COUNCIL on FOREIGN RELATIONS

Bruce W. MacDonald
Council Special Report No. 38
September 2008

China, Space Weapons, and U.S. Security

China, Space Weapons, and U.S. Security

COUNCIL *on*
FOREIGN
RELATIONS

Bruce W. MacDonald
CSR No. 38, September 2008

China, Space Weapons, and U.S. Security

Contents

Foreword

China's successful test of an anti-satellite weapon in 2007, followed by the U.S. destruction earlier this year of an out-of-control U.S. satellite, demonstrated that space may soon no longer remain a relative sanctuary from military conflict. As the United States, China, and others increasingly benefit from the information that military and intelligence satellites provide, the temptation to attack these satellites provides troubling potential for instability and conflict in space that could dramatically affect U.S. military capabilities on earth.

In this Council Special Report, Bruce W. MacDonald illuminates the strategic landscape of this new military space competition and highlights the dangers and opportunities the United States confronts in the space arena. He recognizes that advancing technology has likely made some degree of offensive space capability inevitable but calls on the United States to draw upon all instruments of U.S. power, including a reinvigorated space diplomacy, to lead in establishing a more stable and secure space environment. To this end, he spotlights a series of pragmatic policy, programmatic, and diplomatic steps the United States should take to strengthen its security interests in space and help reduce the chances that the military benefits of space will be cut off when the United States may most need them. In addition, these steps would serve important U.S. and Chinese economic interests and open new channels of communication and understanding between the mid-twenty-first century's likely two leading powers. This timely report breaks new ground in thinking about the space dimension of U.S. security interests and its growing effect on U.S. security in the

twenty-first century, and will be especially useful to those who are unfamiliar with the role of space in U.S. security.

Richard N. Haass
President
Council on Foreign Relations
September 2008

Acknowledgments

An advisory committee provided expert advice during the drafting of this Council Special Report on Chinese military space capabilities and U.S. security, but was not asked to endorse its recommendations. I first want to thank the members of this committee, whose names are listed at the end of this report, for their interest in and support of this study and the invaluable advice they provided. I am particularly grateful to Admiral Dennis C. Blair for chairing the two advisory meetings, and for his extensive and extremely helpful suggestions on the content of this report. Also deserving of much praise is Philip D. Reed Senior Fellow for Science and Technology Charles D. Ferguson, a friend and colleague who offered me the opportunity to write this report and provided invaluable substantive and editorial input. I likewise want to thank the many specialists in and out of government who have been so generous with their time in providing me their perspectives on this important issue and reviewing drafts of this report.

I thank CFR President Richard N. Haass for his support both of this project and of CFR's larger science and technology program. I am also grateful to Vice President, Director of Studies, and Maurice R. Greenberg Chair Gary Samore, another strong supporter of this project. I appreciate the work of former research associate Lisa Obrentz, who organized the two advisory committee meetings, and of Research Associate Michelle Smith, who helped to edit the report, coordinate its distribution, and prepare it for publication. Thanks are also in order for CFR's Publications team of Patricia Dorff and Lia Norton, and the Communications team headed by Lisa Shields and Anya Schmemann.

This publication was funded, in part, by the generous support of the John D. and Catherine T. MacArthur Foundation. The statements made and views expressed in this report are solely my responsibility.

Bruce W. MacDonald

Acronyms

ASAT	anti-satellite weapon
CBM	confidence-building measure
CRINKIL	China, Russia, Iran, North Korea, India, and lesser threats
DOD	U.S. Department of Defense
GLONASS	Global Navigation Satellite System
GPS	Global Positioning System
IADC	Inter-Agency Space Debris Coordination Committee
KE-ASAT	kinetic energy anti-satellite
LEO	low earth orbit
NASA	U.S. National Aeronautics and Space Administration
ORS	operationally responsive space
PAROS	(Treaty on) Preventing an Arms Race in Outer Space
PLA	People's Liberation Army
SSA	space situational awareness
UAV	unmanned aerial vehicle
UNCD	United Nations Conference on Disarmament

Council Special Report

Nature of China's Challenge and Threat

On January 11, 2007, China launched a missile into space, releasing a homing vehicle that destroyed an old Chinese weather satellite. The strategic reverberations of that collision have shaken up security thinking in the United States and around the world. This test demonstrated that, if it so chose, China could build a substantial number of these anti-satellite weapons (ASAT) and thus might soon be able to destroy substantial numbers of U.S. satellites in low earth orbit (LEO), upon which the U.S. military heavily depends. On February 21, 2008, the United States launched a modified missile-defense interceptor, destroying a U.S. satellite carrying one thousand pounds of toxic fuel about to make an uncontrolled atmospheric reentry. Thus, within fourteen months, China and the United States both demonstrated the capability to destroy LEO satellites, heralding the arrival of an era where space is a potentially far more contested domain than in the past, with few rules.[1]

Having crossed a space Rubicon with their ASAT demonstrations, neither nation can un-invent these capabilities. As the United States approaches major security policy reviews with the advent of a new administration in early 2009, both it and China face fundamental choices about the deployment and use of such capabilities, and the development of more advanced space weapons.[2] The United States and China stand at a crossroads on weapons and space: whether to control this potential competition, and if so, how. While the United States is likely well ahead of China in offensive space capability, China currently is much less dependent on space assets than the U.S. military, and thus in the near term has less to lose from space conflict if it became inevitable. China's far smaller space dependence, which hinders its

military potential, ironically appears to give it a potential relative near-term offensive advantage: China has the ability to attack more U.S. space assets than vice versa, an asymmetry that complicates the issue of space deterrence, discussed later. This asymmetric Chinese advantage will likely diminish as China grows increasingly dependent on space over the next twenty years, and as the United States addresses this space vulnerability. Thus, the time will come when the United States will be able to inflict militarily meaningful damage on Chinese space-based assets, establishing a more symmetric deterrence potential in space. Before then, other asymmetric means are available to the United States to deter China, though at possibly greater escalatory risk. That is, the United States could threaten to attack not just Chinese space assets, but also ground-based assets, including ASAT command-and-control centers and other military capabilities. But such actions, which would involve attacking Chinese soil and likely causing substantial direct casualties, would politically weigh much heavier than the U.S. loss of space hardware, and thus might climb the escalatory ladder to a more damaging war both sides would probably want to avoid.

War between China and the United States seems unlikely, given their increasing economic interdependence and ongoing efforts in both countries to improve relations. Looming in the background, however, is the possibility of war over Taiwan, a plausible if unlikely scenario that could bring the United States and China into conflict. China might then be tempted to attack U.S. military satellites as a casualty-free way to signal resolve, dissuade Washington from further involvement in a Taiwan conflict, and significantly compromise U.S. military capabilities if such dissuasion failed. Such Chinese actions could well escalate any conflict between the United States and China. As a result, both countries have interests in avoiding the actual use of counterspace weapons and shaping a more stable and secure space environment for themselves and other spacefaring nations, which could easily be caught in the undertow of a more militarily competitive space domain.

Many nations benefit from space assets used for military purposes, including communications, reconnaissance, and positioning. Howev-

er, space militarization does not necessarily mean space weaponization; the important distinction between the two lies in the unfettered use of space. While space militarization has indispensably augmented U.S. conventional military forces, such capabilities do not deny others the use of similar capabilities. Space weaponization, on the other hand, can seek to prevent an adversary from using space for military purposes. According to the U.S. Air Force, space weaponization, or "offensive counterspace capabilities," would involve space-based or earth-based weapons that could destroy, disable, or disrupt space-based systems such as satellites. Earth-based weapons capable of attacking satellites' ground stations and communications links must also be considered as part of any evolving space-weaponization architecture.

With China's demonstration of an ASAT weapon, the United States is concerned that China might soon deploy a substantial ASAT arsenal, consisting of either a fleet of the ASATs it tested in 2007, co-orbital small satellites ("space mines"), or, later, a more advanced ASAT capability based on technologies such as lasers, microwaves, or cyberweapons. Such a Chinese deployment could substantially reduce the effectiveness of U.S. fighting forces. While more traditional counterspace capabilities like jammers have a long and well-recognized role in electronic warfare, their effects are localized and temporary and thus can be tailored. Offensive counterspace capabilities could permanently damage or destroy costly satellites and leave substantial harmful debris in space if they physically destroy the satellites.

Space debris can collide with and destroy satellites and is an important element in thinking about space weapons. Like radioactive fallout from nuclear war, debris from space war can linger for many years. While the word "debris" sounds harmless based on common usage, most orbital debris moves at a speed of more than seventeen thousand miles per hour. Thus, relatively small debris pieces are highly destructive to a satellite in a collision. One only has to imagine what life would be like if thousands of bullets from World War II were still whizzing around to get some feel for the danger that debris growth poses for the future of space. At present, twelve thousand detectable debris pieces that are ten centimeters or larger orbit the earth, as well as millions of

smaller pieces. The National Aeronautics and Space Administration (NASA) estimates China's 2007 ASAT test alone increased orbital debris by 10 percent, and its fallout will take more than one hundred years to reenter the atmosphere. Despite important international efforts to reduce it, the total quantity of space debris grew by 20 percent in 2007. All nations have a compelling common interest in avoiding the massive increase in space debris that substantial ASAT conflict would create. Many nations, including China, Russia, and the United States, have agreed to nonbinding guidelines to minimize space debris, including by deliberate destruction. Perhaps technology will allow removal of space debris in the future, but nothing is now on the horizon, and space clean-up would likely be very costly in any event.

The implications of these new counterspace developments for peacetime and crisis stability, as well as the conduct of warfare, are profound. The sudden major loss of satellite function would quickly throw U.S. military capabilities back twenty years or more and substantially damage the U.S. and world economies. While backup systems could partially compensate for this loss, U.S. military forces would be significantly weakened. In addition to shoring up its defenses, the United States also needs to better understand China's evolving and ambiguous space doctrine.

CHINA'S GROWING COUNTERSPACE CAPABILITIES AND EVOLVING SPACE DOCTRINE

China has been developing a significant military and civilian space capability since 1955. This effort was led by Tsien Hsue-shen, a brilliant U.S.-trained rocket scientist who cofounded the U.S. Jet Propulsion Laboratory at Caltech, but whom the United States deported to China during the excesses of the McCarthy era. While Dr. Tsien helped China develop ballistic missiles to improve its nuclear deterrent, Beijing has mainly concentrated on economic development in the past three decades: Of Deng Xiaoping's "Four Modernizations," national defense

received the least priority. Recently, though still focused on economic growth, China has been building its military strength, including multiple offensive counterspace options, with the U.S. Department of Defense noting China's "multidimensional program to generate the capability to deny others access to outer space."[3] Well aware of its military inferiority to the United States, China is likely doing what countries in comparable security situations do: developing military capabilities targeted against the vulnerabilities of its stronger potential adversary. The United States' relative space advantage will probably shrink as China strengthens its space capabilities over the next ten to twenty years.

The voluminous People's Liberation Army (PLA) literature on space conflict underscores that PLA officers are explicitly interested in space weapons. But Chinese military writings are no more likely to accurately reflect Beijing's policy than midlevel U.S. military writings would Washington's official policy. However, arguments that this PLA literature is merely academic lost some credibility in the aftermath of China's 2007 ASAT test.

It is unclear whether China's offensive counterspace capabilities are intended for deterrence or as usable weapons of war, though deterrence is repeatedly discussed. As a possible precedent, China's strategic nuclear policy has been one of minimum deterrence and declared "no first use." The small Chinese nuclear force is not meant to wage war, but is capable of destroying a few cities, a capability that allows China to resist potential foreign coercion. However, space and nuclear deterrence are not the same. Because the effects are not as devastating as the detonation of a nuclear weapon, crossing the space weapons "threshold" is easier, especially if the effects are temporary. Some PLA writings suggest China is considering a "no first use" space weapons policy, though the lower level of destruction in space conflict makes it more likely China would preempt in space if it were advantageous to do so.

Some PLA authors see space conflict as a natural evolution of military technology, and space weapons as desirable for China, though others appear to adopt a more deterrence-oriented framework for

these weapons. Some in the PLA directly connect Chinese doctrine on strategic nuclear forces with that on space weapons, urging the same "minimum deterrence" doctrine.[4] Chinese leader Mao Zedong was explicitly quoted on China's 1975 nuclear policy: "We will not attack unless we are attacked. If we are attacked, we will certainly counterattack."

Important for China, as for the United States, would be the credibility and effectiveness of its counterspace forces, which could be either ground or space based. Deploying weapons in space could appear risky to China due to the difficulty in assuring their survivability. The primary weakness of all space-based arms is their vulnerability, making them high-priority targets for opponents and thus a major source of crisis instability by which an attacker would stand to reap significant advantage. In contrast, ground-based space weapons have fewer such drawbacks, being more easily maintained and defended, and thus more difficult to attack. Chinese writings suggest a preference for such weapons over space-based ones.

In a number of fora and military writings, China has unofficially indicated that the United States should not underestimate China in space or its ability to respond to U.S. military space initiatives that China perceives as a threat. Chinese specialists have stated that, in addition to protecting their satellites against U.S. offensive capabilities, China will develop a deterrent space force if there is no change in U.S. space policy, which they see as shunning any restrictions and reflecting U.S. attraction to space dominance. They have suggested that China would be prepared to deploy sufficient offensive counterspace capability to build confidence in its ability to deter U.S. use of weapons against Chinese space assets. This would not require China to match U.S. space-force deployments, but to have enough to deter. In general, as the CFR-sponsored Independent Task Force report on U.S.-China relations noted in 2007, "China does not need to surpass, or even catch up with, the United States in order to complicate U.S. defense planning or influence U.S. decision-making in the event of a crisis in the Taiwan Strait or elsewhere."[5] This could reflect Chinese thinking on space weapons, as well.

China has openly announced its intention to build "informationized armed forces and being capable of winning informationized wars by the mid-twenty-first century;"[6] offensive counterspace capabilities would be an important component in this capability. Coordinating and executing any such attack would be difficult and fraught with danger for China. Some are concerned that an action-reaction cycle involving space weapons could result in an "arms race in space," even without actual conflict, making both the United States and China worse off than if neither went down this path.

China's military space doctrine and intentions are far from clear and urgently require further analysis and understanding, leaving the United States with no choice but to hedge prudently against this uncertainty. But there is at least some suggestion that China may be moving toward a doctrine of deterrence in offensive counterspace capability, at least in the near to mid term, partially patterned on its strategic weapons doctrine and policy. This doctrine would include:

- an officially preferred ban on all space weapons;
- a secondary doctrine of deterrence, based on finite capability rather than total competition with the United States;
- no requirement for quantitative parity with the United States; and
- a preference for ground-based space weapons over space-based weapons.

It is unclear whether the PLA subscribes to this embryonic doctrine. China is possibly seeking a full space war-fighting capability and not just a finite deterrence posture. However, PLA writings make clear what Chinese diplomacy does not: the PLA envisions conflict in space and is preparing for it. Accordingly, the United States needs to assess how robust a program of space offense China plans. Caution suggests the United States must prepare itself for the possibility that China could soon have an arsenal of ASAT weapons, though it is not a foregone conclusion. This uncertainty compels the United States to hedge its risks, but carefully, and not in such a way as to create a self-fulfilling

prophecy. Far more U.S. attention and understanding of this issue is needed.

STRATEGY FOR A STABLE SPACE REGIME

While China represents the most prominent challenge to U.S. space assets, it is not the only one. Russia and others[7] are taking another look at space to counter U.S. military capability, and friendly countries such as India are reexamining space's role in this new era, in at least partial response to China's 2007 test. India's army chief of staff has stated that "the Chinese space program is expanding at an exponentially rapid pace in both offensive and defensive content," and another Indian general has observed that "with time we will get sucked into a military race to protect our space assets and inevitably there will be a military contest in space."[8] Such actions could possibly trigger responses from other regional adversaries as well.

The strategic landscape of this new space era is largely unexplored and poorly understood. Nonetheless, certain objectives are clearly in the interest of the United States. The risks inherent in space conflict, where vital U.S. interests are at stake, suggest that preventing space conflict should be a major U.S. security objective, and that all instruments of U.S. power, not just military measures, should be drawn upon to this end. The United States needs to deter others from attacking its space capabilities and bolster an international space regime that reinforces deterrence, the absence of conflict in space, and the preservation of space as an environment open to all. Such a regime would allow the United States to continue reaping the critical information and service benefits that U.S. military space assets provide. To achieve this, the United States needs vigorous diplomatic initiatives as well as defense programs and strategy. Such a stable space regime would seek to:

- focus U.S. policies on stability, deterrence, escalation control, and transparency;

- create incentives that encourage nations to avoid actions that are inherently destabilizing and cannot be reversed;
- construct a military space architecture on the basis of an in-depth, layered defense in order to ensure the availability of vital space services;
- reduce incentives to and the ability of adversaries to target space capabilities;
- foster uncertainty with respect to the consequences of such an adversarial action;
- increase warning time to enable both strategic- and operational-level actions;
- facilitate agreements and understandings that would constrain the most destabilizing dimensions of space competition and provide ground rules for normal space operations; and
- maintain ongoing dialogue among U.S., Chinese, and other military and policy experts to promote greater understanding and reduce chances for misunderstanding and miscalculation.

U.S. policy is largely silent on these issues and offers no organizing principle for addressing counterspace issues. One Bush administration official raised some of these stability concerns in an article calling for a stabilizing space-protection strategy, from which some of the eight stability tasks above are adapted, but this was not official policy, and the individual has left the government.[9]

Possible U.S. Military Options for Addressing the Chinese Challenge

CURRENT U.S. SPACE POLICY

The Joint Chiefs of Staff issued an important document on space doctrine in 2002, which states that "[T]he United States must be able to … deny the use of space assets by its adversaries" and addressed "negation of enemy adversary space systems."[10] This doctrine has created some uneasiness among other space powers. Some of this policy approach was carried over into the new National Space Policy that President Bush signed in 2006,[11] which directs the Secretary of Defense to "develop capabilities, plans, and options to ensure [U.S.] freedom of action in space and, if so directed, deny such freedom of action to adversaries."[12] President Bush stated that "freedom of action in space is as important to the United States as air power and sea power." The Bush administration states that no new agreements are needed because there is no space arms race. However, this begs the question of space *stability*, which the recent Chinese and U.S. ASAT demonstrations suggest may well deteriorate in the next decade without concerted action. The U.S. objective should be space stability that advances U.S. security interests, whether or not a formal "arms race" is under way.

One often overlooked passage in this new U.S. space policy is an important statement: the United States considers space capabilities—including the ground and space segments and supporting links—"vital to its national interests." The Bush administration described this passage in congressional testimony as going "beyond previous policies by

identifying space capabilities as a top national priority." One Bush official called this "the most important lesson learned" during the development of the revised space policy.[13]

Identifying one's own space capabilities as a vital national interest, while reserving the right to attack others in space (which would likely provoke retaliatory attacks against our "vital" space assets), appears internally inconsistent, even contradictory. For one, the technology for degrading and disrupting space systems from the ground is fairly inexpensive (relative to the cost of most satellites) and not too difficult to acquire, compared to the technology required to protect satellites from attack. There is the further complication of satellites used for both civilian and military purposes—communications and some timing-positioning satellites. These systems cannot be protected in a way that makes economic sense. The trade-off is more balanced in cost and technological difficulty for attacking satellites from other satellites. Attacking others' satellites would invite retaliation, putting at risk a "vital national interest" where the United States has much more to lose than the attacker. In the nuclear arena, keeping the option open to retaliate with nuclear weapons if U.S. vital interests are attacked is firmly anchored in a doctrine of deterrence, not war fighting. The absence of discussion on deterrence in U.S. space policy beyond a brief mention is disturbing and requires clarification. Threatening to attack the space assets of competitors who also possess offensive counterspace capability could only be in the security interests of the United States if:

- the United States can successfully defend its space assets; or
- the right to attack others is implied in terms of deterrence rather than war fighting; or
- the effects of attacks on satellites are fully reversible; or
- attacks are limited and localized (i.e., tactical in nature, not strategic).

Even the latter two cases would involve significant risk of escalation. The administration has stated that "the current preferred approach to protect U.S. terrestrial forces from space threats is through the use of temporary and reversible effects," though this has not been

confirmed as official policy.[14] China's ASAT test, however, led to a major U.S. reaction, and a potential action-reaction cycle appears likely. If China deployed direct ascent ASATs (ground-launched missiles that fly directly at their space targets, such as the ones China tested in 2007), these would become high-priority targets for the United States in a crisis or actual conflict due to the threat they would pose. General James E. Cartwright told Congress that the United States is prepared to strike land-based Chinese ASAT launchers if China shoots down U.S. satellites. Such a statement may help dissuade China from attacking U.S. satellites in a crisis, but, if actually carried out, it would inflict many casualties and risk serious escalation. This highlights the disparity between deterrence and war-fighting strategies. At a minimum, such statements would give China an incentive to make their ASAT systems mobile.

The administration has not adequately addressed the political and military risks associated with an unconstrained offensive counterspace competition. There is an inherent potential for instability when a relatively modest investment of military resources can produce a disproportionate effect on an adversary's military capabilities, as with space assets. In the context of an escalating crisis, such potential instability could be magnified to critical proportions. While the United States currently enjoys substantial space superiority, should China—or others—assert comparable rights and buttress these assertions with counterspace weapons programs, the potential for future space- and earth-bound instability would be substantial and worrisome. In the near to mid term, threatening to attack Chinese satellites, which China depends on far less than the United States does its military satellites, appears counterproductive and could easily provide a Chinese rationale for a response in kind that could seriously damage U.S. military capability.

In response to the security message of the Chinese ASAT test, press reports indicate that the Bush administration has been developing countering strategies in the Departments of Defense and State and drafting a funding plan to procure technologies. The president is reported to have issued a classified memo calling for agencies to improve

U.S. space situational awareness (SSA), avoid future foreign ASAT launches, and address defensive and offensive measures.[15]

IMPROVED SPACE SITUATIONAL AWARENESS

SSA is the ability to track and understand what objects are in orbit and what their capabilities are. By providing real-time or near real-time location and status information on spacecraft, SSA enables better management and operation of these assets and provides warnings of potential hazards—natural or manmade, intentional or unintentional—to allow preventive or mitigating steps to be taken. In addition, accurate SSA is needed to know for certain if a satellite's operations have been intentionally affected by an adversary. The United States currently maintains a public information data network that provides important orbital and related information on over twelve thousand detectable orbiting objects, data that it makes freely available on the Internet. Yet many experts agree that the United States "needs significant improvements in space situational awareness, such as the development of the ability to attribute in real time all activity in circumterrestrial space … including birth to death tracking and assessment of all threats capable of affecting [U.S.] space systems," similar to the role civilian authorities play in air travel.[16] Whether one wants to pursue a purely defensive space policy or a mixture of offense and defense, improved SSA is imperative. Air Force Space Command has called for much better capabilities to identify what is already in space, understand orbiting objects' mission, and, ultimately, determine intent. The U.S. Army has placed improved SSA near the top of its list of needs. Improved SSA has broad support among both supporters and opponents of offensive counterspace.

The United States would be well served by going beyond SSA and enhancing space intelligence that better understands the purpose and motivation behind the space objects being identified and tracked.[17] Otherwise, understandable worst-case planning could lead to just the kind of escalation in a crisis that all parties seek to avoid. In addition,

satellites themselves need to be alert to their surroundings and sense when they are threatened or under attack. Furthermore, the United States must be able to attribute an attack to a particular country, a prerequisite to any effective retaliation or deterrence strategy.

DEFENSIVE MEASURES

The United States has placed significant emphasis on protecting its satellites, an effort that enjoys broad support. There are costs and operational trade-offs for added protective steps. Stealth, maneuverability, and protecting satellite sensors from blinding laser and other attacks are among the many defensive options available. According to one Air Force general, "the Air Force is shifting its space mindset to one of operating in a contested environment with an increased emphasis on space protection."[18]

OFFENSIVE MEASURES

The United States says virtually nothing about any offensive space programs it may develop. While the February 2008 U.S. satellite interception demonstrated ASAT capability, it seems likely that any U.S. offensive counterspace weapon would not be designed to create space debris and would depend on properties such as electronic jamming or lasers, with an emphasis on temporary, reversible effects. Notably, the Air Force's top two priorities for space control are improved SSA and protection, neither of which is offensive in nature.

OTHER MEASURES

By maintaining a capacity to quickly replace damaged or destroyed satellites with spares or quickly launchable satellites of lesser capability, the United States could partially offset the effects of an attack on its space systems through an operationally responsive space (ORS) capability. Such satellites could even be launched preemptively in a crisis to

add capability and demonstrate political intent. France has recently expressed strong interest in ORS capability for the same reasons as the United States, explicitly citing the Chinese ASAT test as motivation.

Non-space backup systems include unmanned aerial vehicles (UAVs) and ground-based signal and communication transmitters, which cost less than replacement satellites. However, these systems would probably not offer the same level of functionality or durability as a satellite. Nonetheless, it is essential that the United States more widely distribute these "vital national interest" space capabilities across a larger and more diverse set of space and non-space platforms to both reduce U.S. space vulnerability and make it more difficult for potential adversaries to hold those assets at risk.

The development of space technology is essential, no matter how the United States decides to respond to Chinese or other nations' counterspace capabilities. SSA, defensive and offensive measures, ORS capability, and evaluation of the Chinese program all require more advanced technology in order to be successful, such as advanced sensors, software, micro- and nanoelectronics, and ultra-long endurance UAVs.

POSSIBLE FUTURE MILITARY SPACE REGIMES

While the Bush administration revised U.S. space policy in 2006, it suffers from the same defect as earlier space policy: There is no clear presentation of an organizing principle or doctrinal framework for U.S. space policy, especially the policy's offensive dimension. This leaves open the question of whether offensive space capabilities will be planned, procured, and deployed under a doctrine of deterrence; whether they are seen as just one more weapon of war; or some mixture of both. In shaping a future military space regime, the United States can choose to pursue one or some combination of three doctrinal options: diplomacy, space deterrence, and space dominance.

Diplomacy and Arms Control

Some advocate primarily an arms control approach to the counterspace challenge. The growing multilateral nature of the problems that the United States and others face in space strongly suggests that diplomatic approaches have an important role to play in constructing a space regime that best meets U.S. security needs, perhaps including specific arms control agreements. Unfortunately, China's ASAT test, its ongoing programs, the United States' growing military dependence upon space, and the general advance of technology available to many countries indicate that reliance purely on negotiated agreements and defensive measures to protect U.S. space assets would involve a high degree of security risk. With its ASAT test and its arms control proposal, China appears to have shown that its interest in banning space weapons applies chiefly to space-based, not ground-based, weapons. The latter would be harder to verify in any event.

Without some counterspace capability, the United States would need to rely on its ability to attack vital Chinese national interests in other ways in order to deter China from attacking U.S. space assets. In a crisis, the PLA, like any military force, would be tempted to exploit such an important advantage. The United States would be worried that China could destroy LEO satellites in a matter of hours, an intolerable situation. Such uncertainty would be amplified by the short timelines that crises often impose on the decision-making process.

One example where arms control could play a supporting role in space security is with a ban on the testing or demonstration of "hit-to-kill" anti-satellite capabilities, or any act that intentionally produces substantial amounts of space debris. While the covert development of such capabilities remains possible, China would not enjoy the confidence that normal testing would give it. The successful Chinese ASAT test was the third in a series, following two that were unsuccessful. While such a ban would thwart China's 2007-style ASAT, it would not thwart more advanced ASAT technologies that do not rely on smashing into their targets. Furthermore, space debris from such tests would pose a danger to China's own plans for a greater space presence.

The rejection of arms control in current U.S. space policy is counterproductive and should be replaced by a more open, or at least agnostic, approach. Arms control cannot solve U.S. space security problems, but it can help address them, especially in concert with wise policy, strategy, and appropriate military programs. Current U.S. policy ignores the synergistic benefits President Ronald Reagan reaped from combining military programs with arms control to achieve his security objectives. Instead, current policy has produced negative reactions from close U.S. allies and adverse foreign policy repercussions that complicate U.S. space objectives. Dialogue and discussion are not zero-sum games and would allow the United States to learn more about its adversaries.

SPACE DETERRENCE

The next broad space regime option is deterrence. Under this option, the United States would consent to the use of space for most military purposes by other countries so long as they did not interfere with U.S. military use of space, and would take prudent steps to defend its own space systems against attack, though they would probably not be invulnerable. The United States would maintain the capability to attack other countries' satellites but would see using such capability as a last resort, and would pursue space doctrines, programs, negotiations, and contingency plans aimed at discouraging any country from initiating conflict in space. Such a regime would operate differently for space than for nuclear weapons. As nuclear weapons deterrence concepts have developed over the last sixty-five years, thresholds between tactical and strategic uses have diminished, and the "first use" threshold of any type of nuclear weapon has grown higher. With space weapons, their limited use in purely tactical situations, though not without risk, would be less likely to lead to escalation than tactical nuclear use. Whether ground or space based, using jammers against satellite systems on a tactical basis would likely provoke a response, but not necessarily escalation. Indeed, satellite jammers have been a standard part of

the "electronic battlefield" for years. Deterrence in this situation would have little in common with deterrence in tactical nuclear conflict. On the other hand, a successful, broad, and irreversible attack against the full space infrastructure of the United States would be catastrophic and highly escalatory. The United States would likely consider retaliating against such attacks—not just with attacks against an adversary's space assets, but also with widespread attacks of its own against important targets outside the area of direct conflict. Deterrence would operate in a more complicated and nuanced fashion for space attacks than for nuclear weapons, and it clearly requires additional study.

If counterspace weapons existed primarily for deterrence, except in tactical situations with jammers, then "deterrence sufficiency," not quantitative parity, would be most important. In the same way that China has felt secure with its smaller strategic force, such a situation could also prevail in the counterspace world, though this would depend on China's perceived security needs. It is also important to remember that denying access to space does not have to mean that the conflict moves to space. Air Force officers point out that one way to deny an enemy access to space is to attack its ground stations and launchpads, so one does not necessarily need to take the fight to space: Bombing a ground site can be just as effective, though it still risks escalation.

Whether for deterrence or war fighting, any offensive space forces the United States were to develop or deploy should meet strict criteria, including:

- effectiveness;
- survivability;
- resilience;
- credibility;
- reversibility of effects;
- cost-effectiveness at the margin; and
- minimum collateral damage when used.

Credibility is important both to enhance deterrence and to provide options should space deterrence fail. Whatever future counterspace capabilities are developed should have reversible effects. For example, a jammer disrupts a satellite ground station link, but does not permanently damage the satellite or the ground station, and leaves no debris. This kind of weapon would be far less dangerous, and thus less destabilizing, than one that permanently destroyed or disabled satellites and/or their support infrastructures. Ironically, this reversibility could reduce deterrent potential, but even the threatened temporary loss of space information crucial to the performance and survival of terrestrial forces would retain substantial deterrent value. Cost-effectiveness at the margin refers to incremental offensive capabilities being cheaper than the incremental cost of defending against them.[19]

China may prefer a "no space weapons" approach, but its own behavior has made this exceedingly difficult. Unless China becomes more forthright about its ASAT test and space weapons programs, the United States will have to assume at least some Chinese ASAT capability in the future. The February 2008 U.S. demonstration of ASAT capability and U.S. policy suggest that China will need to assume the same for the United States. Both countries will have to live with the reality that neither will have a monopoly on offensive space capability.

The United States faces a delicate situation before China becomes highly dependent upon space. Even if the United States deployed superior offensive counterspace forces, China may actually be better equipped for deterrence due to its more limited space dependence, at least in the near to mid term. The challenge facing the United States is to strengthen its own asymmetric means of deterring China from attacking space assets in a crisis or conflict, as outlined earlier, as well as countermeasures to protect and defend them.

International finance offers an economic analogue to these space challenges. A number of countries have the ability to wreak havoc on the international banking system through cyber attacks and other means. Yet to do so would affect the attacking country's international financial transactions and invite an equally devastating attack on a country's own banks, an act of economic suicide. As the United States,

China, the European Union, and others more deeply embed their economic and military strength in space infrastructure, both threats of retaliation and growing interconnectedness and interdependency of their economic infrastructures may make large-scale counterspace attacks comparably unthinkable.

There are many issues this doctrinal approach raises that are well beyond the scope of this report and that urgently require attention. One in particular merits special mention: the countermeasures that the United States would have to take to operate in a conflict where an enemy would have to worry only about temporary and reversible U.S. counterspace capabilities. In several years, China will probably be able to take pictures from space of U.S. ports and bases in the western Pacific and relay those images in minutes to Chinese missile systems and air crews, an advantageous capability heretofore only possessed by the United States since the first Gulf War. While such a Chinese capability would increase China's space dependence and thus "raise the ante" for it to strike first in space, new U.S. tactics and countermeasures will be required to maintain the current U.S. advantage under a future deterrence regime.

SPACE DOMINANCE

A third doctrinal option is sustained offensive U.S. space dominance. In this case, the United States would maintain such a powerful offensive and defensive counterspace capability that no other nation could compete with it. Such a capability would be highly sensitive to the motivations and responses of China and other CRINKIL countries. Even if China adopted a policy of minimum space deterrence, space dominance would be unstable because U.S. efforts to maintain it would by definition weaken China's ability to deter. Chinese efforts to restore its deterrent would then spark responsive efforts by the United States to maintain dominance, and a serious arms competition in space would be inevitable unless one side gave up. Where a U.S. adversary was determined to maintain rough parity in offensive space capability,

the resulting strategic space environment would be even more unstable. Sudden technological breakthroughs by either side, rarely predictable, would aggravate this dynamic.

Such a dominant stance could theoretically convince a competitor like China that it should not even attempt to develop the capability to attack U.S. space systems, much less put such capabilities in space, but in reality such a result is highly unlikely. China's burgeoning economy, its nonmilitary space programs, and its strong nationalist streak make it far more likely to continue to spend considerable resources on its satellites and counterspace capabilities. China would see such a U.S. doctrine as provocative, and it would likely stimulate a more determined Chinese response. Attempting to maintain space dominance would thus be very costly, destabilizing, and ultimately unsuccessful, compromising U.S. ability to pursue other military and nonmilitary priorities in the meantime.

ASSESSING FUTURE SPACE REGIMES

The United States faces challenging choices in responding to this new space environment and must respond wisely as well as vigorously to protect the security interests of itself and its allies. Imprudent choices could create a self-fulfilling prophecy, spurring China, for reasons of security or national pride—or both—to accelerate its counterspace efforts in such a way that both the United States and China would be worse off.

With so many different ways to attack space assets, it is much easier and less costly to attack spacecraft than defend them. Thus, a U.S. or Chinese doctrine of space dominance seems likely to fail. Provocative military postures can result in more adversarial efforts than nonprovocative postures. The United States would never accept Chinese hegemony in space, and as their ASAT test strongly implies, China seems unlikely to accept U.S. hegemony or dominance. Developing defensive and offensive capabilities to defend U.S. space assets from attack is a legitimate act of self-defense, though it will be best accom-

plished at reasonable cost if integrated into an overall doctrine of space deterrence.

Current U.S. space policy contains a potential problem when it states that the United States will "deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests." This creates a possible conflict with the same policy's statement that U.S. space capabilities are "vital to its national interests," given that U.S. attacks on the space capabilities of others run a high risk of sparking counterattacks, and the costs of hardening U.S. systems against similar attacks are so high.

This tension has remained largely unaddressed for nearly two years. Washington needs to consider the costs and benefits of such attacks and address them in policy and force doctrines. The implication of current policy is that others, not the United States, must make trade-offs in space, yet it is highly unlikely that China and other spacefaring nations will accept substantially subordinate status, or that the United States would make the substantial investments required to enforce such a dominant position. If the United States can resist the urge to overreach, it may be able to achieve a more stable, less costly military space posture and doctrine that could maintain a measure of U.S. space superiority, based on the strategic nuclear balance precedent. The United States could preserve space superiority relative to China, deriving more benefit from space than China does and retaining more offensive capability, though China would still keep its ability to deter the United States from attacking China's growing space capability. Such a capability appears well within China's reach, in spite of Washington's wishes otherwise.

Over the long term, deterrence-based superiority would be grounded in the reality of the difficulty of maintaining dominance in space, and the fundamental vulnerability of space-based weapons both to other space-based weapons as well as to ground-based counterspace weapons, especially directed-energy weapons. Deterrence-based superiority would be less costly to maintain than dominance and could be substantially more stable under the proper conditions, though neither achievement nor maintenance would be simple. At a minimum, it will

require the anchoring of offensive counterspace capabilities within deterrence doctrine, healthy U.S.-China relations that avoid provocative rhetoric, continued dialogue, and confidence-building measures (CBM).

Such a deterrence posture would also require the weapons systems to support it. Their precise characteristics are beyond the scope of this paper, but they should embody the criteria listed on page twenty. Jammers, lasers, and other forms of reversible electronic and electro-optical offense should be considered. Given the demonstrated counterspace capability of minimally modified missile-defense interceptors, some inherent kinetic energy antisatellite (KE-ASAT) capability is inevitable; however, bans on testing against satellites could limit its effect. A vigorous, defensive counterspace program should accompany these steps.

Until China becomes substantially more dependent upon its space assets, the United States will need to supplement this strategy with alternative asymmetric means to deter China from attacking U.S. space interests, including potential disruption of PLA communications and the ability to attack high-value ground targets, though this would also risk serious escalation.

In the long run, if China sustains its economic growth to a point where its economic and technological prowess is roughly comparable to at least Japan's, if not the United States', U.S. offensive counterspace superiority could be more difficult to sustain if China decided it wanted parity or more, a distinct possibility. Yet by that time, China would be struggling with the economic and political impact of its demographics, where its one-child policy will lead to a rapidly aging workforce. Chinese leaders require decades of external stability so that they "can continue to focus their attention on economic growth and political reform. China can ill afford external distractions that would absorb resources and jeopardize the environment that China requires for continued economic growth."[20] China has many other looming sociopolitical issues, too, making space force parity likely a lower priority for it, as long as it could maintain space deterrence. If the United States and China can successfully navigate the shoals of uncertainty

over the next two or three decades and achieve friendlier relations, such considerations could shrink greatly in significance. But achieving such a state requires that these issues be discussed and debated, with as much information as can safely be made public. As a former Air Force vice chief of staff recently wrote, "It is important to encourage a debate on space power to include development of a space deterrent theory. We need something similar to the intellectual ferment that surrounded nuclear deterrence."[21]

Diplomatic Options

Diplomacy has an important role to play in U.S. space security interests, and it is unfortunate that in recent years the United States has not made more use of it. Three broad approaches exist: dialogue, voluntary cooperation regimes, and formal agreements. Dialogue on space weapons has been minimal, though there has been more in non-weapons areas, such as debris. The administration has strongly resisted formal agreements that legally obligate signatories to comply. The only new restrictions it has supported are voluntary, e.g., debris limitations and best practices on safe space operations. Vigorous U.S. opposition has prevented UN negotiations on a treaty to prevent an arms race in outer space (PAROS), though the UN Conference on Disarmament (UNCD) is not an ideal forum for such early discussions because of its unwieldy size.

CHINESE DIPLOMACY

China has preferred a comprehensive arms control approach to space security for a number of years. China and Russia have joined together in the UNCD to promote a treaty to ban all weapons in space. The stated purpose of their proposal, which aims to prohibit space-based weapons and the use of force against outer space objects, was to close the gaps in existing international space law. Russia also proposed a moratorium on the placement of weapons in outer space. China has said its proposal seeks to prevent the deployment of weapons, an arms race, and the threat or use of force against objects in outer space.

Notably, China itself has conceded the difficulty of verifying such an agreement. The paper that China and Russia provided at the UN

analyzed the feasibility of a verification regime for a future legal instrument. It offered the view that a verification regime in a future treaty applicable to outer space would be highly complicated and would encounter formidable technological and financial challenges. The United States has rejected the China-Russia approach, and it is highly unlikely the U.S. Senate would ratify any agreement that was not shown to be effectively verifiable.

China's 2007 ASAT test also exposed more general shortcomings in China's diplomacy and national security planning. The Chinese foreign ministry appeared to be unaware of the test, and was unable to competently respond to questions asked by other countries. Twelve days of denial passed before the ministry confirmed the test. This raises questions about whether China's leaders adequately review military decisions with major foreign policy implications. It also suggests a disturbing lack of coordination within the Chinese government that could have potentially serious ramifications in a future crisis.

CONFIDENCE-BUILDING MEASURES AND SPACE CODES OF CONDUCT

As the number of spacecraft, the amount of debris in orbit, and the demand for orbital slots and transmission frequencies increase each year, there is a growing need for all spacefaring nations and entities to cooperate so spacecraft can function without incident. Just as roads, airways, the broadcast spectrum, and other commonly used but finite resources require management, similar rules are needed to regulate "traffic" in space. [22]

Measures such as space traffic management and codes of conduct should be viewed as essential aspects of U.S. space policy. There is a need to build up "rules of the road" that all spacefaring states accept. This process will not be rapid, but gradually developing boundaries for acceptable action will provide the basis for a safer space environment and build trust that could make needed agreements possible. By proactively engaging the international community on these initiatives, the

United States would demonstrate its leadership role in, and proper stewardship of, the space domain, as well as reap the resulting practical benefits.

In terms of global security policy, space traffic management, codes of conduct, and CBMs can lay the foundation for a system in which nervous countries are reassured by sound data and a modus operandi that emphasizes observation, communication, and explanation, rather than fear-based reaction caused by limited information. Even on a voluntary basis, a code of conduct delineating the rights and responsibilities of spacefaring nations could provide a means to reduce the growing chaos in space and create international behavioral norms. Many variations of such a code have been discussed; one useful example is provided in Appendix I of this report.

IMPROVED COMMUNICATIONS

To improve communications, Washington and Beijing can build upon the recent U.S.-China hotline agreement, as well as several related proposals.

In the mid-1970s, the United States and Soviet Union signed an incidents-at-sea agreement to reduce misunderstanding. Navy officials have spoken of its usefulness, not only because the agreement helped to reduce confusion, but also because it opened up new channels of communication that proved useful in other circumstances. An "incidents in space" accord could have a similar effect for the United States and China.

There have been modestly beneficial exchanges between U.S. and Chinese military leaders that should be expanded. Specific venues, such as exchanges between war colleges and even military simulation centers, should be explored. Admiral Timothy J. Keating and General Peter Pace (Ret.) have visited China, but their reciprocal invitations to senior PLA leaders to come to the United States for broad discussions have not been accepted.

POSSIBLE NEGOTIATED LIMITS

While limits on certain counterspace capabilities may be difficult to negotiate, dismissing the approach is imprudent. The 1996 U.S. National Space Policy struck a useful balance on this subject, stating that "the United States will … conclude agreements on such [arms control] measures only if they are equitable and effectively verifiable and enhance the security of the United States and its allies."[23]

One objection that is often raised about such agreements is that once Washington commits to the process, it focuses on the negotiations to the detriment of national interests. This objection clashes with the reality of recent experience, as with the late 1990s negotiations to ban land mines. Led by Canada, the United States participated in the negotiations but did not sign the final agreement for national security reasons, despite substantial international criticism.

The Bush administration's space arms control arguments have more validity when it comes to broad proposed restrictions, like a ban on all space weapons.[24] Sweeping proposals are probably unverifiable; certainly most deployment bans on such weapons would be. Historically, overbroad proposals have acted more as a delaying tactic than serious policy. Verification is more feasible with targeted restrictions that focus on easier-to-confirm actions, such as testing limits.

One possible restriction that merits consideration is a ban on KE-ASAT tests. Space conflicts in which satellites are destroyed by KE-ASAT would increase space debris levels and could render important orbital areas inhospitable for military or civilian use for decades, even centuries. If U.S. space assets are a "vital national interest," preventing such contamination should be a logical goal. All nations lose when lethal space debris fills commercial satellite orbits. Especially compelling would be a ban on such tests at geosynchronous orbits, where debris permanently remains. Such test restrictions could be housed in the Inter-Agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guidelines, to which the United States, China, and other nations are signatories.

Spacecraft of other countries flying too close to a country's military satellites could create anxiety about intent, as well as the risk of collision. Another possible restriction is keep-out zones for satellites.[25] Combined with appropriate notification procedures when close approaches are unavoidable, they could provide confidence of intent.

Finally, an agreement on use of lasers during peacetime would allow acceptable uses of lasers, such as communications, range finding, and information gathering, while banning damaging activities that could constitute acts of war.

GPS/BEIDOU COMPATIBILITY

The Global Positioning System (GPS) has contributed significantly to military and civilian life in the United States and around the world. Other systems are now joining GPS: Russia's Global Navigation Satellite System (GLONASS), China's Beidou system, and Europe's Galileo system. Making GPS and Beidou compatible—and others if possible—would allow for more accurate positioning information for users worldwide. Compatibility could be terminated in the event of a crisis or actual conflict.

Conclusions and Recommendations for the United States and China

OBSERVATIONS ON THE NEW STRATEGIC LANDSCAPE IN SPACE

The United States and China have strong incentives to avoid counterspace warfare with each other, and especially to avoid actions producing substantial quantities of long-lasting space debris. The overwhelmingly adverse security and economic consequences of such "debris warfare" for both countries—and the world—should outweigh most other considerations.

In addition, satellites' predictable orbits make them vulnerable to a variety of offensive counterspace technologies that are growing more sophisticated and capable over time. In space, offense has a major advantage over defense. The United States appears to be taking steps to reduce this vulnerability, both through defensive counterspace techniques (e.g., hardening and maneuverability) and through other measures that will distribute its space capabilities across a large number of satellites, rather than a few high-value satellites that would be tempting targets in a crisis. Such steps would be unlikely to more than modestly reduce U.S. space vulnerability.

Accordingly, the United States will soon confront a situation where its satellite fleet becomes increasingly exposed to advancing technology and ever more sophisticated attack because of the major negative military consequences such a loss would produce. Other economically and militarily advanced countries—particularly China—will face a similar, if not quite as stark, situation within the next two decades.

The United States faces a serious challenge as its military and economic prowess increasingly depend upon space infrastructure that grows more vulnerable as worldwide space technology advances, especially in China. While the United States will likely remain the preeminent space power at least for the next twenty to thirty years, it will no longer enjoy the level of near monopoly on military space capability that it has enjoyed since the fall of the Soviet Union. As China becomes a credible space power with a demonstrated offensive counterspace capability, the question for U.S. policy is what kind of feasible and stable space regime best serves U.S. long-term security interests. This question should be addressed early in the new administration's tenure, if not earlier.

The fundamental U.S. security interest in the wake of China's 2007 ASAT test should be deterring China and others from attacking U.S. assets in space, using both a combination of declaratory policy, military programs, and diplomacy, and promoting a more stable and secure space environment. At the same time, the United States and China should both pursue diplomatic options to increase clarity and minimize misunderstanding on space-related matters, and reduce the chances of accidental conflict. This comprehensive mix of military and diplomatic measures is more likely to achieve U.S. space and larger national security objectives than either by itself.

As important as deterrence is, however, it should not be the only objective. Given that deterrence failure in space is less unlikely than nuclear deterrence failure, it is in the interest of the United States to prepare for this possibility. Modest, traditional counterspace attacks—such as localized jamming of U.S. satellites and attacks against in-theater ground stations—seem almost certain to occur at some point in the future and should not pose a major threat if protective measures and countermeasures are taken.

The present asymmetry in U.S. and Chinese space assets affects deterrence. Given that China's space presence is growing rapidly, the effect of this uneven dependence on space will lessen over the next fifteen to twenty years. In the meantime, the United States should have a clear set of asymmetric deterrence options available—such as inter-

ference with internal Chinese lines of communication and control and overall conventional superiority—as a hedge until China's space infrastructure becomes more substantial. In addition, Washington needs accurate estimates of China's likely military and civilian space architecture, and improved understanding of China's offensive counterspace doctrine.

Some are attracted to a U.S. posture of dominance in space, and such a vision has superficial appeal. However, this attraction overlooks the serious difficulties that accompany it. Space assets are far more difficult to defend than to attack, and it will be well within China's capability in the mid term to prevent the United States from attaining a dominant space position. Already China's economy is growing as fast as that of the United States in absolute terms. One may wish otherwise, but the United States will not be able to maintain its near monopoly on space power into the future, though perhaps, with smaller margins, it can remain preeminent in space for many years to come.

The United States faces an attractive space future if it does not let the best be the enemy of the good. U.S. space superiority is possible, but space dominance is not likely. Ground-based offensive assets are more survivable, and hence less destabilizing in a crisis, and are also likely to be less expensive and more reliable. Conversely, space-based offensive assets are vulnerable and have significant potential for crisis instability, offering huge incentives for adversaries to strike first. Thus, what the United States chooses to acquire as its offensive capability should first be evaluated against these criteria, as well as those suggested on page twenty.

While the United States has too long abjured possible diplomatic approaches to space, the Bush administration has recently begun to make serious efforts to seek agreement with China and others on nonbinding confidence-building measures and rules of the road. Their efforts are commendable, worthy of prioritized effort, and should be encouraged. Despite differences of view between the United States and China on issues of space, diplomatic progress should be possible, given the overlapping interests of both.

RECOMMENDATIONS FOR THE UNITED STATES

To reinforce the positive dimensions of current U.S. space posture, policy, and doctrine, and enhance national security, the United States should pursue a combination of policy, programmatic, and diplomatic options. Together they would constitute a powerful, sophisticated response to China's offensive counterspace challenge.

Policy Recommendations

- The Department of Defense (DOD) should establish stability and space-asset protection as major U.S. objectives in space and work with the State Department to develop framework deterrence principles for U.S. counterspace policy that recognize the primacy of deterring attacks on U.S. space assets and maintaining stability in space.
- The president and the National Security Council should modify national space policy to allow negotiated restrictions on the basis of verifiability and U.S. interests and discuss possible negotiating options with U.S. allies prior to beginning discussions with China and other space powers.
- Defense and State should assess the impact of different U.S. and Chinese offensive space postures and policies on stability and deterrence in space through intensified analysis and "crisis games," in addition to war games, to gain a better understanding of the strategic landscape of space and deterrence.
- The National Security Council should evaluate the desirability of a "no first use" pledge for offensive counterspace weapons that have irreversible effects.
- On a quid pro quo basis, State and NASA should discuss with China the opportunities for greater civilian space cooperation as a confidence-building measure.

Program Recommendations

- DOD should evaluate all future space programs and initiatives in terms of their contribution to stability and deterrence in addition to its other criteria and place greater emphasis on survivable ground-based offensive capabilities with reversible effects than on space-based capabilities.
- DOD should develop a broad suite of space-asset defensive capabilities, such as shielding, spoofing, avoidance maneuvers, "self-aware satellites," and others commensurate with the importance of those assets to U.S. military posture.
- DOD and the Office of the Director of National Intelligence should enhance U.S. SSA capability and augment it with corresponding space intelligence capabilities, as well as with their ability to monitor how U.S. satellites and others are behaving under potential or actual attack conditions.
- The Air Force should pursue 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.
- DOD should diversify its means of providing space information and services across additional space and non-space assets to reduce vulnerability to attack and complicate adversary attack planning.
- DOD should refrain 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.

Diplomatic Recommendations

- The State Department and DOD should expand dialogue with China to establish rules of the road, codes of conduct, and other confidence-building measures, as well as to build upon current military-to-military dialogue on space issues.

- The State Department and DOD should enter into discussions with China on a KE-ASAT testing ban, as the major near-term need is to address KE-ASAT on both sides, especially at geosynchronous orbit, where lethal space debris would last forever.
- President Bush should offer China at least a mutual moratorium on further KE-ASAT testing, if not a formal agreement, and invite other countries to join.
- As a confidence-building measure, the State Department and the Department of Commerce should review restrictions on commercial and scientific space activity with China, easing them where possible and prudent (subject to national security caveats) in return for greater Chinese transparency on its military space efforts.

RECOMMENDATIONS FOR CHINA

China has a potentially bright future and is in the process of becoming a first-rank economic and military power, a status that does not have to threaten U.S. security interests. As it increases its presence in space, China should give serious consideration to steps that can help it play a more effective role in world space issues commensurate with its rising power.

Policy Recommendations

- The PLA should provide more transparency into its military space programs, since in the absence of transparency, others will form their own worst-case judgments.
- The PLA should refrain from further direct ascent ASAT tests as long as the United States does, and should not deploy such weapons.
- President Hu Jintao should establish a senior national security coordinating body, equivalent to a Chinese National Security Council, that he chairs. Such a body would include all interested parties in China's government to ensure that actions with signifi-

cant international implications are given the full and careful review they merit.
- The PLA should strengthen 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.

Diplomatic Recommendations

- The PLA and foreign ministry should provide a clear and credible policy and doctrinal context for its 2007 ASAT test and counterspace programs more generally, as China has now demonstrated the kind of capability it has called dangerous and has warned could provoke an arms race in space.
- President Hu should address foreign concerns over China's ASAT test by releasing a more specific statement on the issue and offering to engage in dialogue with the United States on mutual space concerns.
- The PLA and foreign ministry should become actively involved in discussions on establishing international space codes of conduct and confidence-building measures.

Appendix I

The result of a collaborative effort by the Henry L. Stimson Center's Space Security Project and nongovernmental organization (NGO) partners from five spacefaring nations, the following provisions seek to preserve and advance the peaceful exploration and use of outer space.[26]

RIGHTS OF SPACE-FARING STATES

– access to space for exploration or other peaceful purposes;
– safe and interference-free space operations, including military support functions;
– self-defense, as enumerated in the Charter of the United Nations;
– to be informed on matters pertaining to the objectives and purposes of this Code of Conduct; and
– consultation on matters of concern and the proper implementation of this Code of Conduct.

RESPONSIBILITIES OF SPACE-FARING STATES

– respect the rights of other space-faring states and legitimate stakeholders;
– regulate stakeholders that operate within their territory or that use their space launch services in conformity with the objectives and purposes of this Code of Conduct;

– regulate the behavior of its nationals in conformity with the objectives and purposes of this Code of Conduct, wherever those actions occur;
– develop and abide by rules of safe space operation and traffic management;
– share information related to safe space operations and traffic management and to enhance cooperation on space situational awareness;
– mitigate and minimize space debris in accordance with the best practices established by the international community in such agreements as the Inter-Agency Debris Coordination Committee guidelines and guidelines of the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space;
– refrain from harmful interference against space objects;
– consult with other space-faring states regarding activities of concern in space and to enhance cooperation to advance the objectives and purposes of this Code of Conduct; and
– establish consultative procedures to address and resolve questions relating to compliance with this Code of Conduct, and to agree upon such additional measures as may be necessary to improve the viability and effectiveness of this Code of Conduct.

Appendix II

EXTRACTS FROM U.S. NATIONAL SPACE POLICY, OCTOBER 2006

The President authorized a new national space policy on August 31, 2006 that establishes overarching national policy that governs the conduct of U.S. space activities. This policy supersedes Presidential Decision Directive/NSC-49/NSTC-8, National Space Policy, dated September 14, 1996.

1. Background

For five decades, the United States has led the world in space exploration and use and has developed a solid civil, commercial, and national security space foundation. Space activities have improved life in the United States and around the world, enhancing security, protecting lives and the environment, speeding information flow, serving as an engine for economic growth, and revolutionizing the way people view their place in the world and the cosmos. Space has become a place that is increasingly used by a host of nations, consortia, businesses, and entrepreneurs.

In this new century, those who effectively utilize space will enjoy added prosperity and security and will hold a substantial advantage over those who do not. Freedom of action in space is as important to the United States as air power and sea power. In order to increase knowledge, discovery, economic prosperity, and to enhance the national security, the United States must have robust, effective, and efficient space capabilities.

2. Principles

The conduct of U.S. space programs and activities shall be a top priority, guided by the following principles:

- The United States is committed to the exploration and use of outer space by all nations for peaceful purposes, and for the benefit of all humanity. Consistent with this principle, "peaceful purposes" allow U.S. defense and intelligence-related activities in pursuit of national interests;
- The United States rejects any claims to sovereignty by any nation over outer space or celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right of the United States to operate in and acquire data from space;
- The United States will seek to cooperate with other nations in the peaceful use of outer space to extend the benefits of space, enhance space exploration, and to protect and promote freedom around the world;
- The United States considers space systems to have the rights of passage through and operations in space without interference. Consistent with this principle, the United States will view purposeful interference with its space systems as an infringement on its rights;
- The United States considers space capabilities—including the ground and space segments and supporting links—vital to its national interests. Consistent with this policy, the United States will: preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests;
- The United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space. Proposed arms control agreements or restric-

tions must not impair the rights of the United States to conduct research, development, testing, and operations or other activities in space for U.S. national interests; and
- The United States is committed to encouraging and facilitating a growing and entrepreneurial U.S. commercial space sector. Toward that end, the United States Government will use U.S. commercial space capabilities to the maximum practical extent, consistent with national security.

3. United States Space Policy Goals

The fundamental goals of this policy are to:

- Strengthen the nation's space leadership and ensure that space capabilities are available in time to further U.S. national security, homeland security, and foreign policy objectives;
- Enable unhindered U.S. operations in and through space to defend our interests there;
- Implement and sustain an innovative human and robotic exploration program with the objective of extending human presence across the solar system;
- Increase the benefits of civil exploration, scientific discovery, and environmental activities;
- Enable a dynamic, globally competitive domestic commercial space sector in order to promote innovation, strengthen U.S. leadership, and protect national, homeland, and economic security;
- Enable a robust science and technology base supporting national security, homeland security, and civil space activities; and
- Encourage international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of space, as well as to advance national security, homeland security, and foreign policy objectives.

4. General Guidelines

In order to achieve the goals of this policy, the United States Government shall:

Develop Space Professionals. Sustained excellence in space-related science, engineering, acquisition, and operational disciplines is vital to the future of U.S. space capabilities. Departments and agencies that conduct space related activities shall establish standards and implement activities to develop and maintain highly skilled, experienced, and motivated space professionals within their workforce.

- *Improve Space System Development and Procurement.* United States space systems provide critical capabilities to a wide range of civil, commercial, and national security users. The primary goal of space system development and procurement must be mission success. Achieving this goal depends on effective research, development, acquisition, management, execution, oversight, and operations. Toward that end, departments and agencies shall create an environment that enables mission success, including, but not limited to, creating a common understanding of realistic and stable requirements and operational concepts; clearly identifying and managing risks, including system safety; setting and maintaining realistic and stable funding; delivering space capabilities on time and on budget; and providing acquisition managers with the tools, responsibility, budget flexibility, and authority to achieve this goal.
- *Increase and Strengthen Interagency Partnerships.* The challenges of the 21st century require a focused and dedicated unity of effort. Interagency partnerships provide opportunities to jointly identify desired effects, capabilities, and strategies. Departments and agencies shall capitalize on opportunities for dynamic partnerships—whether through collaboration, information sharing, alignment, or integration.

– *Strengthen and Maintain the U.S. Space-Related Science, Technology, and Industrial Base.* A robust science, technology, and industrial base is critical for U.S. space capabilities. Departments and agencies shall: encourage new discoveries in space science and new applications of technology; and enable future space systems to achieve new and improved capabilities, including incentives for high-risk/high-payoff and transformational space capabilities. Additionally, departments and agencies shall: conduct the basic and applied research that increases capability and decreases cost; encourage an innovative commercial space sector, including the use of prize competitions; and ensure the availability of space related industrial capabilities in support of critical government functions.

5. National Security Space Guidelines

United States national security is critically dependent upon space capabilities, and this dependence will grow. The Secretary of Defense and the Director of National Intelligence, after consulting, as appropriate, the Secretary of State and other heads of departments and agencies, and consistent with their respective responsibilities as set forth in the National Security Act of 1947, as amended, Title 10, U.S.C. and Title 50 U.S.C., the National Security Intelligence Reform Act of 2004, and other applicable law, shall:

– Support the President and the Vice President in the performance of Executive functions, and senior Executive Branch national security, homeland security, and foreign policy decisionmakers; other Federal officials, as appropriate; and the enduring constitutional government operations and infrastructure;
– Support and enable defense and intelligence requirements and operations during times of peace, crisis, and through all levels of conflict;
– Develop and deploy space capabilities that sustain U.S. advantage and support defense and intelligence transformation; and

- Employ appropriate planning, programming, and budgeting activities, organizational arrangements, and strategies that result in an operational force structure and optimized space capabilities that support the national and homeland security.

To achieve the goals of this policy, the Secretary of Defense shall:

- Maintain the capabilities to execute the space support, force enhancement, space control, and force application missions;
- Establish specific intelligence requirements that can be met by tactical, operational, or national-level intelligence gathering capabilities;
- Provide, as launch agent for both the defense and intelligence sectors, reliable, affordable, and timely space access for national security purposes;
- Provide space capabilities to support continuous, global strategic and tactical warning as well as multi-layered and integrated missile defenses;
- Develop capabilities, plans, and options to ensure freedom of action in space, and, if directed, deny such freedom of action to adversaries;
- Have responsibility for space situational awareness; in this capacity, the Secretary of Defense shall support the space situational awareness requirements of the Director of National Intelligence and conduct space situational awareness for: the United States Government; U.S. commercial space capabilities and services used for national and homeland security purposes; civil space capabilities and operations, particularly human space flight activities; and, as appropriate, commercial and foreign space entities; and
- Establish and implement policies and procedures to protect sensitive information regarding the control, dissemination, and declassification of defense activities related to space.

To achieve the goals of this policy, the Director of National Intelligence shall:

- Establish objectives, intelligence requirements, priorities and guidance for the intelligence community to ensure timely and effective collection, processing, analysis and dissemination of national intelligence;
- Ensure that timely information and data support foreign, defense, and economic policies; diplomatic activities; indications and warning; crisis management; treaty compliance verification; appropriate civil, homeland security, and law enforcement users; and perform research and development related to these functions;
- Support military planning and satisfy operational requirements as a major intelligence mission;
- Provide intelligence collection and analysis of space related capabilities to support space situational awareness for: the United States Government; U.S. commercial space capabilities and services used for national and homeland security purposes; civil space capabilities and operations, particularly human space flight activities; and, as appropriate, commercial and foreign space entities;
- Provide a robust foreign space intelligence collection and analysis capability that provides timely information and data to support national and homeland security;
- Coordinate on any radio frequency surveys from space conducted by United States Government departments or agencies and review, as appropriate, and approve any radio frequency surveys from space conducted by the private sector, State, or local governments; and
- Establish and implement policies and procedures to: classify attributable collected information and operational details of intelligence activities related to space; protect sensitive activities; and declassify and release such information when the Director determines that protection is no longer needed.

8. International Space Cooperation

The United States Government will pursue, as appropriate, and consistent with U.S. national security interests, international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of space, as well as to advance national security, homeland security, and foreign policy objectives. Areas for potential international cooperation include, but are not limited to:

- Space exploration; providing space surveillance information consistent with security requirements and U.S. national security and foreign policy interests; developing and operating Earth-observation-systems.

The Secretary of State, after consultation with the heads of appropriate Departments and Agencies, shall carry out diplomatic and public diplomacy efforts, as appropriate, to build an understanding of and support for U.S. national space policies and programs and to encourage the use of U.S. space capabilities and systems by friends and allies.

11. Orbital Debris

Orbital debris poses a risk to continued reliable use of space-based services and operations and to the safety of persons and property in space and on Earth. The United States shall seek to minimize the creation of orbital debris by government and non-government operations in space in order to preserve the space environment for future generations. Toward that end:

- Departments and agencies shall continue to follow the United States Government Orbital Debris Mitigation Standard Practices, consistent with mission requirements and cost effectiveness, in the

procurement and operation of spacecraft, launch services, and the operation of tests and experiments in space;

- The Secretaries of Commerce and Transportation, in coordination with the Chairman of the Federal Communications Commission, shall continue to address orbital debris issues through their respective licensing procedures; and
- The United States shall take a leadership role in international fora to encourage foreign nations and international organizations to adopt policies and practices aimed at debris minimization and shall cooperate in the exchange of information on debris research and the identification of improved debris mitigation practices.

Endnotes

[1] While the United States and Russia developed several types of weapons during the Cold War, they were largely focused on strategic nuclear roles and were thus "protected" by each side's nuclear forces. Today, satellites are an integral component of U.S. conventional force capabilities and most are less credibly protected by the threat of U.S. nuclear retaliation.

[2] The term "space weapons" as used in this report refers to weapons that can degrade, disrupt, damage, or destroy satellites in earth orbit. Such weapons could either be space based or earth based. The term here does not include orbiting weapons whose targets are on Earth. Used somewhat interchangeably are the terms anti-satellite weapon and counterspace weapon. The term ASAT refers more specifically to weapons that physically intercept and destroy satellites, while counterspace weapons refer to all weapons that interfere with a satellite's normal functioning, not just through physical interception.

[3] See, for example, *Annual Report to Congress: Military Power of the People's Republic of China 2008* (Washington, DC: U.S. Department of Defense, 2008); Larry M. Wortzel, *The Chinese People's Liberation Army and Space Warfare: Emerging United States-China Military Competition* (Washington, DC: American Enterprise Institute, 2007), pp. 7–8.

[4] Bao Shixiu, "Deterrence Revisited: Outer Space," *China Security* 3, No. 1 (2007), pp. 2–11.

[5] *U.S.-China Relations: An Affirmative Agenda, A Responsible Course* (New York: Council on Foreign Relations Press, 2007), p. 54.

[6] State Council of the People's Republic of China, China's National Defense in 2006, December 2006.

[7] China, Russia, Iran, North Korea, India, and lesser threats—the CRINKIL countries—all could have at least modest counterspace capabilities over time if they so chose.

[8] Gavin Rabinowitz, "Indian Army Wants Military Space Program," Associated Press, *Seattle Post-Intelligencer*, June 17, 2008, available at http://news.yahoo.com/s/ap/20080617/ap_on_re_as/india_china_space_race.

[9] Thomas G. Behling, "Ensuring a Stable Space Domain for the 21st Century," *Joint Force Quarterly* 47, 4th Quarter 2007, pp. 105–8.

[10] *Joint Doctrine for Space Operations*, Joint Chiefs of Staff Joint Publication 3–14, August 9, 2002, pp. vii, xi.

[11] Extracts from this policy statement are presented in Appendix II.

[12] *U.S. National Space Policy*, Office of Science and Technology Policy, Executive Office of the President, August 2006.

[13] Mark Kaufman, "Bush Sets Defense as Space Priority," *Washington Post*, October 18, 2006.

[14] James B. Armor Jr., "Weaponizing Space: Is Current U.S. Policy Protecting Our National Security?," Testimony to the House Committee on Oversight and Government Reform, Subcommittee on National Security and Foreign Affairs, May 23, 2007.

[15] Amy Butler, "Secret Steps," *Aviation Week and Space Technology* 167, Vol. 15 (2007).

[16] U.S. Department of State, *Report on U.S. Space Policy* (Washington, DC: International Security Advisory Board , 2007), p. 6.

[17] Section 416 of the FY2008 Intelligence Authorization Bill calls for additional efforts in this area; available at http://www.fas.org/irp/congress/2007_rpt/hrpt110-478.html.

[18] C. Robert Kehler, "Shaping the Joint Fight in Air, Space, and Cyberspace," *Joint Force Quarterly* 49, 2nd Quarter, 2008, p. 35.

[19] Survivability, effectiveness, and cost-effectiveness at the margin are criteria proposed in 1985 by Ambassador Paul H. Nitze for the Strategic Defense Initiative. The Reagan administration adopted these criteria and Congress enacted them into law. "Fact Sheet on the Strategic Defense Initiative," National Security Decision Directive 172, June 1, 1985; *National Defense Authorization Act for Fiscal Year 1986*, Public Law 99–145, 99th Congress, 1st session, November 8, 1985, § 222.

[20] Testimony of Richard N. Haass, president of the Council on Foreign Relations, U.S. Senate Foreign Relations Committee, May 15, 2008, p. 5.

[21] Gen. Thomas S. Moorman Jr., USAF (Ret.), "Military Space—Its Origins and Future," *Aerospace America*, March 2008, p. 29.

[22] Space "traffic" is defined as the set of parameters and measures within which space actors endeavor to maximize the sustainable use and the continued availability of orbital resources, and to minimize the risk of unintentional physical or radio frequency interference to operational spacecraft.

[23] *U.S. National Space Policy*, National Science and Technology Council, Executive Office of the President, September 1996.

[24] This difficulty is further discussed by Ross Liemer, "China's Anti-Satellite Weapons and U.S. National Security" (senior thesis, Woodrow Wilson School of Public and International Affairs, Princeton University, April 9, 2008), pp. 78–79.

[25] See, for example, Albert Wohlstetter and Brian G. Chow, *Self-Defense Zones in Space* (Marina del Rey, CA: Pan Heuristics, 1986).

[26] Adapted from "Model Code of Conduct for Responsible Space-Faring Nations," Henry L. Stimson Center, 2007, available at http://www.stimson.org/pub.cfm?ID=575. Michael Krepon is the Model Code of Space Conduct's project director. NGO partners from Canada, China, France, Japan, and Russia participated in creating the provisions of the code.

About the Author

Bruce W. MacDonald is an independent consultant in technology and national security policy management. From 1995 to 1999, he was assistant director for national security at the White House Office of Science and Technology Policy as well as senior director for science and technology on the National Security Council staff. Earlier, Mr. MacDonald was a professional staff member on the House Armed Services Committee and was defense and foreign policy adviser to Sen. Dale Bumpers (D-AR). He also worked for the State Department as a nuclear weapons and technology specialist in the Bureau of Political-Military Affairs, where he led the Interagency START Policy Working Group, served on the U.S. START delegation in Geneva, and dealt with space and missile defense issues. He also supported the Defense Department's SALT Task Force as staff scientist at System Planning Corporation. He is a member of the Council on Foreign Relations.

Mr. MacDonald holds a BSE from Princeton in aerospace engineering and two master's degrees, also from Princeton—one in aerospace engineering, specializing in rocket propulsion, and a second in public and international affairs from the Woodrow Wilson School.