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THE 21ST CENTURY: SPACE EXPLORATION, COMPETITION AND THREATS

Shamsiyev Saidakbar
The University of World Economy and Diplomacy
Student of International Relations
saidakbarshamsiyev@gmail.com
ORCID 0009-0006-5309-5447

A B S T R A C T

This article analyzes the 21st-century space exploration efforts by major powers, their struggle, competition for dominance in outer space, as well as the formation of alliances among states in this endeavor. It examines the spatial capabilities and potential of leading nations, the increasing number of military-purpose satellites, and future space programs. Furthermore, the article explores the strategies of the United States in pursuing space hegemony, the innovative projects and initiatives of China rapidly closing the gap, and the efforts of Russia to preserve the legacy of the Soviet space era.

K E Y W O R D S

Satellite, Starlink, SpaceX, Satellite Communication System (SCS), Military Satellite, Sputnik, Space Race.

Introduction

In the 1960s, humankind made its first launching outer space, signaling that the conquest of space would define the centuries to come. This pivotal moment marked the beginning of a new era in human history. It was the dawn of the Information Age. The emergence of the global information network can be directly traced to humanity's initial exploration of space. Satellites launched into orbit not only began providing the Earth with valuable information but also undertook diverse functions, such as monitoring the planet, capturing images, and transmitting data to designated destinations. Simultaneously, major powers began using these space technologies to enhance their military capabilities, leveraging them for strategic advantage. The great powers, always mindful of the need to prepare for the worst[1], utilized space technologies to support their land, air, and naval forces with precise location coordinates, navigation systems, as well as imagery and video data. Thus, humanity began to employ the very space-based structures it had launched for a variety of purposes, ranging from civilian to military applications.

To begin with, a brief overview of humanity's history in space exploration reveals that, while theories about reaching space had been proposed in various places, the Soviet Union (USSR) was the first to

[1] Thatcher, M. (2003). Statecraft : strategies for a changing world. London: Harper Collins.

make significant advancements in this field. In 1957, the Soviet state became the first to launch a spacecraft into space, thus inaugurating the Space Age. The Soviet Union also achieved the historic milestone of sending the first human into space: in 1961, Yuri Gagarin became the first person to venture beyond Earth. Between 1961 and 1991, the Soviet Union laid the foundation for the space industry[2]. The country's space programs were directed by the central Communist Party, which oversaw their implementation for both military and social purposes. Funding for these programs came from ministries and the state budget. The Soviet Union—and later modern-day Russia—used spacecraft for several purposes, including space exploration, advancing space sciences, maintaining human presence in space through logistical missions, and acquiring critical spatial data such as navigation (via navigation satellites), geodetic measurements (via geodetic satellites), telecommunications, Earth observation, and national security intelligence. Overall, the USSR was the first nation in the world to develop comprehensive space exploration programs, setting the stage for the future of space science and technology.

The United States represents the second-largest hub in the conquest of space. In 1958, the U.S. introduced the Project SCORE initiative, developed by the Ballistic Air Force Division (AFBMD). The first Defense Satellite Communications System (DSCS) was launched in 1962, followed by DSCS II in 1971. This program was later renamed Service Life Enhancement Program (SLEP)[3]. From the very beginning, U.S. space exploration programs were divided into two primary domains: military-purpose satellites and civilian space programs. This dual approach became the foundation of America's strategy, which, by the 1990s, solidified the country's position as the world's leading space power. To coordinate its military space objectives, the United States established NASA (National Aeronautics and Space Administration) on October 1, 1958[4]. Through its military space programs, the U.S. has leveraged space technology to support its land, air, and naval forces with critical and specialized information. Additionally, these programs have enabled the U.S. to monitor other nations, collect global data for navigation and imaging, and conduct comprehensive Earth observation activities.

After the dissolution of the USSR, the Commonwealth of Independent States (CIS) was established on December 8, 1991, under Russia's leadership. Within this framework, the Minsk Agreement was signed, stipulating that space communication systems developed during the Soviet era should be shared equally among the member states. To oversee this, the CIS Space Monitoring Agency was established in 1999. Alongside this, Russia also formed the Russian Space Agency (RSA) on February 25, 1992[5]. This organization is responsible for launching subsequent satellites, collecting data, and regulating space activities. One of Russian key strategies in the post-Soviet era was to place spacecraft in Earth's orbit as close as possible. This proximity facilitates much faster data exchange and allows ballistic missiles to be accurately targeted during times of war or military conflict. It is noteworthy that the Soviet Union was the first to develop intercontinental ballistic missiles (ICBMs), and its hydrogen bomb was significantly more powerful than that of the United States. During the Cold War, the Soviet

[2] History and Current Status of the Russian Space Program. (1957). Available at: https://www.princeton.edu/~ota/disk1/1995/9546/954605.PDF.
[3] (No date) The U.S. Air Force and the military space program. Available at: https://media.defense.gov/2010/Dec/02/2001329901/-1/-1/0/AFD-101202-013.pdf (Accessed: 11 January 2025).
[4] NASA (2020). NASA: 60 Years & Counting - Beginnings. [online] NASA. Available at: https://www.nasa.gov/specials/60counting/begin.html.
[5] History and Current Status of the Russian Space Program. (1957). Available at: https://www.princeton.edu/~ota/disk1/1995/9546/954605.PDF

Union's space missile program was primarily intended for military purposes. The ASAT project, initiated in 1963, aimed to place nuclear and intercontinental ballistic missiles in space and develop anti-satellite programs to protect against potential missile attacks. The Soviet Union used this project as leverage to exert pressure on the United States. However, in 1967, the Outer Space Treaty was signed, which declared that space is the domain of all humankind, prohibiting any nation from claiming ownership of it. It also banned the deployment of military weapons in space. Despite this agreement, during the current competition between the United States and Russia, Vladimir Putin has been pushing forward with the ASAT project[6]. Today, Russia continues to operate many of the space communication systems and spacecraft established during the Soviet era. Additionally, Russia has launched several new satellites, such as the LEO (Low-Earth-Orbit) program, which enables rapid imaging of the Earth, and reconnaissance satellites capable of high-resolution photography and digital transmission. Russia also operates satellites like Vostok (including Resurs-F, which operates for 2–3 weeks), Kosmos 2290, and Zenit satellites for oceanic reconnaissance, capable of operating at approximately 400 km altitude with a 2 km resolution. Other satellites, such as the Tsiklon (650 km altitude) and Zenit (850 km altitude), serve electronic reconnaissance purposes[7]. As of 2023, Russia has a total of 181 satellites, with 110 dedicated to military purposes. For comparison, the United States operates 247 military satellites, while China has 157[8].

The United States is the world's most advanced nation in both civilian and military space capabilities. Countries worldwide rely on American space services in one form or another. The U.S. oversees the largest satellite communication system and the most extensive space defense systems. In 2024, the U.S. allocated $546 billion for space-related economic activities. Satellite centers for both communication and military purposes are spread across the globe. In Europe, EUCOM oversees 21 million square kilometers and 51 countries, while AFRICOM covers 53 countries on the African continent, both headquartered in Germany in Ramstein. Additionally, the INDO-PACOM center, located in Pearl Harbor, manages space planning, data aggregation and military operations for 38 countries and 100 million square kilometers in the Indo-Pacific region. The National Reconnaissance Office (NRO) of the United States manages 46 bases across 18 countries, directly connected to space-related intelligence[9]. In 2003, the U.S. developed the Prompt Global Strike Program, which enables the country to launch missile strikes within hours to any location on Earth from space. The key functions of the U.S. Space Forces are as follows: Space Superiority - Protection from space threats, prevention of orbital warfare and electromagnetic warfare, and managing space-related conflicts. Global Mission Operations - Maintaining functional supremacy on a global scale, including missile launch detection, satellite data aggregation (navigation and positioning), and conducting international operations. Assured Space Access - The deployment, maintenance, and support of satellites.[10]

[6] Berkowitz, M. and Williams, C. (2024). Russia's Space-Based, Nuclear-Armed Anti-Satellite Weapon: Implications and Response Options. [online] Available at: https://nssaspace.org/wp-content/uploads/2024/05/Russian-Nuclear-ASAT.pdf.
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[8] World Population Review (n.d.). Military Satellites by Country 2023. [online] worldpopulationreview.com. Available at: https://worldpopulationreview.com/country-rankings/military-satellite-by-country
[9] Austin, G., Rajagopalan, R. and Wright, T. (2022). Military ambitions and competition in space: the role of alliances. [online] Available at: https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2022/iiss-_cyber-competition-in-space-1.pdf [Accessed 26 Jan. 2025].
[10]https://www.spaceforce.mil/Portals/2/Documents/SF101/ussf_101_glossy_FINAL_e-version.pdf

The United States continues to develop numerous military space programs. One significant project is Starlink, a military satellite program developed by SpaceX. In 2018, the U.S. Air Force signed a contract worth $28 million with SpaceX to assess the potential of program. Starlink has since been used in Ukraine on a trial basis. Additionally, as part of this large project, the "Blackjack" program was created by the U.S. Advanced Research Projects Agency (DARPA), with a budget of $117 million.[11] However, with the emergence of powerful nations competing with the U.S. in space, America has announced new plans to further develop its space potential. In 2020, the United States Space Force (USSF) was established, and currently, four defense support programs are operational in space. These include five Space-Based Infrared Systems (SBIRS) to detect missile launches. By 2025, the OPIR (next-generation infrared warning satellites) will be launched and by 2032, the Evolved Strategic Satellite is planned to be operational[12]. During his inauguration on January 20, 2025, President Donald Trump emphasized: "And we will pursue our Manifest Destiny into the stars, launching American astronauts to plant the stars and stripes on the planet Mars"[13]. With projects involving figures like Elon Musk and his space ventures, the next four years are expected to see a significant expansion of U.S. space programs and projects.

China is another powerful state for space dominance, and it has rapidly become a significant challenger to the United States, particularly in the realm of space capabilities. China has been labeled a "pacing challenge" to the U.S. due to its rapid progress in space technology and its increasingly assertive role in global space competition. In 2015, China made a pivotal decision to initiate a new framework for international space and cyber security competition. This strategy outlined in special goal to surpass Russia by 2030 and then leave the United States behind by 2045, with the ultimate goal of becoming the number one space power in the world. As of 2023, China has already outpaced Russia in several key areas. The country currently operates 157 military satellites and 623 civilian satellites, with 107 military satellites actively functioning. In comparison, Russia has only 76 active military satellites.[14] China is also the world's second-largest player in terms of intelligence gathering through satellites, following the United States. One of the most advanced space assets is its "Tangxin Jishu Shiyan" series of three geostationary satellites, which are capable of high-frequency early warning data transmission. This positions China as a major contender in both space defense and surveillance. China and Russia have established strong cooperation in space technology, particularly in the development of space vehicles. China relies on Russia for several critical technologies necessary for launching space vehicles, which demonstrates the interdependence of their space programs. Moreover, China is keen on developing its own anti-satellite (ASAT) capabilities, and it has been working on a system called DA-ASAT SC-19, which is capable of targeting rockets in Low Earth Orbit (LEO).

In the **21st century**, in addition to the United States, Russia, and China, several other countries are also attempting to establish a foothold in space. While many of these countries collaborate through

[11] Системы управления, связи и безопасности №4. 2022 Systems of Control, Communication and Security. (n.d.). Available at: https://sccs.intelgr.com/archive/2022-04/07-Pehterev.pdf [Accessed 11 Jan. 2025].
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partnerships and alliances with space power nations, they are still making strides to enhance their space capabilities, both for scientific and military purposes. These countries include **France, Germany, the United Kingdom, India, Japan, Israel, Italy, Australia, and Saudi Arabia**. While most of these nations are involved in space activities related to **data acquisition, research, and information security**, some are also focused on increasing their technological independence and military presence in space.

Among these emerging space-faring nations, **India** stands out. India is striving for technological independence and aims to position itself as a **global power** in space. Through its **Defense Research and Development Organization (DRDO)**, India has developed significant space technologies and is keen to assert itself as a self-reliant space power. Initially, India was resistant to using space for military purposes, especially in the realm of **anti-satellite (ASAT)** operations. However, the successful progress of China in this area prompted India to recognize potential threats to its national security in space. In response, India established the **Defense Space Agency (DSA)** in **2018**, aimed with protecting Indian assets in space. As of **2023**, India operates **62 space vehicles**, of which **9 are military satellites**, marking it as a prominent player in the space domain. India stands out for its rare ability to collaborate with both **Russia** and **the United States** in space activities, balancing its relationships with two major space powers. Indian succeses in space can play a crucial role in elevating its status in **international relations**.

Similarly, **Japan** has been watching China's growing space capabilities with concern, particularly in the East Asian region. The space ambitions of Japan date back to **2008**, when it began developing military space capabilities to ensure its security. By **2020**, Japan established a **defense space division**, further signaling its commitment to space as a strategic domain. However, despite its ambitions, Japan's progress in space has been somewhat limited. Out of **88 space vehicles**, only **2** are dedicated military satellites, suggesting that Japan's space program has faced hurdles in its pursuit of military space dominance.

Countries such as **France, Germany, the United Kingdom, Israel**, and **Italy** also maintain active space programs, often focused on civilian applications, data collection, and research. While many of these countries continue to rely on cooperation with established space powers, their increasing investments in space technology and infrastructure suggest that they are keen to carve out their own space-related roles in the coming decades. As these nations continue to grow their capabilities, they will likely contribute to the emerging multipolar space environment, where new geopolitical dynamics and alliances form. In conclusion, while the U.S. Russia and China dominate the space race, these emerging space nations are actively working to expand their interests in space, balancing **collaboration** and **competition** in the ever-evolving space domain.

In the ongoing **space competition** among the leading powers, **the United States, China, and Russia** have been actively forming **alliances** and **partnerships** with other nations to strengthen their positions. While the U.S. has maintained a clear edge in building strategic coalitions, both Russia and China have sought to form alliances to counterbalance American dominance in space. The **United States** has long led the way in forming space-related alliances. One of the most prominent frameworks is the **Five Eyes** agreement, which includes **Australia, Canada, New Zealand, the United Kingdom**, and **the U.S.** These countries are the most trusted American space allies, and they share vast amounts of intelligence, including satellite data, and coordinate efforts in space activities. In addition, the U.S. has bilateral space agreements with several countries. For example, **U.S.-Israel**: Israel operates **12 military** and **29**

general-purpose satellites in collaboration with the U.S. **U.S.-Japan** and **U.S.-South Korea**: These countries have **21 total satellites**, of which **2 military**. **U.S.-Taiwan**: Taiwan operates **7 satellites**, including **2 military ones**, with direct links to U.S. space operations. Furthermore, the U.S. has also formed the **QUAD coalition** with **Australia, India, Japan**, and itself to monitor and control space in the **Indo-Pacific region**.[15] These nations share a significant number of satellites, and their cooperation enhances the U.S. dominance in space operations across the globe. The QUAD is a crucial part of the U.S efforts to secure its strategic space objectives in this vital region. Through these extensive alliances and agreements, the U.S. conducts a comprehensive global **space policy**, leveraging these partnerships to strengthen its leadership in space exploration, defense, and security. On the other side, **Russia** and **China**, despite their differences, have increasingly found common ground in their space ambitions. In **2017**, the two countries signed a **space cooperation agreement**. This partnership, while not based purely on mutual trust, reflects **geopolitical necessity** and the desire to keep a balance of U.S. dominance in space. **China** and **Russia** are united in their efforts to develop advanced space technologies, including **anti-satellite (ASAT)** capabilities and **space station projects**. This collaboration allows them to share **space research**, **satellite technology** and **military space technologies**. The partnership between China and Russia represents a strategic alignment in space, especially considering their shared interests in space exploration and security. While **China** aims to overcome the top powerful space country in the world by **2045**. Also, **Russia** continues to use its expertise in satellite systems, launch technologies, space defense to support the collaboration.

The **Russia-Ukraine war** has significantly heightened the value of **military satellites**, as the critical role of space-based assets in modern warfare has become more evident.[16] These satellites provide essential information that directly influences the course of conflicts, making their function even more vital for military operations. Some of the key roles of military satellites in this context include: **Surveillance and reconnaissance data**: Gathering intelligence about enemy movements and activities. **Navigation and positioning**: Accurate tracking of forces and equipment. **Early missile warning systems**: Detecting potential threats before they reach their targets. **Electronic and signal intelligence (SIGINT) which is** Intercepting communications and electronic signals to understand enemy plans and actions. **Nuclear threat detection**: Monitoring signs of nuclear activity or tests. **Cybersecurity**: Protecting space-based systems from digital threats. These capabilities allow militaries to make informed decisions, significantly impacting the outcome of battles. If a side can receive and act on this information quickly, accurately, and reliably, it can tilt the balance in its favor. The **precision of space-based intelligence** has thus become a decisive factor in modern warfare, making **military satellites** an indispensable asset. Despite facing **Western sanctions**, **Russia** has been making efforts to reduce its dependency on foreign technology and gain **technological independence**, not just on Earth but also in space. Russian **military space program** has been evolving to maintain its strength and capabilities in space, especially when it comes to gathering reconnaissance and defense. Russian ability to operate **independent military satellites** has become crucial in the ongoing conflict. As tensions continue to rise, the country has been focused on securing its **military space assets** to gain an

[15] Austin, G., Rajagopalan, R. and Wright, T. (2022). Military ambitions and competition in space: the role of alliances. [online] Available at: https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2022/iiss-_cyber-competition-in-space-1.pdf

[16] Gurantz, R. (2024). MONOGRAPH SERIES. [online] Available at: https://media.defense.gov/2024/Aug/21/2003529805/-1/-1/0/20240822_Gurantz_Satellites_Online_b%201.PDF

advantage in the **global information and intelligence race**, which has direct implications for its defense strategy.

The increasing reliance on space for military purposes is contributing to growing **mistrust and conflict** among states. As nations focus more on controlling space-based assets for **reconnaissance gathering, surveillance**, and **defensive measures**, the risks of **geopolitical tension** and **arms races in space** rise. In particular **poor nations** may face themselves under greater pressure. These nations often lack the technological capabilities to keep pace with the space advancements of more powerful states. This disparity in **space capabilities** could lead to questions about their **sovereign independence**, as powerful states leverage their space assets to exert influence and control over them. While the likelihood of **direct space warfare** between major powers (like the U.S., Russia, and China) is low, the competition for **space-based intelligence** is intensifying. Perhaps the competition will be in the acquisition of information in space, reconnaissance, the effectiveness of early warning systems, and the effective maintain of information security.

Conclusion

As we move further into the 21st century, the **space race** is likely to intensify, with countries striving to maintain their dominance and secure their place in an increasingly contested environment. The growing number and sophistication of **satellites** in orbit will play a central role in **international relations**, as powerful nations and emerging space players alike use space to assert their **technological, military**, and **economic advantages**. Countries like the **United States**, **Russia**, and **China** are actively working to assert or maintain their **space positions**. These nations are investing heavily in **military** and **civilian space programs**, with goals ranging from **securing national security** to **gaining strategic advantages** over rivals. For instance, the **U.S.** continues to strengthen its position by developing advanced satellites for both **military** and **commercial** use, while also ensuring strong international partnerships. In contrast, **China** has set its sights on surpassing the U.S. by 2045, signaling its ambition to dominate the space arena. **Russia**, having inherited vast space infrastructure from the **Soviet Union**, is working to regain the lost ground and restore its influence in space, particularly in **military and communication satellite capabilities**. Countries such as **India** and **Japan** are motivated to participate in this competition to safeguard their **national interests** and **defend against potential threats** posed by the rise of powerful space actors like China. Several other nations, including **Australia**, **France**, and **Germany**, are aligning themselves more closely with the **United States** to strengthen their **position** in the space race. This partnership offers **technological, economic**, and **military benefits** that allow them to enhance their space-related activities while ensuring **security** through collaboration. The competition for **space dominance** will undoubtedly shape global relations in the coming decades. As more countries join the space race, there will likely be **greater tensions** and **increased competition** for access to space-based resources, including **satellite technology**, **communication systems**, and **early warning systems**. The **strategic value** of space will continue to grow, and as nations seek to secure their interests, space will play an increasingly critical role in **international security** and **politics**.

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