

**Countering Co-Orbital ASATs:
Warning Zones in GEO as a Lawful Trigger for Self-Defense**

Winner of the College Debate Space Paper Policy Contest

Michael B. Cerny, Emory University
Raphael J. Piliero, Georgetown University
David Bernstein, Georgetown University
Brandon W. Kelley¹, Georgetown University

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¹ Corresponding author: Brandon W. Kelley, Associate Director of Debate at Georgetown University. Center for Security Studies, Georgetown School of Foreign Service. 3700 O St., N.W. Washington, D.C. 20057. Email: bwk9@georgetown.edu

Abstract

The existing literature on space arms control is plagued by a notable gap. Despite widespread acknowledgment of the potential threat posed by co-orbital counterspace operations, particularly in geosynchronous orbit (GEO), one of the most promising solutions remains undertheorized: the declaration of safety zones around satellites. After four decades of debate, proponents and critics have persistently failed to synthesize arguments for and against such proposals in a comprehensive and systematic fashion. The result has been predictable: critics have given unduly short shrift to such proposals, while advocates have failed to sufficiently address their greatest shortcomings. One prominent advocate recently noted regarding a critic of zone proposals that “we agree on all the facts, yet our conclusions are often opposite”. This paper demonstrates that both sides of the debate have merit, and that there is a path to agreement that navigates these contradictions. Critics are correct that, as currently framed, most zone proposals violate international law or are undesirable on policy grounds. However, this need not be true. Framed solely as an information-gathering mechanism supporting the conditional and preemptive use of force in self-defense, “warning zones”—distinguished herein from both “self-defense zones” (SDZs) and “keep-out zones” (KOZs)—are a lawful and effective solution to co-orbital anti-satellite (ASAT) threats in GEO. Designed properly, such warning zones also avoid the most salient policy objections to SDZs and KOZs, while constituting the only presently effective means of addressing a potentially catastrophic threat to space security. They also offer a rare opportunity for truly cross-ideological agreement, and a way forward for international space arms control discussions—something sorely needed in this current political moment.

Introduction

There is increasing realization among both space policy experts and government officials about the vulnerability of United States satellites to attack or disruption by other states. In recent years, one such threat is co-orbital counterspace operations (also known as rendezvous and proximity operations, or RPOs).² Under such a scenario, a United States satellite could be closely approached or tailgated by the satellite of another entity in order to disable or destroy it. This threat is particularly pressing, as the “dual-use” nature of activities in space allows an aggressor to masquerade as a civilian satellite under an ostensibly peaceful purpose such as active debris removal or on-orbit servicing.³ Due to the now burgeoning space industry, experts worry that the increase in government and civilian space activities would increase the vulnerability of United States satellites.

Open-source reporting has confirmed that the threat posed by co-orbital operations is growing. A 2020 report by the Secure World Foundation evidence that the Russian Federation is actively testing advanced RPO technologies in both low-earth orbit (LEO) and geosynchronous orbit (GEO).⁴ At least two active programs⁵ are ostensibly non-aggressive, but the “dual-use” nature of the technology could nonetheless be applied in military or strategic contexts. Similarly, the People’s Republic of China may be close to possessing such capability; while China has not yet conducted a destructive co-orbital intercept of a satellite, China has conducted multiple RPO tests in both LEO and GEO.⁶ Highlighting concerns about the nature of this technology, a report by the Center for Strategic and International Studies also concluded that both Russia and China are testing the ability to maneuver satellites around one another.⁷

² Chow, Brian G., and Brian Weeden. 2020. “Transcript of a Discussion between Dr. Brian Chow and Dr. Brian Weeden on Space Zones and Bodyguards for Proximity Operations.” Presented at the Panel II of a Space Policy Workshop Co-sponsored by the Nonproliferation Policy Education Center and the American Bar Association Standing Committee on Law and National Security. <http://npolicy.org/article.php?aid=1465&tid=2>.

³ Ibid.

⁴ *Global Counterspace Capabilities: An Open Source Assessment*. 2020. Washington, DC: Secure World Foundation. Pp XII. https://swfound.org/media/206970/swf_counterspace2020_electronic_final.pdf.

⁵ The Secure World Foundation lists a co-orbital ASAT program referred to as *Burevestnik* and a surveillance and tracking program called *Nivelir*.

⁶ *Global Counterspace Capabilities: An Open Source Assessment*. 2020.

⁷ Harrison, Todd et al. 2020. *Space Threat Assessment 2020*. Washington, DC: Center for Strategic & International Studies. https://aerospace.csis.org/wp-content/uploads/2020/03/Harrison_SpaceThreatAssessment20_WEB_FINAL-min.pdf.

Open-source intelligence also confirms many concerns about the threat posed by co-orbital counterspace technology. A new Russian program, *Burevestnik*, in Russia's Central Scientific Research Institute of Chemistry and Mechanics (CNIHM), referred to as a "space security complex" in official documentation, is believed to be developing the use of microsattellites to target enemy satellites in GEO.⁸ This fact is unsurprising considering Russia's long history of co-orbital technology development. As early as 1961, the Soviet Union attempted to develop an early co-orbital system (the Istrebitel Sputnikov), and in the 1980s, the Soviet Union attempted to create a higher-altitude co-orbital system known as the Naryad.⁹ Recent observations of close Russian satellite approaches (such as the close approach of the USA-245 in 2020) suggest a resurgence in Russian co-orbital interest.¹⁰

Co-orbital capabilities represent a significant threat to the United States most critical satellites. Given American reliance on space for all facets of military operations, the risk is particularly acute. Unlike during the Cold War, the contemporary US military relies on satellites for its "eyes and ears," providing missile-defense warnings, battlefield communications, and signals for guiding precision munitions.¹¹ In GEO, the United States maintains high-orbit satellites to alert the military when other countries launch ballistic missiles, and these "early warning" satellites serve as the lynchpin of security.¹² In a scenario described by Dr. Brian Chow, close approaches could be used to pre-position multiple enemy satellites near critical United States early warning satellites.¹³ With the ability to attack at a moment's notice, the United States satellites are currently defenseless to this form of attack.¹⁴ Furthermore, the compressed response time is what makes co-orbital attacks uniquely challenging to counter. While a direct-ascent ASAT attack in

⁸ Hendrickx, Bart. "Russia's secret satellite builder," *The Space Review*. May 6, 2019. <https://www.thespacereview.com/article/3709/1>

⁹ Thompson, Cort. 2020. "Russia's Recent Space Activity Is a Return to Old Form." *Lawfare*. <https://www.lawfareblog.com/russias-recent-space-activity-return-old-form> (May 25, 2020).

¹⁰ Ibid

¹¹ Davenport, Christian. 2019. "The Battlefield 22,000 Miles above Earth." *The Wilson Quarterly*. <https://www.wilsonquarterly.com/quarterly/the-new-landscape-in-space/the-battlefield-22-000-miles-above-earth/> (May 25, 2020).

¹² Arbatov, Alexey. "Arms control in outer space: The Russian angle, and a possible way forward," *Bulletin of the Atomic Scientists*. Vol, 75, No. 4. 2019

¹³ Chow, Brian G., "Stalkers in Space: Defeating the Threat," *Strategic Studies Quarterly* 11, no. 2 (Summer 2017): 82, https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-11_Issue-2/Chow.pdf, 82

¹⁴ Chow, "Stalkers in Space," 82.

GEO would give the United States only four to six hours to both anticipate and respond, a pre-positioning co-orbital attack would be comparatively instantaneous.¹⁵

Such risks are also not theoretical. Many incentives exist for Russia and China to press United States boundaries in space and conduct close approaches. According to the “Senkaku Paradox” articulated by Michael O’Hanlon, China might start with small acts of aggression in the South China Sea or Senkaku Islands to test American resolve.¹⁶ Although it is unlikely China would engage in overt military attack, these low-level acts of aggression represent gambles over an “essentially worthless collection of rocks.”¹⁷ According to O’Hanlon, such attacks would likely begin in space due to the United States’ vulnerability, as destruction or disruption of critical satellites could hamper a timely and effective American response. Furthermore, a public narrative that China or Russia could effectively deny American responses by disrupting critical satellites poses a latent risk to American alliances and assurances, even if such attacks never occur.¹⁸

Independent of the risks to American security commitments, the space domain itself is also prone to misunderstandings and miscalculation. Space is an “offense-dominant” domain, where satellites are inherently vulnerable and difficult to defend, lending an advantage to the attacker. This creates a structural incentive for a state with substantial dependence on space to strike while the iron is hot, protecting their own satellites.¹⁹ The combination of compressed timelines for responses with a lack of crisis management history create a lethal cocktail for a dispute to spiral out of control, with the ensuing conflict spreading to the terrestrial domain.²⁰ Deterrence also runs unique crisis stability-related risks in space, as it requires states to consistently demonstrate capability and resolve;²¹ the aforementioned characterization of space as an offense-dominant domain makes this uniquely unstable.

However, some experts disagree with the extent of the threat posed by these operations.²² Performing a close approach to an enemy satellite would present a challenge, let alone successfully

¹⁵ Swarts, Phillip “Space Wars: The Air Force Awakens,” Air Force Times, 2016, available at <https://www.airforcetimes.com/news/your-air-force/2016/02/15/space-wars-the-air-force-awakens/>.

¹⁶ O’Hanlon, Michael “Can America Still Protect Its Allies? How to Make Deterrence Work,” Foreign Affairs, Vol. 98, No. 5. September/October 2019

¹⁷ Ibid

¹⁸ See, for example: Brandon J. Weichert, “Preparing for a Russian ‘Space Pearl Harbor,’” Orbis, June 14, 2019, <https://doi.org/10.1016/j.orbis.2019.05.002>.

¹⁹ Grego, Dr. Laura, Union of Concerned Scientists, Space and Crisis Stability, March 2018, <https://www.law.upenn.edu/live/files/7804-grego-space-and-crisis-stabilitypdf>

²⁰ Ibid

²¹ Ibid

²² Chow, Brian G., and Brian Weeden. 2020. “Transcript of a Discussion between Dr. Brian Chow and Dr. Brian Weeden on Space Zones and Bodyguards for Proximity Operations.” Presented at the Panel II

disabling an enemy satellite while remaining undetected. Instead, an aggressor would likely resort to any number of other options, such as a terrestrially launched ASAT attack, signal jamming, or a cyber-attack.²³ Yet, concerns persist within the United States federal government and the United Nations about the threat posed by co-orbital capabilities. In 2018, U.S. Vice President Mike Pence commented that “Both China and Russia have been conducting highly sophisticated on-orbit activities that could enable them to maneuver their satellites into close proximity of ours, posing unprecedented new dangers to our space systems.”²⁴ These concerns have been echoed by working groups of the United Nations, and, in 2019, the UN Disarmament Commission examined the threat posed by co-orbital satellite operations.²⁵

To address the threat posed by these operations, experts and government contractors have proposed that the United States establish a policy by which zones would be designated around American space assets, which, if breached, would justify an armed response against the potentially aggressive satellite.²⁶ Although significant disagreement persists about the legal, technical, and political feasibility of these zone proposals, there exists common ground amongst proponents and critics about the value of signaling state intent in outer space. United States military officials have acknowledged that, even if space zones are informal, they provide a means of registering a grievance; another official noted that zones can help communicate a menu of increasingly escalatory options in space, similar to the use of flares or warning shots for maritime vessels.²⁷

Furthermore, the United States has a unique opportunity to be the standard-bearer for a new form of arms control to address co-orbital counterspace technologies. This is intentionally differentiated from a strategy based primarily on deterrence in space. A deterrence-driven approach would, in the words of Professor David A. Koplow, be “expansive and therefore

of a Space Policy Workshop Co-sponsored by the Nonproliferation Policy Education Center and the American Bar Association Standing Committee on Law and National Security.
<http://npolicy.org/article.php?aid=1465&tid=2>.

²³ Ibid.

²⁴ Remarks by Vice President Pence on the Future of the U.S. Military in Space. August 9, 2018.
<https://www.whitehouse.gov/briefings-statements/remarks-vice-president-pence-future-u-s-military-space/>

²⁵ UNDIR. “Practical Implementation of Transparency and Confidence-Building Measures (TCBMs)” Briefing Series for UN Disarmament Commission Working Group II. April 10-12, 2019.
<https://www.unidir.org/sites/default/files/2019-12/Microsoft%20Word%20-%20Agenda%20-%20UNIDIR%20UNDC%20April%20Events%20-%20Designed.docx.pdf>

²⁶ Ibid

²⁷ American Bar Association Standing Committee on Law and National Security, “Working Smarter with America’s Spacefaring Allies,” Workshop Report. March 2020. http://npolicy.org/article_file/march-2020-space-report.pdf

expensive”, requiring the US to be perpetually on the look-out for any potential threat in space.²⁸ In contrast, arms control could be mutually agreeable and effective. Professor Koplow argues that ASATs are nascent enough to be effectively regulated while in the development and testing phase; ASATs have yet to be used in conflict, which makes now a particularly opportune time for a mutual accord.²⁹ The US has an interest in protecting the space capabilities that it relies on for war; meanwhile, China and Russia have an interest in enshrining binding restraints on further advances that the US could make with regards to military space capabilities.³⁰

Indeed, a failure to actively push for arms control creates a concomitant risk to US credibility. While China, Russia, and the European Union have advanced their own series of arms control proposals, the US has mostly remained on the sidelines. Douglas Loverro, the former Deputy Assistant Secretary of Defense for Space Policy, has argued that US must take ambitious actions to reverse a reputation of intransigence. He argues that “A clear consensus arose that whatever reasons the United States may have for not being willing to negotiate a binding treaty like the PPWT or a non-binding instrument like the ICoC, it should propose alternative measures which it is willing to support. Rebuffing international attempts to create more collaboration without providing alternatives means that the United States is failing to take a leadership role.”³¹ Even skeptics of the zone proposal agree, with Dr. Weeden noting that “US leadership has waned... space security issues... the lack of strong US engagement... allowed Russia, with... China to... seize the diplomatic narrative and ultimately derail the negotiations... the US has long refused to offer any substantive proposals, leaving Russia and China to set the agenda with their proposals for banning space weapons and no first placement of weapons in space, both... designed to provide advantages... over the US.”³² Furthermore, Weeden writes that the US could “propose restrictions on the ability of satellites to engage in close approach... thereby clarifying threatening behaviors and enabling the use of self-defense measures... rallying allies and partners to our call...”³³ One potential proposal would be warning zones in space.

²⁸ David A. Koplow, *Deterrence as the MacGuffin: The Case for Arms Control in Outer Space*, Updated January 2020, 10 J. NAT’L SECURITY L. & POL’Y __ (forthcoming), https://jnslp.com/wp-content/uploads/2020/01/Deterrence_as_the_MacGuffin.pdf pp 38.

²⁹ *Ibid*, 72.

³⁰ *Ibid*.

³¹ Loverro, Douglas, “Summary of Discussions of the Expert Roundtable on The Weaponization of Outer Space: Ethical and Legal Boundaries,” *Center for Ethics and the Rule of Law*. April 6-7, 2018. Pp 24. <https://www.law.upenn.edu/live/files/10006-cerl-conference-summary-report-weaponization>

³² Weeden, Brian. “The Space Review: The Trump Administration Needs to Exercise Leadership in Space Security Diplomacy,” August 20, 2018, <http://www.thespacereview.com/article/3554/1>

³³ *Ibid*.

The following report synthesizes historical and contemporary political, technical, and legal discussions on establishing specialized zones in outer space to protect American satellites from co-orbital ASAT technology. Developing a taxonomy of different zone proposals across the space security and arms control literature, we assess the relative legal merits of these proposals. Our findings suggest that previous proposals would be untenable due to legal limitations on space activities set forth by the Outer Space Treaty. However, we propose the establishment of a new type of zone— ‘warning zones’ —which, if framed solely as an information-gathering mechanism supporting the conditional and preemptive use of force in self-defense, would constitute a lawful and effective solution to co-orbital ASAT threats in GEO.

Summary of Key Findings

We find the following:

- Preemptive uses of force in self-defense in space are clearly lawful, so long as all relevant proscriptions on its exercise are observed.
- Prior zone proposals, which envision enforcement of zones *per se*, are almost certainly in violation of the Outer Space Treaty (OST)'s prohibitions on national appropriation by means of sovereignty or use (Art. II) and harmful interference with the activities of other States (Art. IX). This paper's proposed "warning zones," in contrast, fully comply with both provisions, placing a subset of safety zones on unassailable legal footing.
- The existing literature regarding legality of zones uniformly fails to consider such a formulation. Proponents have thus far leaned on strained analogies to the ITU, ISS, or law of the sea, which critics have rightly identified as spurious.
- The unique physical characteristics of GEO render all available alternatives incapable of adequately addressing the threat posed by co-orbital interception from prepositioned assets, should technical capacity be(come) sufficient to enable such loitering and interception to be undertaken reliably. This is a realistic possibility, and the resultant risks to international stability could be substantial.
- Both critics and proponents of zones have failed to systematically address each other's arguments. Each side is correct in key respects often glossed over by the other. Designed properly, warning zones can avoid nearly all major objections raised by critics, while meaningfully increasing crisis stability and decreasing the risk of interstate conflict.
- Most saliently: prepositioning of co-orbital assets poses a unique threat undervalued by critics, and addressable in the near-term only by drones. Critics' well-founded concerns that drawing red-lines will create perverse incentives to test and increase the propensity for crisis escalation are resolved by this paper's reformulation of zones as a flexible mechanism for deriving signals of possible intent. Meanwhile, claims that the adversary will simply loiter outside the bounds of the zone, or that the zone cannot reliably extend far enough to prevent close-approaches, fail to understand the true value of the proposal, which is *informational*, not prohibitive. Finally, the ability to operate on the edge is a bug, not a feature, as it increases the ability and likelihood of states sending clear signals and adds important rungs of bargaining, short of the use of force, to the escalation ladder.
- Warning zones are a form of space arms control that is appealing to all parties. As a uniquely self-executing crisis stability measure, zones are devoid of the verification concerns, definitional debates, and fears of restricting freedom of action that have brought space arms control negotiations to a grinding halt. This provides a unique opportunity to forge consensus, and take the first steps toward a new space arms control agenda. Doves, hawks; Democrats, Republicans; Americans, Chinese, Russians, Europeans: all are well-served—and none are harmed—by increased clarity around intent in orbit.

This paper will begin by taxonomizing space security zone proposals and assessing their (il)legality. Only warning zones (WZs) are conclusively lawful under the OST, and international law places several additional constraints on their operation. The paper will then evaluate the case for WZs on normative policy grounds, comprehensively surveying the arguments for and against such zones. This paper finds that critics' arguments are well-founded, and may very well be damning to other zone proposals; but that in one specific context, WZs with certain specific design elements are capable of resolving such criticisms while providing an invaluable contribution to space security.

Typology of Zones

The dearth of international law regulating co-orbital anti-satellite technology (ASATs) leaves states with few options to combat the burgeoning threat posed by these weapons. Nonetheless, steps must be taken to regulate dual-use space systems before they are deployed *en masse*. A significant number of proposals argue that safety zones around satellites should be established, though the existing literature on these zones elides important legal and policy distinctions between them. This section seeks to rectify the conflation between different types of zones by sketching a clearer zone taxonomy, and then evaluating their relative legal and policy merits. For purposes of this paper, we only consider zone types related to arms control proposals; a more expansive typology of space zones which elaborates on other varieties such as non-interference zones³⁴ and space traffic management/collision-minimization zones should be subject to further research.

Proposals to establish zones in outer space within which certain conduct by states could be restricted or prohibited date to the earliest days of space arms control during the Cold War.³⁵ For example, in 1980, *M.I. Lazarev* proposed the establishment of security zones around settlements in outer space through which other states could only pass through peacefully.³⁶ In 1986, *P.Q. Collins* and *T.W. Williams* proposed a “Traffic Zones” system whereby international law could proscribe certain movements and types of passage by satellites in bands of space reserved for solar power generation and space stations³⁷ Furthermore, T. K. *Schwetje* identified a variety of other proposals in the 1980s to establish zones designed to protect states’ space assets which, if penetrated without permission, would allow retaliation through the use of force.³⁸

These proposals may be broadly divided into three categories: ‘keep-out zones’ (KOZs), ‘self-defense zones’ (SDZs), and ‘warning zones.’ This taxonomy is a relatively novel contribution. Works to date use these (and many other) terms imprecisely—for many authors they

³⁴ Cody Knipfer, “The Space Review: Revisiting “Non-Interference Zones” in Outer Space,” *The Space Review*, 2018, <https://www.thespacereview.com/article/3418/1>.

³⁵ Schwetje, Kenneth. 1987. “Protecting Space Assets: A Legal Analysis of ‘Keep-Out Zones.’” *Journal of Space Law* 15(1 & 2): 131–46.

³⁶ Lazarev, *Future Space Cities*, 5 ANNALS AIR & SPACE L. 529 (1980) in Schwetje, “Protecting Space Assets: A Legal Analysis of ‘Keep-Out Zones,’” 132.

³⁷ Patrick Q. Collins and Trevor W. Williams, “Towards Traffic Control Systems for Near-Earth Space,” in Proc. 29th Colloquium on the Law of Outer Space (IISL, Space Future, 1986), 161–70, http://www.spacefuture.com/archive/towards_traffic_control_systems_for_near_earth_space.shtml.

³⁸ Schwetje, “Protecting Space Assets,” 131–46; Richard Dalbello, “Rules of the Road: Legal Measures to Strengthen the Peaceful Uses of Outer Space” (1985) 28 in Schwetje, “Protecting Space Assets,” 132.

are interchangeable, while others seek to distinguish their own proposal but fail to provide any systematic account of the legal and policy distinctions among types of zones.

I. Keep-Out Zones. KOZs seek to restrict close approaches by declaring areas of space around sensitive space assets through which unauthorized entry or passage may be met with military force. A 1985 report by the United States Office of Technology Assessment (OTA) proposed the archetypal example of a KOZ, which OTA defined as “a volume around a space asset, off-limits to parties not owners of the asset.”³⁹ The OTA noted that such zones “could be negotiated or unilaterally declared,” and contended that “the right to defend such a zone by force and the legality of unilaterally declared zones under the OST remain to be determined.”⁴⁰ OTA’s proposed KOZ would ensure that satellites “keep 100 km and 3 degrees out-of-plane from foreign satellites below 5,000 km [and] keep 500 km from foreign satellites above 5,000 km except those within 500 km of [GEO],” would allow “one pre-announced close approach at a time,” and would establish that “in the event of... violation... the nation... which most recently initiated a maneuver ‘burn’ is at fault and... satellites trespassing... may be forcibly prevented from continued trespass.”⁴¹ According to the OTA’s assessment, such zones would be useful in the defense against passive anti-satellite weaponry.⁴² Passive anti-satellite weaponry (ASATs), such as space mines, might loiter near a satellite prior to performing an aggressive maneuver.⁴³ Furthermore, a principal finding of the report is that the United States could unilaterally “declare and defend protective [KOZs] around critical satellites,” which could entail the use of force.⁴⁴

II. Space Defense Zones/Self-Defense Zones. SDZs seek to apportion specific orbital regions for primary use by a particular state or group of states. Unauthorized trespass may be met with force, typically justified on self-defense grounds, but peaceful passage by foreign satellites is allowed with permission. Perhaps the most comprehensive and best-known SDZ proposal comes from Albert Wohlstetter and Brian G. Chow in 1986,⁴⁵ and was included in the Commission on Integrated Long-Term Strategy’s Congressional report on “Discriminate Deterrence” (1988) as a means for the United States to remedy its weakness in space.⁴⁶ Wohlstetter and Chow proposed

³⁹ “Anti-Satellite Weapons, Countermeasures, and Arms Control” (Washington: U.S. Congress, Office of Technology Assessment, September 1985), ix.

⁴⁰ Ibid.

⁴¹ Ibid, 136.

⁴² Ibid, 10.

⁴³ Ibid., x, 9-18.

⁴⁴ Ibid., 8.

⁴⁵ Albert Wohlstetter and Brian G. Chow, *Self-Defense Zones in Space* (Marina del Rey, CA: Pan Heuristics, 1986).

⁴⁶ Albert Wohlstetter and Brian G. Chow, “Self-Defense Zones in Space,” Contract, Integrated Long-Term Defense Strategy (Marina Del Rey, CA: Pan Heuristics R&D Associates, July 1986); Fred Iklé and

that the United States and then-Soviet Union establish large, protective sectors in geosynchronous orbit through which foreign satellites could pass peacefully (only) with permission;⁴⁷ should a foreign satellite trespass without such permission, there would be an “explicit right to inspect, expel or render harmless invading satellites.”⁴⁸ There are crucial differences between SDZs and KOZs. First, as Schwetje notes, “rather than attempting to protect every satellite with a critical mission” as do KOZs, “an SDZ protects the mission itself... [and is] not attached to the satellites”; to accomplish this, “Wohlstetter and Chow reserve entire sectors for satellites of various defense groupings... to be assigned to the Western Alliance or the Soviet Bloc.”⁴⁹ This distinction greatly impacts the threat posed by loitering of co-orbital ASATs, as the “SDZ arrangement would make the entire ‘shell’ inaccessible to an attacker” such that the “threat of space mines would be lessened.”⁵⁰ Second, the express articulation of a legal right grounded in self-defense to preempt an approaching threat with whatever force might be required is thought to render SDZ more effective at dealing with violations.

Such proposals are not limited to Wohlstetter and Chow. Dan Quayle, for instance, proposed similar “space self-defense zones” in 1986, writing that they would:

... allow defenses, enhance verification, and significantly reduce the incentive for either side to attack the other's satellites. What the zones would do is simple: Keep one side's satellites far enough apart from the other's to make an instantaneous surprise attack by either side virtually impossible. Both sides would be permitted an equal number of zones within which they would have exclusive rights to position their satellites permanently, and to inspect, expel, or otherwise render harmless intruders if they exceed an agreed upon, safe number.⁵¹

LTC A. J. Butler recommends a layered proposal, in which,

...two distinct types of zones would be established. The first would be a true safety zone that required permission prior to entry and would be of limited dimension. The extent of the safety zone would

Albert Wohlstetter, “Discriminate Deterrence: Report of the Commission on Integrated Long-Term Strategy” (Commission on the Integrated Long-Term Strategy, January 1988), 54;

⁴⁷ Schwetje, “Protecting Space Assets,” 133.

⁴⁸ *Ibid.*, 133.

⁴⁹ *Ibid.*, 133.

⁵⁰ *Ibid.*, 133.

⁵¹ “Dan Quayle, “Making War Less Attractive: Space Self-Defense Zones,” *Christian Science Monitor*, March 24, 1986, <https://www.csmonitor.com/1986/0324/espace.html>.

only be as large as necessary to protect activities in which safety was a prime factor. Outside the safety zone, a Space Defense Identification Zone (SPADIZ) would be established. The SPADIZ would be quite large; all approaching spacecraft would be required to identify themselves and give prior notice of approach.⁵²

Many more contemporary formulations of the concept retain the central emphasis on self-defense, but alter the details to account for the dramatic evolution in the space environment since the 1980s—the exponential increase in traffic and use and the post-Cold War shift away from bipolarity, among others. Perhaps the most comprehensive proposals in recent years have come from Chow, who now argues for the establishment of SDZs around certain satellites the penetration of which would trigger the right to “punish infringement,” at least under certain specified threshold conditions.⁵³

III. Warning Zones. This paper contends that a third type of zone would overcome the shortcomings of KOZs and SDZs. Although KOZs and SDZs have their merits, they suffer from two major drawbacks: first, our analysis finds that both violate international law; second, both are highly vulnerable to certain well-reasoned policy objections. Warning zones, if framed, designed, and implemented properly, would resolve these issues and objections. Warning zones, much like KOZs, would demarcate areas around certain vulnerable but strategically vital assets, and much like SDZs would emphasize the preemptive use of force in self-defense. However, unlike either KOZs or SDZs, the declaration of the zone itself is *not* understood—either implicitly or explicitly—to grant any right to the declaring state that it does not already possess. Instead, much like certain similar zones in the maritime domain, warning zones in space serve an information-gathering function: “trespass” *per se* is not restricted, but can, upon meeting certain thresholds, provide increasingly certain evidence of hostile intent which would justify preemptive use of force in self-defense. Warning zones, would, therefore, provide an important—indeed, essential—mechanism for clarifying intent, reducing the propensity for miscalculation by either side, improving signaling by both parties, and enhancing stability in crises.

⁵² Schwetje, “Protecting Space Assets,” 133.

⁵³ See Brian G. Chow, “Stalkers in Space: Defeating the Threat,” *Strategic Studies Quarterly* 11, no. 2 (2017): 82–116: 94-95. Chow writes that by adapting the international maritime law regarding state’s contiguous zones, along with Article 17 of the United Nations Convention on the Law of the Sea (UNCLOS), states would not be violation of the ‘non-appropriation’ and ‘free access’ principles of the OST.

Legality of Zones

Within this taxonomy, the critical distinction between zone proposals is their legality under international law. After the launch of Sputnik in 1957, the United Nations established an Ad Hoc Committee in 1959 to consider establishing legal rules to prevent state “interference among space vehicles.”⁵⁴ Though the Committee sought to find analogous principles in maritime and airspace law to apply to outer space, the Committee acknowledged that outer space was distinguished “by many specific factual conditions,” most important of which is that outer space is, “on conditions of equality, freely available for exploration and use by all in accordance with existing or future international law or agreements.”⁵⁵ It was these conditions, that no area of space was unavailable for free exploration or use by all states, that crystallized into the OST a decade later in 1967.

The OST has since set forth two key criteria that guide the legality of different zone proposals. First, Article I of the OST restricts the ability of a state to infringe on another state’s “free access to all areas of celestial bodies” and mandates equality between states “without discrimination of any kind” (henceforth referred to as the ‘free access’ principle).⁵⁶ Second, Article II of the OST prohibits any state appropriation over outer space not only “by claim of sovereignty,” but also “by means of use or occupation, or by any other means” (henceforth referred to as the ‘non-appropriation’ principle).⁵⁷

Articles I and II, Text of the Outer Space Treaty

Article I	Outer 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. ⁵⁸
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⁵⁴ Collins and Williams, “Towards Traffic Control Systems,” 161–70.

⁵⁵ Glenn Reynolds and Robert Merges, “Jessup & Taubenfeld, The United Nations *Ad Hoc Committee on the Peaceful Uses of Outer Space*, 53 *American Journal of International Law* 877 (1959),” in *Outer Space: Problems Of Law And Policy* (Routledge, 2019).

⁵⁶ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* (OST), Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205 (effective Oct. 10, 1967).

⁵⁷ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*.

⁵⁸ *Ibid.*

Article II	Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means. ⁵⁹
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Notably, there is firm international consensus on these principles. As of 2019, 109 countries are party to the OST, 89 of which are signatory states.⁶⁰ Strong evidence suggests that the ‘non-appropriation’ principle also constitutes customary international law. The origins of the document during the Cold War indicate the treaty was drafted as a general practice to prevent militarization of space.⁶¹ Furthermore, the *travaux préparatoires* explicitly write that “[c]elestial bodies should not be subject to any claim of sovereignty.”⁶² Additionally, *A. D. Pershing* makes a strong case that the non-appropriation of space is *opinio juris* and broadly supported by states’ domestic legislation.⁶³

Consequently, the critical task for zone proponents is to overcome the ‘free access’ and ‘non-appropriation’ principles set forth by the OST and firmly held by the international community. As *T.J. Schwetje* wrote on the subject of zoning outer space in 1987:

The international community has generally not objected to the establishment of special zones if the zones under the circumstances were reasonable and did not unduly hamper or interfere with another nation's freedom to navigate the seas or supra-adjacent airspace. Important in the following discussion is the notion that the key to gaining international acceptance of such zones has been that they extend no claim of sovereignty. There is a clear distinction between

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Abigail D Pershing, “Interpreting the OST’s Non-Appropriation Principle: Customary International Law from 1967 to Today,” *The Yale Journal of International Law* 44, no. 1 (2019): 154-155.

⁶² Letter from Arthur Goldberg, Permanent Representative of the U.S., to the Chairman of the Comm. On the Peaceful Uses of Outer Space (June 16, 1966), http://www.unoosa.org/pdf/limited/c2/AC105_C2_L012E.pdf [hereinafter Letter from Arthur Goldberg] in Pershing, “Interpreting the OST’s Non-Appropriation Principle: Customary International Law from 1967 to Today,” *The Yale Journal of International Law* 44, no. 1 (2019): 155.

⁶³ Pershing, “Interpreting the OST’s Non-Appropriation Principle,” 157-162.

sovereignty and the right to exercise a preventive, protective, or regulatory jurisdiction (Footnote omitted).⁶⁴

Consequently, the core question regarding the legality of zones centers on whether proposals constitute a *de facto* claim of sovereignty.

Unlike international maritime law, under which the United Nations Convention on the Law of the Sea clearly establishes the areas of water over which states exercise sovereignty, the limits of sovereignty over airspace are murky as no international agreement establishes an altitude limit on what constitutes “airspace.”⁶⁵ State sovereignty over airspace dates back to the Roman Empire, but technological development over subsequent millennia, such as the advent of hot-air balloons and early airplanes, progressively increased the altitude over which states argued they could exercise effective control and claim sovereign right.⁶⁶ With the launch of Sputnik by the Soviet Union in 1957, the emergence of manmade satellites prompted significant legal questions about the bounds of airspace over which a state could exercise sovereignty.⁶⁷

Out of concern that a boundary between airspace and outer space might constrain their military activities, neither the United States nor the Soviet Union pressed for official demarcation after the launch of Sputnik.⁶⁸ Prior to Sputnik, the Soviet Union held that no vertical limit on its airspace existed, but reversed this position to affirm the legality of Sputnik, arguing that no state could claim sovereignty over outer space.⁶⁹ The launch of Sputnik also incited internal debate within the United States about the vertical limit of United States airspace.⁷⁰ Essentially enshrining the principle of overflight into international law, the United States elected not to object to the Soviet position that Sputnik did not penetrate United States airspace.⁷¹ From the perspective of the

⁶⁴ Schwetje, “Protecting Space Assets,” 134.

⁶⁵ Dean N Reinhardt, “The Vertical Limit of State Sovereignty,” *Journal of Air Law and Commerce* 72, no. 1 (2007): 65-137.

⁶⁶ John C. Cooper, “High Altitude Flight and National Sovereignty,” *The International Law Quarterly* 4, no. 3 (1951): 411–18: 412.

⁶⁷ Albert I Moon Jr, “A Look at Airspace Sovereignty,” *Journal of Air Law and Commerce* 29, no. 4 (1963): 328–45.

⁶⁸ M.V. Smith, “Ten Propositions Regarding Spacepower,” *The Fairchild Papers* (Maxwell Air Force Base, Alabama: Air University, Air University Press, 2002): 4.

⁶⁹ Reinhardt, “The Vertical Limit of State Sovereignty,” 82-83.

⁷⁰ *Ibid.*, 85.

⁷¹ George M. Moore, Vic Budura, and Joan Johnson-Freese, *Joint Space Doctrine: Catapulting into the Future*, *Joint Force Quarterly* (Institute for National Strategic Studies, National Defense University, 1994): 74; Reinhardt, “The Vertical Limit of State Sovereignty,” 82-88; *The Harvard Law Review*

United States Air Force, this position allowed the United States to freely orbit the Soviet Union in its own space activities.⁷² Furthermore, the lack of a clear delineation between airspace and outer space prevented “the direct assimilation of any pattern of conduct in space to the existing legal principle of airspace sovereignty, and thereby enables nations to approach space problems unfettered by prior commitments.”⁷³

The physics of Earth’s atmosphere and orbit shape the practical exercise of sovereignty. Since the Earth’s atmosphere gradually thins with altitude, there is no identifiable cut-point between airspace and outer space.⁷⁴ A number of arbitrary cut-points⁷⁵ have been proposed by both

Association, “National Sovereignty of Outer Space,” *Harvard Law Review* 74, no. 6 (April 1961): 1154–75: 1167.

⁷² Delbert R. Terrill Jr., “The Air Force Role in Developing International Outer Space Law” (Air University, Air University Press, 1999), https://www.airuniversity.af.edu/Portals/10/AUPress/Books/B_0069_TERRILL_OUTER_SPACE_LAW.pdf.

⁷³ The Harvard Law Review Association, “National Sovereignty of Outer Space,” *Harvard Law Review* 74, no. 6 (April 1961): 1154–75: 1169.

⁷⁴ Nadia Drake, “What Is the Kármán Line, and Where Is the Edge of Space?,” *National Geographic*, 2018, <https://www.nationalgeographic.com/science/2018/12/where-is-the-edge-of-space-and-what-is-the-karman-line/>.

⁷⁵ Stanley B. Rosenfield, “Where Air Space Ends and Outer Space Begins,” *Journal of Space Law* 7, no. 2 (Spring & Fall 1979): 137-148. p.139-140:

“These categories include:

1. The line based upon the concept of atmosphere, which has already been noted.
2. A line based on the division of the atmosphere into four layers, the troposphere, the stratosphere, the mesosphere and the ionosphere. Each division has its own scientific characteristics and each has given rise to a variety of different proposals, ranging from 31 miles above the earth to as high as 500 miles.
3. The ICAO theory previously: noted) based on the maximum altitude of aircraft flight.
4. The von Kármán line, by which the line would be established at the point where aerodynamic lift yields to centrifugal force, which would put the line at approximately 275,000 feet.
5. The line based on the lowest perigee of an orbiting satellite. This is based on the fact that when the earth's atmosphere is too dense, an artificial satellite cannot remain in orbit.¹⁹

national and international organizations, but the lack of a physical boundary has spoiled attempts at concrete demarcation (see footnote).⁷⁶

The distinction between airspace and outer space bears important consequence for both the ‘free access’ and ‘non-appropriation’ principles. Satellites in low-Earth orbit and celestial objects beyond Earth’s orbit constantly orbit through areas of space belonging to other states and are unsuited to the vertical application of sovereignty.⁷⁷ However, a satellite in geosynchronous orbit, where it “appears to ‘hover’ over one spot on the Equator,”⁷⁸ could hypothetically “hover” within a state’s borders on Earth. Eight equatorial countries in the 1976 Bogota Declaration claimed sovereignty over geosynchronous orbit: because everything within Earth’s gravitational field along the equator constituted airspace directly above their geographic territories.⁷⁹

6. The line based on the point where the gravitational pull of the earth ceases. This theory arises from the basic assumption that for state security, the extent of sovereignty should extend beyond the point from which any object may be dropped.

7. The line between sovereign air space and outer space should be drawn at the limit of the underlying state's capacity to effectively apply its authority. This would provide a different limit on sovereign air space for different states.

8. The zonal theory under which air space would be divided into sovereign air space, based upon either the height at which aircraft can operate or some other line of demarcation; a contiguous zone, through which all non-military flights would have a right of free passage; and all that above contiguous space which would be free space.

9. Drawing the line between air space and outer space by a combination of one or more of the previously mentioned proposals.

⁷⁶ See 3 and 9 for further discussion.

For example, an initial 1978 proposal by the Soviet Union argued that the lowest possible perigee of a manmade satellite constituted outer space.⁷⁶ However, the aforementioned political considerations led the United States and Soviet Union to operate on the premise that any satellite in orbit is in space and refused to offer an official boundary.⁷⁶ Although this position did not clarify the boundary between airspace and outer space, it did clarify that satellites are in outer space and not airspace. For more, see Reinhardt, “The Vertical Limit of State Sovereignty,” 116.

⁷⁷ C.W. Jenks, *International Law and Activities in Space*, 5 *Int'l & Comp. L.Q.* 99, 103-104 (1956); Moon Jr, “A Look at Airspace Sovereignty,” 335-337.

⁷⁸ Mindi Capp/MSFC, “NASA - Geosynchronous Satellites,” *Feature Articles, Image Feature* (Brian Dunbar), accessed May 4, 2020, https://www.nasa.gov/audience/forstudents/5-8/features/geo_feature_5_8.html.

⁷⁹ Nayebi, Nima. 2011. “The Geosynchronous Orbit and the Outer Limits of Westphalian Sovereignty.” *Hastings Science & Technology Law Journal* 3(2): 471–98.

However, the sovereign declaration by these states was resoundingly rejected by the international community. Detractors argued that longstanding state practice during which the ITU delegated orbital slots to spacefaring nations was enshrined as custom.⁸⁰ Although the Bogota Declaration signatories asserted that geostationary orbit was “a physical fact linked to the reality of our planet because its existence depends exclusively on its relation to gravitational phenomena generated by the earth [sic],” these claims were also rejected.⁸¹ Experts disagreed with the claim of exclusive dependence, stating that “geostationary orbit is dependent on several factors such as: the launch and station-keeping propulsion, the attraction of the earth, the moon and the sun, and the solar radiation pressure.”⁸²

Lastly, although the Bogota Declaration signatories argued that the 1967 OST did not define outer space (which, in their view, meant that one could not logically conclude geosynchronous orbit was in space),⁸³ it was already well established that satellites in outer space are not located in airspace. Not only was state practice by the United States and Soviet Union a testament to this fact, but the international community generally accepted that “airspace activities cannot take place beyond an altitude of sixty kilometers,” which “would suggest that the sovereignty of airspace issue, based on the international law of the 1944 Chicago Convention, terminates at a level of sixty kilometers beyond which altitude, the Convention does not apply.”⁸⁴

Zones and Self-Defense

Whether on the basis of unlawful penetration or hostile approach, the unifying element among all zone proposals is the right to invoke self-defense. Consequently, it must be first

⁸⁰ *Ibid.*, 489.

⁸¹ *Declaration of the First Meeting of Equatorial Countries*. 1976.
https://www.jaxa.jp/library/space_law/chapter_2/2-2-1-2_e.html.

⁸² Andrej Gorbiel, “The Legal Status of Geostationary Orbit: Some Remarks,” *Journal of Space Law* 6, no. 2 (1978): 171–78: 176.

⁸³ Michael J. Finch, “Limited Space: Allocating the Geostationary Orbit,” *Northwestern Journal of International Law & Business* 7, no. 4 Fall (1986 1985): 788–802.

⁸⁴ Ferdinand Onwe Agama, “Effects of the Bogota Declaration on the Legal Status of Geostation Orbit in International Space Law,” *Nnamdi Azikiwe University Journal of International Law and Jurisprudence* 8, no. 1 (2017): 24–34; Furthermore, it has been argued that states lack effective control over such high altitudes which consequently states sovereignty over orbit, though this reasoning is unclear because states can take measures against craft penetrating their airspace beyond targeting the craft itself (The Harvard Law Review Association, “National Sovereignty of Outer Space,” *Harvard Law Review* 74, no. 6 (April 1961): 1154–75). In either case, the international community decided that the signatories of the Bogota Declaration had no reasonable claim of sovereignty over geosynchronous orbit.

established that the function of any type of zone, to defend against co-orbital ASATs, is legal under international law.

Although there exists a right to self-defense in outer space (see footnote),⁸⁵ this does not necessarily imply the permissiveness of any zone, whether they be KOZs, SDZs, or warning zones. These zones, however, must comport with requirements of necessity and proportionality. While proportionality in self-defense is almost by definition context-dependent, contemporary jurisprudence identifies one or both of two tests: force at the level of equivalence of the initial attack, and force required for cessation of the attack.⁸⁶ Warning zones clear both thresholds. As such, a nation choosing to disable or destroy a “stalking” enemy satellite has acted proportionally, provided they limit, to the extent possible, the response solely to the satellite in question, and avoid “cross-domain” escalation. If bodyguard satellite technologies prove effective and feasible, a proportional response would likely be to disable solely the satellites that have violated a warning zone. If these technologies, however, do not offer an effective defense against co-orbital ASATs, the United States will need to consider other options, such as holding an adversary's critical satellites at risk and threatening retaliation.

The first potential threshold for proportionality is the equivalence, or symmetry requirement: the defender, when acting to dispel the aggressor, must roughly approximate the force level of the attack. Such a restriction is a necessary component of *jus ad bello*; otherwise, in the view of Professor *Yoram Dinstein*, the most minor of skirmishes could result in an asymmetric

⁸⁵ Spanning only seventeen articles, the OST provides little more than a broad framework to govern space activities. However, in lieu of explicit provisions regulating specific activities, Article III states unequivocally that activities in outer space must be “in accordance with international law, including the Charter of the United Nations...” Accordingly, the explicit requirement that activities in space comport with international law, presupposes that outer space is a domain to which international law can be applied, as opposed to a lawless, Wild West completely liberated from international legal restraints.

Such analysis is reflected in both state doctrine and practice. Recent research seeking to clarify existing international law at the intersection of outer space and military operations has been undertaken for the development of the *Woomera Manual Project* (see *Germany v. Denmark and the Netherlands* (also known as *The North Sea Continental Shelf* cases). 1969. International Court of Justice). The manual argues that Article III of the OST, which has been ratified and accepted by all signatories, explicitly applies international law and the United Nations Charter to outer space.⁸⁵ Furthermore, the International Law Commission (ILC) has concluded that provisions of international law that govern times of war, such as the Law of Armed Conflict (LOAC) is *lex specialis* during any period of armed conflict, regardless of the domain in which it occurs (Dale Stephens, summarizing the existing work of the Woomera Manual Project, “Military Space Operations and International Law,” *The Woomera Manual Project – Part 1*. March 2, 2020) As a result, the legal basis for preemptive self-defense in terrestrial domains also demonstrates its legality in outer space.

⁸⁶ Etezazian, S., “The nature of the self-defence proportionality requirement,” *Journal on the Use of Force and International Law*, 3(2), 2016. 260–289

response intended to fell the entire forces of the attacker themselves.⁸⁷ International custom supports this premise. In the case of the *Caroline* incident,⁸⁸ the British thought a proportional response to the perceived threat posed by forces on the *Caroline* was elimination of the ship, a roughly symmetrical response; there would have been no entertaining of a land-invasion in response.

With ample warning and *ex ante* clarification, KOZs, SDZs, and warning zones are proportional. Zones set a series of specific redlines that, if crossed, provide information to the defender that they should expect an attack. If the United States informs adversaries that it expects there to be, for example, 50 kilometers separating United States' satellites from foreign spacecraft, and that encroaching would be an act of war, adversaries knowingly crossing into those zones communicates to the defender that a threshold has been crossed. For the defending state to presume intentional aggression and dispel in an anticipatory matter is eminently reasonable. Such warning epitomizes a tit-for-tat response: in response to an enemy satellite threatening to destroy a nation's satellite, the defending state destroys the offending satellite. In such a case, the response would likely be limited solely to the tailgating satellite in question. Compared to the elegant simplicity of a response that treats a threat against a satellite as warranting destruction of the attacker's satellite, cross-domain responses, however, (which range from economic coercion such as sanctions to military responses such as ground strikes) would be inappropriate and not analogous.

The second potential threshold for proportionate self-defense concerns whether it's aimed merely at dispelling the attacker, the "Cessation Approach." Such a right of self-defense solely provides the grounds for an anticipatory response to the attacker. Upon disabling the threat, the prosecution of the war effort ends, as the objective of self-defense has been accomplished.⁸⁹ This

⁸⁷ Dinstein, Yoram, "War, Aggression and Self-Defence," *Cambridge University Press*, 5th edn 2011. 262–63.

⁸⁸ In December of 1837, forces under the authority of Great Britain set ablaze the *Caroline*, an American vessel docked in U.S. shores at Schlosser's Landing, destroying it. The *Caroline* housed a group of Canadian separatists seeking to foment political unrest. Claiming that the vessel posed a threat to Canadian (and, subsequently, British) interests, Great Britain argued that there existed a right to act against that which could pose a future threat, prior to the actual occurrence of such threat. After the incident, a statement was issued by United States Secretary of State Daniel Webster that, to justify the invocation of self-defense, a state must demonstrate "a necessity of self-defense, instant, overwhelming, leaving no choice of means, and no moment deliberation" (see Historical record of correspondence between Secretary Webster and Lord Ashburton provided by the Yale Law School Lillian Goldman Law Library).

Over the past several centuries, this has crystallized into the principle of anticipatory self-defense, which relies on two conditions: necessity (the lack of other, countervailing options), and proportionality (not exceeding the threshold needed to respond to the existing threat).

⁸⁹ Antonio Cassese, "Terrorism Is Also Disrupting some Crucial Legal Categories of International Law," *European Journal of International Law*, Vol 12. 993. 2001

approach also finds support in existing custom. In the *Nicaragua*⁹⁰ dissent by Judge Schwebel, it's noted that "It would be mistaken ... to think that there must be proportionality between the conduct constituting the armed attack and the opposing conduct. The action needed to halt and repulse the attack may well have to assume dimensions disproportionate to those of the attack suffered...."⁹¹ As with the symmetrical threshold, it is clear that warning zones do not run afoul of the Cessation Approach. The anticipatory action is aimed solely at disabling the attacking satellite, with no corresponding military campaign taking place either in outer space or terrestrially.

More broadly, the previous cases examined have a common through-line: while proportional responses will depend on the situation, they will always be defined by a use of force narrowly tailored to a potential threat. In the case of the *Caroline*, acting against the ship was justified; invading the United States would not be. Similarly, actions in space to respond to the aggressive, stalking satellite are narrowly tailored, only using a level of force that is both equivalent to the initial threat and limited to dispelling the attacker. Additionally, part of the inquiry in *Nicaragua* may offer a useful insight: the threshold of reasonableness. Judge *Schwebel's* opinion alluded to a "reasonableness" inquiry as part of self-defense, writing that there exists "a right to take such actions as are *reasonably* necessary to end the attack promptly and protect the threatened values" [Emphasis is ours].⁹² While there may be no cut-and-dry method, if a threat poses a grave danger to the national interests of a state, the state's response should be accorded some leeway provided that it appears justified in light of the threat posed. A threat in space to multiple critical satellites, with a symmetrical response, surely clears such a threshold. As a result, any zone proposal must establish clear boundaries such that, if penetrated by another state, confirm the use of force in self-defense.

⁹⁰ *The Republic of Nicaragua v. The United States* (1986), decided by the ICJ, touched on the precise issue. Holding the United States at fault for supporting the Nicaraguan Contras against the Sandinistas government, the court found a violation of sovereignty via intervention in the internal affairs of another state through an arms trade (see *The Republic of Nicaragua v. The United States of America* (1986). International Court of Justice). Regardless of the specific point at issue, in evaluating the American claim that arms sales to the Contras were an act of self-defense, the court drew a useful extrapolation from the case to apply to self-defense more broadly. In his dissent, United States Judge *Stephen Schwebel* argued that no caveat exists in Article 51 which evidences that the right to self-defense may be invoked "if, and only if, an armed attack occurs." Rather, the phrasing of an inherent right makes it applicable, regardless of circumstance, instead of merely being prescribed to an *ex post* response (See Anthony Clark Arend, "International Law and the Preemptive Use of Military Force," *The Washington Quarterly*. Volume 26, Spring 2003. pp. 89-103). Additionally, other sections of the UN Charter lend credence to such interpretation. Article 2 prohibits the "threat or use of force" (Article 51 of the Charter of the United Nations. June 6, 1945) against member states; notable is the prohibition not just on the aggressive action itself, but a prohibition on events that may portend future aggression.

⁹¹ *The Republic of Nicaragua v. The United States of America* (1986). International Court of Justice

⁹² *The Republic of Nicaragua v. The United States of America* (1986). International Court of Justice

Keep-Out Zones

Proposals to establish KOZs, which restrict close approaches by declaring zones around sensitive space assets in which unauthorized entry into or passage through which may be met with military force, are in clear violation of both the ‘free access’ and ‘non-appropriation’ principles. In its initial proposal, the OTA acknowledged that the ‘free access’ and ‘non-appropriation’ principles presented the primary barrier to KOZs, because they would constitute the appropriation of outer space to defend against anti-satellite weapons. The OTA’s counterargument to this criticism was that the allocation of the geosynchronous orbital slots by the ITU “already incorporates a variation of the ‘keep-out zone’ principle,” because satellites must be placed several angular degrees apart to avoid interference, and, that this “precludes the placement of other satellites near its position in the orbital arc.”⁹³ However, there are a variety of reasons as to why the ITU does not provide legal precedent for KOZs.

By way of background, the allocation of orbital slots by the ITU originates from the designation of geostationary orbit along the equator as a “limited natural resource” in Article 33 of the International Telecommunication Convention (ITC) due to limited orbits available and concerns about radio frequency interference between satellites. As a result, the International Telecommunication Union assumed responsibility for the allocation of orbital slots to spacefaring nations to reduce radio frequency interference.⁹⁴

It is firmly established that the allocation of orbital slots by the ITU does not constitute a violation of the ‘free access’ or ‘non-appropriation’ principles of the OST. First, although orbital slots do, in effect, create a zone in which no state (other than the state to which the slot is allocated) can place geosynchronous satellite, the ITU does not limit a state’s ‘free access’ to an orbital slot. Rather, all states are afforded freedom of access on a “first come, first served” basis and are not granted any proprietary rights over the orbital slot.⁹⁵ Although states are unable to place satellites in orbital slots not specifically allocated to them by the ITU, there is absolutely nothing that permits a state from preventing infringement through the use of force. As a result, there is no practical equivalence between orbital slots and KOZs as proposed by the OTA.

Second is the nature of the actor involved. Unequivocally, Article II prohibits the ‘national appropriation’ of outer space, such as by nations including the United States and Russia. In the

⁹³ “Anti-Satellite Weapons, Countermeasures, and Arms Control” (Washington: U.S. Congress, Office of Technology Assessment, September 1985), 118.

⁹⁴ Collins and Williams, “Towards Traffic Control Systems,” 161–70.

⁹⁵ Elina Morozova and Yaroslav Vasyanin. 2019. “International Space Law and Satellite Telecommunications.” *Oxford Research Encyclopedia of Planetary Science*. <https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-75> (May 7, 2020).

case of the OTA's proposal, it suggests that the United States unilaterally declare KOZs surrounding United States space assets or negotiate these zones through a treaty.⁹⁶ Consequently, to analogize the United States to the ITU in this context is incorrect. As an international organization, the ITU is meaningfully distinct from a nation.⁹⁷ Although some have argued that the "process of allocating orbital space and excluding nations from particular slots seems to be an obvious case of appropriation," the ITU has broad international character and preserves "access for all space actors, current or future."⁹⁸ This fact explains why the ITU has never been abolished or restricted from its activities allocating orbital slots.⁹⁹

Next is the question of what constitutes 'appropriation.' In Stephen Gorove's article, *Major Legal Issues Arising from the Use of the Geostationary Orbit*, Gorove defines "appropriation" as "the taking of property for one's own or exclusive use with a sense of permanence."¹⁰⁰ Gorove further writes that—

While a state may certainly exercise exclusive control over a traditional object, such as a ship, or an aircraft, or a part of airspace, it is not clear that a satellite in geostationary orbit would be able to maintain its exact position and occupy the same area over a period of time. Even if a position could be accurately maintained, and thus possibly constitute an "appropriation" within the meaning of article II, the satellite would have to be kept in that orbit with a "sense of permanence" and not on a temporary basis.¹⁰¹

This demonstrates two reasons as to why KOZs and orbital slots are meaningfully distinct. First, all states are afforded freedom of access to an orbital slot on a "first come, first served" basis and are not granted any proprietary rights over the orbital slot— they are, both legally and in effect,

⁹⁶ "Anti-Satellite Weapons, Countermeasures, and Arms Control" (Washington: U.S. Congress, Office of Technology Assessment, September 1985), 8.

⁹⁷ Dietrich Westphal, "International Telecommunication Union (ITU)," Oxford Public International Law, accessed May 8, 2020, <http://opil.oup.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e514>.

⁹⁸ Timothy Justin Trapp, "Taking Up Space By Any Other Means: Coming To Terms With The Nonappropriation Article Of The OST," *Illinois Law Review* 2013 (2013): 1681–1714: 1709-1710.

⁹⁹ Trapp, "Taking Up Space By Any Other Means: Coming To Terms With The Nonappropriation Article Of The OST," 1709-1710.

¹⁰⁰ S. Gorove, *Studies in Space Law: Its Challenges And Prospects* 82 (1977) in Stephen Gorove, "Major Legal Issues Arising from the Use of the Geostationary Orbit," *Michigan Journal of International Law* 5, no. 1 (January 1, 1984): 3–12: 5.

¹⁰¹ Gorove, "Major Legal Issues Arising from the Use of the Geostationary Orbit," 5.

impermanent.¹⁰² Second, the categorization of geostationary orbit as a “limited natural resource” in Article 33 of the International Telecommunication Convention (ITC) shields orbital slot allocation from claims of ‘appropriation’ by the ITU.¹⁰³ Authority on this question can be found in the International Law Association’s Report of the Fifty-Fourth Conference 427 (1970), along with the United Nations Committee on the Peaceful Uses of Outer Space, which have suggested that ‘appropriation’ does not apply to natural resources.¹⁰⁴

Although KOZ proponents do not advocate that states claim sovereignty over the zones themselves, and therefore meet the “by claim of sovereignty” qualification in Article II, this does not elide Article II’s limitation on appropriation by “means of use or occupation.”¹⁰⁵ This is perhaps the most clear indication of KOZs illegality under the OST, because the basis for limiting another state’s ‘free access’ to the zone itself is its ‘use’ by a state’s satellite. For example, the basis for the OTA’s argument about the legality of ‘keep-out zones’ rests on the notion that, based upon ITU regulations, “geosynchronous [orbits] must be space several degrees apart in order to avoid frequency interference. Therefore, such a satellite precludes the placement of other satellites near its position in the orbital arc.”¹⁰⁶ In other words, the usage of the orbital slot precludes its access and usage by another state. As we have already established, the ITU is exempt from Article II in the context of geosynchronous orbit. However, for a state to declare a ‘keep-out’ zone on the basis that it preserves national security, as *Blau* and *Gore* propose, this would certainly constitute national appropriation “by use” according to the text of Article II.¹⁰⁷

Other proponents of KOZs note that precedent exists in the four-kilometer “nominal approach” zone and 200-meter protective “‘keep-out’ zone” around the International Space Station

¹⁰² Morozova and Vasyanin, “International Space Law and Satellite Telecommunications,” 2019; Mark Holmes, “Hot Orbital Slots: Is There Anything Left?,” *Via Satellite*, March 1, 2008, <https://www.satellitetoday.com/uncategorized/2008/03/01/hot-orbital-slots-is-there-anything-left/>; Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future* (Martinus Nijhoff Publishers, 2008).

¹⁰³ *Ibid.*, 6; Collins and Williams, “Towards Traffic Control Systems,” 161-170.

¹⁰⁴ INTERNATIONAL LAW ASSOCIATION, REPORT OF THE FIFTY-FoURTH CONFERENCE 427 (1970). This position has also been adopted by UNCOPUOS in reference to the natural resources of the moon and other celestial bodies. See UNCOPUOS, Doc. A/AC.105/C.2/WG.1/WP.3; Press release U.S.-U.N. 37 (73) in Goroves, “Major Legal Issues Arising from the Use of the Geostationary Orbit,” 12.

¹⁰⁵ *Ibid.*

¹⁰⁶ “Anti-Satellite Weapons, Countermeasures, and Arms Control” (Washington: U.S. Congress, Office of Technology Assessment, September 1985), 118.

¹⁰⁷ Schwetje, “Protecting Space Assets,” 133.

(ISS).¹⁰⁸ Unlike KOZs, however, the zones around the ISS do not permit any state to enforce the zone, prevent entry, or invoke the right to self-defense. Furthermore, states aboard the ISS have not claimed sovereignty over the area or sought to exclude other states from entering the area.¹⁰⁹ Instead, the zones around the ISS are “guidelines that are used to assess whether the threat of such a close pass is sufficient to warrant evasive action or other precautions to ensure the safety of the crew.”¹¹⁰ As a result, these zones, much like warning zones, can be interpreted as an information-gathering mechanism as opposed to an exclusive measure to allow the invocation of self-defense.

Self-Defense Zones

Unlike KOZs, SDZs bear resemblance to zones on Earth, such as *B.G. Chow’s* self-defense zone and *Lt. Col. Butler’s* “Space Defense Identification Zone” strategies, yet previous proposals would similarly violate Articles I and II of the OST.¹¹¹ *T.A. Newsome* explains that Air-Defense Identification Zones (ADIZs), perhaps the most comparable terrestrial zone to SDZs, “represent the most direct challenge to Article II’s prohibition on national appropriation.”¹¹² Similar to SDZ proposals, ADIZs on Earth do not establish any sovereign right, can be established unilaterally, rely on voluntary compliance, permit overflight, and, most importantly, can permit the right to self-defense. However, much like states are prohibited from claiming sovereignty over outer space, the Convention on the High Seas prohibits states from claiming sovereignty over the high seas.¹¹³ Could this state practice justify the establishment of SDZs?

To propose that ADIZs legally justify SDZs would be unreasonable. Although ADIZs themselves do not create a sovereign right over airspace, the legality of ADIZs extend from preexisting state sovereignty over a state’s national airspace and territorial seas.¹¹⁴ Importantly, ADIZs cannot legally extend beyond areas over which states do not already claim sovereign right.

¹⁰⁸ Rebecca Reesman and Andrew Rogers, “Getting in Your Space: Learning from Past Rendezvous and Proximity Operations” (The Center for Space Policy and Strategy, The Aerospace Corporation, May 2018), <https://aerospace.org/sites/default/files/2018-05/GettingInYourSpace.pdf>.

¹⁰⁹ Newsome, “The Legality of Safety and Security Zones in Outer Space: A Look to Other Domains and Past Proposals” (Montreal, Quebec, McGill University, Institute of Air and Space Law, 2016), 66-69.

¹¹⁰ Mark Garcia, “Space Debris and Human Spacecraft,” Text, NASA, 2013, http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

¹¹¹ *Ibid.*, 133.

¹¹² Newsome, “The Legality of Safety and Security Zones in Outer Space,” 66-69.

¹¹³ Elizabeth Cuadra, “Air Defense Identification Zones: Creeping Jurisdiction in the Airspace,” *Virginia Journal of International Law* 18, no. 3 (1978 1977): 485–512: 499.

¹¹⁴ “Air Defence Identification Zones,” Oxford Public International Law, accessed May 7, 2020, <http://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e237>.

To this effect, the Convention on the Territorial Sea and the Contiguous Zone and the Convention on the High Seas prohibit states from claiming sovereignty over the high seas.¹¹⁵ Importantly, ADIZs are grounded in customary international law, so there is no convention that permits the legality of ADIZs over the high seas for a special purpose, such as national security.¹¹⁶

International consensus on the inappropriateness of China's ADIZ in the East China Sea (ECS) demonstrates the limited applicability of ADIZs to SDZs. In 2013, China announced the establishment of the "East China Sea Air Defense Identification Zone," which covered large swaths of the ECS, including disputed areas between China and Japan.¹¹⁷ The United States, Japan, South Korea, and Taiwan criticized China's ADIZ as escalatory, and Japan argued that the zone was a violation of international law.¹¹⁸ Legal experts have rejected China's ADIZ in the ECS. For example, *R.G. Almond* explains that:

ADIZs can only be legally applied in relation to preventing the unauthorized entry of aircraft into the national airspace. ADIZs cannot be used to control foreign aircraft not intending to enter the national airspace. States only enjoy exclusive sovereignty over the airspace above their territory, a right which ends at the 12 nautical mile border of the territorial sea. Beyond this territorial belt, all states enjoy the high seas freedoms, including freedom of overflight, a customary principle memorialized in UNCLOS.¹¹⁹

As a result, China's ADIZ does not permit them to disallow overflight by other states and invoke the right to self-defense if such overflight occurs. Furthermore, the Convention on International Civil Aviation, the treaty whose principles guide the implementation of ADIZs, was amended in 1983 to prohibit the use of weapons against civilian aircraft.¹²⁰

The conclusion of the Permanent Court of Justice in the *Lotus* case further complicates the ability for states to claim some competence or special jurisdiction in SDZs. As described by *Z. Papp*—

...international law does not prohibit a state from exercising (prescriptive) jurisdiction in its own territory in respect of any case

¹¹⁵ Cuadra, "Air Defense Identification Zones," 499.

¹¹⁶ Cuadra, "Air Defense Identification Zones," 500.

¹¹⁷ Ian E Rinehart and Bart Elias, "China's Air Defense Identification Zone (ADIZ)," Congressional Research Service Report, 2015, 45: 6-7.

¹¹⁸ Rinehart and Elias, "China's Air Defense Identification Zone (ADIZ)," 18-22.

¹¹⁹ Roncevert Ganan Almond, "South China Sea: The Case Against an ADIZ," 2016, <https://thediplomat.com/2016/09/south-china-sea-the-case-against-an-adiz/>.

¹²⁰ Almond, "South China Sea: The Case Against an ADIZ," 2016.

which relates to acts that have taken place abroad. According to the findings of the Court, the states' corresponding discretion is solely limited by prohibitive rules of international law. As regards exercising enforcement powers, it cannot be exercised by a state outside its territory except by virtue of a permissive rule derived from international custom or from a convention.¹²¹

Consequently, for a state to lawfully create an SDZ, it would need to establish that the zone itself was not prohibited by international law, and that the zone was enforceable outside the state's territory due to some permissive rule.

However, Article II of the OST prohibits a state from establishing these conclusions. This brings us to the third qualification to the 'non-appropriation' principle in Article II that national appropriation is prohibited "by any other means."¹²² Despite the fact that states only exercise special jurisdiction in ADIZs over the high seas, *Cuadra* writes the "competence claimed here, however, is one of limited sovereignty in airspace over waters beyond the territorial seas, for the specific purpose of 'national security.'"¹²³ Demonstrating that these principles would constitute national appropriation according to Article II of the OST, the exercise of "limited sovereignty" through an SDZ would certainly constitute national appropriation, because such a claim would be tied to a specific purpose or competence, such as national security, that is explicitly prohibited under the "any other means" qualification in Article II of the OST. Furthermore, without some special purpose or claim of limited sovereignty, states could not invoke the right to self-defense. For example, *Blau* and *Gore* propose that the penetration of an established zone in space would constitute a threat, but *Schwetje* offers no evidence to suggest that this would constitute some permission allowing or circumventing the issue of appropriation.¹²⁴

Customary international law which undergirds ADIZs would also not be applicable to orbit. As *Cuadra* describes—

...any legal basis for ADIZ's extending over the high seas must derive from some aspect of customary international law that is so

¹²¹ Zoltan Papp, "Air Defense Identification Zone (ADIZ) in the Light of Public International Law," *Pecs Journal of International and European Law* 2015, no. 2 (2015): 28–54: 33-34.

¹²² "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies". United Nations Office for Disarmament Affairs. Accessed May 8, 2020.

¹²³ *Cuadra*, "Air Defense Identification Zones," 499.

¹²⁴ *Schwetje*, "Protecting Space Assets," 133.

fundamental a principle as to prevail over the will of the community of nations as expressed in these conventions.¹²⁵

There is consensus that ADIZs are beginning to crystallize into customary international law based upon decades of state practice.¹²⁶ However, there is no comparable customary international legal basis for the appropriation of areas around a satellite based upon state practice.¹²⁷

This presents three major obstacles to the application of ADIZ principles to outer space. Considering that ADIZs draw from customary international law, but are limited in scope by existing international conventions, there must be some analogous custom that would permit the establishment of SDZs. Our research has identified no such custom. Furthermore, the sweeping and explicit prohibition on national appropriation in Article II of the OST limits the ability of the state to take advantage of this lacuna. Second, considering that states have no sovereign claim over outer space, which is firmly established by the OST and international rejection of the Bogota Convention, states cannot reasonably limit transversal of an SDZ because they are not preventing a spacecraft from entering their airspace. As explained by *Almond*, ADIZs “can only be legally applied in relation to preventing the unauthorized entry of aircraft into the national airspace.”¹²⁸ Third, to overcome the aforementioned two arguments, states would need to claim some special competence over outer space, such as for the purpose of national security, which is expressly prohibited by Article II of the OST.

Warning Zones

Overcoming the aforementioned barriers to previous zone proposals, the application of the concept of maritime warning zones to outer space offers an intriguing solution to the dangers posed by co-orbital ASATs. In a maritime context, warning zones serve as “Defense bubbles” surrounding naval vessels.¹²⁹ As explained in the United States Commander’s Handbook on the Law of Naval Operations—

As States endeavor to protect their interests in the maritime environment during peacetime, naval forces may be employed in

¹²⁵ Cuadra, “Air Defense Identification Zones,” 500-501.

¹²⁶ *Ibid.*, 485; Papp, “Air Defense Identification Zone (ADIZ) in the Light of Public International Law,” 47-48.

¹²⁷ See previous section.

¹²⁸ Almond, “South China Sea: The Case Against an ADIZ,” 2016.

¹²⁹ Wolff Heintschel von Heinegg, “Current Legal Issues in Maritime Operations: Maritime Interception Operations in the Global War on Terrorism, Exclusion Zones, Hospital Ships and Maritime Neutrality,” *International Law Studies* 80, no. Issues in International Law and Military Operations (2006): 207–33: 213.

geographic areas where various land, air, surface, and subsurface threats exist. Commanders are then faced with ascertaining the intent of persons and objects (e.g., small boats, “low slow flyers,” jet skis, swimmers) proceeding toward their units. In many instance [sic] ascertaining their intent is very difficult, especially when operating in the littorals where air and surface traffic is heavy. Given an uncertain operating environment, commanders may want to establish some type of assessment, threat, or warning zone around their units in an effort to help sort the common operational picture and ascertain the intent of inbound entities. This objective may be accomplished during peacetime while adhering to international law as long as the navigational rights of other ships, submarines, and aircraft are respected.¹³⁰

Much like Article I of the OST, international maritime law does not recognize any situation during which freedom of navigation on the high seas can be limited. However, warning zones are neither operational nor exclusionary, and instead “merely serve to protect the naval vessels from attack or from illegal activities...”¹³¹ Although these zones are historically established during wartime or national emergency, it is generally accepted that these zones can be established during peacetime under international law to protect naval vessels.¹³² As *W. H. von Heinegg* writes, “the extent of these zones and the measures taken cannot be determined *in abstracto*. Rather, it will depend on the circumstances of each single case, especially on a known threat and on the location of the ships concerned, and whether the extent of the warning area may be reasonable or excessive.”¹³³

In outer space, the establishment of these zones on a case-by-case basis under threatening circumstances is particularly important. There should be two central considerations: the distance of attacking satellite, and the number of defending satellites being tailgated. The concurrent fulfillment of *both* of these conditions should suffice to allow an armed response. While this paper does not propose a specific number, leaving that to be determined through diplomatic negotiations, there should be an agreed-upon distance, or zone of separation between satellites. If a foreign satellite crosses within that zone, that clears the “distance” condition. The second condition is triggered by multiple satellites being followed within the zone of separation. Demonstrating warning zones’ compliance with Article II of the OST, warning zones can be established without

¹³⁰ “Safeguarding U.S. National Interests in the Maritime Environment,” in *The Commander’s Handbook on the Law of Naval Operations*, August 2017 (Navy Warfare Development Command, Norfolk, VA: Department of the Navy Office of the Chief of Naval Operations, 2017), 4-9.

¹³¹ von Heinegg, “Current Legal Issues in Maritime Operations,” 213-214.

¹³² *Ibid.*, 214.

¹³³ *Ibid.*, 214

any operational or exclusionary purpose beyond the protection of the vessel itself.¹³⁴ As a result, the establishment of warning zones does not confer upon the state any additional right, or employ any special purpose jurisdiction, under international law.¹³⁵ In other words, a warning zone does not permit a state to violate freedom of navigation and forcibly remove any vessel from the zone. However, the zone itself does provide a means for states to ascertain or clarify the intent of nearby traffic and whether the invocation of self-defense may be necessary.¹³⁶

Ascertaining intent is at the heart of addressing the risks posed by co-orbital ASATs. Chow writes that prohibiting passage through a zone around a satellite is impossible because of the difficulty distinguishing between co-orbital ASATs and civilian satellites, and the necessity of these forms of passage for regular satellite operations.¹³⁷ In a maritime context, warning zones allow ships to navigate a similar dilemma. In the global War on Terror, it can be difficult for navies to distinguish between threatening and peaceful civilian seacraft, so warning zones have been applied by navies to ascertain the intent of seacraft as they pass through a warning zone.¹³⁸ By establishing a “defense bubble” around the naval vessels, warning zones allow commanders to ascertain the intent of incoming seacraft, whether they be warships, small boats, or jet skis.¹³⁹ Furthermore, by directing all maritime traffic around the zone and requiring that all traffic passing through the zone communicate their intentions, commanders are able to clarify any threats and determine the need to invoke self-defense.¹⁴⁰ Upon notice, state or civilian seacraft might avoid entering the zone itself or choose to do so while communicating their intent to the United States Navy.¹⁴¹

The unilateral establishment of warning zones around United States satellites presents a potential solution to the threat of co-orbital ASATs without violating Articles I and II of the OST. First, the establishment of warning zones would not limit ‘free access’ to the area of the zone as specified by Article I. According to the general practice of warning zones, the establishment of the zone itself does not limit another state from entering the area. Furthermore, the penetration of the

¹³⁴ Jon M. Van Dyke, “Military Exclusion and Warning Zones on the High Seas,” *Marine Policy* 15, no. 3 (May 1, 1991): 147–69, [https://doi.org/10.1016/0308-597X\(91\)90059-K](https://doi.org/10.1016/0308-597X(91)90059-K); von Heinegg, “Current Legal Issues in Maritime Operations,” 213-214.

¹³⁵ Newsome, “The Legality of Safety and Security Zones in Outer Space,” 33-34.

¹³⁶ *Ibid.*, 33-34.

¹³⁷ Chow, “Stalkers in Space,” 95-99.

¹³⁸ von Heinegg, “Current Legal Issues in Maritime Operations,” 215.

¹³⁹ “Safeguarding U.S. National Interests in the Maritime Environment,” in *The Commander’s Handbook on the Law of Naval Operations*, 4-9.

¹⁴⁰ *Ibid.*

¹⁴¹ *Ibid.*

zone by another state does not license the use of force by the state enforcing the zone. As explained by the Commander's Handbook—

Specifically, when operating in international waters, commanders may assert notice (via notices to airmen and notices to mariners) that within a certain geographic area for a certain period of time dangerous military activities will be taking place. Commanders may request that entities traversing the area communicate with them and state their intentions. Moreover, such notice may include reference to the fact that if ships and aircraft traversing the area are deemed to represent an imminent threat to U.S. naval forces, they may be subject to proportionate measures in self-defense. Ships and aircraft are not required to remain outside such zones and force may not be used against such entities merely because they entered the zone. Commanders may use force against such entities only to defend against a hostile act or demonstrated hostile intent, including interference with declared military activities.¹⁴²

Warning zones would also avoid the 'national appropriation' principle under Article II. Referring back to the initial three qualifications of the treaty, the first of these qualifications is that national appropriation is prohibited "by claim of sovereignty."¹⁴³ As our previous analysis suggests, warning zones would not constitute a claim of sovereignty because they do not grant any sovereign right over the area of outer space. As a result, we direct our analysis towards the secondary and tertiary qualifications of what constitutes national appropriation "by means of use or occupation," or "by any other means."¹⁴⁴

Proponents of 'keep-out' zones have cited ITU precedent for the limitation of space traffic through areas of outer space, arguing that its allocation by the ITU and use by a satellite is a limiting factor.¹⁴⁵ However, our previous analysis suggests that the OST restricts this interpretation through its second qualification to the prohibition on national appropriation "by means of use."¹⁴⁶ Warning zones, however, circumvent this problem. Unlike maritime warning areas, which predicate the establishment of the zone on its use for military activities, warning zones are not

¹⁴² Ibid.

¹⁴³ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies* (OST), Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205 (effective Oct. 10, 1967).

¹⁴⁴ Ibid.

¹⁴⁵ "Anti-Satellite Weapons, Countermeasures, and Arms Control" (Washington: U.S. Congress, Office of Technology Assessment, September 1985), 118.

¹⁴⁶ "Anti-Satellite Weapons, Countermeasures, and Arms Control," 118.

established on an operational basis associated with their use.¹⁴⁷ Instead, the establishment of the warning zone is predicated on a potential threat posed to the naval vessel. Applied to an orbital context, a threatening configuration of co-orbital ASATs would permit the establishment of a warning zone on the basis “that if ships and aircraft traversing the area are deemed to represent an imminent threat to U.S. [forces], they may be subject to proportionate measures in self-defense.”¹⁴⁸

The next qualification concerns appropriation of outer space “by any other means.”¹⁴⁹ In this context, warning zones offer a comparatively better solution than SDZs. As we have previously explained, the basis for the establishment of SDZs would be on some permissive right or special purpose such as national security. However, *Cuadra*’s analysis indicates that this basis entails a limited form of sovereignty,¹⁵⁰ which would run afoul of the prohibition on appropriation by “any other means,” if not by a “claim of sovereignty.”¹⁵¹ Warning zones, on the other hand, circumvent this concern because no permissive right or special purpose is established, but the right to self-defense is predicated off threatening approaches by other states.¹⁵² As a result, states “may use force against such entities only to defend against a hostile act or demonstrated hostile intent, including interference with declared military activities.”¹⁵³

Some may object that anticipatory responses in space fail to clear the threshold for imminence required by the “necessity” prong of self-defense. While there exists no one-to-one relationship between “pre-positioning” a satellite near another and an attack, there nonetheless is little reason to loiter near multiple foreign satellites intentionally except to mount an attack when the situation calls for it. This, clearly, exists as a preparation for an armed attack and justifies anticipatory responses. In geostationary orbit (GEO), where critical satellites such as nuclear early warning systems are located, all objects are stationary relative to other objects, with a fixed orbital slot. Remaining in place in GEO is comparatively easier than in other orbits, such as low-earth orbit (LEO). As such, ascertaining intent behind deliberate maneuvering in GEO is easier than in other orbits; a foreign satellite suddenly moving towards a nation’s own satellite in GEO is very likely an intentional step. Now, consider the pre-positioning of foreign satellites right up against multiple satellites owned by a nation. GEO, unlike other orbits, is exceptionally distant, with a

¹⁴⁷ von Heinegg, “Current Legal Issues in Maritime Operations,” 213-214.

¹⁴⁸ “Safeguarding U.S. National Interests in the Maritime Environment,” in *The Commander’s Handbook on the Law of Naval Operations*, 4-9.

¹⁴⁹ *Ibid.*

¹⁵⁰ *Cuadra*, “Air Defense Identification Zones,” 499.

¹⁵¹ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*.

¹⁵² “Safeguarding U.S. National Interests in the Maritime Environment,” in *The Commander’s Handbook on the Law of Naval Operations*, 4-9.

¹⁵³ *Ibid.*

significant lag time between launches and objects reaching orbit. If, in peacetime, an enemy had pre-positioned dozens of their own satellites right up against our most critical satellites, the United States would have no choice but to watch helplessly at the onset of a conflict as they disabled satellite after satellite.

Regardless of the precise contours of one's view on proportionality, it is clear that warning zones are both symmetrical and limited solely to the cessation of the enemy's aggression against the defender's satellites. This makes clear that such zones are an appropriate, measured response undertaken for the purpose of anticipatory self-defense, without running afoul of *jus in bello*. The trailing or "stalking" of one's satellites serves as a grave threat to the territorial integrity of a nation, clearing the thresholds of necessity and imminence for a *jus ad bellum* determination that anticipatory action is needed; such is consistent with decades of custom, backed by the imprimatur of Article 51, and is as applicable in space as in any terrestrial domain.

Policy Rationale for Zones

Defining Space Stalking

The threat posed by co-orbital ASATs remains new and ill-defined by both policymakers and academics. Few scholars have attempted to define what qualifies as tailgating, yet the policy community is beginning to take the threat of co-orbital anti-satellite weapons seriously again. The lack of agreement demonstrates that states must take proactive measures to discuss what behaviors qualify as tailgating and which do not. Russia and China have, on multiple occasions, conducted close approaches but have refused to acknowledge that these behaviors could be considered escalatory or provocative. In one 2015 incident, Russia's Luch satellite parked itself in-between two commercial satellites operated by Intelsat and refused to respond to multiple requests by the company for Russia to clarify its behavior.¹⁵⁴ More recently, the Russian Cosmos 2542 and 2543 satellites have closely mirrored the orbit of a National Reconnaissance Office spy satellite without clarifying their behavior, demonstrating the potential for Russia to weaponize advancing RPO technologies.¹⁵⁵ International dialogue to recognize tailgating as a hostile and provocative act would lay the groundwork for future negotiations to enhance the stability of the space domain.

Dr. Chow emphasizes the urgency of such an approach, as the most vulnerable nuclear command, control, and communications (NC3) satellites will be vulnerable to interference throughout the 2020s.¹⁵⁶ Citing comments from US Air Force Secretary Wilson, Chow noted that the US Space Based Infrared System (SBIRS) is outdated, and vulnerable to attack. While the Air Force is planning a follow-on constellation of new SBIRS satellites in 2029, Chow remains concerned that for the next nine years prior to the update, the existing satellites will remain vulnerable.¹⁵⁷ Even if the US were to race ahead to develop a new, resilient constellation, Chow has expressed skepticism that a truly resilient fleet will be ready in the near or medium-term, and that in the interim, those satellites will need other protections.¹⁵⁸ In addition to being time-intensive, such new, resilient constellations may face other vulnerabilities by nature of being

¹⁵⁴ "Russian Satellite Maneuvers Illustrate Why U.S. Alarm Bells are Ringing," November 6, 2015, <https://spacenews.com/editorial-russias-orbital-provocations/>

¹⁵⁵ Malcolm Davis, "Spy Games in the Grey Zone of Outer Space," ASPI Strategist, February 12, 2020, <https://www.aspistrategist.org.au/spy-games-in-the-grey-zone-of-outer-space/>

¹⁵⁶ Chow, Brian, "Op-ed: Nuclear vulnerability: In-orbit bodyguards would help protect NC3 satellites from attack," SpaceNews. April 1, 2019. <https://spacenews.com/op-ed-nuclear-vulnerability-in-orbit-bodyguards-would-help-protect-nc3-satellites-from-attacks/>

¹⁵⁷ Ibid.

¹⁵⁸ Chow, Brian, "Stalkers in Space: Defeating the Threat," Strategic Studies Quarterly 11, no. 2 (Summer 2017): pp. 89, https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-11_Issue-2/Chow.pdf.

smaller, in addition to having fewer capabilities than their larger counterparts.¹⁵⁹ However, even if such a resilient architecture could come online in time, many worry that a strategy based primarily on protecting arsenals may be inadequate. Such a “deterrence by denial” approach may not stop a determined adversary from continuing to attempt attacks,¹⁶⁰ or from attacking at lower thresholds, such as electronic or cyber interference.¹⁶¹

Final agreements about the size and character of warning zones should be discussed and determined by relevant space actors. Chow proposes a 0.2 orbital degree separation for zones, or a zone of approximately 148 km.¹⁶² This standard offers a useful baseline for international negotiations to begin. Within the US, the defense and intelligence communities should consult over establishing a reasonable threshold that would allow the US to effectively protect its satellites without infringing upon the right of states to peacefully move throughout space.

Addressing Simultaneous Tailgating by Multiple Satellites

It should be established that this proposal would apply only to the close, simultaneous approach of satellites towards *multiple* US satellites at any period in time. Individual close approaches to a single US military satellite does not pose as significant a threat, as the US maintains redundant satellite capability to compensate for malfunction, outage, or limited attack.¹⁶³

Simultaneous stalking, however, poses a unique military threat by opening the potential for multiple crucial targets to be destroyed instantaneously. Without classified intelligence, it is not possible for policy advocates to determine how many satellites can be threatened before it becomes a threat to national security, yet international dialogue over this topic can serve as a crucial confidence-building measure between states and demonstrate willingness to admit potential vulnerabilities for the benefit of all actors. As *Bruce MacDonald* describes:

While jamming one or two satellites in isolation appears unlikely to quickly escalate into all-out space war (given the longstanding role of electronic warfare in past conflicts), attacking multiple

¹⁵⁹ Koplow, “Deterrence as the MacGuffin,” 69-71.

¹⁶⁰ Davis, Paul K., “Toward Theory for Dissuasion (or Deterrence) by Denial: Using Simple Cognitive Models of the Adversary to Inform Strategy,” RAND Papers. January 2014. Pp. 3-5
https://www.rand.org/content/dam/rand/pubs/working_papers/WR1000/WR1027/RAND_WR1027.pdf

¹⁶¹ Lambakis, Steve, “A Guide for Thinking about Space Deterrence and China,” National Institute for Public Policy. July 2019. Pp. 4-6 <http://www.nipp.org/wp-content/uploads/2019/07/Lambakis-Guide-to-Thinking-About-Space-for-web.pdf>

¹⁶² Chow, “Stalkers in Space,” 96.

intelligence-gathering satellites would carry a far higher risk of escalation. Somewhere between these two extremes, however, is an uncertain and unknowable boundary that divides offensive space actions that modestly threaten stability from those that are clearly destabilizing and escalatory.¹⁶⁴

Setting the threshold at one satellite would risk precluding a variety of important space operations. For example, active-debris removal (ADR) operations use advanced RPO capabilities to reliably clean up orbits that have become increasingly congested with debris. Although these operations will prove crucial to prevent space from becoming unsustainably littered with orbital debris, they may also be interpreted as a prelude to an attack given the dual-use nature of space technologies and absence of international dialogue to regulate these technological advancements.¹⁶⁵ Commercial on-orbit servicing (OOS) spacecraft will also require close approaches to fix and inspect old and malfunctioning satellites, yet these systems can easily be perceived as weapons since they have robotic arms which could be repurposed for offensive operations.¹⁶⁶ Furthermore, space situational awareness operations conducted by the Geosynchronous Space Situational Awareness Program (GSSAP) require close approaches to provide comprehensive knowledge of the space environment and provide states with more reliable pictures of the orbital environment.¹⁶⁷ Considering the inevitable necessity of close-approaches, establishing a threshold of one satellite would reduce the degree of certainty provided by the zone regarding the other party's intent, in turn ratcheting up the risk of misperceptions and inadvertent

¹⁶⁴ Bruce MacDonald, "Chapter 2. Space and Escalation" in *Outer Space; Earthly Escalation? Chinese Perspectives on Space Operations and Escalation*, A Strategic Multilayer Assessment (SMA) Periodic Publication, August 2018, https://nsiteam.com/social/wp-content/uploads/2018/08/SMA-White-Paper_Chinese-Persepectives-on-Space_-Aug-2018.pdf

¹⁶⁵ Frank Rose. "The Role of Diplomacy in Keeping Outer Space Safe, Secure, and Sustainable," Remarks at the 32nd Space Symposium, April 14, 2016 <https://2009-2017.state.gov/t/avc/rls/255834.htm>; Ward Munters and Jan Wouters, "The Road Not Yet Taken for Defusing Conflicts in Active Debris Removal: A Multilateral Organization." Leuven Centre for Global Governance Studies and the Institute for International Law, Working Paper No. 183 – May 2017; Zachary Keck 18, "Space Is Truly the Final Frontier (For the Next Great War)" *The National Interest*, June 17, 2018 <https://nationalinterest.org/blog/the-buzz/space-truly-the-final-frontier-the-next-great-war-26284>.

¹⁶⁶ Joshua P. Davis, John P. Mayberry, and Jay P. Penn, "ON-ORBIT SERVICING: INSPECTION, REPAIR, REFUEL, UPGRADE, AND ASSEMBLY OF SATELLITES IN SPACE," CENTER FOR SPACE POLICY AND STRATEGY, April 2019, https://aerospace.org/sites/default/files/2019-05/Davis-Mayberry-Penn_OOS_04242019.pdf

¹⁶⁷ Steven Lambakis, Foreign space capabilities: Implications for U.S. national security, *Comparative Strategy* 37(2): 115, 2018, <https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=to>; Michael Nayak, "CubeSat proximity operations: The natural evolution of defensive space control into a deterrence initiative," *The Space Review*, 2016, <http://www.thespacereview.com/article/2902/1>

escalation via incidental close approaches or a failure to enforce the zone due to well-warranted caution.

As a result, the ‘warning zone’ proposal would apply only to the close, simultaneous approach of satellites towards *multiple* US satellites at any period in time. In part, warning zones are functionally and legally distinguished from KOZs due to this caveat. A state does not claim sovereignty over, nor will it preclude others from entering, an area; free passage will be permitted, yet states will have a clearer understanding when passage through the warning zone is conducted for peaceful purposes (such as ADR and OOS missions), or whether passage should be interpreted as hostile intent.

The Proposal Only Applies to Geosynchronous Orbit

International discussions should initially only focus on establishing warning zones in geosynchronous orbit (GEO). First, orbital physics makes this proposal easier to implement in GEO. Satellites in GEO, which rotate at the same velocity as the planet, are essentially parked above the earth (whereas satellites in LEO and MEO have far more complicated and occasionally overlapping orbital trajectories).¹⁶⁸ Due to complex satellite trajectories in the LEO, which will be magnified by increased commercialization, the LEO is “highly congested and only small zones would be feasible,” meaning that warning zones would offer little protection because it would be far more difficult to ascertain another state’s intent when positioning satellites near other satellites.¹⁶⁹ Transversal of a warning zone in GEO could be clearly construed as conveying hostile intent, as no state would have a legitimate peaceful motivation to position satellites in close proximity to another state’s military and intelligence satellites in GEO.

Second, GEO is home to many vital and vulnerable national security satellites. The majority of satellites in LEO are commercial and are less likely to direct American military and intelligence operations. It would be disproportionate to construe a close approach to a commercial or weather satellite as constituting aggression or a prelude to an armed attack. Furthermore, many national security satellites in GEO, such as NC3 satellites, are old, fragile, and incapable of being maneuvered out of the way of close approaching objects. Adversaries would likely target these NC3 satellites at the outbreak of a conflict as a prelude to a first strike, making it critical that they remain defended and protected. Furthermore, a state fearing an adversary’s disabling attack on NC3 satellites may strike first rather than lose their nuclear deterrent capability. Warning zones

¹⁶⁸ David Wright, Laura Grego, and Lisbeth Gronlund, “The Physics of Space Security: A Reference Manual,” (Cambridge, MA: *American Academy of Arts & Science*, 2005), <https://aerospace.csis.org/wp-content/uploads/2019/06/physics-space-security.pdf>

¹⁶⁹ Newsome, “The Legality of Safety and Security Zones in Outer Space,” 17.

around these satellites would allow states to ascertain whether adversaries are about to execute a first strike, reducing the risks of miscalculation.¹⁷⁰

Third, an international space traffic management system for assigning orbital slots in GEO already exists. The ITU assigns orbital slots of an average of 2 degree orbital separation, far larger than the warning zones suggested by this proposal.¹⁷¹ More specifically, to comply with these warning zones, states “need not reposition any of their operational satellites to observe the above suggested rule of 0.2-degree minimum satellite separation between any pair of... GEO satellites.”¹⁷² Applying and enforcing zones in LEO represents far more of a challenge because of commercial sector involvement. Chow acknowledges potential difficulties in asking commercial providers to monitor and change orbital paths to avoid traversing zones.¹⁷³ Furthermore, commercial space firms and consultancies have expressed concern about the changes in trajectories required to avoid zones. Scott Kordella, the director of outer space systems at Mitre, fears that extensive new US licensing regimes in space could sacrifice American commercial leadership.¹⁷⁴ In the status quo, most spacecraft in LEO lack transponders and specific orbital slots; the creation and enforcement of specific orbital slots (and warning zones surrounding those slots) would require the creation of a licensing regime.¹⁷⁵ Others have argued that maneuvering in LEO might be frequent enough to require burdensome “active guidance measures” for each commercial

¹⁷⁰ Brian Chow. “Op-Ed | Nuclear Vulnerability: In-Orbit Bodyguards Would Help Protect NC3 Satellites from Attacks,” SpaceNews.com, April 1, 2019, <https://spacenews.com/op-ed-nuclear-vulnerability-in-orbit-bodyguards-would-help-protect-nc3-satellites-from-attacks/>.

¹⁷¹ “Sharing the Sky - ITU’s Role in Managing Satellite and Orbit Spectrum Resources” ITU Background, Plenipotentiary 2014, <https://www.itu.int/en/plenipotentiary/2014/newsroom/Documents/backgrounders/pp14-backgrounder-sharing-the-sky.pdf>.

¹⁷² Chow, “Stalkers in Space,” 96.

¹⁷³ Ibid., 94-97.

¹⁷⁴ Kordella, Scott, “Op-ed: Protecting low Earth orbit from becoming the new Wild West,” Space News. March 16, 2019. <https://spacenews.com/op-ed-protecting-low-earth-orbit-from-becoming-the-new-wild-west/>

¹⁷⁵ LaunchSpace, an educational and consulting organization dedicated to training and continuing education for space professionals and to supporting the aerospace community, “Not A Job, But An Adventure - Space Traffic Controller,” 11 September 2018, Space Daily, http://www.spacedaily.com/reports/Not_A_Job_But_An_Adventure__Space_Traffic_Controller_999.html

operator.¹⁷⁶ The risk is particularly salient as onerous launch and licensing restrictions might hamper further commercial space development.¹⁷⁷

However, international deliberation could eventually expand to include the development of warning zones in LEO, and proposals could involve negotiations with the private sector. Zones could also be integrated into a broader space traffic management regime, yet such a system will require extensive cooperation with the private sector and all spacefaring states. Similarly, warning zones in GEO would be ideally established by consensus in a multilateral forum, but they can also be agreed to on bilateral bases that would still provide mutual understanding and reduce the risk of misperception.¹⁷⁸

Cooperative Approaches

To establish warning zones, the US should adopt a cooperative posture. The current absence of international negotiations over space stability have created a culture of distrust and hostility that risks increasing tensions which could spiral into conflict.¹⁷⁹ In particular, the US has damaged its international credibility over space arms control by consistently vetoing treaties such

¹⁷⁶ Collins Patrick, “Legal Considerations for Traffic Systems in Near-Earth Space.” Proceedings 31st Colloquium on the Law of Outer Space, IISL, pp. 296-303.
http://www.spacefuture.com/archive/legal_considerations_for_traffic_systems_in_near_earth_space.shtml

¹⁷⁷ Joshua Hampson, “The Future of Space Commercialization,” Niskanen Center, January 25, 2017. Pp. 14-19, 31-34 <https://niskanencenter.org/wp-content/uploads/2017/01/TheFutureofSpaceCommercializationFinal.pdf>

¹⁷⁸ For more comprehensive versions of this proposal that would still apply in LEO see Brian G Chow, “Space Arms Control: A Hybrid Approach,” *Strategic Studies Quarterly* 12, no. 2 (Summer 2018): 107-132, https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-12_Issue-2/Chow.pdf; Geoffrey Forden ““After China's Test: Time for a Limited Ban on Anti- Satellite Weapons,” *Arms Control Today*, vol. 37 (April), <https://www.armscontrol.org/act/2007-04/features/after-chinas-test-time-limited-ban-anti-satellite-weapons>; James Alver, Andrew Garza, Christopher May, “An Analysis of the Potential Misuse of Active Debris Removal, On-Orbit Servicing, and Rendezvous & Proximity Operations Technologies,” 5-6-19, Secure World Foundation, https://swfound.org/media/206800/misuse_commercial_adr_oos_jul2019.pdf, Mark A. Gubrud, “Chinese and US Kinetic Energy Space Weapons and Arms Control,” *Asian Perspective* 35, no. 4 (2011): 628-631.

¹⁷⁹ Brian Weeden and Xiao He, “U.S.-China Strategic Relations in Space” *The National Bureau of Asian Research*, NBR Special Report #57, April 2016, https://www.nbr.org/wp-content/uploads/pdfs/publications/special_report_57_us-china_april2016.pdf; “Attacking Satellites Is Increasingly Attractive—and Dangerous,” *The Economist*, July 18, 2019, <https://www.economist.com/briefing/2019/07/18/attacking-satellites-is-increasingly-attractive-and-dangerous>.

as the Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT) and the Prevention of an Arms Race in Space Treaty (PAROS). Proposing negotiations on the basis of peaceful intent will help reverse the perception that the US aims to aggressively dominate the space domain.¹⁸⁰

The US must be wary of the prospect that other states, particularly Russia and China, would view any arms control proposal as a veil for US militarization of outer space. Even Chow admits that “[r]ealistically, potential adversaries are far more likely to want the United Nations to adopt alternative space proposals, which ignore the space-stalking threat.”¹⁸¹ However, the UN thus far has failed to generate proposals that overcome definitional hurdles and enforcement-related barriers. The PAROS and the PPWT proposed and supported by Russia and China both neglected to define “space weapons,” and would likely not include any restrictions on co-orbital ASAT capabilities as they are not designed to conduct space-to-ground strikes. With regards to the PPWT, concerns have also been raised that China may be negotiating in bad faith to insulate their space arsenal from regulation: the PPWT would allow ground-to-space (direct-ascent) ASAT capabilities, of which China possesses a veritable suite. Russian and Chinese opposition to the International Code of Conduct for Outer Space Activities proposed by the European Union, which would have included a right to preemptive self-defense, underscores the likelihood that Russia and China would likely refuse to participate in accords to cooperatively establish warning zones.¹⁸²

The US should begin international negotiations over warning zones before declaring them unilaterally. Declaring zones without prior deliberation might lead other nations to perceive these zones as a guise for militarizing space. Other states may also probe the credibility of these declared zones, particularly to exploit a lack of international consensus on their legality. Although Russia or China might violate unilaterally declared zones, the US should be careful to respond absent certainty that preemptive self-defense is legal. Opening negotiations to all relevant parties, adversaries and allies included, will give states the opportunity to air grievances regarding warning zones before they are established. Even if Russia or China ultimately reject the proposal, the US will be able to point to its good faith effort of initiating dialogue and respecting Chinese and Russian concerns. As Chow describes:

¹⁸⁰ Michael Listner, “The art of lawfare and the real war in outer space,” *The Space Review*, September 17, 2018, <http://www.thespacereview.com/article/3571/1>

¹⁸¹ Chow, “Stalkers in Space,” 109

¹⁸² The Economist, “Attacking satellites is increasingly attractive—and dangerous,” July 18, 2019. <https://www.economist.com/briefing/2019/07/18/attacking-satellites-is-increasingly-attractive-and-dangerous>; James Alver, Andrew Garza, Christopher May, “An Analysis of the Potential Misuse of Active Debris Removal, On-Orbit Servicing, and Rendezvous & Proximity Operations Technologies,” Secure World Foundation, May 6, 2019. https://swfound.org/media/206800/misuse_commercial_adr_oos_jul2019.pdf, 15-16

In the worst-case scenario where no space arms control comes out of this hybrid approach, the United States would still have acted in good faith for pursuing an international space arms control treaty. Consequently, the world would have more understanding and support toward the United States as it had no choice but to switch to unilateral space arms control measures to ensure space security and stability.¹⁸³

While there will inevitably be detractors, zones will be most stable and effective when they receive international buy-in.

There is some evidence to suggest that Russia and China would also accept the warning zone proposal. First, Russian and China might recognize that warning zones are mutually beneficial, giving them a legal right to defend their satellites while maintaining stability as a variety of RPO capable spacecraft are rapidly deployed.¹⁸⁴ Even if the two parties do not accede to the agreement at first, the failure of existing proposals to address dual-use threats from RPO capable spacecraft might encourage Russia and China towards acceptance of warning zones.

Second, the United States can gain political leverage and engage in “full-contact lawfare” by highlighting the contradictory positions of Russia and China regarding space arms-control diplomacy.¹⁸⁵ As the two nations continue to conduct potentially destabilizing RPO tests in orbit, the international community will eventually recognize their dual-use nature as ASATs. This is especially salient considering the recent Russian testing of the Nudol, as well as the much-pilloried Chinese direct-ascent and debris-producing ASAT test of 2010.

With regards to China, this reality is particularly relevant when one considers China’s desire to leave a mark on international institutions in the space domain. For example, Brian Weeden and Xiao He, an assistant research fellow at the Institute of World Economics and Politics in the Chinese Academy of Social Sciences, argue that China feels boxed out of most international arenas where the US is already well-established. Space offers an area where China can proactively participate and lead in international governance, shaping rules to align with their own interests.¹⁸⁶ Furthermore, He writes that China has recognized international resistance to the PPWT proposal and considers the likelihood of success as remote. Furthermore, Chinese President Xi Jinping has

¹⁸³ Brian G Chow, “Space Arms Control: A Hybrid Approach,” *Strategic Studies Quarterly* 12, no. 2 (Summer 2018): https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-12_Issue-2/Chow.pdf. 129.

¹⁸⁴ Chow, “Space Arms Control: A Hybrid Approach,” 115-119.

¹⁸⁵ Listner, “The art of lawfare and the real war in outer space.”

¹⁸⁶ Xiao He and Brian Weeden, “U.S.-China Strategic Relations in Space,” *The National Bureau of Asian Research*. April 2016. Pp. 73-74. https://www.nbr.org/wp-content/uploads/pdfs/publications/special_report_57_us-china_april2016.pdf

emphasized cooperative security a central aspect of China's foreign political approach, hoping to produce win-win outcomes in contrast to the zero-sum thinking that dominated during the Cold War.¹⁸⁷ Additionally, China has an economic incentive to pursue stability in orbit. As China continues to use satellites to expand its Belt-and-Road Initiative (BRI), they have a strong incentive to protect their own assets.¹⁸⁸

Such international and economic incentives similarly exist for Russia, a declining power with a desire to increase international engagement in orbit. For Russia, space has long been an area of great national pride. In recent years, however, scientific projects and joint ventures in space have declined alongside a steadily weakened economy.¹⁸⁹ Hoping to maintain its status as a great power in space, Russia would likely be interested in the prestige associated with a major cooperative venture.¹⁹⁰ While warning zones are not a form of scientific cooperation, the process of negotiating new, groundbreaking norms for outer space gives Russia a much-desired seat at the table in international negotiations.¹⁹¹ While China and Russia may prefer to wait for their preferred approach to arms control, if the US holds firm and makes clear that it will not accede to the PPWT, there may be increasing willingness on the part of China to return to the negotiating table on American terms in the face of pressure.

¹⁸⁷ Sverre Lodgaard, "Arms Control and World Order," *Journal for Peace and Nuclear Disarmament*, Vol. 2. Issue 1. Pp. 17-19. <https://www.tandfonline.com/doi/full/10.1080/25751654.2019.1631243>

¹⁸⁸ Brian Chow and Henry Sokolski, "Priority-One for Space Policy Should Be to Protect U.S. Satellites," *SpaceNews.com*, October 12, 2019, <https://spacenews.com/op-ed-priority-one-for-space-policy-should-be-to-protect-u-s-satellites/>.

¹⁸⁹ Pavel Luzin, "Russia's Position in Space," *Foreign Affairs*, September 21, 2016. <https://www.foreignaffairs.com/articles/2016-09-21/russias-position-space>

¹⁹⁰ *Ibid.*

¹⁹¹ Nicole Jackson, "Outer Space in Russia's Security Strategy," *Simons Paper in Security and Development*. No. 64, August 2018. 5.

Potential Objections

There exist a number of potential objections to the warning zones proposal. This section aims to distill the most relevant objections and to demonstrate why many of these objections reinforce the necessity of establishing warning zones in outer space.

Space Situational Awareness (SSA)

Military and intelligence officers may worry that restrictions on RPO behavior may prevent the US from conducting close approaches with surveillance satellites, such as through the Geosynchronous Space Situational Awareness Program (GSSAP). Described as the “neighborhood watch,” GSSAP satellites are considered crucial for deterring adversary aggression by signaling the United States is continually monitoring activities on orbit.¹⁹² GSSAP satellites are capable of performing RPO operations and occasionally make close approaches to adversary satellites on surveillance missions or to signal that the United States is constantly watching. The proposed warning zones in this approach would not impede operations conducted by GSSAP satellites. Individual close approaches for surveillance purposes would not pose a military threat and would not rise to the level of demonstrating hostile intent. As of now, the United States does not field capabilities to allow multiple simultaneous close approaches and would sacrifice little by agreeing to a mutual restriction on behavior in space. Furthermore, multiple close approaches could be conducted over multiple days instead of simultaneously.¹⁹³

Furthermore, some have argued that monitoring and enforcing zones would be too burdensome; keeping tabs on every satellite in orbit would be a challenge that is, in the words of Steven Lambakis, “monumental.”¹⁹⁴ However, the warning zones proposal is expressly limited in scope to activities in GEO, as opposed to the substantially more difficult task of monitoring in LEO.¹⁹⁵ In GEO, existing US space situational awareness (SSA) capabilities may fill the gap. Chow notes that the US Geosynchronous Space Situational Awareness Program (GSSAP) already

¹⁹² Steven Lambakis, Foreign space capabilities: Implications for U.S. national security, *Comparative Strategy* 37, no. 2 (2018): 115, <https://www.tandfonline.com/doi/full/10.1080/01495933.2018.1459144?scroll=to>; Michael Nayak, “CubeSat proximity operations: The natural evolution of defensive space control into a deterrence initiative,” *The Space Review*, 2016, <http://www.thespacereview.com/article/2902/1>

¹⁹³ Chow and Sokolski, “Op-Ed | Priority-One for Space Policy Should Be to Protect U.S. Satellites.”

¹⁹⁴ Lambakis, Steven, “On the Edge of Earth: The Future of American Space Power,” The University Press of Kentucky. Pp. 120-130 2001

¹⁹⁵ Chow “Stalkers in Space,” 98.

performs the role of monitoring activities in GEO, with sufficient precision and timeliness to alert the DOD of potential zone breaches.¹⁹⁶

Loitering

Zone opponents frequently argue that they provide limited safety, as adversaries could easily park satellites outside of the zones and still be prepared to execute a devastating attack.¹⁹⁷ Concerns about loitering merit attention, yet they do not obviate the importance of the zone. If a determined adversary wants to attack a US satellite during a crisis, they will inevitably do so. Warning zones are not meant to provide absolute protection to satellites, but instead will help clearly define violations as constituting hostile intent. In the current environment, adversaries can loiter as close to a satellite as they wish. Warning zones will enable states to easily ascertain intent from adversaries that loiter outside of, or enter, a zone. SDZs and KOZs offer the illusion of protection for satellites, yet they cannot reliably defend against all incoming attackers.

Deterrence

Some believe the United States should reject limitations on behavior in space and strive for complete freedom of action in orbit.¹⁹⁸ Advocates of offensive space control argue that the United States can only achieve peace through strength and should reject any constraints on military capabilities in the space domain. Many of these detractors fear that China or Russia will inevitably cheat on any mutual restrictions to leapfrog US capabilities and erode US military advantage.

¹⁹⁶ Ibid.

¹⁹⁷ Newsome, “The Legality of Safety and Security Zones in Outer Space,”; Alex Gliksman, “Options for Space Arms Control,” *America Plans for Space*, A Reader Based on the National Defense University Press, Dec 15, 1987, <https://apps.dtic.mil/dtic/tr/fulltext/u2/a187465.pdf>; James A. Vedda and Peter L. Hays, “Major Policy Issues in Evolving Global Space Operations.” The Mitchell Institute for Aerospace Studies, Air Force Association. <https://tinyurl.com/y4cj6ran>

¹⁹⁸ US National Space Policy, 2006, https://aerospace.org/sites/default/files/policy_archives/Natl%20Space%20Policy%20fact%20sheet%2031Aug06.pdf; Christopher Stone, “Re-thinking the National Security Space Strategy: Chinese vs. American perceptions of space deterrence”. *The Space Review*. 2013. <http://www.thespacereview.com/article/2395/1>; Christopher Michael Stone, “Defending critical space infrastructure,” *Space News*, December 5th, 2016 <http://www.spacenewsmag.com/commentary/defending-critical-space-infrastructure/>; Baker Spring and Michaela Bendikova, “More Limits on U.S. Space Systems Unacceptable,” http://thf_media.s3.amazonaws.com/2012/pdf/wm3470.pdf; John Yoo and Jeremy Rabkin, “Chapter 7: Coercion in Space,” in “Striking Power: How Cyber, Robots, and Space Weapons Change the Rules for War.”. Encounter Books. 2017

Many of these ideas rest on faulty assumptions, yet even proponents of offensive dominance will be in favor of establishing warning zones around vulnerable satellites.

First, establishing warning zones would not prevent the United States from using RPO operations to hold adversary satellites at risk. The United States could still conduct counter space missions; adversaries would gain clarity that these close approaches are undertaken to convey hostile intent. Crisis bargaining would become far more stable and predictable if the international community were to agree upon warning zones (and how they can be peacefully traversed), otherwise close approaches could always be perceived as a likely prelude to war.

Second, few have yet to articulate a reason why the United States needs to conduct multiple close approaches simultaneously to execute a counter space mission. The United States can develop a slate of counter space capabilities including direct-ascent ASATs, cyber weapons, and jammers that can hold adversary satellites at risk without violating warning zones. The United States can also continue to test RPO capabilities through limited close approaches, so the United States can still use these systems for offensive missions if needed.

Third, most RPO capable satellites are better suited for defensive space operations than for asserting offensive control. Some of the most likely systems, small satellites known as Cubesats, are ideal defensive systems because they can act as bodyguards to protect otherwise vulnerable satellites.¹⁹⁹ As space is an offense-dominant domain and the United States possesses an asymmetric dependence on space assets for military operations, it would be preferable for the United States to primarily concentrate on defending satellites before attempting to dominate the space domain.

Boundary Testing

Critics of the proposed warning zones may fear that establishing these zones would encourage further boundary testing by adversaries. Publicly declaring a zone may encourage adversaries to probe American resolve to see if the United States will actually punish violations or prefer to avoid confrontation in space. However, maintaining strategic ambiguity over how the United States may punish violations could create a superior deterrent effect for adversaries may fear the consequences of American retaliation. A public declaration that the United States will not

¹⁹⁹ Michael Nayak, "CubeSat proximity operations: The natural evolution of defensive space control into a deterrence initiative," 2016, <http://www.thespacereview.com/article/2902/1>;

Edward Ferguson and John Klein, "The future of war in space is defensive," *The Space Review*, December 19, 2016, <https://www.thespacereview.com/article/3131/1>;

Michael Nayak, "Deterring Aggressive Space Actions with Cube Satellite Proximity Operations: A New Frontier in Defensive Space Control," *Air and Space Power Journal* 31, Vol. 4, pp. 92-103, https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Volume-31_Issue-4/SEW-Nayak.pdf

tolerate close approaches without a specified response option may leave the United States with extra flexibility to punish violations as seen fit.

These detractors overlook some central concerns. First, adversaries are already exploiting the lack of international agreements to continue grey zone provocations.²⁰⁰ Adversaries are far more likely to probe US boundaries in the absence of international consensus that stalking should be considered hostile. Russia and China, in particular, will no longer be able to exploit the lack of international consensus against stalking if they are invited to international negotiations. Even if they reject the proposed deal, the rest of the international community might condemn their boundary testing and recognize an American right to preemptive self-defense if necessary.

Second, threats of asymmetric retaliation to violations of warning zones will ring hollow and not effectively deter adversary aggression. Adversaries will recognize American threats as illegal, disproportionate escalation.²⁰¹ In particular, threats to retaliate terrestrially will be seen as unnecessarily expanding the domain of conflict, ensuring that the international community does not support the American response. American dependence on space also makes these disproportionate threats ineffective, as adversaries will always have more to gain by destroying American space capabilities than they have to lose.

²⁰⁰ Malcolm Davis, "Spy Games in the Grey Zone of Outer Space," ASPI Strategist, February 12, 2020, <https://www.aspistrategist.org.au/spy-games-in-the-grey-zone-of-outer-space/>.

²⁰¹ See Koplow, David A. 2019. Deterrence as the MacGuffin: The Case for Arms Control in Outer Space. Rochester, NY: Social Science Research Network. SSRN Scholarly Paper. <http://papers.ssrn.com/abstract=3436311> (May 25, 2020).

Conclusion

Governments and militaries have little experience discerning intent in space operations given a lack of crisis management experience in orbit. Warning zones have the potential to enhance mutual understanding and allow states a means to peacefully signal intent inside and outside of crises. Agreed upon in an amicable and cooperative setting, norms of behavior in space offer a crucial mechanism for states to credibly signal their intent during crises. With the contemporary lack of international agreement regarding co-orbital activities, a state may preposition a satellite during a crisis, yet it is unclear that their adversary will receive the intended signal. By agreeing to this warning zone proposal, states can reliably interpret when violations of zones are peaceful or hostile. This ensures security for defending states by giving them a signal of impending adversary aggression and allows aggressing states to ensure their signals of hostile intent are properly interpreted during crises.²⁰²

²⁰² Audrey Schaffer, "The Role of Space Norms in Protection and Defense," JFQ 87, 4th Quarter 2017, 88-92, <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-87/jfq-87.pdf>

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