zone exhibits certain characteristics, such as the Newsome test, there will be a higher likelihood that other States will respect them. The crux of the matter is, there is a risk in implementing a unilateral approach if other States refuse to respect it. If other States respect the unilaterally declared zones, everything is fine, but if other States refuse to oblige, there is no legal mechanism to enforce compliance. The Parties to the Artemis Accords are attempting to establish multilateral safety zones, at least vis-à-vis the other signatories.[424] The drawback to this approach is that non-parties would not be bound to it. However, by implementing a clear practice, if the method proves successful, other

[422] Andrea J Harrington, "Preserving Humanity's Heritage in Space: Fifty Years after Apollo 11 and Beyond" (2019) 83:3 J Air L & Com 299 at 375.
[423] *The legality of safety and security zones in outer space*, *supra* note 163 at 76.
[424] *Artemis Accords*, *supra* note 116 s 11.

non-parties to the Accords may likely adopt similar rules, or even respect the safety zones regardless.

The US has also attempted to establish unilateral principles for responsible behavior in space. In 2021, the US Secretary of Defense published "Tenets of Responsible Behavior in Space," which includes five tenets with an order to the Commander of USSPACECOM to develop guidelines related to the tenets and "associated specific behaviors for DoD operations."[425] On 9 February 2023, the US Secretary of Defense approved USSPACECOM's recommended guidelines, which add some specific examples to illustrate what the five tenets mean.[426] The five tenets and subsequent guidelines are:

1. Operate in, from, to, and through space with due regard to others and in a professional manner.
    - When conducting a rendezvous or operating in proximity to the space objects owned or operated by non-U.S. government entities, avoid actions that may harmfully interfere with the function of the other space object, or where the effect will cause or significantly increase the risk of a potential collision.
2. Limit the generation of long-lived debris.
    - Design, operate, and maintain space objects through end-of-life disposal in ways that limit the generation of long-lived debris.
3. Avoid the creation of harmful interference.
    - Take all practicable steps to prevent affecting the command and control of space objects in a manner that increases the risk of loss, damage, or destruction of a space object.
    - Take all practicable steps to prevent interference with capabilities that contribute to strategic stability, including but not limited to: national technical means of verification; strategic missile warning space systems; and nuclear command, control, and communications (NC3) space systems.
4. Maintain safe separation and safe trajectory.
    - Ensure space objects designed to conduct rendezvous or proximity operations have appropriate collision avoidance systems and follow trajectories that allow other space objects to maneuver in a safe manner.
5. Communicate and make notifications to enhance the safety and stability of the domain.
    - Provide notifications to affected parties if a potential collision is predicted, and, provide public notification as soon as practicable in the event of an uncontrolled or anomalous reentry.

[425] Lloyd P Austin, *Tenets of Responsible Behavior in Space* Secretary of Defense, 2021).
[426] Sandra Erwin, "DoD releases updated guidance on 'responsible behaviors in space,'" (3 March 2023), online: *SpaceNews* <https://spacenews.com/dod-releases-updated-guidance-on-responsible-behaviors-in-space/>.

- Share space situational awareness data, including space objects and debris locations, as necessary to facilitate spaceflight safety, avoid collisions, and minimize launch and reentry risks.
- As soon as practicable, provide notifications to affected parties of the loss of control of a space object, if that loss of control may result in a collision, cause interference with other space objects, or cause an uncontrolled reentry.[427]

The USSPACECOM press release states that the purpose of the "non-legally binding tenets and best practices" is to "increase transparency, reduce miscommunication, and reduce misperceptions," which is aligned with the UN sustainability guidelines for outer space activities.[428] These tenets are unilateral, and non-legally binding, to the extent they do not simply restate binding principles from the OST, such as acting with due regard, on any operators outside the US Department of Defense, it is one step toward establishing "rules of the road" by exhibiting a transparent declaration of how the US will conduct operations in space. This may have the positive effect of convincing other States to develop and officially release their own guidelines and regulations for how their satellites will act in outer space.

CHAPTER 5: LIMITATIONS AND BARRIERS TO IMPLEMENTATION SSZS

"I think there needs to be a discussion on norms of behavior and on responsible behavior in space. Space fairing nations need to have that conversation, and I would encourage more dialogue." – General John Raymond[429]

A. LACK OF GEOPOLITICAL CONSENSUS

The biggest barrier to implementing an SSZ is the current lack of geopolitical consensus. The tensions between the major space powers, especially vis-à-vis China and the US, likely preclude any agreements to establish such rules. In 2011, the US Congress passed the Wolf

[427] *Tenets of Responsible Behavior in Space*, *supra* note 425; US Space Command, "Tenets of Responsible Behaviors in Space," (12 April 2023), online: *United States Space Command* <https://www.spacecom.mil/Newsroom/Publications/Pub-Display/Article/3360751/tenets-of-responsible-behaviors-in-space/http%3A%2F%2Fwww.spacecom.mil%2FNewsroom%2FPublications%2FPub-Display%2FArticle%2F3360751%2Ftenets-of-responsible-behaviors-in-space%2F>.
[428] *Tenets of Responsible Behaviors in Space*, *supra* note 427.
[429] *Raymond calls out Russia for 'threatening behavior' in outer space*, *supra* note 234.

Amendment which prevents the NASA or the Office of Science and Technology Policy (OSTP) from bilateral cooperation with China or Chinese-owned companies.[430] The Wolf Amendment was passed to prevent sensitive space technologies from being stolen by China.[431] A later update to the Wolf Amendment added a mechanism for the US Federal Bureau of Investigation to approve requests for the US to collaborate with China when the coordination: "1) poses no risk of resulting in the transfer of technology, data, or other information with national security or economic security implications" and 2) "will not involve knowing interactions with officials who have been determined by the United States to have direct involvement with violations of human rights."[432] So it is not technically correct to call the Wolf Amendment a ban, but it does create a barrier to cooperation between the US and China in outer space.[433] The political implications are likely more significant than the legal ones.[434] The Wolf Amendment would not bar China from signing the Artemis Accords, but it would limit the extent that China would be allowed to participate in the Artemis Program to return to the Moon. Therefore, it is unlikely China would want to sign it, now that it has agreed with Russia and others on its own lunar project in the ILRS.[435] The law also has a chilling effect which deters US officials from working with Chinese space agencies and companies, out of fear of running afoul of the law, even in cases where collaboration may be permitted.[436]

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[430] *Department of Defense and Full-Year Continuing Appropriations Act, 2011*, Pub L No 112-10 §1340, 125 Stat 38 at 123.
[431] Victoria Samson et al, *10 Years of the Wolf Amendment: Assessing Effects and Outcomes* (Secure World Foundation Zoom Webinar: 2021) at 13.
[432] *Consolidated Appropriations Act, 2023*, Pub L No 117-328 §526(c), 136 Stat 4459 at 4560.
[433] *10 Years of the Wolf Amendment: Assessing Effects and Outcomes*, *supra* note 431 at 13.
[434] George Whitford, "Trouble in the Stars: The Importance of US-China Bilateral Cooperation in Space," (27 October 2019), online: *Harvard International Review* <https://hir.harvard.edu/trouble-in-the-stars-the-importance-of-us-china-bilateral-cooperation-in-space/> [*Trouble in the Stars*].
[435] Leonard David, "Can the U.S. and China Cooperate in Space?," (2 August 2021), online: *Scientific American* <https://www.scientificamerican.com/article/can-the-u-s-and-china-cooperate-in-space/>.
[436] *10 Years of the Wolf Amendment: Assessing Effects and Outcomes*, *supra* note 431 at 32.

This is not to say that binding international treaties are completely off the table. The Incidents on the High Seas Agreement shows that even States in conflict with one another can come together to agree to rules of the road when it becomes clear that the lack of rules pose a threat to unnecessary escalation. The treaty-making process provides additional assurances that non-binding instruments do not.[437] For the US, a treaty requires the advice and consent of the Senate, which means that the treaty's terms are subject to review by committees and hearings.[438] This gives other States a degree of confidence that the US will honor its commitments to the treaty, and that a future Presidential administration will be less likely to undo the agreement.[439] Likewise ratifications by other States increase the likelihood that the signatory States will follow the terms of the treaty.[440] The *pacta sunt servanda* principle, which requires parties to a treaty to perform the obligations of the treaty in good faith, additionally gives States a degree of assurance that other States will uphold their obligations.

As Schwetje observed, there are currently no rules regarding SSZs, because the system has been working without them for a long time, at least the system has not yet reached a breaking point although there are signs of stress.[441] As the number of satellites in orbit expands almost exponentially, the need to establish some governing rules is becoming apparent. The question is whether States will come to an agreement before some catastrophe proves the point. A historical example of a time when such an obvious need to come to an agreement between parties during

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[437] Goldsmith & Posner, *supra* note 257 at 91–93.
[438] *Ibid* at 92; US Const art II, §2, cl 2.
[439] Goldsmith & Posner, *supra* note 257 at 92"The Treaty of Moscow illustrates these issues. When President Bush announced his intention to achieve significant arms control reduction with the Russians, he initially proposed that the deal be sealed with a handshake between him and Vladimir Putin. Putin and several U.S. senators balked at this form of agreement. They insisted that the agreement be written down, consented to by the U.S. Senate and the Russian Duma, and formally ratified. And this is what happened."
[440] *Ibid*.
[441] Schwetje, *supra* note 131 at 131 While the topic has been of interest academically, no genuine need to establish any such zones has yet emerged.

conflict is the Partial Nuclear Test Ban Treaty in 1963. During the height of the Cold War, the US and the USSR recognized the danger that further nuclear weapons testing in the upper atmosphere and outer space would cause and agreed to ban such weapons tests. In that case, it was apparent that they could not continue nuclear testing in space.[442] The OST is also the product of a recognition of a need to establish rules for outer space, in particular preserving outer space for peaceful purposes, so that celestial conflict would not result in a terrestrial one. The militarization of space, and the establishment of military space forces, has led to fears that war in outer space is inevitable.[443]

Another reason there is likely some reluctance to entering into a binding treaty is that at this point the OST is widely accepted, with some scholars arguing that some of its principles have risen to *jus cogens* status.[444] Article XV of the OST allows States to propose amendments to the treaty, however, this is a risky mechanism to change the law, because any amendments would only be applicable to those States that agree to the changes.[445] Any holdouts will not be bound to the amendments. To further limit the freedom of a State by requiring adherence to an SSZ may cause some States to object to such norms, rendering the whole idea useless.

B. RISK OF RUSSIAN NUKES

There are a few national security threats that SSZs would not be able to address, but nevertheless highlight the importance of rules of the road in space. On 14 February 2024, there

[442] Richard Stone, "U.S. tests ways to sweep space clean of radiation after nuclear attack," (26 December 2019), online: *Science* <science.org/content/article/us-tests-ways-sweep-space-clean-radiation-after-nuclear-attack>.
[443] Ram S Jakhu, Kuan-Wei Chen & Bayar Goswami, "Threats to Peaceful Purposes of Outer Space: Politics and Law" (2020) 18:1 Astropolitics 22 at 29–31 [*Threats to Peaceful Purposes of Outer Space*].
[444] Ram Jakhu argues that four principles of the OST have *jus cogens* status, 1) Space Activities, for the Benefit and in the Interests of all Countries, 2) Freedom of Exploration and Use of Outer Space, 3) Prohibition of National Appropriation, and 4) Respect for the Rights of Other States Ram Jakhu, "Legal Issues Relating to the Global Public Interest in Outer Space The Vision for Space Exploration: A Dedicated Issue" (2006) 32:1 J Space L 31 at 48 [*Legal Issues Relating to the Global Public Interest in Outer Space The Vision for Space Exploration*].
[445] *The Outer Space Treaty*, *supra* note 66 at art XV.

was a news report that Russia was developing a nuclear ASAT capability.[446] Other news reports stated that the weapon likely would produce a nuclear electromagnetic pulse (EMP) and could have a devastating impact on many satellites in orbit.[447] On 20 February 2024, President Vladimir Putin strongly denied the existence of the weapon, claiming that Russia was "categorically against the deployment of nuclear weapons in space."[448]

On 24 April 2024, the American and Japanese delegates on the UN Security Council drafted a resolution calling on all nations to reaffirm their commitment not to deploy or develop nuclear weapons in outer space, which was vetoed by Russia, with China abstaining.[449] The Russian UN ambassador dismissed the resolution as a "dirty spectacle," saying it did not go far enough in banning space-based weapons.[450] On 24 May 2024, Russia and China submitted a draft resolution to ban all weapons of any kind in outer space, which was rejected by France, Japan, Malta, Republic of Korea, Slovenia, the UK, and the US.[451] The US Ambassador argued that the difference between Russian and the US-Japan draft resolutions is that the Russian draft did not affirm previously existing terms of the OST, while the US-Japan proposal did.[452] Furthermore, the US Ambassador accused Russia of launching a satellite on 16 May 2024 in which the US "assesses is likely a counterspace weapon presumably capable of attacking other satellites in low Earth orbit."[453] US Space Command (USSPACECOM) reported that COSMOS 2576 is the same

[446] Geoff Brumfiel & Tom Bowman, "Russia is working on a weapon to destroy satellites but has not deployed one yet," *NPR* (15 February 2024) online: <NPR> [https://www.npr.org/2024/02/15/1231594952/russia-national-security-threat-space-nuclear].
[447] Bart Hendrickx, "Russian research on space nukes and alternative counterspace weapons (part 1)," (13 May 2024), online: *The Space Review* <https://thespacereview.com/article/4793/1> [*Russian research on space nukes*].
[448] *Ibid*.
[449] *Ibid*.
[450] *Ibid*.
[451] Scott Kelly, "Second draft resolution on weapons-free outer space fails in Security Council | UN News," (20 May 2024), online: <https://news.un.org/en/story/2024/05/1150126>.
[452] *Ibid*.
[453] *Ibid*.

type of Russian "inspector" satellite that has previously engaged in "reckless" behavior.[454] The USSPACECOM spokesperson also said that COSMOS 2576 is in the same orbit as a US government satellite.[455] These developments, which are occurring at the time of the writing of this Thesis, highlight the importance of establishing rules restricting the ability of highly maneuverable satellites, especially military ones, from drawing close to other satellites.

C. SPACE DOMAIN AWARENESS AND LIMITATIONS WITH SPACE TRAFFIC MANAGEMENT

One of the biggest limitations to establishing viable SSZs is Space Domain Awareness (SDA) or Space Situational Awareness (SSA). SDA and SSA are the ability to rapidly track objects in space, detect, and warn users of threats to their space objects.[456] To be effective, these systems need powerful ground-based telescopes and radars as well as space-based sensors to maintain continuity of tracking objects.[457] As satellites continue around the Earth, in orbits other than geostationary, ground-based sensors lose track of them as they move out of the line of sight. Since no country has territory in enough places around the world, this is an effort that requires international cooperation on a bilateral or multilateral basis. The US, for instance, has ground stations in the continental US, Alaska, Hawaii, and Antarctica. There are still blind spots, however, where partners such as South Africa, Australia, Norway, Greenland, Chile, Sweden, and others can provide tracking of objects to preserve continuity.[458] Otherwise, an object such as

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[454] Joey Roulette, "US assesses Russia launched space weapon in path of American satellite," (21 May 2024), online: *Reuters* <https://www.reuters.com/world/us-assesses-russia-launched-space-weapon-near-american-satellite-last-week-2024-05-21/>.
[455] *Ibid*.
[456] US Space Force, "Space Domain Awareness & Combat Power," (8 May 2024), online: *Space Systems Command* <https://www.ssc.spaceforce.mil/Program-Offices/Space-Domain-Awareness-Combat-Power>.
[457] *Ibid*; *Physics of War in Space: How Orbital Dynamics Constrain Space-to-Space Engagements*, *supra* note 204 at 3.
[458] NASA, "11.0 Ground Data Systems and Mission Operations—NASA" in Sasha Weston, ed, *State-of-the-Art of Small Spacecraft Technology* (Moffett Field, CA: NASA Ames Research Center, 13 Feb 24) at 298.

an RPO satellite could lay dormant, like Luch did, until it is in a blind-spot and starts to maneuver, making it hard to keep track of. Improvements to SDA technologies and the implementations of SDA data-sharing agreements would go far in alleviating some of these concerns.[459] There is some increased risks of broadly sharing the precise position of sensitive satellites, because, for example, such data could be used by an adversary to target those satellites.[460]

To enforce an SSZ, the State would need to be able and willing to attribute the action to another State's RPO satellite and prove that they have violated the zone, otherwise the zone would be meaningless. To facilitate the enforcement of these rules, SDA would play a significant role in identifying the satellite, when it engages its thrust, and how its orbital trajectory changes bringing the satellite inside the SSZ. Although these satellites are moving very quickly in orbit, it takes time for them to move to their position, which means in many cases operators will see the space object approach and anticipate a breach of the SSZ before it happens.[461] This could be the impetus for consultations under Article IX of the OST, as long as the other operator responds in a timely manner.

There have been proposals to go one step further than SDA and implement a Space Traffic Management (STM) system. Proposals abound about what model STM should follow, but most proposals base their rules either on a maritime model or an airspace model.[462] The maritime model requires each State to enforce management by exercising its jurisdiction and control over its flag carriers, with collision avoidance based on rules of navigation rather than some

[459] Green, *supra* note 353 at 130–31.
[460] *Ibid* at 44–45.
[461] For example, AGI identified Luch early on as an object of interest and began tracking where it moved and, in several instances, anticipated its next target. *LUCH Space Activities—Spacecast 14*, *supra* note 218.
[462] Ruth E Stilwell, Diane Howard & Sven Kaltenhauser, "Overcoming Sovereignty for Space Traffic Management" (2020) 7:2 Journal of Space Safety Engineering 158 at 159.

international body.[463] In other words, the operators of ships use a set of rules to guide them in situations where two ships may collide. It is a decentralized approach. Airspace traffic management, on the other hand, has State officials delegating authority to contracting States to provide air traffic control (ATC) in international airspace through the International Civil Aviation Organization (ICAO) Council, but these providers must follow ICAO guidelines and procedures.[464] Failure to obey an ATC authority can result in fines, criminal prosecutions, and in extreme cases, result in a military response. Article VI of the OST places responsibility for space objects with the appropriate State, which seems to suggest that STM will follow the maritime model, absent a multilateral treaty establishing an international body with delegated power to manage traffic.[465] In the near term, it seems that STM will be conducted by various governments and private entities to make the orbit data available for operators to use to make informed decisions, rather than a top-down prescriptive approach.[466]

One effort in this regard is the Unted States pushing to move the authority over STM to the Department of Commerce, to open the capability to commercial interests, rather than in the national security realm, which is inherently more reluctant to share its information.[467] US policy is to leverage commercial sector investment and expertise to advance the notion that improving SDA accuracy and timing is essential to manage the integrity of the operating environment.[468]

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[463] *Ibid*.
[464] *Ibid*.
[465] *Ibid* at 159.
[466] *Space Traffic Management—Spacecast Episode 21* (YouTube.com: 2019) loc. 7:10.
[467] "Space Policy Directive-3, National Space Traffic Management Policy – The White House," (4 March 2024), online: <https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/>.
[468] *Ibid*.

D. ESTABLISHING A THREAT RING AND THE IMPLICATIONS OF SELF-DEFENSE

An important feature of the Safety and Security Zones is that it establishes a threat ring around the space object or facility. There has hitherto been a reluctance of States to overtly draw close to another State's classified military satellites.[469] Nevertheless, the demonstrations of Russia and China's RPO satellites' capabilities pose a considerable risk to satellites in orbit.

One of the most common justifications for any national security asset is the principle of self-defense. The principle of self-defense in space is controversial. In 2015, the European Union hosted the Multilateral Negotiations on an International Code of Conduct for Outer Space Activities (Multilateral Negotiations).[470] In the negotiations, which failed to produce anything substantive due to strong disagreements on many topics, there was a strong objection to including the principle of self-defense in the code of conduct.[471] Additionally, in the China/Russia sponsored Prevention of Placement of Weapons in Space Treaty (PPWT), Article IV recognizes the inherent right to self-defense although the Treaty bans any kind of weapons in space.[472]

Indeed, States must consider the implications of self-defense in customary international law and Article 51 of the UN Charter, both of which apply to outer space through Article III of the OST. Article 51 of the UN Charter states, "[n]othing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member

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[469] For example, Luch had drawn close to WGS-9, an unregistered US military satellite, but moved away after the US updated its registry. It is unclear if the Russians knew that Luch was purposefully in between WGS-9 and NSS-12 and used NSS-12 as a plausible target. By moving its satellite, Russia seems to have acknowledged the risk of appearing to be too close to WGS-9. For a further discussion, see Chapter 1(e) above. *LUCH Space Activities—Spacecast 14*, *supra* note 218 loc. 23:49.

[470] P J Blount, "Sorting out Self-Defence in Space: Understanding the Conflicting Views on Self-Defence in the EU Code of Conduct" (2017) 1:1 Conflicts in Space and the Rule of Law (Maria Manoli & Sandy Belle Habchi, eds) (Monograph Series V) 311 at 311 [*Sorting out Self-Defence in Space*].

[471] *Ibid* at 311.

[472] *Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects*, at art IV [*PPWT*].

of the United Nations."[473] Article 51 requires an "armed attack" before self-defense, under Article 51. The ICJ in *Nicaragua v. United States of America* held that if the "scale and effects" of an activity could be classified as an armed attack if it were carried out by armed forces, then the right of self-defense would attach.[474] In addition to the UN Charter's recognition of the right to self-defense from an "armed attack," States, by virtue of their sovereignty, have an inherent right to defend themselves in customary international law.[475]

In asserting self-defense, the State must justify the response in terms of necessity and proportionality.[476] This means that when a State acts in self-defense, it must limit its actions to those that are necessary to defend itself, and proportional to the extent required to "repel the armed attack and restore the security of the party attacked."[477] If a State suffers an attack in outer space, the attacked State may respond in another domain, but a response in outer space is also justified if it is necessary and proportional.[478]

Necessity and proportionality are crucial in justifying actions taken in self-defense. Military necessity is the principle "that justifies the use of all measures needed to defeat the enemy as quickly and efficiently as possible that are not prohibited by the law of war."[479] Proportionality

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[473] *UN Charter,* 26 June 1945, Can TS 1945 No 7, at art 51 [*UN Charter*].
[474] *Case Concerning Military and Paramilitary Activities in and against Nicaragua (Nicaragua v United States of America)*, [1986] ICJ Rep 14 at 103–4 [*Nicauragua v. United States of America*].
[475] John Cobb Cooper, "Self-Defense in Outer Space and the United Nations" (1968) 1:1 Explorations in Aerospace Law: Selected Essays by John Cobb Cooper, 1946-1966 (Ivan A Vlasic, ed) 412 at 413 [*Self-Defense in Outer Space and the United Nations Part Six*]; See also John J Klein, "Space Warfare: Deterrence, Dissuasion and the Law of Armed Conflict," (30 August 2016), online: *War on the Rocks* <https://warontherocks.com/2016/08/space-warfare-deterrence-dissuasion-and-the-law-of-armed-conflict/> [*Space Warfare*].
[476] Myres S McDougal, Harold D Lasswell & Ivan A Vlasic, *Law and Order in Outer Space* (New Haven: Yale University Press, 1963) at 295–96.
[477] *US Law of War Manual*, *supra* note 347 at para 1.11.1.2.
[478] *Space Warfare*, *supra* note 475; See also Claus Kreß, "The International Court of Justice and the 'Principle of Non-Use of Force'" in, *The Oxford Handbook of the Use of Force in International Law* (Oxford: Oxford University Press, 2015), 561 at 586–88 There would seem to be a broad consensus that the exercise of the right of self-defense under international law is governed by the principles of necessity and proportionality. Reference is generally made to the famous 1837 *Caroline* incident in support of that position.
[479] *US Law of War Manual*, *supra* note 347 at para 2.2.

has reference to the scope and reasonableness of the response, and in the context of self-defense, is related to reasonableness and imposes an obligation to refrain from responses that result in excessive collateral damage.[480]

Another important aspect of self-defense in outer space is preemptive self-defense. This theory has its roots in the *Caroline* Case. In 1837, Canadian rebels received aid from an American ship, the *Caroline*, and her crew to transport men and supplies across the Niagara River.[481] On the night of 29 December 1837, British forces crossed into the US and set the boat on fire, killing two Americans.[482] The British claimed that they were acting in self-defense, but the US Secretary of State, Daniel Webster, asserted to his British counterparts that to justify preventive self-defense, the authorities must show "a necessity of self-defense, instant, overwhelming, leaving no choice of means and no moment of deliberation."[483] Webster acknowledged that military necessity may require crossing into US territory, but the action must be limited to self-defense, and must be "kept clearly within it."[484]

The *Caroline* Case is still cited for justification of preemptive self-defense, especially by the US.[485] Nevertheless, the doctrine has its critics, arguing that Article 51 of the UN Charter limits self-defense only in response to an armed attack.[486] Proponents of anticipatory self-defense, however, claim that it is an absurd result for a State to be required to subject themselves to an armed attack before being able to act in self-defense.[487]

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[480] *Ibid* at para 2.4.1.2; Kreß, *supra* note 478 at 590.
[481] Cooper, *supra* note 475 at 416.
[482] *Ibid* at 416.
[483] *Ibid*.
[484] *Ibid*.
[485] Alex Potcovaru, "The International Law of Anticipatory Self-Defense and U.S. Options in North Korea," (8 August 2017), online: *Lawfare* <https://www.lawfaremedia.org/article/international-law-anticipatory-self-defense-and-us-options-north-korea> [*The International Law of Anticipatory Self-Defense*].
[486] Cooper, *supra* note 475 at 418–19.
[487] *Ibid* at 420–22.

Self-defense is important to the discussion of SSZs, especially in light of concerns over Russia and China's ASAT capabilities. One recent way States have tried to address these concerns is through developing "bodyguard satellites." As discussed in Chapter 3, bodyguard satellites have great potential to facilitate self-defense in space. Bodyguard satellites would work well with SSZs because they could be maneuvered close to the assets they are protecting and serve as a credible way to enforce an SSZ. For example, if a State declares a 50-kilometer SSZ around a national security satellite, the State could deploy several bodyguards within the SSZ. Then, if an unfriendly satellite enters the SSZ, the bodyguards could intercept the approaching craft to block potential harm to the critical asset.

There are questions regarding security and self-defense on the Moon and celestial bodies as well. Article IV of the OST states that the Moon and celestial bodies are "exclusively for peaceful purposes."[488] Article IV also bans the "testing of any type of weapons" as well as "military [maneuvers]."[489] The question is, does this trump the right of self-defense? It does not appear to. The prohibition is for weapons tests and military maneuvers, this does not prohibit security forces from carrying weapons in self-defense or for law enforcement purposes. Does this mean that Moon bases cannot have firing ranges for security forces to practice or to train proficiency with their weapons in lower gravity than they would be accustomed to on Earth? It depends on the purpose, a firing range is used to train proficiency with a weapon, not to test the weapon itself. Nevertheless, these questions will need to be addressed as the Artemis and ILRS programs begin to establish permanent bases on the Moon and other celestial bodies. What seems clear, however, is that Article IV does not abrogate the right of self-defense, nor does it,

[488] *The Outer Space Treaty*, *supra* note 66 at art IV.
[489] *Ibid*.

per se, prevent the arming of security forces to provide defense and law enforcement capabilities on the Moon and celestial bodies.

CONCLUSION

The catchphrase that space is "congested, contested and competitive" has become almost cliché in discussing space issues.[490] However, some argue that to address those issues there must be a focus on "cooperation, collaboration, and communication."[491] The issues faced in LEO, GEO, and on the Moon and other celestial bodies, both now and in the future, can be mitigated by developing clear rules of the road. Air law and maritime law have found some success in achieving safety and security by implementing various zones to manage complicated and uncertain situations.

This thesis proposes Safey and Security Zones (SSZs) to mitigate some of the safety and security risks posed by close operations in LEO, GEO, and on celestial bodies. I explored 1) the need for SSZs; 2) the legal basis upon which they may now or in the future be established; 3) the possible rules that would apply to the SSZs; and 4) potential limitations and barriers to implementing SSZs. The philosophical justification for these zones is both safety and security. In outer space, these two concepts are linked because a security risk that causes long-lived space debris becomes a safety issue potentially for years or decades depending on the location. That risk will only increase as human spaceflight becomes more common.

The need for SSZ lies in the proliferation of highly maneuverable RPO satellites which can threaten critical national security assets as well as valuable commercial satellites (which often

[490] Roger G Harrison, "Unpacking the Three C's: Congested, Competitive, and Contested Space" (2013) 11:3 Astropolitics 123 at 124 [*Unpacking the Three C's*].
[491] Cassandra Steer & Matthew Hersch, "Conclusion: Cooperation, Collaboration, and Communication in Space" in Cassandra Steer & Matthew Hersch, ed, *War and Peace in Outer Space: Law, Policy, and Ethics* (Oxford: Oxford University Press, 2020), 301 at 302–3.

are dual use, engaging in some national security activities on a contractual basis). Additionally, close-proximity lunar operations will soon take place which will raise additional safety and security risks. RPO satellites, although promising some amazing technologies such as on-orbit repair and refueling, active debris removal, and others, also pose a grave risk to other satellites that engage in critical activities. There is currently a lack of rules governing the close approach of one satellite to another without consent, outside of the OST requirement for due regard and refraining from harmful interference. Therefore, a need to establish some rules for these operations is imperative, especially as geopolitical tensions rise.

The most solid legal justification for an SSZ would be a binding international agreement. This would establish rules and requirements as between the parties that would However, under Article III of the OST, there is authority for States to unilaterally establish an SSZ using general principles of international law. There are numerous terrestrial zones which States have established for many years and have contributed to maintaining peace. The ADIZ is one such zone which despite no international agreement establishing them, many coastal States have established an ADIZ, which is usually respected by other States. The SSZ may not permanently exclude space objects or personnel from other States without running afoul of the non-appropriation principle of Article II of the OST. It is reasonable that a State could establish a SSZ that requires an operator to identify itself and the purpose of the close approach if it enters the SSZ. The legal justification would be through Articles VIII and IX of the OST, requesting consultations when another State encroaches upon another satellite. The State establishing the SSZ around one or more of its satellites may communicate that an unauthorized entry into an SSZ would be considered an unfriendly act, at a minimum, in which the State would respond accordingly in a time and place of its choosing.

SSZs on celestial bodies would serve to create a buffer zone around a lunar facility to protect human life and operations taking place there. The danger to human life justifies a more robust safety and security zone. If the Artemis and ILRS programs establish lunar bases at the South Pole of the Moon, the two would be in proximity. Liftoffs and landings of space vehicles will kick up regolith that could interfere with the others' operations, or potentially threaten the lives of astronauts living at the other station or stations. These potential risks justify SSZs being established.

As congestion in outer space continues to increase, there will need to be rules to govern how to act near other space objects, especially as crewed missions become more common. An irresponsible act or accidence during a time of geopolitical crisis could escalate tensions beyond the breaking point, leading to war. Therefore, it is imperative that States adopt SSZs, or some other regime, to govern close proximity operations in LEO, GEO, and on celestial bodies, before it is too late.

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