Achieving Space Superiority in an Era of Great Power Competition

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It was never a guarantee that if you moved first in space that you were going to win. But in every wargame we played, if you were the second mover, you were guaranteed to lose.
—General David L. Goldfein, U.S. Air Force Chief of Staff

Is the first mover in space the winner, as General Goldfein suggests? What does the first mover mean in terms of space superiority? With Russia and China steadily increasing their space-based capabilities to compete with the U.S., space is becoming the most strategically important domain in the operational environment with detrimental impacts to land, air, maritime, and cyberspace domains if threatened by adversaries. Consider a U.S. Special Forces team deep in enemy territory during a conflict with a peer adversary trying to geolocate a high-value target (HVT) for an airstrike. Detailed planning for the operation accounted for the protection of strategic communication satellites that the team utilizes in their area of operations. With the enemy jamming line of sight radio communications as part of the defensive posture, the team attempts to call in the HVT's location via satellite communications. However, they are unable to send their report because, unbeknownst to the team, the peer adversary denied their ability to communicate via space by destroying the overhead communications satellite. Despite extensive planning for space-based capabilities and essentially being the "first mover" regarding space support in joint military operations, the adversary is still able to disrupt and degrade efforts in space and to seize the military advantage.

The U.S. faces diverse threats from peer competitors in space, which has become the most vital domain for the joint warfighter. From global positioning systems (GPS) to ballistic missile defense systems, U.S. national security relies on space-based technology to gain and maintain the advantage in joint military operations. Additionally, the contested and congested nature of the space domain combined with outdated international policies, such as the Outer Space Treaty no longer guarantees the U.S. use of space as a refuge from great power competition as space dominance is one of China's policy objectives.[1]

Space Superiority in a Contested Environment

Many decades ago, the world saw the space domain as a peaceful sanctuary, and the U.S. enjoyed its space-based technology advantage over potential adversaries, a complicated reality in an era when space is a contested and easily disrupted environment. The Outer Space Treaty of 1967

[1] The views expressed are those of the author(s) and do not reflect the official policy or position of Joint Forces Staff College, National Defense University, the Department of Defense, or the U.S. Government.

recognized humankind's interest in the "peaceful use" of the space domain and set the basis for space law.[2] Space superiority, defined as "the degree of control in space [domain] of one force over any others that permits the conduct of its operations at a given time and place without prohibitive interference from terrestrial or space-based threats,"[3] remained easily achievable by the U.S. for the decades to come.

While the U.S. focused on the Global War on Terrorism, China and Russia observed the importance of the space domain to the U.S. way of war and developed space-based offensive and defensive capabilities.[4] In January 2007, China launched its first anti-satellite (ASAT) missile from a ground-based, mobile launcher against a malfunctioning weather satellite in low earth orbit (LEO).[5] Russia demonstrated an ASAT missile capability in 2015, and India conducted their first successful ASAT missile test in 2019.[6] Even with the successful test of a U.S. ASAT capability in 2008, the proven capabilities of other countries highlight the erosion of the U.S. advantage and its ability to ensure space superiority in the 21st-century battlespace.

U.S. warfighters depend on space-based capabilities to conduct operations in all other physical domains (air, land, and sea). GPS navigation systems, high-bandwidth shipboard communications, and unmanned aerial vehicles, such as the MQ-1 Predator, all rely on space assets to conduct operations. Adversarial space disruption capabilities or advancements threaten the joint warfighter's ability to operate and execute missions effectively. Major General Tim Lawson, Mobilization Assistant to the Commander of U.S. Space Command, contends that "adversaries don't have to dominate space, they merely need to have the capability to disrupt space operations."[7] Emerging threats to U.S. space-based assets may include high-power lasers and satellite communications jamming. One method of combating the threats is by launching numerous small satellites into orbit to deter adversaries from kinetic aggression in space.[8] By doing so, the U.S. will also ensure resiliency and redundancy, thus protecting the ability of the U.S. to achieve space superiority.[9]

In 2005, General Lance W. Lord, [former] Air Force Space Command Commander, noted, "Space Superiority is the future of warfare. We cannot win a war without controlling the high ground, and the high ground is space."[10] China and Russia continue to modernize their counter-space capabilities to diminish, degrade, and disrupt an adversary's use of the space domain, neutralizing the competitive advantage of the U.S.[11] As the space domain will remain competitive, congested, and contested, the U.S. must take a more aggressive approach to be able to achieve space superiority when required and, under its terms, to freely operate in the domain.

Policies and Doctrine

The Outer Space Treaty, or more 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," has been ratified by the United States, Russia, China, and 107 other United Nations members and establishes limitations for weaponizing space. While it does prohibit military-related events and activities on celestial bodies, it bans only weapons of mass destruction from being placed in orbit.[12] Operating in the gray area, Russia, China, India, and the U.S. have successfully demonstrated an ASAT missile capability. Some of the tests have created substantial space debris that poses a threat to operational satellites nearby. By executing ASAT missile tests

on their satellites, the countries are projecting the ability to disable or destroy an adversary's satellite during a conflict. As nations have the inherent right to self-defense, the ASAT missile capability is arguably a form of peace through deterrence. As such, it can be construed as a defensive weapon within the construct of the Outer Space Treaty, specifically the "peaceful use" of the space clause.[13]

The continued testing of kinetic ASAT capabilities or their use in conflict will create additional amounts of space debris. Orbiting the Earth, the debris has the potential for wide-ranging impacts that could harm U.S. interests. Traveling in space at thousands of miles per hour, the impact of even the tiniest of space debris with orbiting satellites or spacecraft can cause significant damage, creating even more space debris. Until the Earth's gravity pulls it back into the atmosphere, the space debris will continue to orbit the Earth and threaten the operability of objects in its path. While the testing of kinetic ASAT capabilities may fall under the guise of "peaceful use," their second and third-order effects may not be so peaceful.

In response to the U.S. drone strike that killed Iranian General Quasem Soleimani in January 2020, Iran purchased commercial satellite imagery of Al Asad Airbase prior to their missile attack.[14] While the U.S. was able to evacuate the majority of planes and forces between Iran downloading the imagery and the attack, the event demonstrates how space commerce is affecting military operations. The 2017 National Security Strategy recognizes that the use of space by both governments and the private sector impacts U.S. military operations and their ability to prevail in conflict.[15] Even though it may seem contradictory that one of its priority actions is to promote space commerce, it brings to light the realization that technological advances in the private sector have opened the space domain to the world. On the one hand, the widespread availability of commercial technology threatens U.S. superiority, but on the other hand, the U.S. must continue to partner with the private sector to develop defensive mechanisms and maintain a competitive edge against their adversaries. Plainly stated, private sector partnerships project power in the space domain, and the sentiment is echoed in the 2020 National Space Policy. However, the Biden administration's Interim National Security Strategy Guidance fails to address private sector partnerships in space even though it references the partnerships for cyberspace and counterterrorism.[16] If the administration's National Security Strategy fails to further private sector partnerships in space, the ability to achieve U.S. space superiority will be at increased risk.

The 2020 National Space Policy focuses on private sector partnerships to help enable U.S. space-based capability assurance and defense.[17] It also identified the Intelligence Community and Department of Defense as responsible for the development of space capabilities and services that provide intelligence and decisive military advantages.[18] Addressing the enduring disorganization of its management, coordination, and use of space assets, the U.S. created the U.S. Space Force and reestablished U.S. Space Command to better organize their unity of effort in space and maximize U.S. military space activities.[19] The U.S. Space Force helps to achieve U.S. strategic goals by exerting space power. Building a trained and capable force with robust offensive and defensive space capabilities assists the U.S. to leverage national power to influence and control the international system. In line with the other warfighting domains, the U.S. Space Force doctrine states that many critical objectives in space warfare are decision superiority, deterrence, dissuasion, compellence, and assurance, all of which reside in the cognitive domain.[20] While the U.S. Space Force is prepared to fight and win in the space domain, one of its core beliefs is to outthink,

outwit, and outmaneuver the adversary within the cognitive domain.

The 2017 National Security Strategy suggests that the U.S. clearly understands the extreme risk that a conflict in space poses to achieving space superiority as it states that the U.S. will retaliate against any attack on their space interests with a deliberate response *in the domain of their choosing*.[21] Non-kinetic cyber fires in other domains can have just as big of an impact on adversarial space operations as kinetic fires without risking the use of the space domain due to space debris. Recognizing the danger to the space domain posed by creating space debris, the Space Force understands that success in the cognitive domain against adversaries is essential to achieving space superiority. Their mindset emphasizes how the benefits of a contested space domain outweigh an unusual space domain. Understanding the all-or-nothing dilemma underscores the imperative to ensure the space domain remains usable to achieve space superiority.

The Adversary's Ability to Disrupt U.S. Space Superiority

In response to U.S. threat perceptions, Russia and China reorganized their services in 2015 and updated their military doctrines to emphasize space operations. Russia formed the Aerospace Defense Forces as a merger of portions of its Air Force and Outer Space Force to "monitor, identify, and prevent potential threats to its space security."[22] China formed the Strategic Support Forces, which is a combination of electronic warfare (EW), space, and cyberspace capabilities.[23] The changes highlight the renewed importance of warfighting in the space domain to remain competitive with the U.S. and the intent to counter U.S. and allied military effectiveness.

After the reorganization of its military services, Russia updated its counter space doctrine with information dominance as a key focus of its space-based capabilities. Russian military strategists identify space-based military capabilities as part of information dominance. They suggest that controlling the adversary's understanding of the operational environment and impacting the decision-making process through information dominance is crucial in conflict.[24] Russia is cognizant of the U.S. reliance on space-based information systems and technologies, and of particular concern is U.S. long-range precision strike capability tied to space-based systems.[25] If Russia can disrupt or degrade the ability of the U.S. to maintain situational understanding during times of conflict, then they can exploit opportunities to achieve a military advantage.

Similarly, Chinese doctrine places importance on space-based "informative" warfighting systems to have real-time battlefield awareness.[26] China assesses that counter space operations are a viable response to deter and counter regional conflicts, such as a potential U.S. intervention in Taiwan.[27] China also identifies U.S. intelligence, surveillance, and reconnaissance (ISR), navigation, and communications satellites as high payoff targets whose loss to the U.S. will significantly contribute to the success of China's course of action.[28] While it is unlikely that China will overtly target U.S. satellites with kinetic strikes unless as part of a declared conflict, they could disrupt or degrade U.S. military satellite capabilities through nonattributable means such as directed-energy weapons or cyberattacks. China achieves information dominance by hindering the ability of the U.S. to maintain situational awareness of military operations. With the reorganization of Russia and China's military service, updated counter space doctrine, and identification of U.S. satellites as high payoff targets in the space domain, U.S. space superiority will be challenged.

The development of dual-use space technology is another concern. Dual-use entails adversaries using commercial satellites for primarily benign purposes but also recognizes that the satellite capability can serve nefarious functions. For example, China developed a satellite robotic arm to perform maintenance functions allowing one satellite to latch on and conduct repairs on another satellite while in orbit.[29] The robotic technology has dual-use concerns because it is possible to repair satellites just as much as it is possible to intentionally damage an adversary's satellite electronic components, disabling the satellite. Even more alarming, in July 2020, Russia launched an object from Cosmos 2543, a Russian satellite already in orbit, under the guise of conducting an inspection on another satellite.[30] Based upon the speed of travel, U.S. Space Command assessed that the object was an anti-satellite test occurring in orbit.[31] According to General Raymond, Commander of U.S. Space Command and U.S. Space Force Chief of Space Operations, "The Russian satellite system used to conduct this on-orbit weapons test is the same satellite system that we raised concerns about earlier this year when Russia maneuvered near a U.S. government satellite."[32]

Before more recent endeavors in on-orbit space weapons, Russia focused on the development of terrestrial-based weapons, such as directed-energy weapons and EW capabilities that can disrupt space-based systems. As a result of limited resources due to international sanctions, they likely shifted to developing terrestrial-based weapons as a cost-effective way to remain competitive and to exploit U.S. reliance on space-based systems.[33] Russia is developing directed-energy weapons such as lasers that can blind a satellite's imaging sensor either temporarily or permanently.[34] Russia also favors the use of EW and demonstrated these capabilities during the conflict in eastern Ukraine in 2014.[35] Ukrainian forces experienced jamming of their artillery battery radars, navigation systems, and smartphones.[36] By jamming Ukrainian artillery radar systems, Russia was able to fire on Ukrainian positions while protecting Russian forces from Ukrainian counterfire. Additionally, jamming navigation systems and smartphones degraded Ukraine's ability to communicate and report location data. The effects from terrestrial-based systems demonstrate the successful interference of space-based systems that impacted tactical operations.

Compared to Russia, China expanded its satellite infrastructure and added the BeiDou Global Satellite Navigation System as part of its One Belt One Road Strategy. Even with the expansion, China remains second in the world to the U.S. in the number of operational satellites and adds thirty satellites to China's existing satellite infrastructure of more than 120 ISR and remote sensing satellites.[37] The BeiDou constellation is commercial based with oversight by the People's Liberation Army and offers civilian communications services to other countries. From a military perspective, analysts conclude that the constellation advances China's capabilities in precision-strike targeting and real-time situational awareness for command and control.[38] Alternatively, the emphasis on providing civilian communications services may support China's simple pursuit of economic ventures to further their global influence. While the latter seems reasonable, the threat exists on both fronts because the BeiDou constellation removes the reliance on U.S. GPS and Russian GLONASS. The reduced reliance allows China the opportunity to jam or spoof the rival systems while continuing their military operations. The BeiDou constellation also allows China the strategic opportunity to connect more countries to its view of the international world by dominating space-based infrastructure.[39] China believes that whoever controls space-based infrastructure will also dominate geopolitics.[40] Their reduced reliance and increased influence threaten both the U.S. led international order and the U.S. ability to achieve space superiority.

The reduced costs of space technologies have allowed for much greater access, which means one cannot attribute U.S. space superiority challenges solely to nation-states. The potential threat of non-state actors, such as terrorists or criminals, targeting U.S. space capabilities is a possibility because the actors do not have direct consequences if they act compared to nation-states that have investments in space technology.[41] Nonstate actors could conduct a kinetic attack on terrestrial space-based infrastructure, such as key satellite communications nodes or conduct a more symbolic attack against a U.S. launch site, such as at Cape Canaveral Air Force Station.

Nonstate actors could gain access to the same commercial EW technology as nation-states to disrupt U.S. space-based military capabilities. Additionally, criminals or "space pirates" with a motive to steal information to make a profit could conduct cyberattacks against military or commercial space technologies such as SpaceX. With the U.S. Space Force working in conjunction with industry, military space-based operations will likely be vulnerable to criminal activity. Overall, the changing Russian approach, China's ventures to increase influence, and the reduced cost to access space that empowers non-state actors, all create challenges to achieving U.S. space superiority.

Conclusion

With Joint Force reliance on space-based capabilities for warfighting, an increasingly contested space domain, and outdated guidance based on the Outer Space Treaty regarding weapons in space, the U.S. will continue to face future challenges achieving space superiority especially in the new era of Great Power Competition. Freedom of action in the space domain is critical to the success of joint military operations in the land, air, maritime, and cyberspace domains. With the creation of the U.S. Space Force in 2019 signaling an urgency in addressing space-based threats, the U.S. needs to further address additional ways to achieve space superiority when its counts. The U.S. must lead the effort in the United Nations to establish a new international agreement that builds upon the Outer Space Treaty and further defines what constitutes acceptable conduct in the space domain.

Space, as a contested environment, requires detailed planning for redundancies, such as ground and airborne assets and quick-launching small rockets with replacement payloads for military communications, ISR, and navigation satellites to remain operable. Although expensive, redundancies would deter adversaries from viewing U.S. satellites and other space-based systems as attractive high payoff targets. The U.S. must also invest in non-kinetic cyber fires to disrupt an adversary's use of space under certain conditions and to protect U.S. space-based capabilities.

Finally, space will be a contested domain for the foreseeable future, and the U.S. must prepare to fight with disrupted or degraded space capabilities. Leveraging industry and U.S. allies with satellites, such as Japan and India, will be important in creating a coalition of space partners that can achieve and maintain multinational space superiority if a country experiences a disruption of space-based capability during conflict. While China creates customer dependency for its BeiDou satellite constellation, the U.S. needs to build its team of trusted partners to apply international pressure on adversaries to follow informal space codes of conduct until an updated Outer Space Treaty is ratified. Overall, space, as the newest warfighting domain and in the age of a second

space race, is critical to U.S. military operations across all other domains and requires thoughtful changes to international policy and U.S. capabilities to achieve U.S. space superiority when it counts.

Notes

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