SPACE: EXPLORING NATO'S FINAL FRONTIER

EDITED BY

NICOLÒ FASOLA

SONIA LUCARELLI

ALESSANDRO MARRONE

MARIA VITTORIA MASSARIN

FRANCESCO N. MORO

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"Space: Exploring NATO's Final Frontier"

Editors: Nicolò Fasola; Sonia Lucarelli; Alessandro Marrone; Maria Vittoria Massarin and Francesco Niccolò Moro.

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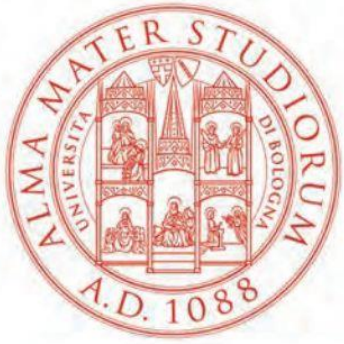

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EXECUTIVE SUMMARY

Space has recently gained a position of crucial significance for the security of the Euro-Atlantic region. In 2022, NATO's Strategic Concept duly acknowledged this reality, integrating it as an operational domain into the Alliance's deterrence and defence posture. As this environment is becoming increasingly contested, congested and competitive, the Alliance is faced with more challenges than in the past. In fact, space has the potential to significantly enhance a state's ability to anticipate or respond to threats more effectively. Space cooperation among NATO member states is essential to address the evolving challenges posed by the possible military activities in space. This cooperation is centred on three key elements: multi-purpose applications of space; a rising number of actors, sensors and systems; and rapid advances in technology. These elements have created new opportunities while also introducing new risks, vulnerabilities and threats to the security and prosperity of allies. This calls for NATO to critically evaluate how it can maintain its strategic edge in space in the same manner as it does in the other four interconnected operational domains, in response to the growing importance of space in modern warfare. A more united approach to addressing the challenges posed by military operations in space should be fostered as cooperation could serve as a powerful means to deter potential adversaries, safeguard allied space assets, and gain an operational advantage in this critical domain. Three key aspects of space in relation to NATO's policies and stance are tackled in this publication: the global space context and the development of a NATO posture in space; the Alliance's space capabilities and decision-making; and space threats and their implications for NATO's deterrence and defence.

The global space context and NATO's posture in space. The increasing use of space services and technologies has brought about a host of benefits to societies worldwide. However, this domain has undergone a significant transformation in recent years, with more countries and non-state actors acting on orbits. This has led to a growing commercialization and privatization of space which also raised concerns about the security and the potential for armed conflict in outer space. Alongside this, the return of great power rivalry and the integration of space in military operations have added a layer of complexity to space security dynamics. NATO has recognized the salience of this domain in support of its missions and operations and has made strides towards addressing emerging challenges and opportunities but has yet to fully integrate it into its overall strategy and doctrine. While individual member states have taken steps to strengthen their space capabilities, there is a lack of coherence and coordination across the Alliance. This gap is evident in NATO's limited understanding of the normative framework governing space activities, the lack of clarity on the applicability of Article 5 to space threats, and the challenges in bridging the gaps among allies and with Partners.

Furthermore, the development of counterspace capabilities by major powers poses threats to the sustainable use of space and contributes to a security dilemma in space between the United States and China. However, China's overall behaviour in space has not yet openly challenged established international norms and principles. To best ensure space security, NATO needs to consider space situational awareness capabilities, collective threat assessment processes, and resilience measures. Cooperating with Partners, engaging in arms control and space diplomacy, contributing to the norms of responsible behaviour in space, and fostering strategic dialogue with potential adversaries is also of paramount importance.

As counterspace capabilities advance, the need for effective governance mechanisms to regulate space activities and maintain a safe, secure and sustainable environment becomes more pressing. The current global framework for space security is fragmented and inadequate to address the emerging threats and risks. The absence of a solid international legal framework for regulating space activities creates a complex and uncertain environment. In addition to the challenges posed by counterspace capabilities, increasing geopolitical tensions and the evolution of the space landscape complicate the issue along with the war in Ukraine, which has further highlighted the need for international cooperation on space security. Despite these challenges, there is an evident global consensus on the need to protect outer space and ensure its peaceful use. NATO should strive to harmonize terminology and principles of behaviour related to space activities. Strengthening cooperation with the European Union on space matters is crucial, as is addressing the entanglement of civilian and military space capabilities. Lastly, NATO should ensure adequate resources and mechanisms for sharing space-related information. To maintain its relevance in a rapidly changing security environment, NATO should further develop a dedicated space strategy. By better outlining the Alliance's interests in space and identifying mechanisms for collective action in space to address emerging threats and maintain its collective defence posture, it is also necessary to address the need for adequate resources, subject matter specialists and transparency, thus developing a coherent and sustainable space posture.

NATO's space capabilities and decision-making. Space undoubtedly presents an additional area of attack in multiple ways: ground station attacks and cyber warfare are some of the easiest ways through which a potentially hostile actor could threaten or disrupt space services. More sophisticated attacks include challenges through the electromagnetic spectrum and even kinetic actions such as the use of anti-satellite capabilities. While the latter is yet unprecedented, albeit tested by Russia and China on their own assets, it is critical that NATO decides at the political level what an appropriate response to a range of threats might look like. On a technical level, it is important that there are space situational awareness (SSA) capabilities in place to support the collective threat assessment process that will have to occur should space assets in operation for NATO be under threat. The resilience of space systems and the strengthening of redundancy in the system – perhaps through burden-sharing among allies or with the tie-in of commercial partners – will also be essential for future operations. In parallel, the Alliance is encouraging the development of dual-use capabilities and diversifying those developed by its members, as well as working to improve its overall understanding of space and to ensure that it has the required workforce to deal with an increasing role of space in its activities.

NATO declared that an attack against a member state's space systems could lead to the invocation of Article 5 of the North Atlantic Treaty. This is a clear example of the increasing importance of this domain for military operations. The different space capabilities to support allied militaries range from Earth observation to early warning, from ensuring secure Satellite Communications (SatCom) to making use of the already existing position, navigation, and timing (PNT) systems. The Alliance relies on a few member states to provide space capabilities such as SatCom and space-based remote sensing. This raises questions about how these capabilities will be integrated and, ultimately, become compatible with other members' capabilities.

Forthcoming challenges include a high level of coordination and integrated planning to create consistent information sharing and compatibility to better protect assets. Space integration should be, indeed, a crucial aspect of NATO's overall space strategy, as it plays an increasingly important role in the Alliance's operational effectiveness. To achieve seamless integration of space capabilities into NATO's multi-domain operations and leverage them effectively, two key aspects need to be addressed, namely: interoperability and the fostering

of partnerships. Efforts have been directed towards improving NATO's interoperability and data-sharing and should be increased.

Space threats and NATO's deterrence and defence. The growing great power competition in this domain is among the major causes of an increasing centrality of space in contemporary warfare, underscoring the role of private actors in space operations and the need for NATO to effectively engage with them. Divergent national approaches have been further amplified in space security discussions as space systems are vulnerable to attack or interference through a wide range of counterspace capabilities. Experts have documented the rise in development and testing of these capabilities in recent years, highlighting that they are no longer being developed by traditional space powers only, but are now pursued by a number of different actors. As a result, states' threat perceptions and priorities for regulation vary.

NATO has a major role to play in enhancing resiliency, interoperability and redundancy, and it will need to engage formally with the EU on all fronts of its work in space. Through the development of a more comprehensive and integrated approach to space security, the Alliance should focus on coordinating its members' activities, enhancing its capabilities, and cooperating with other partners in order to deter adversaries and defend its interests in space. A priority for NATO should be bringing all its members up to speed with the United States and the EU in particular, but also a few other larger members, and their space capabilities so that every allied contribution fits seamlessly into the Alliance's shared space architecture.

The rise in hybrid warfare and rapid technological developments, including in outer space, has significant impacts on cross-domain interactions. Threats to space systems are not explicitly regulated under the existing legal framework for space activities. This limited regulation and decades-long deadlock at the UN Conference on Disarmament has sparked several attempts to move multilateral discussions forward. The UN Open-ended Working Group on reducing space threats was convened under the UN General Assembly in 2022 and 2023 to assess the existing international legal framework, explore threats to space systems, and propose recommendations for norms, rules, and responsible behaviour in outer space. While the working group ultimately failed to achieve consensus, it nonetheless served as a valuable platform for fostering dialogue and exchanging perspectives among diverse stakeholders from around the world.

The space elements of general deterrent postures cannot be separated from the space elements of collective defence operational plans, as solid warfighting capabilities enhance the credibility of deterrence. To deter space threats, the Alliance can undertake steps to strengthen its defence posture in the space domain, which will require evolving strategic thinking toward a holistic approach. A comprehensive NATO doctrine that outlines its approach to space deterrence and defence should address issues such as the role of this domain in NATO's overall strategy, the use of space-based assets for deterrence, and the response to attacks against allied assets in orbits. Three pivotal areas requiring focused attention have been identified: decision-making processes, information sharing, and interoperability.

In the end, space somehow represents NATO's ultimate frontier, and the Atlantic Alliance still has a long way to go in order to effectively secure this frontier for its members by contributing to international security and stability.

INTRODUCTION

Sonia Lucarelli, Alessandro Marrone and Francesco N. Moro[1]

The 2023 Academic Conference, held in Bertinoro on 8-10 November, brought together over 60 practitioners and experts to delve into the intricate relationship between space, international security, and NATO. The significance of addressing this topic was underscored by the evolving dynamics of global security, where space has become a critical domain for military operations and strategic competition.

Against the backdrop of a rapidly changing space landscape, the first Working Group (WG) adopted a comprehensive approach, analysing the global space context and the development of NATO's posture in space. It scrutinised the international legal framework, encompassing initiatives within the UN, and examined the roles of major non-allied countries, such as China. The WG delved into strategic considerations for framing a NATO posture, giving due consideration to the pivotal role of space powers within the Alliance, particularly the United States.

The second WG focused on space capabilities and NATO decision-making, with a specific focus on space situational awareness (SSA) and the use of space assets in support of military operations and political decisions. Discussions encompassed data acquisition and sharing, relevant technological developments, the expanding role of the private sector, and related opportunities for the Alliance. The WG also explored best practices and capabilities developed by the European Union (EU) and the advantages of NATO-EU cooperation in this field.

The third WG addressed space threats and their implications for NATO's deterrence and defence. Aligned with the 2022 Strategic Concept, which envisages full integration of the space domain into the Alliance's

[1] Sonia Lucarelli is Professor of International Relations and European Security at the University of Bologna, and member of the Board of Directors of the Istituto Affari Internazionali (IAI). Alessandro Marrone is Head of the Defence Program of IAI and teaches at the Istituto Superiore di Stato Maggiore Interforze (ISSMI) of the Italian Ministry of Defence. Francesco N. Moro is Associate Professor of Political Science at the University of Bologna and Adjunct Professor of International Relations at the Johns Hopkins University Europe Campus.

deterrence and defence posture, the WG examined the application of established military principles and concepts to space. Recognising the unique challenges posed by space assets and operations, the WG explored options for the Alliance in safeguarding its interests in this increasingly vital domain.

Accordingly, the publication is structured in three sections. Each section is devoted to a specific WG and includes the two papers that framed the discussion, as well as a report summarising the subsequent debate, held under Chatham House rules.

As with the previous publications resulting from Academic Conferences jointly organised by NATO Allied Command Transformation (ACT), University of Bologna and Istituto Affari Internazionali (IAI), this report is meant to provide readers with a thought-provoking compilation of views, fostering intellectual exchange between policy-making and academic communities, and advancing the international debate on these critical topics

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WORKING GROUP

I

EXISTING INTERNATIONAL GOVERNANCE, CURRENT MULTILATERAL EFFORTS AND CONTEMPORARY SPACE SECURITY DEVELOPMENTS AND TRENDS

Sarah Erickson - United Nations Institute for Disarmament Research

Introduction

Outer space services and technologies have made an unequivocal impact on modern civilization. Space-based services are crucial for both civilian and military operations and support activity in a variety of sectors such as economics, agriculture, education, health, etc. As technological prowess advances the benefits received from space assets, so it presents challenges for maintaining current and adequate governance mechanisms for regulation and maintaining a secure space environment in light of counter-space technologies and developments.

Global trends such as increasing military competition in space, the development, testing and use of counterspace capabilities, the recognition by some of outer space as an operational military domain, increasing military expenditure, and offensive simulations or wargaming exercises threaten the sustained use of outer space for peaceful purposes. Furthermore, intensifying geopolitical tensions, multipolar rivalries seeking space superiority and an evolution in the number and make-up of space actors has led to an escalatory space environment on the risk of experiencing armed conflict. The current international framework to govern and secure space from such threats and risks is fragmented and deficient in negating the possibility for space to become a theatre for conflict.

This paper seeks to first provide a critical synthesis of the existing international governance framework. It explains in which way the current one insufficiently ensures a secure space domain but also provides insight into how that framework serves as a basis that can be further developed, explored and strengthened. The paper also presents an overview of ongoing processes and efforts that are taking place, namely within the United Nations, to work towards achieving a comprehensive international regime on issues of space security and how the international community interacts with current proposals and governance ideas. Finally, the paper provides an analysis of other ongoing global developments and trends in the field of space security, including counterspace capabilities, domestic and regional defence policies and space security strategies, and military restructures for the creation of designated space forces within national armed forces. The overall aim of this paper is to provide updated and timely context into global space security governance trends in order to inform effective future efforts of space governance that contribute to a more secure and sustainable outer space environment.

Existing International Mechanisms for Space Security[1]

[1] This subsection is not an exhaustive illustration of current existing governance mechanisms applicable to space security, but rather an outline of select key initiatives. For a more comprehensive analysis of the existing legal and

The international outer space governance framework comprises several different mechanisms. International Disarmament Law and agreements, including examples such as the Limited Nuclear Test Ban Treaty, Convention on The Prohibition of Military or Any Hostile Use of Environmental Modification Techniques (ENMOD), Missile Technology Control Regime (MTCR), and The Hague Code of Conduct against Ballistic Missile Proliferation (HCOC), explicitly regulate activities in outer space even when the agreements themselves may not concern solely the space environment. Laws on the use of force, including the UN charter and International Humanitarian Law, are of value when assessing threats emerging from space activities and in the event armed conflict arises in space. Aviation Law, the Law of the Sea, and the Antarctic Treaty serve as useful guidance resources, and their respective legal regimes have served to inform the interpretation of Outer Space Law. Many of these initiatives contribute to ensuring a more secure and stable space environment. However, despite the body of international law and governance initiatives applicable to space, there remains the possibility and concern that outer space could become a theatre for conflict, wherein terrestrial wars proliferate into space.

Out of the five treaties negotiated to govern space activity,[2] the Outer Space Treaty contains explicit security and arms control measures. For example, under Article III it requires:

> "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with International Law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding".

Hence the article refers to specific security implications such as the applicability of Article II paragraph 4 of the UN Charter on the Threat or Use of Force, which stipulates that "all Members shall refrain in their international relations from the Threat or Use of Force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the Purposes of the United Nations". Yet the same reference also extends to Article 41 of the UN Charter,[3] under which it stipulates that partial or complete interruption of communication does not constitute use of force. The UN Charter does not provide a definition for the use of force, it does, however, provide a constraint on what constitutes use of force. Under such constraints, counterspace activity, which could lead to partial or complete interruption of communications, including by certain cyber, electronic and other non-kinetic means, exists in a grey zone without clear limitation or prohibition of their use (Shull & Aganaba, 2023).

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regulatory space framework *see* UNIDIR (2022). "Existing Legal and Regulatory Frameworks concerning threats arising from State behaviors with respect to outer space", UN Doc A/AC.294/2022/WP.1.

[2] The five UN treaties are:

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

[3] Article 41 of the UN Charter states: "The Security Council may decide what measures not involving the use of armed force are to be employed to give effect to its decisions, and it may call upon the Members of the United Nations to apply such measures. These may include complete or partial interruption of economic relations and of rail, sea, air, postal, telegraphic, radio, and other means of communication, and the severance of diplomatic relations".

Additional explicit security considerations are included in the Outer Space Treaty under Article IV wherein it states that "States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner". Furthermore, Article IV outlines the following:

> "The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited".

We see that Article IV establishes clear parameters on the prohibition of placing Weapons of Mass Destruction (WMD), including nuclear weapons, in orbit around the Earth, on celestial bodies, or stationing them in any other manner. However, this prohibition is specific to only WMDs. The extent to which other types of weapons are prohibited is limited only to their testing on celestial bodies. The development, placement, stationing, and use of counterspace capabilities which do not fall under the umbrella of WMDs remain permissible, including their testing anywhere but on celestial bodies.

Other measures within the Outer Space Treaty and subsequent UN treaties, while not completely solving the issues, provide useful mechanisms and principles that can contribute to a more stable and predictable space environment. For example, Article IX of the Outer Space Treaty starts with the obligation of States to conduct their space activities "with due regard to the corresponding interests of all other States Parties to the Treaty". In addition to this duty of due regard, Article IX lays out three more obligations for States Parties to pursue in their conduct and exploration in outer space: avoid harmful contamination of outer space, avoid adverse changes in the Earth's environment resulting from the introduction of extraterrestrial matter, and undertake appropriate international consultations if a State has reason to believe its space activities would cause potentially harmful interference in the peaceful exploration and use of outer space by another State (Goehring, 2020). Additionally, Article IX contains the legal right of a State party to the treaty to request consultation if it has reason to believe the space activities of another State would cause potentially harmful interference to its own peaceful exploration and use of outer space. Despite the existence of these mechanisms, there is no established State practice implementing them (Listner, 2022: 28-32). That is to say, the principle of due regard is theoretically an enforceable international legal obligation in space and a State could breach this obligation, constituting an internationally wrongful act (Goehring, 2022). Yet, in practice, States have not invoked Article IX for the principle of due regard and, as Goehring concludes, this may be because without a clear meaning of due regard it is difficult to know when it has been breached. Furthermore, States have not invoked their right for consultation as prescribed under Article IX. This is not to say that States are not actively exploring the principle of due regard further or its implementation.

The Republic of the Philippines, within the work of the recently concluded UN Open-ended Working Group (OEWG) on reducing space threats through principles, rules and responsible behaviours, proposed in the first session that the duty of due regard could serve as a principle of responsible behaviour in space and offered interpretations of its application (Republic of the Philippines, 2022). The proposition received considerable attention and throughout the OEWG process, States including Japan, the Republic of Korea, Austria, Brazil, and France called for the clarification of due regard to inform space activities and highlighted the importance

of compliance of due regard. China noted the divergence of interpretation of due regard. 34 States in a joint working paper to the last session of the OEWG included, among several other points, the importance to conduct space activities with due regard to the corresponding rights and interests of other States, and the chairperson in their summary included the point that Article IX and the principle of due regard should be further discussed. It is evident that further exploration of due regard and its meaning and applicability will continue, and States may in the future establish State practice of its implementation leading to it being customary international law and facilitating a more transparent and predictable space environment.

Similarly, other provisions in the Outer Space Treaty can foster trust and transparency in space. For example, according to Article XI of the Outer Space Treaty, States Parties agree to inform the Secretary-General of the UN as well as the public and the international scientific community of the nature, conduct, locations, and results of their outer space activity. Currently, the UN Office for Outer Space Affairs maintains a registry of State activity submitted under Article XI. However, it is seldom utilized, with only 25 information submissions in the last five years.[4] In connection to this, the Outer Space Treaty also contains the concept of "State of registry" in Article VIII. This concept was further developed in the Registration Convention, which requires the following:

> "When a space object is launched into earth orbit or beyond, the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary-General of the United Nations of the establishment of such a registry".

Furthermore, the Registration Convention under Article III stipulates that the Secretary-General shall ensure "full and open access" to the register with such information. However, there is no specific time requirement for the registry except for what is "as soon as practicable", and, beyond few specific information criteria,[5] the launching State determines the contents of each registry and the conditions under which it is maintained. States can, therefore, take it upon themselves to pursue good practices of timely and consistent registration with as much relevant information as possible to preclude misinterpretation about their space activity, utilizing existing mechanisms such as the Registration Convention and Article XI of the Outer Space Treaty. To further promote the applicability of the aforementioned provisions and mechanisms, a first important step would be to universalize relevant UN treaties by encouraging all States to sign and ratify them, especially given the fact that none of the five UN treaties governing space activity enjoy universal adherence and ratifications. As an interim step, States who have not ratified corresponding treaties still have the ability to

[4] The data provided considers registries up until December 05, 2023. Registries can be viewed on the UN Office for Outer Space Affairs Index of Submission by States under Article XI 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.

[5] The specific information requirements outlined in the Registration Convention Article IV section 1 are as follows:

a) name of launching State or States;
b) an appropriate designator of the space object or its registration number;
c) date and territory or location of launch;
d) basic orbital parameters, including:
    i. nodal period;
    ii. inclination;
    iii. apogee;
    iv. perigee;
e) general function of the space object.

submit information to the Registration Convention, in accordance with UN General Assembly Resolution 1721 (XVI) International Co-operation in the Peaceful Uses of Outer Space.

It is not only legally binding mechanisms that play a significant role in ensuring continued access to outer space. Under the auspices of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), two sets of voluntary guidelines have been established. The Space Debris Mitigation Guidelines were endorsed by the UN in 2007 and provide relevant applicability to security discussions especially as seen through guideline 4: "Avoid intentional destruction and other harmful activities" (United Nations Office for Outer Space Affairs, 2007). Additionally, the Guidelines for the Long-term Sustainability of Outer Space Activities (LTS), endorsed in 2018, also are relevant to space security discussions through guidelines such as A.4 paragraph 3, wherein it states: "Consistent with the purpose of Article 45 of the ITU Constitution, States and international intergovernmental organizations should ensure that their space activities are conducted in such a manner as not to cause harmful interference with the reception and transmission of radio signals related to the space activities of other States and international intergovernmental organizations, as one of the means of promoting the long-term sustainability of outer space activities" (United Nations Office for Outer Space Affairs, 2018). The implementation of these guidelines is dependent on a State's ability, will, and capacity to implement, update, and review their national governance according to the proposed Guidelines and States may report their implementation overview and approach of the LTS Guidelines to COPUOS. The adoption of both guidelines has made space sustainability a more salient topic, orientating more national space strategies to consider the principle of sustainability as one of their overarching priorities (Erickson and Azcárate Ortega, 2023).

Given the nature of space activity, in particular space launches and how they directly correspond to concerns over the use and proliferation of missiles, there exist voluntary international agreements to restrict the proliferation of both missiles and transfer risks associated with dual-use technology and information within the space sector. Such multilateral initiatives include the Hague Code of Conduct against Ballistic Missile Proliferation, the MTCR, and the Wassenaar Arrangement. The MTCR and Wassenaar Arrangement strengthen international security through the voluntary commitment of applying domestic export controls to sensitive dual-use technologies. These initiatives also facilitate communication and transparency by (a) providing pre-launch notifications on ballistic missile and space-launch vehicle launches and test flights and submitting an annual declaration of State policy on ballistic missiles and space-launch vehicles (HCOC, 2020); (b) exchanging information through regular meetings and conducting outreach (MTCR, 2023); and (c) reporting on arms transfers and transfers or denials of certain dual-use goods and technologies to destinations outside the Wassenaar Arrangement on a six-monthly basis and maintaining a national point of contacts structure for information requests and exchange (Wassenaar Arrangement, 2022).

Current Efforts towards Space Security within the United Nations

Within the UN framework, space governance issues are discussed within the COPUOS of the UN Office for Outer Space Affairs, the *Conference on Disarmament, the Disarmament Commission*, and the *First* and Fourth Committees of the UN General Assembly (italics indicates which groups have security focused discussions). The concept of Prevention of an Arms Race in Outer Space (PAROS) was introduced in 1978 at the General Assembly's Tenth Special Session on Disarmament. Since then, it has evolved into an umbrella concept under which space security discussions at the UN are framed and contextualized, including topics such as the prevention of placement of weapons in outer space and reducing space threats through norms, rules and

principles of responsible behaviour. The Conference on Disarmament regularly adopts PAROS as an agenda item with the aim of creating a legally binding instrument on it. However, negotiations on a treaty have been stagnant, with only a draft Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects[6] submitted by Russia and China that has not received consensus support.

The most recent process that concluded was the OWEG on reducing space threats through norms, rules and principles of responsible behaviour. A UN Open-ended Working Group is an inter-governmental process in which discussions on the prescribed mandate are open to all UN Member and Observer States, intergovernmental organizations, and non-governmental organizations with ECOSOC consultative status to attend the public meetings of the working group, while the negotiation and decision making are exclusive prerogatives of Member States. The OEWG on reducing space threats was convened by Resolution 76/231, adopted in December 2021. Resolution 76/231 called for an open-ended group to convene over four meeting periods in the span of two years starting in 2022 with the following mandate:

a) To take stock of the existing international legal and other normative frameworks concerning threats arising from State behaviours with respect to outer space;

b) To consider current and future threats by States to space systems, and actions, activities, and omissions that could be considered irresponsible;

c) To make recommendations on possible norms, rules and principles of responsible behaviours relating to threats by States to space systems, including, as appropriate, how they would contribute to the negotiation of legally binding instruments, including on the prevention of an arms race in outer space;

d) To submit a report to the General Assembly at its seventy-eighth session.

In addition to being open to all UN Member States, the OEWG allowed participation by non-governmental stakeholders from academic, civil society, and industry sectors, making it an open and inclusive approach to address issues of threats to space systems. The OEWG also brought non-legally binding and normative approaches together, allowing for a greater understanding on the complementarity between both approaches, which had previously been regarded by some as incompatible (Azcárate Ortega & Lagos Koller, 2023). The first session was dedicated to taking stock of the existing legal and normative framework applicable to outer space, in which States were able to largely agree on reaffirming the applicability of international law to outer space, including the UN Charter, customary international law, and treaties to which States are a party. However, initial discrepancies between perspectives on the discussion of International Humanitarian Law (IHL) appeared, where some States held the position that affirming the applicability of IHL, also known as the Law of Armed Conflict, was premature and counterproductive to discussions aimed at ensuring space be kept free from conflict. Other States explained that because Article III of the Outer Space Treaty states that outer space activities shall be undertaken according to international law, this inherently includes IHL.

The second OEWG session was dedicated to identifying threats to space systems and actions which could be considered irresponsible —e.g., ground-based anti-ballistic missile systems and anti-satellite (ASAT) missile

[6] The draft Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects was submitted by Russia and China in 2008, with a further revised version submitted in 2014. It can be found under UN document number CD/1839.

tests; space-based antiballistic missile systems or missile interceptors; co-orbital ASATs; directed energy capabilities; cyber and electronic interference; the destruction or damage of space objects; the disruption or interference with normal functioning of a space object; use of space objects to destroy other objects; uncooperative *rendezvous* and proximity operations (RPO); interference with civilian-critical infrastructure or military command-and-control capabilities (West, 2023a). As States positively contributed to their perceived threats, so did some States voice concern and opposition to the idea of using responsible and irresponsible as a labelling system for space activity. The case was made that the taxonomy of responsible versus irresponsible introduced yet another set of terms that would have to be defined and universally understood, and there were concerns over how in practice such a taxonomy could be politicized.

The third session was dedicated to making recommendations on possible norms, rules and principles of responsible behaviours including as appropriate how they could contribute to a legally binding mechanism. Of the many recommendations that were made by States some include: conducting space activity with due regard for others in accordance with the Article IX of the Outer Space Treaty; information sharing; not causing physical damage or harmful interference to space systems; establishing domestic frameworks to govern non-State space actors and ensure compliance with international law; refrain from conducting activity that would interfere, disrupt, or impair critical civilian infrastructure and services; commit not to use or threaten force against space objects, seek hegemony, or adopt aggressive rhetoric or doctrines for outer space; commit not to develop, test, deploy, or use weapons in, towards, or from outer space; and not preclude the right of any State to access, use and benefit from outer space (West, 2023b).

The OEWG concluded with the fourth session ending September 1, 2023. Despite the robust and active discussions that took place throughout the previous sessions, the OEWG did not produce a final report, nor was it even able to produce a procedural report. States had discovered diverging perspectives on topics such as IHL and the meaning and application of the term "responsible" to space activities, but ultimately one State led the block on consensus. The reasoning was the belief that the OEWG processes and the responsible behaviours approach had served to drive States further apart on issues and further away from the task of negotiating a legally binding treaty. In spite of this outcome, it was clear that the process invigorated multilateral discussions on space security and influenced convergence on many issues. Notably, within the final session, a working paper on a cross-regional initiative in support of the OEWG was submitted by 34 States.[7] This working paper was an important outcome because it showcased that a significant and diverse coalition of States agreed that the OEWG was constructive to the goal of PAROS and complementary to other processes and approaches. The idea that political commitments on responsible behaviours can be developed in support of, and without prejudice to, the pursuit of legally binding measures and that the two approaches are not mutually exclusive was further strengthened in a concluding joint statement delivered on behalf of 39 States was in the closing plenary of the OEWG.[8] The ability of the OEWG to foster such a diverse coalition

[7] The working paper in support of the OEWG at the final session was delivered on behalf of: Argentina, Australia, Austria, Belgium, Brazil, Canada, Cambodia, Chile, Colombia, Costa Rica, Denmark, Ecuador, El Salvador, Ireland, Italy, Finland, Germany, Japan, Malawi, Mexico, the Netherlands, New Zealand, Nigeria, Norway, Panama, Peru, Philippines, the Republic of Korea, Singapore, Sierra Leone, Spain, Sweden, Switzerland, Uruguay. It can be found under UN document number A/AC.294/2023/WP.21.

[8] The joint concluding statement was delivered on behalf of: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Costa Rica, Colombia, Czech Republic, Denmark, Ecuador, El Salvador, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Malawi, Mexico, the Netherlands, New Zealand, Nigeria, Norway, Panama, Peru, Philippines, Portugal, the Republic of Korea, Samoa, Singapore, Spain, Sweden, Switzerland, the United Kingdom, Uruguay.

of States in support of a mutually reinforcing approach towards space security goals, demonstrated the importance of the process in and of itself.

The current process taking place is the Group of Governmental Experts (GGE) on further practical measures for the prevention of an arms race in outer space. A Group of Governmental Experts is a closed process wherein Member States nominate a government Expert to conduct informal deliberations on a mandated topic in their personal capacity. Up to 25 Experts are then chosen for a GGE on the basis of fair and equitable geographical representation. The current GGE was convened in 2022 by Resolution 77/250, which mandates the Group to consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space. This Resolution passed with a vote of 115 in favour, 47 abstaining, and seven against. The first session of the GGE took place from November 20 to December 1, 2023. The intersessional meeting will take place February 29 through March 01, 2024, and will be open for the participation of all Member States as well as non-governmental entities. It will be important to see how discussions from the recent OEWG impact the GGE, and whether recommendations for rules, principles and responsible behaviours, which were expressed in the OEWG, feed directly into the GGE.

In addition to the current GGE, the UN First Committee adopted in October 2023, two Resolutions which establish the creation of two new OEWG processes. One is Resolution A/C.1/78/L.55 which establishes an OEWG to take place from 2024-2028 to consider and to make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, *inter alia*, on the prevention of the placement of weapons in outer space, as well as to consider various aspects of the prevention of an arms race in outer space in the context of an international legally binding instrument on the prevention of an arms race in outer space. The other Resolution is A/C.1/78/L.15/Rev.1 which establishes an OEWG to take place from 2025-2026 to make recommendations on the prevention of an arms race in outer space through the development of norms, rules and principles of responsible behaviours in specified areas[9] and to consider how the implementation of norms, rules and principles of responsible behaviours could be monitored and verified, including through the provision of capacity-building, cooperation on space situational awareness and the possible establishment of a mechanism for inter-state coordination and consultation on matters pertaining to space security, and how they would contribute to the negotiation of legally binding instruments, including on the prevention of an arms race in outer space. From these resolutions, it is clear that the international community has a roadmap through 2028 to continue discussions on preventing an arms race in outer space and more broadly ensuring the peace and security of outer space. It will be critical for States to bridge the gap between approaches and find a complementary solution, inclusive of all threat perceptions, in order to achieve such goals.

In addition to established fora and ad hoc processes, the UN General Assembly adopts several annual resolutions concerning space security including: Prevention of an arms race in outer space (Res. 77/40); No First Placement of Weapons in Outer Space (Res. 77/42); Further Practical Measures for the Prevention of an Arms Race in Outer Space (Res. 77/250); and Transparency and Confidence-building Measures in Outer Space Activities (Res. 77/251). In 2022, Resolution 77/41 on Destructive direct-ascent anti-satellite missile testing

[9] The mandate of the Group will consider norms, rules and principles of responsible behaviors in the following areas: (a) intentional damage to and destruction of space systems; (b) threats to the safe operation of space objects; (c) rendezvous operations and proximity operations that could increase the risk of misunderstanding and miscalculation; (d) protecting critical space-based services to civilians as well as services that support humanitarian operations; (e) other activities and measures that could reduce the risk of unintended escalation and conflict.

was also adopted and passed with 155 votes in favour, nine abstaining, and nine against. This Resolution was initiated by the United States based on its unilateral commitment not to conduct destructive direct-ascent ASAT missile tests (The White House, 2022). Up to date, 37 countries have also made the political commitment. The number has recently risen after the European Union ahead of the final session of the OEWG released a statement in which EU Member States commit not to conduct such tests. Similarly, annual Resolution 77/42 is a political commitment to not be the first to place weapons in outer space and has been made by 33 States.

Global Space Security Developments and Policy Trends

Never before has space played such a critical role in our civilization for carrying out both civilian and military functions. This growing dependence on space-enabled services will only continue as more States and people benefit from space technology. Furthermore, the current war in Ukraine has further demonstrated the utility of space assets in terrestrial armed conflict. On the one hand, the increased recognition of essential functions that space-enabled services provide to critical infrastructure and military operations compel States to ensure the protection of their space assets. On the other hand, the strategic value of space assets is also the driver for developing counterspace capabilities in the pursuit of national security interests.

There are useful open-source information resources maintained and created by different civil society organizations, which track global counterspace capabilities development. One such resource is the Secure World Foundation's Counterspace Capabilities Report which since 2019 has grown from featuring six States to eleven, nearly doubling in the span of five years.[10] Moreover, the 2023 assessment shows four out of the eleven States having used at least electronic counterspace capabilities in conflict and reports an increasing number of incidents of GPS interference (Weeden & Samson, 2023).[11] In the same five-year period from 2019-2023, the Space Threats Assessment by the Center for Strategic and International Studies (CSIS) have included a total of 14 States in their assessment, four of which differ from the Secure World Foundation's report.[12] In addition, the CSIS report also considers the counterspace capabilities development of non-state actors (Bingen et al., 2023). In light of these global developments, States are increasingly crafting space security strategies and military doctrines as well as recognising space as an operational domain within national defence policies. This is happening not only at the national level, as cross-regional alliances and partnerships are also developing space security strategies. Examples of such policies and selected key priorities within can be seen below in Figure 1. The rise in published space security doctrines can contribute to establishing global expectations on military activities conducted in, towards, and from space contributing to further transparency and international stability. However, space security doctrines can also accelerate and exacerbate concerns over arms races and conflict in space by providing domestic pathways for further counterspace development and offensive space operations.

Figure 1: Example Priorities from Select Global Defence Strategies

[10] In 2019, Secure World Foundations Counterspace Capabilities report contained information on China, India, Iran, North Korea, Russia, and the USA and has since expanded to include Australia, France, Japan, South Korea, and the U.K.
[11] The four States are the USA, Russia, China, and Iran.
[12] The States that differ from the Secure World Foundation's report include Israel (2019-2023), Libya (2019), Pakistan (2019), and Ukraine (2019).

Strategy	Example Priority
Defence Space Strategy of the United States	**Maintain Space Superiority:** Establish, maintain, and preserve US freedom of operations in the space domain and will be prepared to protect and defend US and, as directed, allied, partner, and commercial space capabilities and to deter and defeat adversary hostile use of space.
Space Defence Strategy of France	**Grasp opportunities to build up strategic autonomy:** Take advantage of the disruptive technologies and uses associated with New Space, rethink its industrial model and extend cooperation to space operations and open up to new partners.
Space Security Initiative of Japan	**Expand the Use of Space Systems for National Security:** Establish a wide-area, high revisit rate, high precision information-gathering posture from space; respond to missile threats by space systems; establish a multi-layered, anti-interception and anti-jamming satellite communications posture; enhance satellite positioning functions; and build large-scale and flexible space transportation posture.
The Russian Federation National Security Strategy	**Strengthen a leading position:** Achieve competitive advantages in the rocket and space industries.
National Space Security Policy of the United Kingdom	**Increase resilience to the risk of disruption to space services:** Improve understanding of space security risks and dependencies; pursue a proportionate approach to investing in resilience, balancing protective measures with other means of promoting resilience; strengthen the ability to understand and forecast space weather events and their effects; international cooperation with allies for an integrated approach to security in European space programs and wider space policy
National Security Strategy of Nigeria	**Develop significant capacities to exploit the space-based potential for improvements in overall national security preparedness and responses:** Generate a critical mass of academic interest in the use of space; develop human capital for space science; development of indigenous space technologies; develop advanced communications and surveillance capabilities; development proprietary space infrastructure; establish geo-spatial laboratories across the country.
National Defence Policy of Brazil	**Ensure access to data and enable the development of critical technologies of interest to the country:** Develop solutions for satellite launch vehicles; increase skills associated with the design, manufacture, and integration of space platforms; seek innovative solutions for telecommunication between space and terrestrial segments; promote international cooperation in the areas of conception, design, development and operation of space systems.

NATO's Space Policy	**Integrating space and space-related considerations into the delivery of NATO's core tasks:** Collective defence, crisis management and, where appropriate, cooperative security.
European Union Space Strategy for Security and Defence	**Partnering for Responsible Behaviours in Outer Space:** Promoting norms, rules and principles for responsible behaviours in outer space; engaging with the UN on space and security; partnering with the US on space security and defence; dialogue with third countries on space security; partnership with NATO on space security and defence.

Through such policy shifts and recognition of space in national security goals and defence strategies, States can work towards the implementation of those policies. Although space has been militarized since the beginning of the space race, the formation of highly specified military space structures is more recent history. States have undertaken military restructures to create dedicated units and, in some cases, branches of their respective militaries tasked with the responsibility of overseeing the state's space security interest. Not only do these responsibilities include providing central support of space-enabled services to whole of military branches and operations and the use and monitoring of satellite data to maintain space domain awareness and response preparedness, but can also include wargaming, simulating, exercising, and strategic planning and development of offensive space operations (Dolman, 2022). One of the first examples of such a military restructure took place in 2015, when the Russian Federation restructured its military and created a new branch of the Russian Armed Forces, the Aerospace Forces, a combination of the previous Air Force and Aerospace Defence Forces (Ministry of Defence of the Russian Federation, 2015). Although the Russian Space Force Command had existed since 2001, under this restructuring, it was moved to be one of the three main Commands of the Aerospace Forces (Ministry of Defence of the Russian Federation, 2023).

Similarly, in 2019 the United States created the US Space Force, a new branch of its armed forces. Furthermore, the US has bolstered its space defence presence through its space defence enterprise, comprising the US Space Force, the US Space Command, and the Space Development Agency (US Department of Defense, 2020). Such actions, as taken by Russia and the US, have spurred the creation of other space forces or dedicated space military organs around the world. Some such examples of other creations include, but are not limited to, the French Space Command, Japan's Space Operations Squadron, Australia's Defence Space Command, and Nigeria's Defence Space Administration.

The military structures and the delineation between civilian and military contributions to national space security goals is not always clear. The combination of civilian and military resources to pursue national space security objectives is increasing, and some States have pursued such civil-military integration as their official approach for structuring their militaries and strategic goals. For example, the Strategic Support Force of the People's Liberation Army (PLA) of China, which was created in 2015 partly to employ the PLA's space capabilities and adheres to the system of military-civilian integration (Pollpeter et al., 2017; Chinese Communist Party News Network, 2016). This official strategy has evolved further from civil-military integration to civil-military fusion (Fritz, 2019). Overall, the creation of dedicated space forces contributes to the capacity for both defensive and offensive space operations while also increasing global space military expenditure and activity.

Conclusion

Space is a unique environment that would suffer extremely detrimental and possibly irreversible effects in the face of conflict. Such consequences could potentially deny access to space forever to all countries. Therefore, given that the use and exploration of space is the province of all humankind, the international community has a shared goal to protect the safety, security, and sustainability of outer space in order to preserve it for continued human prosperity.

The rapid proliferation of counterspace capabilities, and the rate at which emerging technologies outpace the efforts of the global community to regulate them, complicates the issue even more. Furthermore, current geopolitical tensions decrease the stability and security of space by threatening to proliferate terrestrial conflict into the cosmos. Regrettably, those same tensions are undermining much-needed cooperation in the field of creating international mechanisms to protect space. The war in Ukraine further complicates prospects for solving space security, as it deepens geopolitical divides and provides complex case studies on the role of space-based systems in conflict.

Despite all of these challenges, there exists a global consensus on the need to ensure the protection of and access to outer space. The existing legal framework has acted as a cornerstone for the expectations and guidelines for space activity, but the need to develop it through a variety of approaches and initiatives to ensure the security of space is evident. Historically, outer space governance has always constituted an array of both non-legally binding and legally binding elements. Using non-legally binding initiatives to establish a foundation or steppingstones on which legally substantive instruments may be later achieved should be considered. Positively, despite the current state of international affairs, cross-regional efforts and convergences on ideas, language, and priorities are emerging in multilateral space security discussions. The international community should take care to foster these efforts and nurture recently shared ideas and recommendations into future discussions.

Furthermore, it is crucial to consider perspectives, abilities, efforts, and potential contributions from the array of stakeholders involved in the space sector. Only through cooperative and inclusive methods of establishing future space governance will the international community be able to implement a robust, enduring, and successful regulatory regime. By pursuing inclusive approaches in good faith by a diverse set of actors, it can be ensured that outer space is unequivocally sanctioned as a domain of peace for the advancement of humanity.

References

Azcárate Ortega, Almudena & Hellmut L. Koller (2023). “The Open-Ended Working Group on Reducing Space Threats Through Norms, Rules and Principles of Responsible Behaviours: The Journey so Far, and the Road Ahead”, In Air and Space Law, 48, 19-40.

Azcárate Ortega, Almudena & Victoria Samson (2023). “A Lexicon for Outer Space Security”, UNIDIR.

Bingen, A. K., Kaitlyn Johnson & Makena Young (2023). “Space Threats Assessment 2023”. Center for Strategic & International Studies.

Chinese Communist Party News Network (2016). “习近平向中国人民解放军陆军火箭军战略支援部队授予军旗并致训词 [Xi Jinping awarded the military flag and delivered a speech to the strategic support force of the Chinese People's Liberation Army Rocket Force]”.

Department of Defense of the United States (2020). “Defense Space Strategy Summary”.

Dolman, C. Everett (2022). “Space is a Warfighting Domain”. In Æther: A Journal of Strategic Airpower & Spacepower, 1(1), 82–90.

Erickson, Sarah & Almudena Azcárate Ortega (2023). “To Space Security and Beyond: Exploring Space Security, Safety, and Sustainability Governance and Implementation Efforts”, UNIDIR.

European Union (2023). “European Union Space Strategy for Security and Defence”.

Federal Republic of Nigeria (2019). “National Security Strategy”.

Fritz, Audrey (2019). “China’s Evolving Conception of Civil-Military Collaboration”. Center for Strategic & International Studies.

Goehring, S. John (2020). “Can We Address Orbital Debris with the International Law We Already Have? An Examination of Treaty Interpretation and the Due Regard Principle”. In Journal of Air Law and Commerce, 85(4), 309-337.

Goehring, S. John (2022). “The Russian ASAT Test Caps a Bad Year for the Due Regard Principle in Space”. Just Security.

Government of Brazil (2020). “National Defense Policy”.

Government of the United Kingdom (2014). “National Space Security Policy”.

HCoC (2020). “The Hague Code of conduct against ballistic missile proliferation (HCoC)”.

Listner, J. Michael (2022). “The Paradox of Article IX and National Security Space Activities”. In Æther: A Journal of Strategic Airpower & Spacepower, 1(4), 21–34.

Ministry of Defence of the Russian Federation (2015). “НовыйвидВооруженныхСилРФ – Воздушно-космическиесилы – приступилкнесениюбоевогодежурстваповоздушно-космическойобороне [A new branch of the Russian Armed Forces – the Aerospace Forces – has begun combat duty in aerospace defence]”.

Ministry of Defence of the Russian Federation (2023). “Космические войска [SpaceForces]”.

MTCR (2023). “Objectives of the MTCR”.

North Atlantic Treaty Organization (2022). “NATO’s overarching Space Policy”.

Pollpeter, L. K., Michael S. Chase & Eric Heginbotham (2017). “The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations”. RAND Corporation.

President of the Russian Federation (2021). “Decree of the President of the Russian Federation No. 400 About the National Security Strategy of the Russian Federation”.

Republic of the Philippines (2022). “The duty of ‘due regard’ as a foundational principle of responsible behavior in space”, UN Doc A/AC.294/2022/WP.12.

Shull, Aaron & Timiebi Aganaba (2023). “Formulating, interpreting and Applying International Law in space”. Centre for International Governance Innovation.

The French Ministry for the Armed Forces (2019). “Space Defence Strategy”.

The Space Development Strategy Headquarters of Japan (2023). “Space Security Initiative”.

The Wassenaar Arrangement (2022). “Wassenaar Arrangement About Us”.

The White House (2022). “FACT SHEET: Vice President Harris Advances National Security Norms in Space”.

UN General Assembly (2021). Resolution 76/231. Reducing space threats through norms, rules and principles of responsible behaviours, UN Doc A/RES/76/231.

UN General Assembly (2022). Resolution 77/250. Further Practical Measures for the Prevention of an Arms Race in Outer Space, UN Doc A/RES/77/250.

UN General Assembly (2022). Resolution 77/251. Transparency and Confidence-building Measures in Outer Space Activities, UN Doc A/RES/77/251.

UN General Assembly (2022). Resolution 77/40. Prevention of an arms race in outer space, UN Doc A/RES/77/40.

UN General Assembly (2022). Resolution 77/41. Destructive direct-ascent anti-satellite missile testing, UN Doc A/RES/77/41.

UN General Assembly (2022). Resolution 77/42. No First Placement of Weapons in Outer Space, UN Doc A/RES/77/42.

UN General Assembly (2023). Resolution A/C.1/78/L.15/Rev.1. Reducing space threats through norms, rules and principles of responsible behaviours, UN Doc A/C.1/78/L.15/Rev.1.

UN General Assembly (2023). Resolution A/C.1/78/L.55. Further practical measures for the prevention of an arms race in outer space, UN Doc A/C.1/78/L.55.

UNIDIR (2022). “Existing Legal and Regulatory Frameworks concerning threats arising from State behaviours with respect to outer space”, UN Doc A/AC.294/2022/WP.1.

UNOOSA (2007). “Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space”.

UNOOSA (2018). “Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space”.

US Department of Defense (2020). “What's With All the US Space-Related Agencies?”.

Weeden, Brian & Victoria Samson (2023). “Global Counterspace Capabilities Report”.

West, Jessica (2023a). “The open-ended Working Group on Space threats: Recap of the second meeting, September 2022”. Project Ploughshares.

West, Jessica (2023b). “Recommendations by states from the Third Session of the UN OEWG on reducing space threats”. Project Ploughshares.

NATO'S SPACE POLICY AND THE GLOBAL CONTEXT: ISSUES AND CHALLENGES

Dimitrios Stroikos – London School of Economics and Political Science (LSE)

Introduction

In recent years, the space domain has undergone a significant transformation, as more countries than ever before participate in space activities for economic, scientific, social, political, and military purposes. At the same time as States across the globe expand their presence in space, technological advancements have resulted in making it more accessible to non-state actors, propelling the commercialization and privatization of space. Therefore, what was once a domain confined to the activities of great powers has now evolved into a mixed-actor environment evident in the growing number of new actors, from countries of the Global South to private entities, a process that has been described as the "democratization of space" (Baiocchi & Welser IV, 2015). Alongside this, the growing military uses of space and the return of great power rivalry, exemplified by United States (US) strategic competition with China and Russia, have added a layer of complexity to space security dynamics. It is in this reconfigured context that over the last years NATO has recognized the salience of space in support of its missions and operations and has made strides towards addressing emerging challenges and opportunities by formulating an overarching space policy and by stressing the role of space-based assets in its 2022 Strategic Concept.

Against this backdrop, the first part of the paper considers the forces that currently shape space activities at the global level by paying particular attention to the militarization of space, space diplomacy, and the rise of China. Next, it provides an overview of NATO's space policy as it has evolved from 2019 onward, expressed in key statements and policy documents. Finally, the last section briefly assesses NATO's space policy by discussing the role of international cooperation and diplomacy. The intention is not to plug all the gaps or to tie up all the loose ends but rather to highlight some of the most important challenges associated with the global context of space security that are relevant to NATO.

The Global Context: Space Militarization, Diplomacy, and the China Factor

Space Militarization

One of the most important features of the global context is the growing militarization of space amid great power competition and strategic uncertainty. To be sure, the use of space for military purposes is not new. In fact, it has been a constant theme underpinning the interest in acquiring access to space that can go as far back as the launch of the first ballistic missiles during the Second World War (Neufeuld, 2020).[1] However, it is clear that the Cold War acted as a catalyst for the development of space capabilities as a result of the superpower rivalry between the US and the Soviet Union. Nevertheless, even though space was seen as a potential new battlefield from the beginning of the Space Age, both superpowers gradually realized the strategic benefits that could accrue from keeping space free from actual conflict, as it was in their interest to

[1] On the militarization of space, inter alia, see Bowen (2023), Handberg (2000); and Johnson-Freese (2017).

continue using space-based assets in support of crucial military activities for nuclear deterrence and strategic stability, including surveillance, reconnaissance, and early warning. As Moltz (2019) shows, this shared understanding of keeping space free from conflict was reflected in the emergence of cooperative restraint that defined interactions between the United States and the Soviet Union, especially from 1962 to 1975. This was a process of social learning concerning the qualities of space as an environment, what Moltz (2019) refers to as "environmental learning" in the sense that both the United States and the Soviet Union began to acknowledge the growing dangers linked to nuclear detonations in high altitudes and Anti-satellite (ASAT) tests, due to the generation of Electromagnetic Pulse (EMP) radiation and space debris.

Facilitated by the balance of power between the two superpowers and expressing the logic of great power management, this process of strategic restraint was manifested in the bilateral arms control agreements between the United States and the Soviet Union, which covered several aspects of space security (Stroikos, 2022a).[2] Illustrative of this was the 1972 Interim Agreement on the Limitation of Strategic Offensive Arms (Interim Agreement or SALT I) and the Anti-Ballistic Missile (ABM) Treaty, which made references to non-interference with the ''National Technical Means of Verification" (NTM). Those were understood to describe the use of reconnaissance satellites (Kuskuvelis, 1985; Stares, 1985: 165). Meanwhile, the logic of great power management was also manifested in the support for multilateral diplomacy within the United Nations framework that gave rise to the international regime governing space activities and space law. Nowhere was this more evident than in the 1967 Outer Space Treaty. However, the point to emphasize here is that this process was not confined merely to space law. Rather, it entailed "a patchwork of international agreements, principles, national policies, and informal behavioural rules through which all the States with a stake in space tried to balance their common and conflicting interests" (Gallagher, 2005, 3). Briefly stated, strategic restraint as a reflection of the balance of power and great power management enabled the creation of the international regime for space activities (Stroikos, 2022a).

In many ways, the end of the Cold War and the consolidation of the United States as the sole superpower posed challenges to the logic of great power management. On the one hand, a key feature of the 1990s was an emphasis on international space cooperation embodied in the decision to construct and operate the International Space Station (ISS) through cooperation among the US, Russia, Europe, Japan, and other space powers. On the other hand, this was accompanied by important developments in the military field. Of particular note is the 1991 Gulf War against Iraq, which demonstrated for the first time the importance of the use of satellite-based global positioning systems (GPS). This marked a significant shift from utilizing space power to strengthen strategic deterrence to employing it at the operational and tactical levels. Therefore, there was a growing recognition of the force multiplier effects on terrestrial military forces. But since the 2000s, there has also been a change in the political attitudes towards space militarization, from an appreciation of the role of space as a force multiplier to increasingly treating space as a potential theatre of military operations in its own right, like the air and sea domains (Sheehan, 2007: 109).

[2] Great power management refers to the idea that great powers are members of a club by dint of seeking to be recognized by others to assume, and have been recognized by others, to assume managerial responsibilities and special rights in international society. (Bull, 2002: 194, 196). According to Hedley Bull, great power management is a key aspect of how great powers play a role in contributing to the maintenance of international order, which is expressed in two ways: "by managing their relations with one another; and by exploiting their preponderance in such a way as to impart a degree of central direction to the affairs of international society as a whole" (Bull, 2002: 200). For a discussion of the relationship between great power management and strategic restraint in space, see Stroikos (2022a).

Consequently, over the last years, global space security has been characterized by the trend towards the development of counterspace capabilities by major space powers, such as China, India, Russia, and the United States, including the conduct of destructive anti-satellite (ASAT) tests that create space debris threatening the sustainable use of space.[3] Generally, there is evidence to suggest that key space players have an interest in the research and development of a wide range of destructive and non-destructive counterspace weapons, such as direct ascent, co-orbital, directed energy, electronic warfare, and cyber.[4] Coupled with this, there is an emerging discourse, especially within the United States, that treats outer space as a warfighting domain premised on the assumption that a war in space is inevitable.

Diplomacy

Diplomacy and multilateralism have been a key feature of the global governance of outer space activities from the beginning of the Space Age. In 1959, the United Nations General Assembly set up the Committee on the Peaceful Use of Outer Space (COPUOS) in Vienna as an ad hoc committee, which serves as the main multilateral forum for promoting international cooperation and discussing legal matters related to outer space. As such, COPUOS played an essential role in the development of the legal framework that governs space. In addition, the Conference on Disarmament (CD) in Geneva has been involved in discussions on arms control and space security, such as the Prevention of an Arms Race in Outer Space (PAROS) as an agenda item. Yet, disagreements over several issues, from whether an arms race exists to defining what a space weapon is, and difficulties of verification meant that discussions at the CD reached an *impasse*.

Given the militarization of space, together with the emergence of global space challenges such as tackling space debris and ensuring the long-term sustainability of space, there has been no dearth of diplomatic initiatives as a way to break the stalemate at the CD, with some being more successful than others. More specifically, in 2008, China and Russia submitted to the CD a draft for a legally binding Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT) (Loshchinin & Wang, 2008). Even though an updated draft was submitted in 2014, the proposed treaty did not garner much support.[5] Furthermore, in 2008, the EU issued a draft Code of Conduct for Outer Space Activities, a non-legally binding framework aimed at strengthening the safety, security, and sustainability of outer space activities (Council of the European Union, 2008). The proposed code of conduct gained some support, and after rounds of consultations, it was revised to the "International Code of Conduct for Outer Space Activities" (ICOC), but it soon lost *momentum*.[6]

Still, other initiatives have achieved greater success. In 2007, COPUOS approved the "Space Debris Mitigation Guidelines", which were developed by the international Inter-Agency Debris Coordination Committee (IADC) (United Nations Office for Outer Space Affairs, 2010). Then, in 2013, the UN General Assembly (UNGA) endorsed the recommendations put forth in the final report of the Group of Government Experts (GGE) on

[3] Both the United States and the Soviet Union carried out ASAT tests during the Cold War, but restraint prevailed. China conducted an ASAT test in January 2007, India in March 2019, and Russia in November 2021. Following China's 2007 ASAT test, in February 2008 the United States carried out Operation Burnt Frost to destroy an errant US satellite (USA-193), which demonstrated an ASAT capability.

[4] On this trend, for example, see Bingen et al. (2023) and Weeden and Samson (2023). Also, see Marrone and Nones (2022).

[5] For an insightful analysis of the updated draft PPWT, see Tronchetti, F., & Liu (2015).

[6] The last draft was published in March 2014, and can be accessed here: https://www.eeas.europa.eu/sites/default/files/space_code_conduct_draft_vers_31-march-2014_en.pdf.

Transparency and Confidence-building Measures (TCBMs) in Outer Space (UNGA, 2013). In addition, in June 2019, following extensive negotiations, COPUOS adopted the Guidelines for the Long-term Sustainability of Outer Space Activities, which comprise a set of 21 voluntary best practices to advance the sustainability of space activities, endorsed by 92 member States (United Nations General Assembly, 2019). More recently, in December 2020, the UNGA adopted Resolution 75/36 on "Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours", initiated by the United Kingdom, with the goal of developing norms, rules and principles of responsible behaviour in space (United Nations General Assembly, 2020). These efforts culminated in the establishment of the Open-ended Working Group on reducing space threats through norms, rules and principles of responsible behaviours which held four sessions.[7] But despite support from the majority of delegates, the Russian delegation has led the objections to the procedures, curtailing the process (Hitchens, 2023).

As far as multilateralism is concerned, therefore, there is a group of States led by the United States with a preference for non-legally binding frameworks covering space security based on voluntary measures and another group of States led by China and Russia adhering to the view that a legally binding treaty on the placement of weapons in outer space should be prioritized.[8] More recently, there has been an effort led by the United States to delegitimize the conduct of debris-producing direct-ascent ASAT tests because of their harmful impact on the sustainability of the space environment and their destabilizing effects on global security. More concretely, in April 2022, the United States announced its commitment not to conduct destructive, direct-ascent ASAT testing and called on other countries to follow its example and help establish this as an international norm of responsible behaviour (The White House, 2022).[9] Likewise, in December 2022, the UNGA adopted a new draft resolution on "destructive direct-ascent anti-satellite missile testing" initiated by the United States (UNGA, 2022). However, although 155 countries voted in favour of the resolution, China voted against the adoption, and India abstained (United Nations, 2022). It remains to be seen how successful such initiatives will be, but they point to a growing realization that it is necessary to resist some of the unwanted impacts of space weaponization amid an increasingly fragmented global space order.

The Rise of China

One of the most noteworthy features of the current space order is the rise of China as a major space player. As Beijing emerges as a global power, its impact on the international context of space activities cannot be understated. A number of points are especially salient here. First, China's ambitious space program has made substantial strides in the field of exploration, evident in a series of remarkable feats, including the launch of Shenzhou 5 that carried China's first astronaut, Yang Liwei, making it the third country in the world to place a human into orbit using its own launch vehicle and spacecraft. Since then, as part of the Shenzhou project, China has successfully launched several human spaceflight missions and operated two space laboratory

[7] More information on the open-ended working group (OEWG) can be found on the site of the United Nations Office for Disarmament Affairs: https://meetings.unoda.org/open-ended-working-group-on-reducing-space-threats-2022.
[8] For a useful discussion of this turn to non-legally binding measures, see Silverstein et al. (2020).
[9] Following this, several countries have made similar commitments. The EU also joined the ASAT ban when in August 2023, in a document issued as part of its contribution to the workings of the UN OEWG on Reducing Space Threats, it stated that "the Member States of the European Union commit not to conduct destructive direct-ascent antisatellite missile tests" (European Union, 2023: 2).

modules as experimental test beds for the Tiangong space station, its larger orbital space station, the construction of which was completed in 2022. Apart from human spaceflight, China has accomplished a series of missions as part of its lunar program, known as Chang'e, including becoming the first country to land a spacecraft, Chang'e 4, on the far side of the Moon in 2019. In addition, in 2020, Beijing launched its first Mars mission, Tianwen-1. Consequently, not only have these successes established China as a major power in space, but they have prompted other countries to renew their interest in revitalizing their own space programs in order to remain competitive.

Second, China has been keen to demonstrate its leadership ambitions and its role as a "responsible great power" through the provision of public goods (Stroikos, 2022a). For example, China created the Asia-Pacific Space Cooperation Organization (APSCO) in 2008, an intergovernmental organization, which is headquartered in Beijing and consists of seven other members: Bangladesh, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey. Equally, China, in collaboration with the United Nations Office for Outer Space Affairs (UNOOSA), has formed the United Nations/China Cooperation on the Utilization of the China Space Station under the auspices of UNOOSA's Access to Space for All Initiative, which intends to offer scientists and researchers from across the globe the opportunity to engage in experiments and research activities onboard the Chinese space station. What is more, China has integrated space into the Belt and Road Initiative (BRI) through the establishment of the "Space Information Corridor" or "Space Silk Road" (State Council Information Office of the People's Republic of China, 2022).

Third, China has been developing across-the-board military space capabilities that have raised legitimate concerns, especially given the lack of transparency and difficulty of deciphering Beijing's intentions in space. In addition to building a network of dual-use satellites for communications, global position, timing and navigation, and remote sensing aimed at enhancing Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR), China has been deploying a range of dedicated military satellites. As was mentioned earlier, Beijing is also developing various destructive and non-destructive ways to interfere with space activities beyond direct-ascent ASAT capabilities like the one that was tested in 2007, which created a large amount of space debris. What is noteworthy is that space has assumed importance under the leadership of Xi Jinping. Typifying this, space has been central in the context of the military-civil fusion (MCF) policy, which is geared toward integrating the advancement and utilization of civilian technologies into military applications. Further reflecting this, in 2015, the People's Liberation Army Strategic Support Force (PLASSF) was established, as part of a significant restructuring of the Chinese military forces, designed to enhance the strategic-level coordination and integration of space, cyber, and electromagnetic operations (Stroikos, 2024).

As a result, China's rise has precipitated a debate about an imminent transition of power in space premised on the assumption that its ulterior motives or ambitions involve displacing the United States as the dominant space power. Crucially, however, in contrast to other domains, China's international behaviour in the domain of space does not appear discontent or defying the main principles and norms underpinning the current space order (Freeman, 2020; Weeden, 2019). With the exception of its 2007 ASAT test, Beijing has attempted to play a constructive role in shaping the global governance of space activities, manifested in its contribution to key initiatives, such as the 2007 Space Debris Mitigation Guidelines, the Working Group on the Long-term Sustainability of Outer Space Activities, and the aforementioned GGE on TCBMs. As was mentioned previously, it has also assumed great power responsibilities, especially through the provision of public goods oriented toward the Global South and its region. In fact, it seems that the prevailing narrative of China as a threat in space-based on the belief that it wants to displace US leadership has to do more with its assertive

behaviour in other domains than in space, while simultaneously downplaying the multidimensional nature of US space power. In this respect, Washington and Beijing appear increasingly caught in a security dilemma in space and the big challenge is how to manage and diffuse tensions (Zhang, 2011).[10] This is not to say that China does not pose challenges and it does not raise legitimate concerns, especially with regard to its military build-up. Rather, the point is that the formulation of a good strategy rests on recognizing the nuances of Beijing's behaviour across different domains, which can help identify areas of common interest and promote cooperation in addressing global challenges, such as space debris. As discussed below, NATO could play a positive role in this regard.

NATO's Space Policy: An Overview

Reflecting the evolving global space context and the ensuing new risks and potential threats to its member countries, in recent years, NATO has recognized the importance of space for the Alliance's and Allies' security as well as the need for a comprehensive approach to space. Some tentative steps towards space cooperation were taken in the early 2010s as a result of a shift in US space policy towards an emphasis on working together with partners. Subsequently, in 2016, NATO adopted the Allied Joint Doctrine for Air and Space Operations (AJP-3.3) that outlined how space capabilities can effectively support NATO operations, with a focus on the mission areas of Space Situational Awareness (SSA), space force enhancement, and space control.

NATO's Overarching Space Policy

One of the most important developments has been the adoption of NATO's first Overarching Space Policy in 2019, which was designed to guide the Alliance's approach to space. As NATO Secretary General Jens Stoltenberg observed at the time, "we can play an important role as a forum to share information, increase interoperability, and ensure that our missions and operations can call on the support they need" (NATO, 2019a). Significantly, in the same year, NATO also announced that it recognized space as an operational domain alongside air, land, sea, and cyber. According to the Secretary General, "this can allow NATO planners to make requests for Allies to provide capabilities and services, such as hours of satellite communications". However, he stressed that NATO does not have any plans to place weapons in space, and its approach to space will continue to adhere fully to international law (NATO, 2019b). Likewise, in December 2019, the *communiqué* issued by the heads of State and Government summit in London noted that "we have declared space an operational domain for NATO, recognizing its importance in keeping us safe and tackling security challenges, while upholding international law" (NATO, 2019c). Organizationally, in October 2020, NATO Defence Ministers also agreed to establish a NATO Space Centre at Allied Air Command in Ramstein, Germany, aimed at serving as a focal point for providing space support to the Alliance's operations, enhancing coordination and information-sharing. This was followed by the creation of the Space Centre of Excellence

[10] In international Relations theory, the concept of the security dilemma "refers to a situation in which a State's effort to enhance its own security through military means has the effect of decreasing the perceived security of its competitor, setting in motion a sequence of action–reaction" and it has been applied especially to US-China space relations (Stroikos, 2022b: 3, 3-5).

(NATO Space COE) in Toulouse, France, which received official accreditation from the North Atlantic Council in July 2023.[11]

More fundamentally, the 2021 summit statement attracted much attention because attacks from space were added to the mutual defence clause. In particular, NATO leaders stated "that attacks to, from, or within space present a clear challenge to the security of the Alliance, the impact of which could threaten national and Euro-Atlantic prosperity, security, and stability, and could be as harmful to modern societies as a conventional attack. Such attacks could lead to the invocation of Article 5". Yet, it was noted that NATO would determine when space attacks would trigger Article 5 on a case-by-case basis (NATO, 2021a).

Russia's ASAT missile test in November 2021, which produced more than 1,500 pieces of debris threatening satellites and activities in this domain, validated concerns about space security and stability and gave further impetus for cooperation among NATO countries. In response, NATO issued a statement confirming NATO's commitment to "protecting and preserving the peaceful access to and exploration of space", the statement also called for Russia "to join the international efforts to develop norms, rules, and principles of responsible behaviour in order to reduce space threats" and to refrain from carrying out destructive ASAT tests (NATO, 2021b).

Typifying the political weight given to the Alliance's approach to space and the importance of communicating that to a broad audience both within and beyond the Alliance, in 2022, NATO made its "overarching space policy" publicly available for the first time (NATO, 2022). The policy document first describes in some detail the wide range of increasing threats and risks in space and brings attention to the fact that all three segments (space, ground, and link) can be susceptible to attacks. The next section of the document outlines the set of principles and tenets that underpin the overarching space policy of the Alliance in line with those of NATO's overall posture, highlighting that "space is essential to coherent Alliance and defence" (paragraph 5). Crucially, it also emphasizes that NATO does not intend to "become an autonomous space actor" or to build its own space-related capabilities. Rather, the goal is the use of space in support of NATO's operations and activities on a voluntary basis (paragraph 5). Then, the document moves on to describe a number of key roles that NATO can play as part of its space policy (paragraph 6). These include: serving as a forum for discussion and information sharing; as a focal point not only for coordination but also for incorporating space into NATO's core tasks, that is, collective defence, crisis management, and collective security; and fostering compatibility and interoperability. Following this, the document identifies several functional areas on which NATO should direct its efforts: SSA, the use of space for monitoring across environments (atmospheric, oceanic, space); intelligence, surveillance, and reconnaissance (ISR), satellite communications, position, navigation, and timing; and shared early-warning capabilities (paragraph 7).

It is notable, however, that some sections of the document hint at the fact that NATO's space policy is still a work in progress. For example, in the context of discussing "deterrence, defence, and resilience" (paragraph 11), it is noted that NATO "will consider a range of potential options, for Council approval, across the conflict spectrum to deter and defend against threats to or attacks on Allies' space systems". It is also suggested that the alliance "should develop a common understanding of concepts such as the role of space in crisis or conflict" as well as guidelines regarding "how to secure and ensure NATO's access to space data, products, services and capabilities". On the one hand, this is not surprising, not least because space is a dynamic strategic environment, and the space policy of Allies is still evolving. On the other hand, it is likely that there

[11] More information on NATO Space COE can be found on its site: https://www.space-coe.org.

are still different perspectives among NATO members on how the alliance should move forward with certain aspects of space policy, especially with regard to issues pertaining to crisis and conflict.

The Strategic Concept and Space

The 2022 NATO Strategic Concept singles out for the first time the challenges posed by China's policies to NATO, including in space, albeit Beijing is not explicitly described as a threat (NATO, 2023: 1, 5). Regarding space, the document refers to how strategic competitors are interested in acquiring technologies that have the potential to restrict or threaten the Allies' access and freedom to operate in space and degrade their civilian and military infrastructure and capabilities (NATO, 2023: 5). It goes on to note that NATO's deterrence and defence posture relies on a combination of nuclear, conventional, and missile defence capabilities, which are complemented by space and cyber capabilities (NATO, 2023: 6).

Moreover, the Strategic Concept reaffirms the Allies' commitment to strengthen their ability to operate in space in an effective manner "to prevent, detect, counter and respond to the full spectrum of threats, using all available tools" and recognizes the importance of promoting responsible behaviour in space and improving resilience (NATO, 2023: 7). Equally importantly, it stresses that "hostile operations to, from, or within space… could reach the level of armed attack and could lead the North Atlantic Council to invoke Article 5 of the North Atlantic Treaty" (NATO, 2023: 7). Clearly, there is broad, overall alignment between NATO's space policy and its Strategic Concept.

Deepening EU-NATO cooperation in space and the role of diplomacy

Despite the fact that the formulation of NATO's space policy has long been overdue in many respects, it is merely a first step precipitated by the need for the Alliance to adjust to the reality of a more complex space environment. Not surprisingly, therefore, it has raised several issues that remain to be addressed, including the important issues of Articles 5 and 6 discussed elsewhere. However, the following discussion examines the role of international cooperation, which is a rather neglected aspect of NATO's space policy.

To begin with, NATO will benefit from considering ways to improve cooperation with its partners. A case in point is cooperation with the European Union, not least due to the latter's space-based assets, such as Galileo and Copernicus; in fact, in recent years, NATO and the EU have taken tentative steps toward exploring avenues for cooperation in several areas, including space. The European Union Space Strategy for Security and Defence, which was published in March 2023, provides some insights into how the EU values the role of NATO in space in the context of the EU-NATO strategic partnership. These build on the third joint declaration on the EU-NATO partnership of January 2023, which identified space as an area where the two organizations should expand and deepen their ties. The EU document notes that "both organizations are contemplating the evolution of space from a capability in support of military and civilian operations into a strategic domain", and their "responses to space incidents and threats will be complementary and mutually reinforcing". It also stresses their commitment to seek cooperation opportunities in the realm of space by engaging in regular interactions, which could also include joint exercises by the EU and NATO personnel with a space component (p. 16).

Underpinning this focus on space is a growing realization that there is scope for EU Member States and NATO Allies to work together in order to augment the resilience of their critical infrastructure. As part of these dynamics, President von der Leyen and NATO Secretary General Stoltenberg made a joint announcement in January 2023 regarding the establishment of an EU-NATO Task Force focused on strengthening the security of critical infrastructure. The Task Force was launched in March 2023 as an integral part of the EU-NATO Structured Dialogue on Resilience, consisting of individuals from the European Commission, the European External Action Service, and NATO (European Commission, 2023). Notably, the final assessment report of the Task Force, which was issued in June 2023, identifies space, together with energy, transport, and digital infrastructure, as a key sector of "cross-cutting importance" that makes up the critical infrastructure of Member States and Allies. The report also specifies ways through which EU and NATO could build on their cooperation to strengthen the resilience of space infrastructure and offers recommendations for the next steps, including stepping up exchanges between high-level EU and NATO officials, enhancing the Structured Dialogue on Resilience and the Structured Dialogue on Military Mobility, and promoting parallel and coordinated assessments of threats and undertaking actions to alleviate potential vulnerabilities (European Commission, 2023).

Apart from cooperation with partners, there is scope for exploring what role NATO can play in arms control and space diplomacy. So far, although NATO's space policy includes references to strategic communications and its support for international attempts to establish norms of responsible behaviour in outer space, it has not articulated concretely how the Alliance intends to contribute to the development of such norms. In some ways, it appears that the focus has been less on diplomacy as a key component that could be part of a comprehensive strategy in space. For example, the Arms Control and Disarmament Committee could be asked to explore the ways in which NATO can contribute to the promotion of norms of responsible behaviour in space (Rose, 2020).

There is also much scope for thinking about the role NATO can play in great power management as an order-building process by engaging in dialogue with adversaries amid great power competition and strategic uncertainty. While it can be argued that pursuing such an endeavour with Russia is strategically futile as long as the war in Ukraine continues, this should not be the case with China. To be sure, China's military build-up in space, combined with the lack of transparency and its assertive international behaviour, means that the conditions do not appear ripe for dialogue. However, it is precisely because of the current state of mistrust mired with misperceptions, security dilemmas, and assumptions based on worst-case scenarios prevailing on both sides that there is a need to foster a modicum of cooperation in the context of strategic dialogue, which can help NATO Allies to communicate better their strategic intentions in space to China by establishing a set of guardrails to manage competition and crisis avoidance.

The need for such a dialogue derives from the pessimistic view that a war between the United States and China, two thermonuclear powers, is possible, including in space, within the next decade (Brands and Beckley, 2022; Coker, 2015). Further complicating space security dynamics, as well as NATO's posture in space, and highlighting the need for a dialogue with China, is the issue of "entanglement" in the sense that space-based assets are "entangled" with conventional and nuclear missions, which can increase the risk of escalation (Acton, 2018). In this way, such a dialogue should not be seen as an end in itself, but as a means to the end of managing strategic competition aligned with an overall space strategy aimed at stabilizing deterrence and keeping channels of communication open so an inadvertent war is avoided. To be sure, a key determinant will be China's willingness to participate in such a process as part of an effort to assume a more constructive role in the management and maintenance of space order that is commensurate with its status

as a responsible great power in space (Stroikos, 2023: 19). Nevertheless, as far as NATO is concerned, an effective space strategy will require a set of clear political objectives, pragmatism, empathy, patience, flexibility, creativity, and strategic thinking outside of the box, all key qualities of effective strategizing when it comes to great power management at a time of strategic uncertainty.

Be that as it may, even though NATO's overarching space policy and the 2022 Strategic Concept point to the right direction in terms of recognizing the importance of this domain in supporting the alliance's operations as a response to a changing global context of space activities, there are important issues that need to be addressed. Whether NATO can be good at strategizing in space, which is imperative but not an easy task even for single States, will be the crucial challenge. It remains to be seen whether NATO Allies have the desire or the capacity to formulate a comprehensive space strategy that aligns available means with clear political ends.

Conclusions

This paper has examined the evolving global landscape of space activities and its significance for NATO, highlighting three particular aspects of the current global space order: space militarization, diplomacy, and the China factor. Today, global space security is underpinned by the development of counterspace capabilities by major powers, posing threats to the sustainable use of space and contributing to a security dilemma in space between the United States and China with important implications for NATO. Yet, although there are legitimate concerns about China's military activities in space, its overall behaviour in space has not challenged established international norms and principles associated with the space regime, until now at least. It has also been argued that, as far as US-China space relations are concerned, the key challenge is how to manage an increasingly competitive relationship without deteriorating space stability and security.

In this context, the role of NATO in space security is of paramount importance. The Alliance has formulated a space policy and recognizes space as a critical domain for the prosperity and security of its members. However, NATO's approach to space faces complex issues and challenges, and certain dimensions of its space policy require more clarity. Cooperation with partners, particularly the European Union, and engagement in arms control and space diplomacy are avenues that NATO should explore further. Moreover, contributing to the norms of responsible behaviour in space and engaging in strategic dialogue with potential adversaries, such as China, are vital steps toward ensuring space security and stability. Nevertheless, NATO's ability to strategize effectively in this evolving environment will be one of the most critical challenges in the coming years.

References

Acton, James M. (2018). "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War". In International Security, Vol. 43, No. 1, pp. 56–99.

Baiocchi, Dave & William Welser (2015). "The Democratization of Space: New Actors Need New Rules". In Foreign Affairs, Vol. 94, No. 3, pp. 98–104.

Bingen, Kari A., Kaitlyn Johnson & Makena Young (2023). “Space threat assessment 2021”. In Center for Strategic and International Studies.

Bowen, Bleddyn (2023). Original Sin: Power, Technology and War in Outer Space. London: Hurst & Company.

Brands, Hal & Michael Beckley (2022). Danger Zone: The Coming Conflict with China. New York City: W.W. Norton & Company.

Bull, Hedley (2002). The Anarchical Society: A Study of Order in World Politics. Third Edition. London: Palgrave.

Coker, Christopher (2015). The Improbable War: China, the United States and the Logic of Great Power Conflict. Oxford: Oxford University Press.

Council of the European Union (2008). “Draft Code of Conduct for Outer Space Activities”.

European Commission (2023). “EU-NATO Task Force: Final assessment report on strengthening our resilience and protection of critical infrastructure”.

European Union (2023). EU joint contribution on the works of the Open-Ended Working Group on reducing space threats through norms, rules, and principles of responsible behaviours. Fourth part: recommendations on possible norms, rules, and principles of responsible behaviour relating to threats by States to space systems.

Freeman, Carla P. (2020). “An uncommon approach to the global commons: Interpreting China’s divergent positions on maritime and outer space governance”. In The China Quarterly, Vol. 241, pp. 1–21.

Gallagher, Nancy W. (2005). “Towards a reconsideration of the rules for space security”. In John Logsdon and Audrey Schaffer (Eds.) Perspectives on Space Security, Space Policy Institute, George Washington University.

Handberg, Roger (2000). Seeking new world vistas: The militarization of space. Westport: Praeger.

Hitchens, Theresa (2023). “Russia spikes UN effort on norms to reduce space threats”. In Breaking Defense.

Johnson-Freese, Joan. (2017). Space warfare in the 21st century: Arming the heavens. London: Routledge.

Kuskuvelis, I. I. (1985) “Verification and the Space Related Agreements”. In Proceedings of the Twenty-Eighth Colloquium on the Law of Outer Space, American Institute of Aeronautics and Astronautics.

Loshchinin, Valery & Qun Wang (2008). “Draft ‘treaty on prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects (PPWT)’”.

Marrone, Alessandro & Michele Nones, M. (2022). “The Expanding Nexus between Space and Defence”. In Instituto Affari Internazionali.

Moltz, James Clay (2019). The politics of space security: Strategic restraint and the pursuit of national interests. Third edition. Redwood City: Stanford University Press.

NATO (2016). Allied Joint Doctrine for Air and Space Operations.

NATO (2019a). NATO Defence Ministers Meeting, June 27.

NATO (2019b). “Foreign Ministers take decisions to adapt NATO, recognize space as an operational domain”.

NATO (2019c). London Declaration Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in London 3-4 December 2019.

NATO (2021a). Brussels Summit Communiqué Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Brussels 14 June 2021.

NATO (2021b). Statement by the North Atlantic Council on the recent anti-satellite missile test conducted by the Russian Federation.

NATO (2022). NATO’s overarching Space Policy.

NATO (2023). NATO 2022 Strategic Concept.

Neufeld, Michael J. (2020). “Cold War – But No War – in Space”. In Geppert, Alexander C. T., Daniel Brandau and Tilmann Siebeneichner (Eds.), Militarizing Outer Space: Astroculture, Dystopia and the Cold War, London: Palgrave Macmillan.

Sheehan, Michael (2007). The International Politics of Space. Abingdon: Routledge.

Silverstein, Benjamin, Daniel Porras & John Borrie (2020). “Alternative approaches and indicators for the prevention of an arms race in outer space”. In United Nations Institute for Disarmament Research (UNIDIR).

Stares, Paul B. (1985). The Militarization of Space: U.S. policy 1945–1984. Ithaca: Cornell University Press.

State Council Information Office of the People’s Republic of China (2022). “China’s Space Program: A 2021 Perspective”.

Stroikos, Dimitrios (2022a). “Power Transition, Rising China, and the Regime for Outer Space in a US-Hegemonic Space Order. In Knudsen, Tonny Brems and Cornelia Navari (Eds.), Power Transition in the Anarchical Society: Rising Powers, Institutional Change and the New World Order, London: Palgrave Macmillan.

Stroikos, Dimitrios (2022b). “International Relations and Outer Space”. In Oxford Research Encyclopedia of International Studies.

Stroikos, Dimitrios (2023). “Still Lost in Space? Understanding China and India’s Anti-Satellite Tests through an Eclectic Approach.” In Astropolitics.

Stroikos, Dimitrios (2024). “China and India as Rising Powers and the Militarisation of Space”. In: Hoerber, Thomas and Iraklis Oikonomou (Eds.). The Militarization of European Space Policy, London: Routledge.

The White House (2022). Remarks by Vice President Harris on the Ongoing Work to Establish Norms in Space.

Tronchetti, Fabio & Liu, Hao (2015). “The 2014 updated draft PPWT: Hitting the spot or missing the mark?”. In Space Policy, Volume 33 (Part 1), pp. 38–49.

United Nations (2022). General Assembly Adopts over 100 Texts of First, Sixth Committees Tackling Threats from Nuclear Weapons, International Security, Global Law, Transitional Justice.

United Nations General Assembly (2022). Resolution 77/41, Destructive direct-ascent anti-satellite missile testing, A/RES/77/41.

United Nations General Assembly (2013). Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities. A/68/189.

United Nations General Assembly (2019). Guidelines for the Long-term Sustainability of Outer Space Activities. A/AC.105/C.1/L.366.

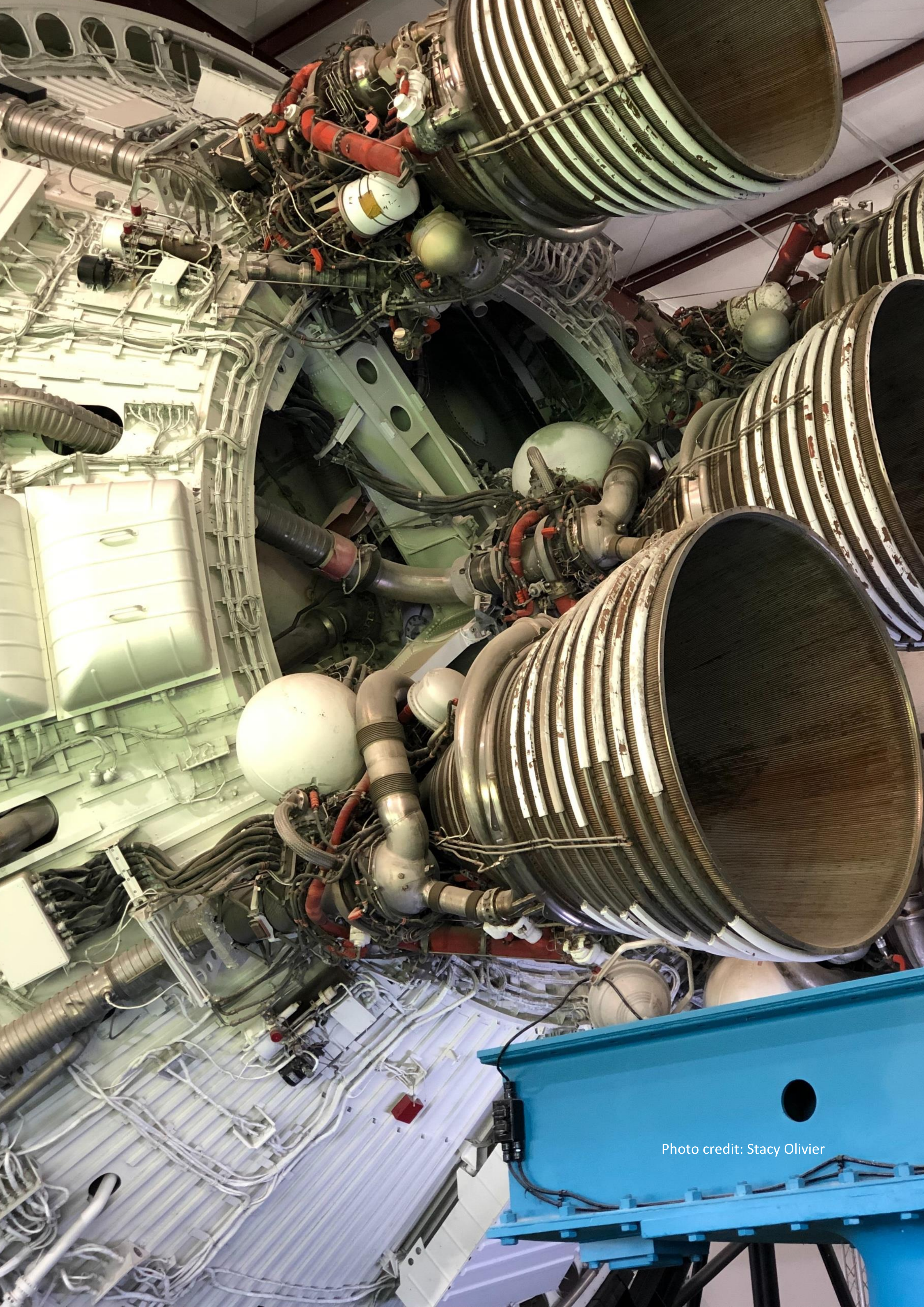
United Nations General Assembly (2020). Resolution 75/36, Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviors, A/RES/75/36.

United Nations Office for Outer Space Affairs (2010). Space debris mitigation guidelines of the committee on the peaceful uses of outer space.

Weeden, B. (2019). Testimony before the U.S.-China Economic and Security Review Commission. Hearing on China in Space: A Strategic Competition?

Weeden, B. & Samson, V. (2023). Global counterspace capabilities: An open source assessment. In Secure World Foundation.

Zhang, Baohui (2011). “The security dilemma in the U.S.-China military space relationship: The prospects for arms control”. In Asian Survey, Vol. 51, No. 2, pp. 311–332.



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WORKING GROUP REPORT

THE GLOBAL SPACE CONTEXT – THE DEVELOPMENT OF NATO'S POSTURE IN SPACE

Dr Nicolò Fasola – University of Bologna

Societies worldwide are heavily reliant on Space for civilian as well as military purposes. Today, Space is as fundamental to everyday communications as to the conduct of nuclear strikes; a key enabler of global interconnectedness and technological progress, it has moved back at the centre of great power competition. Such conditions call for the development of a coherent, realistic, and sustainable NATO posture in Space.

So far, allied efforts have taken place within a very loose grand strategic design. Individual member states have strived to adjust their policies and structures to the demands of Space security – but a truly shared NATO approach has yet to emerge. The Alliance has yet to fully integrate Space in its posture as a stand-alone domain on par with land, sea, air (and cyber). Even the necessary organisational adaptations might lead to nowhere, if they are not embedded into a broader goal-oriented strategic framework, or absent sufficient human and physical resources to sustain a joint NATO effort in Space.

Participants in this Working Group debated the normative and security implications of the expanding relevance of Space for the Allies, with the aim of casting observations useful to the development of a yet-to-be-born NATO Space posture.

Normative context and political dynamics

There exists a rich international normative framework that strives to regulate Space activities, with an emphasis on ensuring secure, responsible, and sustainable practices. Yet such regime, which is centred on the Outer Space Treaty, is fragile, fragmented, and slowly responsive to a fast-paced international environment. A mix of case-specific injunctions and unclear principles leaves plenty of room for interpretative grey zones and results in the patchy implementation of norms of behaviour. The richness of recent normative efforts undertaken within the United Nations, among other organisations, signals a relative degree of willingness to better regulate Space. However, all such initiatives have been largely inconsequential, because of the clash of principled positions and strategic priorities of key states.

This leaves Space in a condition of de facto anarchy, which states have to decide what to make of – paraphrasing Alexander Wendt. Participants in the Working Group showed somewhat contrasting positions on how such challenge should be interpreted. On the one hand, Space anarchy could be seen as a structural condition that is unlikely to be dispensed with. From such perspective, the current fragility of the normative framework would persist and usher into increasing patterns of competition in and militarisation of Space.

Inter alia, those who hold such view tend to securitise China's presence in Space and make of that a key point of departure to develop a NATO Space posture.

Other participants shared a more positive outlook on Space anarchy. They emphasised how the ordering of Space had proven historically feasible, even at a time of intense strategic competition between ideologically incompatible blocs – such as the Cold War. Albeit shaky, the existing Space governance regime is actually the result of responsible practices of great power condominium implemented by the United States and the Soviet Union; significantly, it represented a relative improvement with respect to the normative void that had existed beforehand. If the achievement of such result was possible back then, then it should not be excluded a priori even in the current context. According to the proponents of such view, NATO should actively seek for normative bargain and de-escalation with competitors over Space matters.

The basic choice of 'what to make of Space anarchy' should lie at the basis of NATO's strategic reflection and inform the development of an allied Space posture. This issue should be settled within the North Atlantic Council, coherently with the goals and ambitions enshrined in the latest Strategic Concept.

Bridging the gaps between NATO, Allies, and Partners

When answering such paramount strategic question and charting its own Space posture, NATO should also take into consideration broader problems and opportunities that might influence the efficiency of the Alliance and its ability to maintain a strategic hedge over competitors. In this regard, two main themes have been identified and discussed by the participants in the Working Group.

First, participants stressed the difficulties in speaking the same language within the Alliance, also regarding Space-related activities, standards and capabilities. Allies did agree on making Space an operational domain and set limits to NATO's mandate in such domain (no weapons system will be deployed in Space and NATO will not own Space capabilities). However, important avenues of discussion remain unexplored. Notably, Allies have not clarified yet the applicability of Article 5 in the Space domain. Irrespective of (debatable) arguments in favour of strategic ambiguity, a clearer stance on collective defence in Space is a logical precondition for the clearer definition of NATO's desired role and capabilities in such domain. In particular, member states should agree on what constitutes an attack or harmful/irresponsible behaviour in Space. As noted earlier, striking such definitions is particularly problematic and has been hampering the progressive development of international governance efforts. Within NATO, however, it should be easier to reach such an agreement, in light of the Alliance's institutional leverages and the like-mindedness of its member states.

NATO has proven its ability to foster convergence among its members time and again – from the operational to the strategic level, from the standardisation of military requirements to the definition of common approaches to tackle crises. This should be achieved in relation to Space-related terminology and principles of behaviour, too. By doing so, NATO would score three important goals: supporting a more efficient implementation of Space capabilities; enabling more effective strategic messaging vis-à-vis partners and competitors; and potentially contributing to broader international efforts to govern Space. In fact, by agreeing on terminology and behaviours already within NATO, the collective West would be able to speak at other international fora, such as the United Nations, with a sole voice – hence acquiring greater bargaining leverage.

Second, participants in the Working Group have stressed the need to strengthen the NATO-EU partnership also in the Space domain. The two institutions have signed an increasing number of common declarations and policies, but their practical implementation could be improved also to the benefit of Space activities. Moreover, in such domain, the EU presents NATO with successful examples of normative and behavioural convergence. Work conducted under the European Defence Fund, the EU Space Surveillance and Tracking system, the Network of European Regions Using Space Technologies, as well as the drafting of an EU Space Strategy for Security and Defence are concrete instances of the possibility to foster convergence of views and capabilities across European capitals. These also testify to the existence of a working set of ideas on which select Western (read: allied) states agree already, and to the availability of Space-related capabilities, projects, procedures that could benefit NATO, too.

By taking stock of such EU-led processes, NATO could set up new procedures to push forward its Space agenda, un-tap allied capabilities, and contribute more decisively to transatlantic Space security. Yet to do so successfully, participants noted, the Alliance should tackle two standing problems: first, bureaucratic barriers and vested interests preventing the smooth communication between the two institutions should be overcome; second, and related, Western decision-makers need to escape prevailing thinking on US-Europe relations, which sees the latter as either completely autonomous from or totally dependent on the former. This dichotomous narrative hinders the synthesis of North American and European interests and prevents the creation of greater synergy across the Alliance.

Further reflections

The Working Group generated a series of additional observations, recommendations, and questions for the consideration of NATO's decision-makers.

To begin with, participants looked at the ongoing proliferation of dual-use Space capabilities and invited to reflect critically on whether such trend is structurally unavoidable, or civilian and military systems could be kept separated. Some noted that their separation could be achieved, but that would entail serious material costs and the potential risk of duplication. Yet efforts to reverse the entanglement of civilian and military technologies could also generate benefits: first, it would help make NATO's capabilities and intentions clearer to competitors, thereby increasing the predictability of the strategic environment; second, it might help governments regain greater agency in the Space domain, if they were to take on the responsibility to develop and deploy military capabilities – while the private sector's role were to be limited to the civilian sphere; third, and related, by limiting the integration of commercial products into the military supply chain, the vulnerability of critical Space capabilities vis-à-vis external shocks could be reduced.

Participants in the Working Group also noted that the development of an Allied Space posture should take into consideration the 'nuclear nature' of NATO and include a clear statement of the allied position on the matter of Space governance. Moreover, the implementation of such posture should be enabled by adequate levels of resources – including subject matter specialists, of which there's currently a lack in NATO's Command Structure –, as well as by greater transparency in the sharing of security-relevant Space-related information among the Allies.

Finally, participants stressed the continued relevance of two strategic imperatives, that NATO should consider in charting its course in Space and beyond. First, NATO decision-makers should strive to avoid over-

stretching the Alliance. In a world of limited resources, waning Western influence over global governance, and increasing great power competition, Allied should keep its ambitions and activities strictly adherent to NATO's military nature and the core tasks. That means, for example, that Space exploration should not fall into NATO's responsibilities, which could include the protection of critical infrastructures in orbits instead. Second, the development of a NATO Space posture should be an exercise in strategy-making, indeed, without falling into the contemporary trap of substituting strategy with plans. Planning for organisational overhauls, Space activities, and related partnerships outside of a coherent strategic framework would result in the aimless waste of resources.

Conclusion

Space is an increasingly important domain for the preservation of transatlantic security and, as such, it requires the development of a dedicated NATO strategy. The organisational adaptations implemented so far, and the verbal declarations accompanying them, qualify as positive yet insufficient steps towards the construction of a coherent, realistic, and sustainable NATO Space posture. Allies should engage in a deep reflection on what their interests in space are and how they should be pursued vis-à-vis competitors. On the basis of that, Allies should be able to identify adequate mechanisms for collective action in Space, also taking stock of the work being conducted in other Western fora, such as the EU. Critical transversal issues regarding the entanglement of civilian and military capabilities, intra-alliance transparency, and the proverbial balance between strategic goals and resources should be kept in mind, in order to not bring NATO's efforts in Space to a premature failure. The development of a NATO Space posture, grounded in a solid strategic outlook, is precondition for the Alliance to remain ahead of the curve and fulfil its core tasks effectively in a rapidly evolving world characterised by great power competition.

Photo credit: National Aeronautics and Space Administration

WORKING GROUP
II

NATO AND THE SPACE DOMAIN: COORDINATING NATIONAL CAPABILITIES AS A PATHWAY TO SUCCESS?

Mathieu Bataille - European Space Policy Institute (ESPI)

Introduction

Space has become a strategic topic whose political and military salience has been significantly raised in the past years. Most recently, the war in Ukraine has demonstrated the specific added value of space capabilities in a conflict characterized by an imbalance between two opponents, allowing weaker actors to withstand aggression.

NATO decision-makers are aware of the enabling nature of space for the conduct of war. In recent years, they have taken several measures to increase the involvement of the Alliance in space matters and make sure that NATO members do not miss the opportunities associated with these technologies. A space policy was adopted by NATO defence ministers in June 2019 (and a public version was released in January 2022); in December 2019, the Alliance officially recognized space as an operational domain. This was confirmed in the 2022 Strategic Concept, which lists the threats facing space systems and emphasizes the need to take measures to respond to them. In October 2020, NATO Allies agreed to establish a NATO Space Centre in Germany to support NATO operations and foster information exchange and coordination on space efforts (NATO, 2022a); and in 2023, a NATO Space Centre of Excellence was formally established to enhance space-related education and training, develop concepts and doctrine, and foster experimentation (NATO ACT, 2023). Finally, at the NATO Brussels Summit in June 2021, the Allies declared that an attack against space systems or from space could lead to the invocation of Article 5 of the North Atlantic Treaty, on a case-by-case basis. This was reiterated in the final *communiqué* of the 2023 Vilnius Summit, which also recognized that "maintaining secure use and unfettered access to space is key to effective deterrence and defence" and recalled the commitment taken by Allies to better share space data, products, and services (NATO, 2023c).

This evolution was triggered by the recognition that space capabilities have become increasingly crucial for the conduct of military operations while, in parallel, threats towards these systems have increased. According to the Alliance, space is a key enabler for action in other operational domains and must therefore be protected. Indeed, space systems are relevant for the military, across two different dimensions: "Space for Defence" and "Defence of Space" (Bataille and Messina, 2020).

"Space for Defence" relates to the multiplicity of applications derived from space systems that are used to support or enable the conduct of military operations on Earth. These applications are manifold. In the remote sensing area, Intelligence, Surveillance and Reconnaissance (ISR) is an essential tool providing situational awareness to support decision-making at strategic, operational, and tactical level. Space-based contributors to ISR are Earth observation capabilities (with different types of sensors) and signal intelligence (i.e., the interception of signals used for communication or other purposes). Similarly, space-based early warning is a specific technology detecting the launches of missiles through the heat they emit. This capability helps to better protect military forces and assets located in the targeted area. Meteorology is crucial to plan

operations through better knowledge of the environmental conditions. Beyond traditional meteorology, defence actors are now interested in getting information on the atmospheric, oceanic and space environment. In parallel, secure satellite communications enable the transmission of data and orders and the command and control (C2) of military units. These systems also allow to pilot and retrieve information from unmanned vehicles. Position, navigation, and timing (PNT) is a crucial capability to locate troops on the field and trigger precise and synchronized operations. PNT is also required for the use of precision-guided ammunition. Finally, given the role played by space systems, Space Situational Awareness (SSA) is increasingly sought after by military authorities, including for operations that are conducted on Earth. Indeed, SSA is a tool to protect the space assets on which these operations rely and provides intelligence on the presence of adversaries' satellites over an operational theatre, thus enabling appropriate measures (e.g., to conceal actions being prepared). The concept of SSA has recently evolved towards Space Domain Awareness (SDA), which consists of "detecting, identifying and characterizing space objects of interest in near real time, describing and understanding their behaviours, and connecting this information to underlying doctrines and related space systems" (European Commission and HR/VP, 2023).

The "Defence of Space" dimension refers to the protection of space systems against the proliferation of threats they are facing. Indeed, counterspace technologies, destructive or not, are being developed and fielded by potential adversaries of NATO to disrupt, damage or destroy space capabilities and deny the advantage provided by space. In parallel, there is an accelerated development of technologies with dual-use applications (e.g., rendezvous and proximity operations systems). These systems can serve civil and military purposes, and be used for both beneficial (e.g., repairing a satellite) and nefarious (e.g., disabling a spacecraft) purposes. Therefore, they create additional risks, as they could be deployed under civilian auspices but ultimately be used to target other countries' spacecraft. "Defence of Space" encompasses all the active and passive technologies aimed at enhancing the security of satellites, hence capabilities such as appropriate SSA/SDA or manoeuvrable spacecraft are relevant for this dimension.

Space is thus a key enabler to achieve military objectives and this centrality is expected to increase in the future. NATO will therefore need to continue counting with this domain and will have to develop or procure appropriate capabilities. While existing national capabilities of the Allies provide a good foundation, NATO is pushing forward several initiatives to connect them. Such initiatives may benefit from best practices developed in other contexts, like the EU.

The space capabilities of NATO Allies, a good foundation for the Alliance's space efforts

NATO is not a spacefaring organization. Although the Alliance had operated its own satellites for decades, a change occurred in the 2000s; since then, the Organization has relied on its members for the provision of space data. Nowadays, responsibility for the control and command of satellites are left to their national operators; however, the Alliance is the proprietary of ground stations and user terminals used to retrieve data from the space systems, thus giving it the possibility to control and select the recipients of these data.

Two major programmes were set up in the past decades to procure Satellite Communications (SatCom) services from selected NATO member countries. The first project, NATO SatCom Post-2000, ran from 2005 to 2019 and allowed France, Italy and the United Kingdom (UK) to sell the overcapacity of their national SatCom capabilities to the Alliance. The same countries, joined by the United States, then signed a Memorandum of Understanding to deliver the same service between 2020 and 2034. Overall, the Alliance

has planned to spend more than one billion euros during this period (NATO, 2020). In addition, NATO also gets SatCom capacity from other countries through dedicated agreements. For instance, in 2016, the Luxembourg firm LuxGovSat was awarded a contract to enable secure communication between the UAVs used for the Alliance Ground Surveillance (AGS) System and their ground segment.

NATO could afford to abandon ownership of its own systems and rely on its members because it includes the most advanced spacefaring nations. These nations have developed military, governmental and dual-use satellites for their own purposes, but they can also be beneficial to the Alliance. In recent years, some Allies have also displayed willingness to make the provision of space services part of their NATO contribution. Luxembourg is a prime example: on top of the LuxGovSat contract, the country announced that data from its next Earth observation satellite, LuxEOSys, will be provided to the Alliance. Moreover, in 2023, an agreement was signed between Luxembourg, the United States, and NATO; under this 10-year program, Luxembourg is acquiring 195 million euros worth of capacity from SES' O3b mPower constellation to put it at the disposal of NATO (Rainbow, 2023).

To understand the capabilities on which NATO can rely, it appears therefore necessary to get an overview of the space assets of its members. The table below presents the spacecraft currently owned and operated by NATO Allies, which have a declared military purpose. These spacecrafts are either fully military or dual-use capabilities publicly used for military applications. The list excludes spacecraft launched for technology development. Some of them may have been funded, developed or operated by several nations together; in that case, they are listed with the primary owner and other involved NATO members are specified.[1] Moreover, although they are not presented in the table, it is worth noting that Allies can provide space support to NATO through purely civil governmental satellites as well.

Table 1: List of NATO members' national military space capabilities in orbit as of 30 October 2023 (source: UCS Database/ESPI Launch Database)

	Remote sensing	Satellite communications	PNT
Denmark	1		
France	13 (inc. with Italy, Belgium, Spain and Greece)	5 (inc. with Italy)	
Germany	6	2	
Italy	7	3 (inc. with France)	
Luxembourg		1	
Spain	1	3	
Türkiye	2		
United Kingdom		6	

[1] Non-NATO members can also be involved in some of these programs but, for the sake of clarity, they are not mentioned here.

United States	71	73 (inc. with Canada, Denmark, Luxembourg, Netherlands and the United Kingdom)	35

In addition to institutional satellites, it is likely that NATO members will increasingly rely on commercial actors to serve their defence objectives, either through specific partnerships or the direct purchase of data and services. The latter trend is growing in the Western world, and the war in Ukraine has emphasized the added value of private actors to anticipate, plan, and react to a crisis (e.g., Starlink allowed to restore communications of the Ukrainian military after the disruption of existing infrastructure). Commercial space is thus becoming part of the military decision-makers' toolbox. As a consequence, NATO will also enjoy the benefits provided by these actors, either through its members or by directly procuring their services. This is even more likely as a large part of the most successful companies come from or are based in NATO members' territories (e.g., SpaceX and Maxar in the United States, ICEYE in Finland). Whether these private capabilities should remain complementary or become the backbone of operations (at least for some activities) remains debated, but their added value is recognized across the Alliance, which will likely lead to their increased exploitation.

NATO can therefore rely on the institutional satellites developed by its members, but also on the 'firepower' of their commercial space ecosystem. However, the integration of space into NATO operations can still be enhanced and interoperability between the different stakeholders could be improved. This raises questions about the steps that NATO can actively take to improve its involvement in space activities and grasp all the opportunities they offer.

The future of NATO in space: leveraging existing capabilities

When space was declared an operational domain in 2019, NATO's Secretary General Jens Stoltenberg was careful in clarifying that the Alliance does not plan to develop offensive capabilities, that is, capabilities in space or on Earth that would be able to disrupt, damage or destroy other nations' spacecraft. Yet some NATO Allies are openly developing self-defence capabilities which, if they are not designed to attack other satellites, would protect assets in orbit, in particular through better monitoring of their immediate surroundings. Such information could then be used to call upon other nations for their potentially threatening actions. At NATO level though, the short-term evolution and growing involvement in space capability development is likely to focus on one mission: "ensuring effective provision of space support and effects to the Alliance's operations, missions and other activities" (NATO, 2022b), i.e., "Space for Defence".

The NATO Space Policy released in 2022 provides some details on what the Organization plans to do when it comes to the development of space capabilities. On the one hand, the Policy underlines the importance of national assets and the "full authority and sovereignty" that Allies retain on them. On the other hand, to make the most of these capabilities in the context of the Alliance, it is necessary to ensure that data, products and services coming from different stakeholders (governments, industry) can be easily used by the armed forces. Therefore, it appears necessary to develop solutions to combine them, which raises questions regarding the compatibility and interoperability of the different systems used. This is where NATO could play a role, hence the integration of the space domain into its capability development programs (NATO, 2022b). To reach these objectives and encourage a cooperative approach to space between Allies, NATO has set up

several initiatives. Two of them are particularly meaningful: the Alliance Persistent Surveillance from Space (APSS) and the Strategic Space Situational Awareness System (3SAS).

The Alliance Persistent Surveillance from Space (APSS)

The APSS was set up in 2022 and formally launched in February 2023 (Davis, 2023), with the signing of a Letter of Intent between eighteen countries and an initial contribution of 16.5 million euros provided by Luxembourg.

This initiative takes stock of the evolution of the Earth observation (EO) sector, in particular, to serve security and defence objectives. Actors from this domain making use of EO capabilities to perform their missions express a growing interest in multisource information (in terms of sensors but also integrating new approaches such as OSINT), push for more integration between space and terrestrial (including uncrewed aerial vehicles (UAVs), High-altitude platform station (HAPS), aircraft, radars, etc.) intelligence-gathering means and consider data fusion as a must-have to provide added-value products.

The APSS takes all these changes into account. In line with NATO's approach, it does not plan to develop NATO-owned space hardware but rather to interconnect existing systems: in this sense, APSS is a "data-centric" initiative, which is "sensor-agnostic and solution-agnostic" (NATO, 2023b). It will enhance NATO's space-based surveillance and better integrate space in NATO's intelligence ecosystem, with the primary objective to support the conduct of NATO operations. APSS is, therefore, an intelligence-driven initiative, and will not include any component related to action in space. Overall, the initiative will "help streamline data collection, sharing and analysis among NATO Allies and with the NATO command structure, while generating cost savings" (NATO, 2023a). Indeed, NATO representatives realized that a wealth of ISR data was produced by space assets and could be better exploited to fill the gaps identified at operational and strategic level, even though ISR data sharing was already occurring among Allies. The relevance of EO data in the war in Ukraine gave additional impetus to this assessment.[2]

Facing this reality, the APSS was conceived. The initiative has three dimensions: a political one (managed by the International Staff), a military one (managed by SHAPE, with a more operational perspective), and a technical dimension (with the involvement of the NATO Communication and Information Agency, NCIA). Specific objectives of the initiative are the following (NATO, 2023b):

- Achieve "persistent surveillance", that is allowing NATO to collect data on any location at any given time;
- Increase space-based intelligence sharing across the Alliance, leading to a more comprehensive cross-domain intelligence picture necessary to inform political decision-making and military operations;
- Improve NATO's overall intelligence through a more effective use of both government-owned and commercial space-based assets, technologies, and data;
- Increase the speed at which space-based data is collected, aggregated, and delivered by leveraging new technologies like Artificial Intelligence (AI) and machine learning tools;
- Ensure that data is in usable formats for NATO decision-makers and military commanders;

[2] Interview with NATO representative

- Build, through training, education, and cooperation, a community of practice among NATO nations that will increase data management efficiency and enhance national and collective resilience.

In this view, capability development will happen first and foremost at the ground level to collect, process and fuse the data received from institutional and commercial satellites through the establishment of a virtual constellation called Aquila. The first calls for industry participation in the APSS were published in 2023. The technical implementation of Aquila will initially rely on the Luxembourg contribution and be implemented by the NCIA.[3] Allies will be able to contribute to the APSS in three main ways: by providing data, analytic capacity, or monetary contribution. In the near future, it is expected that a Memorandum of Understanding will be signed between participating countries and NATO, thus making the whole framework more solid.[4]

The Strategic Space Situational Awareness System (3SAS)

While the APSS addresses space-based systems monitoring the ground, NATO is also interested in developing its capabilities in space surveillance. As previously explained, SSA is a must-have to conduct operations in space but also brings major added value in the planning of operations on Earth. Several NATO members own ground-based SSA capabilities (e.g., France, Germany, the United States), including some directly managed by military actors; a few countries also have developed spacecraft dedicated to the surveillance of other objects in space (e.g., the United States with the Geosynchronous Space Situational Awareness Program).

In this context, NATO launched a pilot project called the "Strategic Space Situational Awareness System". The project benefits from a contribution of Luxembourg amounting to 6.7 million euros, which was formalised through the signature of a Joint Statement in 2021. As expressed by NATO Deputy Secretary General Mircea Geoană, the objective of 3SAS is to "better understand space objects and space events, and their effects across all domains" (NATO, 2021). More precisely, according to the Minister of Defence of Luxembourg Francois Bausch, "it will further improve NATO HQ and Allies ability to efficiently detect and track human-made and natural threats, predict and assess the risks involved and support mitigation measures protecting space and ground assets" (NATO, 2021).

The 3SAS initiative will, therefore, support freedom of action in space but contribute as well to the work of the Situation Centre of NATO, in particular its Geospatial Section. However, it is worth noting that 3SAS remains a decision-making tool dedicated to informing decisions taken at the Council, and not an operational instrument. An additional objective of this initiative is to increase coordination, cooperation and data sharing among Allies in this field. The project will also rely on private companies, in and outside the defence sector, to help with the development of relevant technologies. Therefore, it is in line with the ambitions expressed by the NATO Space Policy.

Other initiatives

In addition to the APSS and the 3SAS, NATO will expand its access to space capabilities through other ongoing initiatives.

[3] Ibid.
[4] Ibid.

First, with the MEO Global Services (MGS) program (already mentioned), the United States and Luxembourg will contract SES and its O3b mPOWER constellation to provide SatCom services for NATO operations in the next ten years. This program is conducted through the Alliance's "support partnership" framework: participating nations define their requirements together but request the NATO Support Procurement Agency to contract the services on their behalf. Using such a framework also allows other countries to join if they wish.

Second, the NATO Science and Technology Organization implements the NATO Alliance SmallSAT Constellation (ALLSAT), a "research activity aimed at developing a 3-ball nationally-owned satellite constellation as a testbed for collaborative S&T and experimentation in low-Earth orbit. Each satellite in the proposed constellation would carry three S&T payloads – a space weather sensor, an optical sensor for space domain awareness and an optical communication payload for the ALLSAT constellation – and the entire system would be owned by Nations" (NATO Science and Technology Organization, 2023). This project has two primary objectives: accelerate technology development among Allies and ensure interoperability of the future military capabilities on which NATO will rely. The expected date of launch for these spacecrafts is 2024.

Finally, NATO funding entities will also support space projects. Thus, both the Defence Innovation Accelerator for the North Atlantic and the one billion euros NATO Innovation Fund have identified space as a domain of interest for their activities and could, therefore, contribute to the development of future space capabilities.

Overall, NATO supports the development of cooperation and coordination on space affairs between its members and wants to foster the interoperability of their capabilities. Indeed, the main objective of the Alliance is not to develop capabilities *per se*, but to get and transmit data that is useful for its operations. In this sense, APSS and 3SAS illustrate the move from a "platform-centric" to a "data-centric" approach, and from a focus on ownership to access to data. This shift and the greater involvement of NATO in space will lead to the necessity of sharing more data between Allies. To this end, the NATO Space Policy asserts that one of the key roles of the Alliance is to "facilitate the development of compatibility and interoperability between Allies' space services, products and capabilities" (NATO, 2022b). Although the crucial nature of this endeavour was acknowledged by the Allies at the latest Vilnius Summit, this is a challenging task that will heavily depend on the goodwill of nations. First, NATO has not managed space projects for almost two decades, which can lead to limited expertise on these matters. Second, Allies are currently not equally aware of the importance of space for military operations and do not all enjoy the same level of capabilities. Therefore, their interests in space may not always be perfectly aligned, an issue that the NATO Space Policy is targeting but will take time to solve. To help NATO succeed, it is relevant to look at similar efforts conducted by other organizations and identify the best practices that could be transposed to the Alliance. For instance, the European Union has been working for years to establish cooperative projects in the field of space, and some of them could be used as potential models for NATO initiatives.

The European Union, a relevant model for NATO initiatives

The EU is a growing actor in space and is increasingly linking its space activities to security concerns. Several projects have emerged in recent years, be it in the context of the Permanent Structured Cooperation (PESCO), the European Defence Fund (EDF) or the European Defence Agency (EDA). Most of them aim to incentivize greater cooperation between EU Member States, including for the research and development of new military space capabilities. On top of these recent initiatives, more established frameworks also exist, which could

prove a valuable source of inspiration for NATO ambitions. Some of them are similar to the efforts undertaken by NATO with the APSS and the 3SAS, which makes the comparison relevant. The remainder of this paper will analyse two EU entities/initiatives: the EU Satellite Centre (SatCen) and the EU Space Surveillance and Tracking Partnership (EU SST).

The EU Satellite Centre (SatCen)

The SatCen was created in 1992 by the Western European Union and incorporated as an EU agency in 2002. It is under the supervision of the Council of the EU, but its operational direction remains the responsibility of the High Representative/Vice-President (HR/VP) of the European Commission, who is in charge of managing the Common and Foreign Security Policy of the Union (CFSP), including the Common Security and Defence Policy (CSDP). The main mission of the SatCen is to support the decision-making and action of the EU and its Member States through the provision of geospatial intelligence products and services. It can also support other international organizations. The SatCen is the entrusted entity delivering the Support to EU External Action (SEA) component of the Copernicus Security Service and supports Frontex in the delivery of the Border Surveillance component of the same service. Finally, it also carries out research and development (R&D) activities to support its operational activities.

In the context of the war in Ukraine, the SatCen was asked by the HR/VP to provide geospatial intelligence to Ukrainian authorities immediately after the Russian invasion in February 2022 (Reuters, 2022). It has delivered intelligence to EU decision-makers during the conflict, for instance about the destructions in Bakhmut and Mariupol, the consequences of the destruction of the Kakhovka dam or the risks around the Zaporizhzhia nuclear power plant. These analyses were also shared with Ukraine (EEAS, 2023). Therefore, the SatCen directly contributes to the definition of EU position and actions and to Ukrainian decision-making in this conflict.

The SatCen does not own any spacecraft, and images from the Copernicus program are only used in the context of the SEA. Otherwise, the SatCen relies on open-source information, national spacecraft in the framework of existing agreements, as well as commercial capabilities, like NATO plans to do with the APSS. It also exploits non-space data, such as aerial imagery and collateral data, to strengthen its analyses and prepare its products.

Commercial actors constitute the main source of data for the SatCen, which makes an increasingly extensive use of their services to provide a situational picture that is as complete as possible. Therefore, the SatCen has signed agreements with various companies to guarantee access to their imagery in a secure manner and respect its confidentiality requirements (e.g., about its areas of interest).

The SatCen can also benefit from governmental capabilities through several agreements signed with EU Member States possessing relevant space assets for its activities. Thus, it receives images from France's Helios 2 and CSO, while classified direct links have been established with Italian COSMO-SkyMed first and second generations as well as with the German SAR-Lupe and SARah ground segments (Bataille and Messina, 2020). However, the provision of data coming from national military spacecraft depends exclusively on the wish of the country operating the asset, which may be reluctant to do it for national security or confidentiality

reasons.[5] Moreover, the delivery process for these data takes time, while users increasingly want near-real-time information.[6]

Figure 2: Space sensors and archive imagery accessible by SatCen (source: EU Satellite Centre, 2023):

Once raw data is collected, a dedicated team processes the images, which are then delivered to the analysts (EU Satellite Centre, 2023). Depending on the request (especially if it does not require a complex analysis), the Centre can also make use of data already processed by the provider. SatCen chooses the best way to respond to the user's demand and delivers the appropriate products: they usually consist of images and their analysis to facilitate their understanding by the requesting organization.

The SatCen interacts with a multiplicity of potential users, a challenge that the APSS will also face. To overcome this difficulty, a clear process has been established to guarantee the efficiency of the Centre. Every year, an annual Plan is set up to manage the different requests that are already known and establish a balance between the different priorities of users. A harmonization of the initial set of requests takes place in order to avoid overlap and redundancy between them, and EEAS representatives perform a prioritization of these requests. This allows SatCen to start the year with streamlined guidelines for its activities but, of course, the Plan is then adjusted to adapt to potential unexpected events, as was the case with the start of the war in

[5] Interview with a SatCen representative
[6] Ibid.

Ukraine in 2022 (EU Satellite Centre, 2023). At a technical level, SatCen is increasingly working with open standards to address the diversity of its users.[7]

The EU Space Surveillance and Tracking Partnership (EU SST)

The EU SST Partnership is a framework allowing 15 EU Member States[8] to collectively provide data from their ground-based and space-based sensors to survey and track space objects, as well as processing capabilities to analyse the data and deliver related information. The EU SST provides three types of services for collision avoidance, re-entry analysis, and fragmentation analysis. Since the beginning of 2023, these services have also been open to non-EU users under specific conditions.

The EU SST was created in 2014 and a consortium of five original participating Member States[9] was established in 2015, which then extended to seven in 2019. In 2022, the Consortium evolved into a Partnership and welcomed eight more States. The Front Desk of the EU SST, which operates the portal delivering the services, used to be managed by SatCen before transitioning to the EU Agency for the Space Programme (EUSPA) in 2023. These evolutions show that the EU SST is a flexible framework able to integrate an increasing number of participants, a characteristic that may be of interest to the 3SAS initiative of NATO. Indeed, SSA/SDA-related initiatives are strengthened when the number of their contributors increases, as well as the diversity and location of the sensors used.

To become a member of the EU SST, EU Member States must submit an application to the European Commission to demonstrate compliance with two main criteria: the ownership or access to SST sensors or operational analysis or data processing capacities; and the establishment of an action plan for the implementation of the actions supported by the framework. The Partnership relies on national capabilities, which remain fully under national control; therefore, Member States are also responsible for their maintenance, operations, and renewal. The governance of the Partnership is led by Member States and leaves room for gradual networking of their capabilities, while giving responsibilities to the European Commission (the EU SST being a sub-component of the EU Space Programme). The Commission's responsibilities are mostly related to the admission of new members and the determination of the actors entitled to access the EU SST services.

To provide the services, the original participating countries have shared the work and specialized in one of the following activities: sensor networking, data processing, or service provision.[10] National Operations Centres (NOCs) lead the operations. In particular, they use the unclassified SST data that is pooled and shared in a central platform, the EU SST Database. The Database also enables the management of sensor tasking and provides additional information (e.g., status of the current network). To generate the three services, the original participating countries also use the data they have in their national databases and those of the other members of the Partnership. These services are delivered via the SST Service Provision Portal, which is

[7] Ibid.

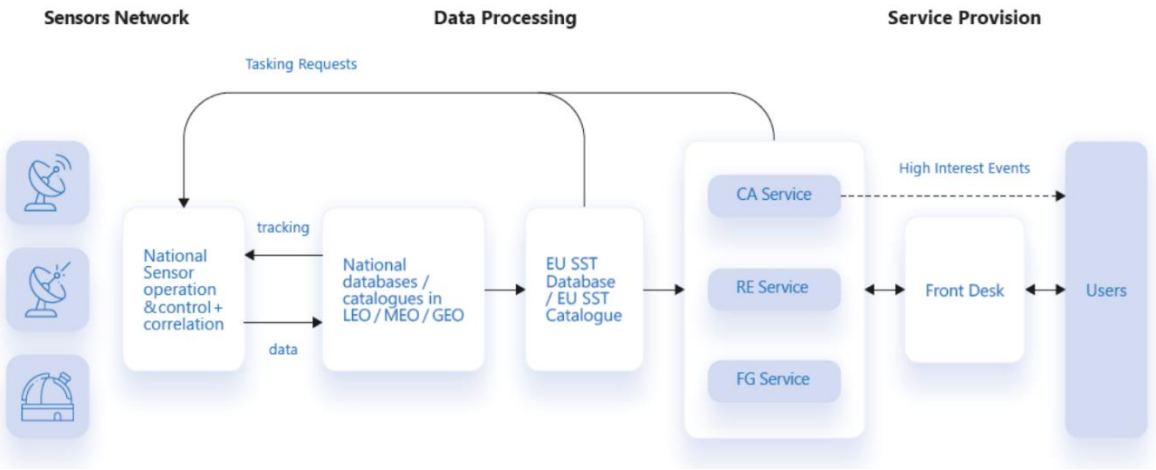
[8] Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Spain, and Sweden.

[9] France, Germany, Italy, Spain, and the United Kingdom (which left the EU SST after Brexit)

[10] To keep the governance and service provision model efficient and agile without interruption, countries that have become members of the EU SST afterwards mostly share data from their sensors but are not involved in the processing or generation of the services.

managed by EUSPA. Through this Portal, EUSPA oversees the distribution of SST services to all users and conducts activities on dissemination and performance reporting.

Figure 3: EUSST Architecture (source: EUSST website)



Several of the capabilities used to provide data to the EU SST are owned and operated by the armed forces, thus raising concerns at national level regarding the security of data sharing. To overcome this difficulty, a specific process has been implemented. Data are vetted at national level before being transmitted to the EU SST Database. However, a fully revised Data Policy agreed in December 2022 allows the sharing of 'raw' sensor measurements, for which vetting at national level is not anymore required; instead, the sensitivity of these data is determined at the level of the EU SST Database and Catalogue and, once the appropriate security measures implemented, data are integrated for the generation of EU SST services. In addition, a dual governance has been established, with involvement of the military. Indeed, although each Member State nominates one representative to the Partnership (most often from the national space agency), they are supported by a representative of the armed forces, ministries of defence, or national security agencies in the Security Committee. This Committee makes sure that SST data and information are exchanged in a secure manner, and designs and monitors security-related and data policy issues. A similar body would be of particular interest to alleviate the potential concerns of NATO Allies willing to participate in the 3SAS.

Commercial actors also provide data to the Partnership through contracts with Member States and funding of the EU. There is currently a willingness to increase this contribution. Therefore, together with the European Commission, the EU SST launched the first session of the EU Industry and Start-ups Forum (EUISF) on STM in April 2022. The main objective of the Forum is to foster "the innovation and competitiveness of the SSA's commercial sector to achieve a higher level of strategic autonomy in Europe" (EU SST, 2022).

Drawing lessons from EU initiatives

EU efforts in pooling and sharing capacities from its Member States and the private sector can provide useful lessons for the implementation of NATO initiatives in space. Indeed, the APSS and 3SAS are in their infancy, and their structure can still be shaped.

First, NATO must make sure that the frameworks it is proposing bring actual added value compared to the outcomes that would be reached through national efforts only. For instance, they could deliver targeted analysis via products dedicated to specific users or collect and integrate data from scattered sources that are complementary to each other.

Second, requests to receive the data, services, and products should be made through a unique system centralized at the NATO level in order to facilitate the access of users to the desired information and encourage them to adopt the system. In addition, arrangements for data exchange should be established before a crisis occurs, to make sure that established processes are up and running when they are actually needed.

Third, data coming from national assets should be shared on a voluntary basis to overcome any potential reluctance from allies and, to incentivize NATO members to contribute, appropriate measures should be taken to guarantee the security of the data exchange process (e.g., creation of a Security Committee and elaboration of a Data Policy for each initiative).

Fourth, the established frameworks should be flexible enough to accommodate new partners even after their creation and facilitate their integration and contribution to the joint effort.

Fifth, private actors from both traditional and emerging spacefaring nations should be involved in order to increase the quantity and quality of data received while supporting the economy and innovation in NATO member countries. To this end, NATO needs to expand its links with the space industry, which remains limited at the moment. The establishment of specific mechanisms to foster this relation, such as the recently announced Spacenet network, may be a first step.

Finally, NATO would likely benefit from liaising with other similar initiatives to directly benefit from their experience and create synergies with their own activities. Close cooperation would also allow to avoid unnecessary duplications, a risk that may appear given the current objectives of the APSS and 3SAS. For instance, in the latter initiative, the actual interest of NATO stakeholders is related to SDA (i.e., the exact mission of an object) more than the safety dimension of SSA (e.g., avoiding collisions). Cooperating with existing initiatives such as the EU SST could convince militaries to use these ones while enabling the 3SAS to focus its resources on one specific mission: identifying the limited number of objects of military interest and gathering required intelligence on them to benefit military missions.

Conclusion

Due to the enabling function of space for military operations, NATO has a vested interest in enhancing its involvement in this domain. At the same time, the Organization has clearly expressed that it will continue to rely on national assets. Consequently, the main issue consists of finding solutions to improve interoperability and data-sharing across various capabilities and 31 countries. Experience from other joint multinational efforts involving a large number of partners, such as those carried under the umbrella of the EU, can prove to be a relevant guide for action for the Alliance. However, when delving deeper into the space domain, NATO must be aware of a few additional elements.

First, beyond purely military capabilities, it is likely that NATO member countries will increasingly rely on dual-use capabilities (i.e., systems serving both civil/commercial and military missions). The Alliance should

support the development of such capabilities by its members as it will serve its missions without straining the militaries' financial resources. In addition, NATO could encourage the diversification of the space capabilities developed by its members. Indeed, such diversification could lead to a "division of labour" (as occurs in the EU SST, for instance), which would strongly incentivize countries to cooperate to access a greater variety of data, products, and services (Palombi, 2023).

Once capabilities will be fielded by participating countries, NATO should verify that they are operable, in particular by making sure that allied forces are able to use them properly due to appropriate training, exercises and wargames. The overall understanding of space within NATO needs to be improved at all levels (policymakers, military leaders, etc.) and the relevant measures should be implemented. It also appears necessary to ensure that NATO has the required workforce to deal with an increasing role of space in the activities of the Alliance. So far, 85 people are expected to be dealing exclusively with the space domain by 2030, which is clearly not enough and does not match the ambitions of the Alliance.

Finally, the increasing reliance of NATO on space means that it will need to convince its members to better protect their space systems ('Defence of Space'). This could lead to other capability development programs, this time focusing on operations in space. Some NATO members are already carrying out such projects, but how it can benefit all Allies remains to be seen.

References

Bataille, Mathieu & Valentine Messina (2020), "ESPI Report 72 - Europe, Space and Defence - Full Report". European Space Policy Institute.

Davis, Gordon (2023). "The future of NATO C4ISR: Assessment and recommendations after Madrid".

EEAS (2023). "The EU Satellite Centre: the EU's eyes in the sky".

EU Satellite Centre (2023). "SatCen annual report 2022".

EU SST (2022). "First European Union Industry and Start-ups Forum on STM event in April".

European Commission and High Representative of the Union for Foreign Affairs and Security Policy (2023). "European Space Strategy for Security and Defence".

GOVSATCOM 2023 (2023). "Welcome Speech & official opening from Luxembourg Department of Defence Minister, Francois Bausch".

NATO (2020). "NATO begins using enhanced satellite services".

NATO (2021). "NATO and Luxembourg boost Alliance Space Situational Awareness".

NATO (2022a). "NATO's Approach to Space".

NATO (2022b). "NATO's overarching Space Policy".

NATO (2023a). "16 Allies, Finland and Sweden launch largest space project in NATO's history".

NATO (2023b). "Alliance Persistent Surveillance from Space (APSS) – Factsheet".

NATO (2023c). "Vilnius Summit Communiqué".

NATO ACT (2023). “Lift-off, NATO Launches New Space Centre of Excellence”.

NATO Science and Technology Organization (2023). “2022 Highlights”.

Palombi, Emma (2023). “NATO’s Role in Space: How and Why NATO Member States Should Expand Their Purpose and Capabilities in Space”. Journal of Indo-Pacific Affairs, May-June 2023.

Rainbow, Jason (2023). “Luxembourg approves program to give NATO O3b mPower access”.

Reuters (2022). “EU to help Ukraine with intelligence from own satellite centre-EU's Borrell”.

Union of Concerned Scientists (2023). “UCS Satellite Database”.

SPACE: A NEW FRONTIER FOR NATO'S DEFENCE

Juliana Suess - Royal United Services Institute (RUSI)

Abstract

NATO, like other advanced military forces, relies on space for the full extent of its military capabilities. From navigation and communications to meteorology and reconnaissance, space is vital for modern defence. The denomination of space as an operational domain by the Alliance in 2019 simply formalized what was already known: that space was fundamental to operations but, further, could itself become an environment at risk through the use of counterspace measures and weapons. With this recognition came the decision of how NATO was going to handle space: not owning any space assets themselves, the Alliance would rely on its Member States to put forward capabilities such as Satellite Communications (SatCom) and space-based remote sensing. This triggers questions around how these capabilities will be integrated and ultimately, become compatible with members' other capabilities. Further on from compatibility, there is the remaining question about how information can be shared appropriately. While this remains an obstacle, the war in Ukraine has shown that classification and bureaucracy problems can be overcome if the need arises. The utility of space assets further renders them a potential target that needs to be protected - and attacks to which must be deterred. For these reasons, space situational awareness (SSA) capabilities, collective threat assessment processes and resilience measures must be considered.

Introduction

A modern military cannot function without access to space and without the many functions and assets that space enables. Space has been used in modern-day conflict since the 1990 Gulf War, when US troops made use of GPS for their infantry and artillery movements for the first time (Greenemeier, 2016). Fighting forces hardly looked back after that watershed moment – space has become tightly entangled with today's military technologies – UK Space Power Doctrine clearly stating that "the vast majority" of its operations rely on space (UK Ministry of Defence, 2022). While the intersection of space and the military often seems like science fiction at first glance, the oxymoron lies in the fact that the entanglement of space with other military domains, such as land, air and the maritime, usually consists of routine logistical matters, such as navigation, communication, and intelligence gathering.

The very utility of space for militaries also renders the domain a potential target area: space systems could become targeted themselves in order to disrupt or deny access to such an essential service as GPS. Space systems generally consist of the satellite in orbit, the ground station on Earth and the data links in between the two (uplink sending towards the satellite and downlink sending towards the ground station). All elements of these systems are potentially vulnerable and can be targeted by a number of counterspace weapons and measures. In this way, disruption to a space system may take the simple shape of a data signal not reaching its destination.

Recent policy developments make clear that space is important to NATO and that its importance to the future of defence as both a capability enhancer and a potential risk has been recognized. The 2023 *communiqué* states that space plays a critical role in security and economic terms, which is also "increasingly contested" (NATO, 2023). Not only has it made clear that its deterrence and defence posture is supported by space and access to the domain, but it also reiterated during the Vilnius Summit in July 2023 that an attack to, from or within space could ultimately invoke Article 5 of the Washington Treaty (NATO, 2023).

This paper will outline NATO's approach to space before delving into the obstacles that the Alliance may encounter when integrating space further into its military operations. By relying on its Member States to supply space capabilities, the Alliance's burden sharing has gained a new dimension that must be taken into account for future decision-making and planning purposes. A fast understanding of the situation is vital in every operational domain, but the risk of miscalculation in space is higher due to the at times subjective nature of space situational awareness, lending further importance to informed decision-making. What will become essential for NATO will be increased integration and compatibility of assets among alliance members. Alongside streamlined information sharing, space threats can thus be understood better, and decisions can be taken faster. Lastly, this will limit vulnerabilities and strengthen resilience through redundancy.

The NATO approach to space

While militaries active as part of NATO missions have been relying on space during operations, space was also formally declared an operational domain in 2019 (NATO, 2019). What followed was the declaration of a NATO approach to space in 2021 (NATO, 2023). It outlined how NATO was going to make use of space – by not acquiring its own satellites (as it once had in the 1970s) but by instead relying on its Member States to put forward its capabilities as and when needed.

Satellite Communications

The main functions that space supports are the bread and butter of defence logistics: communications, navigation, Intelligence Surveillance and Reconnaissance (ISR). In terms of satellite communications, NATO relies on a select group of its allies to provide the capability. A memorandum of understanding between France, Italy, the UK and the US will provide NATO with SatCom services until the end of 2034 (NATO, 2021). The national satellite systems SYRACUSE (France), SICRAL (Italy), Skynet (UK) and WGS (US), supplemented by commercial providers in Luxembourg and Norway, form NATO SatCom Services 6th Generation (NSS6G) and cover super high frequency (SHF), ultra-high frequency (UHF) and extremely high frequency (EHF) bands. The capability is run by the NCIA, which previously managed the SatCom satellites that were owned by NATO (NATO, 2019). In this way, the program is managed in a central location with legacy knowledge. This means that, in theory, existing expertise is being built into new structures, allowing for continuity and preventing gaps as new systems are being incorporated.

ISR

Meanwhile, space has become an important part of ISR. Not only can space assets overfly certain areas multiple times a day, thereby being able to monitor certain areas over time, but they also have the further benefit of not having to enter hostile airspace. Similar to its ability to use SatCom, there is a streamlined process for intelligence gathering and surveillance analysis, called Alliance Persistent Surveillance from Space (APSS). This was formed by 16 member States in February 2023 and the virtual constellation "Aquila" is made up of both national and commercial assets (NATO, 2023). The constellation is meant to allow for "persistent surveillance", allowing for fast data collection anywhere (NATO Factsheet, 2023). The project promises that the system will help with "comprehensive cross-domain intelligence" meant to speed up decision-making at the political and military level, while also ensuring the data is accessible (NATO Factsheet, 2023). Further, the use of AI as part of the system is meant to increase the speed of the collection and delivery of the data, while it is promised that training and cooperation will form "a community of practice", positively impacting how data is handled and ultimately increasing resilience (NATO Factsheet, 2023). If the system does as promised, then Aquila will become more than the sum of its parts: rather than just functioning as an asset providing services, the aim is to create a truly integrated data (sharing) approach by incorporating a common asset. A change in the data-sharing processes of NATO, through a system that stands at its centre and is inherently joint rather than owned by any Member State, could prove a real game-changer for the Alliance. This is not just potentially transformative for space: it is meant to further aid the digital transformation and the NATO 2030 agenda (NATO Factsheet, 2023).

Navigation and Early Warning Missile Defence

For navigation, NATO uses the US system GPS, which is used as the default navigation system by Western States (Vasen, 2019). Meanwhile, the US provides NATO with its space-based early warning data for NATO's permanent ballistic missile defence mission. This means that NATO is already receiving this data live, as US forces would (Air Force Space Command, 2012).

Logistical Structures

While pulling together resources, such as SatCom and ISR, into coalitions, NATO further carved out a logistical nerve centre for space: for "education and training, analysis and lessons learned, concept development and experimentation, as well as doctrine development and standards", the NATO Space Centre of Excellence was set up in Toulouse, France and is the educational focus point on space (NATO, 2023). Meanwhile, the operational focus point for space remains with the NATO Space Centre as part of NATO's Air Command in Ramstein, Germany (NATO, 2023). This is also where coordination and information sharing for the domain takes place (NATO, 2023).

It must not be forgotten that the aforementioned structures still underlie the political structures within the Alliance. In particular, the Space Centre sits under the Supreme Headquarters Allied Powers Europe (SHAPE), which leads nine operational commands, but which ultimately reports to the political level (NATO, 2023). This means that space is not unique in how it is being managed – ultimately, it is the individual Member States who decide which of their capabilities they will put forward. While NATO is currently covered well in terms of the space capabilities volunteered (specifically in the ISR and SatCom areas), only time will tell if space becomes more of a priority for other members, who are currently not contributing capabilities. As has

been already pointed out by several experts, different threat perceptions in countries leads to different defence prioritisations (McKay, 2022). In this sense, space capabilities are not unique but fall in line with the rest of the military capabilities volunteered by NATO Member States: priorities will be different depending on each state.

With space being a newly declared domain within the Alliance, many NATO members, including the US, France, Italy and Germany, have only recently established their respective Space Commands, often under the administrative wings of their Air Forces. Space strategies and policies are either in the works or newly published (e.g., Germany, UK), and while space has been a part of the defence for decades, it is clear that thinking around space and its integration into military forces is still developing. This means that NATO members range from fully-fledged space powers (such as the US) to those who are still developing into space powers. These different rates of maturity mean that the relative threat perceptions are going to diverge. Specifically, countries that do not have sovereign assets and or do not conduct SSA on a large scale may not prioritize the in-orbit threats as much. Part of this will change with time, as space becomes more integrated on an alliance level, with space evolving to become part of a shared threat perception. Heightened awareness will further evolve with increased information sharing and the coordination of threat assessments. This has two benefits: not only do emerging space powers get to benefit from the expertise and capabilities of established space powers, but they also further practice a nature of joint decision-making, which will enable the Alliance to make informed decisions faster.

The Challenges of Interoperability

When pooling together these resources, the challenges faced by the Alliance include those of integration and compatibility to guarantee interoperability. Integration with NATO assets and architecture, specifically in the realm of SatCom, will need to be considered as part of the future force development of Member States. This ranges from the strategic level all the way down to the tactical one and the procurement of technologies that are able to "talk to each other". The problem is not unique to space, and communications infrastructures are notoriously difficult to merge and integrate due to different security systems and modernization standards – for example, even while the hardware used may be the same, interoperability could still be hindered by the fact that the security keys underlying those structures are different (RAND, 2019).

Another problem that underlies the collaboration for communications is differing levels of classification and standards surrounding information sharing. This is particularly difficult in the domain of space. DeAnna Burt, Deputy Chief of Space Operations at the US Space Force, has highlighted this problem around information sharing, stating that security restrictions prevent the US from sharing information about space systems and in-orbit threats with allies outside of the Five Eyes intelligence alliance (Erwin, 2023).[1] With renewed efforts and commitments to share information in the cyber domain, there is hope that this may also spill over into strides in the space domain (NATO, 2023).

Evidence for space being a particularly difficult area to share information has been the difficulty in sharing information gathered through space assets at NATO level (Single, 2008). Similarly, the extreme sensitivity of space programs is hindering discussions within the US defence circles. As of autumn 2023, the US Department of Defense was late in reporting to Congress on whether further programs could be declassified in the spring

[1] The Five Eyes Intelligence Alliance consists of the US, the UK, Australia, New Zealand, Canada.

of 2022. Part of the process involves removing bureaucratic barriers that allow further conversations within the services, but also with the hope that more productive conversations with the commercial industry might become possible as a result (Hadley, 2023).

The fact that bureaucracy can be worked in emergency situations became evident during the war in Ukraine. As General James Hecker, Commander of the United States Air Forces in Europe, said, information was shared that had not previously been disclosed – not because of its content but because of the way it had been collected – signifying that regulations can be overcome (Hecker, 2023). As such, the US is providing the Ukrainian military with information about the location of Russian forces in real-time, including satellite imagery (Harris and Lamothe, 2022). Command Sergeant Major T.J. Holland further explained on a recent panel that the US passes frequency electromagnetic signature to the Ukrainians "32 times a day" (Holland, 2023).

While Ukraine has showcased that information-sharing difficulties can be overcome, it makes sense to already start thinking about future ways of sharing within the Alliance and how processes can be integrated to make information-sharing easier. It is evident that processes need to be built for both routine situations as well as for emergencies in which alliance members or partners may require information that goes beyond the boundaries of what is usually shared.

Space as a contested area

Space, while being considered an operational domain similar to land, air and sea, has specific characteristics that require a unique approach. This applies to more than just the particular details, for example, the speed of movement and distances travelled, that need to be borne in mind when operating in space. Rather than "simply" seeing space as a geography, what must also be considered is how space underlies all other operational domains and is a critical enabler for modern capabilities.

It is, therefore, important that space is considered by modern militaries through two lenses: as an enabler that underlies a whole host of different capabilities and as a domain that can be subjected to a number of counterspace threats. Given the utility of space for military operations, space systems may become targets for attacks themselves. There are several counterspace measures and weapons which can have both temporary and reversible as well as permanent and irreversible effects (Bingen et al., 2023). Some of the more common threats that satellites are likely to be subjected to within the coming years are spying, spoofing, jamming, laser dazzling, and cyber attacks.

Counterspace measures

Surveillance by satellites is a relatively common activity in orbit, with numerous instances of States accusing each other of approaching one of their own satellites for surveillance purposes. These include accusations from France against Russia for attempting to intercept signals from one of their secure communications satellites shared with Italy in 2018 (Reuters, 2018). Most recently, China accused the US of posing a threat to its satellites through a close approach in geostationary orbit (Jones, 2023).

Jamming and spoofing are both counterspace measures taking place in the electromagnetic spectrum. While in jamming, a signal of the same frequency as the original signal is emitted and thereby disrupts the signal that was about to be received, spoofing means that the original signal is replaced with a fake signal, potentially passing on false information (Bingen et al., 2023).

Cyber attacks can target various components of the space system and, much like cyber attacks in other systems, their impacts can vary widely. They may include monitoring of data flows or loss of command and control. One idea of a worst-case-scenario includes an attack that would allow the hackers to take control of the satellite altogether. There has been an instance of such a hack through a ground station in 2007 and 2008 however, in neither case the satellite was maneuvered (Arthur, 2011). On the morning of the Russian invasion of Ukraine in 2022, the satellite internet provider ViaSat was hacked via its customer modems, which downed the network in several European countries (NCSC, 2022). This example not only shows the potential cyber vulnerability but also goes to show that commercial providers may be targeted due to the services they provide to militaries.

Laser dazzling is used to interrupt the services of ISR satellites, though to what extent it has been operationalized is not publicly known – both China and Russia are thought to be working on these capabilities (Weeden and Samson, 2023). While meant to be a reversible measure that leads to the temporary outage of the sensor taking in information, laser dazzling is far from an exact science and may inadvertently lead to permanent damage.

Further counterspace weapons include direct-ascent anti-satellite missiles, co-orbital kinetic weapon systems, high-powered microwave lasers, and nuclear detonations (Bingen et al., 2023). None of these have yet been used against another nation's satellite and would, therefore, present a red line to be crossed. Given this, it can be reasonably assumed that temporary, non-kinetic measures, which also provide a certain degree of plausible deniability, are more likely to be observed in the coming years and in conflicts to come.

The most recent direct-ascent anti-satellite weapons test was carried out by Russia in November 2021. It drew international condemnation in particular because it put the astronauts, cosmonauts and the taikonauts in their respective space stations at risk. The group included two Russian nationals. The collision caused around 1,500 pieces of trackable debris[2] which resulted in all ISS inhabitants engaging in the 'Safe Haven' protocol, which sees the crew confining themselves into their respective capsules (Soyuz and Dragon) in case the space station suffers a direct and evacuation is needed (Gohd, 2022).

Protections and Resilience

The fundamental first step to protecting against space threats is to be able to observe one's own assets and potential threats in one all-encompassing picture. Space Situational Awareness (SSA) is the capability that allows the tracking of space assets as well as any potential threats, whether they be human-made in the form of an approaching satellite or be unintentional – space debris, for example.[3]

[2] Trackable signifies pieces of debris larger than 10cm. However also smaller debris pieces can create significant damage.

[3] The ESA Space Debris Office estimates that there are more than 34,000 pieces of space debris big enough (bigger than 10cm) that are tracked, with around 1,000,000 pieces that are too small to be tracked but which may still have a

It becomes clear that resilience and measures against threats are necessary: first and foremost, an efficient SSA system that allows for quick understanding, then a collective threat assessment that allows for all assets to be accounted for but also for speedy decision-making within the alliance, especially when a sovereign asset is targeted or disrupted. Lastly, it requires a plan to counteract the disruption, either by countering the threat or by falling back on other satellites and having a resilient system in place. This resilience might stem from redundancy – being able to fall back onto other national assets or commercial providers (Burch, 2019).

The Alliance is already working on upgrading its SSA capabilities – with agreements to develop a Strategic Space Situational Awareness System (3SAS) as part of the Situation Centre's Geospatial Section at NATO HQ (NATO, 2021). Having a central system that provides SSA and receiving an all-encompassing picture of assets will accelerate decision-making at crucial points.

This will not replace the due diligence carried out by operators providing for NATO – commercial, as well as sovereign operators, will still have to watch their own assets through their own SSA systems, ensuring safe operations. It should be borne in mind, that by being part of the NATO infrastructure, the risk of the assets being interfered with increases due to the nature of their involvement with a military alliance, as the ViaSat case in February 2022 showed. Therefore, extra care should be taken to ensure the safety of the assets involved. In this case, 3SAS, by being the SSA system at HQ, is indispensable for central coordination and planning.

Threat Detection and Assessment

Furthermore, SSA is critical for a collective threat assessment. As was previously mentioned by Benjamin Silverstein, a collective process is key, as it otherwise might leave NATO allies arriving at different conclusions about the severity or, indeed, the exact nature of the threat at hand, which may ultimately hamper alliance consensus (Silverstein, 2020). The most likely scenario in case of a suspected attack against a NATO asset would see the alliance using US SSA data to confirm the details of the suspected attack. This is due to the fact that the US has the most sophisticated SSA capabilities in the world. So, while a NATO collective SSA capability may alert the Alliance to an incident, it is likely that the exact details would call for US assistance. What will be vital is that the US is able to share the information of the attack with the rest of the alliance. This will matter, especially in instances in which the Alliance may be split or indecisive regarding an appropriate response. The speed and completeness of the information will be critical, as future decisions (whether to move the asset, for example) are likely going to be time-sensitive.

If a NATO space asset is indeed under attack, then any decision regarding appropriate responses to take will be a political decision ultimately. This includes the consideration of whether the attack constitutes a response through Article 5 of the Washington Treaty. The Alliance would therefore be best placed to discuss potential ways forward and available avenues of action already, in case the unprecedented occurs, such as a kinetic attack in space. Given the unprecedentedness of such a dimension, discussions are likely to take time. Time

significant impact: even a small piece of space debris could have the impact of a hand grenade given the speeds of travel involved in orbit (ESA, 2023; ESA, 2017).

can be saved by putting these discussions on the table early, ensuring that the unprecedented does not catch the Alliance off guard.

Lastly, while kinetic attacks are unprecedented, disruption to the electromagnetic spectrum is not. This has been observed extensively in the war in Ukraine. However, the effects of the disruption can be mitigated with preparation and measures for resilience. Therefore, resilience must already be built into the system – a diverse system of systems containing both space and terrestrial-based assets will restrain, and may altogether prevent, disruption to the network.

Partnerships with commercial providers

Resilience through redundancy may become imperative for NATO, especially given that coalitions of systems, including commercial providers, already form vital support elements, such as SatCom and ISR. Further, the services of commercial companies could provide additional support even at short notice, even if they are not part of the original infrastructure. Using private companies for satellite services in wartime settings is not new in itself – for example, 90% of the bandwidth used by the US during the Afghanistan and Iraq wars was provided by commercial companies (ViaSatellite, 2010). However, the war in Ukraine has brought to the forefront the speed with which commercial companies can fill vital gaps at short notice. While commercial companies are by no means a panacea, they can provide resilience through redundancy.

Thinking about the communications domain, commercial providers could provide capacity that can be used for non-sensitive communications and provide extra bandwidth in that way. Starlink is perhaps the most prominent example of how the commercial world has assisted the Ukrainian armed forces in setting up a resilient communications structure and even became the default measure to bring attacked cities back online (Simonite, 2022). However, Starlink should not be considered as a template for future capability development, given the unique and extremely casual way of how the partnership developed. However, one key takeaway remains: commercial entities can plug important gaps and aid resiliency by getting disrupted services back online swiftly.

When discussing the security and resilience of space systems, one must consider the different layers of such a system. As such, commercial providers can provide the outermost layer – which brings bandwidth for non-sensitive information flows. Furthermore, the involvement of a private company may offer crucial expertise. The cautious tale that Starlink has provided is the dependence on commercial assets, including the government using the system not having full control over how the service is ultimately used: one such example is that Starlink is not available in Crimea. While requests had been made to make the service accessible on the peninsula illegally annexed by Russia in 2014, Elon Musk has so far denied these requests (Reuters, 2023). Lastly, the president of Starlink announced in February 2023 that the service should no longer be used for offensive purposes (Roulette, 2023). It is unclear if this obstacle has been resolved since the contract with the US Department of Defense, as its terms are confidential (Stone and Roulette, 2023).

It is evident that collaboration with the private sector is beneficial for both sides and will be a vital factor in staying at the front of the technological edge. Public-private alliances, such as observed with the APSS initiative, which has commercial capability baked into it, may provide a good solution: they allow the alliance to work closely with innovation partners while also not relying on companies to step up to the task on short notice, thereby putting a strain on their systems. On a further note, it enables the industry to continue to

grow: while the phenomenon of New Space - namely the increasing commercialization of the space industry - has made headlines and while the growth of this sector has been projected to skyrocket over the next decade, it should not be forgotten that the supply side of the market has diversified much more than the demand side has. As such, the rise in demand for commercial remote sensing capabilities has seen the industry adapting by creating capacity, while the government has not followed up in handing out big contracts (Erwin, 2023). While space is no longer the sole domain of state powers, they remain the main customers of the industry. This is why a continuous conversation between the customer and the provider is so important: by communicating their needs and concerns openly, the military allows the industry to not just plan long-term and tailor products accordingly, but it also allows for steady growth.

Conclusion

In conclusion, NATO needs to consider both the capabilities that space enables as well as the threats that it may encounter. On the capabilities side, forthcoming challenges include integration and compatibility among alliance members. In part, this will require coordination and planning that creates consistent information sharing and compatibility at the tactical level. Further, it will require enhanced and more open information-sharing, which must be overcome by lowering classification levels where possible. The war in Ukraine has showcased that in the case of an emergency, bureaucratic hurdles can be overcome. Putting systems in place now could mean not only smoother information sharing as a matter of routine but also that there are processes in place for the next emergency, allowing for vital information to be passed on as appropriate.

With all the utility that space offers, it also presents an additional area of attack in multiple ways: ground station attacks and cyber warfare are some of the simpler ways in which even a non-space power or non-state group could disrupt space services. Further attacks include challenges to the electromagnetic spectrum and even kinetic actions. While the latter is yet unprecedented, it is critical that NATO decides already at a political level what an appropriate response to a range of threats might look like. Unprecedentedness does not excuse unpreparedness. On a technical level, it is important that there are central SSA capabilities in place that will supplement the collective threat assessment process that will have to occur should space assets in operation for NATO come under threat. Lastly, the resilience of space systems will be key for future operations. Part of this process is information-sharing between allies, which allows for assets to be protected when needed. Another part is that of building redundancy into the system – perhaps through burden-sharing with other allies or with the tie-in of commercial partners, who are already an essential part of the growing space initiatives. Further considerations will have to include how commercial entities are included in systems that are otherwise made up of sovereign and military-owned assets and how responsibility and risk can be shared, should these assets come under threat because of the clients they serve.

References

Air Force Space Command. (2012). “Air Force Space Command Supports NATO Ballistic Missile Defence Declaration at NATO Summit”. [Archived]

Arthur, Charles (2011). “Chinese hackers suspected of interfering with US satellites”. In The Guardian.

Bateman, Jon (2022). “Russia’s Wartime Cyber Operations in Ukraine: Military Impacts, Influences, and Implications”. In Carnegie Endowment for International Peace.

Besch, Sophia (2022). “EU Defence and the War in Ukraine”. In Carnegie Endowment for International Peace.

Bingen, Kari A., Kaitlyn Johnson, Makena Young & John Raymond (2023). “Space Threat Assessment 2023”. In Center for Strategic and International Studies.

Burch, Ron. (2019). Resilient Space Systems Design: An Introduction. Boca Raton: CRC Press.

Command Sergeant Major Holland, T.J. (2023). “The Association of the United States Army’s 2023 LANPAC Symposium & Exposition”. Honolulu, Hawaii. 16 May 2023.

Erwin, Sandra (2023). “Despite growing interest in commercial satellite data, industry faces uncertainty”. In SpaceNews.

Erwin, Sandra (2023). “U.S. Space Force in talks with allies about how to jointly protect space assets”. In SpaceNews.

European Space Agency (2017). “European conference on space debris risks and mitigation”.

European Space Agency (2023). “Space debris by the numbers”.

General Hecker, James B. (2023). “The Chief of the Air Staff’s Global Air & Space Chiefs’ Conference”. London, United Kingdom. 12 July 2023.

Gohd, Chelse (2022). “Russian anti-satellite test a ‘dangerous and irresponsible’ act that threatens astronauts, US says”. In Space.com

Greenemeier, Larry (2016). “GPS and the World’s First "Space War”. In Scientific American.

Hadley, Greg (2023). “Why Can’t They Declassify the Space Force? Sorry. That’s Classified”. In Air and Space Forces Magazine.

Harris, Shane and Lamothe, Dan (2022). “Intelligence-sharing with Ukraine designed to prevent wider war”, In Washington Post.

Jones, Andrew. (2023). “Chinese study finds GSSAP close approaches a threat to its GEO assets”. In SpaceNews.

Vasen, Tim (2019). “Is NATO Ready for Galileo?”. In Transforming Joint Air and Space Power: The Journal of the JAPCC.

McKay, J.R. (2022). “Pressure, threat and dependence: assessing NATO member state defence spending?”. In Journal of Transatlantic Studies. 20, 385–410.

National Cyber Security Centre (2022). “Russia behind cyber attack with Europe-wide impact an hour before Ukraine invasion”.

North Atlantic Treaty Organization (2019). “NCI Agency provides critical support to development of new NATO space policy”.

North Atlantic Treaty Organization (2021). “Satellite communications”.

North Atlantic Treaty Organization (2023). “16 Allies, Finland and Sweden launch largest space project in NATO’s history”.

North Atlantic Treaty Organization (2023). “Allied Command Operations (ACO)”.

North Atlantic Treaty Organization (2023). “Cyber defence”.

North Atlantic Treaty Organization (2023). “Factsheet: Alliance Persistent Surveillance from Space (APSS)”.

North Atlantic Treaty Organization (2023). “Lift-off, NATO Launches New Space Centre of Excellence”.

North Atlantic Treaty Organization (2023). “NATO’s approach to space”.

North Atlantic Treaty Organization. (2023). “Vilnius Summit Communiqué”.

Pernin, Christopher (2019). “Targeted Interoperability: A New Imperative for Multinational Operations”. In RAND.

Reuters (2018). “France accuses Russia of spying on military from space”.

Reuters (2023). “Musk says he refused Kyiv request for Starlink use in attack on Russia”.

Roulette, Joey (2023). “SpaceX curbed Ukraine’s use of Starlink internet for drones -company president”. In Reuters.

Silverstein, Benjamin (2020). “NATO’s Return to Space”. In War on the Rocks.

Simonite, Tom (2022). “How Starlink Scrambled to Keep Ukraine Online”. In Wired.

Single, Thomas (2008). “Considerations for a NATO Space Policy”. In ESPI Perspectives n°12. European Space Policy Institute.

Stone, Mike & Roulette, Joey (2023). “SpaceX’s Starlink wins Pentagon contract for satellite services to Ukraine”. In Reuters.

UK Ministry of Defence (2022). “Joint Doctrine Publication 0-40, UK Space Power”.

ViaSatellite (2010). “Defence Budget Issue Should Benefit Commercial SatCom”.

Weeden, Dr Brian, & Victoria Samson (2023). “Global Counterspace Capabilities: An Open Source Assessment”. In Secure World Foundation.

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WORKING GROUP REPORT

SPACE CAPABILITIES AND NATO – HOW TO UNDERSTAND BETTER AND DECIDE FASTER

Alessandro Marrone – Head of Defence Program, Istituto Affari Internazionali

Participants in the WG2 focused on a specific angle of the broader theme of space capabilities & NATO: how to understand better and decide faster, an issue that touches upon both the strategic and operational levels of decision-making at both national and NATO levels. A substantial consensus emerged on four main elements:

- the Alliance's added value with regard to established frameworks at the national and European level;
- the role of commercial actors and the need for solid public-private partnerships;
- the combination of people and technologies to deliver significant outputs and the issue of staffing within NATO bodies;
- transatlantic burden sharing and NATO-EU cooperation, taking into account the unique space capabilities owned by the Union.

NATO's added value

Participants took stock of the reality whereby the US already put significant efforts into Earth Observation and Space Situational Awareness at the national level, while European allies do approach EO, SSA and - broadly speaking - space at the national level, through the European Space Agency level, via the European Union. Namely, the EU counts on significant initiatives like the EU Space Surveillance and Tracking (SST) consortium and the Satellite Centre.

Against this backdrop, NATO has to recognize the complexity of the current multi-layered frameworks in Europe while bringing added value with initiatives like Alliance Persistence Surveillance from Space and Strategic Space Situational Awareness. The following guidelines would help the Alliance in this regard:

- First, aiming to establish a centralized system to share data.
- Second, framing data sharing on a voluntary basis among allies.
- Third, creating incentives for such voluntary contributions by ensuring a secure procedure for data sharing. Processing and distributing data is a fundamental political issue to be addressed, a precondition for data-sharing., Hence, NATO should push member states to de-classify the information to be shared.
- Fourth, flexible mechanisms should be established to cope with the diversity of national approaches to space – and related capabilities. Fort, it is of utmost importance to cooperate with existing initiatives in the US and in Europe in order to deliver real added value.

- Finally, NATO should find appropriate ways to involve private actors.

Private actors' role and solid partnerships

The involvement of the private sector has been widely discussed by WG3. Indeed, in the future, data from commercial actors will be more and more the backbone of EO and SSA, while military assets will provide a tailored contribution as well as crucial resilience in case of attacks on space assets. It has been mentioned that the US Space Force is working on space defence commercial operations, whereby private companies provide SSA data on very short notice.

Accordingly, participants agreed that allied militaries should shift their focus from platform-centric to data-centric, and from data ownership to access to data. This entails a renewed approach particularly in Europe, also considering that often the military procurement is not as agile and innovative as procurement in the commercial sector.

However, appropriate policies and frameworks should be established to set solid civil-military partnerships. The example of Starlink's involvement in the Russia-Ukraine war is a mixed one, and different views emerged among participants in this regard. On the one hand, the company provided valuable support to a NATO partner at war with Russia, particularly after a cyber attack disrupted the ground segment of civilian and military space infrastructures in Ukraine. On the other hand, such a new role for a private actor happened in a kind of legal and political vacuum, it was occasional and completely ad hoc. Moreover, it provided a single entrepreneur an unproportionate power in international relations with very little constraints, by creating uncertainty among all other actors – including Ukraine and NATO allies.

NATO should have a strategic, frank and forward-looking discussion on the role of the private sector. A discussion focused on the overarching goals for Allies and on setting frameworks and policies to enable a proper partnership in peacetime, critical moments and wartime. For instance, resilience should build on redundancies of options, including via pre-agreements on contracts to be activated when necessary. Allies should also find innovative solutions to bring in New Space actors: small and medium enterprises, which often cannot afford the transaction costs of complex military acquisition, carry a great potentiality in terms of innovation.

People and technology

Participants recognized that, at least for the next decade, space operations will be mostly about uncrewed satellites providing data which should be protected against cyber, electromagnetic or directed energy attacks. Satellites will be operated to avoid collisions in orbits congested by debris and other spacecraft up to a level far worse than today. In the first semester of 2023, only StarLink constellations run around 15.000 collision avoidance manoeuvres. Some participants estimated that by 2029 there will be up to 100.000 satellites in orbit and 2.5 million manoeuvres per year, hence a very high probability of collisions.

Technology will obviously be key for these operations, including artificial intelligence for collision avoidance manoeuvres. It will be important to be able to process data on board and transmit down to Earth the processed information thus overcoming some bottlenecks. Still, people are and will be key, too. NATO

militaries already have access to a huge amount of data, and they will gradually get more, different and better sensors, more and high-quality data, real-time transmission, more frequent revisit rate. Against this backdrop, a key issue is and will be to extract from data the knowledge needed by the users, otherwise they will not be useful from a military point of view. Accordingly, participants underlined that an adequate number of skilled and trained personnel will be paramount for member states and NATO bodies to manage data and, above all, to get relevant knowledge from them. Allies will increasingly need software engineers, data analytics, intelligence analysts, and operators of space assets and technologies. An adequate pool of human resources will have to work together at the national and NATO levels, as in the end, people play a key role in producing outputs from technology.

Participants discussed the current situation, which looks worrying. For instance, it has been estimated that NATO as an organization envisions less than a hundred subject matter experts working on space, and that allies struggle to fill these posts with national personnel. This level of human resources does not match the current mandate for NATO with regard to this new operational domain and prevents further steps. It has been noted that space experts are needed also to integrate space in multi-domain operations and advanced planning for collective deterrence and defence as well as for crisis management. Therefore, Allies should rapidly increase the ceiling of NATO personnel and should invest in the workforce dedicated to space. Moreover, NATO should hire civilians to do part of data-related tasks that do not necessarily imply a military approach, to ensure an adequate output. Surely, NATO should exploit AI and borrow processes from the private sector to improve efficiency and output. Still, AI-enabled improvements do not resolve the need for greater numbers of skilled personnel, particularly but not only at the NATO Space Centre.

Unfortunately, many participants underlined that the entire space and defence ecosystem needs more graduates to support current and future activities, particularly in Europe. National military commands and space centres need more qualified staff. NATO, the EU, the private sector and academia should cooperate and invest to address the dramatic scarcity of talent among citizens allied countries willing and able to carry on such sensitive jobs. The upcoming establishment of a European space academy is a positive step in the right direction.

Last but not least, to make the best of available technology and increase human resources, NATO needs agreed standards and procedures to process trusted data, understand better and decide faster. Otherwise, the risk is to draw different information and knowledge from these data across the users and damage the decision-making process within the Alliance. Several participants noted that NATO has a good track record of setting standards for allied militaries in many other fields and should work on it by bringing such added value on space. Broadly speaking, technology, human resources, and standards should be part of a comprehensive and pragmatic effort towards space according to the well-known doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) approach.

Burden sharing and NATO-EU cooperation

The issue of burden-sharing within NATO is a recurrent feature of the transatlantic debate. Often, the focus is on the defence budget, whereby many European allies lag behind the fulfilment of the 2% GDP spending goal.

Interestingly, some participants underlined that when it comes to Earth Observation, space surveillance and

tracking, and space situational awareness, Europe has important assets either at the national level, within EU and European Space Agency. To make just one example, the aforementioned EU SST consortium includes 15 countries which pool 50 space assets, delivering a wealth of data, and standing among top global data provider in this field. Moreover, the EDF has been allocating hundreds of millions of euros every year to SSA, responsive space and protection of space assets, since 2022 onwards. Responsive launch is particularly interesting insofar as it enables the placement of small satellites in orbit to cover a crisis area and/or replace assets damaged by debris or attacks. Last but not least, while NATO does not own space assets, the EU does: the PNT Galileo and the EO constellation Copernicus regularly operate with standards comparable to US GPS, and a secure connectivity constellation IRIS2 is in the making.

Here lies an opportunity for a unique European contribution to a more balanced and solid burden-sharing among Allies regarding space and defence. This opportunity is difficult to grasp because of a variety of factors, including the different memberships of the Alliance and the Union, the specific governance of the EU space program, and a variety of national sensitivities in this regard. However, it is not impossible. The recent history of NATO-EU cooperation offers an interesting example with the Berlin Plus agreement signed in 2003 to enable the Union to use NATO command and control structure to conduct EU military operations. According to some participants, it is possible and sensible to envision a similar but reverse agreement enabling NATO to use EU space capabilities for allied military operations and activities. It is a strategic political decision that would provide outputs, send a strong message worldwide of transatlantic unity, make the best of existing initiatives in a cost-effective way, and meet a widespread demand among European allies to not further complicate the already complex space governance. The 2023 NATO-EU Joint Declaration identifies space as a new priority area for partnership, and this paved the way for ambitious thinking in this regard.

Photo credit: European Space Agency

WORKING GROUP III

HOW TO APPROACH NATO DETERRENCE AND DEFENCE ASPECTS

Dr Bleddyn E. Bowen, PhD, FHEA - University of Leicester

Introduction

"*Human beings… make their most momentous decisions by what is fundamentally intuition*"

Bernard Brodie, 1959

In the last few years, NATO's members have been "singing from the same hymn sheet" on threats to Alliance space systems and the need to be prepared to respond to hostile acts against the space assets they rely on. NATO's main work in space, as outlined in the Overarching Space Policy, is that of coordinating and pooling its members' activities and services in space, and facilitating Member State capability development, training, and investment, rather than becoming a 'sovereign' actor in space in its own right. Deterring attacks and large-scale intentional disruptions to allies' space systems, responding to any such attacks, and supporting Member States in the context of space warfare are pressing areas within which NATO must develop both intellectual and material capacities among its members. This is growing more acute as their forces rely ever more on space systems and the capabilities to disrupt or destroy those space systems proliferate. NATO, therefore, has an important role to play in coordinating Alliance space systems and ensuring leaders have the most information and capabilities to hand when making momentous and intuitive decisions in crisis or war, which cannot be prescribed in advance.

This discussion paper proceeds in three sections. Section 1 sets out key definitions and concepts of space and deterrence. Section 2 reviews the language of NATO and some Member States on military space activities and space warfare. Section 3 considers some scenario-based questions to show the different contexts in which spacepower[1] manifests that NATO must be able to think about and respond to. Finally, implications for NATO are drawn out.[2]

[1] "Spacepower" refers to a form of power as defined through access to space technologies. "Space power" is an adjective used to describe an entity that uses or possesses "spacepower". For example: The United States is a major space power because it possesses a great amount of spacepower.

[2] This discussion paper does not categorize all possible space threats or provide a rudimentary introduction to space warfare. The NATO Overarching Space Policy (OSP) contains a useful and clear taxonomy of general types of space threats, and the UK Military Space Primer and UK Defence Space Strategy have extensive yet accessible explanations of many basic kinds of space technologies and orbital physics. The Centre for Strategic and International Studies (CSIS) has a wealth of learning materials at their *Aerospace Security Project* site, and the Secure World Foundation (SWF) produces an annual global counterspace weapons open-source assessment.

Space, Defence, and Deterrence

Whilst space is a big place, the volumes of direct and pressing interest to NATO and its Member States on strategic grounds – i.e., those with military and economic importance – are much more constrained. The focus of this paper, as is NATO's, is on Earth orbit (from around 100km altitude to around 40,000km), as well as terrestrial infrastructures that service or depend on space systems and their users. Whilst there is no accepted universal definition of where space begins, the working Kármán Line of 100km is roughly the lowest altitude at which any unpowered orbital flight can be sustained for any appreciable amount of time. Between there and 40,000km is where the vast bulk of humanity's Global Space Age has happened and continues to happen (Bowen, 2022). This is where the most useful satellites that provide all manner of economic, military, and intelligence services reside. Today, there are around 7,000 active satellites in Earth orbit, owned by or commercially registered among over 80 states.

Therefore, for the purposes of this discussion, the "transverse" region of 25km-100km altitude and vehicles are not discussed (e.g., hypersonic glide vehicles/missiles), or the higher orbits into cislunar and deep space (beyond 40,000km of altitude) are not featured and go beyond the confines of this discussion. Such weapons capabilities are not silver bullets and would inhabit a place that is already monitored by already in place satellite systems, creating effects existing arsenals can achieve for most nuclear weapon states (Bowen and Hunter, 2021).

Whilst deterrence and defence are one of the three core tasks of NATO and extend to Earth orbit, they are hardly the totality of activities in and uses of space (NATO, 2023b: 3). We would not reduce the sum of human experience and interests on the seas or the air to deterrence and warfare, and so it is with space. Nonetheless, the military uses of space are hardly new, and, in fact, they define the origins of most space technologies we rely on today (Bowen, 2022). Command and control of nuclear and non-nuclear military forces; overhead multispectral imagery and ISR; signals/electronic intelligence (SIGINT/ELINT); infrared missile early warning sensors; PNT services all came together between 1960-1990 in the US military to provide a mature and reliable space infrastructure for all NATO military forces that have no equal today - with China catching up with an ever-increasing satellite deployment roster and quickening launch schedules.

NATO's and Member State military and intelligence activities in space, therefore, happen in a wider context within which there are diverse communities within states (e.g., private sector, public civilian infrastructure, science and research) and a global roster of participants, including not only the leading military and nuclear powers but also major developed economies, small states, and developing states across the world, each with their own differing interests, priorities, and most importantly, their own space agencies. In this sense, Earth orbit, therefore, resembles something of a coastline: a crowded, constrained, environmentally fragile, and busy international arena with a multitude of users and uses that enables and constrains political and military operational freedom (Bowen, 2020: 105-157).

As satellites are so important for military and economic power, the protection of space systems as well as the denial of those to adversaries in wartime, are pressing concerns. Deterring attacks on space systems and engaging in space warfare, should open hostilities occur by triggering Article V, are therefore a rational and legitimate area of activity for modern military forces, and as a military alliance, for NATO as well. These are not new considerations for NATO for the 21st century, as attacks on satellites have been a concern in the United States military and Intelligence Community since the early years of the Cold War (Bateman, 2022).

As much as deterrence has been shaped by the nuclear age, it is not solely about nuclear weapons. As such, space deterrence cannot be restricted to only the "end of days" connotations of nuclear deterrence, though space warfare and deterrence of course are still important in nuclear wars and deterrent postures. The core idea of deterrence remains regardless of geographic or technological focus – threatening punishment against unwanted actions or making aggressive actions pointless by denying their impacts. As seen through the Cold War, most notably in the "Flexible Response" and "Limited Nuclear War" debates (Freedman and Michaels, 2019: 361-377; Futter, 2021: 87-115), strategists have never fully been able to make war-planning irrelevant, despite the emphasis on preventing wars via nuclear deterrence. The prospect of Mutually Assured Destruction was and is still not a sufficient condition to end the practice of war planning. Deterrence and warfare are not the same, and therefore "space deterrence" and "space warfare" should not be conflated either. Indeed, the capability to wage war feeds into a credible deterrent posture because a deterrent-only posture effectively amounts to only planning for the opening moves of what could be a major war. With no follow-through after the first move, an adversary who believes they can weather the initial storm may be less likely to be deterred from attacking (Bowen, 2022: 281-323).

The base concepts of deterrence can help us think about military space postures and deterring attacks on space systems: credibility, political will, reputation, uncertainty, irrationality, trust, strategic stability, offence-defence balance, attribution, and communication, to name a few (Brodie, 1959; Schelling, 1960; Kahn, 1984; Freedman, 2004; Quinlan, 2009). Identifying aspects of deterrence is easier than the art (not science) of crafting a convincing deterrent posture, which is ultimately a guessing game as it relies on generating a psychological effect in the minds of "others", an effect that is not always possible to observe or confirm.

Michael Krepon defined space deterrence as "deterring harmful actions by whatever means against national assets in space and assets that support space operations" (Krepon, 2013: 15). This definition could be expanded to include commercial providers of critical space services for military and security needs. However, deterring all attacks or bad behaviour may be less feasible than focusing deterrence on the most destructive behaviour. This underscores the necessity of thinking about deterrence and strategy in tandem according to specific scenarios, as seen below. Deterrence and strategy manifest in space as they do anywhere else where humans do things or through the extensions of machines. 'Space deterrence' only works as a term when it is used to focus discussion on the "space" elements of conducting deterrence, in the same way that "space warfare" is only a thematic focus on "warfare" as a whole. Whilst technical and physical details change according to the domain, we are still in the socio-political universe of deterrence and warfare. Therefore, as this paper focuses on space deterrence and space warfare, our wider thinking can never treat space in isolation from events on Earth, both in how terrestrial activities influence space and vice versa.

NATO and its Members on Space and Defence

Compared to 15 years ago, discussion among space security professionals across the transatlantic security community has moved from questioning whether space should be considered a military domain in its own right and whether threats to allied space systems exist towards accepting those threats exist and what should be done about them. The largest and most space-capable members of NATO are "singing from the same hymn sheet", with space recognized as operational in many militaries or a warfighting domain in others, most notably in the US Space Force, founded in 2019.

The distinctions between "operational" and "military" domains amount to little more than semantics in practice. The reality is that military forces use space systems, many NATO militaries conduct satellite operations, and all NATO members cannot ignore Earth orbit becoming a shooting gallery with kinetic "hard kill" weapons, nuclear detonations, or "soft kill" electronic warfare or cyber intrusions against space systems. Space warfare is a spectre that haunts the war plans of 21st-century military forces, regardless of the language we choose to use in expressing it. Many states possess soft-kill anti-satellite capabilities (in particular radio jamming) and no amount of esoteric doctrinal statements against "warfighting" and "domination" in space will be an insurmountable barrier to a state engaging in counterspace operations with soft-kill methods, should the need arise in a crisis or war.

Reflecting this reality, space is more prominent than before in NATO language and documentation. In 2019 NATO formally recognised space as an "operational domain" (NATO, 2023a). In the same year, its newly adopted Overarching Space Policy (OSP) spelt out the Alliance's perceptions of threats to its space systems and how the Alliance sought not to develop its own capabilities, but rather enhance the sharing of space systems and coordinate postures and crisis responses in space (NATO, 2022). This was followed by the Strategic Concept of 2022, which gave plenty of attention to space, stating that "strategic competitors and potential adversaries are investing in technologies that could restrict our access and freedom to operate in space, degrade our space capabilities, target our civilian and military infrastructure, impair our defence and harm our security". (NATO 2023b: 6) This is accompanied by a list of issues and threats of concern to the Alliance which for newcomers to space should prove to be a useful first exposure to the kinds of threats NATO Members are facing to their space systems.

The Alliance has four key roles in space and nine lines of effort in the OSP:

NATO's key roles regarding space:

1. Integrating space and space-related considerations into the delivery of NATO's core tasks;
2. Serving as a forum for political-military consultations and information sharing on relevant deterrence and defence-related space developments;
3. Ensuring the effective provision of space services to the Alliance;
4. Facilitating the compatibility and interoperability between Allies' space services, products, and capabilities.

NATO lines of effort in space:

1. Space support in operations, missions and other activities;
2. Space domain awareness;
3. Deterrence, defence and resilience;
4. Capability development and interoperability;
5. Training and exercises;
6. Strategic Communications and Responsible Behaviours;
7. Science, Technology and Innovation;
8. Industry;
9. Partnership.

The fact that the Alliance has been able to agree on the above headlines is a testament to the weight of shared opinion within it on the importance of space systems to military power and security, and the gravity

of the counterspace capabilities some states pose to allied space systems and dependencies, with Russia and China singled out as pressing threats in NATO documentation.

The US Defense Space Strategy declares that space is "a distinct warfighting domain", and it aims to "compete, deter, and win" in space as it does on Earth, and is transitioning its general posture of only using space as a support service for terrestrial military services, to one where combat operations and complex manoeuvres may also happen in their own right as space systems are increasingly targeted by potential adversaries (US Department of Defense, 2020: 1, 6, 8). Echoing this, the French Space Defence Strategy states that "while the approach to space as an enabler is indeed being modernized, the notion of space as a domain with its own challenges has not yet been fully addressed". (French Ministry for the Armed Forces, 2019: 8) Germany's 2023 National Security Strategy articulated its intent to create a Space Security Strategy, and says that "the free and unimpeded use of outer space is vital for our security" as well as seeking to expand Space Situational Awareness (SSA) capabilities "so that these capabilities can play a major role in collective deterrence and defence in NATO" (German Federal Government, 2023: 15-16, 32, 68). The UK Defence Space Strategy argues that "deterrence is fundamental to our national security and our ability to protect our national interests and preserve operational independence in space" and explicitly welcomes NATO's recognition of space as an operational domain, and that attacks on satellites could constitute an Article V violation (UK Ministry of Defence, 2022: 19). Italy's 2019 National Security Strategy for Space placed a new emphasis on defence capabilities and the protection of critical space infrastructure from deliberate and unintentional threats. Italy, in the last few years, has reorganized elements of its MoD to place a greater emphasis on space operations and is mulling the possibility of a defence space strategy (La Rocca and Marrone, 2022: 65-67). In addition to this, all countries make some reference to the need for the development of further norms or soft laws for the governance of Earth orbit or at least in developing responsible best practices between users and avoid unintentional harm and risks, supporting the work of the UK-instigated UN General Assembly Resolution on responsible behaviours in space. This complements more traditional military approaches to deterring destructive behaviour.

This dovetails with the creation of multiple new space-dedicated units or organizations across NATO forces. Most notably, the United States Space Force was set up in 2019 and re-established US Space Command which was stood down in 2002. Since then, the UK has set up a UK Space Command and a Joint Space Operations Centre; the French Air and Space Force now takes on a more formal military space role alongside CNES as opposed to a CNES-dominated French space bureaucracy; the Italian armed forces now have a Space Operations Command; the German military have set up a new Air and Space Operations Centre; and the Royal Canadian Air Force has a new Space Division.

NATO's European members are certainly more interested in space than ever before, with military space activities becoming institutionalized through national policy/strategy documentation, budget lines, doctrine documents, military exercises, and new organizations, bringing them closer into alignment with how the Pentagon has informed US space policy and conducted operations in space for over sixty years. Today, Britain and France are also discussing counterspace capabilities and operations, in terms of how to defend space systems from hostile actions and respond.

In US military space doctrine language, this is termed "defensive space control", which includes attacking platforms or vehicles that are deemed to be an imminent threat to one's own space systems. However, unlike the US military, British and French armed forces have not yet taken the discursive or semantic next step of

adopting “offensive” space control postures – that is, attacking enemy space systems even though they are not a direct threat to your own space systems (Pasco and Wohrer, 2023).

For example, that could be attacking an enemy ISR satellite that is supporting enemy terrestrial forces fighting NATO ground forces and not an enemy anti-satellite weapon or vehicle targeting a NATO satellite. Other than electronic warfare and computer network operations and attacks, however, there would be very limited ways for Britain and France to take truly responsive measures against hostile spacecraft at present. The US, China, and Russia are now conducting advanced orbital manoeuvres and “cat and mouse” games of close proximity operations and observations in the geostationary belt with satellites such as Silent Barker, Geospatial Situational Awareness Program, TJS, and Olymp. Some manoeuvres are such that interceptions in GEO were possible, such as with the widely reported Chinese TJS-3 manoeuvres near a US inspection satellite in the summer of 2023. This underscores how, in some areas, material capabilities in the US, China, and Russia are advancing far ahead of what counterspace and other military space systems European NATO is only beginning to develop.

The planned French ground and space-based anti-satellite laser capabilities (BLOOMLASE and FLAMHE projects) could be used in either defensive or offensive roles, which reminds us that doctrinal language is by no means a strait jacket for operational freedom and, therefore, not an article of faith for strategic communications. The base freedoms gained by material capabilities matter more for operational freedom and complicating the calculations of adversaries in deterrent postures as well as war planning.

Scenarios

What is often not clear in general, abstract conversations is what exactly in space actors are seeking to deter. Beyond attacks on the most important space infrastructure, such as strategic command and control satellites, what counts as intolerable attacks on space systems will differ in every scenario, both in allied minds and those of adversaries. This makes it harder still to identify what the “worst” behaviours are that could be prioritized in deterrence signalling. A deliberate kinetic attack on an important command and control satellite during the height of a crisis could be easily classed as an Article V issue; but would electronic warfare absent a major crisis on Earth trigger it, even if the effect of denying a satellite’s service is the same? Such an isolated nuisance would not necessarily be the case. It would be unenlightening and pedantic to spell out every possible type of activity and allocate a measure toward it, as doing so does not help think creatively about actions and consequences that are useful regardless of the details of the particular situation at hand (Clausewitz, 2000: 289-290).

A challenge in deterrence postures and war planning is that no amount of planning and thinking can truly anticipate the actual crises and wars that may happen. However, as Dwight Eisenhower famously quipped, “plans are useless. But planning is indispensable”. Thinking through possible situations helps clarify what we have to work with, the likely hurdles in meeting a range of challenges, and identifying areas where responses may be lacking, as well as areas in the real world where capabilities and coordination can be improved. This section highlights some diverse scenarios that show how a single “deterrent posture” is something of a chimera and cannot be outlined in detail ahead of a crisis, but sketching diverse scenarios out stimulates the creative intellectual capacities needed in the art of deterrence and war.

A large source of that diversity and the impossibility of crafting a detailed, singular deterrent posture or military space strategy is the fact that there are multiple important factors impacting NATO space capabilities that maintain key interests in multiple regions, with each planning for a number of diverse military contingencies. Whilst NATO is a transatlantic alliance with core tasks in Europe, the reality is that NATO overwhelmingly relies on US space systems to function. The US has supreme interests in the Indo-Pacific as well. Therefore, as some of the most pressing military threats to their space systems are coming from Asian powers – namely China and North Korea – NATO has an important duty in being able to support US objectives in the region but also in responding to any consequences of deterrence failure and war on space systems for the Alliance as a whole. It is also important to note that some of the United States' most capable military allies are also in the same region: Japan, South Korea, and Taiwan, each of which has large and modernized conventional forces larger than many European militaries who also enjoy space support from the same US space systems as European NATO. Japan is an increasingly capable space power in its own right and is militarizing its space acquisitions. South Korea and Taiwan are also investing in more defence and security-related space systems.

To aid discussion, here are guiding questions and brief commentaries that should be asked in any scenario that NATO may face in terms of space deterrence and space warfare. The answers to each help to inform whether communications and compromise are possible, whether a party may lash out or back down, or whether the high risks and costs of war may be seen to be "worth it".

1. *What are the political stakes? How badly does each side want/need to win?* As Carl von Clausewitz said: "war is the continuation of politics by other means" (2000: 280-282). The answer to this question is where all should start in analysing approaches and responses to possible scenarios. It is the political objects held in the mantle by each side that will animate the severity of any crisis and the intensity of any war. Even if a crisis occurs in space, it will not happen independently of events and interests on Earth. It is most likely that thinking and actions in space will merely be the space components of a general crisis or war where the biggest political stakes are firmly rooted on Earth. In a crisis over Taiwan, it is not unreasonable to consider the possibility that Chinese political and military leaders may deem debris-generating ASAT attacks to be worth increasing the chances of "winning" in the immediate crisis. Degrading swathes of low-Earth orbit with debris will be a problem for "tomorrow", but a tomorrow where Beijing has assumed control over Taipei makes environmental and economic consequences secondary. Politics can upend calculations allies may deem to be "irrational" and "unlikely".
2. *Which space systems are most relevant?* NATO's access to a wealth of state space assets and commercial providers leads to a complicated mesh of platforms and services. However, depending on the scenarios some systems may not be as important and may not warrant a significant response if attacked. Taking out a commercial Synthetic Aperture Radar (SAR) satellite or three may be a problem for some operational decisions in the theatres they serviced, but it is not the same as destroying the GPS constellation with a coordinated salvo of 90 direct-ascent kinetic ASAT missiles which would undermine much of the world economy as well as most US military operations. The importance of responding to an attack should not be based on whether a system is "civilian", "private", "public" or "military" – rather, it is in the importance and uniqueness of the functions that they serve. Civil-military distinctions in satellites and services are blurred, at best, and the history of war is replete with instances of deliberately targeting privately own infrastructure that supplies the needs of war.
3. *Do allies have the same perceptions of the values and importance of specific space systems?* Taking out the US early warning satellites the Space-Based Infrared Surveillance (SBIRS) system – with jamming or sensor-spamming may be extremely provocative to the United States, who may interpret it as a prelude

to a nuclear attack. However, US sensitivity to such systems may not be universal. European allies have had to face the reality of a nuclear attack where the warning time of space-based infrared sensors is irrelevant – what difference does it make if they are lost? Similarly, in Russia and China, their nuclear postures have not been as dependent on such systems. The Soviet Union was rather late in deploying its own infrared early warning satellites in the Cold War, and China has only in the last few years deployed its first generation. An awareness of differing levels of importance and sensitivity to space systems between allies and potential adversaries is therefore important to bear in mind.

4. *What verbal/political commitments have been made that tie allied hands?* Do previous comments from NATO officials or documents mean that even if an attack on a satellite is nothing more than a nuisance (e.g., Iranian jamming of specific SatComs in the Gulf), NATO's credibility is now at stake if it is seen to do nothing? The danger of spelling out "red lines" for deterrence or outlining a clear, mechanized response to certain actions is that it outlines targets, loopholes, or ambiguities for adversaries to deliberately exploit.
5. *Can risk, ambiguity, and uncertainty be used to increase deterrent effects?* Deterrence, like warfare, cannot escape uncertainty. An element of uncontrollable risk is crucial to deterrence, as the fear of uncontrolled escalation stays the hand of aggression with nuclear weapons. Similarly in space, the fear of the unknown response may increase the fear of attacking important space systems. However, communicating "we may do nothing or something" to potential adversaries is difficult. Contrary to the need for clear communications in a crisis, war plans, and operational command decisions rely on secrecy, surprise, and unpredictability for success.
6. *Would attacking a certain space system be more of a symbolic gesture by an adversary rather than a meaningful military operation?* The extent of NATO members' space systems means that there is a high degree of resilience and redundancy across the alliance, making any singular attacks against larger constellations a rather futile military gesture (e.g., attacking a lone Iridium or Maxar satellite), but it may gain political and public weight out of all proportion to its actual military or economic impact. However, more discrete methods of disrupting or denying the use of those satellites via electronic warfare and computer network operations may be considered less escalatory.
7. *Does a punishment response to an attack against space systems have to be "in kind"?* Against larger states with established military space infrastructures, a tit-for-tat approach, whether with kinetic or non-kinetic attacks, may be easier to devise than against smaller powers who may not be dependent on space systems or have very little of their own. Responses to aggression against space systems need not be in space itself or against space infrastructure, but rather in other areas. Communicating specific messages through actions may be harder across domains, however.
8. *Would losing a specific space system result in irreplaceable losses or are there redundancies or stop-gaps that can be deployed in response?* Deterrence by denial means making the consequences of any attack futile. Not all satellites are equal, and whilst some are important, they could have replacements or methods of compensating for their loss depending on the context of the crisis on Earth. Resiliency in space systems is an important consideration in reacting to attacks on satellites, but high degrees of resilience may make an attacker more ready to strike it in the first place as a lower escalation risk but highly dramatic signalling option due to its reduced impact. Whether or not the attacking party knows is another factor in any response or deterrent posture at NATO.
9. *Does the adversary rely on commercial services from companies registered in NATO member states, or NATO partner states?* In line with NATO members' general preference for economic sanctions over the direct use of force, any belligerent or aggressive actions by states should be punished by ensuring there are costs to their reliance on NATO-based commercial service providers. Commercial providers of national security-related services and products are bound by the laws of their registered states, which also usually

have laws concerning private citizens or companies that betray or go against the state's foreign policy, military, and national security policies. Preventing unwanted or liable behaviour from commercial actors is a question of political will in enforcing existing laws and establishing clear terms of use for commercial services, as well as clauses regarding international crises and emergencies.

10. *Should NATO members confirm or deny that a militarily irrelevant enemy ASAT attack has had little impact?* If an enemy is intent on wasting their efforts and "showing their hand" in futile military gestures, should they be corrected or allowed to carry on with wasteful actions on their part? However, the risk of appearing impotent in the court of public opinion may force NATO's hands to respond in some way.
11. *Is it worth being proactive in attacking hostile or problematic satellites first, or rather responding in kind if attacked upon first?* It is not necessarily the case that striking first against space systems provides insurmountable advantages. As space warfare has yet to happen in a real sense, it may not be the precedent NATO members may wish to create themselves. Positive messaging opportunities will follow if such precedents are set by others, in addition to retaliatory actions. NATO could claim that it is acting defensively to the provocations of others rather than aggressively targeting other states' infrastructures, trying to avoid unnecessary escalation.
12. *Does the adversary have that much to lose by engaging in a "scorched orbit" strategy (Bowen 2020: 121),*[3] *particularly in GEO?* Some ASAT-capable powers have minimal reliance on space for their political, military, and economic functions, and therefore, exercising extreme destruction in space could be a more credible threat. For example, North Korean nuclear detonations in space could cause many problems, especially over the long term, and Pyongyang would not suffer in any direct sense from the loss of orbital infrastructure. China, meanwhile, would suffer significant economic and military setbacks if it lost access to its satellites in LEO, MEO, or GEO should those orbits be targeted by nuclear ASATs. The degree and severity of the reliance of NATO members, and the world economy, on satellite infrastructures may provide a sense of existential deterrence against the nuclear option in space.
13. *How much information on attributing counterspace attacks, dangerous manoeuvres, and confirming their effects needs to be shared?* Physical attacks against space systems can be more easily attributed, and details shared publicly or within the alliance due to the lower technological thresholds in tracking orbital manoeuvres. Nevertheless, electronic warfare and computer network forensics are more challenging in terms of attributing attacks, but not impossible. More problematically, however, it is harder to share information on soft-kill methods that are much more sensitive as it would reveal methods of tracking and defence and attack in the electromagnetic and cyber realms. If a major intentional disruption to extremely important space systems occurred due to intentional jamming, NATO may find it difficult to put a publicly transparent evidence base together to build public support for strong or escalatory countermeasures especially if it occurs outside the context of a major crisis or conflict ongoing on Earth. Similarly, the impacts of space system loss in military and intelligence communities will likely need to be kept secret, but attacks on space infrastructures that impact civilian life will be much harder to keep secret or off the news agenda. That said, there is often scope for public communications on reckless or dangerous actions, such as extremely close co-orbital satellite manoeuvres or excessive communications jamming, without revealing sensitive technical information.

Implications for NATO

[3] A scorched orbit strategy follows the principle of creating as much indiscriminate debris or radiation hazards as possible in specific orbits to disable their use by everyone, including oneself.

These pressing questions lead to significant implications for NATO, but these implications should be interpreted in the spirit of the preceding discussion: that the devil is in the detail of their implementation which is difficult to prescribe in a high-level discussion absent of specific scenarios and imagined crises or conflicts on Earth The correct response in any crisis or conflict will be difficult to determine ahead of time, and therefore much will rely on the skill and intuition of the leaders in the relevant command roles at the time.

It is a positive development that NATO now shares explicit language, concepts, and political consensus on the need to take defence and space issues seriously. This paper's first section has explained how space, and Earth orbit in particular, is a strategically important environment for political, military, and economic purposes. Yet, for its relative novelty to many, classical political concepts of deterrence, warfare, and strategy still apply to outer space and are not too dissimilar to the general problems of deterrence and that NATO already faces on Earth. Concerns over attribution, escalation, and miscommunications, for example, are familiar to NATO leadership on Earth and experience there will be useful in trying to make sense of some technical novelties of advanced space operations, in particular co-orbital, *rendezvous* and proximity operations, which are taxing existing space trace tracking systems.

It is not for nothing, then, that allies are developing their own explicit defence space strategies and capabilities to address such problems, including expanding SSA capabilities and information sharing. As the second section shows, allies are now sharing notes and singing from the same hymn sheet which makes for a stronger alliance if this translates into better coordination and interoperability.

Yet, concepts and strategies only go so far. They are indeed necessary to address issues, but hardly sufficient. As section 3 shows, the art of deterrence and defence requires competent leadership that is able to respond creatively and appropriately to a wide variety of possible scenarios. Doctrines and ideas can help prepare commanders and decision-makers, but they will not provide clear answers or prescriptions for every possible scenario they may face. Below are significant implications that come out of these three aspects of space, deterrence, and defence for NATO.

1. The space elements of general deterrent postures cannot be divorced from the space elements of general war plans. Credible warfighting capabilities enhance the credibility of deterrence. If deterrence fails and war occurs, “deterrent” measures only become the first steps in a new military campaign. As such, second and third order moves in a military campaign should be considered as part of a deterrent posture, which could well be the first move of such a campaign. There is always an “afterpressure” following any significant opening blow or manoeuvre that both sides can anticipate and capitalize upon. Postures entirely reliant on first steps or war prevention are less credible than those that allow for useful follow-up actions and anticipate the effects of such an afterpressure.
2. Politically and militarily, there is nothing particularly unique about outer space. Concerns about attribution, credibility, punishment, denial, thresholds, communications, escalation, and uncontrolled risks are hardly unique to space, raising the same issues over intelligence sharing within the Alliance and with the public when building support for joint actions. There are particular challenges over object tracking in space and various electronic warfare and cyber warfare forensics, but these are technical challenges and threats that still occur in a larger political and strategic context. Specific attacks that may not be easy to attribute immediately but seemingly timed to coincide with major actions on Earth will likely leave much circumstantial evidence.

3. There are limits to how much real-world actions can be pre-planned and pre-decided on paper. Space doctrine language and concepts are not a straitjacket for decision-makers and war planners. Semantic differences over some terminologies are of secondary importance compared to the freedom of actions and spectrum of threats provided by material capabilities. Military history is replete with examples of armed forces acting contrary to or in ignorance of written doctrine. Civilian and military leaders will have to show creative leadership and seize opportunities in the space environment as developments happen in ways that cannot be easily predicted. Crisis and strategy leadership training with space specialisms are therefore required.
4. NATO is correct to focus on coordination and sharing resources between members in space. A priority should be bringing its smaller members 'up to speed' with the United States in particular, but also a few other larger members, and their space capabilities so that even the smallest allied contributions to NATO fit seamlessly into the Alliance's shared space architectures, delivering force enhancement at little extra cost to smaller powers. France, Germany, Italy, and the UK bear a significant responsibility in European NATO to train and integrate smaller European allies.
5. NATO has a major role to play in enhancing resiliency, interoperability, and redundancy as a territorially focused defensive alliance. NATO can put terrestrial, wired backup systems across its Member States, but in particular in eastern member states that lack their own resources to build them. Many ground stations, such as navigation signal augmenters, can be placed on the ground in friendly territories with significant coverage areas. Decoys and other deception measures can be located in friendly territory to complicate enemy missile or electronic warfare targeting plans and raise the costs of enemy attempts to saturate NATO defences and forces with long-range or standoff munitions. When projecting power offensively into hostile territory or liberating previously occupied areas, the availability of terrestrial infrastructure will likely be impaired or non-existent or take time to bring online. This increases military and civilian authorities' dependence on wireless and mobile systems stitched together via satellite infrastructure when taking offensive actions, including liberating any previously lost territories.
6. NATO will need to engage formally with the EU on all fronts of its work in space. NATO's approach is in stark contrast to the EU's which has already become a significant unitary actor in space, including in the military dimension with services such as Galileo navigation and the Copernicus imagery systems. This will soon be joined by the IRIS^2 communications satellites and a unified Space Surveillance and Tracking system. EU investments in additional or new space projects cover all capability areas of interest for NATO in space, such as communications, multispectral imagery, space situational awareness, launchers, and downstream applications. The Union will become the only major source of significant space infrastructure *en masse* that is not US-owned within Europe. The EU provides significant redundancy and resiliency opportunities for NATO, in particular with access to the security-grade PRS signals of Galileo as a backup to GPS' military signals, and potentially more communications and ISR bandwidth. NATO's Strategic Concept already recognizes the EU as a "unique and essential partner for NATO", and this is particularly true in space and the 2023 EU-NATO Joint Declaration highlights space as a priority area for cooperation (NATO, 2023b: 10; European Council, 2023). It is important that all NATO members enjoy a common baseline of access to EU space services, as Canada, the US, UK, and Norway, in particular, are major NATO members but are outside EU structures. US and Norwegian interest in accessing Galileo's PRS as trusted third parties should develop into a NATO-wide endeavour to include Canada and the United Kingdom. Success in delivering Galileo service access to non-EU members could be a template for further NATO-EU cooperation in space.

References

Bateman, Aaron (2022). “Mutually assured surveillance at risk: Anti-satellite weapons and cold war arms control”, Journal of Strategic Studies, 45:1.

Bowen, Bleddyn E. (2020). War in Space: Strategy, Spacepower, Geopolitics. Edinburgh: Edinburgh University Press.

Bowen, Bleddyn E. (2022). Original Sin: Power, Technology and War in Outer Space, London: Hurst Publishers.

Bowen, Bleddyn E. & Cameron Hunter (2021). “Chinese Fractional Orbital Bombardment”, APLN Policy Brief, No. 78, 2021.

Brodie, Bernard (1959). Strategy in the Missile Age. Princeton: Princeton University Press.

European Council (2023). “Joint Declaration on EU-NATO Cooperation”, 10 January 2023, Joint Declaration on EU-NATO Cooperation, 10 January 2023 - Consilium (europa.eu).

Freedman, Lawrence (2004). Deterrence. Cambridge: Polity Press.

Freedman, Lawrence & Michael, Jeffrey (2019). The Evolution of Nuclear Strategy. London: Palgrave Macmillan.

French Ministry for the Armed Forces (2019). “Space Defence Strategy”.

Futter, Andrew (2021). The Politics of Nuclear Weapons. London: Palgrave Macmillan.

German Federal Government (2023). “National Security Strategy”.

Kahn, Herman (1984). Thinking About the Unthinkable in the 1980s. New York City: Simon and Schuster.

Krepon, Michael (2013). “Space and Nuclear Deterrence”. In Michael Krepon et al, ed. Anti-satellite Weapons, Deterrence and Sino-American Space Relations. Stimson Center.

La Rocca, Giancarlo & Alessandro Marrone (2022). “Italy and space, a strong position to enhance”. in Alessandro Marrone and Michele Nones, ed. The Expanding Nexus Between Space and Defence, IAI.

NATO (2022). “Overarching Space Policy”.

NATO (2023a). “NATO’s Approach to Space”.

NATO (2023b). “NATO 2022 Strategic Concept”.

Pasco, Xavier & Paul Wohrer (2023). “Implementing the French Space defence Strategy: Toward Space Control”. In Foundation for Strategic Research.

Quinlan, Michael (2009). Thinking About Nuclear Weapons. Oxford: Oxford University Press.

Schelling, Thomas (1960). The Strategy of Conflict. Cambridge: Harvard University Press.

UK Ministry of Defence (2022). “Defence Space Strategy”.

US Department of Defense (2020). “US Defense Space Strategy”.

Von Clausewitz, Carl (2000). On War, Mathijs Jolles trans. In Caleb Carr, ed. The Book of War, Modern Library.

STRENGTHENING NATO'S DETERRENCE AND DEFENSE POSTURE IN OUTER SPACE

Nivedita Raju – Stockholm International Peace Research Institute (SIPRI)

Introduction

The rapid pace of technological developments, including in outer space, has significant impacts for cross-domain interactions. In particular, the increase in "hybridity" in warfare demands a recalibration of security concepts, especially strategic stability. The rise in threats to space systems features prominently among these developments. Threats to space systems are not explicitly regulated under the existing legal framework for space activities. This limited regulation and decades-long deadlock at the UN Conference on Disarmament has sparked several attempts to move multilateral discussions forward, most recently culminating in the UN Open-ended Working Group (OEWG) on reducing space threats convened under the UN General Assembly. The OEWG was convened over four sessions in 2022 and 2023 to take stock of the international legal framework, discuss threats to space systems, and accordingly propose recommendations on norms, rules, and principles of responsible behaviour for outer space. However, at the final session in August 2023, states were unable to reach *consensus*, even for a procedural report. Objections to the process were reportedly led by Russia and supported by a small minority of states, including China, Iran, and Venezuela. While the process itself did not culminate in a tangible outcome, the OEWG nonetheless facilitated the exchange of views on substantive issues, and cross-regional multilateral engagement. Discussions on further practical measures to Prevent an Arms Race in Outer Space (PAROS) will be conducted through a new UN Group of Governmental Experts in November 2023. Meanwhile, the UK has also submitted a resolution for a second Open-ended Working Group to build on the work of the first OEWG and refine concepts discussed thereunder, at the 78th Session of the UN First Committee.

Achieving tangible progress on space security has been challenging, particularly due to states' differing views on both the substance and the means to achieve PAROS. Divergent national approaches have been further amplified in space security discussions as space systems are vulnerable to attack or interference through a wide range of counterspace capabilities. Experts have documented the rise in development and testing of these capabilities in recent years, highlighting that they are no longer being developed by traditional space powers only, but are now pursued by a number of actors. As a result, states' threat perceptions and priorities for regulation vary.

Counterspace capabilities can have different effects and impacts when targeting space systems. Space systems are comprised of several components: the space segment (the satellite), the ground segment (terrestrial facilities, stations, and receivers), and the data links that connect the space and ground segments. Therefore, apart from satellites, counterspace capabilities can also target supporting systems, for instance, land-based sensors and radars, or data relay satellites that provide supporting functions. Ground segments are also vulnerable to attack by conventional weapons, such as drones or artillery. The unique physical nature

of the space environment also means that satellites can be more easily targeted, than defended, against attacks. Given how susceptible space systems are to attack or interference by an adversary, developing effective policies for allies in the space domain thus first requires careful analysis of the context in which space systems could be vulnerable.

Accordingly, this paper first presents an overview of the varying threats to space systems and then proposes how allies can evolve NATO's approaches to deterrence and defence in relation to such threats. The paper concludes with policy recommendations for NATO members on further steps to address threats to the space systems.

Threats to space systems

There is no consensus on what a "weapon" means in the space security context, nor is there *consensus*, even among experts, on the term "anti-satellite weapon" or "ASAT". These factors have resulted in the increasing use of the term "counterspace capabilities" which refers to offensive, defensive and enabling technologies that can be used to disrupt or damage various components of space systems in order to gain an advantage over an adversary. Broadly, these can be distinguished into kinetic and non-kinetic counterspace capabilities, based on whether they utilize motion-based physical attacks to destroy the target. However, despite trends towards an increase in states' development and testing of kinetic counterspace capabilities, it is important to note that to date, only non-kinetic means have been actively used by states against another's space system.

Kinetic counterspace capabilities

Direct-ascent anti-satellite weapons (DA-ASATs)

Direct-ascent anti-satellite weapons (DA-ASATs) are interceptors launched from Earth to space to target satellites. Considered 'ground-based' counterspace capabilities, the testing and use of these weapons against another space object generate debris in orbit upon striking their target. The states with known DA-ASAT capabilities are China, India, Russia, and the US, each of which has publicly conducted tests in various altitudes in Low Earth Orbit (LEO) over the last decades. Renewed testing of such weapons in recent years has led states to prioritize developing measures banning such tests, culminating in national commitments by a number of states, and a UN General Assembly Resolution in 2022 adopted by a majority of 155 countries, including the US, UK and members of the EU. Since the use of a DA-ASAT would result in creating debris, which would in turn impact the attacking state's ability to use outer space, the decisive nature and overall utility of these capabilities is open to question. However, despite the significant majority, several states voted against the resolution including China and Russia, while others, including India, abstained. The resolution holds political, rather than legal weight, and does not impose binding obligations on states to refrain from destructive DA-ASAT tests. Nevertheless, the resolution can form the basis for norm-building on this issue, and also pave the way for states' consideration of whether a legally binding DA-ASAT test ban should be introduced in the future.

Co-orbital ASATs

Co-orbital ASATs are placed into the same orbits of the target satellite to undertake the attack, thereby rendering them a "space-to-space" threat. A co-orbital ASAT may also potentially use a harpoon or a robotic arm to attack a target satellite. To manoeuvre close to their target, co-orbital ASATs require the ability to conduct precise *Rendezvous* and Proximity Operations (RPOs), and then use an interceptor to collide with the target. However, RPOs by themselves do not necessarily mean that the state is *using* a co-orbital ASAT; indeed, such an RPO could also possibly involve satellites gathering intelligence, for instance by taking images of an adversary's satellite. Still, RPOs are a significant technological advancement that could precede the use of co-orbital ASATs, hence manoeuvres without prior notification or coordination can be highly escalatory. There is no provision under the existing international framework mandating distances to be maintained between the space objects of different states. Non-consensual or uncoordinated RPOs have been increasingly undertaken by some states in recent years in both LEO and GEO, including between space objects belonging to China, Russia and the USA, and between states and their own space objects (Weeden and Samson, 2023). For example, in February 2020, a Russian space object conducted several close approaches within a range of 150 km near a US reconnaissance satellite without any prior notification or coordination, sparking concern among military officials (TIME, 2020).

Non-kinetic counterspace capabilities

Electronic interference

Electronic warfare can refer to different types of interference with space systems using the electromagnetic spectrum. These include jamming (emitting noise into the same frequency as the target system to disrupt the signal); spoofing (creating a false signal to mislead the receiver), and meaconing (intercepting and rebroadcasting the signal of the target) (Raju and Erästö, 2023). Several states have the capacity to engage in electronic warfare, and there are a number of instances where this method of disrupting space systems has been used, including during conflict. This includes incidents of GPS jamming in Norway and Finland during NATO exercises in 2018, and further reports of GPS jamming from the European Union Aviation Safety Authority pursuant to the invasion of Ukraine in 2022. These disruptions were attributed to Russia by various States. Electronic warfare is a growing "grey-zone" activity, since it is still unclear under international law as to when the use of such capabilities would amount to a use of force, if ever. Complexities surrounding the governance of electronic warfare deepen because of the difficulties in the attribution of the attack. In addition, temporality is a key factor in such attacks: the duration of disruption or interference can vary, as they can be temporary and reversible.

Cyber attacks

There is a clear nexus between space and cyber domains as space systems rely on cyber components both for the transmission and storage of data. Cyberattacks are thus a significant threat to space systems. However, while there is a record of cyberattacks against space systems, details of these attacks are often lacking due to States' unwillingness to disclose information, which some experts have attributed to concerns about reputational damage and ongoing preference for over-classification. Attribution is similarly a major challenge for the regulation and governance of cyberattacks. The recent ViaSat cyberattack – that coincided with the Russian invasion of Ukraine on 24 February 2022 – involved the ground segment of a commercial

satellite communications network belonging to ViaSat, disrupting services for users across several States in Europe. The cyberattack temporarily disrupted services for the Ukrainian military, also affected emergency services in France and knocked offline over 5,000 wind turbines of a private company in Germany. Several states attributed the cyberattack to Russia, though Russia did not publicly claim responsibility. Despite limited information on cyber capabilities, the ViaSat case nonetheless exhibits that space systems are appealing targets for cyberattacks. Indeed, since several actors possess significant cyber capabilities, it is important to consider threats to space systems that can not only target a segment in orbit, but also other components on the ground.

Directed energy

These capabilities rely on the direction of concentrated energy through either electromagnetic pulses (EMP), microwave beams, or lasers to attack space systems. States have been pursuing research and development in lasers, though at present, there is no public evidence of directed energy capabilities operationalized specifically for the purposes of targeting space systems. Lasers can attack the optical sensors of satellites by "dazzling" or permanently "blinding" them. It is also possible to develop lasers powerful enough to cause the satellite to overheat, although it is presently unclear whether any state possesses such capability. The effects of such attacks may be reversible or irreversible. In 2006, the US reported that China had briefly "illuminated" one of its satellites, though Beijing did not respond to this claim.

Evolving approaches to deterrence and defence in outer space

The multi-domain nature of contemporary warfare and the risk that warfighting in other domains may spill over to outer space has led states to consider measures to deter attacks on or interference with space systems. However, there is limited clarity on how deterrence would apply to the space domain. This section identifies several bases upon which the alliance can evolve approaches to deterrence and defence in the space domain.

A holistic approach to space warfare

In light of the rising militarization and weaponization of outer space, states increasingly seek policies to deter attacks or interference with their space systems. However, experts have cautioned against thinking too narrowly about "space deterrence", and instead first consider the role of space systems and how they contribute to holistic warfare capabilities in various environments. Accordingly, it is more useful for allies to consider developing postures for deterrence and defence that are derived from a shared understanding of the role of space systems in multi-domain deterrence and operations, collective threats to space systems, differential impacts and effects pursuant to attack or interference, and conduct exchanges on appropriate responses and potential thresholds. This holistic approach requires first establishing a common understanding among allies on how space systems are integrated into states' security architectures in different ways.

Understandings of the roles (and value) of space systems

States rely on space assets to different degrees for strategic and tactical functions. These functions may overlap, which has led experts to highlight the significant escalation risks stemming from the entanglement of nuclear and non-nuclear functions in space systems. The integration of space systems and reliance thereon varies among nuclear-weapon and non-nuclear weapon states and those that possess counterspace capabilities. Consequently, the same type of space system may be valued and utilized differently according to the state's postures and priorities. For example, satellites for early warning systems are an integral component of the USA's nuclear deterrent. This can be distinguished from China, which has reportedly undertaken the launch of early warning satellites in recent years only and does not have the same record of relying on space-enabled early warning for its nuclear posture. In comparison, early warning systems were critical for the Soviet Union's nuclear deterrent, and its space segment was deployed in the 1970s. However, these satellites reportedly experienced technical difficulties, and there have since been efforts by Russia to undertake modernization of the system, particularly introducing new satellites for this purpose (Raju and Erästö, 2023). This indicates that while Russian early warning satellites have not reached the same maturity as the US system, these satellites are nonetheless strategically significant for Russia, given their role in the state's nuclear posture.

Perceived threats to space systems and potential responses to their attack or disruption could thus vary significantly depending on the role and functions of the target space system. This has been reiterated by experts who caution that deterrence strategies for space would need to work quite differently from nuclear deterrence because "actors value their space assets differently from each other and it is not clear how to identify appropriate targets for a retaliatory strategy" (Grego, 2020). These differences are more pronounced in the space context, given the dual-use nature of space systems, which provide multiple and often overlapping functions. For example, a state may attack an adversary's space system in pre-emptive self-defence, under the assumption that the target system is a communications satellite of the adversary. Yet, this could be highly provocative, possibly even risking nuclear escalation, if the target system performs not only communications but also performs early warning functions for the adversary. Establishing shared understanding by convening exchanges on the roles and varying value of space systems for allied states is thus the first step. Such exchanges can include discussions on types of space systems that may constitute critical infrastructure for each state.

Exchange of views on acceptable and legitimate responses

Thereafter, states need to consider acceptable and legitimate responses in case of attacks or disruptions to space systems. There are several varieties of counterspace capabilities with wide-ranging effects and consequences. The use of a kinetic ASAT against another state's space object is unprecedented and, as mentioned, would have indiscriminate consequences due to debris-generation. This is distinguished from electronic warfare such as jamming, which appears to be increasingly used, and has temporary and reversible effects. The use of some capabilities may be, therefore, perceived as more or less escalatory and otherwise more or less politically acceptable than others. As a result, establishing a credible deterrent to attacks on space systems requires first evaluating thresholds and appropriate retaliatory responses in specific scenarios, depending on the role of the space system in the adversary's security architecture, the type of capability used for attack, its effect or temporality, and the circumstances in which it is used (whether during a crisis, for example). Exchange of views to clarify these is necessary, as allies will likely differ on what are appropriate

responses to attacks or interference with space systems. Time for decision-making may also differ based on the state in question, for instance, if it is heavily reliant on space technology and how it values the asset under perceived threat. Such decision-making timelines can be further shortened if the state being targeted also has counterspace capabilities, as there is the potential for "use it or lose it" (Flanagan, Martin, Blanc, Beachamp-Mustafaga, 2023) thinking to incentivize pre-emptive actions, particularly in the case of an RPO involving an adversary state. Internal discussions on potential thresholds and appropriate responses are therefore needed to reduce reliance on strategic ambiguity and enhance cohesion among allies. In addition to these internal discussions, NATO should consider developing more public-facing policy statements that convey a shared position on these issues, which would bolster the credibility of NATO's defence posture in space to adversary States.

These clarifications entail balancing objectives of strategic ambiguity with some degree of transparency. Otherwise, overreliance on strategic ambiguity risks encouraging adversaries to engage in increasingly dangerous grey-zone activities, for instance, cyberattacks against an allied state's strategically relevant space system while remaining under the legal threshold of a use of force. By ensuring a clear internal position shared by allies on thresholds and responses and conveying that such a shared view exists through public-facing statements, NATO can more effectively deter attacks on allied space systems.

While there may be some hesitation to reduce reliance on strategic ambiguity, it is important to note that there is also growing open-source information on space activities, including information on space systems and counterspace capabilities disclosed by state officials and data compiled by commercial actors. This means that some members of the alliance may already have assumptions of acceptable responses or thresholds, and these views are not necessarily shared by all allies. For example, some may underestimate the response of a rival pursuant to attacking its satellite, resulting in inconsistent responses that may instead raise tensions between allies.

Clarifying the utility of counterspace capabilities in different scenarios

Members must also convene to clarify the military advantages and actual utility of using counterspace capabilities in different scenarios, as the same is not clearly established. The utility of counterspace capabilities can widely vary. For instance, some experts have emphasized that it is not necessary that DA-ASATs by themselves would be particularly decisive in a conflict. The use of a single DA-ASAT system to conduct multiple intercepts to attack satellites will change based on the target system, say, where the target is a small number of highly valued satellites, as compared with a large constellation of numerous satellites. Furthermore, it is likely that these multiple intercepts would have to be conducted over a short period of time, in order to gain an advantage. Most importantly, the debris produced from the use of a DA-ASAT would render the orbit significantly polluted which would negatively affect the attacking state as well. For these reasons, some have cautioned that counterspace capabilities "must be deployed in ways that are useful and meaningful in the practical pursuit of space warfare if they are to be deployed at all, else their deterrent effect in the mind of the enemy will be minimal" (Sankaran, 2014). Allies must thus convene discussions to internally clarify the military utility of counterspace capabilities in various scenarios.

Exchanges on "resilience" of space systems

An additional avenue to develop Allies' views and approaches to defence in space is the "resilience" of space systems. The 2022 NATO Strategic Concept includes the objective of boosting "the resilience of the space and cyber capabilities upon which [NATO] depend for […] collective defence and security" (NATO, 2022). Effective steps towards this objective of resilience will require exchanges among allies on what this means in practice. "Resilience" in the space domain has been a key focus area for states such as the US, which has interpreted the term in practice as the "hardening" of space systems to withstand attack or disruption, and further "disaggregating" space assets in larger numbers to reduce reliance on specific satellites (Hitchens, 2022). These practices could impact an attacker's decision to attack space systems since larger numbers of satellites and their improved hardening against specific attacks may provide redundancy, thereby giving the attacker little benefit or advantage. However, it is not clear whether disaggregation strategies, or hardening, would entirely discourage or limit the effect of attacks, or what implications these may have for escalation and strategic stability in outer space overall. Nor is it established whether disaggregation and hardening are effective for all types of space systems providing functions. Most importantly, resilience would look different for each member state, given that there are visible differences in space assets, programs, reliance, and vulnerability. For instance, resilience may also involve other priority areas as highlighted in the EU Space Strategy for Security and Defence, which includes developing capabilities such as "self-protective infrastructure, versatile and responsive launchers, SSA, in-orbit servicing and secured sovereign cloud dedicated to space services" in the interest of increasing EU autonomy and resilience in space (European Union Space Strategy for Security and Defence, 2023). This evidences that increasing sovereign assets, with missions to extend their lifetimes and ensure swift replacement, are also priorities for resilience.

Accordingly, it would be useful for allies to convene sessions dedicated to exchanges on what "resilience" means in practice, how this impacts each state (including those that rely on others' space systems) and how to take effective steps to implement this objective in NATO's collective interest.

Implementing SSA data-sharing

Space Situational Awareness (SSA), sometimes used interchangeably with "Space Domain Awareness", refers to the monitoring, tracking and identification of space objects. This includes predicting the movements of satellites and debris and can enable warning (and subsequent interventions) to prevent collisions between objects in orbit. SSA is not a "threat" to space systems. However, SSA can be considered a counterspace capability because it is essential for target identification. For instance, ASATs would be completely ineffective, unless a state has the SSA technologies necessary to accurately locate and point to a target. Still, SSA is also a much-needed tool for the safety and sustainability of outer space, possibly also for a future space traffic management system. It consists of a network of radars and sensors, which can be both terrestrial and space-based. SSA technology today is derived from the Cold War era early-warning systems. Consequently, the US, followed by Russia and China, have the most sophisticated capabilities. There is also a positive global trend of improving SSA through data-sharing among multiple actors, which can improve the accuracy of data.

Addressing space threats effectively also requires the means to identify and track activities and movements of space objects in orbit, which requires shared SSA capabilities. The implementation of NATO's Strategic Space Situational Awareness System (3SAS) and the Alliance Persistent Surveillance from Space (APSS) initiative will be critical to ensuring that members can identify attacks, disruptions, or potential threats (NATO 2023). 3SAS is aimed at providing allies with a better understanding of the space environment, space events and their effects across all domains, while APSS aims to achieve "persistent surveillance" for NATO through

existing and future space assets of allies (NATO 2023). These capabilities for situational awareness should form the basis for allies' shared understanding of how to identify and assess threats to space systems, as presently only states such as the USA have highly sophisticated SSA capabilities. This points to the need for established processes for allies on how to interpret and assess data obtained for SSA. For instance, even if 3SAS data reveals a potential threat (such as an adversary's space object conducting a rendezvous and proximity operation near an ally's space object), members are unlikely to reach *consensus* on what distance/proximity would render the operation "threatening". In such a scenario, the absence of clarity and procedure needed to effectively use SSA data poses high risks to allies, as adversaries may benefit from the ambiguity and divergence of views.

Recommendations

Consultations regarding the assessment of threats, potential thresholds and appropriate responses

NATO has clearly articulated that attacks on allied space assets would not be tolerated and could lead to the invocation of Article 5 of the North Atlantic Treaty (NATO, 2021). This has been reiterated in NATO's 2022 Strategic Concept, which states that "hostile operations to, from, or within space could reach the level of armed attack" and result in invoking Article 5 (NATO, 2022). However, as exhibited above, steps must be taken to support these policy statements and evolve NATO's approaches to deterrence and defence in space, particularly to bolster its credibility to adversaries.

The need for improved cohesion among allies has been encouraged by many, and the same is even more pronounced for operations in the space domain. There are visible differences in the space assets and national capacities of allies. While some states have increased their use and reliance of space systems in recent years, this is not necessarily accompanied by the requisite strategies to identify or respond to threats to the same systems. On the other hand, some smaller states lack space programs and sovereign assets altogether and may not prefer continued reliance on assets provided by others. Convening consultations to assess members' dependency on space systems, assessing how to make space systems more resilient and discourage attacks, is therefore essential. Effective defence policies for NATO can be derived from the adequate implementation of the 3SAS and APSS that considers practicalities, specifically conducting sessions on how to use and interpret the data and identify threats. In this regard, the exchange of views regarding operations and tactics are also avenues for engagement. Indeed, it has been noted that some allies "have reservations about ceding control of space systems to foreign commanders during a crisis" which may result in overall inefficiency (Silverstein, 2020).

Priority in potential sources of threats to space systems is also not necessarily shared by allies. While the war in Ukraine has highlighted shared concerns about Russia, NATO's Strategic Concept still mentions, among others, China, Iran, North Korea, and Syria, as well as NATO's strategic interests in the Indo-Pacific (NATO, 2022). This has led some to raise concerns that members may be faced with potentially conflicting priorities in the use of space systems, since it may not be sustainable to rely on one or a few states for space assets to monitor activities from all these sources (Stickings, 2020). Convening discussions on the known and estimated capabilities in these regions and how they may be used to attack or disrupt space systems, would be useful

and go one step further towards establishing a common view of potential sources of threats to allies' space systems.

Finally, consultations must focus on specific scenarios to ensure that NATO members share the same views regarding the assessment of threats and consensus on appropriate responses in various scenarios. Determining appropriate responses is especially necessary for forms of electronic or cyber interference with space systems, which may be more ambiguous under international law. Overall, it is important that allies refrain from overreliance on strategic ambiguity, as this can result in dangerous miscalculation and escalation, stemming from assumptions based on worst-case scenarios. These scenarios must consider specificities such as the space system being attacked and the function/role it plays, the means by which it was attacked, and the prevailing circumstances (whether during a crisis).

Steps towards common understandings of international law

International law is also useful in developing NATO's deterrence and defence postures. Common understanding of space law and other applicable laws underscores the legitimacy of NATO's actions and can help enhance overall credibility. It is also another avenue to ensure Allies share the same views on acceptable and permissible actions in military space operations. NATO has acknowledged the importance of applicable law, as exhibited in its 2019 Space Policy, where NATO declared that its members will carry out all activities in outer space in accordance with international law' (NATO, 2022). In addition, NATO has clarified that space is an "operational" domain and that it "has no intention to put weapons in space" (United Nations General Assembly, 2022). Accordingly, an exchange of views in the alliance is needed to take further steps towards shared interpretations of the legal controls placed on military activities in outer space under international law and establishing common understanding of the current international framework. This will additionally require developing further guidance on how to lawfully use current space systems and counterspace capabilities both during peacetime and during conflict as per these commitments. For instance, what are the Allies' views on specific capabilities, such as ground-based DA-ASATs and the circumstances of their use, especially pursuant to UN General Assembly resolution 77/41 (United Nations General Assembly, 2022) banning destructive DA-ASATs? Given that the US is the only ally to possess these capabilities, and that a kinetic strike against another state's satellite is unprecedented, do Allies have a shared position on when – if ever – DA-ASATs could lawfully be used? Given that some states at the UN OEWG suggested possibly banning the use of such weapons, reaching *consensus* on such questions is critical for the Alliance.

At the 2021 Brussels Summit, it was clarified that "attacks to, from or within space…could lead to the invocation of Article 5", and that these decisions regarding Article 5 would be "taken by the North Atlantic Council on a case-by-case basis" (NATO 2021). However, classified, internal engagement on this subject risks limited credibility and unclear signalling to adversaries regarding Allies' common understanding of how Article 5 would be invoked, and when it would apply, as there are several questions that arise under the current international framework as to what may and may not be permissible. Apart from international space law, other applicable bodies of law are also relevant, such as International Humanitarian Law (IHL) and the UN Charter. Achieving internal consensus regarding provisions of these applicable laws to military space operations is necessary, especially for key issues such as the lawful exercise of self-defence in various scenarios. For example, in a scenario where an adversary has engaged in a non-consensual RPO near an ally's satellite, it is possible that the adversary's asset is simply an inspector satellite and not a counterspace capability. In this case, an ally risks unlawfully engaging in anticipatory self-defence possibly violating its own

obligations under international law. Convening discussions with legal experts on the interpretation of law in these scenarios can help contribute to cohesion in NATO, and further buttress allies' legitimacy of operations in the space domain.

Addressing integration and interoperability issues

Given the multi-functional uses of space systems for various military purposes, allies can benefit from their effective integration. This is especially the case with space systems used for Intelligence, Surveillance and Reconnaissance (ISR) as NATO relies on space-enabled ISR, for the timely processing of data from multiple sources (Unal, 2019). Yet, as experts have noted, there are technical challenges arising from the interoperability of space systems. When a state is developing or acquiring space technologies, interoperability can help ensure that these systems will be compatible with those used by other allies for more efficient joint operations (Cesari, 2023). Achieving this in practice has been challenging due to the difficulties in harmonizing standards among systems, protocols required for training forces in their use, and differences among members regarding the ratification of requisite standardization agreements (Cesari, 2023). In addition, different industrial and technological policies at the national level do play a role in this regard.

Integrating the use of space systems into NATO's operations can be more effective if supported by guidance for allies, similar to the Alliance Maritime Strategy, in a manner that accordingly recognizes the differences between members' space assets and clarifies the roles that can be played by smaller states. Partnerships can also be useful for exchanging views on more efficient integration of space systems, particularly between the EU and NATO considering their significant overlapping membership in Europe. The EU Space Strategy for Security and Defence has highlighted the importance of "dialogue and practical cooperation" on space security issues. The Strategy also suggests that "parallel and coordinated exercises by the EU and NATO could include a space domain component" (EU Space Strategy for Security and Defence). These can be useful bases for developing measures that address the integration and interoperability issues among space systems of member states.

Conclusion

The UN OEWG process facilitated significant multilateral exchanges among states on substantive issues of space security. These included exchanges on threats to space systems and possible norms, rules and principles of responsible behaviour and views expressed by several allies. Yet, participation in the OEWG evidences that there is considerable scope to further engage members of the Alliance in space security discussions. Such engagement would further improve the alliance's deterrence and defence posture in the space domain and shape measures to deter attacks on space systems.

Such attacks can be conducted through several means, ranging from kinetic attacks through DA-ASATS and co-orbital ASATs, to attacks or interference using non-kinetic capabilities, including directed-energy, electronic warfare and cyber means. The use of DA-ASATs and co-orbital ASATs is unprecedented, although there is a notable increase in the use of electronic and cyber means of interfering with space systems. To deter such threats, the Alliance can undertake steps to strengthen NATO's defence postures in the space

domain. This requires evolving the Alliance's thinking on deterrence and defence, beginning with a holistic approach to space warfare. As threat perceptions are subjective among allies, it would be useful to commence discussions on threats by first exchanging views on the different roles of space systems in various states' security architectures, and considering how states value such systems differently. This will form a basis for assessing potential thresholds, determining appropriate responses to attacks, and exchanging internal views on what resilience means to each state. Engaging in these discussions will require balancing objectives of transparency with strategic ambiguity, particularly by reducing overreliance on the latter. Allies would also benefit from convening discussions to clarify the utility of counterspace capabilities in different scenarios. Furthermore, allies are encouraged to take steps towards a common understanding on the applicability of international law, including interpretations of space law and IHL in the space domain, as this will further bolster the legitimacy of NATO's actions in space, enhancing overall credibility and cohesion among member states. It is additionally recommended that the alliance take steps to address challenges arising from the integration and interoperability of space systems. The role of partnerships in this regard, in particular with the EU, can be a useful basis to facilitate engagement and develop measures to address these issues.

References

Acton, James, Thomas MacDonald & Pranay Vaddi (2021). "Reimagining Nuclear Arms Control: A Comprehensive Approach". In Carnegie Endowment for International Peace.

Acton, James (ed.) (2021), "Entanglement: Russian and Chinese Perspectives on Non-nuclear Weapons and Nuclear Risks". In Carnegie Endowment for International Peace.

Bingen, Kari A., Kaitlyn Johnson & Makena Young (2023). "Space threat assessment 2021". In Center for Strategic and International Studies.

Blinken, Antony (2022). "Attribution of Russia's malicious cyber activity against Ukraine". In Press statement, US Department of State.

Bowen, Bleddyn (2022). Original Sin: Power, Technology and War in Outer Space. Oxford: Oxford University.

Cesari, Laetitia (2023). "NATO In pursuit of the best standards: what material and legal interoperability for NATO forces?". In NATO Legal Gazette, Volume 42.

Defense News (2018). "Finland, Norway press Russia on suspected GPS jamming during NATO drill".

EU (2023). "Space Strategy for Security and Defence".

Flanagan, Stephen J., Nicholas Martin, Alexis A. Blanc & Nathan Beachamp-Mustafaga, (2023). "A Framework of Deterrence for Space Operations". In RAND.

Grego, Laura (2020). "Outer Space and Crisis Risk". In eds, Steer, Cassandra, Hersch, Matthew, War and Peace in Outer Space: Law, Policy and Ethics, Oxford: Oxford University Press.

GPS World (2022). "European agency warns of GNSS outages near Ukraine".

Hitchens, Theresa (2023). "Russia spikes UN effort on norms to reduce space threats". In Breaking Defense.

Hitchens, Theresa (2022). “Space Force phasing out missile warning from GEO, will focus on lower orbits”. In Breaking Defense.

NATO Alliance Persistent Surveillance from Space (2023).

NATO’s Approach to Space (2023).

NATO Brussels Summit Communique (2021).

NATO Space Policy (2019).

NATO Strategic Concept (2022).

Raju, Nivedita (2021). “Russia’s ASAT test should lead to a multilateral ban”. In SIPRI.

Raju, Nivedita & Tytti Erästö (2023). “The role of space systems in nuclear deterrence”. In SIPRI.

Raju, Nivedita & Lora Saalman (2023). “The space-cyber nexus”. In SIPRI Yearbook.

Samson, Victoria (2023). “The Cyber Counterspace Threat: Coming Out of the Shadows”. In CIGI Essay Series.

Sankaran, Jagannath (2014). “Limits of Chinese ASAT threat to USA”. In Strategic Studies Quarterly, Vol. 8, No. 4.

Silverstein, Ben (2020). “NATO’s return to space”. In War on the Rocks.

Stickings, Alexandra (2020). “Space as an operational domain: What next for NATO?”. In RUSI.

SpaceNews (2006). “NRO Confirms Chinese Laser Test Illuminated U.S. Spacecraft”.

Time (2020). “Strange Russian Spacecraft Shadowing U.S. Spy Satellite, General Says”.

UN General Assembly Resolution 76/231 (2021). “Reducing space threats through norms, rules and principles of responsible behaviours”.

UN General Assembly Resolution 77/41 (2022). “Destructive direct-ascent anti-satellite missile testing”.

UN General Assembly Resolution 77/250 (2023). “Further practical measures for the prevention of an arms race in outer space”.

UN General Assembly (2023). 78th Session, First Committe, Statement by the United Kingdom.

Unal, Beyza (2019). “Cybersecurity of NATO’s Space-based Strategic Assets”. In Chatham House.

Wan, Wilfred & Nivedita Raju (2022). “Strategic instability across domains”. In ed. Rajagopalan, Rajeswari Pillai, Future Warfare and Technologies, Observer Research Foundation.

Weeden, Brian and Victoria Samson (2023). “Global Counterspace Capabilities: An Open Source Assessment”. In Secure World Foundation.

West, Jessica & Almudena Azcárate Ortega (2022). “Space Dossier 7: Norms for Outer Space: A Small Step or a Giant Leap for Policymaking?”. In UNIDIR.

Wilson, Robert S. (2023). “Space Force budget brief: New priorities and long-term developments towards a new architecture”. In Aerospace Corporation, Center for Space Policy and Strategy.

Wright, David, Laura Grego & Lisbeth Gronlund (2005). The Physics of Space Security: A Reference Manual. Cambridge: American Academy of Arts and Sciences.

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WORKING GROUP REPORT

SPACE THREATS – HOW TO APPROACH DETERRENCE AND DEFENSE ASPECTS

Fabrizio Coticchia –University of Genoa

Working Group 3 addressed the issue of "Space threats", focusing specifically on the concept of "space deterrence". The lively discussion of the panel has been stimulated by the papers presented at the beginning of the workshop ("*Space threats: how to approach NATO deterrence and defence aspect*s" by Bleddyn E. Bowen; "*Strengthening NATO's deterrence and defence posture in outer space*", by Nivedita Raju).

The three sessions held during the WG aimed to answer the following demands:

1) What crucial concepts allow a proper understanding of the challenges concerning space threats and space deterrence?

2) What are the vital issues related to the future development of space threats and space deterrence?

3) What are the main questions an organization like NATO should address regarding space threats, deterrence, and defence?

Concepts

The panellists believe that sharing terms and lexicon on space is a first step for enhancing convergence on the topic. To disentangle the concepts of "space threats" and "space deterrence", the WG highlights two primary compulsory efforts. First, the initial conceptual move is "normalizing the space" as an operational domain. Second, the WG emphasizes the relevance of understanding "the peculiarities of deterrence in space". Relatedly, the panel underscore four main aspects.

1) The art of deterrence (by denial and/or by punishment) should be clearly distinguished from the concepts of strategy (as the art of reconciling ends and means in front of an adversary) and – especially – warfare. All notions do apply in space, but a deterrence posture cannot be confused as an attitude aimed "just" to win the next war;

2) The concept of deterrence –largely examined by the security studies literature – should be effectively unpacked. Indeed, deterrence in space does not occur in a vacuum, and a crisis in space cannot be considered isolated from a crisis on Earth. Krepon defines space deterrence as the deterrence of

"harmful actions by whatever means against national assets in space and assets that support space operations" (Krepon, 2012). Thus, territorial activities shape space and vice versa. The WG strongly emphasizes the need to think about space from a broader perspective, adopting a "holist approach" in various environments;

3) Relatedly, the WG focuses on the issue of cross-domain intersection, especially for deterrence. Thus, space systems should be always conceived within a multi-domain perspective;

4) While space is "just another domain", it has peculiarities. This makes analogies taken by the vast literature on nuclear deterrence, or – more recently – by cyber deterrence, not immediately applicable (e.g., survival is not a primary issue here). Wrong analogies represent typical cognitive biases of leaders. Yet, by studying the (almost immense) scholarly debate on nuclear deterrence, many helpful concepts can be used. For instance, within an international context marked by a rising great power competition, the relevance of the "shared understanding" between Moscow and Washington after the Cuban Missile Crisis (1962) is evident. A miscalculation, misperception, and lack of communication are dramatic mistakes that should still be avoided on Earth and in space.

Moving from concepts to questions, if space deterrence requires properly assessing, identifying, and responding to threats, two queries must be answered: *what do you want to deter? Whom do you want to deter?* These two crucial questions allow for linking a conceptual analysis of space deterrence to the discussion on space threats.

Space threats

The literature has no consensus on the main "space threats". Also, the panel recognizes different viewpoints on what weapons could mean in space security. Relying on the paper presented by Raju (2023), the W3 distinguishes between kinetic and non-kinetic counter-space capabilities. Among the first category, we can find direct-ascent anti-satellite weapons (whose ground-based counter-space capabilities are in the hands of few great powers) and co-orbital anti-satellite weapons. Electronic interference, concentrated energy, and cyber attacks on space systems are examples of non-kinetic counter-space capabilities. Beyond the technological dimension (and the problem of attribution of the attack for the second type of capabilities), the WG focuses on the relevance of different threat perceptions towards the wide range of challenges that could require deterrence. Alliances traditionally suffer from divergent threat perceptions on the ground as well as in space. For instance, in the security studies literature, "strategic cacophony" is one of the main obstacles to the development of an actual common European Union Defence policy. Indeed, member states have (very) different threat perceptions that hinder a fully shared strategic assessment of the EU's leading threats. To a lesser extent, the recent (post-2014) NATO debate on the primacy of the Southern or the Eastern "Front" reveals dissimilar standpoints by members of the nature of the main threats posed to the Alliance. Therefore, in front of a wide range of threats, the perspective of NATO members could be very dissimilar according to different capabilities, stakes or relevance attributed to the space systems. States rely on space for various reasons, at different degrees, and NATO members do not have the same perception of space systems. Thus, as for risk assessment on the earth, enhancing consultation on the shared evaluation of

threats helps identify key divergencies and convergences, improving cohesion among allies (and avoiding miscalculation among enemies).

When political leaders draft national security strategies before illustrating the main threats, the premise is usually featured by a detailed description of the scenario where those challenges emerge. Thus, the assessment of space threats – in line with the above-mentioned holistic approach that considers space as a "normal" operation domain, not in isolation from the others – cannot be separated from the analysis of the international context. The W3 emphasizes the growing competition among great powers (which inevitably affects their relationship in space after years of attention devoted mainly to technical cooperation) and the rising militarization of outer space. On the one hand, the Russian invasion of Ukraine (2022) –conceived in the panel as an example of failed deterrence – has profoundly shaped the perceived space of further cooperation in space, a "wake-up" for NATO members of the state of competition across domains. Moreover, in line with the Strategic Concept (2022), the rise of China as a competitor and challenger requires specific attention in space. On the other hand, the conflict in Ukraine remarked on the overall relevance of space as the vital operational domain in contemporary warfare (e.g., GPS, jamming, etc.). Moreover, such relevance is well illustrated by increasing investment in space capabilities, by organizational reforms (e.g., new desks in ministries and new commands in armed forces devoted to space) and by elaborating new doctrines related explicitly to outer space. Alongside, the commercial importance of the domain has dramatically increased, revealing the considerable role played by private actors (*infra*). However, because of its mounting importance, states have become more dependent on space and – consequently – more vulnerable to threats to space systems, whose resilience becomes vital.

Main issues and questions

Relying on the concepts mentioned above and topics, the WG focuses on three major issues requiring specific attention regarding space deterrence and defence.

The first is the decision-making process behind threat assessment, deterrence posture, and – in case – responses to attacks. Beyond investments and capabilities, the role of the human decision-makers should remain central. For the WG, the "art of leadership in deterrence" should be trained and cultivated within a bureaucratic context that contributes to making effective and efficient decisions in space at national and multinational levels.

The second main issue is related to information sharing. On the one hand, information on space deterrence and defence should be provided to the broader public. The criticality of satellite networks is not so widely perceived politically. The WG considers it crucial to "prepare the society", properly illustrating the crucial relevance of space as an operational domain with enormous consequences for civil society. Such a move could enhance the credibility of political actors and the legitimacy of the political decisions, promoting awareness and common understanding. The WG3 shares the relevance of international law and its importance for NATO regarding global guidance, trustworthiness, and exchange of interpretations. This transparency in sharing information on space threats and space deterrence should be balanced with the strategic ambiguity necessary for effective deterrence. On the other hand, information sharing attains communication among allies. The WG agrees in considering NATO a "harmonizing hub", an institutional context that – beyond the above-mentioned crucial consultation for increasing cohesiveness on threat assessment – can shape the external environment, establishing norms and procedures in the space,

harmonizing standards from a legal and technical perspective. The WG believes that NATO needs to share methods to discuss space deterrence. Relatedly, the panellists discussed the need for a "NATO Space Doctrine" that could also foster such a process of information sharing. Therefore, a doctrine (which should focus on prioritization, impacts and consequences of space threats rather than just on specific space assets and capabilities) is relevant not only for developing new approaches and strategies - on deterrence, escalation, red lines, responses, and norms of behaviour - but also for the external audience, transmitting its perspectives and standards in a context marked by the slow development of international norms (from debris to other topics).

The third issue is interoperability. As occurred for NATO on the ground (e.g., during ISAF) and in space joint operations, active cooperation among member states could improve the cohesiveness of the Alliance. Joint training, simulation, drills, wargames, and exercises are valuable tools for reaching such a purpose. Yet, "just more cooperation" is a simple and fascinating slogan that could hide the existing complex political limitations. NATO should always consider such political obstacles with a reasonable degree of pragmatism. Considering these potential barriers, interoperability does not concern only NATO members (and NATO partners, such as Japan) but also the EU and private actors. As a natural ally of NATO, the European Union is a crucial actor in space that has developed (common) technological capabilities, doctrines, and resources. While interoperability with the EU, especially from the Berlin Plus agreement onwards, is nothing new to establish and develop, how to engage (or deter?) private actors in space could be more problematic. The war in Ukraine has highlighted both advantages and risks related to the role of private actors in space during warfare. However, despite the rising relevance of the commercial sector in space, the WG emphasizes a) how state spending in space could be the crucial factor in shaping the relationship with private actors and b) the growing need to think about common standards and regulation.

In sum, the lively discussion of the WG 3 addressed several issues related to space defence and deterrence that need to be dealt by NATO perspective. Crucial questions to answers refer to who (and what) to deter and what are the possible blind spots in threat assessment. On the whole, the peculiarity of deterrence in space domain should be better investigated. Moreover, concerning interoperability, NATO needs to understand what the main barriers to collaboration among allies are, how to overcome them, as well as finding the ways to maximize information sharing. In terms of the critical dependencies in the alliances' space enterprise, European allies should properly realize how to reduce the existing reliance on US space capabilities within NATO. Alliance's forthcoming new space doctrine could answer all the questions related to the features of the NATO's space view. Finally, by identifying the ways to improve partnerships with the EU and with private actors, NATO could enhance considerably the resilience of its space capabilities.

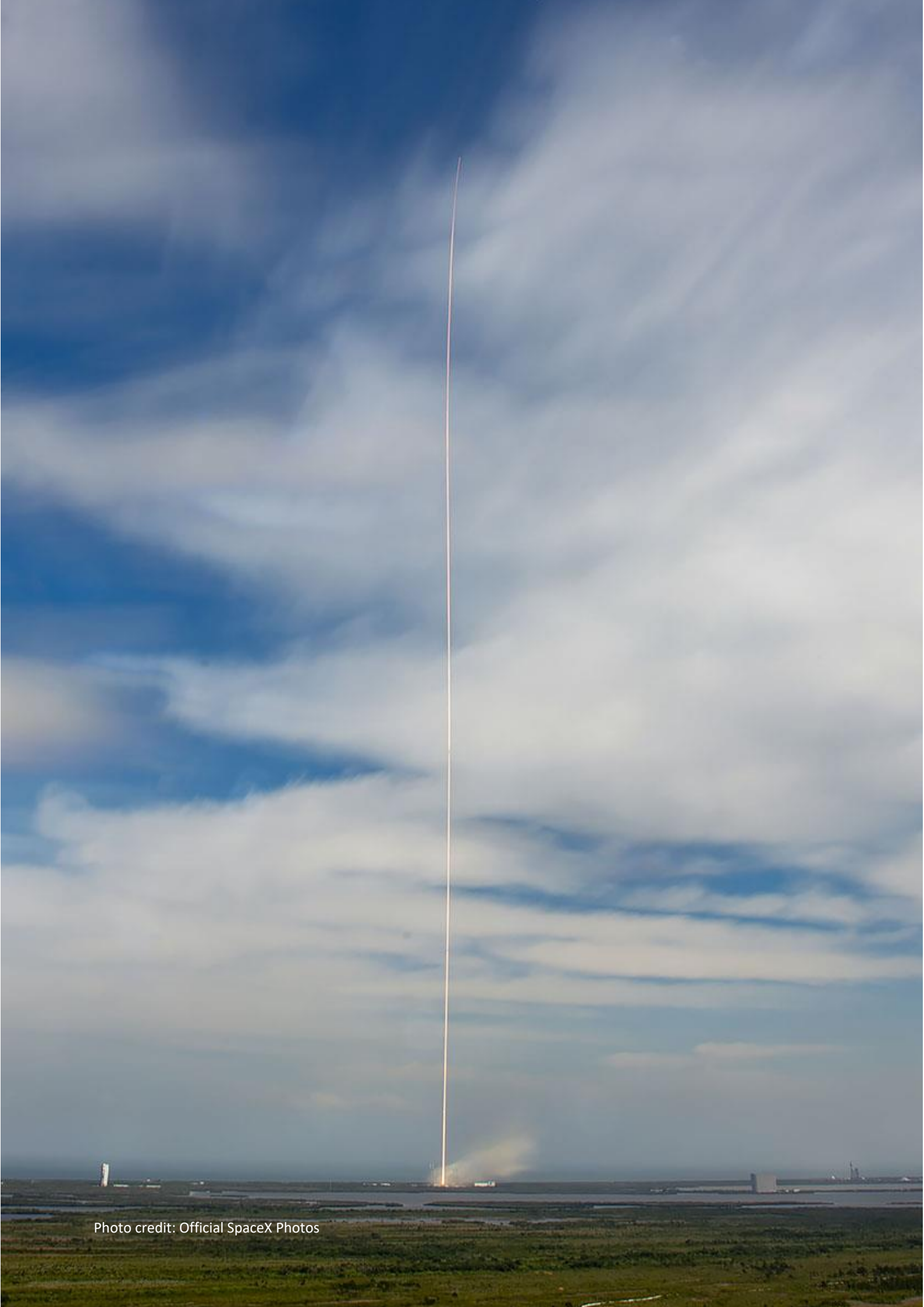
List of acronyms

3SAS	Strategic Space Situational Awareness System
ABM	Anti-Ballistic Missile
ACO	Allied Command Operations
ACT	Allied Command Transformation
AGS	Alliance Ground Surveillance
AI	Artificial Intelligence
AJP-3.3	Allied Joint Doctrine for Air and Space Operations
ALLSAT	NATO Alliance SmallSAT Constellation
APSCO	Asia-Pacific Space Cooperation Organization
APSS	Alliance Persistent Surveillance from Space
ASAT	Anti-ballistic system and anti-satellite
BRI	Belt and Road Initiative
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CD	Conference on Disarmament
CFSP	Common and Foreign Security Policy of the Union
CoE	Centre of Excellence
COPUOS	UN Committee on the Peaceful Uses of Outer Space
CSDP	Common Security and Defence Policy
CSIS	Center for Strategic and International Studies
DA-ASAT	Direct-ascent anti-satellite weapon
DOTMLPF	Doctrine, organization, training, materiel, leadership and education, personnel, and facilities

EDA	European Defence Agency
EDF	European Defence Fund
EHF	Extremely high frequency
EMP	Electromagnetic Pulse
ENMOD	Environmental Modification Techniques
EO	Earth observation
ESA	European Space Agency
ESPI	European Space Policy Institute
EU	European Union
EU SST	EU Space Surveillance and Tracking Partnership
EUISF	EU Industry and Start-ups Forum
EUSPA	EU Agency for the Space Program
GGE	Group of Government Experts
GPS	Global positioning system
HAPS	High-altitude platform station
HCOC	The Hague Code of Conduct against Ballistic Missile Proliferation
HR/VP	High Representative/Vice-President
IADC	Inter-Agency Debris Coordination Committee
IAI	Istituto Affari Internazionali
ICOC	International Code of Conduct for Outer Space Activities
IHL	International Humanitarian Law
ISR	Intelligence, Surveillance and Reconnaissance
ISS	International Space Station
ISSMI	Istituto Superiore di Stato Maggiore Interforze
LEO	Low Earth Orbit

LSE	London School of Economics and Political Science
MCF	Military-civil fusion
MGS	MEO Global Services
MoD	Ministry of Defence
MTCR	Missile Technology Control Regime
NATO	North Atlantic Treaty Organization
NCIA	NATO Communications and Information Agency
NOC	National Operations Centre
NTM	National Technical Means of Verification
OEWG	UN Open-ended working group
OSP	Overarching Space Policy
PAROS	Prevention of an Arms Race in Outer Space
PESCO	Permanent Structure Cooperation
PLA	People's Liberation Army
PLASSF	People's Liberation Army Strategic Support Force
PNT	Position, navigation and timing
PPWT	Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects
PwC	PricewaterhouseCoopers
R&D	Research & Development
RPO	Rendezvous-and Proximity operations
SAR	Synthetic Aperture Radar
SatCen	Satellite Centre
SATCOM	Satellite Communications
SBIRS	Space-Based Infrared Surveillance

SDA	Space Domain Awareness
SEA	Support to EU External Action
SHA	Super high frequency
SHAPE	Supreme Headquarters Allied Powers Europe
SIGINT/ELINT	Signals/electronic intelligence
SSA	Space situational awareness
SST	Space Surveillance and Tracking
SWF	Secure World Foundation
TCBM	Transparency and Confidence-building Measure
UAV	Uncrewed Aerial Vehicle
UHF	Ultra-high frequency
UK	United Kingdom
UNGA	UN General Assembly
UNOOSA	United Nations Office for Outer Space Affairs
US	United States
US Navy SEALs	US States Navy Sea, Air, and Land Teams
WG	Working Group
WMD	Weapons of Mass Destruction



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