The Critical Role Space Plays in Enabling C2 (The Ultimate High Ground)

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United States Army National Guard Soldiers and Airmen move swiftly through the Cyber City area of operation as Blue Team defenders during the Cyber Shield 2016 exercise at Camp Atterbury, IN, April 20, 2016. (Photo by SGT Stephanie A. Hargett, USA)

Introduction

For more than 15 years, the American joint force has been involved in perpetual conflict. During this period, near-peer adversaries have been watching, learning about, and aggressively closing the gap on United States' (US') asymmetric technological advantages (e.g., precision; stealth; or unmanned; cyber; and intelligence, surveillance and reconnaissance).[1] Further, US dominance across all phases of warfighting remains heavily reliant on the ability to maintain situational awareness (SA) for the joint force commander; execute a decision cycle much faster than adversaries; and, ultimately, C2 the joint force (one of seven joint functions essential to accomplishing any mission).[2]

Processing all associated data and distilling it into actionable events requires maintaining interconnected systems to enable these battlefield networks, sensors, and weapons platforms to power and preserve the US' asymmetric advantage. The US military is a force that projects power globally and, when the US fights, it is, historically, an "away game". This requires the ability to reach "over-the-horizon" and span across the tyranny of distance for resourcing, sustainment, and operational connectivity.[3] Therefore, the recent trend of the US military's over reliance on satellite-based battlefield systems has made its digitally integrated C2 mission vulnerable. Since access to space is never a guarantee, preparing for future near-peer conflicts requires the joint force to develop resilient, mitigating techniques now to maintain a critical advantage. It also demands integrating the functionality of untethered operations early into the Department of Defense's (DOD's) next technological evolution—the third offset.

Threats to Space-Based Capabilities

There are several treaties and agreements intended to limit weaponizing space. The Outer Space Treaty of 1967 was the genesis of this effort, which placed legal limits on the ability of nations to base weapons on the moon and other celestial bodies.[4] Several arms treaties added to this legal framework, including the Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I) and the Conventional Forces in Europe (CFE) Treaty, by introducing legal recourse for the use of weapons in space.[5]

Using diplomacy and legal mechanisms is important to reduce the risk of threats to US space assets; but, at the end of the day, they are only paper-thin if not enforced and respected. Attacking US space capabilities could be a "decisive equalizer" causing an immediate and disruptive impact to many US military units by hindering their ability to mobilize and respond effectively. Furthermore, near-peer adversaries of the US have the ability to "deny, disrupt and degrade America's hard-to-defend satellites" if they so choose.[6] One space leader, LTG David Buck, commander of the 14th Air Force, argues that "there isn't a single aspect of our space architecture that isn't at risk."[7] This risk is best described in five broad categories: missile attack, lasers that can blind or destroy reconnaissance satellites, military satellites with offensive capability (e.g., spacebots), jammers, and cyber-attack.[8]

Russia and China have already demonstrated antisatellite (ASAT) missile technology. Russia developed a system at the height of the Cold War and declared it operational in 1973. In the early 1990s they tested the Naryad system, which is believed to have the capability of intercepting satellites in geosynchronous Earth orbit (GEO).[9] China, for their part, received a great deal of international attention when they hit one of their own low-earth orbit weather satellites in January 2007. By 2013, China also tested a missile that could reach Global Positioning System (GPS) satellites and, potentially, threaten US early warning sensors in GEO.[10]

Lasers, or directed energy weapons, are starting to show much of the promise prematurely assumed during the 1980s, where the US, Russia, China, and Israel are currently investing in and advancing the technology. While much of this investment is focused on creating effective air defense platforms, the Russians are known to have the capability to adapt this technology to blind optics on reconnaissance satellites.[11]

A “spacebot” is any satellite or spacecraft which can damage, bump, or nudge another satellite, and any nation with satellite capability could threaten US space assets by using them. In fact, “a spacecraft could simply approach a satellite and spray paint over its optics, manually snap off its communications antennas or destabilize its orbit.”[12] Russia, in particular, is believed to be developing these types of sophisticated military satellites. They launched four satellites in 2013 and 2014, which have maneuvered in suspicious manners by approaching or colliding with other Russian spacecraft.[13]

Jammers and cyber-attacks have the distinction of being threats within the reach of adversaries far below near-peer to the US. These technologies can be obtained off the shelf and can have an outsized impact on US space assets. In the case of jamming, all satellites communicate wirelessly to a ground station and that link is vulnerable. Similarly, cyberattacks do not require a large investment in technology or resources. US satellites could be degraded remotely through cyber means in a variety ways, including receiving an ordered shutdown, being feed false coordinates, or being moved out of a useful orbit, just to name a few. Evidence exists that efforts like these are ongoing. For example, there are indications that China caused the National Oceanographic and Atmospheric Administration to shut down for two days after hacking into its satellite network.[14]

Recommended Near-Term Mitigation Techniques

Given the state of the world and the potential for the next conflict to be against a near-peer adversary, the US military must take advantage of all available time to mitigate gaps in training and capability. All too often, DOD officials assume away threats that impact US technological superiority, but significant near-peer threats already exist. The following is a discussion of some changes that can improve America’s resiliency and effectiveness in the operating environment. These are improvements the US military can make now and in the near-future.

Policy Updates

Policies provide the baseline and authorities for military personnel duties, actions, and responsibilities. As US leader try to protect its interests in the global environment, the military must account for state and nonstate actors who can affect space access. Therefore, a revision to current, or consideration of a completely new policy, needs to force the military to develop tactics, techniques, and procedures (TTP) that can rapidly adapt to the loss of space access. This policy will have to be prescriptive to affect the required changes necessary to transform the way the military fights and, specifically, how it conducts C2. The military must take a proactive role, once the policy and guidance is updated, to self-assess and create TTP to continue operations when the ultimate high ground is denied or degraded.

Plan for Resilient Systems

The near-peer threat is real. The US develops advanced asymmetric systems that provide remarkable capabilities to the joint warfighter, but routinely fails to safeguard those “over-the-horizon” links required to interoperate across the enterprise. Historically, the US military leaders thought about this issue with legacy equipment (e.g., Defense Advanced GPS Receiver (DAGR)), which had protected modes imbedded in it, but with the new high-tech, commercially-available systems, they failed to integrate the same level of protection and redundancy. There are companies that can add simple hardware or software solutions to military equipment and increase responsiveness when operating in a jammed environment. “Space systems need enhanced resiliency to ensure performance of critical functions and overall mission operations during a cyberattack.”[15] Considering long-term equipment use, while partnering with the commercial sector early to identify and mitigate potential threats, will help ensure mission success when space becomes contested, congested, or degraded.

Regional Balloons

There was an effort in the DOD to mitigate terrain impacting access to space with balloons. The Army assisted in developing high altitude airships by testing their Long Endurance Multi-intelligence Vehicle (LEMV). “The football field-sized hybrid airship's design requirements include the capability to operate at 20,000 feet above mean sea level, a 2,000-mile radius of action, and a 21-day on-station availability; provide up to 16 kilowatts of electrical power per payload; be runway independent; and carry several different sensors at the same time.”[16] The LEMV was cancelled in 2013, but it proved the concept of launching a balloon to augment C2 capabilities when space access is degraded for communications and surveillance missions. In other words, the user may not be able to employ a primary communications link by bouncing off a space-based satellite, but the LEMV-like vehicle would still provide an “over-the-horizon” relay, allowing the joint warfighter to maintain battlefield SA and enable commanders to conduct C2.

Prioritization

The military critically depends on space to effectively impose its will upon the enemies of the US. While the military may not counter all the threats to space access, it can counter some, but that contested environment will leave the US with considerably fewer capabilities to support other joint warfighting functions during combat operations. This would not inhibit operations, but would require the US to prioritize what assets and resources are required to support competing mission demands. “While there are numerous satellites capable of supporting a requirement, higher-priority requirements will be satisfied first.”[17] The military has priority lists for normal operations, but these need to expand to what services are required for C2. This deliberate action ensures services and capabilities are available to continue the mission. If done properly, the most relevant units, commands, and operations centers will maintain access to space and have the greatest impact in the fight. In a near-peer engagement, there is no guarantee the US military will regain access promptly, but if it has effective prioritization established—flexible, tailorable, and appropriately focused—it can maximize the access available to take the fight to the enemy.

A U.S. Marine assigned to Headquarters Company, Regimental Combat Team (RCT) 7, sets up Secure Internet Protocol and Non-secure Internet Protocol Router Access Point (SNAP) satellite communications system on Camp Leatherneck, Helmand province, Afghanistan, April 24, 2013. (U.S. Marine Corps photo by Cpl. Alejandro Pena)

However, each Service views prioritization differently. For the Air Force, the focus is on maintaining the C2 of its air assets. This is no easy feat, as the distance and number of forces that require direction from geographically separated operations centers relies heavily on space-based, tethered connectivity. For the Army and Marine Corps, force integration to achieve combined arms will be challenging, as space-based positioning, navigation, and timing (PNT) and communications requirements drive synchronization and C2 to support “on-the-move” operations. For the Navy, the maritime fight is the most forgiving of the environments as Navy vessels have mitigation processes already in-place. Carrier strike groups and vessels underway are able to disperse their forces more effectively to get outside the footprint of jammed signals. Therefore, prioritization (based on key essential tasks) should go to the units and commands involved in the most critical phases of the operation. The prioritization can shift as the lines of effort shift, but the goal should always remain the same—uninterrupted access to space for the most relevant elements in the fight.

Tactical Training and Exercises

Training and exercises may be the most cost effective ways to combat degraded space access. Each unit, in every Service, participates in readiness exercises where they are assessed against accomplishing their core mission-essential tasks. However, most exercise scenarios, from the Army's National Training Center (NTC), to the Air Force's Red Flags, and even the Joint Chiefs of Staff-sponsored events (e.g., Pacific Sentry or Austere Challenge), focus on units prosecuting warfare in permissive environments. Some of these events, such as NTC and Red Flag, have started to incorporate degraded environments into their scenarios; but thus far, the training audience requests to turn-off the simulated interference, so they can continue to conduct their operations unconstrained. Even though commanders wants to look their best at major exercises, training objectives must be adjusted to prove US forces' readiness against nontraditional, disruptive near-peer and nonstate threats.

Even at the tactical level, Services rarely train their units to identify, mitigate, and restore access to space stemming from a contested environment. This training deficiency, ultimately, leaves joint forces a false sense of security and ill-prepared to "fight tonight" against very capable adversaries. The US Service leaders must take a hard look and determine what core, essential tasks are required to accomplish the mission when space access is limited. Then they must develop TTP to mitigate those effects, train American forces, and incorporate realistic scenarios into large-scale exercises to mature competent, space savvy troops who will continue the mission. The Army identified this need and, recently, assigned Space Professions to NTC "in order to facilitate and integrate space related considerations and injects into training exercises across the spectrum of operations"[18]. Therefore, understanding the significance of space access and recognizing its vulnerability on C2 must be every commander's responsibility. It enables the Services to train the way we need to fight.

Considerations under the Third Offset

The idea of an asymmetric technological advantage to give the joint force an edge in warfare is not new. The concept dates back to the President Dwight D. Eisenhower administration in the 1950s. Soon after World War II, it became clear that numerical superiority gave the Soviet Union a competitive advantage over the US and its North Atlantic Treaty Organization allies. With military reductions and a decreasing budget, Eisenhower looked for a way to "offset" this Soviet conventional threat in Europe. The decision was to capitalize on nuclear weapons platforms since the US had an initial advantage. It became the basis for the credible deterrence policy and first offset strategy. The Soviets realized their weaknesses in capabilities and, by the 1970s, were able to erode America's edge. This neutralized the credible deterrence model and drove the US to identify and develop a second offset strategy.[19]

In 1973, the leaders of what later became Defense Advanced Research Projects Agency (DARPA) recommended a conventional weapons approach to counter the anticipated attacks from the Warsaw Pact. The idea was simple—near-zero misses or precision—integrated around a system of systems. By developing a family of conventional munitions with systematic accuracy, it was possible to achieve similar destructive effects to tactical nuclear weapons.[20] A feat validated against Soviet equipment during the first Gulf War in 1991. Unfortunately, after 16 years of persistent conflict since the September 11, 2001 terror attacks, and adversaries studying US warfighting capabilities, significant erosion to the asymmetric, technological advantage is showing once again. Therefore, the DOD is seeking a third offset strategy to maintain its competitive advantage and preserve its credible conventional deterrence.[21]

Unfortunately, most predict that cornering the market of a technological advantage, such as stealth or precision, will no longer forge the staying power (measured in decades) as the previous two offsets once assured. Rapid advances in technology, with the ability to globally interconnect and leverage powerful, collaborative tools against problem sets, can significantly shorten the expected service life of capabilities. The DOD must consider alternate deployment methods and technological concepts to maintain its advantage.[22] Some Services are already thinking along these lines. The Army's high altitude airship program, LEMV, provided methods to maintain C2 by outfitting the balloon's payload with the capabilities required to operate degraded. This "modular, open systems architecture" approach is also the basis for the Air Force plans to develop their next-generation, long-range strike bomber. That platform, now dubbed the B-21, is expected to rapidly upgrade its programmable software and electronic suites to tailor each mission against the expected threat environment. Further, with increased Anti Access Area Denial (A2/AD) concerns and ASAT capabilities of near-peer adversaries, the B-21 is envisioned to team humans with machines by incorporating autonomous platforms capable of being "untethered" from controllers in the US.[23] The Navy plans to develop concepts that capitalize on human-machine teaming as well. Their experimental unmanned system, currently labeled the Stingray, is being considered as a wingman for F-35 pilots and a platform to "fuse" sensor data to increase battlespace SA for the commander.[24]

However, knowing how near-peer adversaries can hold the US' over reliance on space-based assets at risk, the DOD must use the third offset as an opportunity to explore other methods of providing critical C2 capabilities to the joint warfighter across isolating distances. Some options already show promise (e.g., human-machine teaming or high-altitude C2 relay platforms) but others require further funding and research. Alternative concepts should include PNT and communication nodes independent of space assets (such as sophisticated inertia-based systems with imbedded atomic clocks for timing and navigation or an integrated aerial mesh of unmanned autonomous systems for extending the communications network over-the-horizon for an area of operation).[25]

The third offset is not just about technology; it is about innovative concepts, as well. Some low-tech ideas integrated with advanced tool sets can be just as powerful. For instance, develop warfighting concepts less dependent on centralized mission control or systems designed for continuous operation despite losing their "always-on" connection to the larger cloud environment (e.g., apps working on a smart phone when wireless or cell service becomes unavailable).[26] Even simple policy adjustments facilitating a more collaborative approach to battlespace SA can have a significant impact at the operational and tactical levels regarding C2.

Conclusion

There can be little doubt that the US relies on space-based systems. They are often the first eyes on the battlefield, and their importance to C2 and synchronization cannot be overestimated. But these systems are inherently vulnerable. Orbital distance renders most defensive techniques impractical and the complexity of these systems places them at risk.

The US is not without recourse. In this paper, several techniques were identified to mitigate the threat. The primary technique is an update to strategic policy. It is critical. Also, there must be clear guidance on preparation for operations in a degraded space environment. Predetermined and clear prioritization will help alleviate negative effects of degraded space operations by ensuring the remaining capability is effectively allocated.

Also, Training must adapt to reflect the possibility of disruption or loss of space assets. Exercises and readiness events should incorporate training in a degraded space environment. In addition to this, near-term technological solutions should be implemented.

Space-based systems can be made more resilient. Indeed, the US has built redundant modes into equipment like the legacy DAGR; this ethic should be restored. Also, the continually developing and incorporating regional balloons would serve as a backstop technology which can provide a closer, higher power relay to maintain C2.

The final offset holds great promise in addressing space degradation issues, but only if approached correctly. Updated technology must integrate the joint force commander's ability to effectively C2 in the event space capabilities are lost. Development of a robust system of autonomously operating vehicles with secure cross-communications would create a network of enormous resiliency. Such a system could adapt to the disruption of a number of nodes and still provide the commander a picture and C2, even without space assets.

The US' advantage in space is a true combat multiplier, and with proper care, it can be maintained into the future. Several distinct methods have been presented, and their implementation will help ensure the US' success in space throughout the 21st century.

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End Notes

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[1] Deputy Secretary of Defense Robert Work, "The Third US Offset Strategy and Its Implications for Partners and Allies" (speech, Willard Hotel, Washington, DC, January 28, 2015), Defense.gov, http://www.defense.gov/News/ Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies.
[2] JP 3-0, xiv.
[3] Deputy Secretary of Defense Robert Work, "The Third US Offset Strategy and Its Implications for Partners and Allies" (speech, Willard Hotel, Washington, DC, January 28, 2015), Defense.gov, http://www.defense.gov/News/ Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies.
[4] International Legal Agreements Relevant to Space Weapons. Accessed October 15, 2016. http://www.ucsusa.org/nuclear-weapons/space-weapons/international-legal-agreements#.WAJ0cfnR_IU.

[5] Ibid.
[6] Broder, Jonathan. "PEARL HARBOR IN OUTER SPACE Forget ISIS—a Chinese or Russian Attack on US Satellites Could Win a War before Anyone Fires a Shot." *Newsweek Global*, May 13, 2016, 12-16.
[7] Ibid.
[8] Ibid, 14-15.
[9] Strauch, Adam. "Still All Quiet on the Orbital Front? The Slow Proliferation of Anti-Satellite Weapons. "*Obrana a Strategie (Defence and Strategy) DaS* 14, no. 2 (2014): 61-72. doi:10.3849/1802-7199.14.2014.02.061-072.
[10] Broder, PEARL HARBOR IN OUTER SPACE, 15-16.
[11] Ibid.
[12] Billings, Lee. "Are We on the Cusp of War—in Space?" *Scientific American*, October 2015.
[13] Broder, PEARL HARBOR IN OUTER SPACE, 16.
[14] Ibid
[15] Sandria S. Alexander. "Achieving Mission Resilience for Space Systems" *Crosslink Magazine*, 01 April, 2012, Accessed 06 November 2016. http://www.aerospace.org/crosslinkmag/spring2012/achieving-mission-resilience-for-space-systems/.
[16] "Long Endurance Multi-Intelligence Vehicle (LEMV) Agreement Signed," June 17, 2010, accessed October 18, 2016, https://www.army.mil/article/41024/long-endurance-multi-intelligence-vehicle-lemv-agreement-signed.
[17] *Space Operations*, JP 3-14, Joint Chiefs of Staff, Washington, DC, 29 May 2013.
[18] Garcia, David M., "Fighting in a Contested Space Environment: Training Marines for Operations with Degraded or Denied Space-Enabled Capabilities." Naval Post Graduate School, June 2015, 53.
[19] Deputy Secretary of Defense Robert Work, "The Third US Offset Strategy and Its Implications for Partners and Allies" (speech, Willard Hotel, Washington, DC, January 28, 2015), Defense.gov, http://www.defense.gov/News/ Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies.
[20] Ibid
[21] Ibid
[22] Michael Green, Kathleen Hicks, Mark Cancian et al., "Asia-Pacific Rebalance 2025: Capabilities, Presence, and Partnerships," *Center for Strategic and International Studies* (January 2016), accessed October 12, 2016, https://
www.csis.org/analysis/asia-pacific-rebalance-2025, 117.
[23] Mackenzie Eaglen, "The New B-21 Bomber: Under Fire Before It Can Even Take Flight," *Real Clear Defense*, September 18, 2016, accessed September 20, 2016,
http://www.realcleardefense.com/articles/2016/09/18/
the_new_b-21_bomber_under_fire_before_it_can_even_take_flight_110080.html.
[24] Richard Whittle, "Navy Refueling Drone May Tie into F-35s," *Breaking Defense*, March 22, 2016, accessed September 20, 2016, http://breakingdefense.com/2016/03/navy-refueling-drone-may-tie-into-f-35s-f-22s.
[25] Michael Green, Kathleen Hicks, Mark Cancian et al., "Asia-Pacific Rebalance 2025: Capabilities, Presence, and Partnerships," *Center for Strategic and International Studies* (January 2016), accessed October 12, 2016, https://www.csis.org/analysis/asia-pacific-rebalance-2025, 142-144.
[26] Ibid

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