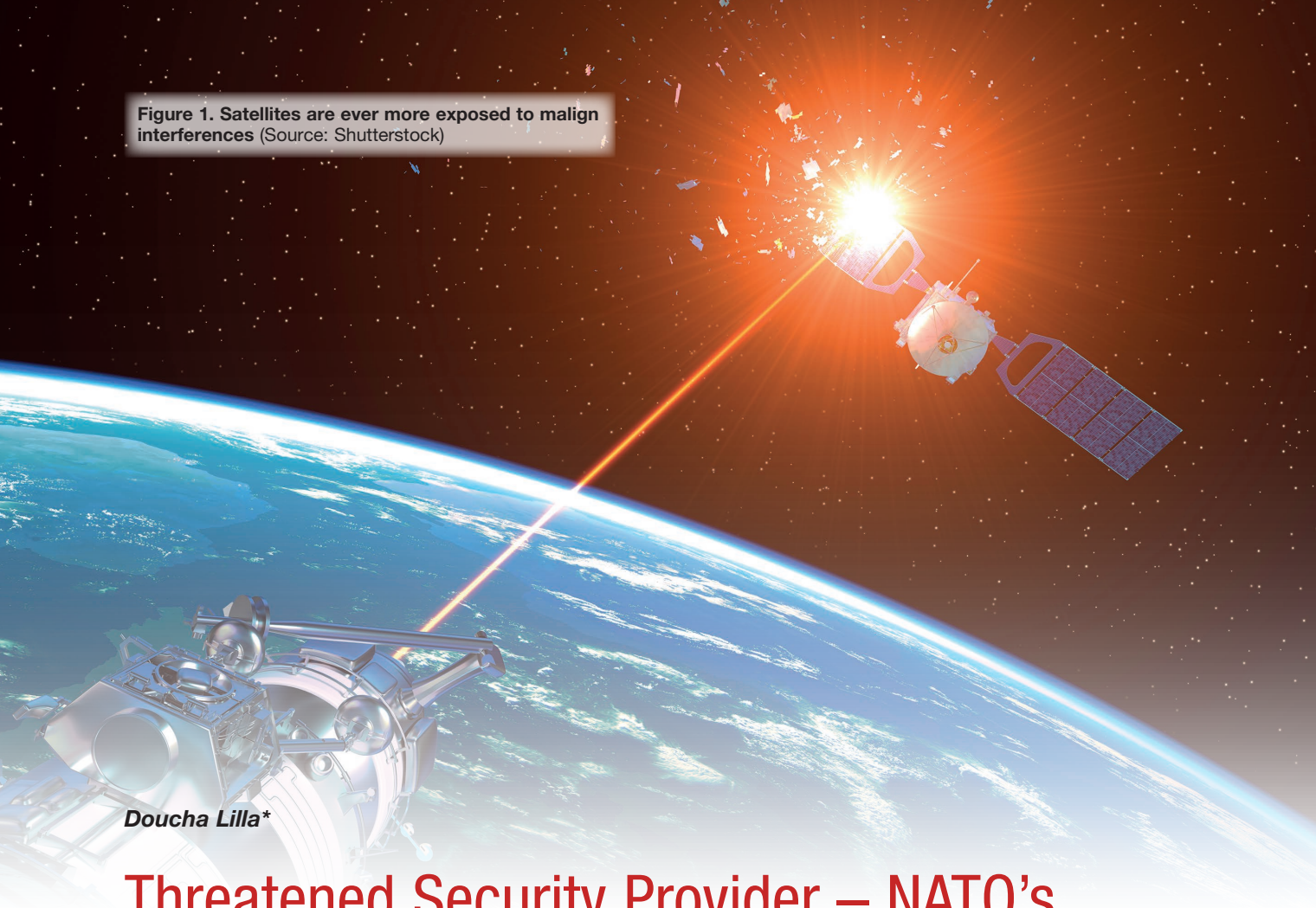

Figure 1. Satellites are ever more exposed to malign interferences (Source: Shutterstock)

*Doucha Lilla**

Threatened Security Provider – NATO's Opportunities and Challenges in Space

Introduction

The North Atlantic Treaty Organization (NATO) is rarely subject to scrutiny in matters of space security due to its only recently obtained status and limited role as a formal space actor. However, space as an operational enabler and enhancer has a paramount role in the core functions of the Alliance of 31 nations. Although this strategic significance is not mirrored by the number of space assets possessed by the international organization, recent developments in the attention devoted to the fifth operational domain highlight that the Alliance is cogently preparing itself to remedy its vulnerabilities in the outer space. But what makes such a new and scarcely present actor one of the most exposed to malicious actions in the orbit?

As the New Strategic Concept notes, "maintaining secure use of and unfettered access to space and cyberspace are key to effective deterrence and defence." [1] The first reference of a strategic concept to outer space's role in the transatlantic Alliance's core tasks underlines that while in recent decades NATO's role has increased in space, the outer space's strategic assessment has also advanced in NATO.

ABSTRACT: What makes NATO one of the most vulnerable space actors? This article elaborates on the threats the most prominent security provider of the Euro-Atlantic region, NATO encounters in the outer space domain. Such menaces to orbiting security providers are assessed by their potential to inflict significant impairment on NATO's core tasks. Followingly legal, normative, and military approaches are tested to highlight deterrence as a potential endeavor for addressing contemporary and future challenges in space.

KEY WORDS: NATO, 5th operational domain, space security, space deterrence, space assets

ÖSSZEFOGLALÁS: Mi teszi a NATO-t az egyik legtöbb fenyegetésnek kitett szereplővé az űrben? Jelen írás célja azon fenyegetések bemutatása, amelyekkel az Euro-Atlanti régió legjelentősebb biztonságot nyújtó szervezete, az Észak-atlanti Szerződés Szervezete szembenéz a világűr műveleti színtéren. A keringő űreszközök fenyegetései a NATO alapvető feladatainak korlátozására való potenciáljuk alapján elemzésre és osztályzásra kerülnek. Ezt követően jogi, normatív, valamint katonai megoldások bemutatásán keresztül kerül bemutatásra az elrettentés, mint a jelenlegi és jövőbeli kihívásokra adható potenciálisan leghatékonyabb fellépés.

KULCSSZAVAK: NATO, ötödik műveleti színtér, űrbiztonság, űrelrettentés, űreszközök

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The new political strategic document, which unconventionally followed the military doctrine of 2019 provided an apt snapshot of the Allinace's threat perceptions and security landscape but also retained the core tasks of NATO like collective defense, emergency response, cutting-edge defense capabilities, and cooperative security. [2] However, major changes occurred in the assessment of the international system as the continuation of the Crimean occupation turned into a war. The unpredictability and instability of the security environment incentivized Allies to recall deterrence and defense of the Cold War in an integrated way to the hybrid warfare. Thus, the New Strategic Concept reiterated the vitality of the 360 degree approach, namely that NATO needs to be able to respond to threats from all direction of the compass and in all operational domains – including space. [3]

Nevertheless, the change in the quality of space's strategic assessment did not transfer into an extensive capability procurement for the organization. As such, NATO does not possess and has no intention to acquire space capabilities of its own. [4][5] Nevertheless, Allies operate about 66% of all orbiting satellites which belong under the protective umbrella of the organization. [6] This vast growth of the number of Allied assets in orbit has altered the symmetry of space-faring actors and increased NATO's exposure to malicious actions.

The formal recognition of space as an operational domain, however, remained unmatched to the immense operational support and strategic advantage the Alliance derived from satellites until the watershed moment of the London Summit Declaration in 2019. In addition to highlighting the invaluable role of outer space in NATO's security, the document directed the attention of the Allies to the threats and challenges of operations beyond the atmosphere. The growing awareness that "the security of space assets will have a defining impact on future terrestrial conflicts" [7] was reflected in the upcoming years' resolutions, like the establishment of NATO's space center in Rammstein in 2020 [8], the extension to the Washington Treaty's collective defense clause to space at the Brussels Summit in 2021 [9], and the creation of the Space Centre of Excellence in Toulouse in 2023. [10]

Without the aim to bring national activities under a joint command and control, NATO's initiatives for defending assets in the 5th operational domain are currently materializing in the development of a Strategic Space Situational Awareness System (3SAS), additional secure communication service procurement, and the creation of a data repository of spacefaring NATO nations. [11] These innovations aim to improve the detection of hazards, maneuverability of satellites, and the reduction of asset vulnerability in an increasingly "congested, contested, and competitive" environment. [12] But are these initiatives appropriate measures to mitigate NATO's exposure to malign activities in space? Which threats have the most potential to inflict significant impairment on NATO's core tasks? The next overview provides a snapshot of anti-satellite (ASAT) weapons to compile an assessment of priorities Allied responses need to address.

A THREATENED SECURITY PROVIDER

"By the time the Cold War finally ended, the Soviet Union had carried out only 20 antisatellite tests, while the American total was just 33." [13] This number spiked to 80 ASAT tests and 4 protagonist actors by 2021 while international cooperation gradually declined. [14] Although the growing tensions have not yet resulted in any violent interstate encounters, power demonstrations[1] of the four major spacefaring states hallmark the race for competitive edge in space militarization. [15] As stressed by the New Strategic Concept, "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" [16] Some of these threats have the potential to inflict significant damage on NATO's ability to deter and defend, therefore risks "that can impact the system's control, reliability, band-width availability, security, flexibility, or affordability" need to be carefully assessed. [17]

Existing counterspace technologies can be sorted into four categories based on the reversibility and nature of the attack;

	Reversible	Non-reversible
Non-Kinetic	Jamming Spoofing Meaconing	Electronic or cyber interferences degrading the control center
Kinetic	Dazzling Rendezvous and proximity operations	Direct-ascent weapons Interception Space mines

Figure 2. Categorization of anti-satellite (ASAT) weapons
(Edited by the author)

Non-kinetic, reversible actions aim to disable, deceive, disrupt, and deny information and services without leaving traces of the perpetrator. The capabilities used for such attacks are easily attainable and do not require high-level technological sophistication. Jamming, the generation of noise disturbing the signal, spoofing, alias false signalling, and meaconing, the retransmission of signals constitute the most common reversible "soft kill" strategies. As these attempts focus on the deprivation of NATO from real-time information, intelligence, surveillance, and reconnaissance (ISR) satellites, and civilian communication satellites (SATCOM) tend to be the most lucrative targets. [18] Moreover, the up and downlinks of positioning, navigation, and timing (PNT) satellites are also highly vulnerable for information disruption. Nevertheless, these attacks are considered the least harmful for the Alliance's assets as their impact is temporary, limited in scope, and the damage is often completely reversible.

Non-kinetic and non-reversible attacks, such as electronic and cyber interferences focus on permanently degrading the service provided by the satellite, and thereby account for significant concern for NATO. The impairment of control units by a breach of the asset's computer, or by an incoming directed energy beam causes irreversible damage and renders the satellite out of commission. Weather satellites, satellites of scientific use, and SATCOMs are particularly exposed to such assaults due to the high number of assets – including relay satellites providing data transfer – required for services, and their operational altitude's proximity to the Earth's surface. Although their degradation would not directly impact allied security, the cost of replacing the dead satellite could

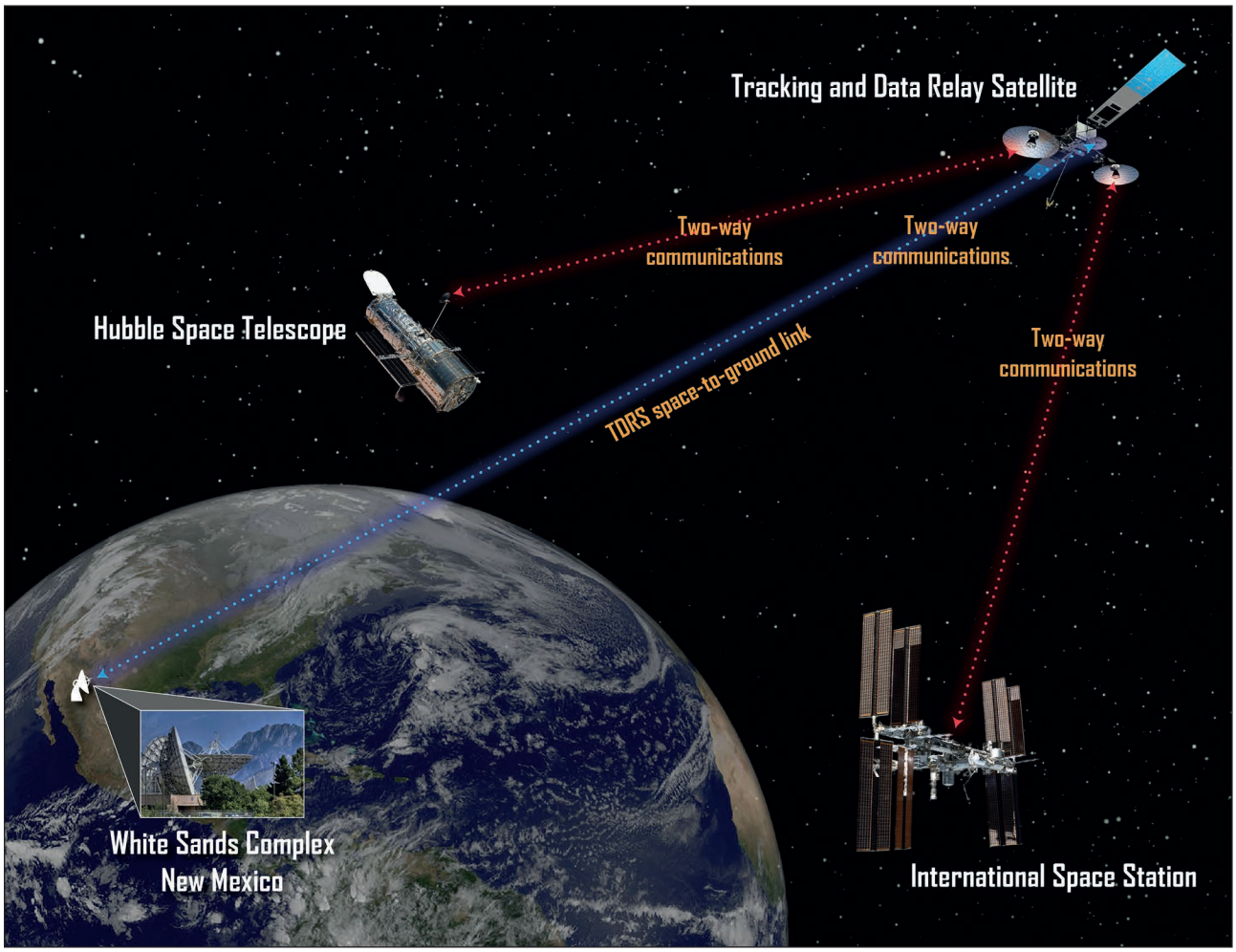

Figure 3. Relay satellites serve as up- and downlinks between larger satellites and ground stations for unfettered communication [19]

trigger the owner nation to seek retaliation against the perpetrator.

Reversible kinetic interferences aim to shorten the lifetime of satellites without rendering the asset defunct. Dazzling, the abuse of optical components by directed energy weapons intends to blind ISR and PNT capabilities, while rendezvous and proximity operations (RPOs), also referred to as co-orbital ASAT-s, coerce satellites to change their trajectory by altering their magnitude or velocity direction to avoid collision. Such maneuvers demand immense fuel consumption and force assets to either shorten, alter or abandon their mission. Such actions can result in significant loss of service, and consequently operational support with severe information reduction for the Alliance's command and control, blue-force tracking, missile detection, and battlefield positioning.

Non-reversible, kinetic attacks target the physical destruction or beyond repair degradation of satellites. Direct-ascent weapons are designed to crash into the targeted satellite, while pre-positioned space mines reach the same effect of erosion by blasting assets into pieces. Interceptors operate by a different logic, as they are capable of repositioning a satellite into a graveyard orbit and thereby dooming it for peril. Low density, high value satellites like assets of the satellite early warning systems (SEWS), military satellite communication (MILSATCOM), and ISR are the most exposed to such detrimental assaults as they result in enormous disruption to missile warning, secure communication, emergency plan execution, and implementation of military operations. Moreover, the debris of destroyed satellites remain in orbit and start to pose indiscriminate threat of collision for every orbiting object. Due to this double-effect, non-reversible kinetic attacks have the highest potential to inflict damage on allied nations and NATO itself.

The assessment of threats to NATO's security provider satellites highlighted that non-reversible attacks – kinetic or otherwise – pose the biggest challenge for the Alliance. Moreover, these assaults do not only rank the highest on potential for causing significant damage, but also on the number of asset types threatened. All listed types of assets are exposed to non-reversible actions with the exception of PNT satellites. Such deviation occurs "as PNT satellites tend to be high-value but also high-density assets, the physical destruction of individual properties yields no additional gains for the adversary than temporarily disabling their services. Moreover, restricting the operational benefits they provide to NATO nations bears less risk of retaliation than the destruction of a satellite as the causes of non-functioning can be various and hardly attributed." [20]

As almost all satellites are lucrative targets for the Alliance's challengers, NATO is pressured to find adept responses to space threats. Legal and normative frameworks, or military solutions need to be weighted

	Weather & sats of scientific use	SEWS	PNT	SATCOM	MILSATCOM	ISR
Non-kinetic, Reversible			X	X		X
Non-kinetic, Non-reversible	X			X		
Kinetic, Reversible			X			X
Kinetic, Non-reversible		X			X	X

Figure 4. Exposure of various satellites to attacks categorized according to reversibility and nature (Edited by the author)

against their ability to mitigate the vulnerabilities in space and to determine the best course of action the Alliance can rely on to provide protection for its assets.

Reducing vulnerability

Back in the age of the first space race legal regulations were seen as a panacea for the peaceful use of outer space. But the heyday of United Nations treaties ruling actions of spacefaring nations was over just after five binding resolutions. Only one of these, the Outer Space Treaty (OST) is addressing international peace and security by prohibiting the deployment or stationing of "nuclear weapons or any other kinds of weapons of mass destruction." [21] "A major problem of the treaty, however, is its lack of enforcement mechanism and no defined threshold for what constitutes a violation that sometimes give way to infringements." [22] As OST fails to be an effective instrument for security, and attempts of the last decades have failed to conclude a binding agreement on military uses of space, the legal framework alone is yet unsuitable to limit the vulnerability of NATO's assets.

Efforts to increase space security also extended to the establishment of norms of responsible behavior, however, their collision with major spacefaring nations' interests prevented them from settling into practice. Unless the conflict of preferences is resolved, norms of behavior remain confined to the only area where unanimity could be achieved; the prevention of intentional space debris generation.

Due to the lack of alternatives, military solutions tend to be the only viable options for NATO to safeguard its allies' satellites. Deterrence, the strategy of "discouraging the enemy from taking military action by posing for him a prospect of cost and risk outweighing his prospective gains" is a preferable nexus of abiding international law, refraining from debris creation, and lowering the risk of assault on allied satellites. Both sub-types, deterrence by denial – the ability to deny the adversary's benefits reaped from an attack by withstanding its ramifications – and deterrence by punishment – the modification of the cost-benefit calculus by a threat of reprisal associated with costs exceeding the benefits of the former attack are promising endeavors.

The implementation of these strategies bears both political and technical ramifications for NATO and in light of the heavy dependency on allied actions and capabilities, for all 31 member states. On the political level the Alliance has an essential role in bridging the gaps between members' threat perception of malign behavior in space, like the Chinese capability build-up, the Russian investments into ASAT technology, and non-state actor activities. A collective assessment of menaces in space would allow Allies to rely on deterrence by punishment's threats in a more reliable and expectable manner. Moreover, strategic and operational level engagement with the Directorate General for Defence Industry and Space (DG DEFIS) and the EU Agency for the Space Programme (EUSPA) could support European allies in avoiding double standards and overlapping mandates.

On the technical level to efficiently use deterrence by denial, spacefaring nations need to invest into resilient satellites equipped to secure services in times of interference while documenting the radiation, signal, or magnetic intrusion. Facilitating trust building processes between the United States and European allies, with spacefaring-aspirant Partnership for Peace and partner nations, and private-public joint ventures for knowledge sharing and information transmission about space situational awareness, threat identification, attribution, and delicate situations like rendezvous and proximity operations is a core function NATO needs to find a way to fulfil. Deterrence by punishment, on the other hand, requires a clear and credible signalling about the potential consequences of an attack on space assets. As the nature of the environment and the generation of space debris heavily limits the credibility of an in-domain reprisal, the Alliance has to fall back on cross-domain operations targeting the adversary's essential infrastructure.

This reliance on deterrence in space underlines that the fifth operational domain is heavily integrated into cross-domain operations, and any response to incidents in space may take place by other means. As such, further inquiries in the applicability and limits of NATO's cross-domain deterrence in space are expected to yield new academic contributions and public policy benefits.As noted in the Strategic Concept, "NATO's deterrence and defence posture is based on an appropriate mix of nuclear, conventional and missile defence capabilities, complemented by space and cyber capabilities." [1] As such, space has become a warfighting theatre where NATO is increasingly exposed to attacks through allied space assets belonging under the collective defense clause.

Conclusion

So what makes NATO one of the most vulnerable space actors? It is the organization's strong reliance on services provided by allied satellites, and the number of orbiting objects serving as a lucrative target for aggressors. Thus, to navigate "the space race we are living in," [23] NATO

needs to be able to credibly deter aggressors from non-reversibly assaulting allied satellites. However, as currently only the United States, Germany, France, and Italy have the capabilities to issue threats to potential attackers, NATO either needs to establish a strategy for implementing the concept of cross-domain deterrence in relation to space operations, or has to encourage allies with minor or no direct access to the outer space to invest into dual-use capabilities for self-defense purposes. In any case, in the upcoming decades NATO's ability to deter aggression in space will play an essential role in ensuring "the collective defence and security of all Allies." [1]

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Jegyzetek

1 Like the case of Kosmos 1408.