China's Military Ambitions in Space and America's Response

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Introduction

Mr. Chairman, distinguished members of the United States-China Economic Security Review Commission, it is a privilege to present testimony concerning China's strategic and military ambitions in outer space. While China pursues a growing commercial, deep space and space science agenda, the foundation of its space program remains the pursuit of military advantage for the People's Liberation Army (PLA). China's space endeavors are subordinate to the PLA.

While the PLA does not offer public briefings or budget information about its space combat programs, there is a considerable body of "secondary" literature presumably based on strategy or doctrine, which has long appeared to justify the development of a PLA capability to wage war in space. Occasionally, however, statements by top officials appear. According to Chinese press reports on 5 December 2012, newly elevated Chinese Communist Party (CCP) Secretary General Xi Jinping gave a speech to a Second Artillery (SA) audience. Almost nothing of the content of that speech was reported, until the late 2014 surfacing of a journal article by SA veteran General Sun Mingfu. In that speech, General Sun said that "President Xi made clear the need 'to enhance the build-up of ground-based anti-satellite combat force to ensure the timely formation of combat capability', and to "accelerate the development of strategic anti-missile capability." This article quickly disappeared off of its hosting web page and a famous Chinese military-technical blog "KKTT" that gave it prominence soon disappeared as well.

On 14 April 2014, Xi was reported to have given a speech before a PLA Air Force (PLAAF) audience in which he called for an "integrated air and space capability." This phrase was also used by former PLAAF commander General Xu Qiliang during the 2009 PLAAF 60th anniversary, and by military academic commentators which listed space weapons the PLA should acquire. Perhaps Xi Jinping also gave the PLAAF specific space warfare preparation guidance. While there has been some discussion in the PLA of a new service or a "Space Force," today it appears that current services of the PLA are being encouraged to develop individual space combat capabilities.

Based on an accumulation of data, it is possible to conclude that the PLA's apparent goal is to exercise denial and then dominance in Low Earth Orbit (LEO) and then to extend control into the Earth-Moon system. Since the early 1990s China has developed four, possibly five, attack-capable space-combat systems. China may be the only country developing such variety of space weapons to include: ground-based and air-launched counter-space weapons; unmanned space combat and Earth-attack platforms; and dual-use manned platforms.

It is also important to consider that the PLA's projection into space is an integral part of China's development of military capabilities to dominate the Asia-Pacific region, and then to project power globally into the 2020s and 2030s. The PLA requires increasing space control in order to assure that space-based Information Surveillance Reconnaissance (ISR) systems can provide targeting and other and support for missile, air, naval and ground forces, future intercontinental Prompt Global Strike (PSG) forces, and for the forces of client/partner states. Sustaining superiority in LEO, in turn, will require control of the "High Ground," or the Moon and Deep Space.

The Chinese Communist Party (CCP) leadership's intertwined pursuit of global military power and dominant space power has three main motivations: 1) to help sustain the power position of the CCP; 2) to aid the CCP's pursuit of economic-political dominance in key regions to best assure resource/commercial access; and, 3) to eventually displace the United States from its position of global leadership. Space power will also be used to support new Chinese-led or promoted anti-U.S./anti-democratic coalitions as it will be used to crush democratic threats to its rule, beginning with the democracy on Taiwan.

As with the former Soviet Union, China's pursuit of regional and then global military power is not rooted in an existential threat, but in the CCP's fears for its power position. This requires a CCP-led "rejuvenation" of China, entailing mobilization for greater power, ever more control over its own people, and then increasing control over others. Another result is China's choice to be hostile to Western rules or concepts that may constrain China's power. This justifies an essential Chinese rejection of American or Western conceptions of transparency and restraint, or verifiable weapons control in space which might constrain its power.

This mirrors the CCP/PLA's repeated refusal of U.S. requests to consider real nuclear weapons transparency and control, transparency over its nuclear and missile exports, and --from many of its neighbors and Washington -- fair settlement of territorial disputes which threaten war. The latter, especially in the South China Sea, is instructive. As it has gained military power in the South China Sea, China has sought to change the strategic environment and dictate new rules to increase its security at the expense of others. Once it gains commanding strength and position in space, will China do the same?

For the United States, cooperation with China in space may yield some benefits, but it likely will have little impact on the direction and severity of terrestrial conflicts which will dominate relations with China. One can see the value of meeting with Chinese space officials, especially higher CCP and PLA leaders, to advance concerns over their actions in space and to promote transparency. But at this juncture, before China has achieved levels of "space dominance", it is crucial to link any real cooperation with China to its behavior in space and elsewhere which threatens U.S. security.

Furthermore, allowing China increasing access to U.S. space technology, space corporations, or government institutions at this time presents two risks. First it could encourage China to advance an illusion of cooperation with the U.S. and the West while differences on Earth become sharper. This could become useful for Beijing to deflect criticism on other issues, or even to obtain leverage over U.S. options and actions. Second, as has been proven repeatedly, China will exploit any new access for espionage gains to strengthen its own space and military sectors.

China's increasing space power, however, like its growing economic and political power, cannot be "contained." Russia appears ready to greatly expand space and military cooperation with China as part of a larger strategic alignment, while the European Space Agency is edging toward greater cooperation with China. These attractions may only increase if China has the only LEO manned space station in the mid-2020s. Already a top commercial space service and technology provider, China will use its gathering space diplomacy tools to aid its pursuit of economic, political and military influence in critical regions like Africa and Latin America.

The challenge for the United States is to maintain the means to compete with China in space both in military and non-military endeavors. China's potential for developing new space combat systems means the U.S. must be able to rapidly develop appropriate deterrent capabilities. There should also be a more developed U.S. capability to rapidly repopulate satellite systems taken down by PLA attacks, and there should be more terrestrial or airborne systems to compensate for lost navigation, communication and surveillance satellites.

In addition, as the PLA moves substantially out to deep space, the Moon, or to the Lagrangian Points, it will be necessary for the U.S. to consider a compensating presence that is affordable, attractive to a coalition of democracies, and helps to deter China from seeking strategic advantage. Strategic priorities would suggest that a presence on or near the Moon is of greater importance than going to Mars. A multinational government-private presence on the Moon is one option, as is the likely less expensive option of a far cis-lunar presence to further develop manned deep space capabilities.

As was the case with the former Soviet Union, relative peace on Earth or in space will not truly be possible until China evolves beyond its Leninist dictatorship. In its final years, the Soviet Union was on the cusp of deploying multiple space combat systems despite years of U.S.-Soviet space diplomacy. Real space cooperation between Russia the West became possible only after the fall of the Soviet Union, and may again become threatened by Russia's slide into authoritarian aggression. Substantive cooperation with China in space offers no assurance that China will change its threatening behaviors on Earth or in space, but does create opportunities for China to exploit U.S. and Western space technology to gain potential military advantages.

The following will address questions posed by the U.S.-China Economic and Security Review Commission. But first, it is necessary to reflect on the relationship between China's pursuit of space power and its military buildup for regional dominance and global projection.

Space Power and China's Military Expansion

During the 1950s and 1960s, Mao Zedong sought to quickly exploit generous assistance from the Soviet Union, and the insights of U.S.-trained engineers like Qian Xuesen, to complete the early nuclear missiles to deter feared U.S. and Soviet nuclear strikes. His 651 Program succeeded in launching the Dong Fang Hong-1 satellite in 1970, while also aiding the development of larger missiles. But Mao's efforts to build broader space power, such as the 640 Program to build strategic missile defenses, and his early 741 Program manned space ship, faltered largely due to his destructive politics. Mao, nevertheless, realized that China required the technology and prestige of space in order to increase its ability to compete with Moscow and Washington on the global stage.

Fears for political survival and ambitions for global leadership remain the basis for China's current surge for global military power and space power. The greatest impetus for the most recent phase of PLA modernization and buildup was the shock of the 1989 Tiananmen rebellion -- the only time the Party's power position was actually threatened by popular, though unorganized, reformist and democratic demands. In addition to ruthlessly crushing any potential for democratic dissent, the transitioning CCP leadership of Deng Xiaoping to Jiang Zemin decided to begin the broad military and space modernization and buildup we see today.

At first focused on coercing Taiwan and then securing control over disputed territories, the early 1990s saw the start of many PLA programs increasing its Anti-Access/Area Denial (A2AD) capability targeted on the "First Island Chain." These include the Chengdu Aircraft Corporation's 4th generation J-10 fighter and its J-20 5th generation fighter, and the large Xian Aircraft Corporation Y-20 heavy jet transport. China's aircraft carrier ambitions predate Tiananmen but second generation nuclear attack and ballistic submarine programs received greater emphasis. This period also saw the beginnings of the PLA's first "reconnaissance strike complex" of terminally guided medium-range missiles, and the ability to target them with high resolution surveillance, navigation and communication satellites. In addition, the PLA started developing its second anti-ballistic missile (ABM) system along with a new anti-satellite (ASAT) system, tested successfully on 11 January 2007.

The early 1990s also saw the beginning of China's second manned space program, code named the 921 Program. With substantial inputs from Russian space companies the 921-1 or *Shenzhou* spaceship made its first unmanned flight in 1999. While the PLA's General Armaments Department (GAD) took control of the manned space program in 1998, we did not learn of this until former CCP Chairman Jiang Zemin congratulated former GAD Director and then Defense Minister Cao Gangchuan as "chief director of the manned space program" after the April 2002 landing of *Shenzhou-3.* The dual-use nature of China's manned space program was starkly demonstrated by the first manned *Shenzhou-5* mission in 2005, when Astronaut Yang Liwei shared his ship with two optical surveillance cameras.

A little over a year later in December 2004, the current phase of PLA modernization and space development was signaled by the "New Historic Missions" enunciated by Chairman Hu Jintao, in which the PLA started preparing to defend the CCP's global interest, in addition to its regional ambitions. Over the following decade, better combat systems for regional dominance emerged, with new aircraft carriers, amphibious projection ships, and new large airborne projection transports designed to enable the PLA to defend more distant CCP interests.

Since the late 1990s, space systems have played an increasing role in the PLA's "Informationalization" strategy, providing commanders with higher resolution optical and radar satellite surveillance, new space electronic intelligence tools, space-based data relay and new infrared-multispectral early warning satellites. Space information systems give PLA platforms global navigation and communication capabilities, as they help to target increasing numbers of precision-guided missiles and bombs. These capabilities are essential to the fulfillment of

Chinese objectives which include the “recovery” of Taiwan, consolidating military control over disputed regions in the East and South China Seas, and undermining and eclipsing American-led alliance relationships in Asia.

China’s space ISR power will also be used to help military allies and clients. Having helped North Korea, Iran and Pakistan to become current or imminent nuclear missile powers, it makes sense that China would directly or indirectly assist their future space ISR requirements. In a scene that could be repeated elsewhere, today China is pushing to help rearm Argentina, which has already agreed to lease a critical space tracking and control facility to China. A Chinese-armed Argentina with access to Chinese space ISR may be able to better threaten war to take the Falkland Islands. Even if Britain settles for a negotiated transfer, China will gain regional prestige for having “defeated” a Western power, further reducing U.S. influence in Latin America.

By the 2020s and the 2030s, the PLA’s development of space projection and combat capabilities could become the leading element of the next phase of PLA modernization. Networks of larger more capable/survivable surveillance satellites, combined with networks of smaller more survivable satellites, will provide more secure navigation, communication, and targeting for larger numbers of power projection platforms such as nuclear powered aircraft carriers, large amphibious projection ships, very large military transport aircraft, and a next generation of export weapon systems. These could include a new generation of “Prompt Global Strike” systems, enabled by high data rate optical data-relay satellites. These could be joined by more ground-based or air-launched ASAT systems, new LEO-based laser or kinetic armed space combat platforms, and Space-to-Earth combat platforms.

China’s political-diplomatic and military space power will be increased by the completion of a dual-use manned space station in the early 2020s and perhaps new small and large reusable dual-use unmanned and manned space planes. If the ISS winds down in the early 2020s it is increasingly apparent that Russia may seek significant space cooperation with China, replacing its space relationship with Washington. By the early 2030s, the new date for the completion of its 100-ton-plus payload heavy SLV, China may be taking its first steps on the Moon and building toward permanent bases by the 2050s or 2060s. China’s push for the Moon is prompted by a quest for prestige and to control areas that may yield potential economic/resource benefits. The PLA can also be expected to seek military benefits from its Moon presence. Should China’s emerging space and terrestrial power increasingly constrain U.S. power, then Europe and India may be tempted to increasingly “bandwagon” with China, especially in space.

Question 1: Provide a net assessment of U.S. and Chinese space capabilities in a 2015 conflict scenario. How does this assessment change, if at all, for a 2030 scenario?

While it is possible to better assess near term Chinese military-space capabilities due to an accumulation of Western and Chinese disclosures, assessing potential capabilities in the next fifteen years requires making estimates that could over- or under-estimate Chinese capabilities. As the PLA does not reveal its military-space intentions in public documents it is necessary to consider a body of “grey” data that offers indications of potential capability intent. This estimate projects from current indicators but does not review potential major technology breakthroughs that might accelerate development projections.

2015 Conflict Scenario: The main difference in assessments of U.S. and Chinese military space capabilities in the near-term is that China has a gathering "active" space combat potential and is beginning to build "passive" mil-space capabilities, whereas it is not possible to determine whether the U.S.is developing the former, though it is interested in the latter. The U.S. is credited with over 500 military and civil satellites. While China has about 120 satellites, about 75 are used exclusively or largely by the PLA, and the PLA has access to more of China's "civil" communication satellites. In 2015 China may be capable of strikes against scores of U.S. satellites in LEO, Geostationary Earth Orbits (GEO, 35,000km), or Medium Earth Orbits (MEO, 2,000-35,000km). In 2015 the U.S. may only be capable of limited retaliation against Chinese satellites in LEO, and would be stressed to repopulate critical U.S. satellite networks.

Space ISR: By 2015 the PLA's surveillance satellite network could comprise about 40 optical surveillance satellites, 10 radar satellites, 8 possible early warning satellites, and about 21 electronic intelligence (ELINT) counter-naval satellites. In addition there may be 4 weather satellites that assist global missile targeting. All of these use LEO polar orbits so they are more vulnerable to ground or air-launched ASATs. However, there are indications that the PLA may be developing much larger surveillance satellites, with the potential they may be placed in much higher orbits.

By 2015 the PLA may have four to five dedicated communication satellites in GEO, and 16 to 20 navigation satellites in GEO or MEO. The Beidou/Compass navigation satellite system has a secondary global communication capability at a text-message level. In addition the PLA will control three *TianLan* data-relay satellites in GEO, intended primarily to support tracking and command of manned platforms, but could also support global military operations. Earth-based global tracking and control networks crucial to maintaining China's space architecture include four large *Yuan Wang* tracking and control ships. In China there are eight tracking and control facilities and it has or will gain access to facilities in Argentina, Chile, French Guiana, Kenya, Namibia and Pakistan.

In September 2013 and November 2014 China launched its *Kuaizhou*, a China Aerospace Science and Industry Corporation (CASIC) solid-fueled mobile SLV based on the DF-21 medium range ballistic missile (MRBM) or a larger intermediate range ballistic missile (IRBM). The model of a potential export version of this missile was displayed at the November 2014 Zhuhai Airshow. Also revealed were six new microsatellites for surveillance and communication missions for this SLV. This could be the beginning of China's "Operationally Responsive Space" initiative to be able to repopulate satellite networks. The China Aerospace Science and Technology Corporation's (CASC) liquid fueled small Long March-6 SLV may also be slated for this mission.

Since the mid-1990s China has also invested heavily in micro and nanosatellites, detailing development work mainly to Chinese aerospace universities including the Harbin Institute of Technology, Tsinghua University, Nanjing University of Aeronautics and Aerospace, and the National University of Defense Technology. China has the capability today to rapidly develop constellations of micro and nanosats that can be used to replace attacked satellites, or to succeed them with more secure but distributed satellite networks. A recent Chinese report notes that the Province of Jilin plans to loft China's first "civil" network of four imaging microsatellites.

In contrast, the more varied U.S. surveillance satellite network makes extensive use of larger systems placed in higher orbit systems in order to reduce their vulnerability. But this is now changing as the PLA develops ASATs able to attack higher orbits. Attempts to build a larger number of smaller surveillance satellites like the SBIRS series faltered due to complexity and expense. As a consequence, the U.S. has shown greater interest in even less expensive and smaller satellites like the U.S. Air Force's TacSat or Operationally Responsive Space-1 (ORS-1).

Ground Based Lasers: On 28 September 2006, the U.S. publication *Defense News* first reported that China had fired a "high power laser at a U.S. spy satellite" as a "test of the Chinese ability to blind the spacecraft." While U.S. officials tried to downplay the test, China's intent to military "blind" enemy satellites was confirmed in the December 2013 issue of *Chinese Optics* in an article "Development of Space Based Laser Weapons" written by three engineers from the Changchun Institute of Optics, Fine Mechanics and Physics. They stated, "In 2005, we have successfully conducted a satellite blinding experiment using a 50-100 KW capacity mounted laser gun in Xinjiang province. The target was a low orbit satellite with a tilt distance of 600 km. Over the following eight years it is likely that China has improved its ground-based ASAT lasers.

In 1997 the U.S. Mid-Infrared Advanced Chemical Laser (MIRCL) demonstrated its ability to "dazzle" a LEO satellite but the U.S. is not known to have developed ground-based lasers capable of conducting ASAT missions. As far as is known publicly, the U.S. Air Force YAL-1 chemical airborne laser was not tested against LEO targets during its 2007 to 2011 testing program.

Ground-Launched ASAT: The PLA's combined ASAT and ABM program that gained momentum in the early 1990s has resulted in at least two known ground-launched ASAT systems. Derived from the CASIC KT-1 mobile solid/liquid fuel SLV, the SC-19 ASAT began a test program in 2005 that resulted in its first successful destruction of a FY-1C weather satellite at 864km in January 2007. Subsequent SC-19 tests on 11 January 2010 and 23 July 2014 were judged as ASAT tests even though they destroyed lower altitude missiles. It is possible that the PLA may now have an inventory of scores of SC-19 ASAT/ABM missiles.

On 13 May 2013, China tested its larger DN-2 ASAT. Chinese sources claim it reached an altitude of 10,000km, while U.S. sources noted it nearly reached GEO. It is possible that both the SC-19 and DN-2 have been put into production although this cannot be confirmed. The DN-2 could be based on a version of the CASC DF-31 ICBM or the CASIC *Kuaizhou* mobile SLV. Mobility for the SC-19 and DN-2 means it can be moved to multiple locations to facilitate surprise ASAT strikes.

On 20 February 2008, a U.S. Navy modified SM-3 surface-to-air missile destroyed a decaying U.S. reconnaissance satellite at an altitude of 247km. Believed to have been a counter-demonstration for China, the U.S. is not known to have put into production a ground launched

ASAT. The SM-3 or U.S. Army THAAD could form the basis for a LEO ASAT but no such program has been reported.

Air Launched ASAT: The April 2009 issue of the journal of the Shenyang Aircraft Design and Research Institute, or 601 Institute, contained an article titled, “The Technologies of the Fighter Platform Launching Trajectory Missile Attack Satellite.” This article concludes that it is “feasible and reasonable” that an aircraft be used to attack a satellite “in the present stage.” This suggests that SAC has already adapted, or may be in the process of adapting its J-11 fighter, a clone of the Russian Sukhoi Su-27, to perform ASAT missions to attack LEO satellites. An ASAT-capable J-11 fighter would offer greater tactical flexibility and could be concealed at numerous PLA Air Force airbases. While there are no open reports of a Chinese airborne ASAT test, it is conceivable that China has developed such a system over the last six years.

The Reagan Administration in 1988 cancelled the ASM-135, the second U.S. air-launched ASAT program, due to cost, technical and Congressional opposition challenges. It was tested successfully once against a satellite target in September 1985. In 2015 the Defense Advanced Research Program Agency (DARPA) reportedly will start testing its Airborne Launch Assist Space Access (ALASA) F-15 fighter-launched small SLV, which could form the basis for an air-launched ASAT.

Co-Orbital Interceptors: China apparently has developed satellites capable of co-orbital interceptions of other satellites for benign or hostile missions. On 19 July 2013, China launched three satellites, two of which, the Shiyan-7 (SY-7, Experiment-7) and Chuangxin-3 (CX-3), interacted with the Shijian-7 (SJ-7, Practice-7) launched in 2005. The SY-7 is believed to have manipulator arm that could perform maintenance or intelligence missions, or attack missions which disable without creating a debris cloud. While classified as an “experimental” system, this satellite could also be developed into a more capable co-orbital close-up surveillance or interceptor platform.

In late 2010 or early 2011, China is believed to have conducted a sub orbital test of its *Shenlong* small space plane, a technology test bed which could also be developed into a multi-mission dual use platform similar to the U.S. Boeing X-37B small space plane. A Russian source confirmed to this analyst that the *Shenlong* was tested, but there is no open reporting that an operational version has been produced. Larger manned and unmanned Chinese space planes are very likely under development.

U.S. experience with co-orbital inspection capabilities may extend to the *Prowler* satellite launched in 1990, and more recently to two XXS and two MITx satellites launched in the last decade. However, it is not known publicly whether these have been developed into operational system; most likely not. The U.S. Air Force has also built three 5-ton Boeing X-37A/B small reusable space planes which are capable of deploying micro or nanosatellites, or carrying passive or active military payloads. They have conducted three lengthy but classified missions. While small, the X-37B would be vulnerable to ground-based PLA interception systems.

Dual Use Manned Platforms: While the U.S. never launched a manned military space platform, the Soviets lofted military Salyut small space stations in the 1970s, and in the late

1980s tried to launch an unmanned space combat platform and were considering turning their *Mir* space station into a base for space bombers. Perhaps influenced by this Soviet example, China could be planning for a range of military uses for its manned space platforms.

The September 2008 *Shenzhou 7* mission, remembered most for China's first manned spacewalk, also saw its launching of a micro-satellite shortly before passing about 45km from the International Space Station. As far as can be determined, China provided no warning of its intention. Also, despite the potential for an accident which may have threatened the lives of two Russian and one U.S. astronaut onboard, there has been no public response to this incident from U.S. or Russian officials. Was this an early Chinese attempt to simulate space docking, or was it a simulated co-orbital attack against the ISS? Does this incident, and the previous use of the *Shenzhou* to carry military payloads, mean that China's manned space platforms will be equipped to perform "active" military missions? If the PLA could equip the *Shenzhou* orbital module to launch the BX-1 micosatellite, could it also modify the orbital module to carry intercept sensors and kinetic kill vehicles (KKVs)? The larger *Tiangong* has payload bays which have used Earth observation cameras. Might China consider modifying *Tiangong* to be perform ASAT or orbital Earth bombing missions?

U.S. programs to develop manned military-mission space platforms like the *Dyna Soar* space plane and the Manned Orbiting Laboratory (MOL) were cancelled by the end of the 1960s in favor of unmanned satellites for military-space missions. While both the Soviet Union and China feared that the U.S. Space Shuttle would be modified for combat missions, there is no open reporting this was done. However, the Shuttle was used on numerous occasions to deploy military payloads but was retired in July 2011. The U.S. National Air and Space Administration's (NASA) Boeing *Orion* manned capsule made its first unmanned test on 5 December 2014 but may not make a manned test until 2021. The private SpaceX Corporation *Dragon* manned capsule may not fly until 2017 or 2018. There is no reported consideration that either may be modified for active military missions

2030 Conflict Scenarios: China's Potential Capabilities

Provided the CCP survives to expand its power, by 2030 China will require increasing space power in order to support its expanding global projection forces on Earth, and because military competition in space will have become more intense, largely due to China's continued development of space combat capabilities. It is likely that an expansion in the number of space combat programs by individual services will have prompted the PLA to create a unique "Space Force." While China's first manned forays to the Moon may not occur until soon after 2030, plans will have advanced significantly toward the creation of a permanent Moon Base by 2050 or sooner. A proliferation of its space combat systems around the Earth will push China to seek increasing advantage, setting the stage for its strategic-military development of the Moon.

As mentioned earlier, absent a fundamental change in the character of the CCP or its evolution in a pluralistic direction, China is unlikely to accept negotiated limits on its expanding space power. Furthermore, Russia, provided its authoritarian anti-Western character increases, may have to seek a far more deeper military relationship with China, assuming Beijing's hunger for Russian resources can be satisfied short of taking its territory.

Space technology may become Russia strong suit in its military relationship with China, provided it can sustain Chinese funds to insure its space sector remains competitive. Since early in the last decade Russia has been considering its post-ISS future in space, considering alternate space station designs, Moon and initial Mars missions, manned architectures and next generation spaceships, perhaps to include nuclear propulsion. While China's preference may be to develop its national space capabilities, as it has done repeatedly regarding weapons technology it could begin broad space technology cooperation with Russia to accelerate next generation capabilities.

China's Future Close-to-Earth Mil-Space Capabilities

If current trends discernable today continue, it is likely that China will have multiple options to distribute its critical satellite service requirements to larger and deeper space platforms as well as to clouds of micro and nanosats. As it does so, it should be expected that China will develop means to both attack and defend its evolving satellite networks.

Large satellites may include 5-ton and 10-ton systems able to reside in deeper space which may active and passive defenses. Chinese academic engineering literature shows some familiarity with large membrane space mirrors, for example as used by the U.S. Defense Advanced Research Projects Agency's (DARPA) Membrane Optical Imager for Realtime Exploitation (MOIRE). Membrane mirrors can be expected to enable large deep space surveillance satellites, as envisioned by MOIRE, or to make micro and nano-surveillance satellites even more powerful.

Future Chinese micro and nanosats might be able to "cleave" or double or quadruple in the event of an attack. A previously mentioned Chinese report notes that the Province of Jilin plans to have a constellation of 137 small satellites by 2030, noting this may enable a revisit time of 10 minutes. The PLA or "civil" authorities in China could be hosting scores of satellite "cloud" constellations by 2030. The potential for China to develop counters to small satellites should also be considered. Already, China is testing and considering other novel concepts for capturing/disabling small UAVs with airborne nets. Conceivably, large nets could be used to co-orbitally intercept small satellite clouds.

A potential Chinese leap-frog technology advance was briefed at the 2014 International Astronautical Congress (IAC) in Toronto attended by this analyst. A Chinese engineer briefed a paper proposing that China's next generation data relay satellites use optical or laser data links, which could phenomenally increase data transfer rates. The major technological obstacle was to develop an optical/laser data transfer to Earth receivers that could overcome atmospheric distortion. If successful, such data transfer rates could go far to enable an intimate level streaming tactical imagery of targets for very distant hypersonic Prompt Global Strike systems, space bombing platforms, perhaps in multiple simultaneous combat theaters. The kicker: the engineer noted this satellite could begin development to construction in 2016 or 2021. China may be the only country investing in this capability.

Occasional statements from Chinese military academics and academic engineering articles point to China's interest in developing a range of future space combat capabilities. Asian military sources told this analyst in 2008 that an initial PLA ABM system could emerge in the early

2020s. This might happen even sooner. Chinese-developed ABM/ASAT capable missiles may become smaller and deployable on aircraft, ship and submarine platforms. In a December 2013 journal article, engineers from the Changchun Institute of Optics, Fine Mechanics and Physics, a leading Chinese laser weapon research body, proposed it would be possible by the mid-2020s for China to loft a 5-ton laser-armed space combat platform. A key enabling technology would be large membrane mirrors. It should be considered that by the mid-2030s might China be able to halve the size of possible laser space combat platforms so as to launch more in a single SLV.

At the 2006 IAC in Valencia, engineers from the China Academy of Launch Vehicle Technology (CALT) briefed a paper on two reusable space plane concepts under consideration: a 130-ton or so manned space plane for LEO operations, and a 100-ton unmanned suborbital space plane for launching payloads on an expendable second stage. Both concepts, which could appear in the early 2020s, apparently are dependent on using the first stage of the Long March-5 heavylift SLV slated to begin testing in 2015 or 2016. The manned space plane concept carries most of its weight in fuel as a "second stage" to reach orbit. However, more reserve fuel may enable greater capability for maneuver than U.S. or Soviet space shuttle concepts, which could increase its military utility.

Chinese military academics and academic engineering articles have addressed the idea of using platforms in LEO to bomb targets on Earth. This could be done with a relatively simple platform derived from the *Tiangong*, a manned or unmanned space plane, or a hypersonic cross air vehicle (CAV), for which there may be some interest as seen in Chinese academic engineering literature.

It also has to be considered that China's interest in manned space combat platforms may extend to its future space stations. The first 120-plus ton space station that may be completed by 2023 is based on the replaceable module concept developed in the 1970s by the Russian Energia Company. There is some reason to conclude that under the guise of goodwill, Russia was unwise enough to allow a significant Chinese espionage exercise within its space companies in the late 1990s and that Energia's space station technology may have fallen victim. The first Chinese space station may have two experimental modules, one of which will have large imaging systems pointed out to space and at the Earth—which could be dual-use. If needed, such modules could be replaced with others equipped for combat, more capable military surveillance or command-control needed to compensate for the loss of Earth control facilities. At the 2014 IAC in Toronto, a Chinese academic told an audience that China was likely planning a larger second generation space station. Given that the first may have a life span of 10 years, the second may be ready by the early 2030s.

Before the 2020s it can be expected that the PLA will also make real progress in creating "Near Space" capabilities that can compensate for the loss of LEO assets. Large UAVs or stratospheric airships capable of performing radar, optical, communication and navigation satellite functions could emerge soon. A next more capable generation of these systems may emerge in the mid-to-late 2020s.

Potential Deep Space Ambitions

As it controls the rest of China's space program, the PLA also controls China's Moon program. As it has done throughout its space program, the PLA can be expected to seek dual use benefits from China's presence on the Moon. Over a decade ago, Chinese Moon program leader Dr. Ouyang Ziyuan, highlighted the Moons military value and the need for China to be able to secure vital resources, perhaps Helium-3 to power future fusion energy reactors. Writing on 31 January 2015 on the website of the CCP Central Committee's journal *Quishi* (Seeking Truth), the Chairman and CCP Party Secretary of the China Aerospace Science and Technology Corporation (CASC), Lei Fanpei, stressed that "We will adhere to the path of developing military-civil integration in our coming demonstration of deep space exploration, manned moon landing, heavy launch vehicle and other major programs, and are of major significance both to the nation's long-term development and to the task of building the nation into a strong space power." This is a strong indicator that the PLA will use its Moon and Deep Space program for military gain. While some Western analysts may scoff at the idea of the Moon having military value, perhaps PLA planners have decided otherwise.

While from the perspective of current technology it may be better to invest in ISR and military capabilities closer to Earth that can dominate LEO and GEO, perhaps as ISR assets move well beyond MEO it may then become useful to have Moon capabilities to find or interfere with such assets. Early in the *Change* unmanned Moon probe program there was mention that the stationary Moon lander might include an experimental payload using a laser to measure distance to the Earth. While recent reporting on the December 2013 *Change-3* Moon landing mission has not included mention of a laser package, at the 2014 IAC a Chinese space company official did mention that it could be included in a future landing mission. A low-power laser on the Moon could become militarily useful were it able to vibrate and thus interfere with the very thin membrane mirror of a potential MOIRE like surveillance satellite.

What if, in about 100 years, breakthroughs in space propulsion make it possible to reach Mars in weeks, versus months or years? Should the Earth's economy come to be dominated increasingly by access to resources on Mars, then the Moon and the Langrangian Points become the nearest "parking garages" to support that commerce. So from a very long term perspective it may be attractive to the PLA to secure a dominant position on the Moon in order to have the option to secure access to other potentially strategic positions in the Earth-Moon system.

Question 2: Given China's emerging counter-space capabilities, which defensive or offensive capabilities should the United States prioritize to maintain its strategic advantage in space? Assess the implications, if any, for U.S. defense budget requirements in these areas.

The degree to which China, with possible Russian help, obtains "space control" will most likely be determined by the degree to which the United States rises to defend access to space by the democracies and deters attacks by China and Russia. From the perspective of the 2015 policy balance in Washington, this will require a fundamental political shift to emphasize a commitment to sustaining a broad rebuilding of U.S. power to include space power. It will also require a constant investment in the futures technologies. There must be a deep search for what will succeed the systems viewed as the next wave of space power: micro and nanosat constellations; mega membrane-based deep-space surveillance satellites; hypersonic cross-air and glide vehicles; liquid-fueled 100-plus ton payload SLVs; solid state lasers; $1 -$20 million space launch services; and, strategic position on the Moon.

Suggested Military-Space Priorities

Retaliation: After nearly 25 years of continuous development of its current ASAT systems, China shows little inclination to consider constraints on its space combat system development. So far China has demonstrated four, possibly five, ASAT systems; ground based lasers, two ground launched ASATs; and both an unmanned and a possible manned co-orbital interceptor. It is reasonable for the United States to conclude that it needs to develop appropriate capabilities to deter the CCP/PLA from starting a shooting war in space. This should include capabilities that produce rapid symmetrical effects following Chinese attacks against U.S. space assets. It may not be necessary for the U.S. to match every Chinese space combat development, but the U.S. may require its own variety of space combat capabilities.

To reduce costs it is suggested that initial ASAT systems exploit existing long-range surface-to-air missiles, to include the U.S. Navy's SM-3 or the U.S. Army's Terminal High Altitude Area Defense (THAAD) and Ground Based Midcourse Defense (GMD), which in some instances may only need appropriate software. This should be succeeded by a common ASAT which is able to use ground, ship, and submarine launch platforms and to reach targets in MEO. It will also be necessary to develop an air-launched ASAT for use from strike fighters or bombers, which would offer fastest response to a PLA space attack. DARPA's ALASA fighter-launched small SLV may offer an early path to an air-launched ASAT but the U.S. should also develop a heavier multi-stage air-launched ASAT that can reach GEO.

Responding to the possible PLA use of unmanned orbital Earth attack platforms may require consideration of multiple responses. Should the PLA launch continuously orbited space combat or Earth attack platforms, perhaps something similar to the Soviet unmanned *Polyus* system, then the U.S. should consider an appropriate in-orbit system to immediately respond to its use. Should the PLA instead launch space combat/Earth-attack platforms in concert with larger military campaigns, then it may be necessary to develop near-space hypersonic platforms able to intercept the PLA space attack platform.

Responding to potential PLA use of manned platforms for military operations, or its placement of military assets on the Moon, also requires serious consideration. One possible conclusion from the 2008 *Shenzhou 7* mission is that China has signaled that it will show no hesitation to attack manned space craft from the United States or other countries that it deems threatening. It is perhaps appropriate now for the U.S. to consider, as a matter of policy, whether it reserves the right of defensive response to China's use of manned space craft for military missions and then to make public that decision.

A key enabling technology for future U.S. space combat platforms or, for providing naval or ground forces a defense against space-launched weapons, will be energy weapons. It is crucial to proceed more rapidly with programs that can increase the strength and reduce the size and energy requirements for solid state lasers. In addition, there should be greatly accelerated development of large and smaller railguns, which have the potential to launch steel pellet clouds to shred PLA anti-ship ballistic missiles (ASBMs), hypersonic glide vehicles (HGVs), and perhaps, space-launched ground attack munitions.

Resilience: The other side of the coin to deterring PLA attacks in space is to demonstrate that any space assets that are attacked can rapidly be either replaced or have its function effectively reconstituted. DARPA is now pursuing a number of programs which are intended to strengthen U.S. space resilience; these are deserving of increased support. In addition to the ALASA air-launched SLV, there is the *Galileo* program, intended to take parts off of older satellites in GEO and reconstitute them in space. DARPA's associated *Phoenix* program would develop a robotic builder satellite, in addition to its "Spacecraft Morphology" project that would use common Lego-like "Satlets" to build satellites for different missions.

In addition to such government-led programs, the U.S. should encourage many private corporate or university based initiatives to loft small sat clouds with the goal of succeeding the functions of larger more costly single satellites. In Japan, the Next Generation Space Systems Technology Research Association (NESTRA) is working on a 30-40 constellation of small sats with a 1 meter resolution. U.S. companies like Skybox, Planet Labs, and Black Sky are also developing constellations of small sats to provide commercial imagery with cheaper-smaller platforms.

If a satellite constellation cannot be replaced, such as the MEO Global Positioning Satellites (GPS), then there should be a greater investment in terrestrial alternatives. For example, growing jamming threats and China's DN-2 ASAT should provide ample justification for the U.S. to invest in E-LORAN to compliment and provide backup for GPS. E-LORAN will at least help provide vital navigation signals for aircraft and ships, aid ground vehicle navigation, and provide time synchronization services. In addition, the U.S. should invest in airborne platforms such as very long-endurance UAVs and near-space airships which can also replicate the functions of many satellite types.

Position: As it seeks to deter via retaliation and resilience, the U.S. must also be investing in strategic-positional deterrence, or simply put, make sure it can contest the "high ground"-- which for the near term means the Moon. For the U.S. to bypass the Moon and simply invest in a Mars program that many take many decades to materialize, and leave China to build dominance over the Moon, would constitute strategic myopia for the United States. Under national policies of "civil-military integration" China likely seek military benefits from its presence on the Moon, perhaps to include developing options to block U.S. access to Mars.

Essential to exercising the option to build a Moon or Cis-Lunar presence would be the development of the heavy lift Space Launch System (SLS), and encouraging private companies to develop more efficient medium-heavy lift SLVs. While the U.S. government may not necessarily require a program to physically return to the Moon, it should retain the means to get there if required, and it should actively encourage multinational government-private initiatives to build an unmanned or manned Moon presence.

This could offer a "new" broad international program to succeed the ISS. It has the advantage of allowing space-faring nations with interests in deep space, like India and Japan, to "own" this project from the beginning and to leverage their participation to develop respective national capabilities such as heavy SLVs. A large multinational Moon program could create positive pressures for Russia and China "play nice" and, depending upon relations on Earth, advance an opportunity for peaceful cooperation that may offer a better chance to challenge China's space-nationalist policies. If this does not work, then the West will have secured a presence on the Moon that can at least offer options to respond to possible Chinese or Russian military exploitation.

Question 3: Discuss China's approach to space diplomacy and cooperation, particularly with the United States. Assess the risks and benefits of U.S.-China space cooperation.

China's space diplomacy approach toward the United States, as with Russia, has been to try to use all doors — the front and the back and sides. Despite occasional opportunities for discussions between space officials, largely due to post-Tiananmen sanctions, China and the U.S. did not engage in space-technical cooperation as China and Russia did starting in the early 1990s. The U.S. was not selling, but Russia was, so China was able to import significant Russian space technology to accelerate its 921 Program manned effort.

China has repeatedly expressed its willingness to consider space cooperation with the United States, as it stands ready to cooperate with many others. But instead of responding to over two decades of variously sourced U.S. concerns about its behavior on Earth, or in space, China's basic space-diplomacy strategy is to wait out the Americans. They are relying on China's accumulation of space power to convince enough U.S. power centers to carry the rest that cooperation with China must proceed despite real risks. It is a strategy that has worked well for Beijing in both economic and military realms.

A 29 September 2014 editorial in the prestigious *Aviation Week and Space Technology* noted, "It is absurd that the U.S. Navy can conduct joint exercises with the Chinese navy but Congress bars NASA from working directly with Chinese engineers and scientists." Well, to the shock of the U.S. Navy and its allies, when China accepted its first invitation to participate in the 2014 multilateral RIMPAC exercises, it brought along its own ELINT ship to record everybody's electronic emissions — a threatening response demonstrating essential hostility to the intent of inviting China's participation. This simply does not bode well for cooperation in space either.

To boot, the U.S., Russia and Europe all have had their sad experiences with Chinese espionage targeting their respective space sectors. According to the testimony of a Chinese solid fuel rocket motor engineer interviewed by this analyst, what they learned from the Martin Marietta solid satellite kick motor used on a Chinese SLV in the early 1990s has enabled all of their solid rocket motors for their new ballistic missiles now targeting the United States and its allies with nuclear weapons. Europe's Galileo navigation satellite program wanted China to be a partner, but when China obtained the technology it needed, it left and built its Compass system. At the 2007 Moscow Airshow, Russian space officials explained their attempt circa 1998 to promote business and cooperation by selling "internships" or access, to some 200 Chinese engineers, to

Russian space companies. The Russians did not sell space station tech to China, but they now know why the Chinese space station looks like theirs.

A simple reality for U.S. policy makers to keep in mind is that cooperation in space with China cannot be separated from China's ambitions on Earth or out into space. Likewise, for the United States to "wall off" space cooperation with China and to treat it as a "special" realm only plays into China's game. As long as it is ruled by the CCP, China is not likely to alter its ambitions to end the democracy on Taiwan, militarily consolidate the South China Sea, ensure that Iran and North Korea, like Pakistan, become nuclear missile states, or facilitate wars which challenge U.S. and Western security interests, merely to advance cooperation in space. It is imperative for U.S. leaders to accept that each of these challenges -- and countering China's expanding military ambitions in space --, are more important to U.S. security than is space cooperation with China.

Question 4: The Commission is mandated to make policy recommendations to Congress based on its hearings and other research. What are your recommendations for Congressional action related to the topic of your testimony?

1. Congress should request detailed information from U.S. sources about China's ambitions and activities in space. It is also crucial that the Congressionally-mandated annual Department of Defense report on the PLA contain a detailed section explaining China's space activities that bear on its military capabilities, and the related security concerns for the U.S. and its allies.
2. Congress should request that the Administration clarify with Chinese officials the recent disclosures that Chinese President Xi Jinping has personally ordered services of the PLA to prepare for space combat.
3. Congress should ask the Administration at what point in China's accumulation of active military space power does the United States respond with its own active military space capabilities to deter Chinese attack in space and to defend the space security interests of the United States.
4. Congress should ask the Administration to explain what are the security, political, and economic dangers to the United States of a Chinese military projection to the Moon and deep space.