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Space and Sino-American Security Relations

Peter L. Hays

China's emphasis on space exploration and its development and use of space capabilities are prominent and tangible expressions of its emergence as a great power and make space an increasingly important dimension of Sino-American relations. In October 2003 China independently launched and recovered its first taikonaut, becoming just the third member of an elite spacefaring club with Russia and the United States. Then in January 2007 China first successfully tested a kinetic energy anti-satellite (ASAT) weapon and again joined Russia and the United States as one of only three states known to have demonstrated this capability. China's growing power and space emphasis may become manifest in mostly peaceful and cooperative ways or may lead to increasing competition and perhaps even conflict with the United States.

Addressing four issue areas can help provide context and focus for these concerns: contrasting Chinese and American views of space and comparing the place of space during the Cold War with its role in the current global security environment; reviewing the evolution of security space capabilities and superpower space arms control; evaluating the role of space capabilities in Sino-American security interrelationships, particularly with respect to a potential conflict over Taiwan; and assessing the prospects for a range of possible cooperative ventures and transparency- and confidence-building measures (TCBMs). Defusing space apprehensions will be difficult and there are currently several worrisome trends, but space holds unique potential to help define the Sino-American security relationship and shape the very future of humanity. If Beijing and Washington can work towards resolving or at least lessening space tensions they will not only better manage their overall relationship but also open more opportunities to use space for the benefit of all humanity through pursuit of genuinely cooperative spacepower objectives such as joint science and exploration missions, generating wealth in space, harvesting energy from space, and, ultimately, improving the odds for humanity's survival by better protecting Earth and creating capabilities to become a multi-planetary species.

Cold War Baggage and Differing Perspectives

Although each is far from monolithic, China and the United States often view the costs and benefits of exploring and using space in different ways; their perspectives reflect the times and environments in which their space capabilities developed and the challenges they were designed to address. Sometimes it can also be difficult to synthesize the statements and actions of China and the United States into a single perspective about space since each has a number of powerful domestic space actors and these organizations at times speak and act in conflicting ways. In addition, their perspectives about space have evolved due to shifts in the relative power of China and the United States and other changes in the global environment. Despite these challenges, it is now more important than ever to continue synthesizing these space perspectives and building a better foundation of shared perceptions and understanding for future dialogue and actions about space security and other issues.

China and the United States started their space activities in very different ways. The United

States first articulated its highest priorities for space in a then-classified policy document, National Security Council (NSC)-5520, signed by President Dwight Eisenhower in May 1955. NSC-5520 indicated that the primary U.S. rationale for going to space was to attempt to open up the closed Soviet state via secret reconnaissance satellites and laid out a process for the United States to help establish a new legal regime for space that would legitimize their overflight of the Soviet Union.[1] Although secret, this policy was an important factor in shaping the opening of the space age and, in retrospect, helps explain the structuring of United States space activities both then and now. For example, it sheds light on issues such as why the United States: did not race the Soviets into space, used its International Geophysical Year (IGY) scientific satellite program as a "stalking horse" to test the acceptability of reconnaissance satellite overflight, is not interested in drawing a clear demarcation line between air and space, and in public diplomacy strongly emphasizes separate civil and military space sectors and the use of space for "peaceful purposes."[2] The United States first successfully recovered satellite imagery of the Soviet Union in August 1960 and created the National Reconnaissance Office (NRO) a year later. Collecting intelligence data has been a primary U.S. space mission ever since.

Intelligence collection from space soon also developed an essential, enabling, and symbiotic relationship with superpower arms control. This role began with the Vela Hotel nuclear detonation detection satellite system that allowed the 1963 Limited Test Ban Treaty to extend the prohibited area for nuclear testing into space, was first codified as "National Technical Means" (NTM) of verification in the 1972 Anti-Ballistic Missile (ABM) Treaty, and remains the most important verification mechanism for several arms control regimes. The NTM language in Article XII of the ABM Treaty was repeated in many subsequent treaties and remains a part of the international legal regime for space despite U.S. withdrawal from the ABM Treaty in 2002. This language helps indicate that NTM are a peaceful use of space, highlights direct interrelationships between NTM capabilities and the units of limitation in arms control agreements, establishes some degree of protection for space-based intelligence collection in international law, but clearly stops well short of being a blanket ban on ASAT weapons or even an explicit approval of all spying from space.

China, by contrast, was not involved in structuring the legal regime at the opening of the space age, has never made collecting intelligence data from space its highest priority space mission, is wary of the role of NTM in TCBMs, and has only limited experience with strategic arms control. Like many other major spacefaring states around

[1]The best and most comprehensive analysis of the complex maneuvering by the superpowers at the opening of the space age remains Walter A. McDougall's Pulitzer Prize-winning . . . *the Heavens and the Earth: A Political History of the Space Age* (New York: Basic Books, 1985). NSC-5520 is reprinted in John M. Logsdon, ed. *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program*, Vol. I, *Organizing for Exploration* (Washington, D.C.: NASA History Office, 1995), 308-313. McDougall in *Heavens and Earth* and R. Cargill Hall's introductory essay, "Origins of U.S. Space Policy: Eisenhower, Open Skies, and Freedom of Space," in *Exploring the Unknown* masterfully develop the context and purposes of NSC-5520.

[2]Hall uses the term *stalking horse* to describe the purpose of the IGY satellite in relation to the WS-117L (America's first reconnaissance satellite program). *Peaceful purposes* for space activity are often referenced and cited but never authoritatively defined. For a revisionist analysis of the IGY program see Rip Bulkeley, *The Sputniks Crisis and Early United States Space Policy: A Critique of the Historiography of Space* (Bloomington: Indiana University Press, 1991).

the world, China does not make clear distinctions between its civil and military space activities, pursuing instead many advanced capabilities with military applications, sometimes even with foreign partners such as on the China-Brazil Earth Resources Satellite (CBERS) program. In 1956 Chairman Mao Zedong set China on a path towards strategic modernization by urging development of "two bombs, one satellite." After developing atomic and thermonuclear bombs, China launched its first satellite, the *Dong Fang Hong* I, in April 1970; this system combined a radio transmitter with tests of satellite technology and science experiments to take readings of the ionosphere and atmosphere. Today China operates a number of dual-use remote sensing satellites but they do not constitute a separate sector of Chinese space activity and they have no organization apparent to western analysts that is equivalent to the NRO.

China's position on NTM during negotiations on the Comprehensive Test Ban Treaty is perhaps the best example of how differently Chinese and Americans view this capability. Although it eventually signed the treaty, China has not yet ratified it and also submitted a signing declaration objecting to the use of NTM as an adequate basis for inspections and opposing "the abuse of verification rights by any country, including the use of espionage or human intelligence to infringe on the sovereignty of China."[3] Even more importantly, China and the United States have no shared experience with strategic arms control, a process that arguably provided the most important channel for maintaining United States-Soviet communications and developing shared understanding of key strategic concepts throughout the Cold War. Using space or some other key dimension of their relationship to build a broader foundation for subsequent strategic dialogue needs to become a high priority for Beijing and Washington since it is very unlikely shared understanding can be developed in real-time during a crisis.

United States and Chinese civil space activities align more closely but are more than forty years out of phase. Following the Soviet triumphs with the first satellite and the first manned orbital flight, the United States reprioritized its objectives in space and publicly emphasized human spaceflight and the civil space sector much more than intelligence or military space missions. The United States shaped the Moon Race as a high technology and ideological contest for prestige, betting that space successes would translate into increased allegiance from the developed and developing worlds. The superpowers also made some effort to pursue cooperative civil space activities but the Apollo-Soyuz Test Project of 1975 proved to be the high water mark for these efforts during the Cold War.

The end of the Cold War removed one important motivation for prestige-based civil space activities and strengthened incentives to pursue cooperative ventures such as the International Space Station (ISS). The United States also had important counterproliferation objectives in employing Russian space scientists in the civil sector as major partners on the ISS effort and lessening their potential to contribute to the weapons market. In addition, development and use of the aerospace workers and industrial base that supports civil and all other space activities are significantly out of phase in the United States and China. The United States has lost 750,000 scientific and technical workers since the end of the Cold War, 60 percent of aerospace industry workers are over age 45,

[3]"China's Attitude Toward National Technical Means (NTM) of Verification," available from Nuclear Threat Initiative (NTI) website at http://www.nti.org/db/china/ntmpos.htm; downloaded on 16 January 2009.

and 25 percent are eligible to retire; by contrast, a large percentage of the Chinese aerospace industry workforce is under age 45 and the Chinese graduate some 351,500 engineers each year, versus about 137,400 engineers graduated from four year engineering programs in the United States.[4]

China's civil space effort began in earnest in the post-Cold War era; it pursues human spaceflight and exploration for prestige and to set China apart as a great power. From the beginning, however, all Chinese space activity, including its civil space activity, has been either directly or indirectly controlled by the People's Liberation Army (PLA). Although some Chinese civil space efforts began in the 1950s and the China National Space Agency (CNSA) was established in 1993, ostensibly to direct China's civil space program, under the current bureaucratic structure and for "most of its existence CNSA was embedded within the Commission for Science, Technology, and Industry for National Defense (COSTIND), a higher ministerial entity that oversaw many of China's defense industries."[5] Moreover, CNSA appears to have little decision-making authority; its main function seems to be to interface with foreign space agencies, a role similar to that played by the Ministry of Defense and other organizations within the Chinese government that present this type of façade as the way the outside world is to interact with the Middle Kingdom. The U.S. Department of Defense believes that "the majority of the technology used in China's manned space program is derived from Russian equipment, and China receives significant help from Russia with specific satellite payloads and applications."[6] China launched its first lunar orbiter, the *Chang'e*-1, in October 2007; "successful completion of this mission demonstrated China's ability to conduct complicated space maneuvers – a capability which has broad implications for military counterspace operations."[7]

Now that it has achieved its major initial prestige goals, China may become more interested in partnering on cooperative efforts

[4]Kevin Pollpeter, *Building for the Future: China's Progress in Space Technology During the Tenth 5-Year Plan and the U.S. Response*, (Carlisle: Strategic Studies Institute, U.S. Army War College, March 2008), 38-9; and Aerospace Industries Association, *The Role of Space in Addressing America's National Priorities*, (Washington: Aerospace Industries Association, January 2009), 11. Complicating comparisons, there is considerable controversy about the accuracy of reported numbers of engineering graduates as well as questions about the consistency of criteria and accreditation for engineering degrees, see Gerald W. Bracey, "Heard the One about the 600,000 Chinese Engineers?" *Washington Post*, 21 May 2006, p. B3.

[5]Dean Cheng, "Beginning the Journey of a Thousand Miles? Prospects and Pitfalls of US-China Space Cooperation," *The Space Review*, 23 March 2009. Cheng explains that COSTIND "was downgraded in a March 2008 Chinese governmental reorganization, which saw many parts of the space bureaucracy subsumed under, after several iterations, what is now called the Ministry of Industry and Information Technology (MIIT). Yet, there has yet been little indication of whether CNSA remains subordinate to this lower entity (the State Administration for Science, Technology, and Industry for National Defense or SASTIND), is its bureaucratic equivalent, or is now independent of the military-industrial bureaucracy. More troubling is the lack of explanation on how CNSA relates to the PLA, and specifically the General Armaments Department (GAD)—one of the four General Departments that manages the PLA. The GAD is apparently responsible for managing all of China's space infrastructure, i.e., its launch facilities and mission control centers. It will also, according to press reports, be responsible for the new Chinese space lab (the Tiangong). Yet, despite its importance, the GAD is rarely mentioned in official Chinese documents on their space program." Downloaded from http://www.thespacereview.com/article/1335/1 on 18 June 2009.

[6]*Annual Report to Congress: Military Power of the People's Republic of China 2008* (Washington: Office of the Secretary of Defense, Department of Defense, April 2008), p. 3.

[7]*Ibid*.

such as the ISS or other joint projects to pursue the ambitious exploration goals it has espoused that include a permanently inhabited space station and a lunar landing by 2020. It is not clear, however, whether China will continue to pursue civil space objectives primarily unilaterally, will work increasingly with the very diverse members of the Asia-Pacific Space Cooperation Organization (APSCO) it has established,[8] or partner with other major space actors. If China is interested in pursuing cooperative civil space efforts with the United States, it will need to make that more clear than it did to Michael Griffin in September 2006 when he made the first visit by a NASA Administrator to China yet was granted only limited access to his counterpart space decision makers and other space personnel and facilities. The rhetoric during the October 2009 visit of the second-highest ranking PLA member, General Xu Caihou, vice chairman of the Chinese Central Military Commission, to a number of important U.S. locations including the headquarters of Strategic Command, as well as the dialogue between Presidents Hu Jintao and Barak Obama during Obama's November 2009 visit to Beijing offer an opportunity to begin building cooperative space efforts and developing better space and security relationships.

United States and Chinese commercial space objectives probably align most closely but they are also out of sync and face considerable friction due to economic competition, protectionist policies, and export controls. The United States was first to develop space services such as communications, remote sensing, launch, and positioning, navigation, and timing capabilities but did so within the public sector. This approach began to change in the 1980s, first with the November 1984 Presidential Determination to allow some private sector communication services to compete with Intelsat, and continued with subsequent policies designed to foster development of a commercial space sector. By the late 1990s commercial space activity worldwide had outpaced government activity and although government space investments remain very important, they are likely to become increasingly overshadowed by commercial activity. Other clear commercial and economic distinctions with the Cold War era have even more significant implications: whereas the Soviet Union was only a military superpower, China is a major U.S. trading partner and an economic superpower that recently passed Germany to became the world's third largest economy, is poised to pass Japan soon, and is on a path to become larger than the U.S. economy, perhaps within only ten years. Because of its economic muscle, China can afford to devote commensurately more resources to its military capabilities and will play a more significant role in shaping the global economic system. For example, China holds an estimated $1.4 trillion in foreign assets (mainly U.S. treasury notes), an amount that gives it great leverage in the structure of the system.[9]

Beginning in the 1990s, China made major efforts to break into commercial space markets, especially with launch vehicles, but this progress significantly slowed after U.S. aerospace firms Hughes and Loral worked with insurance companies to analyze Chinese launch failures in January 1995 and February 1996. A congressional review completed in 1998 (Cox Report) determined these analyses violated the International Traffic in Arms Regulations (ITAR) by communicating technical information to the Chinese. The

[8] APSCO is headquartered in Beijing and began formal operations in December 2008. China, Bangladesh, Iran, Mongolia, Pakistan, Peru and Thailand are member states and Indonesia and Turkey also signed the APSCO convention

[9] James Fallows, "The $1.4 Trillion Question," *The Atlantic*, January/February 2008.

1999 National Defense Authorization Act transferred export controls for all satellites and related items from the Commerce Department to the Munitions List administered by the State Department.[10] The stringent Munitions List controls contributed to a severe downturn in both U.S. satellite exports and in China's share of the worldwide launch services market.[11] To avoid these restrictions, foreign satellite manufacturers, beginning in 2002 with Alcatel Space (now Thales) and followed by European Aeronautic Defense and Space (EADS), Surrey Satellite Company, and others replaced all U.S.-built components on their satellites to make them "ITAR-free" and Russia now dominates the commercial space launch market.[12] The ITAR irritant in Sino-American commercial space relations can be salved if U.S. export control policy can find a better way to balance the conflicting objectives of developing mechanisms to keep dual-use technologies thought to be dangerous out of the wrong hands while promoting exports of benign commercial space technology. Congress and the Obama Administration should make it a priority to reevaluate current U.S. export controls and adjust policies and regulations accordingly. Excellent starting points are the recently released recommendations for rebalancing overall U.S. export control priorities in the congressionally mandated National Academies of Science (NAS) study.[13] In addition, the United States should implement key recommendations from the Center for Strategic and International Studies (CSIS) study on the space industrial base such as removing from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use.[14]

[10]The January 1995 failure was a Long March 2E rocket carrying Hughes-built Apstar 2 spacecraft and the February 1996 failure was a Long March 3B rocket carrying Space Systems/Loral-built Intelsat 708 spacecraft. Representative Christopher Cox (R.-California) led a six-month long House Select Committee investigation that produced the "U.S. National Security and Military/Commercial Concerns with the People's Republic of China" Report released on 25 May 1999. The report is available from http://www.house.gov/coxreport. In January of 2002, Loral agreed to pay the U.S. government $20 million to settle the charges of the illegal technology transfer and in March of 2003, Boeing agreed to pay $32 million for the role of Hughes (which Boeing acquired in 2000). Requirements for transferring controls back to state are in Sections 1513 and 1516 of the Fiscal Year 1999 National Defense Authorization Act. Related items are defined as "satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and non-embedded solid propellant orbit transfer engines."

[11]Satellite builders claim that their exports dropped 59 percent in 2000 and that since March 1999 their share of the global market declined sharply (from 75 percent to 45 percent). Evelyn Iritani and Peter Pae, "U.S. Satellite Industry Reeling Under New Export Controls," *Los Angeles Times*, 11 December 2000, p. 1. According to *Space News*, 2000 marked the first time that U.S. firms were awarded fewer contracts for GEO communications satellites than their European competitors (the Europeans were ahead 15 to 13). Peter B. de Selding and Sam Silverstein, "Europe Bests U.S. in Satellite Contracts in 2000," *Space News*, 15 January 2001, pp. 1 and 20.

[12]Peter B. de Selding, "European Satellite Component Maker Says it is Dropping U.S. Components Because of ITAR," *Space News Business Report*, 13 June 2005; and Douglas Barrie and Michael A. Taverna, "Specious Relationship," *Aviation Week & Space Technology*, 17 July 2006, pp. 93-96.

[13]National Research Council, *Beyond "Fortress America:" National Security Controls on Science and Technology in a Globalized World* (Washington: National Academies Press, 2009). With the new administration and Congress as well as former Congresswoman Ellen Tauscher now confirmed in the key position of Under Secretary of State for Arms Control and International Security, conditions for changing the space export control law are the most favorable they have been for the last decade.

[14]"Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls," (Washington: Center for Strategic and International Studies, February 2008).

Cold War Evolution of Security Space Capabilities and Space Arms Control

Understanding the evolution of space capabilities and negotiations during the Cold War provides an essential foundation for assessing current Sino-American space security issues and evaluating the prospects for space TCBMs. Three major lessons stand out from superpower space security developments during the Cold War: First, the superpowers used space to bolster their strategic warning, communications, and nuclear force structure in significant ways and also conducted extensive testing and limited deployments of ASATs, but both sides chose to end their ASAT deployments without reaching a formal space arms control agreement. Second, the superpowers devoted considerable effort towards negotiations on ASAT arms control and on the Defense and Space Talks but were unable to come close to signing any treaties, agreeing to space "rules-of-the-road," or even defining what constitute offensive or defensive space systems. Finally, all the ASAT testing, deployments, and deactivations show that some level of arms control and stability can be achieved without a formal treaty. For open, pluralist democracies like the United States, arms are *always* controlled as a part of normal debates over guns versus butter and open dialogue about the strategic utility of specific weapons systems. These mechanisms for controlling arms hold the potential to become increasingly important for China if it chooses to embrace democratic processes, publicly debate guns versus butter issues, and engage in transparent dialogue over the strategic utility of space weapons.

The United States began very limited testing of ASAT capabilities in the late 1950s and both superpowers tested and deployed a small number of ASAT systems from the 1960s through the 1980s. From 1963 to 1975, the United States tested and deployed two types of nuclear armed, direct ascent ASAT systems: Program 505, modified Army Nike Zeus missiles stationed at Kwajalein Atoll in the Pacific Missile Range; and Program 437, Air Force Thor missiles on Johnson Island in the Pacific.[15] Between October 1968 and June 1982 the Soviets conducted at least 20 tests of their co orbital ASAT system that employed a warhead with explosively-propelled metal pellets and launched atop a Tsyklon-2 booster from Tyuratam (now Baikonur Cosmodrome in Kazakhstan). By the mid-1970s these ASAT deployments as well as employment of other increasingly comprehensive and mature space capabilities began to reveal basic truths about the attributes of military space systems and the strategic balance in space—many of which remain valid today. A 1976 study for the NSC concluded that a U.S. ASAT would not enhance the survivability of U.S. satellites by deterring use of the Soviet ASAT because the U.S. was more dependent on space than the Soviets.[16] The report also concluded, however, that a U.S. ASAT could be used to counter the threat to U.S. forces posed by Soviet space-based targeting systems such as Radar Ocean Reconnaissance Satellites (RORSATs) and Electronic Intelligence Ocean Reconnaissance Satellites (EORSATs) and that the development of a U.S. system could serve as a "bargaining chip" in possible U.S.-U.S.S.R. ASAT arms control negotiations. In one of the final acts of his presidency, on 18 January 1977 President Gerald Ford signed National Security Decision Memorandum (NSDM)-345, directing the

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[15]Paul B. Stares, *The Militarization of Space: U.S. Policy 1945-84* (Ithaca: Cornell University Press, 1985), p. 121.

[16]*Ibid*., 170. The vulnerability of U.S. Defense Support Program ballistic missile launch detection satellites in Geostationary Earth Orbit (GEO) to being "blinded" by Soviet ground-based lasers was apparently first demonstrated in September and October 1975, adding to U.S. concerns about the survivability and utility of its military space assets. See Stares, *Militarization of Space*, 169; and *U.S. Military Uses of Space, 1945-199: Guide and Index* (Washington: National Security Archive, 1991), "Chronology," p. 41.

Department of Defense to develop an operational ASAT system.[17] This initiated the air-launched miniature homing vehicle (MHV) ASAT program and set the stage for two-track ASAT negotiations during the Carter Administration.

U.S. and Soviet negotiators met for three rounds of ASAT talks: 8-16 June 1978 in Helsinki, 23 January-16 February 1979 in Bern, and 23 April-17 June 1979 in Vienna. The two sides apparently were far apart on most issues during the first two sessions and by the third session had drawn closer together but only by limiting the depth and scope of the original objectives. Some of the controversies that have publicly emerged include debates over: an ASAT ban versus limitations or rules of the road; the degree of protection afforded to third-party satellites; long versus short testing moratoria; and how to deal with systems having latent ASAT capabilities—for example, the Soviets insisted that the U.S. Space Shuttle then under development be included as an ASAT system.[18] By the third session, both sides reportedly tabled draft agreements that only covered provisions on "no use" of ASAT weapons but even at this longest negotiating session they were unable to reach closure on this most basic issue.[19] Carter Administration focus on attempting to get the second Strategic Arms Limitation Treaty (SALT II) ratified, the breakdown of U.S.-U.S.S.R. relations following the Soviet invasion of Afghanistan, and the arrival of the Reagan Administration with its initial lack of enthusiasm for arms control spelled the end of the ASAT negotiations.

The 1978-79 ASAT negotiations were the most militarily focused space-related arms control effort of the Cold War era and offers important specific lessons. Failure to reach any agreement at these negotiations underscores significant conceptual and operational difficulties involved in developing meaningful ASAT arms control agreements including strategic and doctrinal conflicts regarding the military utility of space; unavoidable overlaps and dual-use issues with respect to civil, commercial, and military space capabilities; and a lack of clarity regarding foundational definitions as well as the proper scope and object of ASAT arms control. Unresolved ASAT arms control issues at the time included: whether the primary objective should be to ban the development and testing of dedicated ASAT systems or to create TCBMs such as no use pledges, rules of the road, and keep out zones; conceptual and verification problems related to the growing number of systems with significant residual ASAT capability and the considerable military potential of even a few covert ASAT systems; and questions concerning whether the scope of the negotiations should cover some superpower satellites, all military satellites, or

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[17]Stares, *Militarization of Space*, p. 171. President Ford apparently was "very upset and concerned about the relaxed approach of the Defense Department" towards developing a new ASAT system and felt "the only thing to do was to issue a formal directive." According to Donald Hafner, an analyst with the NSC ASAT Working Group during 1977-78,: "Secretary of State Kissinger argued that the U.S. should redress any asymmetry in ASAT capabilities between the two sides before any arms control restraints were considered. The directive [NSDM-345] by the Ford Administration to go ahead with the MHV system did call for a study of arms control options, but it did not include any concrete proposal for inviting the Soviets to ASAT talks. Kissinger may have felt it was premature to make such a proposal; or indeed, he may not have favored negotiations at all." See Donald L. Hafner, "Averting a Brobdingnagian Skeet Shoot: Arms Control Measures for Anti-Satellite Weapons," *International Security* 5 (Winter 1980/81), pp. 50-51.

[18] Stares, *Militarization of Space*, p. 197; and John Wertheimer, "The Antisatellite Negotiations," in *Superpower Arms Control: Setting the Record Straight*, eds. Albert Carnesale, and Richard N. Haass, (Cambridge, Mass.: Ballinger Publishers, 1987), pp. 145-46. The ASAT talks, like all serious international negotiations, were conducted in secret in order to encourage candor and flexibility; the negotiation record remains classified.

[19]Stares, *Militarization of Space*, pp. 198-99.

all (including third-party) satellites. Breakdown of these negotiations also highlights difficulties with two-track approaches to arms control. Two-track approaches are seemingly attractive for dealing with divergent positions within an administration but they may actually impede progress towards eventual resolution of policy differences by creating committed constituencies behind each track that oppose the compromises that may be required to create coherent policy. Paul Stares argues that the U.S. two-track approach to ASAT arms control legitimized and perpetuated the MHV ASAT system—a system he believes had value only as a bargaining chip. Finally, failure to reach agreement also highlights what Ashton Carter refers to as the "basic paradox of ASAT arms control:" the inverse relationship between ASATs and incentives to place very threatening military systems in space.[20] This paradox emphasizes that space weapons cannot be divorced from terrestrial security considerations, the natural offense-defense dialectic, and the trade-offs inherent in all strategic thinking. Accordingly, any benefits ASAT arms control may provide in limiting space debris or protecting stabilizing space systems such as those that provide hotlines, early warning, or NTM must be balanced against the role of ASATs in discouraging potentially destabilizing space missions such as space-to-Earth force application. This basic paradox, together with the major conceptual difficulties outlined above call into question the overall desirability of ASAT arms control.

During the 1980s the United States and Soviet Union tested kinetic energy ASAT systems, negotiated, and eventually stopped most testing and deployments. Congress imposed various restrictions on ASAT development and testing in response to the unilateral Soviet ASAT test moratorium announced in August 1983 and questions about the commitment of the Reagan Administration to pursuing ASAT arms control. The timing of the Soviet moratorium was no accident, coming shortly after President Reagan's "Star Wars" speech, a pivotal event which reopened continuing debates over the utility of strategic defenses that overshadow discussions about ASATs and space weapons. In order to justify continuing development and testing, the administration was required to submit to Congress a report, "U.S. Policy on ASAT Arms Control" in March 1984.[21] The report detailed more than four pages of "Problems Facing ASAT Arms Control" and reached the following conclusions with respect to deterrence and ASAT arms control:

> Deterrence provided by a U.S. ASAT capability would inhibit Soviet attacks against U.S. satellites, but deterrence is not sufficient to protect U.S. satellites. Because of the potential for covert development of ASAT capabilities and because of the existence of non-specialized weapons which also have ASAT capability, no arms control measures have been identified which can fully protect U.S. satellites. Hence, we must continue to pursue satellite survivability measures to cope with both known and technologically possible, yet undetected, threats.[22]

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[20]Ashton B. Carter, "Satellites and Anti-Satellites: The Limits of the Possible," *International Security* 10 (Spring 1986), p. 68.

[21]Executive Office of the President, "Report to Congress: U.S. Policy on ASAT Arms Control," 31 March 1984; microfiche document 00075 in *Military Uses of Space*. This is the unclassified version of the report; a more detailed classified version was also delivered to Congress at the same time.

[22]*Ibid*., p. 9. The ASAT arms control problem areas listed included: verification, breakout, disclosure of information, definitions, vulnerability of satellite support systems, and the Soviet non-weapon military space threat. Assistant Director of the Arms Control and Disarmament Agency, Dr. Henry F. Cooper, and Deputy Under Secretary of Defense for Strategic and Theater Nuclear

Following this report, the administration was successful in preventing further limitations on ASAT testing and also managed to water down previous restrictions.[23] This allowed the most complete test of the MHV ASAT on 13 September 1985 when it successfully intercepted and destroyed Air Force satellite P78-1 at an altitude of approximately 330 miles.[24] Although just the start of a planned test series, this proved to be the MHV's only test against a satellite in space. A December 1985 congressional amendment banned testing against objects in space unless the President certified the Soviets violated their moratorium by conducting a dedicated ASAT test, effectively giving the Soviets a veto over further U.S. testing.[25] The United States and Soviet Union also conducted years of apparently fruitless negotiations about strategic defenses and space weapons in the Defense and Space Talks begun in 1985. It should be instructive that this was the only category of superpower arms control negotiations started in the 1980s that did not produce a treaty; the Intermediate Range Nuclear Forces Treaty was signed in December 1987 and the Strategic Arms Reduction Treaty was signed in July 1991. Finally, strategic defenses had become the central issue in strategic relations between the superpowers and a catalyst for the end of the Cold War as shown, among other things, by General Secretary Mikhail ***Gorbachev***'s rejection of U.S. proposals at the Reykjavik Summit of October 1986 for continued testing of missile defenses while proceeding over ten years to eliminate all ballistic missiles and thereafter abolish all offensive nuclear weapons, and the end of the Cold War just five years later.

Forces, T.K. Jones, did most of the drafting of the report. The Services were not principle participants in any of the discussions leading to this report but they did, along with the Central Intelligence Agency, draft the appendices in the classified version of the report.

[23]Stares, *Militarization of Space*, p. 233.

[24]The Air Force Space Test Program satellite P78-1 was an experimental system launched in February 1979 that was designed to study the sun's corona. P78-1 was still operational in a LEO between 319 to 335 nautical miles in altitude when it was destroyed by the MHV. The last piece of tracked debris from this test did not decay out of orbit until 2002.

[25]On 12 December 1985, immediately prior to this new and much more serious restriction, the Air Force had placed two instrumented target vehicle (ITV) satellites into LEO of approximately 200 by 480 nautical mile orbits. See "Launch Listing" in *Military Uses of Space*, 118-19. These ITVs cost $20 million, had a limited lifetime, and were specifically designed to minimize debris while providing data on MHV intercepts, see Michael R. Gordon, "Air Force to Test a Weapon in Space," *New York Times*, 20 February 1986, p. A18.

Space in the Sino-American Security Relationship and in a Taiwan Conflict Scenario

Strategic analysts debate whether modern technology can change the basic nature of warfare and how much it has modified fundamental precepts such as mass and the fog of war, but most agree that modern technologies including space capabilities have radically altered the tactics and conduct of war. The evolution of warfare through World Wars I and II showed that coupling the increasingly lethal products of the industrial revolution with improved military organizations and doctrine created a fearsome attrition-based war machine. Modern attrition warfare also necessitated development of what Stephen Biddle calls the modern system: a complex combined arms approach to fire, maneuver, and concealment that enables survival and military effectiveness but requires an adaptive and well trained military to produce the skills required for success in the modern battlespace.[26] The modern system exacerbates disparities in military

[26]Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004).

effectiveness because militaries that lack the resources to adopt a complex combined arms approach or fail to adapt are punished severely in conventional warfare. These factors have also created incentives for development of "hybrid warfare," an approach that attempts to exploit sanctuaries associated with traditional legal constructs for warfare and other vulnerabilities by employing all forms of war and tactics (conventional, irregular, and terrorist), perhaps even simultaneously.[27]

The United States has been at the forefront of employing the modern system and developing a space-enabled global reconnaissance, long-range precision strike complex. Operation Desert Storm in 1991 marked the emergence of space-enabled warfare when a wide range of space systems including those designed for Cold War strategic missions such as the Defense Support Program (DSP) missile launch detection satellites and other constellations that were not yet completed such as the Global Positioning System (GPS) produced transformational effects from the lowest tactical level, for instance guiding individual vehicles across trackless deserts, up through the highest strategic level, including helping to keep Israel out of the conflict. In Operation Desert Storm less than eight percent of air-delivered munitions were precision-guided (none by GPS) and satellites provided only one megabit per second (Mbps) communications connectivity to battalion-sized units deployed in theater; by the time of Operations Enduring Freedom and Iraqi Freedom in 2001 and 2003, almost 70 percent of air-delivered munitions were precision-guided (mostly by GPS) and satellites provided communications at speeds over 50 Mbps to deployed battalions.[28] This acceleration of space enabled capabilities today allows U.S. commanders to draw from worldwide intelligence, surveillance, and reconnaissance (ISR) and analysis, communicate faster, strike more accurately, and assess operational effectiveness in real time. Space capabilities have become so seamlessly integrated into the overall U.S. military structure that commanders can remain focused on strategic objectives instead of making tactical decisions on how to prosecute specific targets. For example, during Operations Enduring Freedom and Iraqi Freedom the majority of aircraft took off on their combat sorties without assigned targets; they were dynamically tasked in flight onto targets that emerged during their sortie or attacked remaining targets assessed as most important after their arrival on station. The United States continues to develop lighter and more easily deployable forces that are better able to leverage space and network-enabled operations and strike more precisely from greater distances to achieve full spectrum dominance over adversaries that may range from emerging military peers to insurgents

[27] Frank G. Hoffman, "Hybrid Threats: Reconceptualizing the Evolving Character of Modern Conflict," Strategic Forum, no. 240 (April 2009), Institute for National Strategic Studies, National Defense University; and Frank G. Hoffman, "Hybrid Warfare and Challenges," *Joint Force Quarterly* 52 (1st Quarter 2009): 34-39. For a more theoretical perspective on the evolving nature of modern conflict, see Thomas A. Drohan, "Clausewitz for Complex Warfare," *The Wright Stuff*, vol. 4, no. 5 (5 March 2009).

[28] Data on Precision-guided munitions and communications are derived from Central Air Forces, "Operation Iraqi Freedom: By the Numbers," Prince Sultan Air Base, Saudi Arabia, 30 April 2003; Benjamin S. Lambeth, *The Transformation of American Airpower* (Ithaca: Cornell University Press, 2000); and Eliot A. Cohen, director, *Gulf War Air Power Survey, Summary Report* (Washington: Government Printing Office, 1993). For viewpoints that deemphasize the role of technological factors in modern warfare see: Stephen Biddle, "Victory Misunderstood: What the Gulf War tells us about the Future of Conflict," *International Security* 21 no. 2 (Fall1996), pp. 139-79; and Darrell Press, "The Myth of Air Power in the Persian Gulf War and the Future of Warfare," *International Security* 26 no. 2 (Fall 2001), pp. 5-44.

and terrorists. Space-enabled warfare can deliver highly precise effects, minimize collateral damage, and shorten the duration of conflict, but should be part of a balanced portfolio of capabilities that encourages pursuit of political objectives using all appropriate tools of statecraft and reduces temptations to overuse or inappropriately use the military instrument of power.

Of course, it has not escaped notice worldwide that the United States has already employed and continues to develop network-enabled warfare or that space capabilities often provide the best and sometimes the only way to make these kinds of operations possible. The Chinese, in particular, have been among the most careful students of the modern system and U.S. space-enabled military operations over the last generation. They have concluded that information operations and space capabilities are required to fight and win what it refers to as "local wars under conditions of informatization" and are following their own unique path toward improved military potential while making significant efforts both to emulate and counter U.S. space capabilities.[29]

In the past, PLA authors acknowledged that its information systems were incapable of enabling it to act more quickly than the U.S. military and their writings focused more on denying space to potential adversaries. However, as the PLA begins to contemplate using space, it recognizes that it must not only deny the use of information to its opponents but also use space to facilitate its own operations.[30]

Leveraging its latecomer's advantage during its 10th (2001-05) and 11th (2006-10) Five Year Plans,[31] China has moved more quickly in developing a wider range of space capabilities than any previous spacefaring state and today has deployed comprehensive space systems that are less capable but parallel those of the United States in all mission areas except for space-based missile launch detection. China's array of space reconnaissance systems offer increasingly precise visible, infrared, multi-spectral, and synthetic aperture radar imaging and include the *Ziyuan*-2 series, the *Yaogan*-1 through -8, the *Haiyang*-1B, the CBERS-2 and -2B satellites, and the *Huanjing* disaster and environmental monitoring satellite constellation.[32] "In the next decade, Beijing most likely will field radar, ocean surveillance, and high-resolution photoreconnaissance satellites. In the interim, China probably will rely on commercial satellite imagery to supplement existing coverage."[33] For navigation and timing, the Chinese have launched five *Beidou* satellites that provide signals with 20 meter accuracy over China and surrounding areas. China also plans to deploy a more advanced, accurate, and global PNT system known as *Beidou*-2 or Compass comprised of five Geostationary-Earth Orbit (GEO) satellites and 30 Medium-Earth Orbit (MEO) satellites; the Compass-M1 experimental satellite was launched in April 2007. In addition, China has "a very advanced indigenous microsatellite

[29] *Annual Report to Congress: Military Power of the People's Republic of China 2009* (Washington: Office of the Secretary of Defense, Department of Defense, March 2009), p. I.

[30] Pollpeter, *China's Progress in Space Technology*, p. 26.

[31] Parts of China's space goals for its 10th and 11th Five Year Plans were announced publicly; see *ibid*., pp. 3-5 and pp. 19-22.

[32] *Military Power of the People's Republic of China 2008*, 27; *Military Power of the People's Republic of China 2009*, 26. Resolution on *Ziyuan* satellites, for example, has improved from 20 to three meters; see Pollpeter, *China's Progress in Space Technology*, p. 26.

[33] *Military Power of the People's Republic of China 2008*, p. 27.

program"[34] with microsatellites currently deployed for technology development, imagery, remote sensing, and communications missions. Finally, China uses a wide range of foreign and domestic communications satellites, is increasing its military employment of these communications capabilities, and is moving to replace all foreign communications satellites with indigenous satellites by 2010. With launch in April 2008 of its first tracking and data relay satellite (*Tianlian* I) the Chinese have demonstrated the potential to develop a nascent real-time, global reconnaissance strike complex.

China is moving more secretly but probably even more quickly and comprehensively in developing "a multi-dimensional program to limit or prevent the use of space-based assets by its potential adversaries during times of crisis or conflict."[35] The PLA has deployed a variety of kinetic and non-kinetic weapons and terrestrial jammers and is also exploring other counterspace capabilities including in-space jammers, high-energy lasers, high-powered microwave weapons, particle beam weapons, and electromagnetic pulse weapons. In addition, China is "researching and deploying capabilities intended to disrupt satellite operations or functionality without inflicting physical damage."[36] The successful Chinese ASAT test of January 2007 was perhaps most notorious for its dangerous irresponsibility in creating a persistent debris cloud that now accounts for more than 25 percent of all catalogued objects in Low-Earth Orbit (LEO),[37] but the debris the test created should not obfuscate the system's very significant strategic implications given the high-value U.S. assets it can hold at risk in LEO, difficulties in finding and tracking the road-mobile transporter-erector-launcher (TEL) for the *Dong Feng* (DF)-21 (or SC-19) intermediate-range missile that launches the ASAT, and the extremely limited protection measures the United States currently has against this capability. Moreover, the direct ascent ASAT is just one of the many types of counterspace capabilities the Chinese are developing or have already fielded; it may not even be their most threatening or pervasive capability. It is more important to consider the synergistic and tailored benefits China is likely to obtain by employing many counterspace capabilities that operate in different ways against different orbital regimes and mission areas including hundreds if not thousands of high-power mobile terrestrial jammers, high-energy lasers with precision tracking capabilities at multiple sites, and potentially sophisticated in-space jamming and negation capabilities.

Tensions between the United States and China and between Taiwan and China have been easing in a number of ways and this article is not suggesting that conflict over Taiwan is imminent. However, many seemingly irreconcilable issues remain, including the "sacred responsibility" of the PLA in stopping

[34]Steven A. Smith, "Chinese Space Superiority? China's Military Space Capabilities and the Impact of their use in a Taiwan Conflict," (Maxwell AFB, Ala: Air War College, 17 February 2006), p. 15.

[35]*Military Power of the People's Republic of China 2009*, p. 27.

[36]*Military Power of the People's Republic of China 2008*, p. 21.

[37]"Fengyun 1-C Debris: Two Years Later," *Orbital Debris Quarterly News*, Johnson Spaceflight Center: NASA Orbital Debris Program Office, vol. 13, no. 1 (January 2009): 2. As a result of the 11 January 2007 Chinese ASAT test, the U.S. Space Surveillance Network has catalogued 2378 pieces of debris with diameters greater than five centimeters, is tracking 400 additional debris objects that are not yet catalogued, and estimates the test created more that 150,000 pieces of debris larger than one square centimeter. Unfortunately, less than two percent of this debris has reentered the atmosphere so far and it is estimated that many pieces will remain in orbit for decades and some for more than a century.

independence and the "anti-succession" law passed by China's National People's Congress in March 2005; U.S. commitments under the 1979 U.S. Taiwan Relations Act to resist any force or other coercion that threatens Taiwan; and Taiwanese independence aspirations. Taiwan is still clearly the most likely flashpoint for any conflict between the United States and China. Because the PLA is continuously improving the quality and effectiveness of its overall military capabilities and "China's space activities and capabilities, including ASAT programs, have significant implications for anti-access/area denial in Taiwan Strait contingencies and beyond"[38] military analysts must continually assess the correlation of forces in this scenario and statesmen must remain aware of its implications. Michael O'Hanlon's 2004 assessment is both reassuring and sobering, especially given the continuing and accelerating progress of PLA modernization and the considerable stresses placed on U.S. forces by ongoing operations in Iraq and Afghanistan:

> It is doubtful that trends in space capabilities or other aspects of defense modernization will radically alter the military balance in the next decade or so. The size and caliber of the U.S. military is sufficient that, even if China were able to close the technological gap and have the potential to cause substantial losses to the United States in a war over Taiwan, the American armed forces would surely prevail. The United States could lose a carrier or two and still maintain overwhelming military superiority in the region.[39]

In a presentation at the Naval War College in April 2009 Secretary of Defense Robert Gates found adversary development of anti-access/area denial capabilities more troubling and noteda particular concern with aircraft carriers and other large, multi-billion dollar blue-water surface combatants – where the loss of even one ship would be a national catastrophe. We know other nations are working on ways to thwart the reach and striking power of the U.S. battle fleet – whether by producing stealthy submarines in quantity or developing anti-ship missiles with increasing range and accuracy. We ignore these developments at our peril.[40]

A large number of factors and complex interrelationships are involved, but all Taiwan scenarios are fundamentally shaped by a small number of geopolitical factors including the very close proximity of the theater of operations to China and its extreme distance from the United States, very limited basing options for U.S. forces in this region, and the increasing vulnerability of all fixed and even some mobile targets to attack from a growing number of long-range precision strike forces. These factors combine to make the effectiveness of U.S. aircraft carrier battle groups a most important variable in any Taiwan scenario. A key objective for China is to find and strike carrier battle groups as far away from Taiwan as possible; keeping them out of the main fight or at least primarily focused on self-defense. For the United States and Taiwan key objectives include finding and striking a large percentage of landing craft and transport aircraft before they can lodge and sustain an overwhelming number of ground forces on Taiwan.

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[38] *Military Power of the People's Republic of China 2009*, p. 25.

[39] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining the Military Uses of Space* (Washington: Brookings Institution, 2004), p. 97.

[40] Presentation by Secretary of Defense Robert M. Gates at Naval War College, Newport RI, 17 April 2009, available from http://www.defenselink.mil/speeches/speech.aspx?speechid=1346

Space and counterspace capabilities play an increasingly important role for both sides in this scenario. For China, space forces, and space ISR in particular, are needed to find, fix, track, target, engage, and assess strikes on carrier battle groups in near real time. Space links considered necessary for day-night, inclement weather, and near real time operation of this kill chain include high-resolution imagery, tracking and data relay, synthetic aperture radar, wake tracking, and electronic intelligence—all capabilities the Chinese appear to have increasingly emphasized. It is not yet clear that China has networked together all the capabilities required for long-range precision strikes against carrier battle groups let alone what the effectiveness of Chinese forces so employed might be, even before they are attrited by the concentric layers of defenses around carrier battle groups.[41]

Nonetheless, it is apparent that Chinese capabilities for long-range precision strikes against ships have improved significantly; U.S. forces are threatened as they approach what the Chinese call the second island chain that includes Guam, and operate at growing peril the closer they come to Taiwan and the first island chain. The increasingly potent anti-access strike forces the Chinese have deployed or are developing include large numbers of highly accurate cruise missiles, such as domestically produced ground-launched DH-10 land attack cruise missiles, SS-N-22/Sunburn and SS-N-27B/Sizzler supersonic anti-ship cruise missiles mounted on *Sovremennyy*-class guided missile destroyers and Kilo-class diesel electric submarines acquired from Russia, as well as an anti-ship ballistic missile based on a variant of the DF-21 that has a range in excess of 1,500 km and highly accurate maneuvering reentry vehicles with conventional warheads and "terminal-sensitive penetrating sub-munitions" to "destroy the enemy's carrier-borne planes, the control tower and other easily damaged and vital positions."[42] It is also a near certainty that China would mount large-scale counterspace operations, perhaps even as a precursor to other attacks, in any Taiwan scenario. Chinese counterspace operations would likely concentrate on cyber and electronic warfare attacks against U.S. communications and positioning, navigation and timing (PNT) capabilities using terrestrial, airborne, seaborne, and perhaps in-space jammers or ASAT systems. In addition, the Chinese could use their direct ascent ASAT and high-energy lasers to attack U.S. ISR assets in LEO and it is unlikely that either preemptive or reactive maneuvering of these assets would be able to protect them or ensure they could collect on assigned targets.[43]

U.S. and Taiwanese space capabilities and counterspace operations are also critically important, would be highly stressed in defending Taiwan, and would be tested in novel ways since the United States has not yet

[41]The Chinese demonstrated an ability to find carrier battle groups and penetrate their defenses in 2006 when a Chinese submarine surfaced within the perimeter of the Kitty Hawk (CV-63) carrier battle group. See Michele Flournoy and Shawn Brimley, "The Contested Commons," *Proceedings Magazine* Vol. 135 (July 2009).

[42]*Military Power of the People's Republic of China 2009*, p. 21; and Michael Richardson, Beijing Takes Aim at U.S. Aircraft Carriers, *Japan Times*, 22 January 2009. The quotations cited in the DOD report are from an authoritative 2004 article for the second artillery corps and the report also notes that this "capability would have particular significance, as it would provide China with preemptive and coercive options in a regional crisis."

[43]Brian Weeden, "How China 'Wins' a Potential Space War," *China Security*, vol. 4, no. 1 (Winter 2008), pp. 134-47. Weeden explains why it is unlikely a U.S. LEO ISR satellite can be reactively maneuvered away from the direct ascent ASAT after launch and how preemptive maneuvering away from known laser or ASAT launch sites would be likely to preclude these satellites from performing key collection and shorten their mission life.

fought against a space-enabled, near-peer military power. All U.S. space-enabled force enhancement capabilities—ISR, missile warning and attack assessment, communications, PNT, and environmental monitoring—would be challenged in attempting just to establish and maintain a kill chain for the thousands of fixed and mobile targets in the Taiwan theater even without enemy countermeasures; in a degraded electronic warfare environment and under direct attack, their efficacy is likely to be significantly reduced. Under these conditions, projecting strike assets into the theater and maintaining an effective kill chain, especially against the many small and fleeting, mobile targets presented by Chinese landing craft and aircraft, would be a daunting challenge. The United States would also engage in counterspace operations, primarily to disrupt PNT and command and control of landing forces as well as in attempts to deny Chinese ability to track and target carrier battle groups. With respect to the latter counterspace objective in particular, it is noteworthy that O'Hanlon believes the United States could be quite hard pressed to disrupt Chinese ability to target carriers in a Taiwan scenario without ASAT capabilities such as those it demonstrated in February 2008 when an Aegis Cruiser used a Standard Missile-3 to destroy the inoperative USA-193 satellite just prior to reentry.[44]

Prospective TCBMs

Seemingly new focus and direction in space policy initially was provided by a statement on the Obama Administration White House website that appeared on 20 January 2009: "Ensure Freedom of Space**:** The Obama-Biden Administration will restore American leadership on space issues, seeking a worldwide ban on weapons that interfere with military and commercial satellites."[45] The language about seeking a worldwide ban on space weapons was taken from position papers issued during the Obama-Biden campaign but was much less detailed and nuanced; it drew considerable attention and some criticism.[46] By May 2009 the space part of the Defense Issues section on the White House website had been changed to read: "**Space:** The full spectrum of U.S. military capabilities depends on our space systems. To maintain our technological edge and protect assets in this domain, we will continue to invest in next-generation capabilities such as operationally responsive space and global positioning systems. We will cooperate with our allies and the private sector to identify and protect against intentional and unintentional threats to U.S. and allied space capabilities." Ongoing space policy reviews including a congressionally-directed Space Posture Review and Presidential Study Directives on National Space Policy are likely to encourage policies that are more supportive of pursuing TCBMs as well as greater reliance on commercial and international partners.[47]

[44] O'Hanlon, *Neither Star Wars Nor Sanctuary*, 101; Flournoy and Brimley, "The Contested Commons." On the engagement of USA-193 see, in particular, James Oberg, "OPERATION BURNT FROST: Five Myths About the Satellite Smashup," NBC News Analysis, 27 February 2008 and James E. Oberg, "Down in Flames: Media "Space Experts" Flub the Shoot-Down Story," *The New Atlantis*, No. 24 (Spring 2009): 120-29. The last piece of catalogued debris from the destruction of USA-193 reentered on 9 October 2008.

[45] The statement appeared on the Defense Agenda section of the White House website, www.whitehouse.gov.

[46] See in particular, the *Space News* editorial for 2 February 2009, "Banning Space Weapons—and Reality."

[47] Section 913 of the Fiscal Year 2009 National Defense Authorization Act (P.L. 110-417) directs the Secretary of Defense and Director of National Intelligence to

Consideration is also being given to the best ways to reconcile any new approach with fundamental goals in the 2006 U.S. National Space Policy to "oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space" while also encouraging "international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit."[48] Indeed, the United States can expect that it will continue to make the best progress in developing effective, sustainable, and cooperative approaches to space security by building on the ongoing thoughtful dialogue between all major space actors in several venues that emphasizes a number of primarily incremental, pragmatic, technical, and bottom-up steps. Prime examples of this approach include the February 2008 adoption by the United Nations General Assembly of the Inter-Agency Debris Committee (IADC) voluntary guidelines for mitigating space debris and the December 2008 release from the Council of the European Union of a draft Code of Conduct for outer space activities.[49] A key challenge for Beijing and Washington is to find ways to move away from inflexible positions and become more involved with and leverage these processes in both bilateral and multilateral ways.

History suggests there is a very important role for militaries both in setting the stage for the emergence of international legal regimes and in enforcing the norms of those regimes once they emerge. Development of any rules of the road or codes of conduct for space should draw closely from the development and operation of such measures in other domains such as sea or air. The international community should consider the most appropriate times and ways to separate military activities from civil and commercial activities in the building of these measures because advocating a single standard for how all space activities ought to be regulated may be inappropriately ambitious and unhelpful. The Department of Defense requires safe and responsible operations by warships and military aircraft but they do not always follow all the same rules as commercial traffic and often operate within specially protected zones that separate them from other traffic. Full and open vetting of these ideas along with others will help develop space rules that draw from years of experience in operating in these other domains and make the most sense for the unique operational characteristics of space.

Another consideration is the historic role of the Royal and U.S. Navies in fighting piracy, promoting free trade, and enforcing global norms against slave trading. Is there an analogous role in space for the U.S. military and other military forces today and in the future? What would be the space component of the Proliferation Security Initiative and how might the United States and others encourage like-minded actors to cooperate on such an initiative? Attempts to create regimes or enforcement norms that do not specifically include and build upon military capabilities

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submit a Space Posture Review to Congress by 1 December 2009. In addition, the Obama Administration has ongoing Presidential Study Directives that are examining the need for changes to current National Space Policy; see Amy Klamper, "White House Orders Sweeping U.S. Space Policy Review," *Space News*, 15 July 2009.

[48]"U.S. National Space Policy," (Washington, D.C.: The White House, Office of Science and Technology Policy, 14 October 2006), p. 2.

[49]United Nations General Assembly Resolution 62/217, "International cooperation in the peaceful uses of outer space," (New York: UNGA, 1 February 2008) and Council of the European Union, "Council conclusions and draft Code of Conduct for Outer Space Activity, (Brussels: Council of the European Union, 3 December 2008).

are likely to be divorced from pragmatic realities and ultimately frustrating efforts.[50] There is much consensus on the general direction in which the international space community is moving regarding many space security issues, but, as in so many other critical issue-areas, the devil really is in the details concerning how best to proceed. As the most important first step, the United States and others should work harder to develop more fully and achieve more universal adherence to the Outer Space Treaty (OST) regime. It simply does not make sense to charge far ahead when this foundational piece still has significant gaps in terms of compliance with existing rules and norms. Particular areas that are underdeveloped within the OST regime include the Article VI signatory responsibilities for authorization and continuing supervision over activities of non-governmental entities in space and the Article IX obligations for signatories to undertake or request appropriate international consultations before proceeding with any activity or experiment that would cause potentially harmful interference.

One key way the United States can continue supporting these OST obligations is by making more progress on sharing space situational awareness (SSA) data worldwide by building on the Commercial and Foreign Entities (CFE) program. Following the February 2009 collision between Iridium and Cosmos satellites and increasing motivation to improve the program and provide SSA data to users in more timely and consistent ways, the Fiscal Year 2010 National Defense Authorization Act expanded the CFE pilot program and gave the Secretary of Defense instructions on providing SSA information and services to non U.S. Government entities. One excellent specific goal would be creation of a U.S. Government operated data center for ephemeris, planned maneuvers, and propagation data for all active satellites. Users would voluntarily contribute data to this center, perhaps through a GPS transponder on each satellite, and the data would be constantly updated, freely available, and readily accessible so that it could be used by satellite operators to plan for and avoid conjunctions.[51] Difficult issues that inhibit progress on sharing SSA data include liability and proprietary concerns; data formatting standards and compatibility between propagators and other cataloguing tools, and security concerns over exclusion of certain

[50] On the role of militaries in enforcing legal norms and analogies between the law of the sea and space law, see R. Joseph DeSutter, "Space Control, Diplomacy, and Strategic Integration," *Space and Defense* vol. 1, no. 1 (Fall 2006), pp. 29-51.

[51] SSA issues are framed by specialized concepts and jargon. Conjunctions are close approaches, or potential collisions, between objects in orbit. Propagators are complex modeling tools used to predict the future location of orbital objects. Satellite operators currently use a number of different propagators and have different standards for evaluating and potentially maneuvering away from conjunctions. Maneuvering requires fuel and shortens the operational life of satellites. Orbital paths are described by a set of variables known as ephemeris data; two-line element sets (TLEs) are the most commonly used ephemeris data. Much of this data is contained in the form of a satellite catalog. The United States maintains a public catalog at www.space-track.org. Other entities maintain their own catalogs. Orbital paths constantly change, or are perturbed, by a number a factors including Earth's inconsistent gravity gradient, solar activity, and the gravitational pull of other orbital objects. Perturbations cause propagation of orbital paths to become increasingly inaccurate over time; beyond approximately four days into the future predictions about the location of orbital objects can be significantly inaccurate. For more about SSA concepts see Brain Weeden, "The Numbers Game," *The Space Review*, 13 July 2009; downloaded from http://www.thespacereview.com/article/1417/1. For more details about this approach and other space security ideas fostered by meetings between the Department of Defense Executive Agent for Space and the Chief Executive Officers of commercial satellite communications providers see David McGlade, "Commentary: Preserving the Orbital Environment," *Space News*, 19 February 2007, p. 27.

satellites from any public data. Developing and institutionalizing better ways to address these existing obligations under the OST regime could be one of the most direct and important steps in dealing with many of the most significant current international space security concerns.

Beyond the OST, efforts to craft comprehensive top-down space arms control or regulation with the Chinese bilaterally, or among all spacefaring actors, still face all of the significant problems that plagued attempts to develop such mechanisms in the past. The most serious of these problems include: disagreements over the proper scope and object of negotiations; basic definitional issues about what is a space system and how they might be categorized as offensive or defensive and stabilizing or destabilizing; and daunting questions concerning how any agreement might be adequately verified. These problems relate to a number of very thorny specific issues such as whether the negotiations should be bilateral or multilateral, what satellites and other terrestrial systems should be covered, and whether the object should be control of space weapons or TCBMs for space; questions concerning which types of TCBMs such as rules of the road or keep out zones, for example, might be most useful and how these might be reconciled with existing space law such as the OST; and verification problems such as how to address the latent or residual ASAT capabilities possessed by many dual-use or military systems or deal with the significant military potential of even a small number of covert ASAT systems. New space system technologies, continuing growth of the commercial space sector, and new verification technologies interact with these existing problems in complex ways. Some of the changes would seem to favor arms control and regulation, such as better radars and optical systems for improved SSA and verification capabilities, technologies for better space system diagnostics, and the stabilizing potential of microsatellite-based redundant and distributed space architectures. Many other trends, however, would seem to make space arms control and regulation even more difficult. For example, micro- or nanosatellites might be used as virtually undetectable active ASATs or passive space mines; proliferation of space technology has radically increased the number of significant space actors to include a number of non-state actors that have developed or are developing sophisticated dual use technologies such as autonomous rendezvous and docking capabilities; and growth in the commercial space sector raises issues such as how quasi-military systems could be protected or negated and the unclear security implications of global markets for dual-use space capabilities and products.

The history of top-down approaches to space arms control repeatedly has shown they are not likely to be the most fruitful ways to advance space security, a point strongly emphasized by Ambassador Donald Mahley in February 2008: "Since the 1970s, five consecutive U.S. administrations have concluded it is impossible to achieve an effectively verifiable and militarily meaningful space arms control agreement."[52] Nonetheless, in ways that seem both shrewd and hypocritical, the Chinese are developing significant counterspace capabilities while simultaneously advancing various proposals in support of prevention of an arms race in outer space (PAROS) initiatives and pursuing the Chinese-Russian draft treaty on Prevention of Placement of Weapons in Outer Space (PPWT) introduced at the Conference on Disarmament in February 2008. For the PPWT in particular, while it goes to

[52]Ambassador Donald A. Mahley, "Remarks on the State of Space Security," The State of Space Security Workshop, Space Policy Institute, George Washington University, Washington, 1 February 2008.

considerable lengths in attempting to define space, space objects, weapons in space, placement in space, and the use or threat of force, there are still very difficult and unclear issues with respect to how specific capabilities would be defined. An even more significant problem relates to all the terrestrial capabilities that are able to eliminate, damage, or disrupt normal function of objects in outer space such as the Chinese direct ascent ASAT. One must question the utility of an agreement that does not address the security implications of current space systems to support network enabled terrestrial warfare, does not deal with dual-use space capabilities, seems to be focused on a class of weapons that does not exist or at least is not deployed in space, is silent about all the terrestrial capabilities that are able to produce weapons effects in space, and would not ban development and testing of space weapons, only their use.[53] Given these glaring weaknesses in the PPWT it seems plausible that it is designed as much to continue political pressure on the United States and derail U.S. missile defense efforts as it is to promote sustainable space security.

Other specific Sino-American cooperative space ventures or TCBMs that have been proposed and are worthy of further consideration include: inviting a taikonaut to fly on one of the remaining Space Shuttle missions and making repeated, specific, and public invitations for the Chinese to join the ISS program and other major cooperative international space efforts. The United States and China could also work towards developing non-offensive defenses of the type advocated by Philip Baines.[54] Kevin Pollpeter explains how China and the United States could cooperate in promoting the safety of human spaceflight and "coordinate space science missions to derive scientific benefits and to share costs. Coordinating space science missions with separately developed, but complementary space assets, removes the chance of sensitive technology transfer and allows the two countries to combine their resources to achieve the same effects as jointly developed missions."[55] Michael Pillsbury outlined six other areas where U.S. experts could profitably exchange views with Chinese specialists in a dialogue about space weapons issues: "reducing Chinese misperceptions of U.S. Space Policy, increasing Chinese transparency on space weapons, probing Chinese interest in verifiable agreements, multilateral versus bilateral approaches, economic consequences of use of space

[53] Reaching Critical Will, "Preventing the Placement of Weapons in Outer Space: A Backgrounder on the draft treaty by Russia and China. For an outstanding analysis of trigger events for space weaponization and why space-basing is not necessarily the most important consideration, see Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment* (Washington, D.C.: Center for Strategic and Budgetary Assessments, February 2001), pp. 97-106. Watts argues that: "There are at least two paths by which orbital space might become a battleground for human conflict. One consists of dramatic, hard-to-miss trigger events such as the use of nuclear weapons to attack orbital assets. The other class involves more gradual changes such as a series of small, seemingly innocuous steps over a period of years that would, only in hindsight, be recognized as having crossed the boundary from force enhancement to force application. For reasons stemming from the railroad analogy . . . the slippery slope of halting, incremental steps toward force application may be the most likely path of the two." Watts discusses high-altitude nuclear detonations, failure of nuclear deterrence, and threats to use nuclear ballistic missiles during a crisis as the most likely of the dramatic trigger events.

[54] Philip J. Baines, "The Prospects for 'Non-Offensive' Defenses in Space," in James Clay Moltz, ed., *New Challenges in Missile Proliferation, Missile Defense, and Space Security* (Monterey: Center for Nonproliferation Studies Occasional Paper no. 12, Monterey Institute of International Studies, July 2003), pp. 31-48

[55] Pollpeter, *China's Progress in Space Technology*, pp. 48-50.

weapons, and reconsideration of U.S. high-tech exports to China."[56]

Bruce MacDonald's report on *China, Space Weapons, and U.S. Security* for the Council on Foreign Relations offers a number of noteworthy additional specific recommendations for both the United States and China including: For the United States: assessing the impact of different U.S. and Chinese offensive space postures and policies through intensified analysis and "crisis games," in addition to wargames; evaluating the desirability of a "no first use" pledge for offensive counterspace weapons that have irreversible effects; pursuing selected offensive capabilities meeting important criteria—including effectiveness, reversible effects, and survivability—in a deterrence context to be able to negate adversary space capabilities on a temporary and reversible basis, refraining from further direct ascent ASAT tests and demonstrations as long as China does, unless there is a substantial risk to human health and safety from uncontrolled space object reentry; and entering negotiations on a [kinetic energy] KE-ASAT testing ban. MacDonald's recommendations for China include: providing more transparency into its military space programs; refraining from further direct ascent ASAT tests as long as the United States does; establishing a senior national security coordinating body, equivalent to a Chinese National Security Council; strengthening its leadership's foreign policy understanding by increasing the international affairs training of senior officer candidates and establishing an international security affairs office within the PLA; providing a clear and credible policy and doctrinal context for its 2007 ASAT test and counterspace programs more generally and addressing foreign concerns over China's ASAT test; and offering to engage in dialogue with the United States on mutual space concerns and become actively involved in discussions on establishing international space codes of conduct and confidence-building measures.[57]

Finally, Beijing and Washington should pursue specific initiatives to follow-up on the cooperative dialogue during the visits of General Xu Caihou and President Obama as well as initiating discussions about recent statements by General Xu Qiliang, Commander of the PLA Air Force (PLAAF), that a space arms race is inevitable and the PLAAF must develop offensive space operations.[58] President Hu quickly repudiated these statements but the two sides need to find a way to initiate and sustain focused discussions about the difficult space security issues raised by the General's statements since they represent an unprecedented level of public transparency on the part of the PLA, undoubtedly reflect the position of the PLA and other important stakeholders within the Chinese government, and represent an inherent part of the context for space security about which the United States and China must develop better shared understanding. Counterintuitively, Beijing and Washington can lay a stronger foundation for sustainable space security through transparent dialogue over these most difficult issues rather than by trying to avoid them since more diplomatic approaches may assuage but cannot eliminate the growing strategic and military potential of space capabilities.

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[56]Michael P. Pillsbury, "An Assessment of China's Anti-Satellite and Space Warfare Programs, Policies, and Doctrines," Report prepared for the U.S.-China Economic and Security Review Commission, 19 January 2007, 48.

[57]Bruce W. MacDonald, *China, Space Weapons, and U.S. Security* (New York: Council on Foreign Relations, September 2008), pp. 34-38.

[58]Kathrin Hille, "China General Sees Military Space Race," *Financial Times*, 3 November 2009.

Most importantly, even if these approaches do improve space transparency and cooperation with China, the United States still bears unilateral responsibilities to improve sustainable space security by better protecting its space capabilities. It is simply irresponsible and untenable for the nation to continue building space systems that are increasingly important and vulnerable. The United States should improve the protection of all space capabilities that support national security through a multifaceted political and technical approach that includes denial, deception, assurance, dissuasion, deterrence, changed employment strategies, hosted payloads, international coalition architectures, technical solutions, and passive and active measures. One of the best technical approaches to accomplishing these objectives would be for the United States to change the space paradigm by emphasizing flexible distributed architectures and sparse arrays consisting of many networked microsatellites in multiple orbits that are able to perform a range of missions as well or better than missions performed by constellations with small numbers of single function satellites and, even more importantly, radically reduce the vulnerabilities inherent in space systems with just a few nodes. Proliferation of the wide range of current and projected threats to all orbital regimes, combined with the intrinsic fragility of space systems and the predictability of their operations indicate that distributed architectures must at least supplement, if not eventually replace, current architectures if space systems are to remain operationally relevant in an increasingly contested domain.

As the most important first steps in implementing specific protection measures, the United States should ensure critical infrastructure protection and continuity of operations by eliminating critical single points of failure on the ground and hardening LEO satellites against total radiation dose failures following high altitude nuclear detonations. A second essential step is to implement and institutionalize the protection standards for all future NSS systems called for in the national security space (NSS) Protection Strategy Framework signed by DOD Executive Agent for Space Peter Teets in March 2005. In addition, all future national security space acquisitions should be required to perform a cross-domain analysis of terrestrial alternatives and the space portion should consider tradeoffs between traditional architectures and microsatellite distributed architectures as well as explicitly evaluating many factors beyond just costs such as persistence, survivability, and space industrial base considerations. Increased effort towards this goal is urgently need now and it is particularly important that the Air Force Space and Missile Systems Center (SMC) and the NRO adopt this approach but moving these organizations toward this approach will be a difficult challenge since they are the centers of current NSS acquisition efforts that have evolved, with good reasons, towards larger and more capable but very small numbers of satellites in most current architectures.[59] Other important steps towards better capability protection that have been initiated or should be undertaken include: developing responsive space capabilities through the Operationally Responsive Space Office that was established at Kirtland AFB in May 2007 and other approaches; funding protection efforts commensurate with their importance;

[59]Outstanding and comprehensive technical evaluations of the prospects for moving toward distributed architectures are provided in: Gregory A. Orndorff, Bruce F. Zink, and John D. Cosby, "Clustered Architecture for Responsive Space," AIAA-RS5 2007-1002, (Los Angeles: American Institute for Aeronautics and Astronautics, 5th Responsive Space Conference, 23-26 April 2007), and Mr. Naresh Shah and Dr. Owen C. Brown, "Fractionated Satellites: Changing the Future of Risk and Opportunity for Space Systems," *High Frontier* vol. 5, no. 1 (November 2008), pp. 29-36.

development of a comprehensive space protection strategy and creation of the joint Air Force Space Command-NRO Space Protection Program in July 2008; use of wargames, "crisis games," and simulations to explore and refine space deterrence concepts and develop shared understanding about specific "red lines" for deterring potential attacks against satellites that support U.S. national security; and multifaceted approaches to raise awareness about space dependency and vulnerabilities as well as adopting a "whole of government, whole of nation, and whole of coalition" approach to address these interdependent issues.[60]

[60]U.S. Representative Terry Everett, "Work Worth Doing," *High Frontier* vol. 5, no. 1 (November 2008), pp. 2-6.