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PROTECTING THE HEAVENS:

IMPLICATIONS OF CHINA'S ANTISATELLITE PROGRAMS

by

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Research for this paper is based on unclassified Chinese open-source writing and official US unclassified publications and speeches. Chinese military writings provide insight into the types of systems military strategists consider important for China to develop and how they may employ those capabilities. The military writings, however, should be viewed with the knowledge they articulate only a desired capability. Economic, political or technical realities may prevent the capabilities described in the Chinese writings from evolving into fielded systems. Another risk in using Chinese publications for analysis is that the material is subject to the manner of the language translation, to the passages selected for translation by the analyst, and by unknown authoritativeness of the author. To overcome these risks, this paper uses translations by three analysts (Pillsbury, Pollpeter, and Wortzel) with the expertise necessary to identify authoritative Chinese authors. Additionally, this paper quotes only Chinese writings with consistent themes and avoids writings which appear more fanciful.

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Chapter 1

Introduction

On 11 January 2007, the People's Republic of China successfully flight tested an antisatellite (ASAT) weapon against one of their own weather satellites, obliterating the satellite and creating thousands of pieces of dangerous debris in low earth orbit.[1] China's flight test brought the world's attention to China's ASAT capabilities and resulted in a variety of US domestic responses. Renewed cries for treaties banning space weapons were heard and calls for the development of US counterspace capabilities began to materialize among military professionals. This singular, but significant, strategic event raises important questions: Does the United States need to revise its space policies and strategies in light of China's developing ASAT space capability? And if so, what is an optimum strategy? These questions are not easy to answer and fraught with ramifications for US national security. Overestimating China's capabilities or misunderstanding their intentions could cause the United States to unnecessarily expend resources protecting U.S space systems. Conversely, underestimating the threat could result in the degradation or loss of US space systems in time of war or crisis, significantly hindering US military power. This paper will examine China's ASAT weapons programs and possible intentions. Based on this exploration of China's ASAT programs, the paper will evaluate potential US strategies, employing diplomatic, informational, military, and economic instruments of national power to influence decisions important to US national security.

Consideration will be given to the role of passive and active defensive counterspace capabilities, offensive counterspace capabilities, and rapid reconstitution capabilities. Lastly, this paper will recommend a strategy to deter China from employing counterspace weapons. With the goal of providing an implementable strategy, this paper will also highlight specific considerations which would need to be addressed to successfully implement such a strategy.

The scope of this paper is limited to Chinese ASAT capabilities as this is currently a topic of high interest within the US military space community. Discussion of the Chinese intentions in other space missions areas (eg. the use of space-based weapons to attack terrestrial targets) or counterspace techniques other than ASAT systems (eg. jamming) are beyond this scope.

Definitions

Before describing China's ASAT programs, it is useful to clarify certain key terms used in to discuss space systems and doctrine. The definitions used in this paper are drawn from either US doctrine or Chinese writings.

Space Superiority. The degree of dominance in space of one force over another that permits the conduct of operations by the former and its related land, sea, air, space, and special operations forces at a given time and place without prohibitive interference by the opposing force.[2]

Counterspace. Those offensive and defensive operations conducted by air, land, sea, space, special operations, and information forces with the objective of gaining and maintaining control of activities conducted in or through the space environment.[3]

Offensive counterspace. Operations to preclude an adversary from exploiting space to their advantage.[4]

Defensive counterspace. Operations to preserve US/friendly ability to exploit space to its advantage via active and passive actions to protect friendly space-related capabilities from

adversary attack or interference.[5]

Space Situation Awareness. The knowledge and intelligence that provides the planner, commander, and executor with sufficient awareness of objects, activities, and the environment to enable course of action development. This involves characterizing, as completely as possible, the space capabilities operating within the terrestrial and space environments. Space situation awareness forms the foundation for all space activities, and is the enabler for counterspace operations.[6]

Space Warfare. The following definition is provided by *Chinese PLA Military Terminology*:

> Military confrontations mainly conducted in outer space between two rival parties. It includes offensive and defensive operations between the two parties in outer space as well as offensive and defensive operations between the two parties from outer space to air space or to the ground and vice versa.[7]

Chapter 2

Is China a Threat?

An ASAT capability alone does not make China a threat to US space power. In order to be a realistic threat, China would also need the intention and the will to employ ASAT weapons. To fully answer the question posed above, this chapter will explore China's intentions with regard to ASAT weapons and China's ASAT capabilities.

The January 2007 ASAT test confirmed China is developing at least one variety of ASAT weapons. Unlike the United States, there does not appear to be any debate in China over the necessity or morality of space weapons, including ASAT weapons. Analyst Kevin Pollpeter has performed a comprehensive review of the most authoritative Chinese writings on space military operations and found they are all in agreement on two main conclusions: "space warfare is inevitable and China must prepare for space war by integrating space into military operations and by developing its own space weapons."[8] ASAT weapons are considered a key component of China's space arsenal. These findings are consistent with Pillsbury's and Wortzel's analysis.[9] In fact, Pollpeter could not find any articles questioning or debating the need for counterspace capabilities.[10] A search by this author of open source translations yielded the same result. Pollpeter points out that the Chinese military writings are significant because military researchers and academics, as opposed to warfighting branches, are responsible for developing the People's Liberation Army (PLA) doctrine.[11] So while these writings cannot be considered official PLA

doctrine, they do provide valuable understanding of Chinese military thinking. But why exactly are the Chinese so convinced that space weapons, including ASAT weapons, are necessary?

China's Motivations and Intentions

China's intentions are difficult to decipher given the lack of transparency of China's military and associated doctrine. A number of plausible theories have been advanced to explain why China is developing ASAT weapons. These theories can be generally grouped into three rationales: 1) to coerce the United States to agree to a space weapons ban[12]; 2) as a primarily defensive reaction to the United States' space superiority and missile defense programs[13]; and 3) as a primarily offensive capability to defeat the United States militarily, specifically in a Taiwan Straits scenario.[14] These theories are not mutually exclusive and China may be motivated by more than one of these rationales.

Fundamental to all these theoretical motivations is a firm Chinese conviction that the United States is developing and deploying weapons for the purpose of conducting warfare in space.[15] China's belief that the United States is developing space weapons is most likely based on their interpretation of official documents dating to at least the mid-1990s. For example, the Commission to Assess United States National Security Space Management and Organization (the 2001 Space Commission), chaired by former Secretary of Defense Donald Rumsfeld, includes in its conclusions: "It is in the US national interest to… Develop and deploy the means to deter and defend against hostile acts directed at US space assets and against the uses of space hostile to US interests."[16]

This was followed in 2002 by publication of US Joint Doctrine for Space Operations (Joint Publication 3-14) which instructs commanders that establishing space superiority should be a "high priority" in order to provide "freedom of action in space" and "deny the opposing force the

same." It further advises commanders to consider the impact of "space combat operations" on friendly forces and cites the example of the "creation of space debris" as an impact to consider. [17] Air Force doctrine for Counterspace Operations (AFDD 2-2.1), released in 2004, expands upon the Joint doctrine and includes doctrine regarding offensive measures which could be taken to "deny, disrupt, degrade or destruct" an advisory's space capabilities.[18] Neither the Joint nor the Air Force doctrine calls out specific counterspace systems, but their extensive descriptions of how to employ such systems could easily lead the suspicious reader to assume such systems exist and are fielded today. Otherwise, the reader may wonder, why would the United States need doctrine to address their employment?

The 2006 National Space Policy appears to have confirmed Chinese perceptions that the United States is intent on developing space weapons. While the policy states that "the United States is committed to the exploration and use of outer space by all nations for peaceful purposes," it also declares

> "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"[19]

The policy goes on to direct the Secretary of Defense to "develop capabilities, plans, and options to ensure freedom of action in space, and if directed, deny such freedom of action to adversaries."[20] Based on these documents, Chinese authors appear convinced that the United States is actively developing and deploying counterspace weapons. This conviction underpins each of the three possible motivations for China to develop ASAT weapons.

ASAT as a Diplomatic Tool? Teresa Hitchens of the World Security Institute's Center for Defense Analysis proposes a number of possible motivations for China's ASAT weapons

program and includes the suggestion that the ASAT program is intended as a diplomatic tool. Under this hypothesis, the ASAT flight test "was an effort to bring the United States to the negotiating table over space-based missile defense and space weapons."[21] A similar view is presented by Eric Hagt, also from the World Security Institute, who suggests that China's ultimate goal is to avoid the weaponization of space and associated arms race in space.[22] This view is rooted in China's historical advocacy for space arms control. China's position on the utilization of space is officially presented in China's Space Activities in 2006 white paper as follows:

> The Chinese government holds that outer space is the common wealth of all mankind, and each and every country in the world enjoys equal rights to freely explore, develop and utilize outer space and celestial bodies; and that all countries' outer space activities should be beneficial to the economic development, social progress of nations, to security, subsistence and development of mankind, and to friendly cooperation between people of different countries.[23]

China has repeatedly brought forward calls for space arms control to the United Nations and, in 2002, presented the UN Conference on Disarmament a draft resolution on Preventing an Arms Race in Outer Space jointly with Russia. China steadfastly maintained this position even after the ASAT test, and repeatedly expressed it in multiple official statements and press conferences. Foreign Ministry Spokeswoman Jiang Yu provided a typical summary of this position during a regular press conference in February 2007. In response to a reporter's question as to whether or not China will conduct similar ASAT tests in the future, Jiang did not directly answer the question and instead provided the following position:

> We are firmly against weaponization and arms race in the outer space. We have never participated in an arms race of whatever form in the outer space. Nor will we do so in the future…In recent years, China and Russia have joined many other countries in actively promoting the Disarmament Conference in Geneva to adopt an international legal document in the prevention of weaponization and arms race in the outer space through negotiation…Our position on the issue remains unchanged.[24]

And most recently, on 8 October 2007, China's Ambassador Cheng Jingye made another appeal to the United Nations General Assembly for a space arms treaty, restating its opposition to the weaponization of space and its desire to "negotiate and conclude a new international legal instrument in this regard. China hopes that substantial work on this issue will be launched at the Conference on Disarmament as soon as possible."[25]

The United States does not support space arms controls for a variety of reasons. Historically, the United States has held the position that space arms control is impractical due to difficulties in agreeing on definitions of ASAT systems and mutually agreeable approaches for compliance verification.[26] It also has argued that arms control is not necessary since no arms race in space exists. Most recently, Robert G. Joseph, Under Secretary for Arms Control and International Security, pointed to the fact that other countries are developing counterspace capabilities and that it would not be in the national security interest to "foreclose technical options to defend those [US] space assets."[27]

As Hitchens points out, it is possible the Chinese grew frustrated with the United States lack of willingness to participate in such a space weapons ban treaty and so developed capabilities to demonstrate the threat presented by space weapons is real and should be seriously considered.[28] Joan Johnson-Freese of the US Naval War College connects the timing ASAT test (January 2007) to the timing of the National Space Policy (August 2006) and suggests the test could be in direct response to the United States position stated in the National Space Policy.[29]

If the Chinese ASAT program is intended to persuade the United States to reconsider its position on space arms control, it is curious that the January 2007 ASAT test was not accompanied with rhetoric to convey this message. In fact, China did not even admit to conducting the test until after it was reported in the open press, nearly two weeks after the test

had been conducted. [30] Even after the test was acknowledged, the Chinese Foreign Ministry appeared unprepared to respond to queries from the international community.[31] However, if the ASAT program is intended to serve political purposes, one would expect much closer coordination between the military and diplomatic branches of government than exhibited following the ASAT flight test. It is possible the flight test was poorly managed from within the Chinese government, resulting in the lack of coordination between the various branches of government. Or it is possible China's ASAT program is being pursued completely independent of China's attempts to negotiate a space weapons treaty. Informal dialog with China's technical community by Carnegie Endowment for International Peace supports the latter. Their work indicates the flight test was a logical step in the ASAT weapons technology development program and not politically motivated.[32]

ASAT as a Defensive Reaction? A second possible motivation for China to develop ASAT weapons is to counter a perceived threat from US space or missile defense systems, or both. The perceived threat from space systems is expressed by Bao Shixiu of the Academy of Military Sciences of the PLA of China. Although the US space policy released in August 2006 was not substantially different from previous administrations' space policies and re-affirms the United States commitment to the use of space by all nations for peaceful purposes, Bao interprets the policy as an attempt to become a space hegemon, that is to dominate the space medium and preclude other nations from freedom of action in space. Bao considers this a serious threat to Chinese sovereignty.[33]

Convinced that the "United States unilaterally seeks to monopolize the military use of space," Bao advocates the development of counterspace systems, including ASAT weapons, to deter the United States from attacking Chinese space assets.[34] His space deterrence strategy is

based on the traditional Chinese approach of "active defense" which entails employing offensive measures to militarily defend oneself. He considers it defensive in that the ASAT capabilities would not be used to conduct a "first strike or take an offensive stance," similar to the China's doctrine on the development of nuclear weapons. Bao points out that strategic deterrence requires the possession of an adequate deterrent force and the will to use such force, as well as clear communication of this force and strategy to an adversary. He then states, "This article attempts to serve to communicate those realities." However, Bao is careful to caveat his work as representing his own views and not any organization of China.[35] No such similar communications stating China's intention to deploy ASAT weapons only in an "active defense" role have come from Chinese officials.

While Bao focuses on the deterrent value of ASAT systems, other authors focus on to the need for China to develop ASAT weapons to defend against from a perceived threat from the United States. Such a view is presented by Hui Zhang, a research associate at Harvard University's John F. Kennedy School of Government. Hui states that "Many Chinese officials assume that China is the real target for US missile defense and space planning."[36] He assumes the United States is actively pursuing space-based ASAT weapons and space-based weapons which could strike terrestrial targets including mobile Intercontinental Ballistic Missiles and deeply buried targets. Such capability could weaken China's strategic nuclear deterrent capability and, in China's view, "subject China to political or strategic blackmail."[37] If China is unable to establish a treaty with the United States banning space weapons, Hui believes China would likely feel a need to counter the perceived threat from the United States and lays out a number of options for countering US space-based weapons, including the development of ASAT weapons.[38]

The need for an ability to defend China's sovereignty is a common theme in Chinese military writings. Dr. Larry Wortzel, a commissioner on the US-Chinese Economic and Security Review Commission, recently completed a comprehensive analysis of Chinese writings on space warfare. Wortzel's analysis illustrates that a number of Chinese authors advocate for "sovereignty control" and consider sovereignty in space to be an extension of national sovereignty. This view is expressed by Chinese General Zheng Shenxia, former Commandant of the PLA Academy of Military Science and the highest ranking Chinese military officer to write authoritatively on this topic. Wortzel's interpretation of Gen Zheng's writing, which was co-authored with Gen Zheng's political commissar, Lieutenant General Liu Yuan, follows:

> Zheng accuses the United States of maintaining a "policy of containment" (*Meiguo dui Hua 'E- zhi' Zhanlue.*) Zheng and Liu's recommendation to meet this challenge is that, to preserve China's own national interests, Beijing must be capable of controlling the electromagnetic spectrum as well as traditional sovereignty control including the land territory, the maritime domain, airspace, and space.[39]

Cai Fengzhen, a senior and widely published Chinese author, also advocates the need for China to control space as "high as its weapons can reach."[40] However, he and other Chinese authors realize political and pragmatic problems with controlling access to space over Chinese territory during peacetime. As such, they "seek a more limited and temporal ability to control space".[41] Cai, writing with and Tian Anping, defines space control as "the capability of one belligerent in a state of war, in a specified period of time, in a defined area of space, to carry out its own operations with freedom while hindering or preventing an enemy from carrying out its own operations or using space." [42]

Based on Bao's and Hui's writings, and Dr. Wortzel's analysis, it is apparent there is at least a faction of senior Chinese military members who believe China must develop ASAT systems in order to defend against a perceived US threat. The perceived US threat may be based

on China's interpretation of US space and missile defense plans, or on a more general fear of the United States attempting to "contain" China. Sovereignty is an historically critical issue in Chinese culture, and so the significance of this perceived threat to the Chinese mindset cannot be overstated. In fact, when Chinese Premier Wen Jiabao was asked during a press conference if the Chinese ASAT test was inconsistent with China's policy on the peaceful uses of outer space, Wen responded by describing China's extensive size, both geographically and population-wise, and then recounted China's suffering from aggression and oppression by imperial countries in the 19th century, and concluded by stating that "China's limited military capabilities are solely for upholding China's security, independence and sovereignty."[43]

ASAT for an Offensive Strike? A third possible motivation for China to develop ASAT weapons is specifically to defeat the United States in a confrontation with China over the issue of Taiwan's independence. This motivation is different from the previous in that the focus is on the offensive capabilities provided by ASAT weapons. In this role, ASAT weapons serve as an asymmetric weapon in a broader anti-access strategy designed to slow the deployment of US forces into the theater thereby providing China the time necessary to accomplish its military and political objectives.[44] Such a strategy could also serve to deter the United States from intervening on behalf of Taiwan by raising the cost of military involvement to unacceptable levels.[45] Chinese military analysts have scrutinized United States' military operations in Desert Storm, Kosovo, and Afghanistan and observed the vast contribution of space-based assets to these operations as well as the United States's significant dependence on these systems. China's PLA has since developed their own strategy of "informationalized" warfare which includes an emphasis on space operations. This strategy is based on the Chinese view that "future enemy military forces will depend heavily on information systems in military operations." Since space

systems are a crucial element of information systems, space is viewed as a "primary battlefield" in the future.[46] Col Li Daguang, an instructor at China's National Defense University, wrote in 2004: "It can be said, gaining space dominance is the root of winning informationalized war."[47]

Likewise, China observed the vulnerability of space-based assets and identified it as a weakness which can be exploited in order to provide China an asymmetric advantage over a technically superior adversary.[48] In his book *Space Warfare*, Col Li urges the PLA to "possess weapons that can act as 'assassins maces (*shashoujian*)' with space attack capability" specifically for the purpose of defeating the United States in a war over Taiwan.[49] A surprise attack against US space systems would be consistent with classical Chinese military thinking, which emphasizes the use of unorthodox methods against a superior adversary as well as surprise, deception, and seizing the initiative. Sun Tzu wrote "If the enemy is numerous, disciplined, and about to advance, first seize something that they love, for then they will listen to you."[50] As a key enabler of the American style of warfare and symbol of American technical prowess, space systems present an appealing target for China to attack in order to produce a strong psychological impact and gain military advantage.

The lack of Chinese transparency makes it nearly impossible to confidently declare any of these motivations as the singular factor driving China to develop ASAT systems. In fact, it is equally possible that different factions within the Chinese military and political bureaucracies are motivated by different reasons. The Foreign Ministry could support ASAT weapons to back its diplomatic efforts while the PLA could support them for both defending their space assets and defeating the United States in a Taiwan Straits scenario.

China's ASAT Weapons Development

Regardless of motivation, the preponderance of writings discussed above suggests China is intent on developing an ASAT capability. Understanding the nature of China's development program can provide addition insights to shape a US strategic response. Again, the closed nature of China's military makes it difficult to accurately assess their technical capabilities. It is expected that China would treat ASAT technologies as highly sensitive and protect technical details to the maximum extent possible. It is also possible that the Chinese writings intentionally overstate or understate capabilities to purposefully mislead foreign audiences. For theses reasons, this paper considers statements from US officials with access to intelligence information to be more reliable than the Chinese open sources.

China's ASAT weapons development program appears to be a multifaceted program, with space-based and terrestrial aspects. Col Li Daguang recommended a comprehensive, evolutionary approach to ASAT technology development in his book *Space Warfare*, published in 2001. It should be noted that while Pollpeter and Pillsbury consider this a reliable source, Col Li is not a space technology expert and his book is not a PLA text book. Nevertheless, the themes from Col Li's writings appear in number of later publications and are worth understanding. Col Li recommends a phased approach to China's overall space technology development. The first phase is defined as "from now [2001] to 2010" and focuses on force enhancement (space-based missions which support terrestrial forces), space support, and "basic combat capabilities." The second phase extends from 2010 to 2025 and improves offensive and defensive capability with the goal of obtaining an offensive capability which is "capable of destroying or temporarily incapacitating all enemy space vehicles that fly in space above our sovereign territory."[51] *Space Warfare* continues with a recommended plan to implement this

strategy and provides priorities for developing military space technologies. The first priority is comprised of missions defined as force enhancement in U.S terminology, the second category is space-based ASAT systems, and the third category is manned space vehicles. For the near term, Col Li states focus should be on land-based ASAT weapons and ASAT satellites.[52]

US analysis confirms China has been pursuing ASAT weapons for some time. In 1999, a Congressional committee established to examine commercial concerns with China (the Cox Committee), reported they believed China was developing space-based and ground-based laser ASAT systems, and had the capability to develop direct ascent weapons.[53] In 2001, the Commission to Assess National Security Space Organization and Management warned that China was developing ways and methods to attack US space systems and that "the United States is an attractive target for a 'space Pearl Harbor'".[54] In 2007, an OSD Annual Report to Congress on China's military power identified the direct-ascent ASAT as one element of a "robust, multidimensional counterspace program."[55] The report states that China also has the capability to jam common satellite communications and GPS receivers, and is developing technologies and concepts for other kinetic weapons and directed energy ASAT weapons. Additionally, it states China is aggressively pursuing small satellite technology with a dedicated small satellite design and production facility. The stated purpose of this capability is for remote sensing missions.[56] However, such cost-effective small satellite technology could also be used by China to develop relatively inexpensive and effective space-based ASAT systems.[57] Lastly, General Cartwright, Commander of US Strategic Command, in his March 2007 testimony before the Senate Armed Services Committee Strategic Subcommittee, indicated China had fielded low-end ASAT weapons into their forces. In addition to jamming capabilities against communications and

navigation satellites, and direct-ascent ASATs, he stated that China will "probably look" at co-orbital ASATs.[58] Each of these areas deserves a closer examination.

Terrestrial-based Kinetic ASAT Weapons. China's only acknowledged ASAT program is its land-based kinetic ASAT program, which it demonstrated in January 2007. Terrestrial-based kinetic ASAT weapons are land, sea, or air based systems which launch a missile to intercept a satellite and destroy it with the kinetic energy of the intercept. The ASAT launched on 11 January 07 used a direct-ascent trajectory, which means it was launched on a flight path to intercept its target without entering an orbit. Such systems are relatively simple to develop and highly effective against low earth orbit satellites. [59] Analysis shows China has the capability to strike medium earth orbit (MEO) satellites such as Global Positional System (GPS), and geosynchronous earth orbit (GEO) satellites such as commercial communication systems, by launching the same type of flight tested kinetic kill vehicle onboard one of their more powerful launch vehicles.[60]

Land-based ASAT weapons are inexpensive and technically simple weapons as compared to other forms of ASAT weapons. However, they have a number of disadvantages and limitations. As evidenced by the January 2007 flight test, they create significant debris which complicates space operations for all space faring nations. China is likely more sensitive to this fact after receiving international condemnation for intentionally creating a significant amount of space debris with its January 2007 flight test. A second disadvantage of land-based ASAT weapons is that they are limited by geography since a target satellite must orbit within range of the weapon launch site to be susceptible to attack. Additionally, they are limited by the number of ASAT launch sites. China currently has four fixed sites from which is could launch ASAT weapons but could overcome this limitation with the development of mobile launchers.[61] (Airborne or sea-

based ASAT kinetic interceptors can overcome this limitation but would increase the cost and complexity of the weapon system.) Perhaps the most significant disadvantage of a land-based ASAT is that the launch event is identifiable by missile warning systems, as evidenced by the United States detection of China's ASAT flight test. The United States could use the ASAT launch information to attack China on the diplomatic front and, if wartime circumstances dictate, physically destroy the launch site to prevent future ASAT launches from the same site.

Space-based Kinetic ASAT Weapons. As mentioned previously, Gen Cartwright testified to Congress that China is developing a co-orbital ASAT capability. Chinese writings also include references to co-orbital interceptor ASAT weapons. These systems could consist of satellites pre-positioned on-orbit or launched into an orbit and maneuvered to intercept with the target spacecraft. Co-orbital ASAT technology was fielded by the Soviet Union in 1970s and likely is within China's grasp.[62] A similar concept is the space mine, where spacecraft are placed in the vicinity of a target satellite or on an intercepting orbit and once commanded, explode or dispense pellets destroying the target. Such weapons are relatively simple to develop and could be difficult to detect given their small size. [63]

Crude space-based kinetic ASAT weapons, such as a small spacecraft capable of on-orbit maneuvering to intercept another satellite, may be inexpensive and effective against any type of satellite in any type of orbit.[64] More sophisticated stealthy ASAT satellites could be launched covertly in advance of a conflict and remain concealed until needed, when they would be commanded to detonate. China could use a large number of stealthy co-orbital ASAT satellites to execute a surprise mass attack, likely causing significant confusion within US military command and control chains. However, the large number of ASAT satellites required for a mass attack and the complexity of stealth technology make this an expensive option. Additionally,

Chinese writings suggest they are only in the preliminary phases of exploring optically stealthy satellites which suggests a covert co-orbital ASAT attack is not a near-term threat.[65]

Land-Based Laser ASAT Weapons. China appears to be pursuing low-power lasers which can blind a satellite's optics, and high-power lasers capable of permanently disabling a satellite. According to a 2005 National Air and Space Intelligence Center (NASIC) report, open-sources claim that China has the ability to blind or damage electro-optical sensors, such as those used on US reconnaissance satellites.[66] Pillsbury identified dozens of Chinese articles dating back to 1990 discussing technical aspects of laser weapons and the feasibility of directed energy technology for ASAT weapons. These writings also indicate China has studied US and former Soviet directed energy ASAT systems.[67]

Chinese directed energy systems, such as lasers, would be especially effective against low-earth orbit (LEO) electro-optical imaging reconnaissance satellites such as US spy satellites. Directed energy weapons are favorable because the attack would likely not produce as much debris as a kinetic weapon. Low-power lasers would be especially advantageous because the temporary effects can be used to send a political message without escalating hostilities. Lasers would also be useful if China were to execute a mass attack since the time interval between attacks would be less than that for land-based kinetic systems. Another significant advantage of directed energy weapons is that it may be difficult to immediately identify an attack is in progress and to pinpoint the source of the attack. This difficulty is exemplified in a 2006 incident between the United States and China. Donald Kerr, then Director of the National Reconnaissance Office, publicly confirmed China had illuminated a US reconnaissance satellite with a low-power laser although it did not harm the satellite.[68] China never confirmed this

incident and states the claim is "conjecture."[69] Without firm evidence, it would be difficult for the United States to confront China over this claim.

Land-based laser ASAT weapons have a number of disadvantages. Similar to land-based kinetic ASAT weapons, they are limited by their physical location. Additionally, a land-based laser cannot fire through cloud cover, further limiting its use.[70] High-power lasers are technically challenging and expensive, and at least one analyst considers them decades away from deployment.[71]

Space-based High-Power Microwave ASAT Weapons. High-power microwave ASAT weapons have not received as much attention in Chinese open sources, but merit attention due to their simplicity and lethality. High-power microwave weapons defeat a satellite by producing an intense radio frequency burst disabling a satellite's electronic components. High-power microwave weapons can be hosted on small satellites and still have a range up to hundreds of meters, making them very difficult to detect. Pillsbury identified one published Chinese paper describing the technical considerations for high-power microwave ASAT system, which indicates at least some Chinese interest in this capability.[72]

Space-based high-power microwave devices have advantages similar to space-based kinetic weapons. They can be employed against any type of satellite in any orbit and, due to their small size, can be employed covertly. Additionally, the United States would likely not know if the target satellite was disabled due to hostile act or a non-hostile system malfunction. Even if it the United States could identify the attack as a high power microwave attack, it would be difficult to attribute it to a particular country. Although not as much information is published in China on high power microwave ASAT weapons, it is reasonable anticipate this is a potential threat given the simplicity of their design.

Organization and Management. Technical programs alone are not full measures of a military capability. If China is to deploy new ASAT weapons, it will require a supporting organizational and management structure to effectively manage research, develop doctrine, and perform operations. Col Li addressed research management in *Space Warfare* where he called for an Experimental Space Force Unit to "guide the strategy for…the development of space technology" and to "lead and organize the development of space weapon systems."[73] In July 2005, the Hong Kong Journal *Chien Shao* reported that the Chinese Army was secretly researching the feasibility of establishing a "space force experimental team" with a mission similar to that recommended by Col Li.[74] China has never confirmed the creation of a "space force experimental team" but it does appear to be emphasizing research and development. In September 2007, China announced it is planning to build new national-level laboratories as "part of a major effort to boost overall defense capabilities."[75]

Summary

The aggregation of public statements from US officials and organizations, coupled with the open source writings of Chinese military and scientific authors, indicate China is pursuing a comprehensive ASAT weapons program backed by doctrinal thinking and technology development. China's intentions, however, remain murky and are likely subject to competing rationales within China's own bureaucracy. Whether China's ASAT capability is a defensive reaction to US space and missile defense capabilities or an offensive strike weapon, it is clearly a priority for China and as such, represents a significant potential threat to US satellites.

Chapter 3

Implications for the United States

China's ASAT weapons programs present a potential threat to US space superiority which must be seriously considered. As General Cartwright declared to the Senate Armed Services Committee, "Space is now a contested domain where, without adjustments to our strategy, we may not be able to count on unfettered access to space based systems should others persist in their course of developing ASAT weapons."[76] Congress also recognized the criticality of protecting space systems and included the following language in its 2008 Defense Authorization Bill: "It is the Sense of Congress that the United States should place greater priority on the protection of national security space systems" and has directed the Secretary of Defense to provide a Space Protection Strategy.[77]

What should be the adjustments to the United States' national security space strategy in light of China's ASAT weapons programs? The National Space Policy states that the United States considers space capabilities as "vital" to its national interests and "considers space systems to have the rights of passage through and operations in space without interference...[the United States] will view purposeful interference with its space systems as an infringement on its rights…[and] will preserve the right to freedom of action in space… and will take those actions necessary to protect its space capabilities". This is codified by doctrine as discussed in the previous chapter. Although the US has space doctrine, it has not published a national space strategy or plan to implement the National Space Policy.

China's ASAT capability is particularly concerning because of the United States's high dependency on space capabilities and the current vulnerabilities of those systems. US space capabilities "empower the American way of war," by providing global communications connectivity and enabling precision strike through navigation capabilities. Space capabilities have been integrated throughout the American military, resulting in a tempo and lethality unmatched by any other military power.[78] The benefits of space systems are not limited to military operations. Space capabilities have become a "permanent utility in global commerce," pumping $90B a year into the global economy.[79] Despite this dependency, today's space systems are designed for a relatively benign environment with the primary threat being the space environment, not intentional hostile acts. Although both the Soviet Union and the United States conducted ASAT weapons experiments during the Cold War, neither fielded systems. This negated the need to consider vulnerability to ASAT weapons as a primary factor in space systems design. As a result, the United States currently finds itself in a vulnerable position should China, or any other country, choose to employ ASAT weapons.

Strategic approaches to minimize the risk from China's ASAT weapons can include a combination of the traditional national instruments of power: diplomatic, informational, military, and economic. Developing an effective strategy is complicated by the lack of understanding of China's motivation, therefore the United States strategy must be flexible enough address China's most likely motivation as well as the worst case scenario. Additionally, while this paper focuses on China, it recognizes there is a global increased access to space. As a result, a US space strategy should also be able to account for potential future threats from other states and non-state actors.

Diplomatic, Informational, and Economic Options

If China's motive for developing ASAT weapons is to defend against on a perceived threat from US space systems as discussed in Chapter 2, then diplomatic and informational efforts could greatly reduce misunderstanding and the need for China to develop ASAT weapons. Increased communications between Chinese and American officials have been recommended by a number of analysts.[80] One area to emphasize to China, as well as the rest of the international community, is the United States' intentions in space. The National Space Policy has been criticized for being ambiguous in defining how the United States would assure freedom of navigation in space.[81] While this ambiguity is advantageous in the flexibility it provides in implementing the policy, it can also lead to misinterpretation by other nations. As a worst case, some nations may believe the United States would deny their freedom of navigation in peacetime although this is not the intent of the policy. It may be useful to clarify this policy with the international community, especially China.

Another commonly recommended approach to reduce misunderstanding is to develop "rules of the road" or a "code of conduct" for the international space community.[82] Unlike the maritime community, the international space community lacks any kind of mutually agreed upon rules of conduct. Simple questions such as "how does sovereignty apply to space?" remain unanswered. Chinese scholars are currently wrestling with this very issue and multiple schools of thought have surfaced. One Chinese school of thought maintains that sovereignty extends beyond territorial airspace and into outer space.[83] This is contradictory to the US National Space Policy, which explicitly "rejects any claims of sovereignty by any nation over outer space or celestial bodies."[84] Other Chinese writings are more consistent with US views and compare the

space domain to the maritime, stating freedom of navigation is acceptable in peacetime and a nation "will likely exercise sovereignty control in space only in times of serious crisis or war."[85]

An equally important term requiring mutual understanding between space powers is the definition of "peaceful" and "non-military" uses of space. Chinese authors have argued that space systems that are used to directly support warfighting, such as intelligence and reconnaissance assets, are not "peaceful."[86] Within the Chinese political and military establishment, these are important debates as they provide a legal and acceptable case for employing ASAT weapons. It would be advantageous for the United States to engage China at this critical juncture in order to establish a mutually agreeable basis and preclude China from establishing this basis on their own terms.[87]

The concept of a "code of conduct" or "rules of the road" for all space faring nations appears to be slowly gaining support. General Kevin Chilton, Commander of US Strategic Command, recently stated that a code of conduct or rules of the road for the space domain should be examined, "thus providing a common understanding of acceptable or unacceptable behavior within a medium shared by all nations."[88] The Stimson Center, a US-based think tank, outlines the following elements as important in facilitating safe space operations: "the need for improved data-sharing on space situational awareness; debris mitigation measures; and improved space traffic management to avoid unintentional interference or collisions in increasingly crowded orbits." [89] The Stimson Center goes on to suggest elements of a more comprehensive code of conduct to also include: "notification and consultation measures; provisions for special caution areas; constraints against the harmful use of lasers; and measures that increase the safety of, and reduce the likelihood of, damaging actions against satellites, such as the deliberate creation of

persistent space debris."[90] The State Department and Department of Defense are actively working the areas of debris mitigation, space traffic management, and purposeful interference.[91]

"Space diplomacy" could also be accomplished through cooperative space programs between the United States and China. Opportunities may exist for cooperation on civil space programs such as the International Space Station, climatology, and space science experiments. Chinese leaders recently re-iterated their desire to participate in the ISS.[92] This cooperation could help encourage China to focus their space program on peaceful applications and well as increase mutual understanding of each others' space programs and intentions. Additionally, by increasing China's connectivity to the international space community, China may be less willing to risk "violation of international norms".[93]

Diplomatic and informational activities could be key elements of a US space protection strategy. Clearly defined norms for responsible behavior in the space domain may help prevent misunderstandings between China and the United States, and hold promise to make the domain safer for all space faring nations. Additionally, increased communications between China and the United States at all levels can help alleviate Chinese fears that the United States is intending to be a space hegemon and lessen China's perceived need to deploy ASAT systems to serve in a limited deterrence role. Likewise, increased transparency on China's behalf could help improve the United States' understanding of Chinese intentions with regards to its ASAT weapons program.

Economic means could also be used to discourage China from employing ASAT weapons. This could be approached either through broad national economic policies or through space-specific policies. Current US policy tightly restricts commercial activities with China due to concerns about technology transfers. This restriction forbids the launch of US satellites on

Chinese spacecraft. Loosening these restrictions could serve as an economic incentive while also providing China an opportunity to gain international prestige by playing a larger role in the international space community. However, loosening restrictions holds the risk of increasing technology transfer. This risk would have to be carefully managed if economic incentives were implemented.

Military Options

Diplomatic, informational, and economic actions alone may not prevent China from employing ASAT weapons, especially if China's intention is to offensively strike at US space capabilities in order to gain a military advantage in an anti-access strategy. To support the national space policy and military space doctrine, a strategy is needed to protect US space systems. The primary objective of such a space protection strategy would be to provide space-based capabilities to warfighting elements in a contested environment. The most effective way to accomplish this objective is to deter China from employing ASAT systems against US assets. Should this deterrence fail, the United States must seek to minimize degradation or disruption of warfighting capabilities.

Deterring an ASAT attack could be achieved by either raising China's costs of an attack to unacceptable levels or decreasing the benefits. Multiple military options exist which could decrease the benefits of an ASAT attack by decreasing the vulnerability of US space systems and architectures. Reducing US space vulnerabilities also serves to protect US freedom of action in a contested environment. Military methods which could be employed to reduce the vulnerability of US space capabilities include passive and active defensive counterspace measures to protect on-orbit assets, rapid replenishment capabilities to compensate for on-orbit losses, and changes to warfighting tactics in the terrestrial domains (land, sea, and air) to minimize the dependency

on space systems. Lastly, offensive counterspace operations could be used in a deterrence role by threatening retaliation and thus raising China's costs to employ ASAT weapons. Each of these strategy elements will be examined in this section.

Passive Defensive Counterspace Measures. Passive defensive counterspace measures can decrease the benefit of attacking a US satellite by limiting the effectiveness of the attack and serve to protect the target spacecraft. Examples of passive defensive countermeasures include hardening against electromagnetic pulses to protect on-board systems[94], hardening against radiation to protect on-board systems[95], reducing radar and optical signatures or employing decoys to make detection and targeting more difficult[96], threat warning systems to alert of an attack[97], and the ability to maneuver to avoid a simple kinetic ASAT[98]

An advantage of passive defensive systems is they tend to be less controversial with Congress and the international community as compared to active defensive or offensive countermeasures. To most, passive defensive systems remain consistent with the "peaceful uses of space" due to the fact they are not provocative and cannot be misconstrued as offensive weapons systems. Threat warning systems with the capability to identify an attack and attribute it to a source country have the additional advantage of contributing to deterrence. China may be less likely to initiate an attack if they know the United States will be able to identify the attacker.

One disadvantage of passive defensive countermeasures is the additional cost and weight they add to a satellite. A second disadvantage is their inherent limited effectiveness in protecting the host satellite.[99] While a passive defensive system such as a threat warning system may identify an imminent attack, the satellite may not be able to maneuver or otherwise defeat the employed ASAT weapon. Additionally, the attacker will generally hold the advantage against defensive systems. If China gains knowledge of the passive defensive systems employed on a

particular US space system, they could adjust their ASAT weapons to overcome these defenses. The United States would have to react by making adjustments to defensive systems, which may prove difficult for spacecraft already launched and on-orbit.

Passive defensive counterspace measures may provide a level of protection against some of China's likely threats, such as directed energy weapons. However, elaborate defensive systems to counter all possible ASAT systems would be costly. In order to determine the optimum balance between performance and cost, the space system development community needs to develop an analytical capacity to assess spacecraft survivability, similar to the aircraft survivability field of study. System threat analyses, countermeasure modeling, and testing would all be key components of a mature spacecraft survivability discipline. Most importantly, survivability requirements should be fully integrated into spacecraft acquisition processes and considered an element of space system engineering. This could be accomplished by specifying a Probability of Survival as a key performance parameter in a space system's Initial Capabilities Document and Capabilities Development Document, and by implementing survivability standards throughout the space acquisition community.

Active Defensive Counterspace Measures. A second possible element of a space protection strategy is active defensive counterspace measures. Active defensive measures are capabilities which protect a satellite by striking the attacking ASAT weapon. Active defensive measures could include "body guard" spacecraft or land-based directed energy systems capable of defeating a Chinese co-orbital ASAT satellite.[100] A space-based missile defense system could also provide an active defense by destroying a terrestrial-based kinetic ASAT weapon before it reached low earth orbit, thereby minimizing resulting debris.[101]

Active defensive measures would be especially effective against Chinese space-based ASAT weapons. In addition to protecting a satellite, these measures may have the advantage deterring China by decreasing the effectiveness of China's ASAT systems. However, active defensive countermeasures are complex systems and may be costly, especially space-based options such as "body guard" spacecraft or a space-based missile defense system. Active defensive counterspace systems are also likely to be more provocative than passive systems since they have an inherent offensive capability. Development and deployment of these systems would require a very careful public communications plan to ensure the international community is fully aware the United States would only employ these systems in a defensive role. Finally, active defensive measures require exquisite intelligence of Chinese ASAT weapons to ensure they are not mistakenly employed against "peaceful" Chinese space assets. Destroying a Chinese satellite, which China could prove was not an ASAT asset, would likely have tremendous negative international political consequences. These political risks may negate the value of developing active defensive systems other than those which have only a temporary and reversible effect.

Rapid Reconstitution. A third possible element of a space protection strategy is the ability to quickly replenish space capabilities after an ASAT attack. Replenishment could be accomplished by either storing satellites on-orbit or by rapidly launching replacements. On-orbit storing is a more robust but more expensive option since the extra spacecraft are built and launched regardless of whether or not an attack is executed.[102] A rapid launch reconstitution strategy could leverage the DoD's Joint Operationally Responsive Space (ORS) Office which stood up in March 2007 at Kirtland AFB, NM. The new program's mission is to develop a capability to respond to the warfighters most urgent needs. Although the capabilities of ORS

satellites are expected to be less than those of traditional satellites, the ability to quickly launch replacement satellites with some capability can partially negate the effects of an ASAT strike.

Rapid launch of replacement satellites in the event of an ASAT attack holds promise as a cost-effective option provided ORS is able to meet its cost goals. Additionally, a robust architecture consisting of multiple smaller satellites, as envisioned for ORS, would be more difficult for China to target and destroy.[103] Lastly, a rapid reconstitution option would enable the United States to absorb an ASAT attack with minimal disruption to warfighting capabilities, which would also limit the "shock and awe" effect of ASAT weapons. A disadvantage of a rapid replenishment strategy is the replacement spacecraft would be vulnerable to the same form of attack which disabled the satellite they are intended to replace. If China deploys a limited land-based ASAT capability, rapid reconstitution is a viable strategy since the ASAT sites could be destroyed by conventional terrestrial military forces before they are able to re-attack replacement satellites. However, rapid reconstitution is a less optimal strategy if China develops ASAT weapons with the capability to attack a large number of satellites and with minimal turnaround time between offenses. Lastly, a robust rapid reconstitution may prompt China to develop a more robust ASAT capability or a capability with mass destructive effects, such as a nuclear detonation in low earth orbit. While this is not a likely outcome, it should be considered when weighing risks.

Reducing Dependency on Space Capabilities. It has been proposed that greater use of terrestrial capabilities in place of space-based systems, such as airborne reconnaissance systems, could lessen the United States warfighters' dependency on space-based capabilities and thereby negate the effects of ASAT weapons.[104] While it is important for warfighters' to understand the impacts of losing space capabilities and how to operate through such a contingency, attempting

to shift this dependency to terrestrial systems does not appear prudent. Terrestrial systems have their own disadvantages, including their own unique vulnerabilities, limited access, and significant life cycle costs. Space systems have enabled the United States military to draw down and transform, and it would be difficult, if not impossible, to rebuild the force and capabilities to operate in a "pre-space" environment.

Additionally, this approach would continue to leave all military, civil, and commercial space systems vulnerable to ASAT weapons. Although the military users may be able to limit the effects of an attack against US space systems, commercial and civil applications of these system, such as GPS, would still be affected. Loss of these systems could have a significant economic impact and damage US national security.

Offensive Counterspace Measures. The last military element to consider for a space protection strategy is the use of offensive counterspace measures in a deterrence role. Offensive counterspace measures are not necessarily space-based systems; they could also include the use of conventional terrestrial forces against a Chinese space system. The knowledge that a strike against US space systems would result in significant degradation or loss of China's own space systems could serve as a strong deterrent. The first step in such a strategy would be diplomatic and informational measures to ensure China clearly understands the repercussions of interfering with or attacking a US satellite. In order to serve as a credible threat, these diplomatic measures must be backed by a known capability and political will to employ a military response. The response does not necessarily have to be space-based; reprisal actions could also be in the land, sea, or air domains. For example, if China launched a land-based kinetic ASAT weapon against a US satellite, the United States could respond with air attacks against the launch site. However, military retaliatory actions against Chinese terrestrial forces, especially within Chinese territory,

have the potential to cause significant escalation in a conflict.[105] Such escalation may be politically undesirable. A capability to respond "in kind" to an attack on US satellites with either space-based or terrestrial offensive counterspace systems could provide flexibility in the response without escalating into an attack on Chinese territory.

US offensive counterspace systems are also advantageous in that they could be employed to deny China its own space capabilities in case of wartime. As Sun Tzu said, "Those who excel at defense bury themselves away below the depths of the Earth. Those who excel at offense move from above the greatest heights of Heaven. Thus they are able to preserve themselves and attain complete victory."[106]

To serve as a credible deterrent, offensive counterspace systems to support a space protection strategy must be capable of responding immediately upon notification of a Chinese attack. In addition, offensive counterspace systems must be survivable to ensure their availability. Land-based directed energy systems and space-based ASAT weapons merit further study to fulfill this role. Lastly, US offensive counterspace systems would have to be scalable and flexible in order to keep pace with the growth of Chinese systems. As China continues to invest heavily in its space programs and mature its space capabilities, especially under its "informationalized warfare" concept, its dependency on space will increase. [107] The intent of a deterrent strategy would not be to outmatch the Chinese ASAT weapons in numbers, but to provide enough capability to deter the Chinese from employing their ASAT weapons.

A significant disadvantage of offensive counterspace measures is the political implications. The acquisition and deployment of ASAT weapon systems may be perceived by an already-suspicious world community as the United States attempting to become a space hegemon. To manage this risk, the deployment of offensive counterspace systems must include a

comprehensive strategic communication plan which clearly informs China and the international community that the United States continues to advocate for the freedom of action of all nations in space, and offensive systems would only be employed against those nations that attempt to deny the United States freedom of action.

Another disadvantage of deploying offensive counterspace systems is the potential risk of China accelerating or expanding their ASAT weapons program in order to outmatch US offensive counterspace capabilities. While such a response is a possibility, it should not be an assumed outcome. China would be faced with a similar decision the United States is facing today. They could decide to expend additional resources to further their ASAT capabilities, or expend resources to develop defensive counterspace systems, or accept the balance between Chinese and US offensive counterspace systems. It is important to recognize that offensive counterspace programs are a lower priority than space support and force enhancement programs for China.[108] As such, it is possible China would not choose to expend significant additional resources on ASAT weapons. Additionally, since China believes the United States has already fielded counterspace weapons, their actual deployment may not change the perceived balance of power from a Chinese view. However, the risk of escalation remains and should be addressed to the maximum extent possible through diplomacy and communications with China.

Given these potential pitfalls of deploying offensive counterspace systems, a national policy decision needs to be made regarding whether or not the U.S. would employ these systems. Current National Space Policy and military doctrine does not preclude the development and use of offensive counterspace weapons, and as discussed in Chapter 2, China appears convinced the United States intends on deploying them. However, Congress has been reluctant to develop offensive counterspace systems with the exception of ground-based systems such as the Counter

Communications Systems. As it currently stands, the United States is appears to be paying the political price of having offensive counterspace systems without reaping the full military benefit. Additionally, if offensive counterspace systems are to serve as a realistic deterrent, China would have to believe the United States would have the political will to employ them. Currently, it is not clear this political will exists. For effective deterrence, the United States should determine how it would respond to a Chinese ASAT attack, under both pre-hostilities and during hostilities, and be prepared to implement this response. As stated previously, a military response does not have to be limited to space-related options and could include terrestrial actions.

Implementation Considerations

Adequate space situational awareness is fundamental to any space protection strategy. It is critical for US warfighters to have the information necessary to understand what is on orbit, changes in posture, and factors affecting US satellites. Space situational awareness systems must be able to track all foreign spacecraft including microsatellites, identify a hostile action, and attribute that action to a source country. In order to react effectively, either diplomatically or militarily, this information must be timely and reliable. Additionally, space situation awareness contributes greatly to deterrence by ensuring that hostile acts will be identified and attributed to a source country. Space situational awareness systems are currently a top priority for USSTRATCOM[109] and are supported by Congress as evidenced by an FY08 plus-up for space situational awareness systems. This continued support is vital for a successful space protection strategy.

A challenge for implementing military options of a space protection strategy is human resources. Developing new space situational awareness and counterspace systems will require a space engineering workforce sufficient in size and skill to meet the challenges of designing

satellites to operate in a contested domain. Aerospace engineers and program managers are in short supply across the military, civilian, and commercial space sectors. This shortage is critical and currently affecting the Air Force's ability to successfully execute new space acquisition programs.[110] Space protection strategies which require new system development and acquisition programs must consider how to meet this challenge. As a matter of national security, the United States must find creative ways to recruit, train, and retain space engineers.

Lastly, a space protection strategy should consider funding resources in order to be considered a feasible strategy. Since 2003 the DoD space budget has remained relatively constant, fluctuating between $20.7B to $21.7B.[111] Budgetary pressures from the long war on terrorism and competing Air Force priorities will likely prevent any significant increases in total military space funding in the future. Additionally, funding within the space major force program appropriation is already stressed by existing programs, leaving little money available for new initiatives. Diverting funding from existing space force enhancement programs, such as GPS or communications satellites, is not desirable since it would ultimately result in degraded space support to military operations. Under such circumstances, China would have successfully achieved the effect of ASAT weapons without ever attacking a US satellite. The combination of these financial constraints demands a space protection strategy consider cost-effectiveness in addition to system performance.

Chapter 4

Conclusions

It is unlikely we will ever ascertain why exactly China is developing ASAT weapons. In fact, it is probable that different factions within China are advocating their development for different reasons. What is clear is that China is intent on developing ASAT weapons and is pursuing a comprehensive, multidimensional ASAT weapons program. China has not given any indication that it will discontinue development of their ASAT weapons systems. In response, the United States needs to take steps to deter China from employing their ASAT capability. Diplomacy and increased communications should be a crucial element of a national space strategy; the United States should engage China, along with the international space community, immediately to develop a mutually acceptable "code of conduct" for space and to eliminate doctrinal misunderstandings. Opportunities for cooperation and loosening restrictions should be given priority and examined further. The combination of these diplomatic, informational, and economic measures could go far in convincing China its ASAT weapons are not necessary.

Unfortunately, the United States cannot depend on diplomatic, informational, and economic actions alone to dissuade China from using ASAT weapons, and needs to be prepared to use military options to protect our space systems. This paper has presented options in the form of passive defensive counterspace measures, active defensive counterspace measures, rapid replenishment capabilities, lessening the dependency on space systems, and a limited offensive counterspace capability. Fully implementing all these options is likely not fiscally realistic and

would strain the current supply of space system engineers. Instead, a space protection strategy should balance these approaches based on their cost and system effectiveness. Defensive counterspace systems provide some measure of deterrence and protection against an ASAT weapons attack. A space system survivability analytical capability needs to be developed to enable detailed trade studies of different defensive counterspace systems. Survivability studies should then be used to support defensive counterspace procurement decisions, based on cost and effectiveness. ORS holds promise to enable rapid replenishment of space systems in case China employs ASAT weapons and should be leveraged for this purpose. Lessening US dependency on space systems does not appear to be as cost-effective or feasible as the other military options studied in this paper. A limited offensive counterspace capability could have a strong deterrent value and so could be a key element of a space protection strategy. However, the United States needs to evaluate the political risks associated with offensive counterspace systems and determine if the political will exists to employ these systems. Deterrence could also be achieved using conventional terrestrial forces. In either case, a strong message needs to be delivered to the Chinese clearly indicating the repercussions of attacking a US space system. Lastly, space situational awareness will increase in importance in a contested space domain, as will the need to recruit and retain qualified space engineers. These areas merit continued focus.

Although China is investing in developing ASAT capabilities, their primary focus is force enhancement capabilities.[112] As such, "space diplomacy", coupled with a reduction in US vulnerabilities to ASAT weapons and a credible threat of retaliation, hold the most promise to persuade China that their limited resources are better spent on force enhancement programs rather than engaging the United States in a counterspace contest.

Endnotes

(All notes appear in shortened form. For full details, see the appropriate entry in the bibliography)

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