Maintaining Space Superiority

Major Albert C. Harris III, USAF

As professionals working within the air and space community, we must understand the strategic environment in order to employ air and space power effectively. This includes knowing US national objectives and the ways that both national and international laws shape and constrain decision making. A commander directing in-theater air operations who observes an approaching aircraft can make a decision quickly, based on the nature of that aircraft; the engagement itself (hostile/nonhostile); and the extended set of international rules, customs, and laws that guide the overall situation. For space professionals, the strategic environment presents different, unique challenges. Complicating the issue further, those professionals must make decisions in an environment where comprehensive rule sets for operations and cooperation on the international level have not fully matured. Regardless, a commander of space forces who observes an approaching object that may present a threat to his or her satellites must still provide direction that responds to that threat.

This article discusses a dilemma faced by space professionals as they conduct complex, day-to-day space activities under a paradigm of slowly maturing international rules. It analyzes recommendations proffered on the world stage, such as implementing an international code of conduct to guide everyday space activities. Additionally, it proposes an alternative space situational awareness (SSA) approach as a means of better enabling decision making within the limitations of current international rules for these activities. This new approach, the Space Situational Awareness Trinity Theory, may offer a more appropriate means of maintaining space superiority. To frame the discussion, the article first turns to the Air Force's core function of space superiority as it reviews the background of the problem.

Background

Space superiority is "the degree of dominance in space of one force over any others that permits the conduct of operations at a given time and place without prohibitive interference from space-based threats."[1] The Air Force achieves space superiority by conducting operations that support the war fighter (space force enhancement); by conducting combat operations from, through, and in space (space force application); by conducting operations that ensure freedom in space (space control); and by conducting operations that deploy space systems (space support). According to joint doctrine for space operations, these four space mission areas "contribute to joint operations" and thus are the means by which the United States attains space superiority.[2] Since the early years of the space era, threats and issues have arisen to challenge US operations in these areas. Indeed, as declared in the *National Security Space Strategy*, these new issues come as the domain becomes increasingly competitive, congested, and contested.[3]

Space is competitive because more nations are realizing the benefits of operating there. As noted by the Organisation for Economic Co-operation and Development, "Space-faring countries have moved from being a small exclusive club relying on strong defense and aerospace industries, to a larger group of advanced and smaller developing countries with very diverse capabilities."[4] However, this rise in space activities comes with a price. In light of the number of objects in space, the effort to maintain SSA of all these systems is becoming much more complicated.

This complication occurs, in part, because of congestion in the domain. Within the space mission area of space control, SSA operations that identify and track space objects play a signifi-

cant role in mitigating the risks of such a congested environment. The US-led Space Surveillance Network supplies a necessary first line of awareness of hostile and nonhostile space threats by tracking and identifying space objects. Unfortunately, the sheer volume of objects placed in orbit—whether operational or nonoperational satellites, rocket bodies, and attendant space debris—raises the probability of catastrophic incidents. Such effects are stressing and outrunning some of the surveillance, tracking, and analysis capabilities of the network. More troubling, those tracking capabilities identify and track only a fraction of the on-orbit objects that could collide with others.

To some extent, this congestion is a consequence of more nations operating in space. Activities to secure the high ground for national, international, and various commercial objectives make the domain more contested. The number of sophisticated spacefaring nations is growing. It has also become apparent that not all countries with ambitions in the High Frontier seek to use the medium for completely peaceful purposes. Some of them are identifying ways to counter US space capabilities to further their own national objectives. Employing such capabilities to prevent treaty compliance or to deny, degrade, or destroy space competencies of innocent parties could become destabilizing. The *National Security Space Strategy* observes that "as more nations and non-state actors develop counterspace capabilities over the next decade, threats to U.S. space systems and challenges to the stability and security of the space environment will increase."[5]

In this evolving environment, it is imperative that we expand, reinforce, and better frame international rule sets or norms for future space activities. Whether a code of conduct or more sophisticated international law, such an evolution could better guide peaceful competition in space, provide a framework for operating within a congested environment, and outline potential rules of engagement when nations must protect their national security interests. As the world becomes more reliant upon space technology and as the presence of humans in space grows, the lack of comprehensive international space law will continue to complicate American projection of space power on behalf of war fighters and peacekeepers, as well as for national, diplomatic, informational, and economic advantages.

Although international rule sets for space heretofore have been limited in scope, they should not be completely discounted. The 1967 Outer Space Treaty was a stunning, groundbreaking achievement developed and signed in the midst of Cold War tensions. In its own way, it is de-escalating the perceived need to prepare for conflict in the space domain. Other treaties and accommodations have followed, and credible organizations such as the United Nations Committee on the Peaceful Uses of Outer Space represent useful international tools in discussions about how to conduct and regulate space activities. As such, these treaties and organizations supply the foundation for the substantial guiding principles used to conduct space operations; still, they fail to go a necessary step further and fully address how nations should act when conducting daily space operations. At times, this makes it difficult to know who is operating with good intentions, who is not, and who has admirable intentions but remains ignorant of the risks to which they subject other countries. Consequently, space operators must determine if an action by another party—even by a nonmilitary entity—constitutes a threat. This highlights the fact that slowly maturing international rule sets for space activities challenge the Air Force's abilities and capacities to maintain space superiority, especially in a competitive, congested, and contested domain.

Scope and Severity

Many events in space history shed light on the scope and severity of such rules. In 2007 China launched an antisatellite (ASAT) missile from the Xichang launch facility to destroy its Fengyun 1C meteorological satellite, generating 100,000 pieces of space debris that remain on orbit and threaten other space systems. Dr. T. S. Kelso reports that "the test produced at least 2,087 pieces

of debris large enough to be routinely tracked by the US Space Surveillance Network."[6] In February 2009, an inoperable Russian military rocket body collided with an American communications satellite owned by the Iridium Corporation. That event sparked international concern as issues of on-orbit safety became a hot topic for international debate. Today, efforts are expanding to identify and track the associated debris from these two collisions because they place at risk the safety of other satellites, including spacecraft intended for human spaceflight. Certainly, this is a daunting task and would be worse if these types of events occurred more frequently.

Recent incidents continue to highlight the severity of the problem. In 2011 Russia launched an interplanetary probe to retrieve soil samples from Mars. Soon after launch, the probe's propulsion system failed, leaving the vehicle uncontrollable in its low Earth orbit and slowly losing altitude. Since the failed probe contained an unspent nuclear power source, its eventual reentry into the earth's atmosphere posed a threat to any country along its orbital path. The United States and other members of the international community assisted Russia in maintaining awareness of the probe's location until it reentered off the coast of Chile.[7] Nevertheless, what would happen if a different nation experienced Russia's problem? Would the international community come together to support a rogue nation like North Korea? If not, should the community passively allow such a country to operate space systems?

These questions are important because they hint at how more fully developed international rule sets or norms for space activities could address the moral implications of conducting space operations. Arguably, nations that cannot operate safely in space or gain operational support from other nations should not conduct space operations. For instance, in early 2012, North Korea attempted to launch a satellite into space, but the launch failed and the "first stage fell into the sea 102.5 miles west of Seoul, South Korea."[8] In December of the same year, North Korea succeeded in launching a satellite into space despite the fact that before the launch, world powers condemned its efforts.[9] North Korea's provocative launches show that it cannot be trusted to conduct space operations with the space community's best interests in mind. What about the actions of near-peer space operators? China's ASAT test shows that it bears watching as well.

Furthermore, what about so-called responsible space operators? Some compulsive provocateurs suggest that the United States did not act responsibly during Joint Task Force Burnt Frost in 2008, a successful intercept of a US satellite reentering with hazardous hydrazine propellant on board. Of course, the opponents who made these claims ignored the crucial differences between the Chinese and US intercepts. Burnt Frost involved the intercept of a target satellite left in an unsustainable low Earth orbit, after which nearly all of the resulting debris burned up in the atmosphere, and the final larger pieces were consumed shortly thereafter. In addition the United States demonstrated transparency in its actions by first briefing the global spacefaring community about its intercept plans and then sharing its projections of minimal threat.

Synthesizing the issues above sheds light on a fundamental dilemma during operations in the space domain. How should an entity handle its space systems? Whether a military unit, commercial organization, or national agency, how should it operate ethically in space? What best practices should we apply, and should the spacefaring community agree to and somehow enforce more comprehensive rules? Current international rule sets for space fail to fully address how nations should act when conducting daily space operations. Although treaties and customary international law do provide guidance and principles, further refinements should be developed and shared among all space operators. The rudimentary regulations that we have followed since the Cold War are not proving themselves sufficiently flexible for the challenges of the twenty-first century.

Given this conclusion, our military commanders confront substantial uncertainties when they direct space operations. Considering the need for the capabilities delivered from space platforms, those individuals must develop a threat assessment for every space launch, satellite maneuver, reentry, and deorbit regardless of whether they are operated by domestic, foreign, com-

mercial, or military entities. Until international rule sets mature more fully, commanders will continue to struggle with the boundaries of their decisions as they conduct operations to maintain space superiority.

Efforts to Solve the Problem

The scope and severity of slowly developing international rules for space are causing the world's space powers and commercial organizations to join in an effort to identify potential resolutions. One may ask, though, why the current system fails to guide complex, everyday space operations. What motivates these players to collaborate on solving the problem? As James Rendleman points out, "Treaties, conventions, and agreements already in force regularize space activities despite their minimalist nature."[10] First, the current system of space law and customs is broad in scope and generally legally binding only to those who agree to it. Because of the ponderous aspects of international space law, the world is still experimenting with what truly constitutes morality regarding decisions about space operations.

Current trends in this "experiment" point to a growing desire for a space code of conduct in lieu of stronger international space law. Wolfgang Rathgeber, Nina-Louisa Remuss, and Kai-Uwe Schrogl observe that "a code of conduct is a non-legally binding instrument, where adhering states voluntarily commit themselves to rules of the road. It can be seen as an ultimate goal in itself, or as a stepping stone toward a legally binding treaty."[11] Essentially, such a code is less binding at first, but as more nations begin to adhere and agree to its tenets, it could eventually develop as a form of customary international law.

Examples of such a code of conduct have already been suggested in the international arena. In 2008 the European Union (EU) presented one that, it argued, would help guide space activities. After some criticism, the EU code was revised and reissued in 2010. Key elements include its encouraging of signatories to commit to using space for peaceful purposes. Voluntary subscription would also require adherence to some limited space laws, agreements, and treaties that currently exist. In terms of its impact on space superiority, the code acknowledges nations' rights to collective self-defense and strongly advocates for open communication about issues that arise during space operations.

Unfortunately, the code in its current form goes too far, potentially limiting the Air Force's space superiority operations. For instance, the proposed version calls upon nations to refrain from the intentional destruction of objects in space; to provide the larger community with notifications of satellite maneuver and malfunction; and to offer extensive transparency in their space operations and strategy.[12] These proposals may prove difficult to reconcile with valid national security interests retained by major spacefaring powers. The US State Department has acknowledged on numerous occasions that acceptance of any such code is contingent upon whether compliance is voluntary and whether it enhances the security of the United States and its allies.[13]

The EU proposal seeks transparency in space operations but remains somewhat unrealistic. If the limits and transparency measures mentioned above had been established, they might have prevented the much-needed operations during Burnt Frost; moreover, they might require the release of sensitive national security or proprietary information regarding satellite maneuvers and, in some cases, tip the hand of commanders conducting vital national security operations. In a report published in *Strategic Studies Quarterly*, Rajeswari Pillai Rajagopalan maintains that "it is naïve to assume states such as the United States and China will release information about their strategies. This is not a realistic goal in the code, because states seek to use all means available for security, including space."[14]

As a complement to the EU's work on a code of conduct, a 2006 study by the International Academy of Astronautics (IAA) offers a separate framework to establish effective rule sets or

norms that guide activities in space. The study focuses on space-traffic management and the mechanisms that enable such a concept. Benefits include its emphasis on safe access to and freedom in space. It also identifies mechanisms for which communication can occur about pressing space issues. Instead of advocating what nations cannot do in space, the guide establishes frameworks to solve immediate problems that arise during space operations. Examples include mechanisms for safety notifications for launches, imminent collisions, and space-object reentries that could put public safety at risk.[15] For commanders who need to preserve their access to space capabilities, applying the solutions proposed in the study could enhance their decision making by supplying an international mechanism for the timely reporting of nonhostile space threats to nonmilitary entities. However, the changes sought by the study have not been realized, and it does not extensively address how nations should act in space on a daily basis. It acknowledges the shortcomings of current international space law but does not go as far as the European code of conduct in limiting the space activities of spacefaring nations.

Although the IAA and the EU are blazing a trail, the necessity for establishing rule sets and norms for space activities will continue to grow as space becomes more competitive, congested, and contested. Michael Krepon, Theresa Hitchens, and Michael Katz-Hyman write that "there is growing sentiment among space operators to develop and implement several key elements of a code of conduct, including improved data sharing on space situational awareness; debris mitigation measures; and improved space traffic management to avoid unintentional interference or collisions in increasingly crowded orbits."[16] Ultimately, this desire for new rules alone will not help space operators and their commanders solve the problems of conducting space activities. To meet future challenges, commanders and civilian leaders can take various steps to ensure national security by maintaining space superiority.

The Way Forward

The United States must lead the effort to establish a code or a set of more effective international laws that guide space activities. Current efforts by other nations and organizations are admirable but do not effectively address the issues at hand. Additionally, given its technical capacity, vast numbers of space systems, preponderance of forces, and capabilities for maintaining space superiority, the United States is better prepared than other nations to monitor any new code or revision to international space law that addresses space activities or to establish rule sets or norms that would direct those activities.

The Department of Defense (DOD) will play a leading role while the United States presents international rule sets or norms for space activities. Specifically, "the departments of Defense and State have agreed [that] an international code of conduct should govern activities in outer space, and officials announced plans to work with the European Union to develop it."[17] Consistent with this statement, DOD Directive 3100.10, *Space Policy*, among other things, directs the department to "support the development of international norms of responsible behavior that promote the safety, stability, and security of the space domain."[18]

Reflecting this growing wisdom, the strategic environment in space has changed immensely since the Air Force first began operations, and the notion of maintaining an awareness of the space environment is receiving more emphasis. As the US government pursues the establishment of a more sophisticated international framework to guide space activities, the US military should pursue a strategy that enables implementation of that framework. Consequently, as the government's executive agent for space, the Air Force should better anticipate pending compliance with rules that will affect its space operations. To do so, it must employ a new paradigm for space operations—a Space Situational Awareness Trinity Theory.

This theory is neither a call for a new mission area nor a revelation of new tactics, techniques, and procedures for space superiority. It is, however, a different way to frame how they are employed, and it may facilitate new ones in the future. This SSA-focused framework for space superiority includes three segments for which space missions are executed: maintaining awareness of space activities by using ground components, maintaining awareness of ground activities by using space components, and maintaining awareness of space activities by using space components (see figure below). The segments would guide missions that utilize various capabilities to preserve space superiority. To realize the objectives within each segment, the Air Force must be aware of friendly military forces (Blue space activities), enemy military forces (Red space activities), and both commercial and foreign entities (Gray space activities). National security space operations, whether joint, coalition, interagency, or service oriented, would fuse the data received from this awareness, disseminate it, and determine the need for either offensive or defensive operations or information sharing. Regardless of whether more sophisticated international rule sets or norms for space activities are established, the SSA Trinity Theory presents a different approach by allowing the Air Force to concentrate on being aware of what occurs in space as the medium becomes more competitive, congested, and contested.

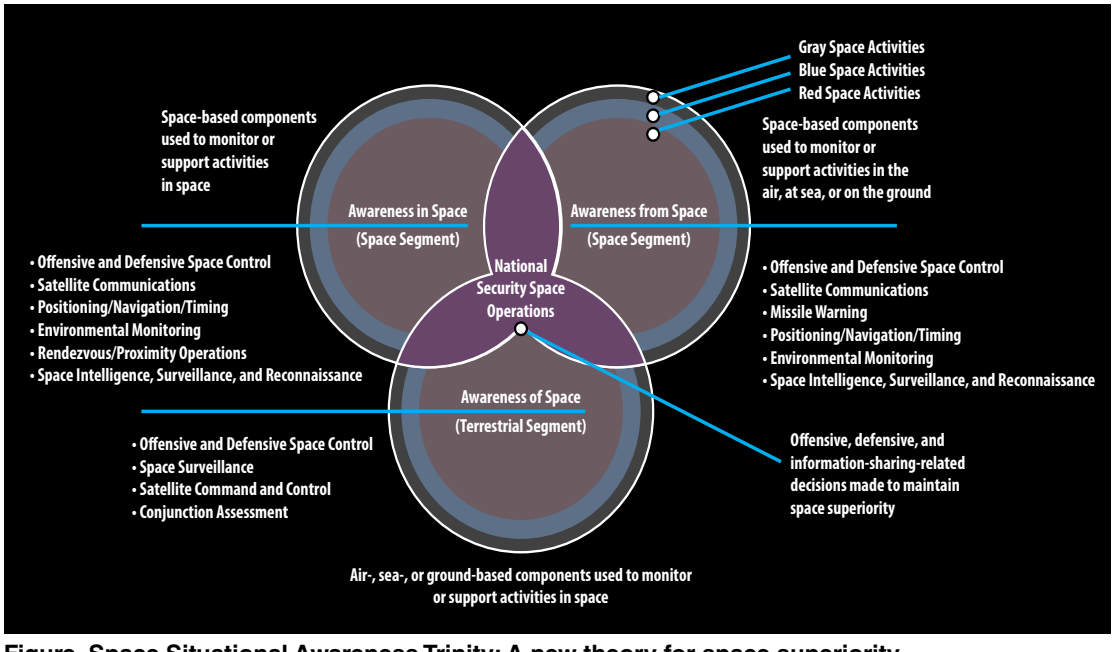

Figure. Space Situational Awareness Trinity: A new theory for space superiority

In the competitive space environment, this theory could provide a framework that compensates for the limitations of international rules and norms that guide space activities. For example, current international law for space does not restrict launches that endanger objects already on orbit. The SSA Trinity Theory's emphasis on maintaining awareness from space would guide missions in a competitive space environment, such as those that employ space assets to detect launches. Concurrently, a focus on maintaining awareness of space in this situation would guide

missions that use ground assets to monitor and track the launch and determine if it threatens an object already on orbit. If a threat is real, commanders can take offensive or defensive steps to mitigate risks to a Blue asset; if not, they could pass information to the appropriate parties.

In the congested space environment, the theory makes available a framework in which air-, sea-, space-, and ground-based components used to monitor or support activities in space enable various capabilities to maintain an awareness of space. For example, conjunction assessment gives the United States an advantage in establishing an international code or norms for space activities, especially regarding space-traffic management. Both the European code and the IAA identify space traffic as a considerable issue for operations in space, and the IAA further acknowledges that the "US's space surveillance capabilities dominate" those of the rest of the world.[19] Having the objective of maintaining an awareness of space, missions conducted under the SSA Trinity Theory would be accompanied by the already-robust US rule sets on the strategic, operational, and tactical levels. Additionally, the theory would guide decisions that support any international effort to conduct space-traffic management.

Given an increasingly contested space environment, we need SSA-focused objectives to facilitate missions that protect the SSA capabilities of the United States or that deny, degrade, or destroy those capabilities of our enemies. If the latter cannot maintain an awareness of space by commanding and controlling their satellites or if they cannot survey the space environment, then their ability to conduct operations in space will become severely limited. Denying, degrading, or destroying an enemy's awareness in space hinders his ability to conduct on-orbit operations; furthermore, denial of his awareness from space will cause his operations in the air, at sea, or on the ground to lose the advantage that space capabilities bring. Thus, maintaining awareness in, from, and of space while denying, degrading, or destroying the same to the enemy is critical to maintaining space superiority.

The SSA Trinity Theory, in conjunction with the US government's effort to establish an international code of conduct for space activities, will ensure that the United States is prepared to sustain space superiority for decades to come. Many events in history show the scope and severity of limited rule sets on the international level. As space becomes more competitive, congested, and contested, that scope and severity will worsen. The United States, the world's most influential voice on space matters, must lead the international effort to establish such rule sets. Moreover, as the Air Force awaits the outcome of this effort, it must remain vigilant and ensure that proper mechanisms like the SSA Trinity Theory are in place to maintain space superiority.

Notes

1.Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 8 November 2010 (as amended through 15 September 2013), 256, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf.

2.Joint Publication 3-14, *Space Operations*, 29 May 2013, II-1 through II-10, http://www.dtic.mil/doctrine/new_pubs/jp3_14.pdf.

3.Department of Defense and Office of the Director of National Intelligence, *National Security Space Strategy: Unclassified Summary* (Washington, DC: Department of Defense and Office of the Director of National Intelligence, January 2011), 1, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

4.Organisation for Economic Co-operation and Development, *The Space Economy at a Glance 2011* (Paris: OECD Publishing, 2011), 20, http://www.oecd-ilibrary.org/docserver/download/9211051ec005.pdf?expires=1382980504&id=id&accname=guest&checksum=2660BC88F172601FB85A12EFADC244A4.

5.Department of Defense and Office of the Director of National Intelligence, *National Security Space Strategy*, 3.

6.T. S. Kelso, "Analysis of the 2007 Chinese ASAT Test and the Impact of Its Debris on the Space Environment" (technical paper presented at the Advanced Maui Optical and Space Surveillance Technologies Conference, Wailea, Maui, HI, 12–15 September 2007), 321, http://www.celestrak.com/publications/AMOS/2007/AMOS-2007.pdf.

7."Russian Mars Probe Crashes into Pacific," *CNN*, 15 January 2012, http://www.cnn.com/2012/01/15/world/europe/russia-mars-probe/index.html.

8.Cheryl Pellerin, "Northcom Acknowledges North Korean Missile Launch, Failure," US Department of Defense, 12 April 2012, http://www.defense.gov/news/newsarticle.aspx?id=67920.

9.Victoria Nuland, "North Korean Announcement of a Launch December 10–22, 2012," US Department of State, 1 December 2012, http://www.state.gov/r/pa/prs/ps/2012/12/201345.htm; and "North Korea Defies Warnings in Rocket Launch Success," *BBC*, 12 December 2012, http://www.bbc.co.uk/news/world-asia-20690338.

10.James D. Rendleman, "Lawful Responses to Attacks on Space Systems," *Space and Defense* 4, no. 1 (Winter 2010): 10, http://www.usafa.edu/df/dfe/dfer/centers/ecsds/docs/Space_and_Defense_4_1.pdf.

11.Wolfgang Rathgeber, Nina-Louisa Remuss, and Kai-Uwe Schrogl, "Space Security and the European Code of Conduct for Outer Space Activities," *UNIDIR Disarmament Forum: A Safer Space Environment?*, no. 4 (2009): 34, http://www.espi.or.at/images/stories/dokumente/studies/space%20security%20and%20the%20european%20code%20of%20conduct%20for%20outer%20space%20activities.pdf.

12.Council of the European Union, *Council Conclusions Concerning the Revised Draft Code of Conduct for Outer Space Activities* (Brussels: Council of the European Union, 11 October 2010), http://www.consilium.europa.eu/uedocs/cmsUpload/st14455.en10.pdf.

13.US Department of State, "An International Code of Conduct for Outer Space Activities: Strengthening Long-Term Sustainability, Stability, Safety, and Security in Space," fact sheet, 17 January 2012, http://www.state.gov/r/pa/pl/2012/180998.htm; and Rose Gottemoeller, "A Code for Outer Space, as Seen from the State Department," US Department of State, 15 March 2012, http://www.state.gov/t/us/186645.htm.

14.Rajeswari Pillai Rajagopalan, "The Space Code of Conduct Debate: A View from Delhi," *Strategic Studies Quarterly*, 6, no. 1 (Spring 2012): 140.

15.International Academy of Astronautics, *Cosmic Study on Space Traffic Management* (Paris: International Academy of Astronautics, 2006), http://iaaweb.org/iaa/Studies/spacetraffic.pdf.

16.Michael Krepon, Theresa Hitchens, and Michael Katz-Hyman, "Preserving Freedom of Action in Space: Realizing the Potential and Limits of U.S. Spacepower," in *Toward a Theory of Spacepower: Selected Essays*, ed. Charles D. Lutes and Peter L. Hays (Washington, DC: Institute for National Strategic Studies, National Defense University, 2011), 401.

17.Lisa Daniel, "Defense, State Agree to Pursue Conduct Code for Outer Space," US Department of Defense, 18 January 2012, http://www.defense.gov/news/newsarticle.aspx?id=66833.

18.Department of Defense Directive 3100.10, *Space Policy*, 18 October 2012, 2, http://www.dtic.mil/whs/directives/corres/pdf/310010p.pdf.

19.International Academy of Astronautics, *Cosmic Study*, 11.

Major Albert C. Harris III, USAF (BA, University of Kentucky; MSIR, Troy University; DPA, Capella University) is the Operations Officer for the Communications Operations Squadron-East, National Reconnaissance Office (NRO), Chantilly, Virginia. While serving in this role he leads a military/contractor team that delivers cyber effects in support of national space systems. Major Harris is a multi-domain leader who focuses his efforts on integrating space, cyber, and intelligence capabilities to meet national security objectives. Commissioned in 2004, Major Harris completed Squadron Officer's School, Air Command and Staff College, is a graduate of the Advanced Space Operations School's Advanced Orbital Mechanics Course and their Advanced Satellite Communications Course, and has earned a doctorate from Capella University's School of Public Service Leadership. His previous assignments include a variety of leadership experiences including intercontinental ballistic missiles, space operations, and joint planning and exercises.