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Alternative Approaches and Indicators for **the Prevention of an Arms Race in Outer Space**

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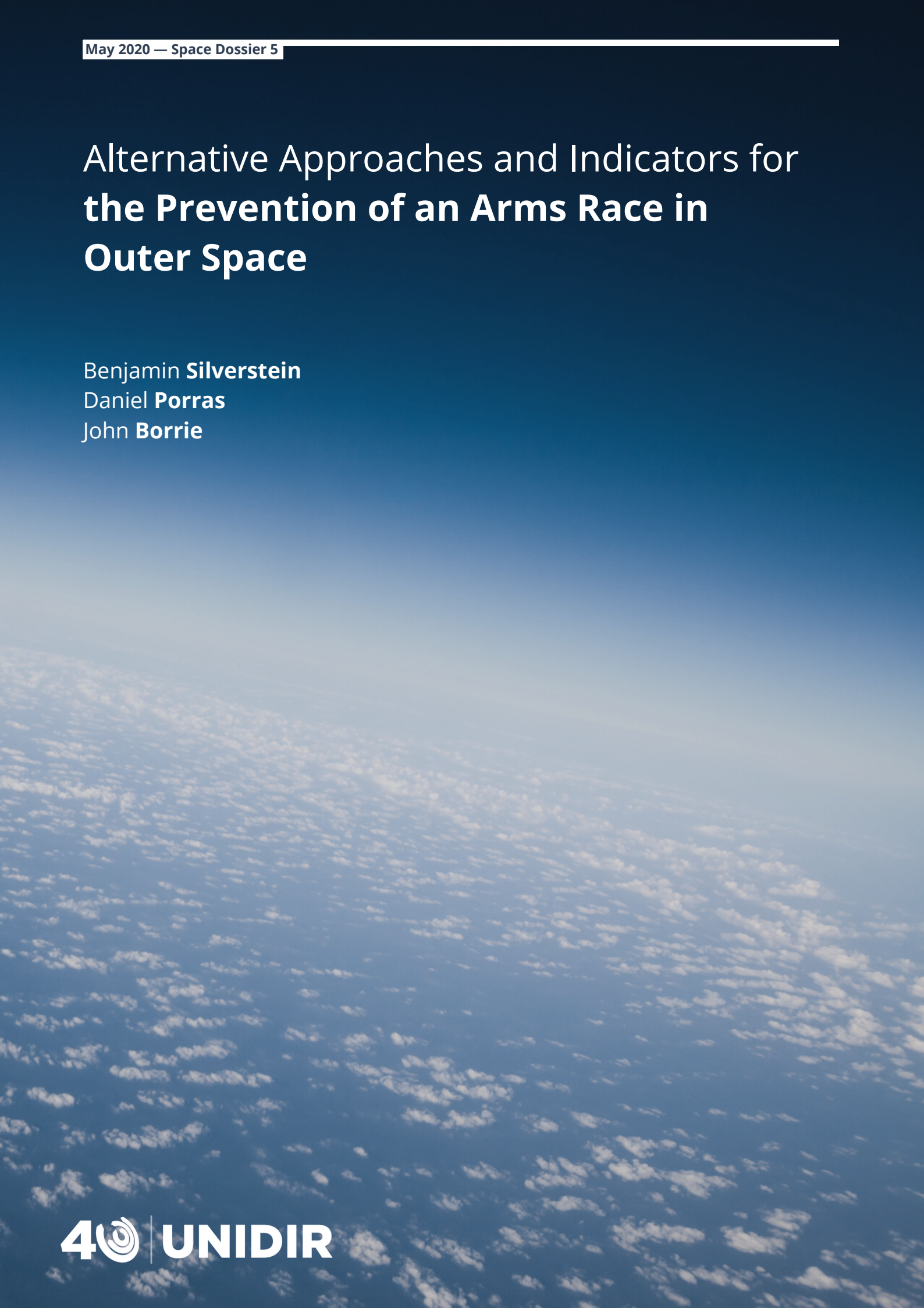

40 | UNIDIR

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TABLE OF CONTENTS

ACRONYMS & ABBREVIATIONS

ASAT	Anti-satellite weapon
CD	Conference on Disarmament
NAM	Group of 21 non-alligned movement members
GGE	Group of Governmental Experts
PPWT	Draft Treaty on the Prevention of the Placement of Weapons in Outer Space
SSA	Space Situational Awareness
PAROS	Prevention of an Arms Race in Space
SSOD	United Nations Tenth Special Session of the General Assembly on Disarmament

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KEY FINDINGS

This paper looks at the origins of the "prevention of an arms race in outer space" (PAROS) debate and how it has evolved.

Recent space-related military developments suggest that PAROS, as the guiding paradigm over the last four decades for space security talks, is fast being overtaken by events.

Our indicators suggest that intensifying competition in counterspace capabilities fit an arms race dynamic.

We suggest limited, practical PAROS-related steps to help to dampen destabilizing arms race dynamics.

1. INTRODUCTION

During the Cold War, the United States and the Soviet Union expanded their competition to the outer space domain, as each sought to demonstrate their technological prowess. By the 1960s, outer space was at risk of becoming a new arena of overt military competition, and the international community sought to curb these developments with agreements such as the 1967 Outer Space Treaty, the 1975 Registration Convention and the 1979 Moon Agreement.[1] If space was not weaponized it nevertheless steadily militarized: space objects became critical to military communications, navigation, nuclear early warning, and other functions. Despite continuing militarization in the context of intense geopolitical rivalry, State activities in space remained generally peaceful and predictable relative to the proxy conflicts and crises unfolding on Earth.

Today, outer space has become more accessible and much more commercially valuable than it was during the Cold War 'space race'. A broad variety of space-based technologies are now essential to the modern global economy and society. Many governments and companies own and operate space assets such as communication, imagery and navigation satellites. Nearly 20 States have active space programmes launching objects into orbit, whether for civil, military, or sometimes combined purposes.[2] Meanwhile, capabilities that could interfere with or destroy space-based systems (generally referred to as counterspace capabilities) have proliferated. At least four States have successfully demonstrated ground-launched anti-satellite weapon (ASAT) capabilities. Many more likely have the means to disrupt or damage space assets using cyber and electronic techniques.[3] As of writing, five States have announced that they are dedicating military units and updating their doctrines for possible combat in space. Several States, eager to protect their

[1] See Jozef Goldblat, *Arms Control: The New Guide to Negotiations and Agreements*, 2nd ed., PRIO and SIPRI, 2002, pp. 166–169.

[2] Daniel Porras, Briefing paper for the United Nations Disarmament Commission, UNIDIR, 2 February 2019, p. 6, https://unidir.org/publication/briefing-paper-united-nations-disarmament-commission.

[3] See Rajeswari Pillai Rajagopalan, "Electronic and Cyber Warfare in Outer Space", UNIDIR Space Dossier File 3, April 2019, https://www.unidir.org/files/publications/pdfs/electronic-and-cyber-warfare-in-outer-space-en-784.pdf.

space-based assets, are focusing research, development, and production efforts on capabilities that improve space systems' resilience to interference or attack, such as 'active defence' systems that leverage high-energy lasers.[4] Some of these new tools and technologies, while defensive in concept and initial deployment, could conceivably be used to deny a State's rivals from accessing space or using orbital infrastructure.

Numerous States have voiced concern about the potential damaging effects of this competition.[5] Although multilateral discussions on topics such as unchecked arms racing in space have intensified, these have not yet translated into tangible agreements or binding measures. For more than four decades, 'prevention of an arms race in outer space' (PAROS) has been one of the four 'core items' on the agenda of the Conference on Disarmament (CD), the 65-member State body tasked with negotiating multilateral disarmament and arms control agreements. In that time, although the CD was able to negotiate new agreements such as the Chemical Weapons Convention and the Comprehensive Test Ban Treaty, it did not adopt new agreements related to space security. Discussions on space security and other topics have continued, but the CD has been unable to commence negotiations on any subject since the 1990s.

In light of the dearth of meaningful results flowing from the CD or other multilateral processes to address arms in space, some States have raised concerns about the development of destructive capabilities that, when used against space objects, generate persistent orbital debris.[6] Others "oppose and reject any

[4] Speech, French Minister of the Armed Forces Florence Parly, 25 July 2020, https://cd-geneve.delegfrance.org/Florence-Parly-unveils-the-French-space-defence-strategy. For a broad overview of global offensive and defensive space systems, see Brian Weeden and Victoria Samson, "Global Counterspace Capabilities: An Open Source Assessment", Secure World Foundation, April 2020.

[5] See "Further Practical Measures for the Prevention of an Arms Race in Outer Space", A/C.1/74/L.58/Rev.1, 31 October 2019, https://undocs.org/en/A/C.1/74/L.58/Rev.1.

[6] European Union Statement by First Secretary Marketa Homolkova, First Committee of the General Assembly, 74th Session, 29 October, 2019, https://www.un.org/disarmament/wp-content/uploads/2019/11/statement-by-eu-os-oct-29-19.pdf.

acts" that violate the "rights of all States in the … use of outer space for exclusively peaceful purposes".[7] One further alarming prospect is that contemporary space security developments could be strategically destabilizing at a time of heightened tension between some nuclear-armed States such as China, the Russian Federation and the United States.[8] This is because, at a strategic level, there are intrinsic connections between space security, missile defences and nuclear weapons (a nexus explored in the next paper in UNIDIR Space Dossier series). This linkage has arguably complicated efforts in the CD to find consensus on a work programme spanning several core issues from PAROS to nuclear disarmament. Yet many States, including those in the Group of 21 (G-21, members of the Non-Aligned Movement), remain attached to PAROS as one of the core issues forming the basis for the CD's work programme,[9] which means simply discarding or setting aside the topic of PAROS in the CD is not a realistic political option.

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Considering the situation described above, ways to approach PAROS merit fresh reflection. To that end, this paper examines how PAROS emerged and developed, and what it means—or perhaps should be understood to mean—today. There is still little agreement at the international level on what the goals of PAROS are, let alone how to achieve them. It is not even clear whether there is consensus on how imminent an arms race in outer space is, or how such a race is likely to manifest.[10] These uncertainties

[7] Statement by the Delegation of the Republic of Indonesia, on behalf of the Non-Aligned Movement, First Committee of the General Assembly, 74th Session, 29 October, 2019, https://www.un.org/disarmament/wp-content/uploads/2019/11/statement-by-indonesia-on-behalf-os-oct-29-19.pdf.

[8] For an introduction to strategic stability in the space domain, see Joseph Rodgers, "Space Security and Strategic Stability", UNIDIR Space Dossier File 1, February 2018, p. 4, https://unidir.org/files/publications/pdfs/space-security-and-strategic-stability-en-697.pdf.

[9] See Paul Meyer, "The CD and PAROS: A Short History (UNIDIR Discussion Paper)", UNIDIR, April 2011, p. 1, https://unidir.org/files/publications/pdfs/the-conference-on-disarmament-and-the-prevention-of-an-arms-race-in-outer-space-370.pdf.

[10] See, for example, D.A. Koplow's assessment that "The world is on the precipice of a new arms race in outer space", The Fault is Not in Our Stars, 59 Harv.Int'l L.J. 331 (2018), p.332, https://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=3101&context=facpub and the countervailing opinion posited by news headlines such as "Space arms race as Russia, China emerge as 'rapidly growing threats' to US", https://www.cnbc.com/2017/03/29/space-arms-race-as-russia-china-emerge-as-

leave room to constructively question and reinterpret PAROS: specifically, are there alternative ways to think about addressing arms racing in space that could achieve more traction in the current strategic environment? This paper examines several alternative approaches and offers some suggestions for how States might move forward. Along the way, the paper offers some possible indicators of inter-State arm racing for observers to use. These indicators and the accompanying discussion underscore the difficulties in objectively measuring an arms race specifically in the space environment.

rapidly-growing-threats-to-us.html, and "New studies provide fresh insights into the escalating space arms race",

https://spacenews.com/new-studies-provide-fresh-insights-into-the-escalating-space-arms-race/.


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2. WHAT IS PAROS?

In 1981, the first two General Assembly resolutions on PAROS emerged. The contrasting approaches they represent endure to the present day.

As a concept, PAROS first appeared in United Nations discussions during the Tenth Special Session of the General Assembly devoted to disarmament (SSOD) in 1978. Its final document concluded that "in order to prevent an arms race in outer space, further measures should be taken and appropriate international negotiations held in accordance with the spirit of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the Outer Space Treaty)".[11] Cold War tensions were rising at that time and, despite broad international agreement on four other treaties regarding space, the United States and Soviet militaries were developing counterspace and ASAT weapon systems.[12] These developments raised a general concern that "rapid advances in science and technology had made the extension of an arms race into outer space a real possibility".[13] Some SSOD delegates considered the Outer Space Treaty, which prevents the placement of nuclear weapons and weapons of mass destruction in orbit, insufficient as it would not prevent the development and deployment of other weapons in space.[14]

In 1981, the first two General Assembly resolutions on PAROS emerged. The contrasting approaches they represent endure to the present day. The "Western European and other States" (including Niger and Uruguay) proposed one of the resolutions, which sought to prohibit ASAT systems.[15] The other proposal, tabled by "Eastern European and other States", took a different approach, proposing a prohibition on the stationing of weapons

[11] 10th Special session of the United Nations General Assembly on Disarmament: Final Document, para. 80, https://unesdoc.unesco.org/ark:/48223/pf0000038404.

[12] Secure World Foundation, "Global Counterspace Capabilities: An Open-Source Assessment", April 2020, pp. 2-1 and 3-1.

[13] *Yearbook of the United Nations*, 1981, p. 80, https://www.unmultimedia.org/searchers/yearbook/page.jsp?volume=1981&page=92.

[14] Ibid.

[15] Ibid., p. 81.

of any kind in outer space.[16] Bulgaria, the Byelorussian Soviet Socialist Republic and Hungary said that such a treaty was necessary to address the increased production of "potential" weapons by the United States, including lasers, particle beams, and the crewed Space Shuttle. A key difference of approach was that the Western and other States' proposal focused on curbing threats to space objects; the latter proposal focused predominantly on curbing threats from space systems.

Despite overlap between the two 1981 General Assembly resolutions on PAROS, the differences in the types of capabilities each aimed to address made merging them unfeasible. States made procedural progress on PAROS, adopting the topic in the CD's agenda, and beginning formal deliberation in 1985. However, divisions between States based on their support for either of the two approaches deepened over the following 20 years, precluding tangible results in the PAROS debate.[17]

The Eastern European and other States continued to argue that existing legal instruments, such as the Outer Space Treaty and the Charter of the United Nations, could not prevent an arms race in space, citing the possibility of conventional weapons, lasers and other high-energy weapons being deployed in space (a concern that mounted after US President Ronald Reagan announced his Strategic Defence Initiative).[18] They also expressed concern about the development of anti-ballistic missile systems that could be repurposed as ASATs.[19]

[16] Ibid., pp. 80–81.

[17] See Paul Meyer, "The CD and PAROS: A Short History (UNIDIR Discussion Paper)", UNIDIR, April 2011: https://unidir.org/files/publications/pdfs/the-conference-on-disarmament-and-the-prevention-of-an-arms-race-in-outer-space-370.pdf. See also Tim Caughley, "The Conference on Disarmament: Issues and Insights", UNIDIR: 2012, pp. 7–11, https://unidir.org/files/publications/pdfs/the-conference-on-disarmament-issues-and-insights-395.pdf.

[18] Conference on Disarmament, *Report of the Ad Hoc Committee on Prevention of an Arms Race in Outer Space*, document CD/1271, 24 August 1994, §12.

[19] The technology for ballistic missile interceptors is well suited to target satellites as well as missiles. In fact, in 2008, the United States fired an SM-3 Block IA mid-course missile interceptor to destroy a malfunctioning satellite by using only a software modification to target a satellite rather than a missile; https://archive.defense.gov/transcripts/transcript.aspx?transcriptid=4145.

In contrast, the Western European and other States argued that existing legal instruments already provided "an equitable, practical, balanced and extensive legal system for ensuring the use of outer space for peaceful purposes" and were sceptical about the need for an additional agreement.[20] Rather, they advocated for voluntary transparency and confidence-building measures as an alternative to a PAROS treaty.

The end of the Cold War and the collapse of the Soviet Union in the early 1990s transformed the broader political landscape, and meant that many of the former Soviet Union's ASAT programmes were put on hold indefinitely.[21] In the CD and other multilateral forums, there were no significant changes to the positions outlined above, and thus few major developments on PAROS. By 2002, essentially only China, the Russian Federation and Canada were active in developing PAROS working papers in the CD. China and the Russian Federation jointly presented a working paper outlining elements of a future international legal instrument on the prevention of deployment of weapons in outer space. The two delegations subsequently submitted compilations of other States' comments on, and suggestions to, their original proposal as CD documents and contributed further working papers on specific aspects of their treaty proposal including on verification, definitions and existing legal instruments.[22]

China and the Russian Federation introduced a draft Treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT) in the CD in February 2008. This draft comprised 14 articles that would bind States not to "place in orbit around the Earth any objects carrying any kinds of weapon" nor "resort to

[20] Conference on Disarmament, *Report of the Ad Hoc Committee on Prevention of an Arms Race in Outer Space*, document CD/1271, 24 August 1994, §13.

[21] Secure World Foundation, "Global Counterspace Capabilities: An Open-Source Assessment", April 2020, p. 2-1.

[22] See Paul Meyer, "The CD and PAROS: A Short History (UNIDIR Discussion Paper)", UNIDIR, April 2011, p. 5, https://unidir.org/files/publications/pdfs/the-conference-on-disarmament-and-the-prevention-of-an-arms-race-in-outer-space-370.pdf.

the threat or use of force against outer space objects".[23] Notably, the draft PPWT defined terms like 'outer space', 'weapon' and 'use of force' that had not previously been introduced in PAROS-related discussions. Perhaps in recognition that the necessary technologies for verification probably did not exist at that time (a criticism of the general approach dating back to 1981), article VI noted that these could later be the subject of a possible protocol.[24]

States had mixed reactions to the PPWT draft. Several other significant space-faring States, notably the United States, objected to it on the grounds that it would not be possible to develop an effectively verifiable agreement for the banning of either space-based 'weapons' or terrestrial ASAT systems.[25] China and the Russian Federation introduced a new text in 2014, which sought to address these concerns by omitting the controversial definition of 'outer space', although the text maintained definitions of other critical terms such as 'use of force' and 'weapon in outer space'. However, today, the United States and other States still object to the PPWT, on the grounds that it cannot be verified.[26] In 2014, the European Union sought to offer an alternative by presenting a revised of the draft voluntary International Code of Conduct for Space Activities that was

[23] Article II of the 2008 draft of the PPWT, submitted by China and the Russian Federation, https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/jkxw_665234/t408634.shtml. See also CD/1839 (29 February 2008).

[24] Article VI of the 2008 draft of the PPWT.

[25] Conference on Disarmament, Letter from the United States: Comments on the Draft Treat on Prevention of the Placement of Weapons in Outer Space and the Threat or Use of Force Against Outer Space Objects (PPWT) as contained in Document CD/1839 of 29 February 2008, CD/1847, 26 August 2008.

[26] Jeff Foust, "U.S. Dismisses Space Weapons Treaty Proposal As 'Fundamentally Flawed'", SpaceNews, 11 September 2014, https://spacenews.com/41842us-dismisses-space-weapons-treaty-proposal-as-fundamentally-flawed/. See also European Union Statement—United Nations 1st Committee: Thematic Discussion on Outer Space, 29 October 2019, https://eeas.europa.eu/delegations/un-new-york/69603/eu-statement-%E2%80%93-united-nations-1st-committee-thematic-discussion-outer-space_en. See also "Further practical measures for the prevention of an arms race In outer space", A/C.1/74/L.68/Rev.1, First Committee vote—124 yes, 41 no, 10 abstain, http://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com19/votes/L58Rev1.pdf.

originally issued in 2012, but this initiative appears to have lost momentum.[27]

Overall, the major competing views held by States on how to approach PAROS within United Nations forums have not dramatically changed since the early 1980s, but realities in the space environment have changed considerably. Notably, more States have announced that they intend to deploy a range of counterspace capabilities. It is thus worth considering whether the current environment resembles the arms race that the multilateral community first envisioned in 1978, whether such a phenomenon can still be prevented, and what steps could be most effective in reducing risks associated with arms racing behaviour in space.

[27] European Union proposal for an international Space Code of Conduct, 31 March 2014, https://eeas.europa.eu/topics/disarmament-non-proliferation-and-arms-export-control/14715_en.

3. IS THERE AN ARMS RACE IN SPACE?

In 1978, when the SSOD outcome included the notion of PAROS, the arms race between the West (led by the United States) and East (led by the Soviet Union) was pronounced. Both superpowers had tens of thousands of nuclear weapons, and led well-armed military alliances poised for conflict. The concern at the time was to avoid outer space becoming a further domain of overt armed competition between the two superpowers, which were also technologically the leading space-faring States (to a significant degree) and would remain so until well after the end of the Cold War.

While outright war and direct conflict in space has not yet transpired, surreptitious activities such as cyber hacking, electronic jamming of space objects, and unauthorized manoeuvres close to satellites in certain cases have challenged perceptions of peace.

The current situation has evolved significantly, and in many ways is more complex than when the concept of PAROS emerged. The use of space no longer reflects the dynamics of a bipolar competition. The number of actors—both governments and commercial entities—launching and operating space objects has greatly increased, as has the quantity of satellites in orbit. While outright war and direct conflict in space has not yet transpired, surreptitious activities such as cyber hacking, electronic jamming of space objects, and unauthorized manoeuvres close to satellites in certain cases have challenged perceptions of peace. Protecting space-based infrastructure is a concern for those States reliant on space systems for strategic military functions such as communications, navigation, guidance for some precision weapons on Earth, and anti-missile systems. Some States are taking steps in that direction through the development of counterspace capabilities, doctrines and the formation of new organizations (in some cases, 'space forces') to deploy them.

Identifying this pattern as an arms race depends on how this specific subcategory of interstate competition is defined. In general, arms races are the outgrowth of competitive pressures that motivate or otherwise induce States to improve the quality of, or expand, their armed forces. This is often captured in an inter-State 'action–reaction' dynamic, in an "intense competition between Powers or groups of Powers, each hoping to achieve an advantage in military power by increasing the quantity or

improving the quality of its armaments or armed forces".[28] Various scholars have offered prescriptive rubrics to identify arms racing behaviours, including indicators that incorporate the impacts of 'bureaucratic political games' and other intra-State interactions.[29] Other definitions address causal aspects of arms racing, tracing the phenomenon back to "conflicting purposes or mutual fears" between "two states or coalitions of states".[30] These definitions capture important aspects of the arms race dynamic, but were developed during the height of the Cold War and focus on the drivers of competition that may only partly motivate States to compete today, if at all. They also often struggle to capture the multifaceted technical and political aspects of modern inter-State competition in space. It is difficult to derive meaningful conclusions from these frameworks when attempting to determine whether there is a budding or ongoing arms race in space.

[28] Hedley Bull, *The Control of the Arms Race: Disarmament and Arms Control in the Missile Age*, Institute for Strategic Studies, 1961, p.4.

[29] C.S. Gray, "How Does the Nuclear Arms Race Work?", *Cooperation and Conflict*, vol. 9, no. 1, 1974, pp. 285–295, https://doi.org/10.1177/001083677400900127.

[30] *See* Samuel P. Huntington, "Arms Races: Prerequisites and Results", *Public Policy*, vol. 8, 1958, pp. 41–86.

BOX 1: ARMS RACE INDICATORS

Categories	Definitions	Indicators	Contemporary manifestations in space
Rivalry	Two or more States engaged in an adversarial search for security, often spurred by competition for territory, resources or geopolitical influence.	At least two participants Territorial dispute Regional influence Global influence Comparable capabilities Resources and economics	Numerous rivalries exist today, notably between (NATO/Russia), (US/China), (China/India). These rivalries may extend to space, based on competition for resources or influence in the domain.
Corresponding capabilities	Capabilities must be intentionally developed in relation to each other. These capabilities need not necessarily be arms per se, or even outright military technologies, but they must either qualitatively or quantitatively improve a State's military abilities.	Offensive weapons Defensive capabilities Dual- or multi-use systems Organization, policy, doctrine	Modern militaries employ space systems to facilitate or enhance military operations and are developing the means to neutralize adversaries' space-based advantages. States are also issuing guidance on how and why space and counterspace systems should be used.
Acceleration of capability development	Meaningful increase in tempo of capability production cycles or deployment. Acceleration can be measured by the pace of proxy indicators such as weapons tests, demonstrations, and policy shifts.	Spending Demonstrations/testing Budgeting	States are modifying existing space defence policies or adopting new ones, establishing dedicated military units, and openly seeking counterspace capabilities. All of these changes are occurring at a faster pace than in prior years.

Although each approach has its flaws, box 1 presents an approach to assess whether arms racing dynamics exist. This simple approach uses three criteria—rivalry, corresponding capabilities and acceleration of military development—to provide the reader with a transparent method to independently consider if an arms race is occurring in any domain, including in outer space. On that score, the current situation matches our criteria for an arms racing situation, although accompanied by important provisos.

On that score, the current situation matches our criteria for an arms racing situation, although accompanied by important provisos.

The first proviso is that space is not an environment in which symmetrical 'like for like' arms capability developments effectively balance rivals. This makes it different from some well-known historical cases of arms races. For example, in the Anglo-German naval arms race before the First World War, each side competed to build Dreadnought-style battleships. Unlike the Dreadnought race, in which battleships were designed to defeat other battleships, counterspace capabilities are generally not designed to defeat a rival's counterspace technology. For example, any deterrent value apart, deploying ASAT missiles is not an effective way to defend against a rival's ASAT missiles. Underscoring the importance of this proviso, many satellite systems are not necessarily weapons systems, but rather elements of infrastructure with broad military applications. In this same vein, qualitative military enhancements are often unrelated to weapons at all, for instance enhancements to improve resilience and redundancy in satellite systems or to tracking of other space objects.

The second proviso is that, as in the Cold War, the strategic dynamics of the outer space domain reflect material capabilities and strategic tensions on Earth. The question at hand is not how to prevent an arms race in space from developing, but how to prevent aspects of terrestrial strategic competitions from spilling into space. This will require those States engaged in competition on Earth to restrain themselves, either unilaterally or in cooperation (for instance, through arms control agreements), from acquiring or deploying counterspace capabilities that are strategically destabilizing. Incentivizing such behaviour may

require understandings and agreements that go well beyond solely counterspace capability-related developments, something discussed in the conclusion of this paper.

The third, and most general, proviso is that arms races are neither inherently 'bad' in a normative sense nor do they inevitably result in inter-State conflict. Lessons from strategic competition between the United States and the Soviet Union in the Cold War show that military improvements can contribute to stability if the changes discourage each side from striking against the other first. In the space context, for example, space situational awareness (SSA) systems, while not arms in and of themselves, could be used to support military targeting of satellites for interference or destruction. On the other hand, a diverse SSA network can improve the ability to locate and track space objects and sources of interference and provide additional redundancies. This improves confidence in the resiliency of space operations. A broad network of SSA systems would be able to support an international system of accountability for behaviour in space, and also reduce the risk of States misinterpreting space activities. As such, it is important to avoid concluding that an arms race is occurring or has occurred based on a perceived reduction in stability or security. Nevertheless, arms races tend to be wasteful, divisive, and can exacerbate tensions between States in a range of ways, some of which can be unforeseen and unintended.

States risk serious destabilization by developing capabilities that are difficult to counter or defend against and thus increase the benefits of a pre-emptive strike. States rely on space-based national security infrastructure systems to provide leaders with more decision-making time during crisis response.[31] An arms race in space that led to capabilities directly threatening systems such as incoming missile detection and early warning notification, for instance by disrupting or destroying critical nodes, could reduce a State's ability to recognize and respond to a surprise attack.

[31] While there is no guarantee that a decision maker would take advantage of this extended time frame to engage in crisis management and initiate de-escalation activities, early warning systems at least open the possibility for such activities.

Such operations against an adversary may be interpreted as a precursor to more widespread attacks and might even create 'use it or lose it' situations for nuclear decision makers in the attacked State.[32] In this way, military countermeasures to reduce the chances of success of pre-emptive attacks might fit certain definitions of arms racing but would probably contribute to stability.

While the most severe and sudden impacts of counterspace capabilities could be related to nuclear tensions, their introduction could prove to be destabilizing in other ways.

While the most severe and sudden impacts of counterspace capabilities could be related to nuclear tensions, their introduction could prove to be destabilizing in other ways. Technology designed to intentionally jam satellite signals, for example, could inflict economic losses by degrading satellites that service rival countries. Co-orbital vehicles can be used to intercept communications to military or commercial satellites. The cost of accessing space could increase for all if kinetic ASAT use creates widespread space debris. As such, the importance of PAROS goes beyond strategic military considerations, encompassing a range of consequences that are not as catastrophic as nuclear war, but which could still be damaging and disruptive for modern society.

[32] James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War", *International Security*, vol. 43, no. 1, 2018, pp. 56–99.


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4. APPROACHES TO PAROS : SOME ALTERNATIVES

In the current geopolitical environment, it seems unlikely the international community will reach a consensus to negotiate legally binding measures on PAROS. As the previous sections have noted, one challenge is that the PAROS debate encompasses an increasingly diverse expanse of technologies and activities. A second challenge is that diverse inter-State rivalries complicate attempts to formulate universal or general agreements that incentivize States to abstain from arms racing in space. Third, as many space-related technologies serve both civil and military missions, States are reluctant to agree to restraints or restrictions that may hamper innovation in the burgeoning commercial or military space sectors.

A fourth challenge for States engaged in the PAROS discussion is that of clearly defining success and the end goals of such an agreement.

A fourth challenge for States engaged in the PAROS discussion is that of clearly defining success and the end goals of such an agreement. As discussed earlier, PAROS emerged from concern about the potential impacts of an unfettered arms race in space, and four decades later the language used in PAROS debates remains largely the same. The most recent version of the General Assembly's annual PAROS resolution lists its principle aims as being to "avert a grave danger for international peace and security" and to ensure the ongoing use of space in accordance with international law and the space treaties.[33] This language gives policymakers necessary latitude in shaping PAROS measures or agreements, but provides no guidance on how to overcome associated political obstacles.

In this regard, a simpler codification of the goals of PAROS could help to advance discussions. States could agree that a near-term goal of PAROS efforts is to ensure that States use space safely and responsibly. That includes access to space and its use for economic, civilian and military purposes. This approach might help to focus PAROS discussions on those technologies or behaviours with the greatest capacity for disruption or

[33] General Assembly resolution 74/32, "Prevention of an arms race in outer space", 12 December 2019, preamble.

destabilization of the space environment. From there, collectively, States could identify the most destabilizing aspects of military competition in outer space and look at how these specific risks could be mitigated, including how rival States could be incentivized to cooperate in such endeavours.

Understanding the pros and cons of these conceptual approaches could help States to identify promising measures to mutually disincentivize the development of arms or use of force in outer space.

There have been some limited systematic efforts to do this over the last decade through initiatives such as two United Nations Group of Governmental Experts (GGE) processes on PAROS, and ad hoc discussions in standing bodies like the CD and United Nations Disarmament Commission. These processes have produced distinctive approaches to PAROS. Respectively, these general approaches are distinct in that the first is, in effect, framed to address specific threat vectors, the second in more general terms of threats from and to space, and the third approach in terms of kinds of destructive capability. Each of these approaches has its advantages and disadvantages.

Understanding the pros and cons of these conceptual approaches could help States to identify promising measures to mutually disincentivize the development of arms or use of force in outer space. At the same time, the principle of 'do no harm' should also apply. A majority of States would prefer to prevent the placement weapons in space and to establish clear rules on which military capabilities and activities are permitted.[34] However, a solution that accomplishes both of these objectives is unlikely, due in large part to the perception held by key States that weapons and offensive capabilities have already been stationed in outer space, and that the window of opportunity to prevent the placement of weapons in space has closed.[35] Furthermore, on

[34] See, for example, General Assembly resolution A/RES/73/33, 18 December 2019, https://undocs.org/en/A/RES/74/33.

[35] Christopher Ford, "Whither Arms Control in Outer Space? Space Threats, Space Hypocrisy, and the Hope of Space Norms", speech, Center for Strategic and International Studies, Washington, DC, 6 April 2020, https://www.state.gov/whither-arms-control-in-outer-space-space-threats-space-hypocrisy-and-the-hope-of-space-norms/.

a broader scale, it is unclear that imposing restrictions on military competition in space is an acceptable solution to major space-faring States. For example, the current technological leader in space, the United States, has signalled through policy documents and its evolving doctrine that it is unwilling to forgo capability to deter and, if necessary, respond to a strong space-based challenge (for example, from China).[36] In view of that, a situation of ambiguity—like the present—might still be preferable to partial measures that undermine norms against the weaponization of space.[37] To what extent that norm is already being undermined is a tricky question, however, and one on which collective international assessment could shed light.

Approach I: Three Vectors

One distinctive approach to considering PAROS emerged during the GGE on that topic in 2018. In their oral report to the General Assembly, the GGE's Chair noted that the experts felt that any future instrument on PAROS should address three vectors for attacks: space-to-space; ground-to-space; and space-to-ground.[38] The first, space-to-space attacks, covers co-orbital vehicles and other types of technology that can threaten sensitive satellites in orbit. This includes the use of such vehicles to destroy a satellite, eavesdrop on or interfere with telecommunication signals, or inspect the physical characteristics of space objects. The second vector, ground-to-space, covers kinetic, destructive weapons such as re-purposed missile interceptors, as well as jamming capabilities. The last category, space-to-ground,

[36] See US National Space Strategy, issued 23 March 2018, noting that one of the core pillars is "peace through strength", and that "President Trump's space strategy builds on the National Security Strategy emphasizing peace through strength in the space domain", https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unveiling-america-first-national-space-strategy/.

[37] Pavel Podvig, "Weapons in Space: The Next Arms Control Challenge", presentation, Princeton University, July 2002, http://russianforces.org/pdf/Podvig-Chicago_Jul_02_Space_Arms_Control.pdf.

[38] Report by the Chair of the Group of governmental experts on further practical measures for the prevention of an arms race in outer space, 31 January 2019, p. 9.

includes technologies that are likely still a long way from being economically or operationally feasible. Systems like large tungsten rods dropped from orbit are seldom mentioned today as a viable system. These three vectors have the advantage of segmenting counterspace technologies into three distinct categories that could, in principle, be addressed independently.

States are concerned about the **space-to-space** threats posed by co-orbital vehicles. These vehicles can be versatile, having many applications across multiple missions, and may operate under benign pretexts. As such, the mere proximity of these systems can foment a perception of threat in the minds of decision makers in other States, especially if there is little available information about the object or its mission. Threat perceptions are often especially heightened if co-orbital vehicles are manoeuvred near, or used to interfere with, strategically important satellites. In the near future it is likely that there will be whole fleets of co-orbital vehicles—operated by both governments and the private sector—servicing satellites in every orbit.[39] Without increased transparency about these objects and their missions, it will be difficult to dispel perceptions about the threats these co-orbital devices might pose. States could use this framework to design specific transparency measures to build greater common understandings of co-orbital missions. They might also choose to regulate behavioural practices that would enforce appropriate distancing between satellites.

Direct-ascent missiles and ground-based electronic interference are two elements in the **ground-to-space** vector. Specifically, jamming communications between satellites and other nodes in space systems is becoming increasingly common.[40] To date,

[39] See interview with Bob Hall, technical Director of Analytical Graphics Inc.), Spacecast, "Ep. 14, LUCH Space Activities", 26 June 2019, https://www.youtube.com/watch?v=D67dg9P3eDY.

[40] See Rajeswari Pillai Rajagopalan, "Electronic and Cyber Warfare in Outer Space", UNIDIR Space Dossier File 3, May 2019,

States and commercial entities seem to tolerate jamming activities, or at least victims have not resorted to overt military or legal responses. This could indicate that jamming is not necessarily very debilitating as currently employed. However, if jamming disrupted certain strategically important space systems, such as those for detection and early-warning of missile launches, it might spark fears of an impending attack and incite a more aggressive response from those targeted. States could negotiate protected bandwidths, designating some portions of the radio spectrum to be 'off limits' to jamming and interference.

The **space-to-ground** vector is particularly difficult to address through international negotiations, most notably because these systems remain, to date, hypothetical or otherwise unproven. The usual example cited is United States space-based missile interceptors for use against surface-launched missiles.[41] After decades of research these still appear to be a long way off, and some experts have argued that space-based missile interceptors fail to make practical sense.[42] But the mere possibility of such a deployment is enough to raise concerns among numerous States.[43] It is also a reason for the United States' major strategic rivals, China and the Russian Federation, to ensure that they have ground-based ASAT capabilities as countermeasures. If, as is planned, the United States builds further space-based sensor layers to augment its missile defence capabilities, these satellites might become targets if rivals fear they undermine their capabilities to retaliate against a nuclear strike.

https://www.unidir.org/files/publications/pdfs/electronic-and-cyber-warfare-in-outer-space-en-784.pdf.

[41] https://media.defense.gov/2019/Jan/17/2002080666/-1/-1/1/2019-MISSILE-DEFENSE-REVIEW.PDF, pp. 36–37.

[42] For instance, see Pavel Podvig, "Missile defense and the myth of strategic stability: Paper prepared for the workshop on 'Stability issues in a new nuclear order'", 15–16 December 2014, http://russianforces.org/podvig/Podvig-Missile%20defense%20and%20strategic%20stability.pdf.

[43] General Assembly Resolution on Further practical measures for the prevention of an arms race in outer space (A/74/366), adopted by vote (131-6-45), preamble: "Expressing serious concern over the plans declared by certain States that include the placement of weapons, in particular strike combat systems, in outer space."

The Three Vectors framework is helpful for arranging counterspace threats in a cogent manner. It also reveals an important aspect: dual- or multi-use capabilities, especially co-orbital vehicles, are not necessarily threats to space security and stability—their destabilizing potential is based on the space objects they could target. In view of this, rather than trying to formally limit counterspace capabilities, States might use this framing as a basis on which to choose to negotiate rules and behavioural norms to guide satellite operators as they interact with certain space objects, particularly strategically sensitive ones. One recent proposal promotes non-interference principles derived from the New START Treaty.[44] Such an arrangement could be expanded to cover all satellites considered critical for strategic systems, such as command and control or guidance.

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This approach is not perfect. States may be reluctant to identify which of their satellites are strategically important. Or, conversely, they might want to designate all of their satellites as critical for strategic systems. Nor does such an approach deal with space-to-ground dimensions, although this would not obstruct parallel or subsequent efforts to do so. In the meantime, the notion of adopting rules or formal understandings in order to protect certain critical satellites could mitigate ambiguity around the deployment of counterspace capabilities.

Approach II: Threats to and from space objects

Another way of thinking about space security is to split the topic into two types of threat: to and from space objects. Technologies such as co-orbital vehicles and direct-ascent missiles

[44] Michael P. Gleason and Luc H. Riesbeck, "Noninterference with national technical means: the status quo will not survive", Aerospace Corporation Center for Space Policy and Strategy, January 2020, p. 10, https://aerospace.org/sites/default/files/2020-01/Gleason_NTM_20200114.pdf.

predominantly represent a threat to space systems in that they destroy or otherwise disrupt the function of space objects. Borrowing language from Three Vectors approach, this category includes both space-to-space threats and ground-to-space threats. The other category covers threats from space systems. This includes missiles deployed in space that can target objects on the ground or in the atmosphere. As mentioned above, although some States are concerned about these types of systems, they do not currently exist.[45] Using this to and from typology to address space systems in general terms allows States to negotiate a solution without being forced to address the specific ways that a space system operates.

Seen through the 'from–to' lens, space-based missile defence plans are at the core of PAROS concerns for some States.

Unfortunately, threats to and from space systems are strongly linked in the perceptions of some policymakers. States may be especially reluctant to formally restrict or abolish ground-based ASATs (that pose threats to space) without a simultaneous ban on the deployment of space-to-ground weapons (that pose a threat from space). Eliminating a viable counterforce capability against threats from space would artificially increase the value of space-based systems without consequential reductions in the efficacy of the threats these systems pose.

Seen through the 'from–to' lens, space-based missile defence plans are at the core of PAROS concerns for some States. In this logic, regulating threats to space objects necessitates looking at threats from space objects. As discussions to date in forums such as the CD show, some States are reluctant to publicly acknowledge this connection, or one between current, surface-based missile defence capabilities and PAROS. Nevertheless, certain experts have argued that being prepared to discuss missile defence interceptors in the context of PAROS is necessary

[45] For example, in 2019, the General Assembly passed resolution A/RES/74/34 on Further practical measures for the prevention of an arms race in outer space (131-6-45), noting in the preamble, "Expressing serious concern over the plans declared by certain States that include the placement of weapons, in particular strike combat systems, in outer space", https://undocs.org/en/A/RES/74/34.

in view of current realities. Among other benefits, such a discussion could help to build trust among States that might yield dividends in terms of their subsequent willingness to engage on strategic arms control matters.[46]

Approach III: Destructive versus Non-destructive

A third way to approach PAROS is to address counterspace capabilities in terms of their destructive potential. While the previous 'from–to' approach focuses on risks to strategic stability, this approach considers the impacts of counterspace capabilities in broader strokes, including in terms of the effects on economic and other civilian space activities that States may want to avoid.

The 2018–2019 United Nations PAROS GGE discussed this approach, distributing classes of counterspace technology on a spectrum based on their destructive potential.[47] This spectrum ranged from jamming capabilities on the least destructive end to nuclear detonations in space on the most destructive end. As noted above, there already seems to be a certain level of tolerance for jamming, perhaps because it is not permanent, and a space object can usually return to normal function once the interference ceases. This type of technology is mostly 'non-destructive' and has a limited impact on the continued accessibility and utility of orbits around the Earth (although extensive jamming might still be destabilizing). The GGE included non-nuclear technologies that destroy space objects on the more severe side of the spectrum, as these counterspace applications can create considerable debris that puts space objects and the future use of space in general at risk.

[46] See Gregory Kulacki, "China is willing to negotiate on nuclear arms, but not on Trump's terms", Defense One, 30 March 2020, https://www.defenseone.com/ideas/2020/03/china-willing-negotiate-nuclear-arms-not-trumps-terms/164204.

[47] Report by the Chair of the Group of governmental experts on further practical measures for the prevention of an arms race in outer space, 31 January 2019, p. 9.

States could apply this approach to PAROS and focus on the destructive technologies that can put more objects in space at risk, especially those raising the prospect of 'tragedy of the commons' situations, for example due to the generation of persistent space debris. There is historical precedent for this kind of changing of minds among policymakers on space-related issues. Nuclear testing beyond the atmosphere in 1962, which disabled satellites and caused electrical damage on Earth, raised concerns among both United States and Soviet policymakers about the impact of nuclear radiation on space programmes, in particular human spaceflight missions. This added new inputs to their strategic calculations and spurred momentum toward a Partial Test Ban Treaty prohibiting such tests.[48]

States could apply this approach to PAROS and focus on the destructive technologies that can put more objects in space at risk, especially those raising the prospect of 'tragedy of the commons' situations, for example due to the generation of persistent space debris.

Today, the utility of destructive ASATs is questionable in a military sense, since a belligerent would likely have to destroy many satellites during a small window of time to execute an effective ASAT attack. Sober cost–benefit analysis might illustrate that the limited value of these weapons is generally outweighed by the negative consequences for the space domain, and thus encourage States to adopt tangible measures towards effective governance of the development and use of such weapons.

One concern is that this approach does not address the issue of space-to-ground threats, although that may not be a problem because (as noted above) these do not currently exist. Space weapons systems that engage terrestrial targets are, by this definition, non-destructive in exo-atmospheric terms (that is; they do not threaten objects in space). Space-based systems that only affect ground targets are difficult to integrate into a linear spectrum that rates space-specific destructive impact. This

[48] The after-effects of the United States' Starfish Prime nuclear test in space in 1962 prompted President John F. Kennedy to become concerned about the radiation effects of these tests on human space flight; see James Clay Moltz, *The Politics of Space Security: Strategic Restraint and The Pursuit Of National Interests*, Stanford Security Studies, 2008.

characteristic makes it more difficult (if not impossible) to include space-to-ground systems in any agreement resulting from this approach. The absence of space-to-ground systems from an agreement could strengthen some States' determinations to have ground-based ASATs as insurance against future space-based threats. Nevertheless, this approach could stimulate progress towards a moratorium on testing of kinetic ASATs that generate debris.

5. CONCLUDING THOUGHTS

It is evident that the development of counterspace technologies and dedicated military space units are part of a broader strategic competition taking place on Earth.

This paper has examined how the PAROS debate emerged and developed, and what it is variously understood to mean today. It is evident that the development of counterspace technologies and dedicated military space units are part of a broader strategic competition taking place on Earth. States are investing in quantitative and qualitative improvements to military functions, and outer space is an additional domain in which some seek to gain—or retain—an advantage over their rivals or future challengers. Competing States are more overtly seeking the means to utilize or neutralize this advantage. As such, it makes little sense to speak of an arms race in outer space isolated from broader strategic developments, as it is an extension of strategic dynamics on Earth.

Progress on PAROS is likely to remain limited until there is progress in the strategic relationships between major competitors such as China, the Russian Federation and the United States. All three are developing technologies that will increasingly impact both the space domain and international stability on Earth. Currently, these relationships are fraught and strategic arms control is fast approaching a crossroads. The United States has indicated, for example, that it wants China to be part of negotiations on various strategic systems in the context of New START, the last remaining nuclear arms control agreement between the United States and the Russian Federation. That desire is not currently reciprocated.[49]

New opportunities for progress on PAROS might nevertheless emerge in the broader arms control efforts between these three States. Their future arms control agreements could address counterspace capabilities alongside relevant strategic capabilities such as nuclear force structures and other strategic systems.

[49] "China Rejects Trump's Renewed Offer to Join Trilateral Arms Control Talks With US, Russia", Sputnik News, 6 March 2020, https://sptnkne.ws/BArj.

Many space systems are inextricably linked to strategic nuclear missions and could be wrapped within arms control agreements that address broader strategic systems. If such agreements were achieved, China, the Russian Federation, and the United States would have incentive to promote broader international efforts to regulate counterspace capabilities. After all, other States, including France, India and Japan, are now pursuing such capabilities as well. These PAROS-related approaches could be negotiated in plurilateral or ad hoc forums if the traditional forums like the CD remain moribund.

The perspectives on PAROS discussed in this paper would also be relevant in those processes. These perspectives suggest specific confidence-building and transparency measures that could be of value, whether at the bilateral, plurilateral or multilateral level. The Three Vectors approach discussed in this paper demonstrates that greater transparency and codified rules of engagement could significantly reduce ambiguity about operations near or directed at strategically sensitive satellites. The second approach, which addresses threats to and from space systems, draws into relief the relationship between missile defence and counterspace capabilities, which could serve as a starting point for discussions on arms control. And finally, considering destructive versus non-destructive weapons could be a way to find an area of mutual interest for all, including among strategic actors, that could lead to agreements not to test or deploy certain capabilities—perhaps on a no-first-use basis. Although none of these approaches address concerns about an arms race in outer space in the round, they could at least serve to refresh discussions on PAROS and offer new ways out of current dead-locked debates.

While the possibility of preventing an all-out arms race in outer space may be slipping away, it is not gone. Faced with increasing militarization and tests of counterspace capabilities, States should focus on accurately defining the purpose of the PAROS debate and shaping it in such a way that allows the international community to appropriately regulate military competition in and

through space. To this end, while the States engaged in the PAROS debate may not have an opportunity to preclude an arms race entirely, PAROS-related agreements could still prevent some of the negative impacts of arms racing behaviour.

Alternative Approaches and Indicators for **the Prevention of an Arms Race in Outer Space**

Recent space-related military developments suggest that the guiding paradigm over the last four decades for space security talks—prevention of an arms race in outer space (PAROS)—is fast being overtaken by events. There are indications that intensifying competition in counterspace capabilities fits an arms race dynamic. This paper looks at the origins of the PAROS debate and how it has evolved, and suggests limited, practical PAROS-related steps to help to dampen destabilizing arms race dynamics.

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