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Space Race 2.0 – Renewed Great Power Competition in the Earth's Orbits

Introduction

With the successful launch of Soviet satellite Sputnik 1 into orbit in 1957, modern civilization eventually arrived in outer space, the final frontier of human exploration. A step which would herald the start of a new era, an age of relentless competition among the great powers, marked by unprecedented heights in scientific endeavor. The Space Race, as this period is referred to, pushed the United States and the Soviet Union to devote immensurable resources into their space programs, thus generating technological advancements that would forever transform human capabilities. From computer technology to telecommunications and navigation, the chase for the stars in the latter half of the 20th century enabled the discovery and advancement of countless applications that impacted both the civil and the military domains in an unparalleled manner. After the Space Race peaked in 1969, with the United States successfully landing Apollo 11 on the moon, the fierce competition defining the early years of the Space Age was increasingly replaced by cooperation. In 1972, the US and the Soviets launched the cooperative Apollo-Soyuz Test Project and other collaborative initiatives, such as the International Space Station (ISS), followed in the years to come. Also, the legal character of space activities started to take shape. The Outer Space Treaty, formally known as the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies", was signed by the U.S., the UK and the USSR in 1967, which, as of now, 109 nations are parties to. This UN treaty, forming the basic legal framework for international space law, prohibits weapons of mass destruction from being placed in space, as well as establishes that "the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind".[1]

In recent years, however, this clause is increasingly being drawn into question and competition is once again on the agenda. While building on the technological legacy of the Space Race allows for ever more sophisticated space-based application, an increasingly hostile environment in the international system has spurred the militarization of space. Especially the growing distrust between the United States and its declared great power rivals, China and Russia, has led to a recent overhaul of the countries' military doctrines, organizations and capabilities in order to meet this new reality, in which "space is a warfighting domain just like air, land and sea", as General John Raymond, commander of the U.S. Air Force Space Command, stated in 2017.[2] What we can observe in space today is a classic security dilemma among the great powers, with space capabilities representing both an increasing vulnerability as well as opportunity during military conflict. This paper shall provide an overview of space-related military developments in the USA, China, Russia and the European Union, shedding light on the current state of the militarization of space.

Space as a Warfighting Domain

The story of humanity in space has many dimensions and it's use for military purposes has been one since the very beginning. Sputnik 1 unleashed fear in the United States that it could represent a harbinger for space-based nuclear weapons, leading to the first anti-satellite (ASAT) program in the US in 1958, with the Soviets quickly following suit. Although several ASAT systems were deployed by both sides over the course of the Cold War, space as a domain for military conflict was not seriously considered by either party. If anything, satellite technology was rather considered a stabilizing element, allowing for the de-escalation of conflicts through enhanced intelligence on the adversary[3].

However, a critical turning point occurred with the First Gulf War in 1990-1991, when space-based capabilities shifted from purely strategic to tactical significance during wartime. Signals intelligence (the interception of adversarial signals), telecommunications, positioning/navigation, and several other novel technical advancements, for the first time, allowed the United States near real-time support of ground forces with intelligence and the effective use of precision-guided munitions. The efficacy of these ground-breaking weapons and intelligence systems based on space-applications naturally did not remain unnoticed by other nations. Consequentially, as capability fuels the development of countercapability, Russia and China initiated ASAT programs that were significantly extended over the past three decades, advancing the militarization of, and magnifying the security dilemma in, space. To better understand space as a potential warfighting domain, two concepts need to be further elaborated on, namely *Space for Defence* and *Defence of Space*.[4]

Space for Defence refers to the aforementioned space-based capabilities that serve as a force enabler during military conflict and can be broadly summarized into three categories: Intelligence, Reconnaissance and Surveillance (ISR); Positioning, Navigation and Timing (PNT); and Satellite Communications (SATCOMs). ISR, for example, includes earth observation, early missile warning systems, meteorology or signals intelligence. PNT facilitates the precise execution of military operations and weapon strikes, continuously providing decision-makers of armed forces with enhanced situational awareness. The U.S. Global Positioning System (GPS) is a primary example of this kind. SATCOMs represent an essential competence for command and control during military conflict, allowing for the consistent and quick transmission of critical intelligence and orders in any en-

vironment. What becomes apparent when looking at these various capabilities is that, while providing nations that are in possession of it with tremendous leverage in and out of combat, they equally represent a serious vulnerability. *Defence of Space* thus refers to the protection of the Achilles' heel that space-based applications have become for countries increasingly reliant on them, most notably the United States, and "consists of all active and passive measures taken to protect friendly space capabilities from attack, interference, or unintentional hazards"[5]. Besides unintentional hazards, such as solar winds or space debris, the threat scenario that militaries encounter in space is continuously expanding, due to technological progress that has considerably increased the spectrum of counterspace-capabilities in recent years. Broadly, one can discern between four different types of such counterspace weapons, which differentiate in the intended consequences for space assets and in varying degrees of technical sophistication. *Kinetic physical weapons,* such as direct-ascent ballistic missiles or co-orbital satellites, represent the oldest and most overt form of ASAT capability. The second type, *non-kinetic physical weapons*, are a more sophisticated alternative to physically damage assets, including electromagnetic pulse weapons (EMP), high-powered microwave weapons (HPM) and high-powered laser weapons. The third type, *electronic counterspace weapons*, aim to jam or spoof radio frequency signals necessary for the transmission of data between the satellite and the terrestrial end-user. The fourth and last type of counterspace capabilities are *cyberattacks*, targeting both the system and the data itself. As such, satellite data can be intercepted, monitored and corrupted. In the worst case, a cyberattack can even result in the seizure of control of a satellite. Defensive efforts to counter these threats include measures to deceive, degrade and destroy enemy targeting systems, physically protect space assets, as well as distribute and diversify the platforms, orbits and systems used for the fulfilment of certain capabilities. The operability of GPS, for instance, is not reliant on a single satellite or ground station, making it highly resilient against interference.

USA

The 20th century witnessed the United States' rise to hegemony, asserting politico-military dominance in practically every domain. A superiority which would also manifest itself in space, be it for scientific, commercial or military ends. Building on the experiences of the Gulf War, outer space was declared a vital interest for U.S national security by the end of the 1990s. Around that time, a Commission headed by Defense Secretary-designate Donald Rumsfeld submitted a report to Congress, assessing the "U.S. National Security Space Management and Organization"[6]. Warning against a potential "space Pearl Harbor", the report advocated for an overhaul of the U.S. space organization and doctrine, in order to meet the increasing threat posed by other nations' counterspace capabilities. Consequentially, the "space dominance" doctrine was adopted by the Bush administration in 2004, stressing that the use of space assets shall not be denied by adversaries during conflict. Although the United States embraced a generally more collaborative stance in space affairs with Obama taking charge of the White House, the notion of offensive as well as defensive space control continued throughout subsequent strategy papers. It was not until Donald Trump assumed office, however, that organizational as well as doctrinal change on a more fundamental level took place and the National Space Council was revived by the President for the first time in 24 years. Instead of merely seeing space-based applications as a critical support function during military conflict, space itself being the theatre of such became the commonly held presumption. The 2018 US National Defense Strategy (NDS) thus "recognizes great power competition with China and Russia as the central challenge to U.S. national security and highlights space as a critical domain in which this competition will occur."[7] Building on the NDS, the Trump administration furthermore issued the 2018 "America First National Space Strategy". Claiming that "competitors and adversaries have turned space into a warfighting domain"[8], the strategy essentially proclaims to increase the resilience of space architectures, strengthen deterrence and warfighting options, improve foundational capabilities (such as PNT and ISR), and foster a conducive environment for the U.S. commercial space industry.

As part of this broader move to overhaul the U.S. military approach to space, Trump issued the creation of the U.S. Space Force (USSF), which was approved by Congress in December 2019. The USSF therefore constitutes the now sixth branch of the U.S. Armed Forces and co-exists with the U.S. Air Force within the Department of the Air Force, similar to the U.S. Navy and the U.S. Marine Corps within the Department of the Navy. This would allow the Space Force to mature within the pre-existing structures of the Air Force, before eventually being transitioned into an independent Department of the Space Force. As such, the USSF "will be responsible for organizing, training, and equipping military space forces of the United States to provide for freedom of operation in, from, and to the space domain, including both combat and combat-support functions to enable prompt and sustained offensive and defensive space operations."[9] Additionally, the U.S. Space Command was re-established, tasked to develop a revised space defense doctrine and oversee warfighting operations in space. The third institutional reform to support the modernization of the U.S. space architecture was the establishment of the Space Development Agency (SDA) to accelerate innovation and development of next-generation space capabilities and conduct space acquisition for the USSF.

The United States unquestionably maintains the most advanced space capabilities worldwide, demonstrating by far the most operational experience in space-integrated warfighting, as well as a highly sophisticated worldwide Space Situational Awareness (SSA) system. Whereas only 10% of American missiles were guided by satellites in the Gulf War, this number increased to almost 70% during the war in Iraq[10]. As of 2018, the U.S. operated more than 350 civil and military ISR-satellites, providing space-based image intelligence (IMINT), signals intelligence (SIGNIT), and

measurement and signatures intelligence (MASINT). In terms of PNT, GPS satellites represent the backbone of U.S. capabilities, being integrated into a multitude of weapons systems and operational practices, but also support a wide range of commercial and civil applications. According to the SDA, it is currently developing the National Defense Space Architecture (NDSA). Budgeted at around $11 billion, 250 satellites will be launched until 2025, providing global next-generation communication services to the U.S. military, including missile defense and PNT capabilities to supplement GPS[11]. Regarding counterspace capabilities, the U.S. does not have officially acknowledged co-orbital or direct-ascent ASAT weapons, it does however possess the means to make use of such capabilities in short time if it chooses so. In terms of electronic counterspace capability, the U.S. operates the Counter Communication System (CCS), providing up-link jamming which has proven to be effective against Russian (GLONASS) and Chinese (Beidou) navigation satellite systems. Also, significant R&D efforts have gone into ground-based high energy lasers for counterspace purposes in recent years. Considering the current resurgence in U.S. space military ambitions and the claim to supremacy in space, U.S. space capabilities will most certainly advance remarkably in the foreseeable future.

China

In China's self-conception as a rising and increasingly competitive power, civil as well as military ambitions in space are firmly established. The latter was first acknowledged on paper by a doctrinal change in 2015, as China's Military Strategy stated that "outer space and cyber space have become new commanding heights in strategic competition among all parties. Countries concerned are developing their space forces and instruments, and the first signs of weaponization of outer space have appeared."[12] This change in doctrine is merely a reaffirmation of preceding developments, in that China has been investing heavily in ASAT capabilities to counter information-enabled warfare ever since the Gulf War. Although the strategy paper also emphasized on China's opposition to an arms race in space and advocated for the peaceful use of space, it became clear that space-related military capabilities are being viewed as vital in serving national interests. This position was reaffirmed in China's subsequent defense white paper in 2019, expressing that "space security provides strategic assurance for national and social development."[13] Moreover, official documents by the People's Liberation Army (PLA) indicate that counterspace operations are viewed as a critical means to counter possible US intervention during military conflict, suggesting the destruction of communication, reconnaissance and navigation satellites to "blind and deafen the enemy."[14]

This doctrinal change was accompanied by an organizational change, as the People's Liberation Army Strategic Support Force (PLA SSF) was established in 2015 and became operational the following year. Under direct authority of the Central Military Commission, the national defense organization of the PRC, it is independent from other branches of the military and combines the management of cyber space, electromagnetic space and outer space capabilities into a single entity. The merger of these areas under one umbrella highlights China's understanding of modern "informationized warfare", a highly recurrent theme in Chinese strategy papers. Besides the development of military space doctrine, the SSF is responsible for R&D of certain space capabilities, space launch and support, navigation, ISR operations, SATCOMs, as well as space attack and defense. As many space applications have dual-use properties, "civil-military integration" has been increasingly emphasized by China. Thus, the PLA SFF collaborates closely with the Chinese civil and commercial space sector, with the intent of leveraging potential synergies.

In terms of capabilities, China is well on track to seriously challenge the United States' longstanding superiority in space. With more than 120 ISR satellites as of 2018, of which around half are owned by the PLA, China possesses the means for worldwide situational awareness. Regarding SATCOMs, China operates over 30 satellites and has initiated testing of next-generation quantum-enabled communications, putting the country at the forefront of the global satellite communications industry. This year, China is set to complete its global constellation of 27 Beidou satellites facilitating worldwide PNT, a system similar to the GPS. In terms of counterspace capabilities, China caught the world's attention for the first time in 2007, when it destroyed one of its own meteorological satellites with a direct-ascent ASAT missile. An act for which it was heavily criticized for by the international community, as more than 3000 pieces of debris now orbiting in low earth orbit (LEO) were produced. Possibly because of this backlash, testing and development of kinetic physical weapons appear to have abated in recent years. Instead, reports suggest that China has seriously stepped up its efforts in the areas of non-kinetic physical and electronic counterspace capabilities, such as directed-energy weapons (lasers) and jamming-technology against enemy ISR, navigation and communication satellites. Additionally, cyberwarfare has been emphasized as a key asset in space-related military operations by the PLA. In space, China and its SSF are most certainly a force to be reckoned with.

Russia

With the Soviet Union having been a pioneer in the space domain, activities in space, be it for military or scientific purposes, have a longstanding tradition in its successor state Russia. Although space capabilities deteriorated after the collapse of the USSR due to budgetary constraints and other setbacks, Russia remains a global leader in space affairs, not only due to its heavy involvement in the ISS and the recent announcement to build a new space station in the foreseeable future. The Russian military doctrine and other strategic documents have long recognized space as a warfighting domain, stating that "no goal will be achieved in future wars unless one belligerent gains information superiority over the other"[15], which consequentially translates into superiority in space. Together with China, Russia has

repeatedly called for a space arms control agreement to curb the weaponization of outer space, a development for which it essentially blames the United States. However, the U.S. dismissed two attempts to reach such an agreement in 2008 and 2014. On the one hand, Russia perceives the tremendous might of U.S. space capabilities as undermining global strategic stability, while on the other hand, it recognizes the vulnerability that an American overdependence on space-based services represents. Russia has therefore been putting great emphasis on counterspace capabilities ever since the Gulf War, while concurrently avoiding to becoming excessively reliant on space-based applications themselves. The notion being that if Russia could deny the adversary space-enabled warfare, its conventional weapons systems would prevail in military conflict.

Organizational change to accommodate the new realities in space happened around the same time as in China. In 2015, Russia merged the Air Force and the Aerospace Defense Troops (which existed since the founding of the Russian Federation, making it the oldest space force in the world) into the Aerospace Forces. The Space Force within this new military department is responsible for maintaining the ballistic missile early warning system, the space surveillance network, the satellite control network, as well as space launches. Russian Minister of Defense, Sergey Shoygu, explained this reorganization by stating that the center of gravity had shifted to the aerospace sphere and was needed to counter the U.S. Prompt Global Strike (PGS) doctrine, a program that aims to allow the United States to deliver military strikes globally in less than an hour.[16] In terms of capability development, Russia relies almost exclusively on state-owned companies, which are managed by the state enterprise Roscosmos, the organization also responsible for Russia's civil space program.

Russia ranks third in number of operational satellites behind the U.S. and China, with 140 satellites in various orbits providing SATCOMs, ISR, navigation and other services[17]. Although fewer in numbers, Russian ISR satellites still surpass Chinese models in individual capability, providing Russia with high proficiency in global SSA. Russian SATCOM, on the other hand, compares poorly to other global powers, which is why recent modernization efforts have been initiated, including partnerships with European satellite manufactures. Russia's PNT capabilities rely on the navigational satellite constellation GLONASS, which is currently being updated with next-generation navigation satellites for improved accuracy. What Russia lacks in terms of space-enabled warfare, it attempts to compensate with counterspace capability. Russia possesses over an exhaustive range of kinetic physical counterspace weapons, including ground and air-launched direct-ascent ASAT missiles, as well as co-orbital satellites. The country has furthermore invested heavily in electronic warfare capabilities, such as the Krashuka-4 mobile jammer, viewing the disruption of enemy communications, command, control and navigation capabilities as crucial during military conflict. In July 2018, the Russian Aerospace Forces presented the Peresvet high energy laser weapon, praised by Putin as a new type of strategic weapon to destroy or disrupt enemy satellites. As information warfare is a cornerstone of Russia's general approach to conflict, also cyber-attack and -defense capabilities in the space domain have undergone serious modernization efforts in recent years. Although Russia may not be able to compete with other space powers in terms of availability of resources and scope, it nevertheless maintains a robust spectrum of capabilities based on decades of experience from the Soviet era. A potential game changer in the current dynamics of global power competition in outer space could be enhanced space cooperation between Russia and China, as joint aerospace projects, such as lunar exploration, have been envisaged by the two countries[18].

European Union

In Europe, military space doctrine and governance are still largely determined by the individual nation states and intergovernmental cooperation in an operational context, be it through bilateral and multilateral arrangements or within the framework of NATO, a defining characteristic. Furthermore, the urgency with which security in space is regarded by EU member states varies depending on national interests and differing strategic cultures. Whereas France adopted the Space Defence Strategy and created a Space Command in 2019, other countries, such as Germany or Spain, have so far been more reluctant to pursue military ambitions in space. However, supranational cooperation is becoming an increasingly prominent feature, as the European Union is incrementally emerging as a key player in the space domain, which was defined as a shared competence between the EU and its members through the Lisbon Treaty in 2007. The EU's ambitions in space affairs were underpinned by the 2016 Space Strategy for Europe. Among other things, the paper highlighted Europe's need for freedom of action and autonomy in space, emphasizing that "space capacities are strategically important to civil, commercial, security and defence-related policy objectives."[19] Building on the Space Strategy, the Commission proposed the EU Space Programme in 2018, which would improve existing initiatives and allocate €16 billion to EU space activities during the next multiannual financial framework 2021-2027 (MFF). Considering prospective budgetary constraints due to the Covid-19 crisis, however, expenditures for space could be at risk of significant curtailment. Furthermore, the Von der Leyen Commission created the Directorate-General for Defence Industry and Space headed by Thierry Breton, with the goal to "improve the crucial link between space, defence and security."[20] A step which underscores the EU's understanding for the intertwined areas of space and defense and most certainly carries significant potential for synergies in key industries. The United Kingdom's future involvement in European space affairs is still clouded by Brexit. Although cooperation on certain initiatives will presumably persist, the country has demonstrated closer alignment towards the U.S. in recent years, especially in the area of space defense.

Operationally, the European Commission manages EU space programs and policy, with the European Space Agency (ESA) as a partner for technical implementation. The European Satellite Centre (SatCen), under operational authority of the High Representative of the Union for Foreign Affairs and Security Policy (HR/VP), gathers data from EU and Member State sources to support EU operations and decision-making in Common Foreign and Security Policy (CFSP) and Common Security and Defence Policy (CSDP) contexts. The European GNSS Agency (GSA) manages the EU's Global Navigation Satellite Systems, the European Geostationary Navigation Overlay Service (EGNOS) and Galileo. In terms of capability development, two Permanent Structured Cooperation (PESCO) projects are dedicated to space affairs, namely the *EU radio navigation solution* to improve military PNT capabilities and the *European Military Space Surveillance Awareness Network* to develop an autonomous, sovereign EU military SSA capability. Also, one of the 11 priorities in the Capability Development Plan (CDP) of the European Defence Agency (EDA) is "Space-based information and communication services" to further develop ISR, PNT, SATCOMs, SSA and cyber defence capabilities[21].

At the heart of EU space capabilities are two flagship programs – Galileo and Copernicus. Under ownership of the EU, these two initiatives represent a real milestone in a supranational approach to space activities. Galileo, set to become fully operational in 2020, is a state-of-the-art global navigation constellation providing PNT for primarily civilian purposes. Nevertheless, Galileo could potentially be used militarily if member states choose to do so. Copernicus provides ISR capabilities through earth observation and monitoring, already serving security and defense purposes through providing border surveillance, maritime surveillance and support to the EU External Action Service. Furthermore, in terms of SATCOMs, the GOVSATCOM program, managed by the Commission, the EDA and ESA, provides satellite communication to CSDP actors in both civilian and military missions. Also, space surveillance is facilitated through the EU Space Surveillance and Tracking initiative (EU SST), programs to detect and predict the movement of objects orbiting earth. As in other areas of security and defense, the EU yet remains a marginal actor in space military affairs. However, spurred an increasingly hostile environment in space, a sense of urgency has developed in recent years for a need to protect shared European space assets and interests. Enhanced EU cooperation and ambitions in the space domain can thus be expected.

Outlook and Recommendations

Considering the current trajectory of military developments in the space domain, the assessment that outer space has once again returned as a theatre for great power competition is absolutely warranted. Most notably the U.S., China and Russia, but also other relevant actors, such as India or Japan, have all acknowledged this fact both in terms of strategic alignment and capabilities. The Space Race was never actually won. The United States merely triumphed in the first lap and, due to renewed strategic rivalry paired with the necessary technical requirements, we are now entering round two. That this development bears great potential for future conflict to the detriment of all mankind goes without saying. As for a lack of international agreements governing military activities in space, the current state of affairs nurtures belligerent sentiments rather than the peaceful co-existence of all nations, as originally laid out in the UN Outer Space Treaty. The European Union, instead of joining the global arms race, would therefore serve its own interests best in propagating international arms control agreements involving all actors, in order to curb the anarchical nature of international relations in space. Nevertheless, preparation for the worst case is most certainly crucial, as space technology, services and data have become indispensable for Europeans and the functioning of all societies in the digital age, which is why developing a robust spectrum of capabilities to protect European space assets is of paramount importance. Besides advocating for the prevention of offensive space military action, the EU should therefore continue to engage in defensive space efforts and develop its own space programs and assets for a number of reasons:

- **Enhancing European strategic autonomy**, for Europe's free access to space underpins the implementation of many EU policies, the competitiveness of the European industry sector, as well as the Union's overall security and defense. Space reinforces the EU's role as a strong and reliable global actor.
- **Improving the EU's crisis response and risk management** to enhance Europe's resilience.
- **Increasing overall European security** by eliminating vulnerabilities related to critical space infrastructure.
- **Fostering an innovative European space industry** to compete in global markets and preserve technological independence.

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Endnotes

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