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China's ASAT Test: Motivations and Implications

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Key Points

The direct-ascent antisatellite (ASAT) weapon that China tested in January 2007 appears to be part of larger efforts to develop a range of ASAT capabilities, including ground-based lasers and jammers. Senior Chinese leaders almost certainly approved the ASAT development program, but China's clumsy handling of questions following the ASAT test indicates a lack of internal coordination, perhaps due to security compartmentation.

If deployed, China's direct-ascent ASAT could hold U.S. satellites in low Earth orbit at risk. Other potential Chinese ASAT capabilities might be able to disrupt the use of satellites in higher orbits, including the Global Positioning System. Loss of these space assets would significantly affect most U.S. military operations in the Pacific, including responses in the event of a Taiwan contingency.

U.S. officials should consider initiatives to convince the Chinese to forego further development or limit deployment of ASAT capabilities, as well as technical and military measures that would mitigate the impact or deter the use of an operational Chinese ASAT program. No single option is simple, cheap, or likely to be wholly effective on its own.

Persuading Beijing not to develop and deploy ASAT weapons will be a difficult challenge. Washington must balance its broader relationship with China against the need to maintain access to space for both military and commercial purposes. The extension of U.S.-China competition into the space domain will complicate efforts to build a stable and constructive bilateral relationship.

National Defense University's Institute for National Strategic Studies convened an unclassified roundtable to discuss the motivations and implications of China's direct-ascent antisatellite (ASAT) weapons test. Participants included China and space experts with a range of policy viewpoints.[1] The roundtable was intended to highlight issues and perspectives that U.S. policymakers should consider in thinking about U.S. responses to China's ASAT test. This report draws heavily on views expressed at the roundtable discussion, but the authors have added more analysis to provide a fuller explication of the relevant policy issues.

China's ASAT Programs

China launched a direct-ascent ASAT on January 11, 2007, which struck a Chinese FY–1 weather satellite in low Earth orbit (LEO). The ASAT's kinetic kill vehicle was likely boosted by a two-stage mobile launcher based on a DF–21 medium-range ballistic missile. China reportedly conducted several previous tests of the system; it is unclear if the same configuration was used for all the tests.[2] The successful test demonstrates a Chinese capability to threaten a number of U.S. satellites in LEO, which may include capabilities for reconnaissance, remote sensing, surveillance, electronic surveillance, and meteorology, as well as some civilian communications satellites with military applications.[3] These satellites and the International Space Station are also at increased, although not significant, risk from the debris cloud created by the recent ASAT test.

The direct-ascent ASAT appears to be part of a larger Chinese ASAT program that includes ground-based lasers and jamming of satellite signals.[4] Chinese analysts, scientists, and strategists have written extensively about ASAT weapons and potential means of countering U.S. military uses of space.[5] A recent Department of Defense report suggests that China appears to be developing a "ground-based laser designed to damage or blind imaging satellites."[6] According to a news article, the Director of the National Reconnaissance Office confirmed that a Chinese laser illuminated a U.S. satellite.[7] In addition, jamming could disrupt U.S. military communications and Global Positioning System (GPS) navigation and targeting signals. The exact performance characteristics of Chinese systems are unknown, but deployment of a range of ASAT capabilities could provide flexible options to temporarily or permanently deny U.S. space capabilities. The Chinese direct-ascent ASAT program appears to be in the research and development phase, and the intent or timing of operational deployment remains unknown.

Chinese Decisionmaking

China's ongoing pursuit of a range of ASAT capabilities in addition to the direct-ascent ASAT is evidence of senior leadership

knowledge and support.[8] Some experts at the National Defense University roundtable argued that removal of language on preventing an arms race in outer space from China's 2006 defense white paper and China's refusal to sign the Hague Code of Conduct against ballistic missile proliferation are evidence of policy coordination across the Chinese bureaucracy on ASAT-related issues.[9] Two months after the test, Prime Minister Wen Jiabao stated that China's position on peaceful utilization of space remains unchanged and endorsed negotiation of a treaty on the peaceful use of outer space.[10] However, China's 12-day silence immediately after the test, uncoordinated messages (including a flat denial from the military), and lack of a clear communications strategy indicate a deficit in internal coordination about the January ASAT test.[11] One China expert suggested that there might be a horizontal compartment (perhaps at the Central Military Commission level) of those who approve China's ASAT programs and a vertical compartment (including the General Armaments Department and laboratories involved in research and development) of those developing and testing ASAT systems. Limited overlap between the compartments might explain why China miscalculated the international response to the ASAT test and was not prepared to address the resulting criticism.

Participants felt Chinese President Hu Jintao almost certainly approved the overall ASAT test program; some thought he may have approved each individual test. The uncoordinated Chinese response suggests that the Ministry of Foreign Affairs was not aware of the January ASAT test in advance. One China expert noted that the Chinese response "sends all the wrong signals" in terms of civilian control of the military, transparency, and consistency with China's "peaceful development" campaign. He contrasted the uncoordinated response with China's 1964 nuclear test, in which Beijing sought to shape international reactions through carefully coordinated messages.

Most participants believe China underestimated the negative international reactions to the test. This may be due to the lack of protests of earlier ASAT-related tests, ignorance of the debris issue, or a Chinese cultural expectation that the United States would keep quiet about any vulnerability to ASAT weapons. Several suggested that senior leaders might not have been briefed that debris generated by the test would pose a threat to other satellites. One noted that China's ASAT test could accelerate U.S. investments in space weapons and empower those who see China as a threat—developments that are not in China's interest. Others questioned how much of a price China would really pay, suggesting that aside from short-term damage to China's image and the loss of civil space cooperation with the United States, the ASAT test would have limited long-term costs.

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Motivations

Most felt that China tested its direct-ascent ASAT in order to develop the system and confirm that it worked properly. A space expert argued that ASATs are like ballistic missile defense: "at a certain point, you need to test or the program won't improve to the next level." The group agreed that the timing of the test is not significant; the important message is the fact that China is pursuing ASAT weapons and has demonstrated a certain capability. One China expert suggested that the key messages are that the United States could not expect to dominate space alone and that intervention on behalf of Taiwan would be increasingly risky and costly. Others suggested Chinese motives might include warning Taiwan against seeking independence and highlighting Chinese capabilities with respect to Japan and India, both of which operate satellites.

Most of the group felt ASAT weapons are one of a series of asymmetric capabilities that China is developing to exploit potential U.S. military vulnerabilities. Chinese strategic analysts are well aware of increasing U.S. military dependence on space; ASAT weapons can potentially exploit this vulnerability and reduce the American ability to operate in the Western Pacific. One space expert argued that ASAT weapons are a logical and relatively inexpensive response to U.S. military dominance, which rests heavily on space capabilities. Others noted that China's military modernization, which emphasizes "informationalization," would rely increasingly on space in the future, reducing the asymmetric impact of ASAT capabilities.

Operational Implications

If deployed, Chinese antisatellite weapons could threaten a range of U.S. military capabilities that rely on space assets and might have significant consequences for a Taiwan contingency. The United States has a range of options for countering Chinese ASAT capabilities and limiting their impact, but there is no simple or cost-free solution.

Because the direct-ascent ASAT system that China tested could threaten satellites in LEO, U.S. military capabilities for reconnaissance, remote sensing, surveillance, electronic surveillance, and meteorology could be at risk. Satellites in medium Earth orbit and geostationary orbit are not vulnerable to a direct-ascent ASAT system boosted by a two-stage DF–21 launcher. Although China has demonstrated the ability to launch satellites into geostationary orbits using larger rockets, the techniques required to reach higher orbits would significantly alter the dynamics for an effective hit-to-kill kinetic kill vehicle, making the current ASAT design unusable for such purposes.

An additional concern is that ground-based lasers could potentially target U.S. reconnaissance satellites. One space expert viewed lasers as a more important threat than the direct-ascent system, while another noted that all efforts to develop high-powered lasers have been plagued with technical problems and that deployment of such capabilities is probably decades away.

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Jammers to degrade GPS signals or interfere with satellite communications are another means of disrupting U.S. space assets, but it is difficult to assess Chinese capabilities in this area. Experts noted that China's doctrine for employing space weapons and ability to link systems operationally were unclear.[11]

Perhaps the most significant operational implication concerns the U.S. ability to respond to a Taiwan contingency. Given American military advantages, China's best chance of success in a conflict over Taiwan would be to delay the arrival of U.S. forces until after it forced Taiwan to capitulate, presenting Washington with a fait accompli. Most agreed that Chinese ability to destroy U.S. satellites in LEO would significantly increase the costs and risks of U.S. intervention on behalf of Taiwan. One China expert pointed out that ASAT weapons are only one in a range of military capabilities that China is developing to complicate and delay U.S. military responses. Even if any individual program had only a marginal impact, the cumulative impact could still be significant. A comprehensive net assessment of new Chinese technologies and potential U.S. counters is necessary to consider how to mitigate strategic risk.

An operational Chinese ASAT capability would provide flexible options for delaying and disrupting an American response to a Taiwan contingency. The direct-ascent ASAT could be used to attack U.S. reconnaissance satellites in LEO; at the same time, China could attempt to destroy Taiwan's Formosat series satellites operating in LEO.[13] Chinese forces might attempt to temporarily blind U.S. reconnaissance and remote sensing capabilities through lasing, while jamming U.S. communication links and GPS signals could disrupt navigation and (more importantly) precision targeting. These efforts might be coupled with cyber attacks to disrupt and delay the response of U.S. forces. This strategy could be conducted in whole or in part—and without a complete integration of systems.

A China specialist noted that the assumption that China would use any and all capabilities in the event of a Taiwan conflict might be incorrect. Nevertheless, U.S. planners have to prepare for worst-case scenarios. He worried about a potential disconnect between U.S. space operators and U.S. Pacific Command planners, who might each think about the impact of Chinese ASAT capabilities only within their narrow areas of responsibility. Others agreed that it was important to think through how the United States might operate in a Taiwan scenario with limited access to space; this scenario should be incorporated into future exercises to force creative responses and greater coordination.

Strategic Implications

A deployed Chinese ASAT capability would complicate the strategic military relationship between the United States and China. Although U.S. early warning and nuclear command and control communications satellites would not be vulnerable to the current direct-ascent ASAT, they could be targeted for denial by other means. Actions that cast doubt on the American ability to use its nuclear force effectively would set up a destabilizing strategic dynamic. A China expert noted that U.S. attacks on Chinese ground-based ASAT systems or components might inadvertently affect China's nuclear command and control system. A Chinese perception that the United States might be attacking its nuclear command and control would be very destabilizing. A space expert also suggested that one motive for China developing ASAT weapons is concern that U.S. space-based ballistic missile defenses might eventually negate China's nuclear deterrent. In this sense, ASAT weapons could be regarded as defensive in that they could prevent China from becoming vulnerable to a potential U.S. nuclear attack.

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The possibility of a U.S.-China space weapons race was discussed. A strategist noted that China probably exaggerates current U.S. space capabilities and overstates the likelihood that the United States will develop and deploy an extensive space weapons arsenal. Statements by U.S. advocates of space control or space weaponization coupled with U.S. reluctance to accept constraints on future space options encourages this misperception. One China expert noted that the People's Republic of China is probably sincere in proclaiming that it has no intention of engaging in an arms race. However, China is also unwilling to lock itself in a position of permanent vulnerability to the United States.

Several experts highlighted China's lack of transparency as a factor that aggravates the negative impact of the ASAT test on U.S.-China strategic relations. One China expert noted that the Foreign Ministry and Defense Ministry both initially claimed to be unaware of the test. China did not acknowledge the test publicly for 12 days. A Ministry of Foreign Affairs spokesman then gave a bland statement: "This test was not directed at any country and does not constitute a threat to any country"—a line also repeated in March by Prime Minister Wen Jiabao.[14] China's reluctance to discuss its military modernization frankly may strengthen its efforts to deter the United States from intervening in a Taiwan crisis, but it also reinforces U.S. suspicions about Chinese intentions and creates the possibility that the United States will overestimate future Chinese space capabilities and respond accordingly. Lack of transparency also heightens U.S. doubts about whether agreements with China to limit space weapons or to ban ASAT weapons could be verified.

One space expert suggested that China may be using a competitive strategies approach against the United States. Space may become an "offensive dominant" arena. By demonstrating a relatively inexpensive response to U.S. space dominance, China may calculate that the United States will pursue costly options that divert resources from other areas. China could avoid an expensive arms race by minimizing reliance on space assets and developing a relatively inexpensive set of asymmetric capabilities. Conversely, other China experts suggested that China's dependence on space for military purposes is likely to increase dramatically over the next 5 to 10 years. Foregoing space capabilities would greatly limit China's ability to fight an "informationalized war." The shift toward more symmetrical U.S. and Chinese dependence on space may create opportunities for arms control or restraint in the development of space weapons.

Countering Chinese ASAT Weapons

Most felt China is unlikely to be able to destroy most U.S. space assets in the near- or midterm. However, it may soon be able to use ASAT weapons to gain advantages in a Taiwan contingency. The group discussed a range of technical and operational means that might help counter potential Chinese ASAT capabilities:

- Direct attacks against Chinese ASAT systems. Attacking ground-based ASAT systems or components prior to launch or use might be effective against known high-powered lasers, but would have only limited utility against possible mobile ASAT systems that would likely be dispersed, hard to find, and located deep in China's interior. China experts noted that attacks inside Chinese territory would significantly escalate any conflict.
- Space-based weapons to attack Chinese ASAT systems or space assets. Some participants believed space-based weapons could potentially help protect U.S. satellites by attacking some types of Chinese ASAT weapons. Others disagreed and suggested that space-based weapons could create even greater insecurity. These systems would take years to develop and deploy and could cause the United States to embark on a costly path (both economically and politically). Some space experts suggested that China might hope to divert U.S. military modernization down this path.
- Rapid replenishment of damaged satellites. The ability to quickly launch replacement satellites could limit the military advantage from ASAT attacks. This is likely to be expensive and might be negated by increased Chinese deployment of less-expensive ASAT weapons.
- Satellites that are harder to find and harder to hit. Smaller satellites that incorporate stealth technology, employ countermeasures, or have the ability to maneuver would be harder for China to target and attack.
- Constellations of small satellites. Dispersing capabilities among a number of small satellites would reduce the vulnerability to the loss of any single satellite and complicate efforts to target U.S. space capabilities. It would also increase the robustness of the system by creating redundancies. This would require a shift in design philosophy and might not be applicable to all military space capabilities.
- Greater use of nonspace tactical reconnaissance systems. Aircraft and unmanned aerial vehicles could substitute for some space-based assets and would potentially be harder to target. However, they may not be able to loiter in critical or contested airspace, rendering them ineffective.
- Use of foreign satellites to increase the political costs of attacks. Some space experts suggested the United States could make greater use of Russian, European, or commercial communications or imagery satellites to take advantage of Chinese reluctance to attack commercial or foreign space assets. Others questioned the willingness of countries to take sides in a conflict, given their increasing economic stake in relations with China.

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U.S. officials should also consider some broader military and policy options:

- Learn to fight without satellites. The modern American way of war depends heavily on space capabilities. Learning to fight without them would take a concerted effort to develop and exercise alternate contingency plans and to field redundant capabilities. Some China experts noted that this would return the U.S. Navy to a 1970s style of fighting with carrier battlegroups and strike aircraft. A military expert noted that the United States needs to rethink the assumption that precision strike, intelligence/surveillance/reconnaissance, and bombers would always translate into military superiority, especially with a contested space environment.
- Consider diplomatic solutions. Diplomatic approaches, including arms control, offer the potential to deal directly with the strategic issues posed by ASAT weapons. These approaches might range from formal treaties on preventing an arms race in outer space or banning ASAT weapons to informal understandings about proper military uses of space. Most participants felt that negotiating and verifying a formal ban on ASAT weapons would be extremely difficult. Some believe that other arms control approaches might be more practical and still have considerable value.
- Adopt an international code of conduct on space behavior. Establishing a code of conduct or rules of the road would reinforce international norms about the right of countries to use space for peaceful purposes.[15] This could limit China's ability to conduct future ASAT tests and to develop more effective systems. Both arms control and code of conduct approaches would impose limits on U.S. freedom of action in space. In addition, a ban against actions that produce space debris would not address strategic issues associated with ASAT weapons or prevent the development of capabilities that could deny or disrupt satellite services. However, the space debris issue could be helpful in mobilizing commercial interests to actively oppose ASAT weapons or actions that interfere with the operations of satellites.
- Establish international partnerships to support peaceful uses of space. The Proliferation Security Initiative offers an example of partnerships among like-minded nations to counter malevolent international behavior. A Space Security Initiative could be developed to discipline actors who seek to limit international uses of space. The goal would be to enlist governmental and nongovernmental space users in efforts to prevent and penalize actions that might threaten the operation of satellites, including issues such as ASAT weapons, space debris, nuclear accidents in space, jamming of satellite communications, or intrusions into satellite broadcasts. The partnership could offer benefits such as shared surveillance of space debris and also serve as a vehicle for sanctions against countries or entities that violate a space code of conduct (whether they are signatories or not). All space-faring nations, including China, could become members of the partnership by agreeing to the code and enforcing its norms.

Dissuasion and Deterrence

Another approach is to try to dissuade China from developing ASAT capabilities and to deter China from using them in a conflict. Successful dissuasion would require the United States and other countries to impose costs on China if it continues efforts to develop and deploy ASAT weapons. A space expert noted that the lack of U.S. response to earlier tests might have led China to underestimate the costs of pursuing ASAT weapons. A China expert noted that U.S. complaints about earlier tests might have helped overcome the compartmentalized Chinese system and forced Chinese leaders to consider the full costs and benefits of the ASAT program. A strong response from the international community would reinforce dissuasion efforts, but most felt that China was currently paying relatively low costs for its ASAT test and ASAT program. Dissuading China from deploying ASAT capabilities would require greater efforts to raise the costs of ASAT deployment and to assure China that it can meet its security needs without deployment. The possibility of conflict over Taiwan greatly complicates this effort.

Most participants believe that China will probably continue developing ASAT weapons, though it might not test the direct-ascent ASAT system again (or do so only in a suborbital mode that would limit debris). Most felt the strategic value of ASAT weapons was high enough that China would likely deploy them. A few space experts argued that China prefers a treaty banning space weapons, although such an agreement would be inherently difficult to negotiate and verify (especially because some Chinese experts consider space-based surveillance assets to be space weapons). Most of the group dismissed the argument that China tested its ASAT to encourage the United States to negotiate about space weapons. Most felt China's primary motive in testing was to demonstrate a military capability that could increase the costs and risks of U.S. intervention in a Taiwan conflict. One participant suggested that although China would continue to champion a treaty banning space weapons, it might well support a code of conduct as an interim measure. Others noted that a code of conduct might address space debris but would do little to address the vulnerability of U.S. space assets.

Deterring the use of ASAT weapons also poses difficult challenges. China experts noted that China does not share the U.S.-Soviet experience with arms control, deterrence, mutual satellite reconnaissance, or dealing with incidents at sea. The U.S. military has internalized these norms into its doctrine and operations, but China does not necessarily accept or share them. While U.S. thinking about deterrence has traditionally focused on deterring conventional and nuclear aggression, deterrence might work differently in the space and cyber domains. The different context may complicate attribution and require rethinking thresholds for response.

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There was general agreement that lack of a clear declaratory policy makes it harder to deter attacks on U.S. satellites. Although some have suggested that destroying a U.S. satellite would be an act of war,[16] official U.S. policy views "purposeful interference with its space systems as an infringement on its rights."[17] However, determining if a lasing or jamming incident constitutes an attack that requires a response raises challenges for effective deterrence. Most participants felt the United States needed a clearer declaratory policy and that effective deterrence would also require the will to respond to attacks on U.S. satellites or computer systems. The U.S. response need not be tit-for-tat; the group discussed the possibility of asymmetric responses to jamming or lasing of U.S. satellites. These options raise complicated legal and operational issues that deserve further study.

U.S.-China Relations

The group also discussed what impact China's efforts to develop ASAT weapons—which most felt were aimed primarily at the United States—should have on U.S.-China relations. Some felt China's decision to conduct an ASAT test that generated space debris and efforts to develop other asymmetric capabilities that could reduce U.S. military advantages raise questions about whether China's behavior is consistent with the U.S. policy goal of making China a "responsible stakeholder" in the international system. Most in the group felt that ASAT weapons would be a militarily significant capability if the United States and China ever fought over Taiwan, but were uncertain how heavily to weight that contingency in the broader calculus of U.S.-China relations.

One China expert noted that if the United States wants to maximize the chances of dissuading Beijing from deploying and using ASAT weapons, then it should hold broader political and economic cooperation at risk. However, this would be costly for other important U.S. interests. Others agreed that economic interests and the need for cooperation with China on issues such as North Korea limit the degree to which the United States could make China pay a price for developing ASAT weapons. While international criticism of China for conducting the test and for heightening the risk to other satellites through space debris has had some impact on Beijing, calls for responsible behavior in space are unlikely to address the underlying strategic issues. A China specialist noted that the United States is still reluctant to accept a nuclear deterrent relationship with China that constrains U.S. freedom of action; a similar dynamic applies with respect to space. A strategist argued that this constraint is not wholly negative; it presents an opportunity to reexamine U.S. objectives and strategy in Asia and to ensure that U.S. strategy is consistent with U.S. interests.

Conclusion

The Chinese direct-ascent ASAT test raises difficult questions about China's intentions, U.S. responses, and the impact on broader U.S.-China relations. The United States has a range of potential responses to Chinese efforts to develop ASAT capabilities. Unfortunately, no single option is simple, cheap, or likely to be wholly effective. U.S. policymakers should consider both policy initiatives to limit Chinese deployment of ASAT

capabilities and technical and operational measures that would mitigate the impact on U.S. military capabilities if China does deploy ASATs. Deterring the use of ASAT weapons may pose new challenges that differ from previous U.S. experience with conventional and nuclear deterrence.

Both China and the United States will have important choices to make. Beijing will have to weigh the potential military benefits of developing and deploying ASAT weapons against the likely damage to U.S.-China relations and to its carefully cultivated image as a responsible country focused on peaceful development. Washington must balance the importance of its broader relationship with China against the need to maintain access to space for both military and commercial purposes. These considerations could lead both countries to exercise some degree of restraint in deciding how vigorously to pursue ASAT weapons and other counter-space capabilities.

However, strategic and bureaucratic imperatives could also create a negative dynamic that affects the broader U.S.-China relationship. The direct impact might take the form of heightened military competition as the United States responds to Chinese efforts to develop asymmetric capabilities such as ASAT weapons. The indirect impact might be felt if each side comes to view the other as a strategic threat and the competitive dimensions of U.S.-China relations overshadow the importance of cooperation in pursuit of common interests. This outcome is not inevitable, but the extension of U.S.-China competition into the space domain will complicate efforts to build a stable and constructive bilateral relationship.

Notes

[1] Participants in the February 15, 2007, roundtable included COL Michael Bell, USA (NDU); Richard Buenneke (The Aerospace Corporation); M. Elaine Bunn (NDU); John P. Caves, Jr. (NDU); Dean Cheng (CNA Corporation); Peter Hays (NDU); Theresa Hitchens (Center for Defense Information); Michael Krepon (Henry L. Stimson Center); Will Lahneman (NDU); Col Charles Lutes, USAF (NDU); Brad Miller (NDU); James C. Mulvenon (Center for Intelligence Research and Analysis); Kevin Pollpeter (Center for Intelligence Research and Analysis); Phillip C. Saunders (NDU); James A. Schear (NDU); Lt Col Michael ("Coyote") Smith, USAF (NDU); Baker Spring (The Heritage Foundation); and Martin Wayne (NDU). Participants expressed a range of views on the issues discussed in this report and should not be regarded as endorsing its contents or recommendations.

[2] For information on the Chinese ASAT test, see Craig Covault, "Chinese Test Anti-Satellite Weapon," *Aviation Week and Space Technology*, January 17, 2007 (first public mention of the test), available at <www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news/CHI01177.xml>; Geoff Forden, "A Preliminary Analysis of the Chinese ASAT Test," Massachusetts Institute of Technology, undated, available at <http://web.mit.edu/stgs/pdfs/A Preliminary Analysis of the Chinese ASAT Test handout.pdf>; and Shirley Kan, "China's Anti-Satellite Weapon Test," CRS Report for Congress (RS22652), April 23, 2007. Air Force Chief of Staff General Michael Moseley is quoted as stating that the Chinese missile was fired from a mobile launcher. See Jim Wolf, "China poses risk to key U.S. satellites," Reuters, April 12, 2007. U.S. Strategic Command Commander General James E. Cartwright, USMC, refers to two previous ASAT test attempts in his testimony before the Strategic Forces Subcommittee of the Senate Armed Services Committee on March 28, 2007.

[3] For a description of satellites in LEO, medium Earth orbit, and geostationary orbit, see Marco Caceres, "Orbiting Satellites: Bean-counter's heaven," *Aerospace America*, August, 2001; available at <www.aiaa.org/aerospace/Article.cfm?issuetocid=122&ArchiveIssueID=17>.

[4] General Cartwright's March 2007 testimony described China as undertaking "a very disciplined and comprehensive continuum of capability against space" that includes GPS jamming all the way through direct-ascent ASAT.

[5] See Phillip C. Saunders et al., "China's Space Capabilities and the Strategic Logic of Anti-Satellite Weapons," Center for Nonproliferation Studies, July 2002, available at <http://cns.miis.edu/pubs/week/020722.htm>; Michael P. Pillsbury, "An Assessment of China's Anti-Satellite and Space Warfare Programs, Policies And Doctrines," Report for the U.S.-China Economic and Security Review Commission, January 19, 2007, available at <www.uscc.gov/researchpapers/2007/FINAL_REPORT_1-19-2007_REVISED_BY_MPP.pdf>; and "PRC Experts Discuss Countering Reconnaissance Satellites with Jamming, Camouflage," Open Source Center CPP20070111465001.

[6] Office of the Secretary of Defense, "Annual Report to Congress: Military Power of the People's Republic of China 2006," 35, available at <http://stinet.dtic.mil/dticrev/PDFs/ADA449718.pdf>.

[7] Warren Ferster and Colin Clark, "NRO Confirms Chinese Laser Test Illuminates U.S. Spacecraft," *Defense News*, October 2, 2006, available at <www.defensenews.com/story.php?F=2141128&C=airw>.

[8] Dean Cheng makes this point in "China's A-Sat Test: Of Interceptors and Inkblots," *Space News* 18, no. 6 (February 12, 2007), 17, 19.

[9] The coordinator of China's defense white paper has told U.S. scholars that language on preventing an arms race in outer space was not included because China published a separate white paper on arms control and nonproliferation in 2005.

[10] "The recent test conducted by China in outer space was not directed against any country. It did not pose a threat to anyone, nor did it violate the relevant international treaties. China stands for the peaceful use of outer space and opposes arms race in outer space. I wish to solemnly reiterate here that China's position on the peaceful use of outer space remains unchanged. I also wish to call on the countries concerned to negotiate and conclude a treaty on the peaceful use of outer space at an early date." See Chinese Ministry of Foreign Affairs, "Premier Wen Jiabao's Press Conference," March 17, 2007, available at <www.fmprc.gov.cn/eng/zxxx/t304313.htm>.

[11] For an exploration of the Chinese decisionmaking process on the ASAT test, see James C. Mulvenon, "Rogue Warriors? A Puzzled Look at the Chinese ASAT Test," *Chinese Leadership Monitor*, No. 20 (Winter 2007), available at <http://media.hoover.org/documents/clm20jm.pdf>.

[12] One useful analysis is Kevin Pollpeter, "The Chinese Vision of Space Military Operations," in *China's Revolution in Doctrinal Affairs: Emerging Trends in the Operational Art of the Chinese People's Liberation Army*, ed. James C. Mulvenon and David Finkelstein (Alexandria, VA: CNA Corporation, 2005), 329–369.

[13] Taiwan's remote sensing satellites can photograph objects as small as about 10 feet in size, a capability good enough to count cruise missiles pointed at Taiwan from the Chinese mainland. See Craig Covault, "China's ASAT will intensify U.S.-Chinese faceoff in space," *Aviation Week and Space Technology*, January 21, 2007, available at <www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news/aw012207p2.xml>.

[14] Chris Buckley, "China confirms satellite test, says no threat," Reuters, January 23, 2007.

[15] See Henry L. Stimson Center, "Code of Conduct for Space-Faring Nations," February 2007, available at <http://www.stimson.org/?SN=WS200702131214>.

[16] For example, see the remarks of Air Force Chief of Staff Michael Moseley, quoted in Dave Fulghum, "U.S. Eyes China ASAT Fallout," *Aviation Week and Space Technology*, May 1, 2007.

[17] National Security Presidential Directive 49, "U.S. National Space Policy," August 31, 2006, available at <www.ostp.gov/html/US%20National%20Space%20Policy.pdf>.

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