Space Commercialization and Weaponization: An Unregulated Final Frontier

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In what ways are countries vying for power and influence in this final frontier and how will this competition impact the United States’ ability to advance a national agenda in this domain? Should the United States support the establishment of international institutions to regulate the space activities of states and private actors, including exploration, commercialization, and weaponization? How might the militarization or de-militarization of space look over the next decade? Will the initiatives of the private sector to explore and monetize space travel help or hinder the space agendas of the U.S. government? To what extent is America’s status as the global leader in higher education in space-related technologies faltering or will the US maintain its competitive edge?

If you can see it, you can shoot it. If you can shoot it, you can kill it.

This old adage describes the necessity of cover and concealment during wartime. Hiding tanks behind berms, hiding soldiers in trenches, hiding formations in the wood line...these tactics protected militaries from being seen and therefore becoming targets during fighting in World War I and World War II. As technology improved, however, countries developed new ways to “see” the enemy to counter the effects of cover and concealment. Intelligence, surveillance, and reconnaissance assets like aircraft with cameras on them, or state-owned satellites that could take pictures of the enemy terrain greatly enhanced the capabilities of great powers during the Cold War. Fast forward even further and seeing is more than imagery, it’s seeing by full-motion video in real-time, it’s seeing by observing heat signatures, it’s seeing through use of lasers and radar...almost all of which is aided by use of satellites in outer space. Over time, the places to “hide” – whether it’s hiding a specific military capability or the initial stages of an attack – began to decrease due to technology. And today, there is nowhere to hide. Today, in 2022, space can see you.

Outer space is a highly congested environment that contains state actors and private companies, both of whom rely heavily on their space-based entities to carry-out every day routine functions. Increased use of and reliance on space drives a need to protect space-based assets, inevitably resulting in the militarization of outer space. The United States faces several challenges in this environment today: the extent to which it should militarize space to protect its economy and national security while avoiding confrontation with other great powers; the support for new or improved international institutions to regulate outer space without constraining itself; and its own ability to maintain a technological advantage in space concurrent with an ability to act even if “blinded” by an adversary.

To address these challenges, this paper will proceed in four parts. First, it will unpack the historical context of space exploration from the time of the Cold War to today. Second, it will
address how space exploration has led to congestion of the environment today and identify key actors who have begun to militarize space to protect their own assets. Third, it will identify what international institutions, laws, and norms currently exist to address space exploration and congestion. And finally, the paper will conclude with a discussion regarding militarization and weaponization of outer space, and the future of this arena of great power competition.

The Evolution of Activity in Outer Space

Eras of great power competition tend to instigate races between states in the system, each working to offset the security dilemma by achieving a competitive edge. This was no more prevalent than during the Cold War between the United States and the Soviet Union: a nuclear arms race was at hand, as well as a space race. When the Soviet Union launched Sputnik, the first artificial satellite, in 1957, the United States followed up with its own satellite launch, Explorer-1 in 1958, the establishment of the National Aeronautics and Space Act (NASA) a few short months later, and then men on the moon by 1969. The Cold War had only two spacefaring nations, that of the United States and the Soviet Union, each sponsoring government led and controlled programs to best one another in space. The Americans sought scientific evolution, while the Soviet Union sought a psychological advantage. Khrushchev used space to bolster the morale of his people and give the enemy pause through exaggeration we might call “Potemkinism,” or building just enough capability to create an illusion of more. Khrushchev recalls this exaggeration, “I said that we had the capability of shooting a fly out of space with our missiles…it always sounded good to say in public speeches that we could hit a fly at any distance with our missiles.”

After the onset of the space race, the United States made a deliberate change in policy to allow for greater private-sector involvement in space research and activity. In 1984, the Commercial Space Launch Act allowed the private sector to pursue space activity, pending they followed specific safety regulations. Pleased with progress and advancements provided by the private sector, the United States further relaxed regulatory standards for space companies in 2004, hoping to encourage private firms and commercial industry to become more active and innovative in the space arena.

Today, the private sector has jumped headfirst into the space industry through development of satellites, rockets, and launch vehicles. A satellite is a moon, planet, or machine that orbits a planet or star. Earth has a natural satellite, the moon, and man-made satellites that are generally comprised of a power source and antennae with a set mission. Satellites are launched into space on rockets and establish an orbit based on intended capability or mission. There are four different orbits for satellites. Most satellites, including the International Space Station (ISS), reside in low earth orbit (LEO); satellites that service a specific area of the earth need to stare at the earth reside in geosynchronous orbit (GEO); satellites that provide global coverage like GPS reside in medium earth orbit (MEO); and satellites with other specific missions reside in highly elliptical orbit (HEO).

The space-based systems above enable several critical functions for daily life: precision, navigation and timing (PNT), primarily through the global positioning system (GPS), which is
the U.S.-owned and operated Global Navigation Satellite Systems (GNSS); television broadcast; voice communication and mobile communication services; internet service; security surveillance; terrestrial, air, and maritime awareness; climate research and weather monitoring; nuclear non-proliferation monitoring; and intelligence collection. Emerging space-based capabilities could also reduce dependence on Earth’s natural resources. Space-based solar power could capture more of the sun’s energy and therefore energize functions on Earth and in space, and space-based mining technologies may be able to extract ice from the Moon and asteroids, utilizing underlying oxygen to fuel rockets and support human life in space. Given the range of activities currently conducted in space and those which may exist in the near future, the U.S. Chamber of Commerce estimates the value of commercial activity in space will increase from $385 billion in 2020 to at least $1.5 trillion in 2040.

The reliance on space has increased with the advent of “space tourism,” or recreational space activities. In 2021, billionaire Richard Branson traveled to space, followed two weeks later by another fellow billionaire Jeff Bezos. Bezos pushed the line further than Branson, traveling high enough to experience the same weightlessness, but also reaching the Kármán Line, 1162 miles above Earth’s surface and the boundary generally accepted by the international community as where Earth’s atmosphere ends and outer space begins.

Reliance on and excitement for space is not a bad thing. “Deep-pocketed” visionaries like Branson, Bezos of BlueOrigin, and Elon Musk of SpaceX have created a new industry of small, low-cost rockets that can launch a few microsatellites at a time. Satellites are now plentiful, cheaper, and designed more like mobile phones. Further, SpaceX’s development of reusable rockets slashed the cost of space launch for everyone, including the U.S. government.

Simplifying this history, space exploration during the Cold War was a small component of great power competition that affected reputation of the governments more so than daily life; whereas today, states and individuals would not be able to communicate or function efficiently and effectively without use of space-based systems. The barrier to space activities has been lowered to such an extent that the environment must now balance the demands of three: 1) the demands of states who seek to enhance their own scientific knowledge and military capabilities via space, 2) the demands of private-sector actors capitalizing on the economic benefits of providing space functionality or using space to increase business effectiveness, and 3) individuals interested in recreational and “non-essential” experiences via space.

**Space Congestion: A Multitude of Actors Militarizing Space**

Today, there are 60 spacefaring nations, compared to only two spacefaring nations—the United States and Soviet Union—during the Cold War. There are over 2,000 satellites in space with the majority of them in LEO. There are 28,000 other objects in space, primarily debris from satellite explosions (both deliberate and accidental). The U.S. Space Force (USSF) tracks any space object or piece of debris that is the size of a softball or larger. However, estimates show that up to 96% of space objects are untracked, and the number of satellites in orbit could increase four to ten times in the next decade. This is a problem with significant impact to all spacefaring nations and private entities. Called the “Kessler syndrome,” space could reach a
point at which debris from one collision sets off continuous collisions where safe space operations become no longer viable. 19

Benefits from activity in space (for the state, for the economy, and for individuals) drives great powers in this new era to contribute more and more to space congestion. This congestion then leads to greater militarization of space as states need to protect their own assets, terrestrially and orbitally. States can easily militarize space assets and interests given the cheapness of launches and satellite development.

The militarization of space refers to a multitude of space activities that seek to both defend one state’s national security and / or threaten the capabilities of another state in space. First, the increase in satellites means that overhead surveillance has become persistent and unblinking. Satellites blanketing the Earth allow states or private companies to track people and objects with extreme precision.20 This may result in a dramatic expansion of time-sensitive targeting.21 Second, technology author Christian Brose writes that, “It is hard to imagine that strategic and military competition will remain confined to Earth.” As the number of satellites and launch vehicles increases at cheaper rates, moving to and from outer space will become easier and more common. Militaries could view space travel as little different than flying or sailing around the planet.22 Although against the current Outer Space Treaty, militaries could use space to establish bases in orbit to pre-position forces and capabilities, manufacture reinforcements during a conflict, and deliver those machines where they are needed on Earth in a matter of minutes.23 Third, there is a host of newer technologies that can be used to threaten actors and their assets in the space domain: kinetic physical counterspace weapons that include direct-ascent ASAT weapons, co-orbital ASAT weapons, and ground-station attacks; non-kinetic physical counterspace weapons such as high-altitude nuclear detonation, high-powered lasers, laser dazzling or blinding, and high-powered microwaves; electronic warfare such as uplink and downlink jamming and spoofing; and cyber-attacks such as data intercept or monitoring, data corruption, and seizure of control.24 The bottom line is best understood through the words of USSF Commander General John Raymond: “Space is no longer a benign environment.”25

Fortunately, the United States is the dominant and most advanced actor in space today. China and Russia are the next two most advanced actors in space. Other states with advancing space capabilities include Iran, North Korea, and India, followed by France, Israel, Japan, South Korea, and the United Kingdom. The following segments will describe the capabilities of China and Russia in space as former Secretary of Defense Mark Esper said in 2020 that “in space, Moscow and Beijing have turned a once peaceful area into [sic] a warfighting domain.”26

China

If the Cold War space race was between the United States and the Soviet Union, then today’s space race is with China. China aims to become the world’s preeminent spacefaring nation and to seize the “lunar high ground,” not only for the economic benefits that come from space but also to better compete with the United States.27 China launched a manned mission in June 2021 for the first time since 2016, became the first nation to land an unmanned spacecraft on the far side of the moon in 2019, and began assembling it’s space station, Tiangong or
Heavenly Palace, in April 2021. Tiangong’s assembly is particularly significant as the International Space Station (ISS), which denied access to China, is set to decommission in 2024 given the predetermined loss of funding from the U.S. Congress and other international partners.28

The organization of Chinese space assets and missions has both civilian and military components. Similar to the U.S. National Aeronautics and Space Administration (NASA), China has the China National Space Administration (CNSA) for research and development. The difference, however, is that all astronauts (called taikonauts in China) are members of the People’s Liberation Army (PLA),29 the armed wing of the Chinese Communist Party (CCP). While there is a strong relationship between the military and civilian community in U.S. space programs, in China “the degree of military control, lack of potential civilian intermediaries, specific chain of command, and broader “military-civil fusions” mission of some civilian institutions give China’s space program a significantly stronger military bent.”30

The concern over the PLA’s active role in China’s space program centers on the potential dual-use of all Chinese space capabilities: for any economic space capability, there is also an associated military capability. For example, in 2020 China launched its final BeiDou satellites. BeiDou is a constellation of 35 satellites that makes up China’s GPS services and provides PNT capabilities to 120 countries.31 BeiDou is a significant component in China’s Belt and Road Initiative (BRI) that provides necessary investment in Asia and increases Chinese economic growth, while simultaneously allowing China greater influence and control over countries receiving investment. Providing PNT capabilities to 120 countries may also allow China to surveille and monitor the activity of those countries.

Finally, China does have significant kinetic physical counterspace weapons. It can threaten any U.S. satellite in LEO, and likely those in MEO and GEO.32 Unconfirmed information suggests that China has a laser weapon system that can target satellites through non-kinetic physical means. And although no publicly acknowledged reports suggest China has used cyber capabilities to attack other states’ space systems, India accused China of jamming Indian satellites to hide PLA movement in the disputed territory known as the Line of Actual Control in Ladakh, between India, Pakistan, and China, potentially indicating capability and intent to integrate operations in the space domain to its ground-based operations.33

Russia

Russia is falling behind in the space race between the United States and China but is still a critical state to consider given its historical experience in space and willingness to conduct bold actions against its adversaries particularly when it comes to testing, exploring, and maneuvering ASAT capabilities.34 Russia is planning a crewed mission to the Moon in 2030, followed by a permanent lunar base in 2035. Russia is also working to solidify cooperation with China in space, including through a joint research base on the Moon and assistance in deep space endeavors. Russia’s space launch vehicle program, Angara, includes vehicles to launch heavy and light satellites, and another program currently in-progress would build satellites for other countries by 2023.35
Like the United States and China, Russia’s space program has military and civilian components. Roscosmos is the civilian component, with military space activities falling under the Russian Aerospace Forces (RAF). Roscosmos is estimated as a $1 billion industry responsible for satellites, launches, and launch vehicles in Russia. Prior to U.S. government investment in commercial space through companies like SpaceX and Boeing, the United States would pay Roscosmos $80 million a seat to launch astronauts to the ISS. Similar to BeiDou, Russia has its own PNT system known as GLONASS that consists of 27 satellites. Russia uses the military site Plesetsk to launch its satellites.

Russia does not have a technological edge over the United States or China as sanctions against domestic state-owned companies have left its commercial satellite market severely underdeveloped. Nevertheless, Russia consistently tests counterspace weapons. In April and December 2020, Russia tested a direct-ascent ASAT system and in July 2020, it conducted a co-orbital ASAT test. The USSF reprimanded Russia on all accounts given safety concerns for other satellites in space (increased potential for the Kessler syndrome) and suspicion about the motivations behind ASAT space capabilities. Russia also maintains an earth-to-space missile capability, potentially a gun that can be fired in space, non-kinetic physical laser capabilities, growing electronic counterspace capabilities, and disruptive cyber capabilities.

**Other Actors**

India is the fourth country, after the United States, China, and Russia, to have developed a successful kinetic counterspace weapon. Iran and North Korea are working to develop counterspace weapons, but currently have greater success in cyber and electronic warfare than kinetic counterspace weapons. Other countries of note include France, Israel, South Korea, Japan, and the United Kingdom, which have all recognized the need for an active role in space.

**Is It Possible to Regulate Space?**

Unfortunately, few internationally accepted norms and regulations govern acceptable and unacceptable behavior in space. The primary international space treaty is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the Outer Space Treaty or OST), signed in January 1967 by 110 countries. The OST broadly encourages the free exploration of space by states and peaceful uses of space and includes other principles such as no claims of sovereignty in space and no nuclear weapons in space. The OST’s language is broad and vague. Russia and China proposed an updated treaty to prevent the placement of weapons in outer space and to prevent the use of force in space, but the United States rejected the treaty for lacking verification mechanisms and presenting no restrictions on ASAT capabilities. The European Union then introduced a non-binding Code of Conduct for Outer Space Activities in 2008, working to address trust and confidence building measures that would encourage peacefulness and transparency in space. This was updated in 2013 with a United Nations report that laid out four categories of information sharing in space. The UN report was heralded as a success, but its implementation is voluntary.

The international community needs to continue efforts to regulate space to address space situational awareness and traffic management given the congestion of space, debris mitigation,
ASAT testing, rendezvous and proximity operations, and the difference between safety and security in space. There are many challenges to installing rules to reduce uncertainty and facilitate reciprocity. States do not want to sign treaties that limit their ability to defend themselves, and the divide between state and private interests in space is hard to reconcile (pursuit of security versus pursuit of revenue). The lack of a legal framework makes enforcement difficult, especially given vague language and evolving capabilities.

Despite these challenges, the United States is paving the way by establishing a set of norms for military activity in space. In June 2021, Secretary of Defense Lloyd Austin signed a memorandum of “Five Tenets of Responsible Behavior” for Department of Defense space operations. These tenets aim to make activity in space safer, limit long-term debris in space, avoid the creation of harmful interference, and communicate clearly when it comes to the safety and stability of space.

Additionally, in July of 2022, the McGill Center for Research in Air and Space Law published “The McGill Manual,” a comprehensive consolidation of 52 of the world’s rules regarding international law applicable to the military uses of outer space. These rules set out to clearly identify ways that international laws constrain state behavior that could otherwise lead to the commencement of an armed conflict related to space. The manual is the outcome of a six-year project funded through McGill’s Manual on International Law Applicable to Military Uses of Outer Space (MILAMOS Project), which was an attempt to answer the United Nations Committee on Peaceful Uses of Outer Space (UNCOPUOS) working group.

On the upside, the international community has made continuous attempts to provide rules for states to follow in outer space. Given the newness of this environment, however, states are often unwilling to bind themselves to a set of rules that could constrain their economic and national security.

**Space Militarization and Space Weaponization: The Future Fight**

The Outer Space Treaty signed in 1967 proclaims the peaceful use and exploration of outer space. Despite this being one of only a handful of international institutions that all great powers agreed to regarding space today, outer space is not peaceful. Outer space is militarized, and outer space is weaponized. Outer space is militarized in ways described in the above section about actors in space: states have the capability to use outer space to support other land, air, and sea components to defend their own national security and threaten other states via the same components, including outer space. Weaponization is a more specific component of militarization that describes actual weapons deployed in outer space that can be used to defend and harm other assets in space or on Earth. Given the economic benefits gained from space and criticality of outer space to monitor adversaries and carry out daily communications, states would be irrational to not find ways to protect their assets.

While writing almost a decade ago in 2013, Vishnu Anantatmula describes the current dilemma well: “As space becomes increasingly competitive, so will the propensity for conflict in space. The historical contest and competition on the sea and in the air realms offer valuable insight into future competition in space. Consequently, space warfare is bound to occur, since
space is of sufficient importance to national security, and it provides a substantial economic benefit.\textsuperscript{50}

**Suggested Readings**

- **Space Threat Assessment 2021.** Center for Strategic and International Studies.

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\textsuperscript{1} Maddie Davis, “The Space Race,” *UVA Miller Center.*


\textsuperscript{5} Sandra May, “What is a satellite?” February 12, 2014, *NASA.*

\textsuperscript{6} Ibid.

\textsuperscript{7} McCall, “Challenges to the United States in Space.”


13 Brose, 71.

14 Brose, 65.


16 McCall, “Challenges to the United States in Space.”

17 Ibid.

18 McClintock, Feistel, Ligor, and O’Connor, “Responsible Space Behavior for the New Space Era.”

19 Ibid.

20 Brose, 167

21 Ibid., 110

22 Ibid., 171

23 Ibid.


30 Ibid.

31 Harrison, Johnson, Moye, and Young, “Space Threat Assessment 2021.”

32 Ibid.
33 Ibid.

34 Pavel Luzin, “Russia is behind in military space capabilities, but that only drives its appetite,” April 2, 2020, Defense News. https://www.defensenews.com/opinion/commentary/2020/04/02/russia-is-behind-in-military-space-capabilities-but-that-only-drives-its-appetite/.

35 Harrison, Johnson, Moye, and Young, “Space Threat Assessment 2021.”

36 Pavel Luzin, “Russia is behind in military space capabilities, but that only drives its appetite.”


38 Pavel Luzin, “Russia is behind in military space capabilities, but that only drives its appetite.”

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41 Harrison, Johnson, Moye, and Young, “Space Threat Assessment 2021.”

42 Ibid.

43 McClintock, Feistel, Ligor, and O’Connor, “Responsible Space Behavior for the New Space Era.”

44 Ibid., 17.


46 Ibid., 12.

47 Ibid., 22.

