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MAREK CZAJKOWSKI

ANTI-SATELLITE WEAPONS – CURRENT STATUS

Abstract. This article is a follow-on to the text this author published in 2021, which contained his view on the state of and prospects for anti-satellite (ASAT) weapons. It aims to review previous findings and predictions, update information on emerging ASAT weapons systems, and provide new strategic assessment relating to the possible development of anti-satellite weapons. The main hypothesis is that anti-satellite weapons are impractical, so the main space powers will most probably not pursue deploying strategically significant quantities of these weapons. The methodology applied in this research rests on qualitative analysis, which will be performed through discourse analysis and content analysis.

Keywords: international security; space security; counterspace measures; counterspace weapons; ASAT weapons; anti-satellite weapons

INTRODUCTION

It is rather obvious that satellite-derived services have become indispensable in everyday human life. They also represent an important part of the economy and a vital element of the national security of individual nation-states. It is not, therefore, necessary to argue on this matter extensively, suffice it to say that the global space economy neared USD 400 B in revenues in 2022 (SIA, 2023), while only the U.S. space economy gross output grew from 2012 to 2021 from USD 180 B to 211 B, accounting for USD 129 B (0,6 %) of national GDP in 2021 (Highfill and Surfield, 2023). It is also commonly held that the use of space systems will increase its significance, which is mostly associated with the ongoing commercialisation of space activities (Brukardt, 2022).

Dr. hab. MAREK CZAJKOWSKI, prof. UJ – Jagiellonian University in Krakov, Faculty of International and Political Studies, Institute of Political Science and International Relations; correspondence address: ul. Reymonta 4, 30-059 Kraków; e-mail: marek.czajkowski@uj.edu.pl; ORCID: https://orcid.org/0000-0003-4276-4984.

On the other hand, there are multiple impediments to further evolution of exploitation of outer space (OECD, 2023). Of many such impediments, intentional disruption of the operation of satellite systems has drawn attention in the last decades as counterspace measures have matured technologically and disseminated among international actors. There are many ways of hindering satellite operations (Czajkowski, 2024), of which destructive measures are, obviously, the most dangerous. Not only because the use of such weapons would result in the permanent elimination of important space assets but also because the destruction of individual satellites would most likely produce large quantities of debris, which, in turn, would destroy other orbiting craft at random. In the very probable worst-case scenario, the cascade effect following the destruction of just a handful of satellites would render many areas in near-Earth space highly contaminated and unusable. By extension, destructive anti-satellite measures would cause a significant decrease in space activities with dire consequences for everyday human life, economies of individual states, and international security.

This article is a follow-on to the text this author published in 2021 (Czajkowski, 2021), which contained his view on the state of and prospects for anti-satellite (ASAT) weapons. Its task is to review previous findings and predictions, update information on emerging ASAT weapons systems, and provide new strategic assessment relating to the possible development of anti-satellite weapons. To do so, the article will first review previous findings supplemented with a quick definitional guide to the weapons in question. Then, the current state of ASAT weapons will be discussed as a basis for following strategic assessment and a quick glance into the future. To facilitate comparisons, the structure of the current text will resemble the former one to a great extent.

The main hypothesis that this research will attempt to verify reflects the findings of the investigation of 2021. It holds that anti-satellite weapons are impractical, so the main space powers will most probably not pursue deploying strategically significant quantities of these weapons. However, related technologies are being developed in many countries, so the actual deployment of ASAT weapons in the short- or medium-term cannot be ruled out. It is probably even more likely than three years ago due to recent changes in the international security environment.

The methodology applied in this research rests on qualitative analysis, which will be performed through discourse analysis and content analysis. The former will be carried out by reviewing selected publicly available analytical texts, while the latter refers to resources containing information used for the description

of the investigated subject. Adopting the realist paradigm as a theoretical framework for the research seems most suitable as military competition and the struggle for political and strategic positions in the world will be considered in this article. However, a constructivist approach will also be selectively used in analysing the motivations of the main competing world powers, whose strategies and policies are the subject of this inquiry.

1. SUMMARY OF PREVIOUS FINDINGS

The 2021 article adopted a narrow definition of anti-satellite weapons, discerning them from a wider category of counterspace measures. The latter term refers to all capabilities designed to adversely affect the satellite systems' operations. Consequently, counterspace measures entail a broad spectrum of physical and non-physical, kinetic and non-kinetic capabilities used to (1) jam or spoof links between satellites and ground control stations or user devices, (2) temporarily dazzle or permanently blind satellites' sensors, (3) damage, destroy orbiting spacecraft/ground stations or (4) perform hostile penetration of satellite systems from cyberspace. Some authors label most of these capabilities "weapons" (Swope et al., 2024, p. 6), which is not baseless as all counterspace measures are used for one purpose: to deny satellite systems' owners services that these systems normally provide. Such actions are highly adversarial in nature, so using the word "weapons" to describe all of these capabilities is not wrong as such. Nevertheless, the author prefers the term "measures" for all of the counterspace capabilities, reserving the label "weapon" for a specific category of measures designed to physically damage or destroy orbital elements of satellite systems. Thus, by that definition, ASAT weapons, the main subject of both the 2021 analysis and the current text, include (1) co-orbital (C-O ASAT) systems designed to attack satellites from stations in orbit and (2) direct-ascent (D-A ASAT) systems that attack orbiters from the ground. Both categories may employ various means of impacting satellites: direct hit by a projectile, nearby conventional or nuclear warhead explosion, and attacks involving directed energy beams.

In the 2021 article, it was ascertained that none of the three main space-faring nations engaged in activities related to anti-satellite technologies (the United States, Russia, and China) possessed a dedicated operational ASAT system of any kind, deployed in militarily significant quantities. However, it was noted that the Ballistic Missile Defence System (BMDS), operated by the United States and designed to fend off ballistic missile attacks, had inherent anti-satellite

capabilities, although the U.S. consistently held that it had no intention to use it in that manner. On the other hand, China and Russia were continuously developing ASAT weapons technologies, but there was no tangible evidence in publicly available sources that these countries actually planned to field significant quantities of anti-satellite weapons systems.

The 2021 text offered several arguments explaining this restraint. They were mainly based on the premise that not only the availability of related technologies drove decisions to field or, rather, not to field anti-satellite weapons; due to the importance and complexity of the matter in question, the main space powers had to consider a very wide and nuanced set of political, economic, and strategic realities.

Firstly, ASAT weapons are inherently clumsy and unpredictable. As already mentioned above, the destruction of a spacecraft in orbit may produce a large quantity of debris, which would be dangerous to the remaining satellites in similar orbits or even further away. As early as in the 1970s, it was calculated (Kessler and Cour-Palais, 1978) that a rapid increase in the number of such debris might lead to massive "chain reactions" in which wreckage parts from destroyed satellites would quickly "wipe out" some orbits and make them inaccessible. It was assumed in the 2021 analysis, and this assumption holds that the occurrence of such an event in the case of using anti-satellite weapons is very high. Thus, if employed, ASAT weapons would not only destroy the intended enemy targets but also likely contribute to the random destruction of many more spacecraft, possibly important assets belonging to the attacking side. This feature makes ASAT weapons somewhat similar to weapons of mass destruction (WMD) in their counterforce role, with vast collateral damage and long-term secondary effects on the environment that they would cause once used.

Secondly, ASAT weapons will not provide those who wield them with the capability to execute "space Pearl Harbour" against the United States, feared for more than two decades (U.S. Congress, 2001). A sneak attack against the American national security space architecture will not substantially shift the balance between main rival world powers. It is because the attacker's space systems would also be obliterated either by the cascade effect caused by multiple satellites breaking into debris or by the American counterattack with the use of BMDS assets – most probably by both. Either way, the existing balance would remain mostly unchanged, and the United States would still be the most powerful country in the world, even if its capabilities were somewhat diminished.

Thirdly, a new leg of the arms race would inevitably break out should one country decide to field a significant quantity of ASAT weapons. However, in this case, the United States already possess a huge advantage in the form of

BMDS, so if competitors have initiated the anti-satellite weapons race, they would be in lost positions from its very beginning. It is because the U.S. will surely lead the new race due to its overall technological advantage and because the American military already has large quantities of weapons that may be used in the ASAT role – matching this arsenal would be very difficult for any country. Thus, the huge cost associated with a new kind of weapon would not bring any substantial change in favour of countries initiating the ASAT arms race.

Fourthly, anti-satellite weapons are operationally impractical. Due to the characteristics mentioned above, they have the potential to cause random effects, likely very significant ones. This characteristics makes it very difficult to plan operations involving ASAT weapons. On the other hand, and it is very important, various non-destructive counterspace measures may be used to effectively deny adversaries the benefits of using satellite systems without physically destroying them.

Consequently, as was the main finding of the 2021 article, deploying ASAT weapons in quantities that would be significant from the point of view of strategic balance had no logical purpose that would justify associated risks and costs. Nevertheless, the question remained: why were several countries still developing technologies applicable to anti-satellite weapons if they had no intentions to equip combat units with them? Most probably, they were doing it for two reasons. For one, to gain prestige that is inherently linked to ASAT weapons as they are very complex and technologically demanding. For two, to hedge against future developments and have mature technologies in case the space weapons arms race actually breaks out, and communicate to potential contenders that such a race would be unproductive if initiated.

Thus, it was assessed in 2021 that ASAT weapons would most probably not be deployed in the then foreseeable future. However, it was also observed that these logical and practical considerations would not necessarily constrain decision-makers, who tend to act irrationally and without proper evaluation of costs versus effects or even for their own private sake, neglecting the best interest of the nation they represent. Thus, it was deemed possible that some nation-states could ultimately decide to field significant quantities of ASAT weapons, dismissing the abovementioned realities. Finally, according to the 2021 article reviewed in this section, deployment of anti-satellite weapons was considered unlikely but not impossible, as scenarios of starting the ASAT arms race by China, Russia or the United States were considered possible to an extent.

2. ANTI-SATELLITE WEAPONS AD 2024

This section will provide an up-to-date assessment of the current status of ASAT weapons as of mid-May 2024. The main sources used for this purpose are two authoritative open-source reports: the already quoted Space Threat Assessment (Swope et al., 2024) published by the Center for Security and International Studies and Global Counterspace Capabilities (Weeden & Samson, 2024)) by Secure World Foundation. The use of the other sources will be separately indicated in every instance. This assessment will focus on indicating changes that have occurred in the last three years. Compared to the 2021 text, what is new is that more observations about counterspace measures other than ASAT weapons systems will be included as they form an increasingly important context for analysing anti-satellite weaponry.

The United States remains officially adamant that it does not pursue capabilities to destroy satellites in orbit. However, it does operate the already mentioned BMDS, which offers global ballistic missile defence capabilities. Some of the weapon systems that it comprises are inherently capable of attacking satellites in low orbits as they are designed to destroy enemy ballistic missiles in the midcourse phase of their flight, which occurs in outer space at altitudes where satellites operate. Furthermore, in principle, shooting down a satellite at a given altitude is easier than a ballistic missile. The most powerful of the American missile defence weapons is the GBI, which can reach orbits as high as 6000 km – 44 such missiles are deployed in Alaska and California. Particularly capable for anti-satellite missions are the SM-3 missile variants, as they may easily reach orbital altitudes (Grego, 2011) and may be flexibly deployed worldwide. As of 2023, the SM-3s were installed on 49 U.S. Navy warships (O'Rourke, 2024, p.6) and in two fixed sites in Romania and Poland. The inventory of these weapons has likely exceeded 500, although there is no publicly disclosed data on that matter. The estimation above is based on annual budget requests, which can be found in subsequent versions of the already quoted Congressional Research Office's report, Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress, updated several times a year[1]. Additionally, the United States has vast experience in rendezvous and proximity operations (RPO), which may be used to design C-O ASAT weapons once the political decision to do that is made. Directed energy weapons (DEW)

[1] A full list of versions of this document containing all the budgetary data referring to the SM-3 programme may be found on the Congressional Research Bureau page: https://crsreports.congress.gov/product/details?prodcode=RL33745.

have also been extensively researched in the United States, so anti-satellite DEW systems, such as lasers, can probably be designed in the medium term by the highly developed and experienced American aerospace industry.

Despite officially expressing the desire to refrain from deployment of destructive ASAT weapons, subsequent United States governments have authorised multiple research programmes and experimental anti-satellite weapons systems deployments since the beginning of the Space Age. It resulted in the accumulation of extensive knowledge concerning every aspect of anti-satellite warfare, including vast expertise in satellite weapons. Counterspace offensive operations are also envisioned in the U.S. doctrinal documents and frequently mentioned by American military officials and politicians. For example, Joint Publication 3-14, Space Operations (JCS, 2020) by Joint Chiefs of Staff, a frequently updated guide to "plan, execute and assess space operations", clearly envisions "offensive operations" in outer space. The newest, not publicly available iteration of this document, issued in August 2023, purportedly uses the phrase "suppression of enemy space capabilities" as one of the primary goals of the whole military activity in the extraterrestrial domain. However, all of this does not automatically imply determination to deploy anti-satellite weapons. It most likely refers to other counterspace measures, offensive in nature but not destructive. Currently, the United States officially operates only one counterspace system designed to interfere with satellite signals, a deployable Counter Communication System (CCS). However, the American aerospace industry possesses the ability to quickly develop other means of highly effective counterspace measures to establish robust capabilities to degrade adversaries' space systems. It is even likely that such systems have already been designed but have not yet been deployed or are in the process of development.

To sum up, the United States remains determined not to deploy ASAT weapons. However, calls for an increased offensive stance in space are growing louder, and sufficient operational doctrine is likely being drawn up. Yet, preparations for offensive counterspace operations most probably refer to non-destructive means rather than anti-satellite weapons, as they are far more practical instruments of warfare. According to Wedeen and Samson (Weeden & Samson, 2024, p. 03-01),

> China has a sustained effort to develop a broad range of offensive counterspace capabilities. Over the last decade, China has engaged in multiple tests of technologies and capabilities that are either offensive counterspace weapons or could be used as such. China has also begun developing the policy, doctrine, and organisational frameworks to support the integration of counterspace capabilities into its military planning and operations. That said, it is unclear whether China intends to offensively use its

> counterspace capabilities in a future conflict, or whether the goal is to use them as a deterrent against aggression. There is no confirmed public evidence of China actively using counterspace capabilities in current military operations, but operational testing has occurred.

As far as publicly available information is concerned, China has not deployed ASAT weapons systems of any kind, although the U.S. intelligence community believes that China did field ground-based ASAT weapons systems (ODNI, 2024, p.11). It most likely refers to the SC-19 missile, which has been held to be an anti-satellite weapon for some time. Additionally, China has also tested other kinds of D-A ASAT weapons, including the ones that could potentially reach GEO. In recent years, China has also concluded a number of RPO tests and three flights of autonomous spaceplanes, which have undoubtedly expanded the knowledge necessary to construct the C-O ASAT weapons system. China is also believed to be conducting extensive work on counter space-capable lasers, although it is not exactly known if they are intended to be powerful enough to be used as destructive weapons.

Based on the above, it might be established that China is able to quickly develop anti-satellite D-A weapons designed to fight in low orbits, which would add to already existing missile defence systems that could be used in the ASAT role. Thus, due to the vast experience accumulated by the Chinese rocket industry and key knowledge, which was surely drawn from multiple tests, China is able to establish a significant D-A ASAT force designed to attack targets in LEOs if it chooses to do so. When it comes to longer-range D-A ASAT, C-O ASAT, and DEW ASAT technologies, it is more difficult to establish the timeframe for possible deployments of operational weapons, although significant progress has been made in the last three years. China is also quickly developing non-destructive countermeasures in the form of electronic warfare, dazzling lasers, and cyber intrusion tools. It is very likely that such systems have already been experimentally deployed or will be deployed soon.

Summarising the Chinese counterspace effort, it should be noted that it is fairly extensive and has apparently led to a significant increase in capabilities to negate adversary's space-derived services. China has also expressed the intention to, as Swope et al. put it (2024, p.8), "…hold at risk their adversaries' space assets, especially those that would enable command, control, communications, and intelligence …". However, it does not mean that Beijing intends to field ASAT weapons even though they are under development or have already been developed, such as low orbit D-A ASAT systems. Most probably, China intends

to deploy or has already deployed only non-destructive counterspace measures, but publicly available information on that matter is scarce and unreliable.

When it comes to Russia, as reported in 2021, air and missile defence systems S-400 and particularly S-500 might have some limited ASAT capabilities in LEO, although detailed information on that matter is unavailable. A longer-range, dedicated anti-satellite weapons system called Nudol has also been tested, but there is no information on its deployment status. Russia also has extensive knowledge of RPO, which could be instrumental in developing C-O ASAT weapons systems. Directed energy weapons have also been tested, as Russia has significant experience in that field. Wedeen and Samson notice that (p. 02-01),

> [t]here is strong evidence that Russia has embarked on a set of program deployments the last decade to regain offensive counterspace capabilities. In some cases, the evidence suggests legacy capabilities are being brought out of mothballs, and in other cases, the evidence points to new capabilities being developed such as the Nudol D-A-ASAT. In all cases, Russia has a strong technical legacy to draw upon. Under President Putin, Russia also has renewed political will to obtain counterspace capabilities for much the same reason as China: to bolster its regional power and limit the ability of the United States to impede on Russia's freedom of action.

Recent tests of the technologies that could be used for anti-satellite purposes seem to confirm the assessment above; nonetheless, it is still impossible to conclude if Russia has fielded any operational D-A ASAT weapons system. There is also no indication of the existence of any C-O ASAT system that is mature enough to be deployed in significant quantities. On the other hand, the U.S. government confirmed in February 2024 that Russia is preparing a new anti-satellite capability, which would be in violation of the Outer Space Agreement of 1967. It may mean that Russia is working on a nuclear-armed space-based weapons system, although no confirmed detail about that has been made public. There are, however, hints from American officials that Russia has already established an orbital test bed for such a weapon (Trevithick and Parken, 2024). On the other hand, if such a system is indeed in development, some time will inevitably pass before it is operational, owing to the overall bad shape of the Russian aerospace industry and economic constraints caused by the war in Ukraine.

Consequently, it could be concluded that Russia is developing multiple ASAT weapons technologies and has accumulated vast knowledge therein; it is even possible that nuclear ASAT, purportedly designed to attack upcoming proliferated American space architecture (Bateman, 2024), is being tested. Nevertheless, multiple constraints adversely affect the Russian effort to field

anti-satellite weapons in significant quantities. It is also not known if Russia does intend to do so in the short- or medium term.

Since 2019, India has joined the ranks of powers wielding anti-satellite weapons. It demonstrated this capability by destroying its own satellite in LEO. Despite that, India is relatively far from deploying significant quantities of ASAT weapons and most likely does not intend to do just that, as the 2019 mission was rather demonstrative in nature, displaying technological prowess for the sake of prestige.

3. TRENDS IN DEVELOPMENT OF MILITARY SATELLITE SYSTEMS

The trends indicated in the 2021 article are still at work in 2024 and have even been reinforced, particularly due to the developments associated with the war in Ukraine (Höyhtyä and Uusipaavalniemi, 2023). The wide access to critical space-borne services that the Ukrainian side possesses and the relative inability of the Russian forces to counteract them, combined with the growing weakness of the Russian national security space architecture (Czajkowski, 2022), have strongly highlighted (1) the need to wield robust space-borne capabilities in navigation, communication, and observation and (2) the necessity to operate counterspace measures to deny enemy benefits from space activity.

Therefore, the last couple of years have seen an acceleration of the development of technologies designed to (1) augment the space systems' sustainability and (2) enhance counterspace measures at the same time. Regarding the former issue, particularly, the United States is investing vast sums of money and great effort into designing proliferated space architecture, which would not only provide better services to warfighters on the ground (Erwin, 2024) but would also be much less vulnerable to any kind of hostile action (Erwin, 2023). Regarding the latter, as the observations from the section above indicate, non-destructive counterspace measures seem to have become the instrument of choice for all three main space-faring nations in their quest to offset the benefits that adversaries derive from space systems. Furthermore, the quick development of anti-satellite technologies and tactics may give other nation-states and even non-state actors the opportunity to acquire and use multiple non-destructive means of hampering satellite operations.

One specific trait of non-destructive counterspace measures should be underlined at this point: they are much more convenient for sustained offensive operations than ASAT weapons. This is because the use of anti-satellite systems

of this kind does not necessarily have to be restricted to open hostilities when states routinely attack and destroy various assets belonging to one another. Electronic attacks against uplinks/downlinks or low-power DEW beams used for temporarily dazzling satellites are not easy to attribute. Thus, if employed, they would not necessarily invoke an answer from the attacked side. Secondly, if no harm was done, possible retaliation does not have to be particularly dangerous, even if the attacked side responds in kind; consequently, possible escalation of hostilities is less likely than if a satellite has actually been destroyed. These characteristics of non-destructive, offensive counterspace weapons make them usable even in peacetime, for example, in times of heightened tensions, or even routinely for everyday operations, for instance, to shield important facilities or military units from observations from space.

Thus, the new trend may be discerned, although it has been in action for some time but has not been clear enough to be defined: offensive countermeasures are quickly being developed and operationalised into politics, strategies, and organisations, but they refer primarily to non-destructive systems, not ASAT weapons. Consequently, the main competing space powers are seriously considering, or even already planning and executing, deployment of non-destructive counterspace systems in significant quantities to conduct anti-satellite warfare if need be.

This trend is an outcome of the characteristics of the space environment, which can be relatively easily and permanently contaminated and made unusable. Thus, if the three main global rivals intend to increase the capabilities of their national space architectures to match growing needs for observation, communication and positioning, and at the same time, they need measures to deny the same to the others, they must employ instruments which, once used, will not cause massive random destruction of orbital assets. The development and deployment of non-destructive counterspace measures and refraining from the ASAT weapons arms race are logical choices that the U.S., PRC, and FR seem to acknowledge tacitly. As a harbinger of things to come, an increasing acceptance or sort of getting accustomed to adversarial anti-satellite non-destructive activities, like cyber operations, unfriendly satellite manoeuvres, and jamming/spoofing satellite systems' links may be observed (Swope et al., pp. 16-19).

As a consequence, it could be concluded that space offensive warfare is near, not inevitably but very likely. It will, however, entail non-destructive orbital and ground-based systems, and a sort of "arms race" involving them will probably break out soon if it is not already underway. It will also draw in some other nations than the United States, PRC, and Russian Federation, as many countries will deem having such systems a strategic imperative.

4. CURRENT REALITIES OF ASAT WEAPONS DEPLOYMENT – MAD SEEMS TO BE WORKING (FOR NOW)

The section above covered general trends in the development of space architecture and counterspace measures. Assessing ASAT weapons specifically, it should be noted that despite maturing technologies, the strategic equation identified in the 2021 text seems intact. The equation is perhaps even more robust now, which seems logical in light of the considerations above. The current balance regarding anti-satellite weapons has two main aspects.

Firstly, all three main space-faring nations possess or may acquire capabilities to destroy adversaries' satellites in the short- to medium-term perspective. Still, as we already know, the ASAT weapons arms race would be potentially equally dangerous to every space-faring nation. Enemy retaliation and likely "cascade effect" would render the attacker's own space architecture degraded at best. On the other hand, space capabilities are increasingly important for everyday activities related to the national security goals of all three countries in question. It is somehow obvious that the United States military and spy agencies are" satellite addicted", but China also relies increasingly on space systems for day-to-day operations of armed forces, intelligence gathering agencies, and for economic purposes. Furthermore, Chinese leader Xi Jinping set an ambitious goal for his country to become the world leader by 2049. It requires not only leadership in space as evidence of power and technological prowess but also global influence and the worldwide presence of armed forces, which would be impossible without huge space architecture. Fielding ASAT weapons and thus fuelling the new arms race would not contribute to these tasks. On the contrary, it could endanger existing and future architectures by increasing the risk of escalation, which could lead to contaminating orbits. Russia also has no good reasons to pursue anti-satellite weapons, as it considers itself a world-class power and likely intends to expand its space architecture for prestige and due to practical considerations. Note that a full-blown ASAT race would be extremely costly, adding strain on the already ailing Russian (Ribakova, 2023) and Chinese (Rosen and Wright, 2024) economies. Thus, as it was noticed in the 2021 text, there is a balance based on the sort of mutually assured destruction (MAD) of space assets in the case of the use of ASAT weapons.

Secondly, as it was also argued above, the parties to any future anti-satellite weapons race are also disincentivised by the development of non-destructive measures designed to negate adversaries' benefits they ripe from operating in space. These measures offer capabilities to conduct offensive operations in space at

a much lower cost, with much lower political risk, without significant threat to the extraterrestrial environment, and without risking own precious space assets. Moreover, these operations may be conducted even in peacetime, as associated political risks are smaller, and the escalation ladder does not seem as steep as in the situation when critical assets of one nation-state are destroyed by another. Furthermore, counterspace operations using non-destructive systems are, in essence, more effective in an operational sense, as they are more precise, and the effect of their use can be better predicted. For the sake of comprehensiveness, it is worth adding that it is also more difficult to assess if non-destructive countermeasures have been effective in certain instances. Despite that, weighing the pros and cons, it seems practical to refrain from the ASAT weapons race, and it is highly plausible that all three main space-faring powers understand it.

Thus, the assessment that anti-satellite weapons will not be deployed in quantities sufficient to change the strategic balance or significantly alter the global strategic environment stands. It should also be reiterated that there is a high probability that offensive, non-destructive counterspace measures will be developed, fielded, and used in the next couple of years, which forms the critically important context of the previous observation.

There is also, as it was ascertained three years ago, the possibility of irrational actions concerning the deployment of ASAT weapons. It is even higher than before, it seems. Scenarios are possible in which one of the three main space-faring nations or other international actor could initiate the anti-satellite weapons arms race. In the 2021 text, this problem was described very briefly, but as the risk of such an irrational decision has grown over the last three years, so possible space weaponisation scenarios should be tackled in more detail.

Among the three biggest space-faring nations, the United States seems the most disincentivised to bring anti-satellite weapons into strategic reality. Since the very beginning of the Space Age, America was the absolute leader in space applications, even if it seemed that the Soviet Union had better technology since it scored “First Man-Made Object in Space”, “First Man in Space”, and other prestigious “prizes”. In the military and economic realities, however, the U.S. benefitted much more than the U.S.S.R. from using space systems. Some of those benefits were unknown to the public during the Cold War but remained very important to American national security. Furthermore, the aerospace industry profiting from space-related manufacturing and services was much better developed than its Soviet counterpart. Now, even in light of the Chinese competition, the United States remains by far the strongest space power and benefits the most from using and manufacturing space systems for national security and economic

purposes. The prestige of the U.S. as a space-faring nation has been tarnished somehow by the skilful political exploitation of its achievements by the Chinese, who are bragging about their new technologies. It should be noted, however, that these newest Chinese techs, like spaceplanes or hit-to-kill ASAT weapons, were perfected by the United States some forty years ago. Moreover, the Chinese achievements are, to an extent, artificially inflated by many Americans themselves, who purposedly point to the prowess of the chief competitor to speed up the space-related efforts in the United States and raise more funds for that. Consequently, the U.S. has absolutely no reason to contribute to endangering the space environment with ASAT weapons.

Despite this logic, it is conceivable that the American leadership would nevertheless decide to field anti-satellite weapons. First of all, many politicians in the United States are known to act illogically or put the individual interests of their constituency or lobbies they represent before the state's overall interests. Furthermore, a good part of the American elite and society remain embroiled in conspiracy theories and inflated external threat perception. In these circumstances, a possibility exists that some leaders would pursue anti-satellite weapons for the purpose of ill-understood prestige, out of pure miscalculation, or lack of knowledge. There are many possible scenarios that could lead to such a development, starting from a misinterpretation of adversaries' intentions by the U.S. leadership, through the wish to satisfy growing needs of industry by politicians connected to certain constituencies and/or lobbies, ending with ill-conceived ideas to enhance advertising that America is "the First" in the world. This way, the United States can initiate the anti-satellite weapons race contradicting its best interest; the likelihood of this scenario is low, although not negligible.

At first glance, it might seem that anti-satellite weapons would give Beijing an advantage over the U.S., which strongly relies on the use of space systems for its national security purposes. Such opinions are, nevertheless, out of reality, as no international actor can destroy American space architecture without losing its own or being otherwise severely punished. Thus, China has no logical reason to deploy any anti-satellite weapons, as mentioned and elaborated in the 2021 text, particularly because it can use non-destructive measures to achieve operational goals on a daily basis.

On the other hand, it is imaginable that misinterpretation of intentions, artificial threat inflation, or ideological considerations would bring China to the decision to field ASAT weapons in a way similar to what we have noted when referring to the United States. Additionally, the decision-making mechanism in China has undergone significant changes in the last half-decade or so, and it has become

less pragmatic and more prone to miscalculations or ideological pressures. Consequently, it may result in the decision to deploy ASAT weapons as a show of force, political will or superiority of the state ideology. The likelihood of such developments has grown since 2021 relative to growing Chinese assertiveness in the international realm. Scenarios referring to that may vary. For one, the Chinese leadership may decide that the U.S. would actually try to threaten the Chinese satellite systems with BMDS, so it might feel compelled to respond by initiating the ASAT weapons deployment. For two, Beijing may be willing to accept the risk of orbit contamination, believing that the prestige of having ASAT weapons jeopardising the U.S. vital systems would outweigh this risk. For three, China could simply accept the situation that, in case of conflict, all the space architectures would be obliterated out of the belief that the U.S. would suffer proportionally more. For four, some lobbies in the military and industry may pressure the ageing and thus volatile leadership for their own self-interest. These and other similar scenarios seem unlikely at the moment, but they cannot be ruled out, and the possibility that they will actually materialize grows steadily.

Russia is in a quite peculiar position as far as space architecture as a whole is concerned. Not only is the dedicated national security architecture dwindling, but other space programs are jeopardised, too, including the crucial GLONASS satellite navigation system (Luzin, 2024). On the other hand, Russian authorities claim that the country is one of the main centres of global politics and a leading technological and economic power. This ideological stance requires advanced space architecture and a capable aerospace industry as an instrument of day-to-day operations and as a show of technological prowess. Thus, it is not logical for Russia to spark a potentially dangerous and costly anti-satellite arms race. The economic aspect is particularly important as Russia has recently manoeuvred itself in a very expensive phase of conflict with the West. However, there are some incentives for Russia to actually field and even use ASAT weapons, which might, in the Kremlin's optics, outweigh the negative aspects of such a decision.

Firstly, Russia has the least to lose if the obliteration of all satellite systems occurs due to the use of ASAT weapons. This way, particularly if feeling cornered, Moscow may decide to harm the United States, even though it would bring it on a collision course with China. Secondly, Russia may feel compelled to demonstrate its otherwise questionable technological prowess by deploying ASAT weapons, even knowing that it would not be able to lead the race it would have sparked. Furthermore, the ageing and petrifying regime may be increasingly entwined in ideological consideration and growing misplaced

conviction that the country's very existence is threatened, which might bring many desperate decisions, including the fielding of ASAT weapons.

For the sake of comprehensiveness, it should also be noted that smaller countries that do not possess well-developed space architectures, meaning that they are not crucial for their national security, might attempt to acquire ASAT weapons, at least in limited quantities. Such nations like North Korea or Iran may use anti-satellite destructive capabilities as a terror weapon to hold hostage better-developed adversaries or even to attempt to trigger an orbital holocaust, having not much to lose and knowing that they would cause huge damage to hated enemies. Such scenarios are not unlikely, but elaborating on them would require a separate study.

CONCLUSION

The research above confirms the hypothesis presented in the introduction but with some important reservations. Indeed, it is unlikely that ASAT weapons will be deployed in significant quantities in the foreseeable future, so the arms race in that category will most likely not occur. It is mostly because the main space-faring nations have no tangible interest in embarking on a costly and fruitless yet dangerous race. The events of the last three years seem to validate this assessment. On the other hand, what might seem illogical but is not, the likelihood that ASAT weapons will be deployed is higher than it was three years ago due to the growing possibility that the decision to do so will be based on non-rational premises. So, shortly put, now it makes even less sense to deploy ASAT weapons than three years ago, so they will probably not be deployed. However, the possibility that the anti-satellite weapons race will eventually break out is growing due to the increasing likelihood that irrational decisions will be made with respect to that.

On top of this conclusion, which supports the assessment from 2021, it should be added that offensive, non-destructive counterspace measures will likely be deployed and routinely used in the foreseeable future. However, it is impossible to assess what impact this would have on the future development of ASAT weapons, which will still linger in the background.

And finally, contrary to the assessment made in 2021, it is highly unlikely that any agreement referring to restraining the development of ASAT weapons would be reached in the foreseeable future. Since 2021, tensions between space powers have grown, and it is much less likely that they would be willing even

to declare an intention to negotiate the issue of anti-satellite weapons limitations. Certainly, in a long-term perspective, the currently deteriorating world order may take some new, institutionalised shape. In such circumstances, some regulations referring to the ASAT weapons and counterspace measures as a whole may be agreed upon, but for now, it is rather political fiction.

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BROŃ PRZECIWSATELITARNA – STAN OBECNY

Streszczenie

Niniejszy artykuł stanowi dalszy ciąg tekstu, opublikowanego przez tego samego autora w 2021, zwierającego jego poglądy na temat stanu i perspektyw ewolucji broni przeciwsatelitarnych. Zadaniem obecnego tekstu jest przegląd wcześniejszych ustaleń, aktualizacja danych na temat systemów broni przeciwsatelitarnej oraz przedstawienie bieżącej analizy strategicznej na jej temat. Główna hipoteza, na której weryfikacji oparto niniejszy artykuł sprowadza się do twierdzenia, że systemy broni przeciwsatelitarnej są niepraktyczne, dlatego też główne potęgi kosmiczne najprawdopodobniej nie rozmieszczą jej w ilościach, które mogłyby mieć strategiczne znaczenie. Metodologia badań opiera się na analizie jakościowej realizowanej metodami analizy dyskursu i analizy jakościowej.

Słowa kluczowe: bezpieczeństwo międzynarodowe; bezpieczeństwo kosmiczne; środki przeciwsatelitarne; broń przeciwsatelitarna; ASAT