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Dr. Joan Johnson-Freese
Professor, Naval War College
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"China's Space & Counterspace Programs"

The question before the Commission concerns how the United States (U.S.) can achieve stated U.S. goals regarding space security given a rapidly expanding and increasingly sophisticated Chinese space program.[1] The importance of protecting the space environment and U.S. space assets in orbit, assets which provide information critical to the U.S. civilian and military sectors and overall U.S. national security, has required that goals be considered and reconsidered at many levels and within multiple communities of the U.S. government. Therefore, it is appropriate to begin by referencing the multiple and nested U.S. strategies related to or referencing space, specifically the 2010 National Security Strategy (NSS), the 2010 National Space Policy (NSP), the 2010 Quadrennial Defense Review (QDR) and the 2011 National Security Space Strategy (NSSS)[2] for analytic parameters.

Guidance in the NSS is simply stated. "To promote security and stability in space, we will pursue activities consistent with the inherent right of self-defense, deepen cooperation with allies and friends, and work with all nations toward the responsible and peaceful use of space." (p. 31)[3] These general ideas are reiterated in the NSP as "the United States considers the sustainability, stability, and free access to, and use of, space vital to its national interests." (NSP p.3)

With security, sustainability, free-access and stability as overall goals, the NSSS recognizes the importance of working with all space-faring nations due to the nature of the space environment stated as both contested, congested and competitive (NSS p.i) and "… a domain that no nation owns, but on which all rely," (NSSS p.i). Specifically, because the United States does not own or control space, "partnering with responsible nations, international organizations, and commercial firms" (NSSS p.8) as well as seeking "common ground among all space faring nations" (NSSS p.5) becomes imperative. Both compels consideration of "how to deal with China." The contested, congested and competitive space environment presents both challenges and opportunities (NSSS p.1) if only through the self-interest of all space-faring nations in protecting the space environment.

Within those parameters, the security-specific NSSS goals are given as: strengthen safety, stability, and security in space; maintain and enhance the strategic national security advantages afforded to the United States by space; and energize the space industrial base that supports U.S. national security. The NSS approaches to achieving the policy goals, are clearly stated.

> The National Security Space Strategy draws upon *all elements of national power* and requires *active U.S. leadership* in space. The United States will pursue a set of *interrelated strategic approaches* to meet our national security space objectives: [italics added]
> • Promote responsible, peaceful, and safe use of space;
> • Provide improved U.S. space capabilities;
> • Partner with responsible nations, international organizations, and commercial firms;
> • Prevent and deter aggression against space infrastructure that supports U.S. national security and;

[1] The views expressed here are solely those of the author and do not represent the views of the U.S. government, the U.S. Navy, or the Naval War College.

[2] http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf

[3] There is considerable complexity even within this guidance. Compared to ground, air, maritime and even cyber, there has been relatively little multilateral or public discussion on what the right of self-defense means in the context of space.

• Prepare to defeat attacks and to operate in a degraded environment. (p.5)

Part of preventing and deterring aggression includes developing capabilities to "deter, defend against, and defeat aggression," drawn from the 2010 Quadrennial Defense Review (QDR) and cited in the NSSS (p.10).

Language in the National Defense Authorization Act for FY 2015 evidences considerable U.S. attention to that approach. Secure World Foundation analyst Brian Weeden suggests attention may be focused on those elements to the exclusion or discounting of others.[4]

In line with promoting responsible, peaceful and the safe use of space other elements requiring focused attention include resilience for military systems, increased transparency and confidence building measures (TCBMs), increased space situational awareness (NSP, pp. 11-12) and a non-binding International Code of Conduct for Space Activities as supported by U.S. Secretary of State Hillary Clinton,[5] Air Force Space Command chief General William Shelton[6] and Strategic Command chief General Robert Kehler[7] in 2012. Strong international norms can also be a strong deterrent, further compelling pursuance. The interrelated nature of the strategic approaches requires implementation of all elements. Pursuing "deter, defend and defeat" through counterspace measures alone not only decreases the potential of strategic success, but can be counterproductive in much the same way export control laws consequent to the 1999 Cox Committee Report proved to be.[8] Further, due to the "global commons"[9] nature of the space environment and the importance of sustainability of that environment, the U.S. must seek common ground with China in areas of common interest. Consideration of what China is doing in space and why is useful in identifying these common interests.

Categorization of Chinese space activities as military or civilian is complicated by the fact that the vast majority of space technology (>90%) is dual use. Further, in order to maximize resources many countries, including China, France and Japan,[10] deliberately develop technology or establish organizations and operations for dual-use purposes. They have far less a dichotomy between military and civilian space activities and organizations than in the United States, though the lines between U.S. programs often

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[4] Brian Weeden, "The End of Sanctuary in Space," *War is Boring*, January 7, 2015. https://medium.com/war-is-boring/the-end-of-sanctuary-in-space-2d58fba741a

[5] http://www.state.gov/secretary/20092013clinton/rm/2012/01/180969.htm

[6] http://breakingdefense.com/2012/03/safe-passage-why-the-pentagon-wants-an-international-code-of-c/

[7] http://www.cfr.org/united-states/conversation-c-robert-kehler/p28404

[8] http://www.bis.doc.gov/index.php/forms-documents/doc_view/898-space-export-control-report

[9] The importance of protecting "commons" environments is increasingly noted. The Defense Department has recently changed the name of the "AirSea Battle" concept to "Joint Concept for Access and Maneuver in the Global Commons." http://news.usni.org/2015/01/20/document-air-sea-battle-name-change-memo, http://news.usni.org/2015/01/20/pentagon-drops-air-sea-battle-name-concept-lives Application to the "commons" principles in space is difficult for definitional, legal and operational reasons. Joan Johnson-Freese and Brian Weeden, "Application of Ostrom's Principles for Sustainable Governance of Common-Pool Resources to the Near Earth Environment," *Global Policy*, Vol. 3, No. 1, 2012, pp. 72-81.

[10] The French space agency Centre National E'tudes Spatiales (CNES) is the technical manager for most French military space programs. It receives a considerable portion of its annual budget from the French General Directorate for Armament (DGA). Regarding information regarding Japan's long reliance on being able to utilize dual-use space technology to circumvent Constitutional provisions regarding military space technology, see: Joan Johnson-Freese and Lance Gatling, "Security Implications of Japan's Information Gathering Satellite (IGS) System, Intelligence and National Security, Volume 19, Issue 3, 2004.

blurred as well. For example, prior to the Space Shuttle, U.S. civilian launchers were born from missile programs, and the Space Shuttle cargo bay was specifically designed to be large enough to carry large U.S. reconnaissance satellites. Overall, the United States is more the exception than the rule in utilizing what can be a duplicative approach to space administration and technology development through its civilian and military space programs.

Because of the largely dual-use nature of space technology, virtually any space activity can be deemed as military. Therefore it is (relatively) easier to know *what* China is doing in terms of space activities than *why*. A co-orbital rendezvous and proximity operation satellite in space can, for example, be observed. Whether the satellite is intended for such benign operations as assessing damage to another satellite, or whether for nefarious purposes such as ramming into another satellite, or both, can rarely be determined based on hardware. A multiplicity of views regarding underlying drivers for space activity in China, just as there are in the United States, further complicates assessments. China is a country of such size, and with a rapidly increasing number of media and internet outlets for expressing views and dispersing information, that "evidence" can be found for almost any assessment, thereby accommodating the substantiation of preconceived assumptions as analysis. Consequently, analysis of intent through written statements inherently involves speculation and so careful scrutiny of sources backing such speculation becomes especially imperative.[11] Unquestionably though, the best way to assess intentions is through dialog and cooperation.

THE "WHAT" OF CHINESE SPACE ACTIVITIES

China has an expansive, ambitious space program intended to fulfill a variety of perceived needs, both civil and military. Whether or not it is aggressive, and how much and in what form a threat to the United States are more complex questions. Therefore a brief review of some key areas of Chinese space activity is in order, with reference to similar capabilities in the U.S. and other countries in some instances.

China is pursuing development of a full range of satellite capabilities and is making significant across-the-board progress in terms of both scope and sophistication. Of the approximately 1235 satellites currently in orbit, America, Russia, and China own the most: the U.S. has 512, Russia 135, and China 116.[12]

The growing capacity of Chinese aerospace industry demonstrates the broad programmatic ambitions and China's pragmatic utilization of industrial facilities for building both military and non-military spacecraft. A massive new factory in the port city of Tianjin, not far from Beijing, was completed in 2013. Floor space of the facility is estimated at about 100,000 square meters, or 1.08 million square feet, big enough to allow for product construction and testing. According to a Tianjin city official, facilities there "will be able to build 6-8 outsize spacecraft a year, satisfying requirements for the space station, outsize [communications] satellites, large remote-sensing satellites, large unfolding precision structures and so on."[13] Some of those will likely be modules for the Chinese space station. Others will likely be for large, military reconnaissance satellites much the same size as the space station components. Representatives of

[11] Gregory Kulacki, "The 2014 USCC Report: Still Sloppy After All These Years," All Things Nuclear, November 24, 2014. http://allthingsnuclear.org/the-2014-uscc-report-still-sloppy-after-all-these-years/

[12] Union of Concerned Scientists database. Numbers valid as of July 31, 2014. http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html#.VK_WsXu4F2A

[13] Bradley Parrett, "Chinese Factory to Build Outsize Spacecraft," *Aviation Week & Space Technology*, January 28, 2013. http://aviationweek.com/awin/chinese-factory-build-outsize-spacecraft

the China's General Armaments Department responsible for military satellites were present at the factory groundbreaking, evidencing military involvement in the facility.

China's development of its own satellite navigation system, Beidou (also known as Compass), owned by the Defense Ministry, began operational testing in 2012, and is expected to provide global coverage by 2020 through a constellation of thirty-five satellites. Reluctant reliance on the U.S. owned and U.S. military operated Global Positioning System (GPS) satellites, given that it and the internet are considered global utilities, likely prompted China's desire for its own satellite navigation system, just as it did in Europe with the Galileo system and Russian restoration of the Glonass system capabilities.

China's earth observation capabilities are rapidly expanding. The Ziyuan-1 series is owned by the Chinese Center for Resource Data and Application and has been used in conjunction with the China-Brazil Earth Resources (CBERS) program with Brazil, while Ziyuan-2 and Ziyuan 3 satellites are owned and operated by the People's Liberation Army (PLA). Chinese media refers to China's Yaogan satellites as for disaster relief, earth observation and scientific experimentation. However, the high resolution optical or radar satellites are fully funded by the People's Liberation Army (PLA). Yaogan satellites were launched in 2007, 2008, 2009, 2010 and two in 2014. Additionally, China launched the high-definition Earth observation satellite, Gaofen 1 in May 2013, followed by Gaofen 2 in August 2014, as part of China's High-Resolution Earth Observation System (CHEOS) program approved in 2010.[14] Another three satellites are planned for launch by 2016. The stated purpose of the program is to bolster disaster relief capabilities, as well improving land resources surveying, environmental monitoring, geographical mapping and precision agriculture, though military applications are technologically feasible and likely.

The Chinese Meteorological Administration launched its third Fengyun polar-orbiting weather satellite in 2014. The Fengyun-3 satellite, along with Fengyun-2, forms a monitoring network capable of persistent three-D, multiple-spectrum and remote-sensing observation of the earth. It also represents China's second generation of polar-orbiting satellites.[15]

China is developing smallsats and microsatellites, most to be developed solely by Chinese manufacturers, as are other countries including the United States, England, Japan, and Russia. Smallsats and microsats are considered useful for a wide range of purposes, ranging from student projects to military and intelligence missions, even as antisatellite weapons if maneuverable. China's BX-1, also known as CompanionSat, was launched in 2008 as part of the Shenzhou-7 (SH-7) human spaceflight mission. Weighing approximately 90 pounds, it was maneuverable and provided images of the Shenzhou-7 (SH-7) capsule, demonstrated the ability to inspect the orbital module (close proximity operations), and conducted some limited proximity operations. Additionally, it carried out a data relay experiment.

Lin Mingsen, deputy director with the Chinese National Satellite Ocean Application Service announced in October 2014 that China would build and launch a new "constellation" of HaiYang maritime monitoring satellites in 2019, employing synthetic aperture radar.[16] Instruments carried onboard previous HY satellites included a microwave imager, a dual-band radar altimeter– used to measure sea levels and wind speeds – and Ku-band radar scatterometer for measuring the sea surface wind field.[17] The new system

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[14] http://www.unoosa.org/pdf/pres/stsc2014/tech-47E.pdf

[15] "China's Polar Orbiting Meteorological Satellite Now Operational," *Space Daily*, May 8, 2014. http://www.spacedaily.com/reports/Chinas_polar_orbiting_meteorological_satellite_now_operational_999.html

[16] "China to Launch New Maritime Surveillance Satellites," October 8, 2014. http://www.business-standard.com/article/pti-stories/china-to-launch-new-marine-surveillance-satellites-114100800618_1.html

[17] Rui C. Barbosa, "China's surge continues with HaiYang 2-A launch via Long March 2B," *NASA Spaceflight.com,* August 15, 2011. http://www.nasaspaceflight.com/2011/08/chinas-surge-haiyang-21a-launch-long-march-4b/

will allow maritime surveillance day or night in any weather conditions, including of the U.S. Pacific fleet.

China enjoys use of a number of communication satellites, many indigenous satellites evolved from the Dong Fang Hong (DFH) design first launched in 1970. Communications satellites have also been purchased from other countries, including the United States, and are operated by such organizations as Apstar, Asiasat, and Chinasat, all officially for civilian use. The Zhongzing version of Chinasat owned and operated by the PLA.

China also has also launched a number of experimental satellites in recent years, specifically the Shiyuan, Chuangxin (Innovation) and Shijian (Practice) satellites. Their stated missions have included earth observation, space weather experimentation, space debris observation, mechanical arm observations and testing space maintenance technologies,[18] through capabilities including close proximity operations. Chinese media refers to China's Yaogan satellites as also for disaster relief, earth observation and scientific experimentation. However, the high resolution optical or radar satellites are fully funded by the People's Liberation Army (PLA). Launches of these satellites have been accompanied by a considerable amount of speculation regarding their intended use. Speculation regarding these missions might be compared to the international curiosity concerning the intended use of the U.S. X-37B Orbital Test Vehicle.

China is also expanding its launch capabilities. The Chinese Long March 3B is currently its most powerful rocket in use, capable of lifting approximately eight tons to Low Earth Orbit (LEO). The first LM-5 in its final stages of assembly in a Tianjian factory will more than triple that capability to carry 25 tons to LEO. While development has been plagued by repeated delays, a LM-5 first launch will likely occur in 2015 from China's Wenchang launch site on Hainan Island. Wenchang is China's newest launch site, in addition to the three remote launch sites at Xichang (geosynchronous satellites, lunar probes), Jiquan (human spaceflight) and Taiyuan (polar orbiting satellites). China selected the Wenchang launch site on Hainan Island, formerly used only for sub-orbital launches, for upgrading specifically due to its low latitude location of 19 degrees north. The equatorial boost from that location will support a significant increase in payload weight that Chinese rockets can carry, a factor important when launching space station components, large satellites, and exploration beyond Low Earth Orbit (LEO). Additionally, rather than having to rely on narrow rail transport of launch vehicles to the remote launch sites, rockets, including the much larger LM-5, can be transported to Wenchang by sea.

China's most publicized space activities are those related to the Shenzhou human spaceflight and the robotic Chang'e lunar programs. Originally known simply as Project 921, the Shenzhou program was approved as a three-step plan for human spaceflight in 1992. China has been relatively open about programmatic goals, and has stuck to its announced plan: send humans into orbit, demonstrate advanced capabilities through a small laboratory (the Tiangong program), and finally, build a large space station. The Tiangong spacecrafts are not space stations intended for long-term use, or to be permanently manned, but form the basis for a small laboratory to test technologies similar to those tested by the United States during the Gemini program, including rendezvous, docking, and life support. Tiangong is likely to host manned missions later in its evolution. At 8.5 tons, Tiangong is smaller than both Skylab (about 80 tons), and the 30-ton space station China has always planned as the culmination of its 1992 three-step plan.

[18] See comments by Gregory Kulacki in, Leonard David, "Mysterious Actions of Chinese Satellites Have Experts Guessing," *Space Insider,* September 9, 2013. http://www.space.com/22707-china-satellite-activities-perplex-experts.html

The prototype Tiangong-1(Heavenly Palace) was used to conduct experiments in conjunction with the Shenzhou 8-10 spacecrafts. Taingong-2 was to be a marginally improved version of Tiangong-1 and was originally scheduled to be launched in 2014. That date got delayed until 2015 at the earliest, when it became clear that more than marginal changes needed to be made in order to achieve the intended mission goals, including docking with a cargo vehicle. Consequently, though originally there was also to be a Tiangong-3 spacecraft with expanded capabilities, it appears those all may be incorporated into Tiangong 2.

China is executing the robust Shenzhou human spaceflight program at a pace simultaneously incremental and accelerated: incremental in following almost the same timeline milestones as the U.S. did during Mercury, Gemini and Apollo, and accelerated in that it accomplished these milestones with fewer flights.[19] For example, between Yang Liwei's first-ever manned flight in 2003 and Zhai Zhigang's spacewalk in 2008 there was only one other Shenzhou program flight. Compare that to the number of flights that occurred during the Mercury (6 crewed flights) and Gemini (10 crewed flights) programs, and one finds a much higher number of U.S. launches, with smaller steps taken by each. Shenzhou 9, launched in June 2012, included China's first female taikonaut, Liu Yang.

Although sometimes presented by the media as fact, China does not have an approved human lunar spaceflight program. Such a program is under discussion, but China currently has an approved human spaceflight program and an approved robotic lunar program. Together, however, these two programs are developing and testing the component parts for a lunar human spaceflight program. It is unlikely that China would take that step until completing its large space station, leaving a lunar focus until the 2025/2030 timeframe.

Chang'e is the mythical Chinese moon goddess for whom the robotic Chinese Lunar Exploration Program vehicle is named. Chang'e 1 was launched in 2007 and operated until 2009, and demonstrated China's capability both to put satellites into lunar orbit and to return imagery. Chang'e 2 was launched in 2010. After flying in a closer-to-the-surface lunar orbit and providing imagery with a high resolution camera—pictures essential for an anticipated soft-landing Chang'e 3 mission in 2013—Chang'e 2 left lunar orbit for the Earth-Sun L2 Lagrangian Point, to test Chinese tracking and control capabilities, capabilities also valuable to the military. Using a non-military program to test technology of potential value to the military is not exclusive to China. The U.S. Clementine spacecraft in the 1990's was a joint program between the Ballistic Missile Defense Organization (BMDO) and the National Aeronautic and Space Administration (NASA) to test BMDO technology by mapping the Moon.

Prior to China, only the United States and the European Space Agency had visited L2. Chang'e 2 then set out for an extended mission to asteroid 4179 Toutatis. Chang'e 3 was launched in December 2013 and became the first lunar soft lander since the Soviet Luna 24 spacecraft in 1974. Chang'e 3 carried with it the lunar rover Yutu, or Jade Rabbit. In February 2014 the Chinese and international press followed the success, demise and revival of the anthropomorphized rover with great interest. Chang'e 5-T1 (formerly Chang'e 4, as a back up to Chang'e 3) was launched and returned to Earth in October 2014 as a precursor to a planned Chang'e 5 sample return mission by conducting atmospheric re-entry tests. The Chang'e 5 sample return is scheduled for 2017.

China is expanding its military space capabilities in all areas of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) that have proved critical in enhancing terrestrial force effectiveness, and in space weapons. While there are still significant gaps in China's capabilities in areas such as surveillance, Beijing has supplemented its needs through purchases from such

[19] http://swfound.org/media/90819/swf_human_space_programs_fact_sheet.pdf

providers as Spot Image (Europe), Infoterra (Europe), MDA (Canada), Antrix (India), GeoEye (United States), and Digital Globe (United States).[20] It is not just a globalized world but a globalized space industry. Commercial access to space technology and space-based information is widely available to China while it develops its own capabilities.

China is also developing counterspace capabilities including at least 1 ground-based kinetic-kill anti-satellite (ASAT) system, the DN-1,[21] and potentially a second ground based system, DN-2[22]. In 2007, China conducted an ASAT weapons test, destroying one of its own defunct weather satellites using a direct ascent, kinetic-kill vehicle. Impact resulted in more than 3,000 pieces of space debris being created, significantly adding to the congestion of the space environment. The debris will take decades to dissipate and in the meantime threatens potentially catastrophic damage if it collides with active spacecraft, including the ISS.

In 2008 the United States conducting Operation Burnt Frost, destroying one of its own malfunctioning satellites using missile defense technology. Given the nearly symbiotic nature of missile defense/ASAT technology, China has seemed to learn that missile defense testing was politically acceptable, while ASAT testing was not (even without debris creation). Consequently, the Chinese have conducted what it deemed (non-destructive) "missile defense" tests in 2010, 2013 and 2014. India is also developing a two-tiered missile defense system with technology potentially useful to the development of ASAT capability, including its first exoatmospheric intercept test in 2014. Russia is threatening to revitalize its once active counterspace program as well.[23]

THE "WHY" OF CHINESE SPACE ACTIVITIES

The motivations behind initial Chinese space efforts and the more recent decision to pursue human spaceflight within the context of China's internal history is examined by Gregory Kulacki and Jeffrey Lewis in the 2009 publication *A Place for One's Mat: China's Space Program from 1956-2003*.[24] Using Chinese-language sources, the authors' central observation is that China understood efforts in three major areas -- launching satellites, launching communications satellites specifically and human spaceflight -- each as "efforts to be a measure of national accomplishment necessary to qualify for inclusion among the major spacefaring countries that set the rules. Equity appears to have been the principal concern of China's political leadership."[25] In that respect, China was and continues to seek recognition as a regional and global power. As a space-faring nation, China seeks to be a stakeholder in setting the rules for space. Whether as an equal – a place for their mat among other powers – or the dominant regional power or as a usurper of U.S. power is a question about which analysts often disagree. China's most recent Space White Paper from 2011 again places Chinese space activities in the context of overall national development strategy.[26]

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[20] http://www.defense.gov/pubs/pdfs/2010_CMPR_Final.pdf
[21] Also referred to as the SC-19, referencing it as the 19th type of rocket launched from Shuangchengzi Space and Missile Center, also known as Jiquan. http://www.nti.org/facilities/71/
[22] Brian Weeden, "Anti-Satellite Tests In Orbit – The Case of China," Fact Sheet, Secure World Foundation, August 2013. http://swfound.org/media/115643/china_asat_testing_fact_sheet_aug_2013.pdf
[23] "Russia, China aim to close military technology gap with US: Hagel," Reuters, September 3, 2014. http://allthingsnuclear.org/the-2014-uscc-report-still-sloppy-after-all-these-years/
[24] American Academy of Arts & Sciences. http://carnegie.org/fileadmin/Media/Publications/PDF/spaceChina.pdf
[25] Kulacki & Lewis, p. 9.
[26] http://images.spaceref.com/china/ChinaSpaceActivitiesin2011.pdf

Domestic pride and international prestige, economic development (including skilled jobs and expanded science and engineering educational programs), and dual-use technology development are all proven reasons for pursuing human spaceflight programs, as demonstrated in the United States with the Apollo Program. China is well aware that the United States enjoyed multiple benefits in all of these areas through the Apollo Program, and all today motivate China's commitment to long-term space exploration programs, including human spaceflight. An ambitious, multi-faceted space program continues China's traditional heritage of undertaking big projects, like the Great Wall and the Three Gorges Dam, to demonstrate national prowess. Space activity continues that tradition, now with a techno-nationalist bent.[27]

Although human spaceflight and exploration are primarily political acts, both generic and specific capabilities developed in conjunction with these activities are in many cases transferrable to the military. Improvement in computational analysis and composites developed for space capsules are of value to the military. Tracking ships required for human spaceflight missions are also be useful in missile tracking. It is reasonable to assume that dual-use satellites will be fully utilized for both civilian and military purposes.

The 1990-91 Iraq War has been termed "the first space war" based on some high profile examples of the use of space-based force enhancement capabilities, such as satellite imagery, by the U.S. military. That war convinced China that it would be no match for U.S. conventional forces for many years. Further, China observed the increased advantages received by conventional forces from space assets, and recognized that a significant space capabilities gap existed between the U.S. and China. Consequently, toward protecting their self-interests, specifically Taiwan, China began attempting to close that gap.[28] That interpretation, offered by Union of Concerned Scientists China Program Director Gregory Kulacki in 2014 based on a Second Artillery operations textbook, is a considerably different "intent" assessment than the preparation for "asymmetric warfare" assessment often made based on 1999 book *Unrestricted Warfare* written by two PLA colonels, a book written for public release.

From a Chinese perspective, a number of U.S. actions could be and were interpreted as challenging to their interests at best, more often threatening, and not just actions regarding space. During the 1996 Taiwan Strait crisis when Beijing conducted a series on missile tests in the waters surrounding Taiwan, U.S. President Bill Clinton sent two aircraft carrier battle groups to the Taiwan Straits. The ability of the U.S. fleet to arrive of China's shores relatively undetected by China and to potentially interfere with what China considers the imperative of China-Taiwan unity resulted in a strong call for expanded military capabilities in China, specifically in the maritime domain. The HY-3 satellites are among the Chinese technologies that will serve China in this regard, providing capabilities to monitor not just activity in and around Taiwan, but also the contested Senkaku Islands and in the South China Sea.

It is important to note, however, that China would likely be developing space capabilities regardless of any specific set of historical events, and probably at the same rate. Jonathan Ray at National Defense University suggests Chinese use of a "technology reserve" model of matching capabilities but deferring deployment applicable in conjunction with a neutron bomb, ballistic missile defense, anti-satellite

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[27] David Barboza, "In China, Projects to Make the Great Wall Feel Small," *The New York Times*, January 12, 2015. http://mobile.nytimes.com/2015/01/13/business/international/in-china-projects-to-make-great-wall-feel-small-.html?referrer=&_r=0

[28] Gregory Kulacki, "An Authoritative Source on China's Military Space Strategy," March 2014. http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/us-china-cooperation/china-anti-satellite.html#.VMb9EcaKjhk

weapons and hypersonic glide vehicle systems.[29] In that model, "strategic environment" is a key factor, making consideration of Beijing perception of the strategic environment essential.

The 1999 Cox Committee Report and consequent State Department interpretations of export licensing regulations were intended to impede Chinese space activities by denying China technology, in effect, to isolate Chinese space activities. Instead, China has worked with other countries that have been more than willing to expand and increase their own aerospace business sector market share, or China developed indigenous capabilities. Parts of U.S. regulations that categorized such items as communications satellites as weapons systems and pointedly handicapped the U.S. satellite industry rather than stunting Chinese space activities held until 2013.[30]

The first Shreiver space wargame was held in 2001. The scenario in that wargame was of a large country threatening its small off-shore neighbor. It wasn't a leap for the Chinese to envision themselves as the adversary in the wargame, designed to explore U.S. requirements for space control, countering advanced adversary space capabilities, and evaluate the enemy's ability to deny U.S. and allied space capabilities.

China is not a partner in the International Space Station (ISS), although for a long time it eagerly sought inclusion. Arguments against Chinese inclusion initially focused on China having little to contribute, in terms of financial support, hardware or knowhow. When that situation began to change, considerations of ideology and technology transfer issues were raised. Opponents considered the U.S. working with an authoritarian communist government as inappropriate, although the U.S. has pragmatically worked with unsavory governments in other areas of the world when it serves U.S. realist interests. When all else failed, potential technology transfer issues were raised to block Chinese inclusion. Not being included has supported arguments within China to build their own space station. China's planned space station will de facto replace the ISS when ISS reaches the end of its operational lifetime, conferring both techno-nationalist and leadership connotations to China. China is already courting other countries along those lines.[31]

The primacist strategy adopted by the U.S. after 9/11 and embedded in the 2002 National Security Strategy was not limited to terrestrial policies, but space policies as well. The 2003 Air Force Transformational Flight Plan, including plans for orbiting weapons, and the 2004 follow-up Air Force Doctrine Document 2-2.1, *Counterspace Operations*, indicated that space was seen as the fourth battlespace. The United States vigorously pursued small satellite technology similar to the BX satellites China is developing and the U.S. sees as threatening. An Air Force official was quoted in the trade publication *Inside the Pentagon* about the Air Force XSS program that "XSS-11 can be used as an ASAT weapon."[32] Actions and rhetoric supported the idea that the United States was moving beyond seeking "space superiority," an advantage over other countries by some potentially minimum amount, to "space

[29] Jonathan Ray, *Red China's "Capitalist Bomb": Inside the Chinese Neutron Bomb Program,* National Defense University press, January 2015.
http://ndupress.ndu.edu/Portals/68/Documents/stratperspective/china/ChinaPerspectives-8.pdf
[30] William J. Broad, "Communications Satellite Made legal for Export," *The New York Times*, January 3, 2013.
http://www.nytimes.com/2013/01/04/science/communications-satellites-banned-as-weapons-now-legal-for-export.html
[31] Andy Pasztor, "China and Europe in Talks on Space Exploration Program," *Wall Street Journal*, July 17, 2014.
http://www.wsj.com/articles/china-europe-in-talks-on-space-cooperation-1405592579?mod=_newsreel_3
[32] Elaine M. Grossman and Keith Costa, "Small, Experimental Satellite May Offer More Than Meets the Eye," Inside the Pentagon, December 4, 2003.

dominance," the unchallengeable ability to control the space environment.[33] That potential was of concern to a number of countries, including allies, not just China.

An editorial ran after the release of the 2006 U.S. National Space Policy in *The Times* (London), titled "America Wants it All - Life, the Universe, and Everything,"[11] stating that apparently space was no longer the final frontier, but the 51st state of the United States. The editorial went on to say that, "The new National Space Policy that President Bush has signed is comically proprietary in tone about the U.S.'s right to control access to the rest of the solar system."[34] That same newspaper ran an article entitled "Son of Star Wars takes out toxic satellite with $30m space attack" after the destruction of US-193 in February 2008. While not challenging U.S. motives explicitly, the article cynically stated the satellite's destruction had been "broadcast" by President Bush "as a safety measure" and "the Pentagon celebrated its $30 million Star Wars-style interception in space."[35]

The U.S. rhetoric – and policies -- that prompted that assessment seemed to dissipate with the realization that while air dominance, control of a limited space for a limited time, was technically achievable, space dominance, control of all of space all of the time, was not.

At the highest levels of government, President Barack Obama met with then-Chinese President Hu Jintao in January 2011. Part of their joint statement addressed the desire for deepened dialogue and interaction in space, which many people interpreted as a new willingness on the part of the United States to work with China. But cooperation was not to be. As of April 2011, NASA funding legislation prohibits any joint scientific activity between the United States and China that involves NASA or is coordinated by the White House Office of Science and Technology Policy (OSTP). That legislation has endured. NASA and OSTP remain banned from bilateral activity with China. The publicly stated rationale behind the legislation was stated by Congressman Frank Wolf in a 2011 interview. "We don't want to give them the opportunity to take advantage of our technology, and we have nothing to gain from dealing with them," Wolf said. "And frankly, it boils down to a moral issue. … Would you have a bilateral program with Stalin?"[36] Congressman Wolf's 2013 letter to NASA Administrator Charles Bolden provides another perspective on rationale, having to do with potentially using the promise of space cooperation as a means to seek meaningful progress in China on freedom of religion and human rights.[37] Nonetheless, the potential for technology transfer, nothing to gain and ideology have been consistent threads of rational for U.S. policies toward China regarding space.

A WAY FORWARD FOR THE UNITED STATES

Regardless of whether Chinese intentions are merely ambitions or more nefariously aggressive, the United States must use all tools of national power – not just those related to deter, defend and defeat – to achieve the space-related goals set out in the NSS, the NSP and the NSSS. Congressman Wolf's statement largely restates the reasons most often used for why the United States should not working with China on space issues - technology transfer concerns, values, and nothing to gain – thus limiting U.S.

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[33] Joan Johnson-Freese, "Strategic Communication with China: What message about space?" *China Security*, Volume 2, Number 1, Winter 2006.
[34] Bronwen Maddox, "America Wants it All - Life, the Universe, and Everything," http://www.timesonline.co.uk/article/0,,30809-2410592,00.html
[35] Michael Evans and Jane McCartney, "Son of Star Wars takes out toxic satellite with $30m space attack," *The Times* (London) 22 February 2008, p. 39.
[36] Jeffrey Mervis, "Spending Bill Prohibits U.S.-China Collaborations, *ScienceInsider*, April 21, 2011, http://news.sciencemag.org/technology/2011/04/spending-bill-prohibits-u.s.-china-collaborations
[37] http://news.sciencemag.org/sites/default/files/media/Wolf%20Letter%20PDF_0_0.pdf

policy options necessary for achieving stated policy goals. Additionally, especially among those who grew up during the Cold War, there is a tendency to equate China with the Soviet Union, despite the vast difference between them and in the context of today's globalized world versus the post-World War II world. Limiting U.S. options has never been in U.S. national interest and isn't on this issue either. Those options enhance deter, defend and defeat efforts. First, however, the counterarguments to each of Congressman Wolf's arguments deserve note.

Congressman's Wolf's perspective assumes that working with the United States would give China opportunities in terms of surreptitiously obtaining U.S. technology otherwise unavailable to it. But we live in a globalized world. Attempting to isolate Chinese space activities has proved futile, and in fact pushed China and other countries into developing indigenous space industries — totally beyond any U.S. control — than they might not have done otherwise, and arguably reap more political and prestige benefits from doing so that if they had gotten the same technology from partnering with the U.S. The only outcome of the past two decades of strict export control there is hard data on is the damage to the U.S. commercial space sector.[38]

Second, Wolf's rationale assumes the United States has nothing to gain by working with the Chinese. On the contrary, the United States could learn about how they work — their decision-making processes, institutional policies and standard operating procedures. This is valuable information in accurately deciphering the intended use of dual-use space technology, long a weakness and so a vulnerability in U.S. analysis. Working together on an actual project where people confront and solve problems together, perhaps, a space science or space debris project where both parties can contribute something of value, builds trust on both sides, trust that is currently severely lacking. It also allows each side to understand the other's cultural proclivities, reasoning and institutional constraints with minimal risk of technology sharing. Perhaps most importantly, cooperation would politically empower Chinese individuals and institutions who are stakeholders in Chinese space policy to be more favorably inclined toward the United States. A cooperative civil and commercial relationship creates interests that could inhibit aggressive or reckless behavior, as opposed to Chinese space policy being untethered to any obligations, interest or benefits it might obtain through cooperation with the United States.

The National Academies of Science (NAS) 2014 report titled *Pathways to Exploration: Rationales and Approaches for A U.S. Program of Space Exploration,* includes a specific recommendation that it is in U.S. interests to work with China.[39] NAS has also successfully completed the first Forum for New Leaders in Space Science with the Chinese Academy of Science in 2014. It brought together 16 early career space scientists from China and the US to meet over two workshops where they shared research results and discussed future research opportunities. A second forum is being planned.

Wolf further stated that the United States should not work with China based on moral grounds. While clearly the United States would prefer not to work with authoritarian and/or communist regimes, it has done so in war and in peacetime when it has served American interests, and continues to do so today. That is the basis of realism: Serve American interests first. While the United States would prefer not to work with Stalin, we continue to work with Putin when it benefits us to do so. Were the U.S. not to work

[38] http://www.bis.doc.gov/index.php/forms-documents/doc_view/898-space-export-control-report
[39] http://www.nap.edu/catalog/18801/pathways-to-exploration-rationales-and-approaches-for-a-us-program

with authoritarian regimes, it would have few regimes to work with at all in the Middle East. The U.S. provided supported Saddam Hussain's regime in the Iran-Iraq War.[40]

Chinese politicians are interested in the ISS for symbolic reasons, specifically, being accepted as part of the international family of spacefaring nations as a sign of regime legitimacy. But it is unrealistic to expect withholding U.S. cooperation on space issues can influence regime change in China. A similar approach was considered with the Soviet Union, and it failed. Further, in terms of the U.S. doing China a favor by working with it, perhaps ironically many Chinese space professionals fear that cooperation with the United States would just slow them down. American politics are viewed as fickle and without the will to see programs to completion. This view is reflected in changing European views regarding space leadership. A 2013 piece in Germany's *Der Spiegel* suggested that Europe is thinking of redirecting its primary space alliance from the United States to China, due to China's "rising power" status in space.[41]

The question of whether China is challenging U.S. leadership in space has received considerable media attention in the form of a U.S. – China "space race," prompted largely by perceptions of declining U.S. space leadership. The U.S. civil space program is not dying, military space activities continue to expand, and no country is doing anything in space that has not already been done by the United States. But having started with such a spectacular accomplishment as the Apollo Program, it has been difficult to maintain the public enthusiasm required to fund further space spectaculars, such as a human spaceflight mission to Mars. Although not completely unsupportive, the U.S. public treats the space program as expendable to other government programs. The reality is that space, as with other areas of international relations, will likely be a multipolar environment in the future.[42] America's unipolar moment is over, and as long as it is reluctant to work with rising partners such as China, the perception of its space leadership will continue to decline as well. That is not to say that the United States will not continue to lead in some areas of space activity. If only by virtue of a heftier budget, the United States will be able to lead in select areas. But the days of total leadership are over. It will be a tough pill to swallow for those who crave exceptionalism—but if we are unwilling to pay the price tag, then swallow it, we must.[43] In that respect, China has not "usurped" the perception of U.S. space leadership, it is being ceded to them.

This rebuttal to Congressman Wolf's views assumes that the United States has a choice regarding whether or not to work with China. If, however, sustainability of the space environment upon which the U.S. generally and the U.S. military specifically relies upon for advantages is to be maintained, the space debris issue alone requires that the U.S. not exclude diplomacy as a policy option.

While missile defense/ASAT testing has been conducted in ways to minimize debris issues since 2007, the potential threat to the space environment in non-test circumstances has become clear. If there was any upside to the 2007 Chinese test, it was the frightening realization by all countries of the fragility of the space environment. With regard to China specifically, since this 2007 test China has done nothing further in space that can be considered irresponsible or outside the norms set by the United States. Mankind's

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[40] Ted Koppel reported in 1992 that the "Reagan/Bush administrations permitted—and frequently encouraged—the flow of money, agricultural credits, dual-use technology, chemicals, and weapons to Iraq." ABC *Nightline*. July 1, 1992.

[41] Kevin Holden Platt, "ESA Mulls New Alliance as China Becomes Space Leader," *Der Spiegel,* February 8, 2013, <http://www.spiegel.de/international/europe/esa-mulls-new-alliance-as-china-becomes-space-leader-a-882212.html>.

[42] *Global Trends 2030: Alternative Worlds,* National Intelligence Council NCI 2012-001, December 2012. <http://www.dni.gov/index.php/about/organization/national-intelligence-council-global-trends>

[43] Joan Johnson-Freese, "Exceptionalism, Conflicting Public Mandates and Ceding American Leadership in Space," *Fletcher Forum*, forthcoming, Winter 2015.

dependence on space assets thereby makes it in the best interests of all spacefaring nations to cooperate to maintain that environment.

China was scheduled to host an international meeting of the Inter-Agency Space Debris Coordinating Committee (IADC) only days after its 2007 ASAT test that significantly worsened space debris, resulting in China cancelling the meeting out of embarrassment. There is a certain (understandable) glee in the U.S. military, which has the most sophisticated government space tracking abilities, at being able to warn China of potential collisions between its own space junk and its own satellites.[44] More recent constructive Chinese involvement with the IADC indicates recognition of need to sustain the space environment and cooperated on relevant issues, particularly the space debris issue.[45] These are the type of "common ground" issues that provide opportunities to work with all spacefaring nations to protect the "congested, contested and competitive" space environment.

U.S. emphasis on counterspace is often presented as in response to actions and intentions of other countries, specifically China, presumably recent. Increasingly, however, it seems speculation about Chinese intentions is based on material not publically shared, making the feasibility of both the speculation and appropriate U.S. responses difficult to assess. For example, to my knowledge China has done nothing since its admittedly irresponsible 2007 ASAT test that goes beyond what the U.S. considers international norms of responsible behavior.

Pursuing efforts to enhance transparency, confidence-building measures, toward identifying "common ground among all space-faring nations," and resiliency for military systems (NSSS, p.8) all must be pursued with the same energy and commitment as counterspace operations. Otherwise, just as efforts to isolate Chinese space activities have backfired on the U.S. in areas such as export control, the unintended consequences of a principally "deter, defend, defeat" strategy could trigger an arms race that puts the sustainability of the space environment at significant risk, to the detriment of U.S. national security.

With regard to the resilience, specifically the purview of the Department of Defense (DOD) and Office of the Director of National Intelligence (ODNI), resilience has faced resistance from elements within as being too expensive or, as with space arms control, just too difficult.[46] The Air Force appears to be taking the time honored approach of studying the problem rather than acting on it. Center for Strategic and Budgetary Assessments analyst Todd Harrison characterized part of the problem as a lack of interest on the part of Pentagon leaders. He stated, "While everyone recognizes space as a critical enabler for the war fighter at all levels of conflict, from low to high end, it is not the sexy weapon system that puts hot metal on a target. So it doesn't attract much interest from senior leaders."[47] Counterspace, however, offers that sexy option.

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[44] Warren Ferster, "U.S., Japan Sign Pact on Space Situational Awareness," *Space News*, March 12, 2013. http://spacenews.com/us-japan-sign-pact-on-space-situational-awareness/

[45] Joan Johnson-Freese, "Taking Out the Space Trash; A Model for Space Cooperation," *BreakingDefense.com*, May 2, 2014. http://breakingdefense.com/2014/05/taking-out-the-space-trash-a-model-for-space-cooperation/

[46] Brian Weeden, "U.S. Satellite Needs More Than Swords and Shields," Defense News, January 20, 2015. http://www.defensenews.com/story/defense/commentary/2015/01/19/commentary-us-satellites-need-swords-shield

[47] Stew Magnuson, "Air Force Space Programs on Hold as New Architecture Studied, National Defense, January 2015. http://www.nationaldefensemagazine.org/archive/2015/January/Pages/AirForceSpaceProgramsonHoldasNewArchitectureStudied.aspx

Regarding transparency, the need to share information about satellite locations was recognized by the private satellite owners and operators, promoting the formation of the Space Data Association. At the government level, Space Situational Awareness (SSA) efforts have largely been to "formalize the existing model of one-way data flow from the American military to other countries and satellite operators"[48] and the U.S. signing bi-lateral agreements with France[49] and Japan, and the U.S., United Kingdom (U.K.), Canada and Australia signing a limited agreement in 2014.[50] While U.S. efforts to provide collision-avoidance information to other countries – including China – are admirable, as an increasing number of countries place an increasing number of satellites in orbit, improving current techniques and increasing collaboration and cooperation on exchanges of information must be aggressively pursued.

And while the U.S. has rhetorically supported the European led efforts toward an International Code of Conduct, continued Congressional restrictions regarding bilateral U.S.-China space cooperation sends a powerful signal regarding U.S. seriousness regarding its intent to work with all space faring nations for the good of the space environment. Anything less than a comprehensive effort to constructively deal with issues related to the "space commons" can yield limited success at best.

Regardless of various interpretations of Chinese intent, the United States must pursue all policy goals of the NSS, NSP and NSSS. That will inherently involve working with China in some areas, and pursuing a full range of approaches to policy goals. The sustainability of the space environment is as key to protecting assets as is protecting assets from hostile actions. They are inherently intertwined.

Policies attempting to constrain, contain and control Chinese space activities have been repeatedly demonstrated of limited value. The most viable way for the U.S. to stay ahead of China in space capabilities is to focus on what it does have control over; its own programs. Funding, acquisition processes, strengthening the industrial base, cultivating and supporting science, technology, engineering and math (STEM) education programs and opportunities, resilience and broad based research and development will yield as much or more gain toward achieving U.S. space policy goals are key in the regard.

To summarize, the U.S. cannot "control" Chinese space ambitions; even influence is limited. Nor can the U.S. "control" space in the same way that it can control airspace. Yet space is a global commons the sustainability of which is critical to U.S. national security. Consequently, cooperation with China in areas of shared interests is in the best interests of U.S. national security. In order to protect U.S. assets and achieve stated U.S. goals, all approaches stated in the nested U.S. space strategies must be pursued with equal attention. Full implementation of U.S. space strategies is the prudent way forward.

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[48] Weeden, January 20, 2015.

[49] Daniel Wasserbly, "U.S. France sign Space Situational Awareness Agreement," *Janes,* January 26, 2014. http://www.janes.com/article/33081/us-france-sign-space-situational-awareness-agreement

[50] Mike Gruss, "News From 30th Space Symposium," *SpaceNews,* May 22, 2014. http://spacenews.com/40651news-from-the-30th-space-symposium-us-three-allies-sign-space/