Examining Space Warfare

Scenarios, Risks, and US Policy Implications

Maj Scott A. Weston, USAF

Editorial Abstract: Militaries plan for contingencies involving space, but few studies have examined the issue with the intent of helping guide policies necessary for shaping military planning. This article takes a practical approach by examining space warfare, beginning with current US political policy and military space doctrine. After examining how the United States intends to fight, the author addresses current fielded capabilities that exist to conduct these battles, both in the United States and in nations considered potential space opponents. Analyzing possible confrontations with space competitors, he concludes that realistic scenarios involving military confrontation in space are extremely limited and, as a corollary, that space weaponization is neither an efficient nor effective way to reduce US vulnerabilities.

THE US MILITARY faces a security dilemma because of both the essential and increasingly vulnerable nature of its orbiting space assets.[1] The United States owns over 400 of the almost 900 active satellites in orbit, whose combined commercial activities added $123 billion to the world economy in 2007.[2] All military branches leverage the "high ground" of space for essential communications; intelligence, surveillance, reconnaissance (ISR); and navigational purposes by using dedicated military satellites and the communication infrastructure of civil satellites. The US military has solely dedicated at least 83 satellites to its use and controls many more for such purposes as navigation and Earth observation.[3] Space assets no longer simply enhance US military forces; they are essential to effective combat operations. At the same time, these assets have become increasingly vulnerable to attack, as demonstrated by China's successful antisatellite (ASAT) missile test in 2007.[4]

The simultaneous rise in the necessity and vulnerability of space assets led the 2001 Space Commission to warn of a potential space "Pearl Harbor"—a warning that confirmed the beliefs of those who seek increased militarization of space, including space-based weapons, to ensure the nation's security.[5] Since that time, others have argued that the deployment of space-based weapons, at best, will lead to a

destabilizing space-weapons race and, at worst, will result in the long-term, catastrophic contamination of highly useful regions of the space environment in a truly Pyrrhic defense of national interests.[6] This article contends that the very concept of a space Pearl Harbor conflicts with the reality of current space-warfare possibilities and that, contrary to the beliefs of "space dominance" advocates, it is still possible to maintain space as a sanctuary while protecting US military capabilities.[7]

The article examines scenarios in which space warfare might occur in the next five to 10 years—first, by assessing the state of US space policy and military doctrine that guide US military planners and then surveying the space-warfare capabilities of the United States and plausible opponents. Based upon this foundation, it examines several possible scenarios involving space warfare to demonstrate the *narrow* set of conditions that would prompt the use of space weapons, and to reveal the fallacy of the Pearl Harbor scenario. It concludes by returning to the vulnerability of US space assets, suggesting that the United States would gain greater utility not by weaponizing space but by reducing its military dependence on such assets and creating conditions for the establishment of space as a sanctuary.

US Policy and Doctrine

Policy and doctrine, the cornerstones of military operational planning, would direct US actions in a near-term conflict. US space policy describes its idea of permissible actions by other nations as follows: "The United States is committed to the exploration and use of outer space by all nations for peaceful purposes." It is not nearly as restrictive in its description of US activities: "The United States will: preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests."[8] The key item here notes that the United States does not explicitly support other nations' rights to operate militarily in space, reserving this right for itself. For military planners, this implies that there are no restrictions on US military action in outer space except for those already set by treaty. Revealingly, US space policy no longer mentions current space-treaty obligations, which seems to agree with the 2001 Space Commission's recommendation to restrict as little as possible US application of national power in space.[9]

As defined in Joint Publication (JP) 1, *Doctrine for the Armed Forces of the United States*, 14 May 2007, doctrine "promotes a common perspective from which to plan, train, and conduct military operations. *It represents what is taught, believed, and advocated as what is right* (i.e., what works best)" (emphasis in original).[10] JP 3-14, *Joint Doctrine for Space Operations*, 9 August 2002; Air Force Doctrine Document (AFDD) 2-2, *Space Operations*, 27 November 2006; and AFDD 2-2.1, *Counterspace Operations*, 2 August 2004—the primary sources of guidance for the employment of space forces—provide insight into capabilities the US military has considered and the effects they should produce. However, doctrine does not specify the type of weapon or system to be used; rather, it specifies the outcomes that space operations need to achieve and advises how to match those objectives with available resources. For this reason, the article first examines doctrine and then considers current military capabilities that could produce the required outcomes.

JP 3-14 and AFDD 2-2 divide military space operations into four categories: space force enhancement, counterspace, space force application, and space support.[11] Space force enhancement includes support functions such as surveillance, missile warning, communication, and meteorology. Counterspace includes those capabilities necessary to achieve and maintain the desired level of space superiority, defined as the "degree of dominance in space of one force over another that permits the conduct of operations . . . at a given time and place without prohibitive interference by the opposing force."[12] Counterspace capabilities include surveillance, protection, prevention,

and negation. Space force application involves missions "with weapons systems operating in, through or from space which hold terrestrial-based targets at risk."[13] Finally, space-support functions include satellite launch and control—enablers to the other missions. This description of different space operations considers all manner of existing and nonexisting capabilities appropriate for operational planning. Space force application "from" space in addition to "through" space implies space-based weapons for ground attack, while counterspace "negation" refers to ground-to-space or space-to-space attacks. Clearly, US doctrine on the use of space forces provides for all conceivable methods of space warfare.

AFDD 2-2.1 more specifically identifies possible threats and military offensive and defensive responses that planners must consider in order to establish and maintain space superiority, which, along with air superiority, represents a "crucial first [step] in any military operation."[14] This document discusses the entire space system, consisting of satellites, ground telemetry and processing stations, links between space and ground, launch facilities, and manufacturing infrastructure. Civil third-party space systems are included since they increasingly affect the potential use of space by an adversary.[15]

AFDD 2-2.1 examines short- as well as long-term threats that the United States could face. As a corollary, it also serves as a list of capabilities that America could develop for its own offensive purposes. Ground facilities and infrastructure could face direct kinetic and electronic attack, jamming, or attack by malicious code from traditional and special operations forces.[16] Ground-, air-, or space-based lasers, depending on their output power, can harm satellites by either blinding optical sensors or overheating the satellite bus, potentially causing critical damage to sensitive electronics.[17] Electromagnetic pulse (EMP) weapons can damage unprotected electronic equipment and threaten space- and ground-based segments of space systems. Finally, the threat list contains traditional kinetic-kill ASAT weapons that destroy satellites by colliding with them at high speed or exploding a warhead in close proximity.[18] Although the document specifies that this list may not be all inclusive, it obviously intends it to be as inclusive as possible, given the unclassified information available at the time of publication. Thus, we have a list of possible threats to US space forces that AFDD 2-2.1 uses to consider possible offensive and defensive options.

Defensive capabilities have both passive and active components, the former including hardening and camouflaging ground facilities as well as hardening and dispersing space assets in multiple orbits. Active defenses include changing orbital parameters to avoid ASAT targeting, changing or hopping frequencies to avoid jamming, encrypting to prevent malicious-code attacks and interception of information, and applying direct force against the enemy's counterspace weapons.[19] Due to acquisition and launch restrictions, most forms of counterspace defense must be incorporated in the design phase, adding cost and complexity to space programs. For economic reasons, few commercial space systems are currently designed with combat in mind. The threats that this doctrine plans to defend against and our assets it intends to use differ considerably from the current capabilities of our forces and those of our potential adversaries.

Space-Warfare Capabilities

If a conflict occurs in the next five to 10 years, the long acquisition process for space systems and limited space-launch schedules will confine the main space systems involved to those now fielded. Therefore, a survey of current counterspace assets is necessary in order to understand how space-warfare scenarios would likely occur. The following considers only those countries most likely to confront the United States militarily in space in the near future—specifically, nuclear states with domestic space-launch and satellite capabilities, nuclear powers possessing ballistic missiles, and nonnuclear states with ballistic missiles capable of direct ascent into occupied space orbits. Each group has the potential to engage in space combat along a spectrum ranging from

creation of a crude debris field to targeted space attacks. Limiting the study to the most plausible threats, the discussion focuses on the capabilities of Russia, China, North Korea, and Iran, citing examples that cover most of the space-warfare spectrum and applying lessons to other countries of interest.

Many works about space weapons quickly move from what the United States and its adversaries can do now to what they could possibly do soon, principally because few fielded terrestrial weapons can attack space assets and because no declared space-based attack assets exist.[20] We could probably field a few promising technologies rapidly in wartime conditions, but as former defense secretary Donald Rumsfeld commented, "You have to go to war with the army you have, not the army you want."[21] Fielded weapons include only the ones tested and turned over to military forces trained to employ them as an integrated part of battlefield forces.[22] The discussion addresses only weapons that target orbiting space assets since all other conventional force capabilities (air, ground, and sea) are already well known.

The United States has just one counterspace weapon—an electronic countercommunication system specifically designed and fielded with the intent of disrupting enemy satellite communications.[23] Recently, however, we successfully utilized the Standard Missile 3 in a dual-use role as a kinetic ASAT weapon.[24] Although the political repercussions from creating additional space debris will likely prohibit further tests, the missile and supporting systems are already fielded in an antiballistic missile (ABM) role; therefore, we consider it an ASAT system that we could field in the near term. The United States can also conduct asymmetric space attacks (e.g., an EMP produced by exploding a US nuclear-tipped ballistic missile in space). Since the United States possesses nearly half of all orbiting satellites, such an indiscriminate attack would do more harm to US interests than to those of the enemy. But what about our opponents' capability? Does a space weapon "gap" exist?

Even after the collapse of the Soviet Union, Russia remains the United States' greatest potential adversary in space. The Soviet Union fielded an operational co-orbital ASAT system in 1979 and, even earlier, a nuclear-armed ABM system around Moscow. It also developed, though never fielded, a space-based platform for delivering nuclear warheads and a high-powered, ground-based ASAT laser system.[25] Once again, however, the question is not what the Russians possessed in the past, but what capabilities they wield today. According to current estimates, the Russian co-orbital ASAT is not operational, and new development of any ASAT capability would require dramatic change in the present structure of Russian forces.[26] So, although Russia has the technological history conducive to fielding effective counterspace forces, its force structure suggests that it likely has neither the current capability to strike in space nor the political desire to create such a capability. However, it remains a major military power and, like the United States, possesses robust space launch. It has nuclear weapons and ballistic missiles that could effectively carry out asymmetric attacks in space. Additionally, the fact that Russia supplied Iraq with global positioning system (GPS) jammers prior to Operation Iraqi Freedom indicates that it has fielded earthbound counterspace technology.[27]

Other than Russia, only China can field substantial counterspace forces. China's successful test of a direct-ascent ASAT weapon in 2007 demonstrated its ability to compete in the space battlefield.[28] But China's fielded forces remain unknown. Since this ASAT test was Beijing's first success, the Chinese have probably not yet fielded or integrated the system into battle planning. Given their great interest in the development of ASAT weapons, however, they are presumably in the process of fielding it, which would make the system at least partially operational in any near-term conflict.[29] Recent reports have also suggested that China has many components of a ground-based ASAT laser system, but its operational status remains unknown.[30] We also believe that China possesses jamming technology similar to Russia's, and, like Russia, it boasts space launch, ballistic missiles, and nuclear weapons.

North Korea, which has developed a nuclear weapon, came close to developing a missile capable of reaching orbit, as demonstrated

by the failed test of the Taepo Dong 1 in 1998, which reportedly threw debris 4,000 kilometers (km) downrange from the launch site.[31] Such a missile, however, could easily reach sufficient altitude to act as a direct-ascent ASAT carrying a nuclear payload, as would North Korea's better tested and fielded Nodong missile, having a range of 1,300 km and carrying a payload of 700 kilograms.[32]

Iran, the least space-capable of our potential opponents, has no nuclear capability at present. Because that country lacks the advanced tracking and guidance systems necessary to intercept a satellite, its only weapon capable of reaching space—a ballistic missile armed with a conventional warhead—would explode blindly, creating a dangerous debris field in valuable low Earth orbits. Iran's most capable missiles, the Shahab-3 and Shahab-4, could possibly reach direct-ascent altitudes of 650 and 1,100 km, respectively.[33]

After all the hype about space warfare and space weapons, an examination of currently fielded forces capable of direct counterspace operations against satellites clearly shows that few countries can conduct this type of warfare. Most threats envisioned in the US military's space doctrine simply do not exist in an operationally deployed form.

Space-Conflict Scenarios

Because current US space policy considers the entire space infrastructure a vital national interest, an attack against it or even preparation for one would likely incur a military response.[34] Rationally, then, we would think that other nations would refrain from attacking US space assets unless they are engaging or already engaged militarily with us. In this regard, the deterrent threat of US retaliation would establish a lower limit to space conflict, much as it does with other forms of military confrontation.

The scenarios offered here include conflicts between the United States and three of the four nations capable of space attack mentioned above: China, North Korea, and Iran. Each highlights different aspects of US vulnerability and ways of constraining the United States in its responses. Russia is excluded due to its apparent lack of current capability and its similarity to China as another state with nuclear ballistic missiles. Considering the major nuclear powers, any direct conflict would occur over objectives below the level of national survival in order to avoid the risk of a nuclear exchange—the upper limit to realistic space-combat scenarios. With these lower and upper limits set, the scenarios include a limited conflict with China; a direct conflict with the more space-capable of the smaller opponents, North Korea; and a confrontation at the lowest level of space warfare with Iran. The development of these scenarios incorporates information available from war-game results that have included counterspace operations.

Though little has appeared publicly concerning the series of Schriever space war games conducted by the US Air Force since 2001, the third round, completed in 2005, included operations to temporarily deny opponents access to space assets.[35] The most recent unclassified war-game experience involving space assets—the RAND Corporation's Army After Next study in 1999—closely approximates our US-China scenario since it involves a space-technology competitor with significant space-based ISR assets.[36] The scenario involved "Blue" forces (similar to those of the United States) deploying to forward locations and then attacking enemy "Red" forces (similar to China's). Red found it in its best interest not to attack Blue's space-based assets during the deployment phase because it did not want to jeopardize its own ISR space assets, which it needed to monitor Blue's deployment. After Blue had forward-deployed, Red could conduct reconnaissance using aircraft, thus putting it in a better position to begin attacking enemy space assets—which it did.

All of these scenarios assume only two players, with other nations neutral to the conflict but involved insofar as their interests include commercial and possibly manned space assets. According to the second assumption, the United States forward-deploys to engage its opponent abroad and does not defend itself from invasion. The RAND study highlights the point

that the nondeploying nation has certain advantages in space warfare, such as the ability to supplement space-based ISR assets with nationally based air-breathing assets and reduced dependence on space-based communications. The preponderance of US strength as a superpower also makes a US deployment scenario more likely.

In the first scenario, the United States deploys to defend Taiwan against China's attempt to subdue the island forcibly. As in the RAND study, China would likely refrain from attacking US space assets to preserve its own space ISR capability, which it needs to monitor the US buildup. The United States would also delay full counterspace operations until fully deployed in order to prepare for retaliation with assets in place instead of in transit, where space disruption would cause much more confusion. With the United States almost fully deployed, China would do well to utilize any counterspace weapons it possesses before the United States targets them. Given its limited ASAT capability, China would likely target US military communication and reconnaissance satellites, avoiding permanent damage to dual-use commercial satellites to preserve its global reputation and protect its own third-party commercial space contracts. The Chinese would use kinetic attacks and any rapidly deployed ASAT lasers against low-altitude satellites, such as those performing reconnaissance, while likely attacking high-altitude communication satellites by jamming or feeding them malicious code. In addition to hitting space assets, China would probably deploy high-powered GPS and other signal jamming throughout the theater to degrade US bombing accuracy and complicate navigation.

US doctrine, which places priority on air and space superiority, suggests that the first US attack would target China's ground-based counterspace capability, using the full range of joint-attack forces and munitions. This first wave of ground attacks would also combine with counterspace offensive operations of a nondestructive nature, as highlighted in the Schriever war games, to temporarily blind Chinese ISR satellites and jam communication and signal-collection satellites. A few political caveats attach to this doctrine-directed target list, however. China's launch facilities are far inland, thus raising the possibility that it would consider strikes in these areas a significant escalation, just as the United States would consider Chinese attacks on US launch facilities at Cape Canaveral, Florida, and Vandenberg AFB, California, provocative. The United States would also have to avoid targeting ground-based missile-launch-detection capabilities, which China might interpret as preparation for a nuclear first strike.

As mentioned in the RAND war-game scenario, China would be far less affected than the United States by the loss of most space assets at this point because its air-breathing ISR assets could cover the immediate theater and short-range ground communications that do not rely upon satellites.[37] Conversely, once US forces have deployed, they would rely heavily upon space assets. In a limited military engagement such as this, it is unlikely that the United States would attempt to facilitate ISR flights by establishing air superiority over all of China. US forces would thus remain highly reliant upon satellites for ISR over mainland China and for communication with the homeland and between deployed units.

The RAND study also pointed out that China would likely contract commercial third-party space assets to provide needed capabilities, complicating repercussions from US attacks. All told, counterspace operations would probably prove as discriminate as possible to prevent strategic escalation. Both sides would hesitate to utilize kinetic-kill ASATs against anything but very low-altitude satellites for fear of incurring international condemnation and increasing debris hazards for their own resources.[38] In all likelihood, the United States would not use its kinetic ASAT capability, preferring to utilize its limited number of sea-based Standard Missile 3s for ABM defense of forward-deployed forces. Thus, the number of satellites destroyed or permanently disabled would be very low.

As limited as this scenario appears, it bears out realistic actions taken under current policy and doctrine, given the resources available to each side. In this case, it is difficult to see how

even one of our most capable space adversaries would have either the capability or the motivation to attempt a surprise attack on US space assets that would rise to the level of a space Pearl Harbor. It is also difficult to understand how the cost of deploying hundreds or even thousands of US weapon satellites to ensure space dominance would greatly affect the outcome of this scenario. Even a deployed space-based missile-defense shield probably would not encourage the United States to intentionally escalate a limited regional conflict with another nuclear power to a full nuclear exchange if there were any risk of nuclear warheads reaching US soil.

The next scenario assumes the United States deploys in response to North Korea's marrying a nuclear warhead to its Nodong missile and massing troops at the demilitarized zone between North and South Korea after negotiations over fuel and food shipments have broken down. Believing its only option to force negotiations and prevent collapse of the regime is to test its new nuclear missile, North Korea sends the Nodong into a direct-ascent profile, exploding the nuclear warhead 500 km over the Sea of Japan and arguing that its test is no different than US atmospheric nuclear testing in the 1960s. In this worst-case scenario, North Korea avoids US ballistic missile defenses either by launching decoys or by some other means. The resultant EMP of the nuclear blast shuts down power throughout most of mainland Japan, including that on the bases of many forward-deployed US troops.[39] Dozens of satellites are disabled or destroyed immediately, with nearly every commercial and even some hardened military satellites in low Earth orbit disabled in the coming days.[40] The United States must now decide how to respond.

Despite the great damage, no lives have been lost, so nuclear retaliation against North Korea resulting in heavy civilian casualties would be inappropriate. Although military confrontation with North Korea would similarly put many lives at risk, it remains the most likely international response to ensure regime change and prevent additional nuclear explosions. In this case, there is little place for counterspace operations because North Korea has no space assets for the United States to attack. The United States would deem any remaining missiles and launch facilities high-priority targets in its first retaliatory strikes. Destruction of launch and satellite communication centers would obviate the need for further offensive space operations. One could possibly consider this case an attack justifying the "Pearl Harbor" label, but *all* spacefaring nations—not only the United States—would become victims. Rather than derive strategic benefit from the attack, the North Korean regime would only guarantee its demise.

Finally, any scenario involving conflict with Iran includes the possibility that that country would use its ballistic missiles to attack US space assets. Because attacking a specific satellite would involve tracking and targeting resources that Iran does not possess, such an attempt would amount to a blind strike against the orbital environment. By scattering debris at altitudes used by the United States' ISR satellites, Iran could hope to degrade or disable as many such satellites as possible. Although this threat is real, many reasons argue against carrying it out. First, debris clouds are indiscriminate and would potentially damage satellites from every nation that uses those specific altitudes. The guaranteed international condemnation would only serve to strengthen the US political position globally with respect to the conflict. Second, the United States' ability to model and track debris clouds to a certain extent would enable it to mitigate some post-attack risk from debris. Finally, the use of Iranian ballistic missiles in this manner would make them unavailable for attacks against US forces on the ground.

Conclusions

Clearly, these scenarios are simplified. Yet, taking into account policy, doctrine, and current capabilities, one sees that they indicate that counterspace operations are useful within only a small piece of the large spectrum of warfare between terrorist attacks and nuclear exchanges. The fear of an adversary's creating

a space Pearl Harbor does not fit the capabilities and constraints that exist in possible conflict scenarios with any opponent who would expect to derive strategic benefit from the attack.

Of the conflicts that would utilize the space-based weapons sought by those who advocate space dominance, we are left with limited, regional fights with nuclear and spacefaring nations as the only current, applicable scenarios for robust counterspace operations. Even in the most vivid dreams of such advocates, the development of space-based kinetic or directed-energy defenses against dominant space powers would not prevent jamming, laser, or ground-station attacks from denying or damaging space capabilities. In the worst case of unintended consequences, these new weapons in space would inspire attacks from other space-based weapons or from ground-based kinetic ASAT weapons, likely leading to a multiplication of space debris.

The scenario of a space Pearl Harbor fails to take into account the fact that a kinetic attack against a single satellite becomes a debris-cloud attack against all satellites in or crossing that orbit. Thus, what is presented as a handful of limited attacks against one nation becomes an indiscriminate attack against all present spacefaring nations—and could create a debris field that might render many valuable orbits unusable for decades or even centuries.[41] Kinetic space weapons, therefore, have long-lasting environmental effects similar to those produced by the use of nuclear weapons on the ground, in that they create contaminated, idle regions.

The main argument for US weaponization of space turns on the inherent vulnerability of space assets and the fundamental need for them to ensure national security and prevent another Pearl Harbor. Space-based weapons and ASAT systems seem to reduce vulnerability either through active defense or deterrence (though that assertion becomes questionable if one takes into account the likely weapons race that would result). They do nothing, however, to address the dependence of military forces upon such systems and create a requirement for a permanent "global fortress" in space. But recently, near-space technologies such as high-altitude unmanned aerial vehicles have shown potential for reducing military dependence upon space-based assets by performing command and control, communication, and ISR missions similar to those conducted by satellites.[42] Sensible policy making requires debating the implications of trying to directly defend space assets versus developing *alternative* military capabilities that would reduce our military reliance upon space and thus diminish the attractiveness of space assets as targets for our adversaries. Though long-term investments, both space-based defenses and near-space vehicles create very different potentials for US space policy.

Uncontested control of the high ground of space seems tempting, especially for a superpower. It is unrealistic to base US policy on this school of thought, however, due to the ability of other spacefaring states to counter US interests by developing their own space weapons and beginning a new arms race—or simply bypassing deployed defenses.[43] Though stable, current US space policy cannot last without a strong diplomatic structure. The rise of another nation to challenge the United States in space will surely alter the status quo in a manner unacceptable to us. Bruce DeBlois articulates a better choice: "The decision to weaponize space does not lie within the military (seeking short-term military advantage in support of national security) but at the higher level of national policy (seeking long-term national security, economic well-being, and worldwide legitimacy of US constitutional values)."[44] This view uses the current US ability to lead negotiations from a position of authority and power to ensure the creation of rules of the road and, eventually, treaties that will protect US space interests in the future. Combined with existing passive defenses and the development of near-space defenses for addressing security vulnerabilities and requirements, a "space sanctuary" provides economic, political, and even security advantages.[45] ❑

Notes

1. Michael Krepon and Michael Katz-Hyman, "Space Responsibility: U.S. Policies Endanger Satellites, Space Access," *Defense News*, 16 October 2006, 16.

2. Futron Corporation, "State of the Satellite Industry Report," June 2008, 5, http://www.sia.org/files/2008SSIR.pdf (accessed 4 August 2008).

3. UCS Satellite Database, *Union of Concerned Scientists*, 8 July 2008, http://www.ucsusa.org/global_security/space_weapons/satellite_database.html (accessed 1 August 2008).

4. The actual intercept of China's satellite made international news, but the Chinese ASAT's two less publicized test intercepts spurred recognition of the threat. For discussion of that country's successful intercept and previous tests, see House of Representatives, *Weaponizing Space: Is Current U.S. Policy Protecting Our National Security? Hearing before the Subcommittee on National Security and Foreign Affairs of the Committee on Oversight and Government Reform*, 110th Cong., 1st sess., 23 May 2007, 16, 27.

5. Donald H. Rumsfeld et al., *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: Commission to Assess United States National Security Space Management and Organization, 11 January 2001), xvii, http://www.dod.mil/pubs/space20010111.pdf (accessed 11 April 2008).

6. Joan Johnson-Freese, *Space as a Strategic Asset* (New York: Columbia University Press, 2007); and James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford, CA: Stanford Security Studies, 2008).

7. The "space dominance" position is well explained in Everett C. Dolman's *Astropolitik: Classical Geopolitics in the Space Age* (London: Frank Cass Publishers, 2002).

8. *U.S. National Space Policy* (Washington, DC: Office of Science and Technology Policy, Executive Office of the President, White House, 2006), 1–2, http://www.globalsecurity.org/space/library/policy/national/us-space-policy_060831.pdf (accessed 21 March 2008).

9. The 1996 National Space Policy's emphasis on conducting operations "consistent with treaty obligations" does not appear in the 2006 policy. "Fact Sheet: National Space Policy" (Washington, DC: National Science and Technology Council, White House, 19 September 1996), *GlobalSecurity.org*, http://www.globalsecurity.org/space/library/policy/national/nstc-8.htm (accessed 12 April 2008); and Rumsfeld et al., *Report of the Commission,* xvii.

10. Joint Publication (JP) 1, *Doctrine for the Armed Forces of the United States*, 14 May 2007, ix, http://www.dtic.mil/doctrine/jel/new_pubs/jp1.pdf (accessed 11 April 2008).

11. JP 3-14, *Joint Doctrine for Space Operations*, 9 August 2002, IV-1, http://www.dtic.mil/doctrine/jel/new_pubs/jp3_14.pdf (accessed 11 April 2008); and Air Force Doctrine Document (AFDD) 2-2, *Space Operations,* 27 November 2006, 4–5, http://www.e-publishing.af.mil/shared/media/epubs/AFDD2-2.pdf (accessed 21 March 2008).

12. JP 3-14, *Joint Doctrine for Space Operations*, GL-6.

13. AFDD 2-2, *Space Operations*, 5.

14. AFDD 2-2.1, *Counterspace Operations*, 2 August 2004, 1,http://www.e-publishing.af.mil/shared/media/epubs/AFDD2-2.1.pdf (accessed 21 March 2008).

15. Ibid., 3.

16. Ibid., 4.

17. Ibid.

18. Ibid.

19. Ibid., 27.

20. JP 3-14, *Joint Doctrine for Space Operations*, IV-10, specifies that "currently, there are no force application assets operating in space."

21. Mike Mount, "Troops Put Thorny Questions to Rumsfeld," *CNN*, 9 December 2004, http://www.cnn.com/2004/WORLD/meast/12/08/rumsfeld.troops/ (accessed 21 March 2008).

22. Michael P. Pillsbury, *An Assessment of China's Anti-Satellite and Space Warfare Programs, Policies and Doctrines* (Washington, DC: US-China Economic and Security Review Commission, 2007), 52, http://www.uscc.gov/researchpapers/2007/FINAL_REPORT_1-19-2007_REVISED_BY_MPP.pdf (accessed 21 March 2008).

23. Although the recent shoot-down of a US reconnaissance satellite by a Standard Missile 3 from an Aegis cruiser in the Pacific surprised many as a dual use of an antiballistic missile system, David Wright and Laura Grego had predicted the possible ASAT application of the system as early as 2002 in "Anti-Satellite Capabilities of Planned US Missile Defence Systems," *Disarmament Diplomacy*, no. 68 (December 2002–January 2003), http://www.acronym.org.uk/dd/dd68/68op02.htm (accessed 21 March 2008). See also "76th Space Control Squadron," fact sheet, http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4808 (accessed 21 March 2008).

24. Thom Shanker, "Missile Strikes a Spy Satellite Falling from Its Orbit," *New York Times*, 21 February 2008, http://www.nytimes.com/2008/02/21/us/21satellite.html?_r=1&hp&oref=slogin (accessed 6 August 2008).

25. Michael R. Mantz, *The New Sword: A Theory of Space Combat Power* (Maxwell AFB, AL: Air University Press, 1995), 6.

26. *Ensuring America's Space Security: Report of the FAS Panel on Weapons in Space* (Washington, DC: Federation of American Scientists, September 2004), 131, http://www.fas.org/pubs/_pages/space_report.html (accessed 21 March 2008).

27. Liza Porteus, "Russian Dealers Provide Iraq with Supplies, Electronics," *Fox News*, 23 March 2003, http://www.foxnews.com/story/0,2933,81917,00.html (accessed 21 March 2008).

28. Pillsbury, *Assessment*, 3.

29. Matthew Mowthorpe, *The Militarization and Weaponization of Space* (Lanham, MD: Lexington Books, 2004), 105.

30. Ibid., 101.

31. *Ensuring America's Space Security*, 136.

32. Ibid., 134.

33. "Iran Profile: Missile Overview," *Nuclear Threat Initiative*, August 2008, http://www.nti.org/e_research/profiles/Iran/Missile/index.html (accessed 12 April 2008). Direct-ascent altitudes are commonly estimated at half the range of the missile.

34. US space policy explicitly notes that "the United States considers space capabilities—including the ground

and space segments and supporting links—vital to its national interests. Consistent with this policy, the United States will: preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests." *U.S. National Space Policy,* 1–2. The idea of denying space capabilities hostile to US national interests could easily imply preemptive action against nations preparing for an attack upon US space assets.

35. Jeremy Singer, "Space War Game Focused on Tactical-Level Operations," *Space News,* 17 February 2005, http://www.space.com/spacenews/archive05/gamearch_021405.html (accessed 21 March 2008).

36. Walter Perry, Bruce Pirnie, and John Gordon IV, *The Future of Warfare: Issues from the 1999 Army after Next Study Cycle* (Santa Monica, CA: RAND, 2001), 120, http://rand.org/pubs/monograph_reports/2007/MR1183.pdf (accessed 21 March 2008). This war game included advanced space-based laser weapons, so only the first few moves of the game are of use here.

37. Ibid., 35.

38. China's interest in international opinion would focus more on limiting further international involvement in what it considers an internal conflict as well as preserving access to third-party space assets. For an examination of orbital-debris policy issues related to ASAT employment and space security, see Moltz, *Politics of Space Security,* 53–54.

39. About 800 miles separate North Korea from the Tokyo area. A US nuclear blast in space a similar distance from Hawaii knocked out power in 1962. See Lt Col Clayton K. S. Chun, *Shooting Down a "Star": Program 437, the US Nuclear ASAT System and Present-Day Copycat Killers,* CADRE Paper no. 6 (Maxwell AFB, AL: Air University Press, April 2000), 4, https://research.au.af.mil/papers/ay2000/cadre/chun.pdf.

40. Peter L. Hays, *United States Military Space: Into the Twenty-first Century* (Colorado Springs, CO: US Air Force Academy/DFES, USAF Institute for National Security Studies, 2002), 101, http://www.usafa.af.mil/df/inss/OCP/OCP42.pdf (accessed 21 March 2008).

41. Moltz, *Politics of Space Security,* 52.

42. Lt Col Edward B. Tomme, "The Paradigm Shift to Effects Based Space: Near-Space as a Combat Space Effects Enabler," Research Paper 2005-01 (Maxwell AFB, AL: Airpower Research Institute, 2005), http://www.au.af.mil/au/awc/awcgate/cadre/ari_2005-01.pdf.

43. Kenneth S. Blazejewski, "Space Weaponization and US-China Relations," *Strategic Studies Quarterly* 2, no. 1 (Spring 2008): 34, http://www.au.af.mil/au/ssq/2008/Spring/blazejewski.pdf.

44. Lt Col Bruce M. DeBlois, "Space Sanctuary: A Viable National Strategy," *Airpower Journal* 12, no. 4 (Winter 1998): 41, http://www.airpower.au.af.mil/airchronicles/apj/apj98/win98/deblois.pdf (accessed 21 March 2008).

45. Ibid., 53.

The Air Force will continue to develop space situation awareness (SSA) capabilities to help protect space assets from future threats. We are also pursuing more robust space protection measures to warn of attacks, provide redundant command and control, harden electronics, and defend against direct attacks.

—*Air Force Posture Statement 2008*