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Contents

Editors' Notes:
The Space Security Dilemma

Bruce Blair and Chen Yali

In the pioneering space war games played in recent years by American military strategists at U.S. space control headquarters in Colorado, the United States and China occupied center stage in hypothetical confrontations that put them on a collision course in the exosphere. These games play on the fault lines that underlie their space relations in the real world, the key features of which include: the massive dependency of the U.S. military on space assets, both military and commercial; the globalization of commercial space services by multinational corporations operating partially outside the jurisdiction of sovereign nations; the recognition by Chinese strategists that space dependency is a potential Achilles heel of an otherwise overpowering U.S. military juggernaut; the resurgence of extreme worst-case threat estimation in U.S. intelligence assessments; the emergence of China as the leading candidate to replace Russia as the next designated super-rival of the United States; and flash points prone to spark military hostilities over competing vital interests.

The volatility of this mixture produces unstable results in war games. In these mental exercises, events tend to rush headlong into conflict. In one exercise, a confrontation over an unnamed island state in the Pacific, obviously a notional proxy for Taiwan, rapidly escalated from diplomatic crisis to limited strikes against space assets to nuclear war. Other forms of instability lurking in this brew simply shut down another exercise – as happened when the players managing a large-scale U.S. military intervention to defend Taiwan discovered that their forces' burgeoning appetite for commercial bandwidth for wartime military communications and reconnaissance operations vastly exceeded the available bandwidth. In this case, the notional adversary state, obviously representing China, managed to buy up long-term contracts with the multinational suppliers for the lion's share of their

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surplus commercial capacity, leaving only bandwidth crumbs for foraging U.S. forces. This deficit of cyberspace brought the U.S. military goliath's operations to a virtual standstill.

These war games point to latent tensions existing in the real world. Although that world today appears placid on the surface, the appearance is deceiving. Far from a vast expanse of tranquility, space is host to an expanding array of military operations and is becoming an arena of tension that mirrors earthly tensions among key nations. To avert the collision that this growing tension portends, the main interested parties – notably, China and the United States must squarely confront the adverse trends and devise new instruments of dialogue and cooperation.

This issue of *China Security* aims to facilitate this dialogue on space. Although it might not read like Western-style policy analysis featuring a wide diversity of perspectives, its literature reviews and articles by top Chinese (and American) experts on what is still an extremely sensitive topic in China offer a rare glimpse of the internal debate over the future of its space program. In China, policy debates among the real experts on such sensitive subjects are generally conducted behind closed doors. This special issue cracks open those doors by presenting the views of leading Chinese policy analysts.

Bringing Chinese voices into the Washington policy discourse, and into thoughtful conversation with their expert counterparts in America and elsewhere, is the purpose of *China Security*. By providing an open forum that informs and enriches understanding of Chinese thinking on critical matters of security, the journal hopes to attract an expanding cadre of contributing experts from China's think tanks affiliated with military, security, foreign policy, and academic institutions. By tapping into the diverse views that exist in these intellectual circles, the journal promises to foster a genuine dialogue that helps bridge the gap of misunderstanding between Chinese and American analysts.

As the articles in this issue show, such bilateral exchanges of information, views, and constructive proposals for cooperation have barely begun in the arena of space policy. The dialogue is oblique, long on rhetoric and short on information. The governments harbor deep-seated suspicions of each other's aims and capabilities, and until they manage to overcome their fears and doubts, serious progress toward accommodation will remain a long way off.

China and the United States find themselves caught in a cruel paradox: space collaboration represents the best hope for allaying mutual suspicion, by making their activities in space transparent to each other, but at the same time this suspicion militates against open collaboration. The vicious cycle only heightens their mutual suspicion, their aversion to collaboration and transparency, and their commitment to secrecy in order to hide exploitable weaknesses and vulnerabilities from a prying potential adversary.

For fortress America, embracing space collaboration with China would

also incur domestic political risks. In the current political climate, military unilateralism and superiority, however questionable or counter-productive, is the politically safer approach to national security. For China, the prevailing worldview sees a superpower striving for absolute security, a quest driven by fear or hegemonic ambitions that are impervious to reason. U.S. space policy might be the best illustration of America's drive for security at the expense of others' security. China's fear of becoming contained and 'encircled' by a hegemonic state and its allies is constant. Through the eyes of the Chinese military, space is the heart of an ongoing revolution in military affairs and has demonstrably served this 'containment' stratagem of the United States. The United States has enforced an unprecedented ban on exporting any space-related technology and commodities to China since 1999, but has steadfastly refused to have any meaningful dialogue with China either through an international forum or bilateral channels. This comprehensive isolation of China's space program confirms the belief and fear of many Chinese military strategists that the United States seeks to arrest China's progress in space in order to thwart its ability to revolutionize its warfighting technologies and win on the high-tech battlefields of the future.

A zero-sum mindset toward space is hardening in China as a result of this apprehension, as amply illustrated in the public media. Space is eyed in China as an area of resources and possibilities to be acquired before it's too late. Shu Xing, whose book is reviewed later in this journal, likens the grabbing of satellite orbits to the "Enclosure Movement" in late 18th Century England in which the more capability one has, the more resources one can seize. Another reviewed author argued that countries scramble into space to fight for the tremendous resources found there and "once this fight for resources causes irreconcilable conflicts, it may lead to radical space confrontations." A space war seems to many Chinese to be another form of resource war. Such urgency in seeking control over resources is not unique to space, but also applies to energy and other areas. Given China's population and rapid economic growth, controlling resources is understandably a paramount concern. Regarding space, however, a zero-sum ('win-lose') attitude is narrow-minded and misguided. If feverish competition for resources in space causes Sino-American relations to deteriorate or leads to the outbreak of war between them, then both parties lose.

Maj. Gen. Chang Xianqi and Sui Junqin of the PLA Institute of Command and Technology (aka. Armament Command and Technology Academy) offer a straightforward description of the aims of China's space activities over the next five to 20 years, and explain why perceptions or accusations of hidden military aims in China's manned space flight program (which sent two astronauts into space in October 2005) do not withstand logical scrutiny. They characterize the country's space mission as dedicated to advancing science and to supporting China's economic modernization. They dismiss two key allegations concerning the manned space program that the Shenzhou spacecraft's ability for mid-course

orbital maneuvering indicates a Chinese military effort to apply the technology to Chinese strategic missiles in order to give these missiles the ability to avoid U.S. missile defenses, and that China envisions its manned spacecraft as platforms for conducting real-time reconnaissance and intelligence collection for military ends. China's orbital maneuver technology, they note, is decades old and evolved independently of the U.S. missile defense program, while the inefficiencies of conducting surveillance from manned platforms compared to satellites are widely appreciated and have led other space-faring nations to choose satellites for this mission.

This is where Chinese and American interpretations strike notes in different octaves. Chang and Sui understand that security is as much a state of mind as it is a physical condition, and therefore emphasize, as many Chinese observers often do, the peaceful intention of the Chinese space program. By this logic, capabilities can be controlled, and lose relevance, if one intends to be peaceful.

American threat assessments, however, focus almost exclusively on real or potential capabilities. Because intentions can be easily changed, asserting peaceful aims carries little weight for Americans. Such assurances do little to assuage suspicions or downgrade threat projections. Also, since the late 1990s, the predominance of "hawkish" American attitudes toward potential threats has pushed the U.S. intelligence community to adopt extremely conservative criteria for projecting threat – for instance, by assessing an adversary's 'possible capabilities' instead of 'likely capabilities.' This is a throwback to the early Cold War habit of using 'greater-than-expected' threats as the basis for building up U.S. nuclear forces. 'Possible' threat is even more extreme than 'greater-than-expected' threat. In any case, there is nothing China can do to convince American worst-case analysts that China could not possibly adapt its dual-use space capabilities for 'possibly' posing military threats to the United States. There is no escape from this logic trap.

Chang and Sui's exclusive focus on China's manned space program sidesteps the more serious U.S. concern with the non-manned space program. In the former arena, the predominance of peaceful purposes in manned space activities is widely appreciated, but the possibilities of threats to U.S. space assets by the non-manned space program are much more pronounced, as Chang's other publication reviewed later makes abundantly clear. We cannot, however, fault Chang and Sui for neglecting an arena that occupies the center of Western suspicions toward China. The non-manned space program is beyond the scope of their article. For a comprehensive examination of both arenas, interested readers should consult Chang's ground-breaking book *Military Astronautics* (reviewed later in this journal in the book review section), which is the product of a Chang-led task force of the PLA on military space.

While the China space threat consists of a spectrum of possibilities, the U.S. space threat to China clearly goes beyond the realm of possibilities, Zhang

Hui at Harvard University contends in his article that examines threats from a Chinese perspective. Drawing on authoritative sources, he argues that the United States is unambiguously committed not only to exploiting space for military purposes, but also to controlling space by all necessary means including weapons deployed in space. The objective is not only to protect U.S. space assets, but to deny adversaries the use of space in wartime. In its most ambitious rendition, controlling space applies even to the transitory period of several minutes when an adversary's missiles are passing through space enroute to their wartime targets on enemy soil. This prospective role for U.S. space control weapons – shooting down an adversary's ballistic missiles – is the central concern of Zhang's analysis, as it represents the most serious threat to China's security. A space-based U.S. missile defense system, especially one designed to shoot down ballistic missiles during their several minutes of boosted flight after launch (boost-phase defenses), would pose the gravest potential threat by enabling the United States to neutralize China's strategic nuclear missile deterrent.

In some respects Zhang and many U.S. analysts understate the degree of potential threat to China by stressing the huge cost of the thousands of space-based interceptors needed to maintain an around-the-clock vigil of Chinese missile launches, and by stressing the relative ease by which China's missiles could punch holes in this defensive constellation. The understatement derives from the fact that a far less extensive galaxy of U.S. space-based interceptors would be needed if the United States could choose the moment for initiating hostilities as part of a preemptive offensive strategy. Even a constellation of dozens of interceptors could be decisive if the United States enjoyed the luxury of setting the terms of the onset of conflict and the interceptors were optimally positioned at that moment.

In Zhang's view, China could counter by deploying anti-space weapons designed to cripple the U.S. missile defense network, but such a step could ignite an arms race in space (and, we might add, create impulses to preemptively strike in space during a crisis). Alternatively, China could ramp up its arsenal of nuclear missiles and warheads to the point at which it would overwhelm the U.S. defense capability, but the downsides are numerous. A Chinese missile build-up could trigger nuclear reactions from India. If Pakistan follows suit, an arms race in South Asia could result. It could also require China to re-start its fissile materials production facilities and thereby unravel China's commitment to the multinational treaty calling for all countries to stop future production of such materials.

From a Chinese perspective, according to Zhang, the prospect of an unregulated military space environment is decidedly bleak, and warrants renewed efforts to ban space weapons. He analyzes various approaches to banning their development or deployment, and concludes that a focused approach that bans the deployment of weapons in space would offer the best solution from the stand-point of feasibility and of China's overall security. Zhang does not adequately

explain why banning space-based missile defenses, thereby ruling out layered defenses, the cornerstone concept of American missile defense architecture, would be politically palatable to U.S. planners. But Zhang does lay out a strong case that space weapons run counter to both Chinese and U.S. interests, and that their regulation through arms control would well serve both nations' interests. He can be forgiven for overlooking the fact that nations often adopt policies that are contrary to their own best interests.

As if to underscore Zhang's notion that America's pursuit of space hegemony ill serves its national security, Joan Johnson-Freese recounts the feeble effort by the United States to retard China's development of military space capabilities, only to stimulate China's indigenous space industry, drive European companies into closer cooperation with China, and hurt the U.S. aerospace industry on which the U.S. military increasingly depends.

Since the politically charged Cox Commission in 1999 accused China of stealing U.S. space technology, the United States has clearly telegraphed to China that it has no desire for bilateral cooperation. Beyond that clear message, however, Johnson-Freese views strategic communications between the two countries on space issues as dysfunctional in all the major dimensions of cultural understanding, constructive engagement, presentation of policy choices, and influence on attitudes and behavior.

A dialogue of the deaf has resulted in both sides talking past each other – a scene replayed repeatedly in U.S.-China strategic dialogues in areas as sensitive as space – as the United States seeks to extract information about specific Chinese technologies and programs, while China seeks to comprehend the strategic and tactical purposes of U.S. space programs. Technological transparency is anathema to the Chinese, whose co-mingling of their civil and military programs keeps them under a shroud of opacity, much to the frustration and chagrin of U.S. observers. As for intentions, the United States seems to be almost schizophrenic. One one hand, there are ample official denials of plans to deploy space weapons, denials supported by the very modest sums being invested in such weapons. On the other hand, current doctrine and war games clearly envision space as a battleground and China as the main opponent there. Johnson-Freese also characterizes as hypocritical the arguments made by the United States in which it describes its own pursuit of certain space technologies as non-threatening while alleging "offensive" and "nefarious" intent when the same technologies are pursued by China.

Out of this uncertainty, inconsistency, and unpredictability springs the near-universal tendency to err on the side of caution. The prevailing view on both sides, Johnson-Freese concludes in her hard-hitting critique of the state of Sino-American discourse on space, holds that space progress is a zero-sum game in which any advance made by either side is harmful to the security of the other side. In this psychological climate, it is unclear what if any space activity would

be considered non-threatening, and the unfortunate effect is to foster an almost irreversible momentum of escalating tensions over space. Before the momentum propels the antagonists across the Rubicon, she recommends that they redouble their effort to convey clear and consistent messages, improve the dialogue, and step lightly into cooperation in the non-threatening area of space science through strategic-level talks about the Bush Moon-Mars Initiative.

In spite of the bleak and deteriorating space relations between China and the United States, hope springs eternal in the essay by Sun Dang En, a research fellow of the Academy of Military Sciences. Sun's hard-nosed realism acknowledges China's uphill struggle to advance its progress in space and China's need for support from international partners, especially the United States, to fulfill its ambitious quest. Like Chang, he disputes the allegations about China exploiting its manned space flight program for military purposes, adding to Chang's points a rebuttal of the charge that the Shenzhou launch vehicle could be fitted with a warhead and serve as an advanced ballistic missile. Sun disputes this dubious charge on the persuasive grounds that this vehicle takes 20 hours to fuel (compared to U.S. and Russian missiles that are always ready for launch within minutes). He implies, correctly, that such lengthy preparations would be readily detectable and that a militarized Shenzhou rocket would be extremely vulnerable to a preemptive strike by U.S. or other forces. We (the editors) estimate that the combined surveillance, detection, and attack time of modern missile and aircraft forces in the U.S. arsenal is far shorter than the Chinese rocket's fueling time alone.

While rebutting allegations that China is advancing its military space program under the guise of a civilian mission, Sun acknowledges that Chinese opaqueness engenders suspicion: "At present, the main obstacle to Sino-U.S. cooperation on manned spaceflight is that the U.S. believes China's space programs lack transparency and are controlled by the military." Yet Sun finds cause for optimism in their space relations building upon recent friendly gestures such as the voluntary passing of information on space debris from the United States to China prior to the launch of Shenzhou VI. He calls upon both countries to expand their cooperation dramatically into a host of space activities dedicated to economic, human, and scientific development.

In the essay by Teng Jianqun of the China Arms Control and Disarmament Association, the specter of weapons in outer space looms large and eclipses the promise of international cooperation envisioned by Sun. Teng's military background doubtless frames his perspective on outer space as a future extension of the battlefield, and concentrates his mind on the extensive militarization of space that has already occurred: "Consequently, it is reasonable to assume that the development of human productivity will ineluctably bring war from land, sea and air into outer space if no constraints are placed on it."

Having tracked the growing dependence on space technology by the

militaries of the world, Teng accepts the prevalent military view that whoever controls outer space will also control the Earth. Military competition for the high ground coupled with rapid advances in space and information technology will culminate in the fielding of weapons in outer space.

By concluding that space weaponization is inevitable and thus defying somewhat the official policy line, Teng speaks from the camp of hard-core realism that is heard only in Chinese academic publications (such as *Military Astronautics*, in which Chang's task force of senior military officers reached the same conclusion), if at all. Teng urges China to shed its passive mindset of denial, recognize the real-world trend, and pursue a policy path that seeks to slow, confine, and shape the future contours of space weaponization by means of effective rules of the road in outer space.

Teng's rather fatalistic prognosis is thus tempered somewhat by his conviction that the international community can delay, channel, and otherwise regulate this inexorable extension of the battlefield into space. In fact, he considers this form of international space cooperation – a non-proliferation regime applied to space weapons to nip proliferation in the bud – to be an urgent priority for the international community. In Teng's view, the prospects for successfully regulating the security environment in outer space hinges upon an early start in identifying, limiting, or banning the application of certain technologies to military missions in space. Dual-use technology with space applications is especially important to control in its infancy. Once these technologies mature and occupy outer space, the ability to regulate them will be infinitely harder. A key difficulty is anticipating the nascent weapons technologies and defining their characteristics well enough to subject them to arms control limitations. Teng's reading of the tea leaves envisions, in very broad outline, a new space battleground in which space and information technology merge – a space and digital arena expanding war into an "electromagnetic space" featuring "digital troops", information weapons, and other cybernetic elements of a computer space war. Future work by Teng will hopefully flesh out more of the details of the pertinent technologies and the arms control agenda needed to subdue them.

Denying technologies to thwart China's development of space and missile capabilities has been a paramount aim of U.S. policy toward China since the 1990s, but the policy has proved unsuccessful, according to Guo Xiaobing of the China Institute for Contemporary International Relations. America's attempt to block China's access to U.S. space technology – notably, by restricting the export of U.S. commercial satellites to China for launch by Chinese rockets, and by requiring foreign exporters to conform to U.S. export regulations if their products contain sensitive U.S. parts – severely hampered China' space program for several years. But China has outmaneuvered the sanctions by developing an indigenous space capability and by forging new partnerships with Europe and around the world, pulling itself out of its temporary doldrums. It appears that many nations, ranging

from Europe to Russia to Brazil, regard the American policy of isolating China's space program as draconian, and the export restrictions as excessive, and have reacted by forming new business relations and joint space exploration projects. The key common denominator of this newfound business cooperation among Russia, China, India, Japan and Europe is the avoidance of U.S. components and U.S. satellite export restrictions.

This sweeping, isolationist U.S. export policy may be inflicting even greater damage to U.S. space companies than to Chinese enterprises. Guo cites statistics indicating that the export restrictions have allowed overseas business competitors such as European satellite components suppliers to flourish while U.S. satellite companies watched their market share plunge. Guo's account of how the unintended consequences of U.S. export policy have harmed its business interests is thought-provoking. He makes a good case that Sino-American space cooperation and a loosening of export restrictions would well serve the interests of both countries.

Guo categorically dismisses the rationale given for blocking space technology exports. He finds no merit whatsoever in the claim that China would steal technology secrets with a view to enhancing its military and missile capabilities. The policy is instead portrayed as stemming from a false indictment of China – one built on exaggeration, political exploitation, a desire to retard China's general economic and military development as well as its space and missile development, and groundless suspicions bordering on paranoia. The article does not close the case, however. If history is a story without end, then this export policy remains open to historical interpretation on any number of levels.

The probable historical reflection on this export policy is that in the end it proved to be a minor drag on Chinese space growth, a minor footnote in a story of rapid expansion of China's commercial and military space program. The dominant narrative of this story will not be U.S. export policy, but rather U.S. space weapons policy and its dynamic interaction with Chinese space interests and apprehensions. The dénouement of this story also has yet to be written, and there exist a number of alternative endings ranging from active cooperation and peaceful coexistence to antagonism and aggression.

Drawing on an extensive set of Chinese- as well as English-language sources, Eric Hagt of the World Security Institute delves deeply into all of the story strands appearing in this journal's collection of articles and weaves the strands into a persuasive tale of two powerhouse nations on a collision course in space. Hagt provides a comprehensive account of China's heady commercial expansion and ambitions in space, and its growing reliance on dual-use space assets for its economic development and military strength. This growing dependency creates a growing vulnerability. As commercial space assets and operations are becoming indispensable to China's economic and military security, they will need to be protected with no less diligence than how America pursues its own

space security. China views a ban on space weapons as one partial answer to the growing vulnerability that attends China's growing dependence on space, but the political feasibility of such a treaty appears strongly in doubt given the U.S. rejection of this option. In Hagt's view, U.S. opposition to a space weapons ban, (eds. note – already strong because of American desire to preserve its options for space-based missile defense), may indeed stiffen as the opaque dual-use Chinese space program continues to expand and seek its own guarantees of protection.

Apart from an official policy of advocating a ban on space weapons, China has not revealed how it will respond to space weaponization if the United States indeed takes that historic step. Hagt distills the thinking found in the literature written by serious military scholars on space and concludes that the Chinese response to the threat posed by the United States in space features a distinctly defensive orientation that emphasizes protecting Chinese space platforms from U.S. offensive attack – for example, past or anticipated efforts to improve satellite hardening, encryption, anti-jamming, maneuverability, redundancy, and rapid replacement. This accretion of Chinese defensive capabilities, coupled with military space operations involving reconnaissance, communications, and navigation, certainly contribute to the militarization of outer space, however. Questions also linger about China's next steps, questions magnified in Western minds by the secretiveness of the entire Chinese space program. The prospect of a Chinese offensive space orientation, driven by China's sense of vulnerability, cannot be ruled out. (As these editors discuss later, a purely offensive Chinese space strategy designed to cripple critical U.S. space assets and thereby diminish U.S. regional warfighting capabilities also cannot be ruled out.) Hagt spins out a relatively mild form of the classic action-reaction phenomenon between two rational actors entwined in a security dilemma and self-escalating arms race. Hagt's scenario features Chinese defensive and American offensive interactions in space, a defense-offense arms spiral that has been observed often in other military contexts. In a twist of the classic arms spiral, however, Hagt explains how China's successful commercial sector growth in space creates demands for protection and pushes China in the direction of space weaponization.

China's military establishment appears to fully embrace the view that operating from space is crucial to modernizing its earthly military capabilities, and cannot fail to notice the many signs of American determination to dominate space in the event of conflict. The standard military response would normally be to devise ways to both passively and aggressively deny the United States the ability to deny China its use of space during hostilities. Hagt focuses on the passive end of the spectrum. But to these editors, if diplomacy fails and China seeks military answers for space protection, then the normal progression of protective measures would include offensive operations ranging from jamming to attacking U.S. satellites with anti-satellite (ASAT) weapons. It seems to us that the Chinese military would be inclined to consider carefully, within the parameters allowed by

their political superiors, the merits of an anti-satellite capability.

The opaqueness of the Chinese effort in this arena precludes a definitive estimate of progress toward the actual development of such an option. A suspicious Western observer might cite, as Hagt notes, the refusal of China to endorse a no-first-deployment of space weapons as a possible indication of a Chinese contingency plan for a 'break-out' of anti-satellite weapons in the event that this security dilemma crosses the tipping point of restraint and triggers a full-scale arms race in space. Hagt correctly notes that the Chinese would perhaps not wish to dignify such suspicions if in fact they have no intention of pursuing space weapons, but his assertion that a no-first-declaration could remedy suspicions can be questioned. While it may be plausibly credible to many nations, it would ring dubious in U.S. military circles. China's diplomatic assurances of its commitment to the peaceful use of space also ring somewhat hollow in the face of the steady Chinese militarization of space, and the Chinese military's certain need to protect both the commercial and military assets on which it increasingly depends.

As Hagt notes, however, the pernicious security dilemma in which China finds itself can negate its best efforts to protect itself in space. China's active pursuit of self-defense in space can be self-defeating if those pursuits only trigger a stronger countervailing reaction by the United States. China must strike a delicate balance between protective effort and restraint, at least as long as the behavior of the United States partially depends on Chinese behavior. It is an open question, with huge implications, whether the United States is committed to maintain absolute dominance in space – the ability to fully protect its own space assets while totally denying an adversary any use of space. If space hegemony is its goal, then Chinese restraint is practically irrelevant, Hagt believes, although we (the editors) believe some agreed rules or norms for crisis management and operational restraint may still have utility in averting conflict. If some lesser degree of unilateral space security is an acceptable U.S. goal, and the challenge for both China and the United States is to escape the security dilemma that presently have them trapped, then a number of cooperative ventures to avert space weaponization could be recommended. Hagt presents a number of good ideas in this vein.

In Hagt's article and much of the germane Chinese literature, the primary motivating rationale for China's military space program is to create a force-multiplying effect on China's ground, sea, and air forces to strengthen their ability to defend Chinese territory and win regional conflicts. As part of this rationale, Chinese space assets must be protected and defended lest the force-multiplying factor dissipates to zero. We (the editors) would add that this protection and defense does not rule out an offensive component meant to deter or thwart an adversary's effort to suppress China's space operations. For instance, a Chinese capability to degrade U.S. satellite communications or surveillance might be developed with a view to deterring U.S. attacks on Chinese satellites.

We have reason to believe that the actual thrust of China's space strategy and technological development is defensive in nature and orientation. However, both the U.S. thrust toward space weapons and the state of Sino-U.S. strategic relations could alter the future direction of China's space program. A certain body of Chinese literature indicates another possible offensive mission for the future Chinese space program: attacking an adversary's space assets in order to diminish its regional warfighting capability. Delivering a sharp and possibly crippling blow to an adversary's ground, sea, and air forces that depend heavily on those assets to conduct operations could have decisive consequences.

If China and the United States unfortunately stumble into a war over Taiwan, the Chinese military, we believe, may be driven to conduct offensive space operations – cutting the adversary's forces' umbilical cords to space, and depriving them of their force-multiplying assets. Chinese strategists steeped in Chinese military traditions are acutely aware that space infrastructure could be an adversary's Achilles Heel, and that an inferior space power may prevail in conflict if it manages to sever those critical tendons. Given that asymmetrical warfare is axiomatic in the Sino-American context, the weaker Chinese side, we believe, would have ample reason to design and utilize offensive weapons such as ASATs in order to degrade critical U.S. space support, by jamming U.S. communications and blinding U.S. sensors, or to cripple them using blunt (nuclear weapons detonated in space) or surgical instruments (attack satellites). Such offensive anti-satellite operations would be conducted for reasons quite removed from the issue of self-protection from adversarial threats. They would be purely offensive in nature.

It is an open question whether this form of asymmetrical offensive space warfare resides exclusively in the realm of Chinese strategic thought, or has advanced beyond theory into practice. According to Hagt, the preponderance of evidence available in the open literature suggests that China's exploration of technologies relevant to anti-satellite weapons – kinetic energy vehicles, ground-based lasers and radars, and high-powered microwave transmitters involves theoretical or basic research only. Hagt challenges allegations to the contrary, such as the Pentagon's 2005 report to Congress asserting that "China is working on, and plans to field, ASAT systems" on the grounds that no evidence exists of China testing or deploying any anti-satellite weapon, or intending to do so.

If Hagt is wrong, and the Chinese intend to take a great leap forward into offensive space warfare technology, then he is right about the adverse unintended consequences of the security dilemma. The two sides may find it impossible to extricate themselves from the escalation dynamics of their predicament in space in an era of revolutionary military technologies and asymmetrical warfare. At this stage of space warfare development, however, the Sino-American relationship still stands on the unweaponized side of the abyss, and neither side appears quite ready to take the leap.

The Chinese caution against shifting from a defensive to an offensive orientation in space appears to stem not only from a strategic calculation that the national interest lies in restraint, and in restraining the United States from embarking on an offensive quest. As Wu Chunsi's and Hagt's essays reveal, China's economic reforms have worked to severely dampen Chinese military ambitions in space in favor of dual-use commercial technology. Such dual-use technology is poorly suited to confer significant offensive military capability, in our (the editors) assessment. Capable offensive weapons generally cannot emerge as a serendipitous by-product of commercial space pursuits. On the contrary, such weapons must be designed to meet military specifications and missions, and little valuable commercial by-product would be derived from this military-driven process.

So the die was cast long ago when China's national strategy subordinated military development to economic development, gave precedence to domestic policies over external challenges, and required China's space program to serve economic goals first and foremost. It seems incredulous to American security analysts (or Russians for that matter) that any national strategy would not define security as its predominant requirement, but as Wu Chunsi of Fudan University persuasively asserts: "Military and security considerations are certainly important to any country, but they are not the first priority in the current Chinese grand strategy." That amazing statement reflects a deliberate choice made by the Chinese leadership some 30 years ago to undertake a sweeping reform program that in effect commercialized many defense industry sectors, including space.

The wholesale reconfiguration of China's space sector thus resulted in civilian, commercially competitive technologies with marginal military applications. Its re-institutionalization and restructuring that continues to this day all but precluded any ambitious military projects or planning for space warfare because the Chinese military was stripped off its previously predominant influence and, in our view, relegated to a distant secondary status in the hierarchy of priorities. This institutional history preordained an inherent technological tilt toward commercial applications that at best allow for minor military defensive-protective measures to evolve alongside. In broader terms, as Wu puts it, "…a large portion of the civilian space program, in terms of the technological sophistication, thus is not useful in modern military terms." At the same time, she implies that the opportunity to pursue dedicated military space weaponry, let alone modern offensive space weapons, has been severely constrained.

This tectonic shift three decades ago was allowed by an improving security environment for China, Wu notes. Receding threats to China from the Soviet Union and the United States opened the window of opportunity for economic reform. As both Wu and Hagt explain, this process of forcing the space sector to transform and compete in the marketplace drastically altered the entire Chinese program. The divestment of the military from commercial activities across the board, including the space sector, since 1999 has created new opportunities and

incentives for international collaboration. In theory (the editors'), Sino-American space cooperation should have deepened rather than frozen. However, the U.S. Cox Commission report engendered an effort to isolate China's space program. Wu remains convinced of the benefits of space cooperation. Many Chinese analysts particularly emphasize the U.S. Mars initiative as a new starting place for Sino-U.S. space cooperation. Deeper integration with the international community would help further separate China's commercial space industry from the military, she contends. Conversely, the continuing isolation of China's space sector has the opposite effect, and may rejuvenate military influence. And although "China does not have the luxury to engage in a military competition with superpowers in space or in other areas," Wu believes that "we now stand at the threshold of space weaponization" and urges the international community to act quickly "to establish a system of rules to manage and coordinate space activities."

The deployment of space weapons by any nation would cast a dark cloud over the future security of China and the world. The Chinese authors in this volume seem quite united in their view of the need to avoid crossing this threshold, and instead revive a spirit of international cooperation in space. That call, we believe, is sincere and places the ball in America's court for now. China bears some responsibility, however, for clarifying its program, making its technologies as well as intentions more transparent, and encouraging both military and civilian policy analysts to study and debate publicly. China needs to address squarely how space will be used to strengthen its national security, and explain how exchanges and cooperation with the United States and others in space projects will not be exploited to obtain potential advantage over those partners. China and the United States should open new venues for dialogue at different levels, and build confidence through cooperation in apolitical matters such as data sharing in debris monitoring. The Chinese view of the paramount importance of the politico-strategic intentions behind space cooperation has merit. If China and other space-faring nations intend to pursue the peaceful use of space and seek cooperation for the benefit of mankind, then the time is ripe to reopen a constructive agenda of action as well as talk.

Active Exploration and Peaceful Use of Outer Space

Chang Xianqi and Sui Junqin

Introduction

China's manned space began more than 40 years after those of Russia and the United States. In 1992, China formally began implementing its manned space flight project which reached a major milestone in November 1999 with the successful launch and recovery of Shenzhou I – an unmanned experimental spacecraft that demonstrated China's grasp of the basic technologies needed for manned space-flight. The project culminated in China's first manned flight with the Shenzhou V mission, launched in October 2003 – making China the third country in the world to carry out an independent manned space mission. And on Oct 12, 2005, Shenzhou VI conducted a two-person, multiple-day space flight experiment, another major step forward.

The smooth development of China's manned space program with its consecutive successful experiments, and in particular the success of Shenzhou VI, has attracted much attention and praise from the world. The peaceful purpose of the Chinese government's space exploration is beyond doubt. Actively exploring and peacefully using outer space are the basic principles upon which China is developing its space program.

Technology and Science in Space

China has made significant contributions to human progress in science and space exploration through its development of space technology and many scientific experiments in space.

The primary goals of China's manned space flight tests are to conduct Earth observation from space, space science research, and technological experiments. The science performed in the course of the various Shenzhou flight tests therefore primarily emphasizes the following two missions:

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First, there is the mission of Earth observation, which includes both orbital experiments and application activities. The aim of this mission is to develop advanced space-based remote sensors at a pace matching international developments, and to expand research on Earth sciences. Remote sensing research utilizes optical spectrum and microwave technologies for studying the ocean, land and air.

Technologies utilized include, for example, moderate resolution imaging spectroradiometry (MODIS), multi-mode microwave remote sensing (including microwave altimetry, radiometry, and scatterometry) and Earth environment monitoring, as well as research into other remote sensing applications. Earth environment monitoring includes solar constant monitoring, solar and Earth ultraviolet radiation monitoring, and Earth radiation budget exploration.

Second, there is China's mission of space science research, which covers space life science, microgravity science (including projects on space material science and microgravity fluid physics), space astronomy projects, and space environment forecasting and monitoring tasks.

The space life science and technology research develops equipment intended to explore the fields of space biological effects, space crystallization of protein, space cell cultivation, space cell electro-fusion, and isolation and purification of biopolymers. The space material science effort aims to develop multi-position crystal growth furnaces and observation equipment for studying crystal growth. This includes research both into materials for space use (such as binary and ternary semiconductor optoelectronic materials, transparent oxide crystals, metals, alloys and so on) and crystal growth in space, including space crystal growth kinetics. The space environment forecasting and monitoring project includes research for the Space Environment Forecast Center, which will provide space environment forecasts for the long, medium and short terms, as well as research intended to predict effects on astronauts, manned spacecraft and space equipment.

Viewpoints on Shenzhou

China's successful launches of the Shenzhou series spacecraft have drawn a great deal of attention from around world. Most people are impressed and delighted by the contributions and brilliant achievements that China has made in space exploration, but there are also those who are critical and view China's active development of space flight as having military intent. Regardless of the attitude of outside observers, the fact that countries all over the world are focusing on, and want to learn more about, China's space program is a positive thing.

Negative views of China's space program primarily reflect concerns about the following two aspects, which require analysis and discussion to promote understanding.

Orbital Maneuvering Technology and the Threat of Missile Penetration

In the view of some, the Shenzhou missions, with their orbital changes in mid-course, are signs that China has grasped technology that can be used to counter the U.S. missile defense system. Some argue that the Shenzhou missions proved that after the spacecraft enters its orbit, it can be rotated even with a low-rate propulsion system. Thus, the thinking goes, China could apply this technology to its intercontinental ballistic missiles (ICBMs) – that is, if an enemy tries to intercept a missile from China, the missile could change its trajectory to avoid interception. This would mean that Chinese ICBMs would be able to evade the U.S. missile defense system.

Actually, the orbital maneuver technology used for manned spacecraft is the same as that used for satellites. It is not a new technology. In the late 1970s, China had already successfully launched and retrieved satellites. Since that time, Chinese orbital maneuver technology has been very sophisticated – even prior to the inception of the U.S. Strategic Defense Initiative. If this capability is truly a threat to the U.S. missile defense system, then that threat preceded the Chinese manned space program. Moreover, major space-faring countries such as the United States and Russia grasped this technology ahead of China.

In regard to the U.S. missile defense program, China opposes an arms race in any form. This position is evident in its consistent and strong support for the non-weaponization of space. China is willing to work with other nations to prevent the deployment of weapons in space by any country or region. If the United States ultimately chooses to deploy weapons in space, it will be profoundly regrettable; however, it will have no impact on China's space program, particularly its manned space program. Regardless of circumstance, China will continue to resolutely uphold its defense-oriented national defense policy, and continue to explore and utilize outer space for peaceful purposes.

Manned Space Flight and the Threat of Ground Reconnaissance

An article published on *Spacedaily.com*, a U.S. professional aerospace website, said "Shenzhou has carried surveillance payloads in the past, and the presence of a crew on a long-duration flight presents an excellent opportunity for advancing this type of mission." [1]

The report further stated that "crews on Soviet and Russian space stations have routinely used high-resolution film cameras to monitor the Earth beneath them, and China could be planning to do the same." A report from Japan's *Sankei Shimbun* said that Shenzhou VI can obtain observation data on 80 percent of the Earth's surface, and explore military installations and underground resources of other countries to some extent; thus, China's intelligence-gathering capacity would be improved considerably.[2] Further, the report noted, if China establishes a space station, most countries will be perpetually under Chinese observation.

Two problems exist in the viewpoints mentioned above. First, it is un-

necessary for China to use a manned spacecraft in order to undertake reconnaissance. Unmanned space vehicles can, of course, observe the ground from space; this is one function of China's application satellites, e.g. meteorological, resource observation and disaster monitoring satellites. China has possessed this technology for a long time, and it can be deployed entirely on satellites. Thus, it is not necessary to perform ground observation by manned spacecraft with limited payloads.

Second, singling out China for such attention is illogical. Nations other than China have utilized Earth observation capabilities for reconnaissance purposes. Furthermore, the major space-faring powers launch numerous Earth observation satellites each year and their precision is improving. Do these not pose larger threats to the safety of other countries? In addition, there are other countries that have carried out manned space flights for many days and also have space stations in orbit year-round. Do these not also pose greater military threats to other countries? This rationale is analogous to stating that a sovereign country has no right to possess Earth observation technology.

Compared with China's other space programs, its manned space project plays a vital and highly unique role. Enormous scientific and economic value can be derived from its continued development, which will produce long-term economic benefits. The program also has great political significance in its ability to inspire national spirit, pride, confidence and unity in the Chinese nation.

As was explained above, the technologies adopted in China's manned space flight program, including the Shenzhou series spacecraft, are essential for conducting space experiments. These experiments are aimed at developing basic technologies to be utilized for the peaceful exploitation of space. A reliable and accurate launch vehicle, with its fault self-detection systems, escape system as well as spacecraft orbital maneuver technology are capabilities that were mastered by the United States and Russia long ago. It is obvious that assertions judging China's manned spacecraft program as a military threat are baseless.

This is not to suggest, however, that the space program cannot improve China's national security in a number of ways. First, space technology, and its development, can facilitate the transformation of national economic structures, stimulate the growth of new commercial sectors, and enhance comprehensive national strength.

In addition, space capabilities, due to their inherent dual-use applications (such as Earth surveillance, navigation and positioning), possess a strong deterrent value. They can prevent an opponent from acting rashly during a national security standoff. In the event of war, space-based support functions – such as Earth surveillance, navigation and positioning – will greatly improve the efficiency and effectiveness of China's weapon systems.

Future Development of China's Space Mission

China will persist in taking the road of peaceful development and unswervingly pursue a national defense policy that is defensive in nature. The development goal for China to strive for in the first 20 years of this century is to build a moderately prosperous society. China will mainly rely on its own strength for development, and therefore poses no obstacle or threat to any one. China needs a peaceful international environment for its own development, which in turn will enhance peace and development in the world.

The Chinese government has long seen its space mission as an important part of its overall development strategy, and has consistently adhered to the goal of exploring and utilizing outer space peacefully for the benefit of mankind. China's basic task as a developing country is to build its economy, continuously modernize and boost overall national strength. The important position and role of space activities in safeguarding national interests and implementing national development strategies determine the specific goals for China's space mission.

With regard to bolstering national strength, the development of 'micro-technology,' particularly microelectronic technology, has led to the birth of small and micro-satellites, which will continue to play a key role in China's space program. Employing the new design concept of miniaturized satellites, scientists can reduce construction time while lowering the cost and risk of R&D. Thus, miniaturized satellites can be mass-produced more easily and along with their capacity to operate in constellations, have demonstrated superior operational capability.

Demonstrating rapid sector growth and widespread application, small and micro-satellites are highly valued by the space sector both in China and abroad. From 1985 to 2000, 660 small satellites were put into orbit worldwide, half of which were micro-satellites. This percentage has been growing with recent progress in aerospace technology. As a key player among the world's space-faring nations, China has also attached great significance to the development of micro-satellites. In fact, China has already begun the research, development and deployment of a series of small and micro-satellites.

However, China will continue to adhere to a defense-oriented national defense policy. Its exploration and utilization of space, including the development and application of micro-satellites, is for peaceful purposes only. China's fledging micro-satellite capabilities are expected to make significant contributions to the civilian field of satellite telecommunications, environmental disaster monitoring, scientific experimentation and high altitude surveillance. In this way, China will be able to facilitate economic growth while enhancing its national strength.

Currently, however, China does not have any plan to use micro-satellites as anti-satellite weapons. This appears to hold true for future defense planning as well. Like many new high technologies, small and micro-satellites are typical dual-use technologies with military and civilian applications. Since China is

neither the first country to possess this technology, nor the country with the most advanced technology, it seems incomprehensible that China should cause concern to others.

Short-term Goals

The 21st Century will be a time when world space activities will thrive. Developments planned for China's space program in the near-term (approximately the next five years) include:[3]

- To build up an Earth observation system for long-term stable operation. The meteorological satellites, resource satellites, oceanic satellites and disaster monitoring satellites can develop into an Earth observation system for long-term stable operation to conduct stereoscopic observation and dynamic monitoring of the land, atmosphere, and oceanic environments of the country, the peripheral regions and even the whole globe;
- To set up an independently operated satellite broadcasting and telecommunications system. Positive support will be given to the development of commercial broadcasting and telecommunications satellites such as geo-stationary telecom satellites and TV direct broadcasting satellites with long operating life, high reliability and large capacity, so as to form China's satellite telecom industry;
- To establish an independent satellite navigation and positioning system. This will be achieved by setting up a navigation and positioning satellite group step by step and developing a relevant application system, which will eventually bring into being China's satellite navigation and positioning industry;
- To upgrade the overall level and capacity of China's launch vehicles. This will be achieved by improving the performance and reliability of the "Long-March" group, developing the next generation of launch vehicles with non-toxic, non-polluting, high-performance and low-cost qualities, forming a new group of launch vehicles and strengthening the capability of providing international commercial launching services;
- To establish a coordinated and complete national satellite remote-sensing application system by building various related ground application systems through overall planning, setting up a remote-sensing data receiving, processing and distributing system covering the whole country for data sharing, and forming a fairly complete application system in major application fields of satellite remote-sensing; and
- To develop space science and explore outer space by developing a scientific research and technological experiment satellite group of the next generation, strengthening studies of space micro-gravity, space material science, space life science, space environment and space astronomy, and carrying out pre-study for outer space exploration centering on the exploration of the Moon.

Long-term Targets

Long-term (approximately the next 15 years or more) development goals include:

- To achieve industrialization and market share of space technology and space applications. The exploration and utilization of space resources shall meet a wide range of the demands of economic construction, state security, science and technology development and social progress, and contribute to the strengthening of the comprehensive national strength;
- To establish a multi-function and multi-orbit space infrastructure composed of various satellite systems and set up a satellite ground application system that harmonizes spacecraft and ground equipment to form an integrated ground-space network system in full, constant and long-term operation in accordance with the overall planning of the state;
- To realize manned spaceflight and establish an initially complete R&D and testing system for manned space projects; and
- To obtain a more important place in the world in the field of space science with further achievements and carry out exploration and studies of space according to China's condition and needs.

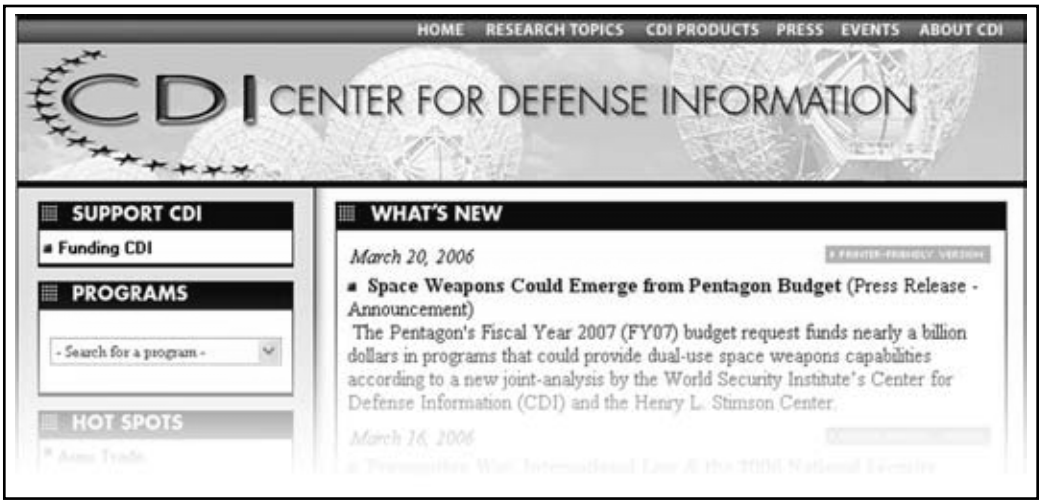
Conclusion

Like all other sciences and technologies that have contributed to human progress, that of space can promote peace and bring prosperity to mankind if peaceful forces utilize it. If terrorist or extremist forces control it, it may pose an enormous threat to the survival of mankind. Therefore, determining the military threat of space development involves two fundamental issues: the issue of technical know-how as well as policy motives.

As an important force for peace in the world, China pursues an independent and peaceful foreign policy. China is modernizing its national defense to satisfy its most basic needs to avoid being at the mercy of others. China is among the most avid supporters of the peaceful application of outer space and has, on numerous occasions, advocated against space weaponization at the United Nations. The policy motive of China in developing space technology is to observe, understand and conquer nature to better benefit mankind. China's mastery of manned space flight technology is not a threat to anyone. Rather, it is a significant step in using high technology to advance world peace and progress of the Chinese nation.

Endnotes

1. Morris Jones, "Weighing Up Shenzhou VI," at *Spacedaily.com*, Sept. 27, 2005. See: http://www.spacedaily.com/news/china-05zzzzzzzr.html.
2. Cheng Gang, Li Runtian, Zhang Lixia, Zhou Dehao, "The Shenzhou VI Poses No Military Threat", *Global Times*, Oct. 24, 2005.
3. This section is comprised of excerpts from: "*White Paper: China's Space Activities*", The Information Office of the State Council of the People's Republic of China, November 2000.



Space Weaponization And Space Security: A Chinese Perspective

Zhang Hui

China has seen much evidence to suggest the movement by the administration of U.S. President George W. Bush toward space weaponization is real. A number of U.S. military planning documents issued in recent years reveal the intention to control space by military means. In practice, the United States is pursuing a number of research programs to enable the development of space weapons, which could be used not only to attack ballistic missiles in flight but also to attack satellites and targets anywhere on Earth. Chinese officials have expressed a growing concern that U.S. plans would stimulate a costly and destabilizing arms race in space and on Earth, with disastrous effects on international security and the peaceful use of outer space. This would not benefit any country's security interests. Beijing believes the most effective way to secure space assets would be to agree on an international ban on weapons in space.

In what follows, I first examine briefly why China says *NO* to U.S. space weaponization. I then explore in detail preventative measures that can be taken.

Why China Says *NO* to U.S. Space Weaponization

China has a number of major concerns about the current direction of U.S. military space efforts. For example, China is worried about how U.S. space weaponization plans might affect Chinese national security, international security, and protection of the space environment.

China's concerns about U.S. actions

Many Chinese officials and security experts have great interest in U.S. military planning documents issued in recent years that explicitly envision the control of space throught the use of weapons in, or from, space to establish global superiority. In its 2003 report, "Transformation Flight Plan," the U.S. Air Force lists a number of space weapon systems desirable in the event of a space war.[1] These include space-based kinetic kill vehicles, space-based lasers (SBL),

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hypervelocity rod bundles, space-based radio frequency energy weapons, space maneuver vehicles, and the Evolutionary Air and Space Global Laser Engagement (EAGLES) laser relay mirror. In 2004, the Air Force showed clearly in its *Counterspace Operations Doctrine* document what it actually intends to do: that is, achieve and maintain *space superiority*, – the "freedom to attack as well as the freedom from attack" – in space.[2]

In practice, the pursuit of controlling space would require anti-satellite (ASAT) weapons to negate an adversary's space capabilities. It is believed that the current Ground-based Midcourse Defense (GMD) system deployed in Alaska will have a significant intrinsic capability for ASAT use. Thus, it is reasonable to argue that one true purpose for the Bush administration's rush for the GMD deployment could be to acquire an ASAT capability for its space control strategy. The scope of space weaponry, generally accepted by many Chinese includes not only weapons stationed in outer space, but also weapons based on the ground, at sea or in the air that target objects in outer space. Outer space objects, in the Chinese definition, include not only satellites but also ICBMs traveling through outer space.[3] Since the GMD system would intercept its target in outer space, it could be seen as a space weapon. Moreover, the GMD system could be the first step toward a more robust, layered system for space control. Consequently, China feels that U.S. plans to deploy a missile defense system is an intentional first step toward the weaponization of space.[4] In addition, the United States also pursues a number of other research programs that could lead to ASAT weapons. For instance, the Air Force has a research project to test small satellites, the Experimental Satellite Series (XSS), that could be used to attack other satellites.[5]

Further, the United States is pursuing space-based ballistic missile defense (BMD) for global engagement capabilities. It is believed that an effective, global-coverage BMD system must start intercepting an ICBM as early as the boost phase, which, under U.S. Missile Defense Agency plans, would entail the use of space-based interceptors. Indeed, the current U.S. budget for missile defense shows continued interest in a number of space weapon-related programs, such as the Near Field Infrared Experiment (NFIRE) satellite and Space-Based Interceptor Test Bed.

The United States does have legitimate concerns about its space assets, given that U.S. military operations, economy and society are increasingly dependent on space assets and such assets are inherently vulnerable to attacks from many different sources. However, it does not mean that the United States currently faces credible threats from states that might exploit those vulnerabilities.[6] Further, space-based weapons cannot protect satellites, since these weapons are also vulnerable to many types of attack, similar to the satellites requiring protection. The true aim of U.S. space plans is not to protect U.S. assets but rather to further enhance American military dominance. Prof. Du Xiangwan, vice president of the Chinese Academy of Engineering, recently presented his view that

the *Transformation Flight Plan* indicated that "many types of space-based weapons will be developed," and "the tendency toward space weaponization is obvious and serious." He further noted that military dominance on Earth is not enough, "the U.S. also seeks to dominate space."[7] Beijing fears that by unilaterally developing missile defense systems and pursuing space weaponization, the United States is seeking to establish a global military superiority using both offensive and defensive means.[8] Moreover, China's fears about U.S. hegemonic tendencies are exacerbated by the fact that space weapons, due to their vulnerability to other less expensive, asymmetric measures, are inherently first-strike weapons. [9]

Neutralizing China's nuclear deterrent

In particular, China is concerned that the U.S. missile defense network will undercut China's strategic nuclear deterrent. Even a limited missile defense system could neutralize China's fewer than two dozen single-warhead ICBMs that are capable of reaching the United States. China is even more concerned about space-based BMD systems that would be far more dangerous to China's nuclear deterrent than a non-space-based BMD system. In addition, Beijing is worried that the deployment of missile defense systems would further promote a preemptive U.S. military strategy.

As viewed by Chinese leaders, China's own small strategic nuclear arsenal appears to be a plausible target for U.S. missile defenses.[10] China fears that the BMD network would give the United States more freedom and power to intervene in its affairs, including undermining the country's efforts at reunification with Taiwan. Moreover, China is concerned that putting weapons in space would constrain its civilian and commercial space activities. China sees itself as a developing economic space power, dependent on free access to space for financial gain. However, U.S. driven space weaponization directly threatens this access.

Arms race

Due to the threatening nature of space weapons, it is reasonable to assume that China and others would attempt to block their deployment and use by political and, if necessary, military means.[11] Many Chinese officials and scholars believe that China should take every possible step to maintain the effectiveness of its nuclear deterrent. This includes negating the threats from missile defense and space weaponization plans.[12] In responding to any U.S. move toward deployment space weapons, the first and best option for China is to pursue an arms control agreement to prevent not just the United States but any nation from doing so – as it is advocating presently. However, if this effort fails and if what China perceives as its legitimate security concerns are ignored, it would very likely develop responses to counter and neutralize such a threat.

Despite the enormous cost of space-based weapon systems, they are vulnerable to a number of low-cost and relatively low-technology ASAT attacks

including the use of ground-launched small kinetic-kill vehicles, pellet clouds or space mines. It is reasonable to believe that China and others could resort to these ASAT weapons to counter any U.S. space-based weapons.[13] This, however, would lead to an arms race in space.

To protect against the potential loss of its deterrent capability, China could potentially resort to enhancing its nuclear forces. Such a move could, in turn, encourage India and then Pakistan to follow suit. Furthermore, Russia has threatened to respond to any country's deployment of space weapons.[14] Moreover, constructing additional weapons would produce a need for more plutonium and highly enriched uranium to fuel those weapons. This impacts China's participation in the fissile material cut-off treaty (FMCT).[15] Eventually, failure to proceed with the nuclear disarmament process, to which the nuclear weapon states committed themselves under the Non-Proliferation Treaty, would damage the entire nuclear nonproliferation regime itself, which is already at the breaking point. As Hu Xiaodi, China's ambassador for disarmament affairs, asked, "With lethal weapons flying overhead in orbit and disrupting global strategic stability, why should people eliminate weapons of mass destruction or missiles on the ground? This cannot but do harm to global peace, security and stability, and hence be detrimental to the fundamental interests of all States."[16]

Worsening space environment

Weaponizing space would further exacerbate current problems with space debris.[17] Even worse, some scientists warn that if a number of satellites are destroyed in the course of a war, the Earth would be encased in a cloud of debris that would prevent future satellite stationing and space access.[18] Given concerns over the space debris issue, senior scientists in China have emphasized that preventing environmental pollution should not only apply on Earth, but should also apply in outer space. As Xiangwan recently noted, "prevention of pollution in space should be put on an agenda and as time goes by, this problem will become increasingly obvious." He further states: "In preventing space pollution, the following two issues are worth noticing: space garbage and weaponization of space." "[W]eaponization of space is more dangerous than ordinary space garbage," since "it will seriously pollute space" and "it will threaten peace and stability on the Earth."[19]

Some Measures for Space Security

As discussed above, the cumulative effect of space weaponization by the United States would undermine global security and the peaceful use of outer space by all nations. If Washington wants to reduce the potential vulnerability of its space assets, there are a number of ways to improve space security. Weaponizing space can only erode this security. As Ambassador Hu recently emphasized, "for ensuring security in outer space, political and legal approaches are more be effec-

tive, while resorting to force and the development of space weapons will only be counter-productive."[20]

There are technical approaches, which, if implemented unilaterally, could improve the survivability of space systems. The United States and others could, for example, harden or shield the most vulnerable parts of their satellites (such as the solar cells and the focal planes) against nuclear, laser, or other conventional attacks. In some cases (e.g. nuclear explosion), hardening satellites would be difficult but technically feasible. To avoid paralysis of a whole system, redundant capabilities could be made available for rapid replacement of satellites in orbit. Increased maneuverability, enhanced situational awareness, and improved stealth capability, would also make it easier to evade a hostile attack.[21]

Furthermore, a number of measures could be taken to secure space assets by multilateral rules or agreements. Specific rules or agreements for space use might include, for example, "keep-out zones," a non-interference rule for satellites, cooperation on reducing space debris, notification of space launch, development of safe traffic management procedures, and building a hotline between major missile and space powers. These "rules of the road" would be intended to reduce suspicion and encourage the orderly use of space. However, it should be noted that the above technical measures and rules, although important for reducing present risks, would not remove the implicit threat of ASAT attacks. A potential rule on "keep-out-zones" would not prohibit an attack by a space-based laser at long distance. Technical solutions are unlikely to suffice in the absence of strengthened international agreements on space activity. In addition, hardening satellites would be extremely costly, and potentially infeasible, in particular for civilian and commercial satellites. It would impair the operational flexibility of satellites.

A Space Weapons Ban

A set of measures to limit space arms proliferation have been proposed, including a ban on the testing or use of any ASAT weapons and a declaration not to be the first to deploy weapons in space or to further test destructive ASATs.[22] It should be noted that, even if the compromise route is taken, any multilateral attempt to address space security should consider all countries' interests. One of China's major motivations for a ban on space weaponization is to reduce its concerns regarding U.S. missile defense plans. Thus, any partial arms control measure involving China should emphasize this concern. For example, a proposal that restricted ASATs while allowing the deployment of a U.S. missile defense system would be perceived by China as discriminatory for two reasons. First, ASATs would be an effective way for China to counter the U.S. missile defense threat. Second, it is difficult to distinguish between anti-ballistic missile systems and ASATs, which would create a probable source of tension.

China's position

In China's view, the most effective way to secure space assets would be to agree on a space weaponization ban. Ambassador Hu stated, "If any country is really worried about possible menace to its space interests, this could certainly be alleviated through the negotiation and conclusion of a treaty on the prevention of space weaponization, as suggested by China… Such a legally binding international treaty will be the best tool to safeguard the interests of all sides."[23]

China's stance on banning weapons in outer space has been consistent since 1985, when it first introduced a working paper to the U.N. Conference on Disarmament (CD). China's most recent working paper on the issue, introduced in June 2002, emphasizes three basic obligations: (1) Not to place in orbit around the Earth any objects carrying any kind of weapons, not to install such weapons on celestial bodies, and not to station such weapons in outer space in any other manner; (2) Not to resort to the threat or use of force against outer space objects; and (3) Not to assist or encourage other States, groups of States, international organizations to participate in activities prohibited by this Treaty.[24]

In recent years, the U.N. General Assembly has adopted resolutions calling for the CD to begin negotiations on the Prevention of an Arms Race in Outer Space (PAROS) with an overwhelming majority of support. However, John Bolton, then U.S. undersecretary of state for arms control and non-proliferation, told the CD: "the current international regime regulating the use of space meets all our purposes. We see no need for new agreements."[25] Many Chinese leaders believe Bolton is wrong. There are no existing treaties that effectively prevent the testing, deployment and use of weapons, other than those of mass destruction, in outer space. In addition, none of these instruments covers the threat or use of force from Earth (land, sea and air) against objects in outer space. The history of proliferation has taught us that banning the testing and deployment of weapons from the outset is much more effective than attempting disarmament and nonproliferation after the fact.

Scope of "space weapon" and U.S. missile defenses

Once negotiations on a space weapon ban begin, the interpretation of the scope or definition of "space weapon" will be of crucial importance. It will not only affect China's judgment on the value of such a ban, but also U.S. decisions on missile defense systems. There is at present no consensus on what constitutes a space weapon. Based on Chinese documents, space weapons would include: (1) any weapon stationed in outer space for the purpose of attacking any object in space, on the ground, in the air, or at sea; (2) any space- ground-, air- or sea-based weapons that target objects in outer space.

Two key issues of definition regarding the scope of space weaponry are the "basing" of weapons and what constitutes an "object in outer space."

Regarding the basing question, any weapon if stationed in outer space should be classified as a space weapon. This interpretation can easily be widely accepted. Here, the basing of an object in space is the key. For the question of what is an object in outer space, if the "object" refers only to satellites, then we can define the scope of the space weapon ban as applying to: any weapons stationed in outer space and any ASAT weapons (what I call the "focused" approach). However, if the "object" refers not only to satellites but also to missiles traversing space, then space weapons will be defined (according to what I call the "broad" approach) as any space-based weapons, any ASAT weapons, and any anti-ballistic missile weapons intercepting missiles in outer space. Thus, the "focused" approach would permit a non-space-based BMD system, while prohibiting a space-based BMD system. However, the "broad" approach would put a strong limitation on U.S. missile defense system development.

China's official documents proposed at the CD do not further clarify whether "object in outer space" would exclude ICBMs traveling through outer space. In its 2001 working paper to CD on PAROS, China pointed out one of the three basic obligations as "not to test, deploy or use on land, in sea or atmosphere any weapons, weapon system or their components that can be used for war-fight-

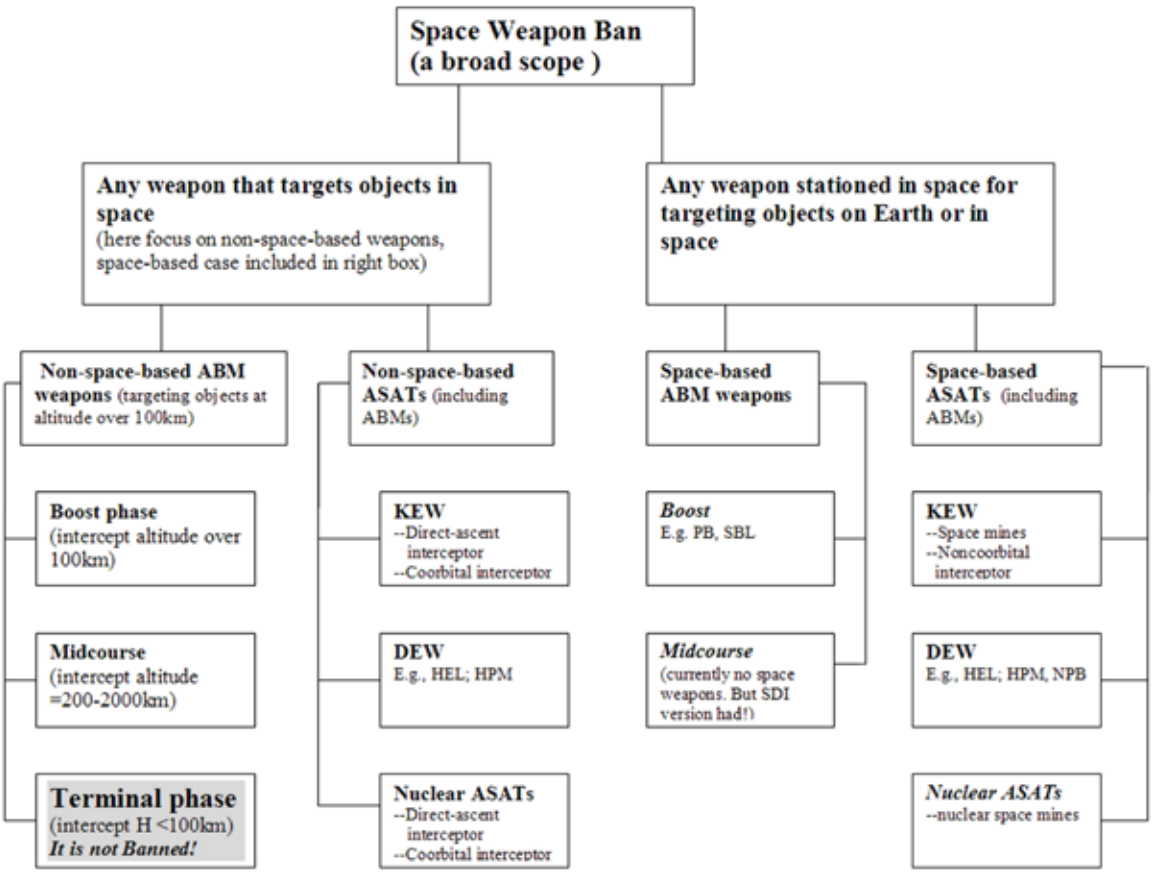

Fig.1: The relation between BMD and the broad scope interpretation of space weapon

ing in outer space."[26] It did not clarify whether using a missile defense system to intercept an ICBM in its mid-course would belong to "war-fighting in outer space." However, many Chinese officials and experts have generally favored the "broad" approach of the definition of space weapons.[27]

An examination of missile defense systems illustrates the importance to any treaty negotiation of unambiguously defining the term "objects of outer space." It assumes outer space as the space above the Earth's atmosphere, i.e. space 100km above sea level. There is no doubt that all potential space-based missile defense systems, including a space-based boost-phase system, would be captured by either a "broad" or "focused" scope ban on space weapons. Regarding non-space-based BMD systems, the key issue is whether their intercept altitude is above 100km. Even the ground-based mid-course missile defense system, which is currently being deployed, would not be permitted under a "broad" definition, as the intercept altitude of the GMD system is about 200km to 2,000km. The only missile defense system allowed under a broad scope ban on space weapons would be the terminal-phase defense system, which would destroy warheads at tens of kilometers through use of a non-space-based interceptor. However, the defense footprint of the terminal-phase defense system is small in comparison to other systems, as it is only a "point" defense for a localized area such as a missile silo. Without other overlapping systems, it would not provide global coverage.

Thus, a broad interpretation of space weapons would rule out almost all U.S. national missile defense systems. If Chinese officials want to limit all U.S. missile defense deployments through an international ban on space weapons, they would focus on the broad scope approach. However, it is unlikely that the United States would accept such an interpretation or a treaty that sought to rollback U.S. missile defenses.

A focused approach

At this stage, it would be difficult to persuade the United States to alter its ballistic missile defense plans, as the GMD system is already being deployed. The United States would, no doubt, refuse such a broad ban. In fact, it is unrealistic to expect that the United States will accept any negotiations on space weapons in the near future. The United States is unlikely to return to anything like the Anti-Ballistic Missile Treaty – instead, it will seek to retain the right to build and operate at least a ground-based missile defense system. If China wants to move beyond mere complaints towards an actual agreement, then it will have to consider proposals that might conceivably be acceptable to the United States. To overcome the deadlock at CD and to reduce the concerns of both the United States and China, a minimum-scope space weapons ban (the "focused approach") with some bilateral confidence-building measures could be a practical first step. This approach could include the following two core elements:

- Banning the testing and deployment of any weapons in outer space, including space-based kinetic energy weapons, space-based directed energy weapons, and any other space-based weapons for attacking space-, ground-, sea-, or air-based targets. This would rule out space-based missile defense and ASAT systems.
- Banning the testing and deployment of any "dedicated" ASAT weapons. This would include any strike system – whether ground-based, sea-based, air-based or space-based – against orbiting satellites.

Subsequently, what is the likelihood of both the United States and China considering a "focused approach" to space weapons?

The U.S. Side

The United States would likely find a focused approach more acceptable than a broad approach. While it bans space-based weapons and ASATs, the former would allow deployment of the GMD system that composes the central part of the Missile Defense Agency's current budget and development efforts. In practice, as a number of studies show, there is no rationale for the U.S. to deploy space weapons and ASATs.[28] For example, an enormously expensive space-based interceptor system for missile defense would be intrinsically vulnerable to a number of cost-effective ASAT attacks and be overwhelmed by the simultaneous launch of several missiles from a compact area.[29] Moreover, the negative impacts of using space weapons for other military missions – protecting satellites, denying the hostile use of space to adversaries and projecting force – would far outweigh the benefits, since the utility of space weapons is limited by three main factors: high cost, considerable susceptibility to countermeasures, and the availability of cheaper, more effective alternatives.[30]

Furthermore, a space-based BMD system would inevitably encourage other countries to pursue ASATs as countermeasures. Thus, a space weapon ban would reduce the proliferation of ASATs. It would reduce the risk of a "space Pearl Harbor" for other military and civilian satellites. As many experts in the U.S. point out, given the heavy dependence of the United States on its space assets, "the United States has more to lose than to gain by opening the way to the testing and deployment of ASATs and space weapons."[31] The United States is now more dependent on satellites to perform important military functions than any other state. By placing weapons in space, the United States could stimulate others to balance symmetrically and asymmetrically against U.S. space assets. It would be very difficult for the United States to maintain unchallenged hegemony once space is weaponized. The current U.S. military advantage in space instead would be lost, or at a minimum degraded, by weaponization. Further, space weaponization would threaten U.S. civilian and commercial assets by making them far more vulnerable than they are today. The U.S. economy and society are highly dependent on the applications of commercial satellites.

In short, as Richard Garwin and his co-authors point out: "A regime that effectively prohibits the deployment of space weapons and the use of destructive ASATs before they can destroy U.S. or other satellites would be a smart, hard-nosed investment in U.S. national security, but would require U.S. leadership."[32] It is clear that the United States still has time for serious re-consideration of its space activities. While current funding requests from the Bush administration show continued interest in space-based weapons systems, the actual level of funding is small and these weapons remain in the conceptual and research stages. At the current speed of development, for example, the planned space-based BMD system would not reach fruition until around 2020.

China's Point Of View

From the Chinese perspective, a non-space-based BMD system would be less threatening to national security than a space-based one. Countermeasures for mid-course missile defense systems would be less expensive and easier for China to develop. These include decoys, anti-simulation measures[33] and an increase in warheads capable of penetrating such a defense system. However, as many scientists point out, a robust, global-coverage BMD system would have to include boost-phase missile defense.[34] From the Chinese perspective, a U.S. space-based, boost-phase missile defense system would pose the greatest threat of all. This is due to the fact that at boost phase, the missile defense system would have fewer targets; the target ICBM would be much larger than the normal re-entry vehicle; the target would be much more fragile than a re-entry vehicle; and the target would be easily detectable due to the bright plumes of the burning booster. A non-space-based, boost-phase missile defense system would not be able to cover China's ICBMs. In fact, an ICBM at an altitude of 200km can be detected within a range of 1,600km by a sensor on the ground, and within 2,000km by a sensor at an altitude of 15km. Because of China's vast area, the United States would have to destroy a Chinese missile in boost-phase from space.[35] As such, even a limited ban on space weapons would significantly reduce the threat for China from U.S. missile defense systems, assuming that Chinese military planners have confidence in countermeasures for midcourse missile defense systems.

Other bilateral confidence-building measures between the United States and China would facilitate China's consideration of a "focused approach" to space weapons negotiations. These measures might include: (1) A U.S. acknowledgment of the seriousness of China's concerns, including an assurance that a U.S. missile defense system will not target China; (2) A U.S. pledge to adopt a bilateral no-first-use policy toward China, following the example of similar Chinese and Russian policies; such a policy would ease China's major concern about the possibility of a U.S. preemptive strike; (3) The clear exclusion of Taiwan in the U.S.-Japan joint theater missile defense plan, and a U.S. move to block the sale of such systems to Taiwan; (4) A limitation on the scale and scope of the envisioned

U.S. non-space-based BMD architecture, including placing a limit on the number of missile defense interceptors and restricting the scope of the overall system to the minimum required for dealing with rogue threats. This latter measure would ensure that China's current stock of fissile materials would be sufficient to fill the number of new warheads needed to balance U.S. missile defense interceptors. In the absence of any limitations on U.S. missile defense systems, China harbors concerns about whether its current fissile material stocks are extensive enough to supply the warheads needed to counter the U.S. threat to its nuclear deterrent. This directly affects China's willingness to participate in the Fissile Material Cut-Off Treaty. Restrictions on the U.S. BMD system would also ensure that China builds its nuclear arsenal in a predictable way – until it has the capacity to balance the U.S. defensive capabilities – which the United States would acknowledge and understand.

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~Book Release~

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Strategic Communication with China: What message about space?[1]

Joan Johnson-Freese

The importance of strategic communication has been stated and restated as part of the "winning the hearts and minds" public diplomacy strategy of the Global War On Terrorism (GWOT). The importance, however, extends beyond the GWOT. Fresh emphasis on strategic communication recognizes the critical nature of properly conveying what America stands for, its values, what it considers important, and its policies and goals in all areas. How, and how well, that is done influences not only how other people and countries view the United States, but how they will react to the United States. While actions may speak louder than words; both words and actions clearly matter.

The overall issue of strategic communication with China is beyond the scope of this article. However, consideration of U.S. strategic communication regarding space activities offers insight into the issues being faced in one important area. In one regard, the message of the United States to China has been crystal clear – the United States is not interested in cooperative space programs with China. Period. More broadly, however, it is less clear what message the United States is trying to send regarding space. Perhaps, that the United States owns space, so other countries should not try to step into that venue? Space is vital to U.S. national interests, so it is critical to protect U.S. space assets. But does that leave room for other countries in space as well? Space assets are often information assets critical for linkage into an increasingly globalized world. Do some countries, but not others, have the right to use space for both civil and military purposes, as the United States does?

If one believes that big problems are best tackled in small bites, 'space' perhaps offers an area where the United States can begin to understand and tackle some of the strategic communication issues it faces.

The Importance Of Strategic Communication

The 2004 report of the Defense Science Board Task Force on Strategic Communications, states: "This task force concludes that U.S. strategic commu-

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nication must be transformed. America's negative image in world opinion and diminished ability to persuade are consequences of factors other than failure to implement communications strategies. Interests collide. Leadership counts. Policies matter." President George W. Bush's close friend and advisor Karen Hughes was sworn in as the State Department's undersecretary for public diplomacy and public affairs, and ambassador for the same, in September 2005 to take on the task of transforming the image of the United States. Recent opinion polls around the world show that she has her work cut out for her. A Pew Research Center Poll taken in April and May 2005, for example, showed China, a communist dictatorship, was viewed more favorably than the United States in 11 of the 16 countries surveyed, including Britain, France, Germany, Spain, the Netherlands, Russia, Turkey, Pakistan, Lebanon, Jordan and Indonesia. India and Poland saw the United States in a more favorable light than China, and Canada was about evenly split.[2] As the world's greatest example of democratic success and the "shining city on the hill" for others to model, the United States is clearly having trouble conveying its message. While to a degree it may be 'normal' for other countries to view the only remaining superpower with angst if not outright hostility – and there are times when if they do not love us, some countries need fear us – these poll numbers seem to indicate negative feelings toward the United States beyond what is normal, and certainly beyond levels desirable.

Strategic relations between China and the United States have many facets and levels. Strategic communication on those different facets and levels may involve a variety of engagements and dialogues with a view toward enhancing mutual understanding. Strategic communications on space, therefore, must be considered within the broader context of U.S.-China relations generally.

Regarding China-U.S. relations, in June 2005, U.S. Secretary of State Condoleeza Rice stated "The U.S. welcomes the rise of a confident, peaceful, prosperous China and wants China as a global partner." U.S. Deputy Secretary of State Robert Zoellick extended Rice's message in September 2005, talking about how China could become a "responsible stakeholder" in the international system. But that message has not always been consistent. In fact, there has also been a recent resurgence in what many analysts, particularly outside the United States, see as U.S. China-bashing,[3] based on concerns from moralistic neo-conservatives; economic protectionists; defense types concerned about China's arms build-up – and needing a worthy peer-competitor to justify the U.S. defense budget; and fundamentalist Christians irate over atheist China's repressive ways. The concerns of these groups usually surface at lower levels, in functional areas. Subsequently, at the highest level, the United States has attempted to convey to Chinese elites a willingness to work with them. Yet, translating that general willingness to work together into meaningful dialogue in functional areas has been problematic; though at all levels the United States tends to want to delve into specifics uncomfortable for Beijing. In U.S.-China Defense Consultation Talks and military maritime se-

curity, for example, the United States seeks transparency on specific capabilities, deployment and spending that China inherently avoids. China, on the other hand, is more interested in engaging in function area dialogue to better understand U.S. strategic intent on issues such as U.S. support for Taiwan, the U.S.-Japan military alliance, the North Korean nuclear issue, and space. Consequently even when dialogue infrequently occurs, both sides can end up frustrated by lack of progress on their goals. Clearly, there is a great deal of work to be done.

The 2004 Defense Science Board report suggests that, "strategic communication describes a variety of instruments used by governments for generations to *understand* global attitudes and cultures, *engage* in a dialogue of ideas between people and institutions, *advise* policymakers, diplomats, and military leaders on the public opinion implications of policy choices, and *influence* attitudes and behavior through communications strategies."[4] A look at each of these components of strategic communication as they relate to U.S.-China space relations clearly illustrates the many issues that must be addressed.

Space Messages

Understand global attitudes and cultures. Part of the difficulty with assessing China is that it is largely a country opaque to outsiders, and deliberately so. Cultural proclivities toward opaqueness, related to Asian concerns about 'saving face' and public pride, predate a military 'abhorrence'[5] of transparency traced back to Sun Tzu. These cultural proclivities are exacerbated by China's closed political system, and even further intensified in space-related areas by often excessive security concerns common to authoritarian states.[6] But in the end, it is the inherently dual-use nature of space technology itself that multiplies the already difficult aspects of analyzing Chinese intentions in space. A submarine has few uses outside the military sector. The same is not true regarding a satellite. An estimated 95 percent of space technology has both civil and military applications and hence is considered 'dual-use,' increasing the complexities of determining 'intent' exponentially. Additionally, military space technology suitable for defensive purposes often is also suitable for offensive purposes. Cultural proclivities, dual-use technology and a multitude of peripheral issues make determining the intended use of Chinese space technology a 10,000 piece puzzle.

Especially without dialogue, deciphering Chinese intent regarding space becomes considerably more difficult than surveying known capabilities. Analysis must be based on information from a variety of official and unofficial sources, with interpretations falling along a spectrum. Underestimating capabilities and best-case intent evaluations risks being unprepared to deal with the threats posed; overestimating capabilities and worst-case intent evaluations can lead to actions which produce unintended negative consequences that ultimately can increase wider range of "tolerable" opinions are appearing within academia and in the media. There are now both "official" publications, which are vetted by the gov-

the potential threat to U.S. capabilities. The United States currently leans heavily toward the latter.

Open source materials, particularly technical journals, are often used as sources of information regarding what the Chinese are working on, or even just thinking about.[7] Most technical journals are very technical, focusing on detailed discussions of optics, trajectories, sensors, etc. There is disagreement on how much can actually be gleaned from them. China analyst Larry Wortzel suggested in an Oct. 15, 2003, Heritage Foundation WebMemo that part of the difficulty with "intent analysis" is that "most technical articles from the science digests in China, admittedly, only deal in the theoretical aspects of how to fight war in space and analyze U.S. strengths and vulnerabilities." Other analysts' opinions range from suggesting that "an aggressive pursuit of available open sources can yield a limited assessment of China's recent military modernization ambitions and achievements,"[8] to there being a wealth of information in the technical literature from which inferences about possible intent can be drawn, including about anti-satellite weapons (ASATs), if carefully translated and followed over periods of time.

Recently there has been considerable concern in the United States about know-how and bits of information gathered through low-tech and largely legal Chinese efforts. These efforts include the people-intensive process of painstakingly sifting through mountains of open source U.S. technical literature and the employment of Chinese visitors and the Chinese Diasporas to gather information through means including casual discussions, conferences, workplace knowledge…and theft.[9] The value of information that can be gleaned from open sources should not be underestimated. According to the Defense Science Board (DSB), open source material is among the most useful, least expensive collection options. [10]

Perhaps the problem is not that the Chinese do too much, but that the United States does not do enough, or do it well enough.

Beyond technical journals, the volume of information and analysis produced within China and commercially available is increasing exponentially. A

wider range of 'tolerable' opinions are appearing within academia and in the media. There are now both 'official' publications, which are vetted by the government, and commercial, unvetted, publications. Media outlets are proliferating, driven by market competition. Whereas, however, Americans understand the risks of relying on *The National Enquirer* or a lone blogger for 'fact,' the need for similar discrimination among open Chinese sources does not always seem to be understood by U.S. analysts.

For example, perhaps one of the most often-cited Chinese quotes on 'ntent' is that of Chinese analyst Wang Hucheng. "For countries that can never win a war with the United States by using the methods of tanks and planes, attacking an American space system may be an irresistible and most tempting choice." The quote is one of braggadocio – attempting to make the point that the United States can be beat – pulled from an article entitled "The U.S. Military's 'Soft Ribs' and Strategic Weaknesses," originally printed in *Liaowang*, a decidedly anti-American publication and one that certainly represents the anti-U.S. perspective. But there is also an element of asymmetric truth being stated, much like the response from India's then-chief of staff when asked by reporters what he had learned from observing the conflict in Iraq during the Gulf War. "Don't fight the Americans without nuclear weapons," he replied. Neither quote, however, is particularly useful for defense planning purposes.

Similarly, while a treatise on defense policy from a university professor or a War College student being encouraged to 'think outside the box' is understood by Americans as not necessarily reflective of U.S. government policy, the same appears not always true about Chinese writers. Another Chinese source widely heralded by U.S. conservatives as indicative of policy is *Unrestricted Warfare*, written in 1999 by two colonels at a Chinese military institution. While interesting as revealing a line of thought, it does not necessarily 'reveal'[11] Chinese intent.

The increasing information available from China from numerous sources increases the potential for communication misfires. That being the case, careful source checking by analysts is imperative.

Both the fiscal year 2003 (FY 03) and FY 04 Department of Defense (DOD) Annual Report on the Military Power of the People's Republic of China contained references to Chinese "parasite" satellites for potential use as ASATs. In the FY 04 report, it was further stated that the claim was still being investigated. That turned out not really to be the case, at least by the U.S. government. According to Union of Concerned Scientist researchers Gregory Kulacki and David Wright, however, a relatively easy Internet search in China places the origin of the story about those satellites with a self-proclaimed "military enthusiast" named Hong Chaofei from a small town in Anhui. Multiple iterations and citations of his story have resulted since it first appeared on the Internet in October 2000. Hong's website also contains scores of stories on 'secret' Chinese weapons to defeat America in a war over Taiwan. China is working on small satellites, but

the parasite satellite appears more one-man's fiction than fact.

There are other instances of misinterpretation as well. *Challenges to Space Superiority*, published by the National Air and Space Intelligence Center at Wright-Patterson Air Force Base in March 2005, highlighted quotes suggesting that China will "threaten on-orbit assets" by Liying Zhan of the Langfang Army Missile Academy. Kulacki and Wright again tracked down the quotes and the source, and again found several key errors; fully documented in a published Union of Concerned Scientists research paper on Chinese military space capabilities.[12] Key words were omitted from the actual Chinese quote and there were misinterpretations of what was included. For example, "should" (indicating a recommendation about a decision not yet made) was misinterpreted as "will," (indicating what China intends to do or is doing). Further, the author was found to be a junior faculty member at a facility primarily responsible for live-fire and simulated training for junior artillery officers, where ASAT research was likely not even going on, and which subsequently has been shut down. Not exactly an authoritative source for U.S. government planning purposes.

China is working on a wide variety of dual-use research potentially applicable to ASAT development, including micro-satellites and small satellites. Some of this research is cited in the 2005 DOD Annual Report to Congress on The Military Power of the People's Republic of China, though not always accurately. The medium-resolution Earth observation Tsinghua series being built with Surrey Satellite Technology Limited of the United Kingdom is included, although the resolution for Tsinghua-1 is stated as 40 meters, when it is actually 30 meters – information easily found on the Internet. Its follow-on, the Naxing-1, is not mentioned in the report, and is in many ways more interesting as a totally Chinese effort with some sophisticated upgrades. In fact, it is currently the smallest satellite with three axis stabilization. Its purpose is stated as "high tech experiments." Chinese commitment to commercial smallsat development, for applications including mapping and environmental monitoring, is further evidenced by the December 2004 opening of a Microsat Industrial Park in Beijing, a commercial venture with over 16,000 square meters of floor space. That venture is not mentioned in the DOD report either.

Until a few years ago, and the advent of the so-called Blue Team, reports on Chinese space activities were scarce, but for the most part scrupulously documented.[13] The Blue Team began in the late 1990s as a small group of congressional staffers, think-tank analysts and academics who vocally and voraciously viewed China as the next enemy. Many of its members have gone from being Washington outsiders during the Clinton years to being insiders with the Bush administration and within the halls of Congress. While ideology prominent in guiding policy decisions during the Bush administration's first term have largely given way to realism in the second term, no such shift has occurred within select but powerful congressional offices. Beliefs about China's true aims and goals are

strongly held on all sides of this debate in the United States, and the apparent willingness among some U.S. analysts to indiscriminately accept any source written in Chinese means that sooner or later all sides can claim evidence to support their views. This does little to further a useful understanding of China's intentions.

Why is it important that U.S. reports regarding China's space program, capabilities and intentions be scrupulously researched and documented? First, analysis researched in support of a preordained conclusion is not analysis and is not useful to defense planners. In fact, it can lead to dangerous miscalculations. Second, if a report is 98 percent valid and 2 percent based on erroneous interpretations or questionable sources, the credibility of the entire report is open to question. Credibility is critical in communications.

Engage in a dialogue of ideas between people and institutions. If the United States is seeking to use strategic communication as a way to influence decision-makers and/or general populations – with influence defined as the ability to shape or affect others' beliefs and actions – then engagement appears necessary, though not necessarily sufficient. Consistently, however, engagement with China on space activities has been summarily rejected by the United States for a variety of reasons, with rejection implemented through both policy and legal channels.

Communication between Chinese and U.S. government agencies is limited and formal. NASA and the China National Space Agency (CNSA) interactions are rare: invitations from NASA to CNSA are seldom offered or visas are often denied[14] if events are open to the public. Official U.S. participation in Chinese-sponsored space workshops or events is a non-starter, so as not to signal intentions the United States is not prepared to follow-up on.

There have been two U.S.-China meetings on space of note. In November 2004, a Chinese delegation was invited to attend a three-day workshop in Houston on Bush's Moon-Mars initiative. As Chinese attendance at these kinds of events requires the blessing of the State Department, this was considered somewhat of a breakthrough from the past. Additionally, former NASA Administrator Sean O'Keefe welcomed CNSA Administrator Sun Laiyan to NASA Headquarters in Washington, D.C., for a courtesy visit translated as 'no business was discussed' – on Thursday, Dec. 2, 2004. Two discussions, however, does not equate with dialogue.

Interaction between the United States and China on military space issues is even rarer. While Air Force Gen. Richard Myers, then-chairman of the Joint Chiefs of Staff, led the first U.S. delegation to the Chinese space center outside of Beijing in 2004, the Chinese facilities tour was restricted at best. That tour did little to counter U.S. frustration about the opaqueness of the co-mingled Chinese civil and military space programs, and even added impetus to the arguments of those who reject engagement.

There are several reasons for the U.S. attitude toward China regarding space cooperation. They include: the term 'engagement' itself being rejected by

some conservative politicians as associated with President Bill Clinton's China policy; efforts by some to link space cooperation with issues like human rights or nonproliferation; refusal by some to work with a Communist country; concerns about transferring dual-use technology; and worries that China's lack of reciprocity makes it a one-sided deal favoring China.

But trying to isolate China, however ideologically satisfying that might be, has proven impossible. While it may be convenient to assume that Chinese space technology has been acquired through 'beg, borrow and steal' methods, more accurately, the Chinese have developed space capabilities by a combination of 'borrowing' generic designs from others, cooperative programs, indigenously developing technology, and buying what they needed and could afford from that which others would sell them.

In a globalized world with a globalized economy, actions on the part of the United States to try to isolate China (or any other actor) into activity or non-activity by denying it something else can only be effective if the United States has full control of whatever it is denying – and there are few remaining areas where the United States holds a monopoly. In fact, space is one of the most globalized aspects of world commerce. Even with the U.S. military's 'dominance' of military space power, it is highly unlikely that the United States will ever be able to *monopolize* the space arena.

For example, among the countries that China has worked on space efforts are: European countries collectively and individually; Canada; Russia; and Brazil, on the China-Brazil Earth Resource Satellite, touted as the largest space venture by two developing countries and potentially indicative of China posturing toward 'leading' other developing countries into space. China's 2005 satellite sale to Nigeria, and its work with the Asia-Pacific Space Cooperation Organization – an international governmental organization headquartered in Beijing that aims to promote regional multilateral cooperation in space technology and its application – provide further evidence of China's desire to cooperate on space activities. So, although U.S. engagement with China on space issues has been strictly limited, China has nevertheless advanced technologically and formed significant strategic space partnerships.

Since the supposedly bipartisan, but in fact politically charged, Cox Commission report in 1999 dealing with espionage at national laboratories and technology theft in conjunction with commercial satellite launches in China, the United States has restricted the transfer of satellite technology to China – to the detriment of the U.S. aerospace industry on which the U.S military is increasingly reliant.[15] Ostensibly, the restrictions were intended to hinder development of Chinese military space capabilities. The breadth and development of Chinese military space capabilities, however, suggest that the U.S. policy has been ineffective. U.S. restrictions apply to commercial communications satellites and their launch, largely unrelated to the sensor technology China particularly needs for

development of its military space program. Additionally, restrictive U.S. policy has pushed European companies toward cooperation with China and away from working with the United States.

It might be argued that the Chinese would be even further ahead if the United States had not closed the door on the Chinese market. The fact of the matter is, however, that although the technology China has acquired elsewhere may not be as good as that available from the United States, it's good enough. And if U.S. restrictions slowed Chinese advancement, it has also perhaps made China more determined to develop its own capabilities rather than being dependent on others. U.S. technology restrictions certainly prodded European satellite companies into moving from being niche component providers to U.S. prime contractors to becoming prime contractors themselves.

Further, the United States has foregone whatever opportunities it might have had to 'shape' Chinese space goals in accordance with U.S. interests, though it has successfully done so with other countries. For example, until the United States balked at launching two experimental European communication satellites in the late 1960s, cooperative opportunities with the United States kept France from being able to gather the support requisite to build a European launch vehicle to challenge the U.S. commercial monopoly. More recently, merging the U.S. and Russian manned space programs toward cooperation on the International Space Station was largely motivated by the desire to keep Russian rocket/missile scientists employed and off the international job market. After the recent Shenzhou VI manned launch, editorials in China – especially the rural areas – questioned government expenditures on space that could go into domestic programs.[16] Clearly too, money being spent on manned space reduces that which can spent on military space.

China is not a partner on the International Space Station (ISS), though it has wanted to be for some time. Initially, the United States rejected Chinese overtures because China lacked either money or technology that partners were required to contribute. When Chinese technology matured to the point where it could have made a useful contribution, and technically-less-advanced Brazil was brought into the partnership but still China was spurned, it became clear to all that politics was really the basis for Chinese exclusion. Conservative U.S. politicians did not want to include the largest remaining Communist country in the world in a program largely motivated by a desire to show that countries could peacefully work together. Media comments from Rep. Dana Rohrabacher, R-Calif., in 2001, regarding discussions about increasing international financial contributions to the space station in 2001, are illustrative. While acknowledging that China might have the resources to contribute to the station, Rohrabacher said he has ruled out approaching Beijing due to that country's human rights abuses. Specifically he stated, "The space station's supposed to stand for something better."[17] The question that must be asked, however, is whether the benefits of exclusion outweigh

the costs already cited.

At a July 27, 2005, hearing before the House Armed Services Committee, two views on the benefits and dangers of contact with the Chinese (particularly the military) were expressed, fairly typical of those prevailing. Franklin Kramer, former assistant secretary of defense for international security affairs, spoke in favor of contact.

> "I think that if we use the right public information we can make sure that we have the Chinese understanding really what we're about. We can also try to get a better understanding of what they're about. They're non-transparent, I think, would be a kind word. And we have sometimes tried to get really reciprocal visits. We have not achieved reciprocal visits. But I think we can nonetheless get some good insights by going there and talking to their people and getting as much as we can."

As Kramer states, engaging with the Chinese allows information to be gathered from a still largely-closed society. Further, creating a Chinese dependence on U.S. technology offers the United States more leverage than pushing Beijing closer to others. Including China in cooperative manned programs also utilizes Chinese funds that might otherwise go into military programs, makes the tortoise and the hare space race plaguing the United States vanish, and emphasizes U.S. leadership in a positive manner.

Richard D. Fisher, vice-president, International Assessment and Strategy Center, expressed a different view.

> "When China does launch a space station, I think we have to consider that that space station may serve both military as well as civilian purposes. And when we look at our own potential future cooperation, dialogue, space dialogue with China, we have to keep this in mind. That when we invite – if we were to invite – a Chinese astronaut onto the space shuttle, that the information technology that that single individual might pick up could be turned into a potential Chinese military space platform."

The suggested technology transfer that might occur were a Chinese taikonaut to participate on a shuttle mission is stunning. When the United States was trying to share technology with other developed countries in the formative years of COMSAT, it was found to be very difficult, even when blueprints and manuals were shared. Further, while there appears concern that the Chinese will develop a significant manned military capability, history shows that both the Americans and Soviets tried to find an advantage to a manned military presence,

and couldn't. The Manned Orbiting Laboratory (MOL) was a program planned by the U.S. Air Force to house military astronauts, and it was cancelled. Sensors have much better eyesight than astronauts. Is there a fear that Chinese ingenuity will be able to find value in a military-man-in-space that eluded the U.S. military? There seems little basis for such a fear.

While U.S. dialogue with China is spotty, as noted above, China has been proactive in dialoguing with other countries, sometimes effectively making points at the expense of the United States. In the multilateral arena, China, with Russia, has been a strong and vocal advocate for a treaty banning space weapons – a pursuit for which it has been successful in gaining support at the United Nations. In 2000, the U.N. General Assembly voted on a resolution called the "Prevention of Outer Space Arms Race." It was adopted by a vote of 163 in favor to none against, with three abstentions: the Federated States of Micronesia, Israel and the United States.[18] On Dec. 8, 2003, 174 nations voted 'yes' on a United Nations resolution calling for negotiations toward preventing an arms race in space.[19] Only four countries abstained: the United States, Israel, Micronesia, and the Marshall Islands.

The United States has not been interested in space arms control in general, feeling it is not in its best interests. China has taken advantage of that stance. Further, China's choice of venue for its issues with space weapons – the U.N. General Assembly or the Conference on Disarmament – offers China considerable negotiating leverage with a low-risk of being held to task for potential follow-through. Bilateral negotiations would be much more difficult and higher risk for both sides. While the U.N. venue offers China positive public relations exposure with low-risk of constraining its activities, there may also be another reason for avoiding more difficult bilateral talks.

China lacks experience in strategic arms control negotiations and verification follow-up. The Union of Concerned Scientists have been conducting annual workshops for the past several years toward training Chinese researchers to being more adept at such negotiations, in the hopes that their expertise will be put to use sometime soon. Bush's appointment of 'neo-conservative super-hawk'[20] Robert G. Joseph to replace John Bolton as undersecretary of state for arms control and international security affairs does not bode well in that regard. Joseph has been a leading advocate of countering Chinese advances not with dialogue or arms control, but with the unilateral U.S. deployment of high-tech active, as well as passive, weapons systems. It isn't China that comes across internationally as wanting to turn the Heavens into a shooting gallery.

Advise policymakers, diplomats, and military leaders on the public opinion implications of policy choices.[21] With an authoritarian government in place, Chinese public opinion is not a force comparable to that in the United States, but it is increasingly becoming a force with which the Chinese leadership must contend. A full spectrum of attitudes toward the United States can be found, as evidenced in

the June 2005 Pew study.[22] Clearly, however, the Chinese are influenced by single events. Chinese citizens reacted virulently, for example, to both the accidental U.S. bombing of the Chinese embassy in 1999 and the death of the Chinese pilot in the EP-3 incident over Hainan Island in 2001. If the Chinese are negatively impacted by events, perhaps they can be positively impacted too.

The current U.S. approach to strategic communication seems to understate the importance of positive 'singular opportunities' and images, though the increase in favorable opinion toward the United States after its 2004 tsunami relief efforts clearly demonstrated that opportunities exist. A single bold act, such as allowing a Chinese taikonaut on a shuttle flight, could create a powerful, positive effect on Chinese public opinion. Such a shuttle flight would generate tangible images and news coverage much the same as Apollo-Soyuz did in 1975. If one's goal with strategic communication is, in part, to alter Chinese public opinion, these images could be very potent.

Currently, Chinese policy-makers are being more affected by U.S. policy than the Chinese public. While the U.S. commitment to manned space may be tenuous, its commitment to utilization of space and space technology as key military assets is not. Although the Gulf War was dubbed 'the first Space War,' it was actually a first step into much larger reliance and utilization of military space (milspace) assets in areas such as Intelligence, Surveillance and Reconnaissance (ISR), communications, and use of Precision Guided Munitions (PGMs, or smart bombs), culminating most recently in Operation Iraqi Freedom (OIF).[23] For example, from Operation Desert Storm in 1991, to Operation Allied Force in Serbia in 1992, to Operation Enduring Freedom in 2001-2002 in Afghanistan, PGMs as a percentage of total delivered air weapons went from 7.7 percent to 29.8 percent to 60.4 percent.[24] Increased dependence on space assets leads to an increased need to protect those assets and U.S. efforts in that regard are carefully followed in Beijing. Chinese officials are particularly wondering whether or not efforts are being limited to the defensive realm.

With the issuance of Air Force Doctrine Document 2-2.1, *Counterspace Operations*, in August 2004, U.S. intentions regarding protecting U.S. space assets and denying the use of space to potential adversaries was more clearly articulated in an unclassified document than ever before. Intentions include the development and use of offensive counterspace capabilities. Counterspace operations are those intended to defend U.S. space assets and capabilities, but also to deny enemies the same. "Offensive counterspace" basically means the ability to attack in defense of your own assets or the denial of assets to others. Statements regarding potential space weapon development in the past had always referenced a purely defensive mission. But this doctrinal shift potentially puts satellites of all types, including commercial and those from neutral countries, potentially at risk. The document also indicates a clear belief on the part of the Air Force leadership who wrote and approved the document that space warfare has the support of

the civilian leadership. That, coupled with preemption principles embedded in the 2002 National Security Strategy, has generated considerable alarm in some countries, perhaps China most of all.

Beyond paper documents, actions can be interpreted as indicators of U.S. intentions in space as well. For example, a new ground-based system capable of attacking enemy satellite communications, the so-called Counter Communications System, was announced at an aerospace conference in September 2004 by Air Force Brig. Gen. Larry James, vice commander of the Space and Missile Systems Center in Los Angeles.[25] Also, small satellite technology that the United States has grave concerns about China developing is being vigorously pursued in the United States. In fact, an Air Force official, speaking to a reporter from the trade publication *Inside the Pentagon* about an Air Force smallsat program known as XSS, stated, "XSS-11 can be used as an ASAT weapon."[26] What message should be read into that statement?

While the *Counterspace Operations* doctrine document says the United States seeks "space superiority," an advantage over other countries by some potentially minimum amount, "space dominance," the unchallengeable ability to control the space environment, appears the ultimate U.S. goal. The lineage of this position comes from documents such as *Vision for 2020*, published in 1997 by U.S. Space Command, which stated, "The emerging synergy of space superiority with land, sea, and air superiority, will lead to Full Spectrum Dominance." The themes of that document were later echoed in the 2000 *Report of the Commission to Assess U.S. National Security Space Management Organization*. Known as the Space Commission and chaired by Donald Rumsfeld, just prior to his assuming the position as U.S. defense secretary, that congressionally chartered commission warned in its final report submitted to Congress on Jan. 11, 2001, that: "If the United States is to avoid a 'Space Pearl Harbor,' it needs to take seriously the possibility of an attack on U.S. space systems." The commission recommended the creation of a U.S. Space Corps that would defend space-based "military capability." In 2003, the Air Force released a *Transformation Flight Plan*,[27] including plans for orbiting weapons that would send giant metal rods crashing to Earth, officially called Hypervelocity Rod Bundles, though dubbed 'Rods from God.' That document, however, only talked about hardware. The 2004 *Counterspace Operations* doctrine document adds another component part to the trend of developing space as the fourth battlespace: the component that states when and how such hardware would be used.

U.S. rhetoric and activities have not gone unnoticed in other countries, including China. When the U.S. government begins publishing documents on web pages showing lasers firing from space, as the *Vision 2020* website originally did, people and countries tend to get nervous. The 'Rods from God' concept, with an artist's rendering provided in the June 2004 issue of *Popular Science*, has generated considerable discussion at scientific conferences, not only about tech-

nical viability, but whom the United States intends to use it against.

In July 2004, the British press first began reporting fears that the United States was developing killer satellites capable of destroying European Galileo navigation satellites if it felt that potential adversaries could use them against the United States.[28] The following October another round of media reports surfaced, mostly in Europe, that the United States had threatened to blow Galileo out of the sky during a meeting at Whitehall on the topic of Europe's challenge to the U.S. Global Positioning System.[29] While it turned out that reporters totally exaggerated the issue, the incident is illustrative of the mistrust of the United States in space.

In 1997, when the United States still strongly embraced multilateralism, countries reassured each other and accepted reassurance from Washington that U.S. intent was benign and defensive. Today, with the United States seen as not just embracing, but boasting, a primacist grand strategy, employing preemptive tactics, and talking in terms of 'preventive war' as the future norm, accepting that reassurance has become increasingly difficult for allies and potential competitors alike. Whereas Chinese references to *Shashoujian*, the Assassin's Mace or silver bullet approach, draws concern about China's intentions in the United States, similar concerns are raised internationally by the U.S. focus on preemption, preventive war and unilateralism.

Regarding the Chinese manned space program, immediately following the October 2003 first launch of a taikonaut, the official U.S. response to China joining the exclusive club of manned spaceflight capable countries was coolly congratulatory. While other countries and world leaders praised the Chinese accomplishment – albeit in the case of countries like Japan and India, somewhat grudgingly and not without some jealousy – the U.S. reticence toward congratulating a Communist country for a technological achievement was obvious. Subsequent to the launch, the program has drawn some fire in the United States.

The Chinese flew sophisticated military equipment on the ShenzhouV capsule. Conservative analysts in the United States translated that to equating the program being a Trojan horse for military space activities.

> "And more ominously, the PLA may envision manned military space platforms inasmuch as its first manned space flight, the Shenzhou-V of October 2003, was primarily used for military surveillance. It cannot be dismissed that future Chinese manned space stations planned for the next decade could perform defensive and offensive military-space missions."[30]

Either these analysts forget, however, or don't care, that the size of the Space Shuttle cargo bay was specifically dictated by the U.S. military in order for it to carry intelligence payloads, or that the Pentagon nearly stopped the ISS

in its tracks with its demand to retain the right to conduct research there. Few U.S. analysts would suggest, however, that either the shuttle or the ISS is a cover for military space activities. Consequently, the tone of the concerns about the Chinese activities comes across as more than a little hypocritical.

Whether the promulgation of documents and activities interpreted as potentially threatening has gone generally unnoticed by the mainstream U.S. media and the public – and subsequently policy-makers – or, alternatively, that there is "near-hysterical ranting" by those against weaponization, who invoke charges of fear mongering and "whipping up anxieties with little rational justification"[31] – depends on perspective. A third perspective states that talk about space weaponization is merely "bold rhetoric" on the part of military officials that should not be taken seriously.[32] Unfortunately, the Chinese and others are unsure when the United States should be taken seriously and when it should not. After all, the United States has made errors itself, perhaps most notably when Washington dismissed *glasnost* and *perestroika* as Soviet window dressing. Perhaps not coincidentally, space in many ways remains one of the last venues of Cold War thinking, with assets considered so important that zero-sum thinking prevails.

There is some evidence that policy-makers now are considering public opinion in U.S. space policy. The new National Space Policy that has been due out 'any day' for months will likely not include language as explicitly supportive of space weapons than it might have had weaponization not garnered media attention briefly in May 2005.[33] It is far more likely, however, that it was U.S. public opinion seen as potentially reacting negatively to an overt weaponization policy, and hence influencing policy, than international public opinion. But international public opinion influences reactions in and from other countries with which the United States must then contend.

Influence attitudes and behavior through communications strategies. Militarily, the world understands that it is futile to take on the United States force-on-force. That makes asymmetrical responses both logical and attractive. While it does not currently appear to be the case, China could seek an asymmetrical advantage in space as well, since parity is technically and economically out of the question for some time, and perhaps not even needed to be a space power.[34] Currently, however, Beijing does not have a coherent military space architecture, but rather it appears to be actively pursuing a wide-range of capabilities. China watched the United States establish space dominance in the first Gulf War, Kosovo, Afghanistan and Operation Iraqi Freedom. It realized how far behind it was. "We are so dominant in space that I pity a country that would come up against us," said Maj. Gen. Franklin Blaisdell, director of space operations for the Air Force, eight days before Operation Iraqi Freedom began.[35] Nevertheless – or perhaps at least partly pushed by that pronouncement – China clearly feels compelled to develop military space capabilities.

Two critical events occurred in 2001 that the Chinese interpreted as sending clear messages to them. First, as noted earlier, the United States issued the Space Commission report. The part of the report that caught the attention of the Chinese was the statement that space would inevitably become a battleground, therefore the United States would be remiss not to prepare,[36] with the unspoken assumption being that preparation meant the development of space weapons. Second, the United States held its first-ever space war game, called Schriever I.[37] In that well-publicized war game, U.S. forces were pitted against an opponent threatening a small island neighbor, one about the size and location of Taiwan. It didn't take the Chinese long to conclude that they in turn would be remiss not to prepare for the inevitability of U.S. development of space weapons, as China might well be the target of those weapons. From the Chinese perspective, officials have concluded that if the United States would be remiss to not prepare for the inevitable weaponization of space and against a space Pearl Harbor, they would be remiss not to prepare for the execution of the U.S. *Counterspace Operations* doctrine as part of a unilaterally developed and supported preemptive action. Is that the response that the United States has been seeking?

Both China and the United States see space assets as so valuable to their national security equations that any gain made by one country in advancing its capabilities is viewed as not just threatening but as a loss by the other. China is interested in developing military space capabilities as part of its military modernization effort, as are most countries in the world. It is further interested in development of space capabilities as part of globalization efforts and to send a techno-nationalist message regionally and globally. But China is also responding to the message it hears from the United States.

Rather than the Space Pearl Harbor analogy, perhaps another analogy should be considered instead: Space 1914. While far from a perfect analogy, the image of two countries becoming locked into a particular understanding of a strategic environment and unnecessarily setting themselves on a course for future crises with considerable escalatory potential does fit. The resultant conflict could have been wholly avoidable, had the participants a better understanding of the true situation. Strategic communication should make that better understanding possible.

Intended Message/Received Message

The United States says it is interested in working with China "as a global partner." Yet actions don't match words when in functional areas such as space, it maintains a strategy that the United States might characterize as hedging, but many see as containment,[38] trying to ignore the Chinese regarding cooperation in space while the other nations of the world are falling all over themselves to engage China. China, on the other hand, is making it clear it is open to cooperation. In fact, at the first International Association for the Advancement of Space

Safety (IAASS) conference, held in Nice, France, in October 2005, an official from the government-run China Aerospace & Science Corporation (CASC) offered an open invitation to international cooperation on Chinese programs during a presentation. So, while engaging in a dialogue of ideas between people and institutions is one of the four fundamental premises of strategic communication, the United States has summarily rejected that premise regarding China and space. The message from the United States is clear in that regard. Whether it is the right message, however, is increasingly doubtful.

In other areas, regarding U.S. intentions in space and the U.S. view of Chinese space activities, the message is less clear. The United States seems to be almost schizophrenic in denying any intentions regarding space weapons on one hand and having Air Force officials boast of their accomplishments and gee-whiz programs in that area, based on no apparent requirement, on the other. Further, holding and widely publicizing a space war game with China as the obvious 'enemy' could be interpreted as indicating U.S. plans. Was that the intent?

Moreover, the United States makes arguments that come across as hypocritical. When the United States pursues certain technologies, remote sensing and communications, for example, it is for connectivity in a global world. When China pursues similar technology, nefarious intent is assumed because of its Communist government. In the area of smallsat and microsat technology, the pursuance of programs like the XSS is presented in the United States as defensive, while China's small satellite program is viewed as an obvious step to developing an offensive ASAT capability. Even Chinese manned space activities are viewed by conservative analysts in the United States as inherently for military gain, though the United States was unable to capitalize on a manned program for military gain except indirectly and NASA has not been immune to the Pentagon imposing itself on its programs.

Finally, the United States has made it clear that it is not interested in space arms control – while China and Russia have led the world in obtaining a majority vote at the United Nations – where the United States once again comes across as holding a position diametrically opposed to world opinion, and once again appears to focus on military answers to all questions of international relations. Consequently, it seems that China may currently hold a global advantage over the United States regarding strategic communications on space. Although U.S. policymakers may presume that as a democracy, U.S. intentions are inherently viewed as benign, opinion polls show this is a false presumption. While the United States may see itself as Han Solo or Obi-Wan Kenobi, much of the rest of the world, including China, hears the eerie voice of Darth Vader when the United States speaks of its plans in space.[39]

Conclusion

Space is an enabler of globalization and of military modernization. China

fully intends to be active in both. China is determined not to allow the technology gap between the United States and China to continue to grow unchallenged. The more the United States relies on military technology as the answer to all problems, the more China will look for ways to circumvent those technologies – and defense is much easier and cheaper than offense. The United States must find ways to prevent other countries, specifically China, from gaining a military advantage in space without making its own assets more vulnerable. It must do so without being put in a position of having to both dominate offensively and defensively, which realistically may be impossible to sustain.

Reviewing U.S. efforts regarding strategic communication with China on space up to the present, it can only be concluded that the United States is failing in all areas. The United States summarily rejects one key premise; does poorly in the other three; and ultimately is less than clear in presenting a message that will likely invoke a positive response from China, or any country. In fact, the basic problem is that it is not even clear what kind of space activity, if any, China could pursue that the United States would consider non-threatening.

Assuming that the strange bedfellows who thwart engagement with China will continue to exert themselves in many functional areas in the near future, including space – and that is likely the case – then at the very least the United States must decide what message it wants to send China, and other countries, about space and do so clearly and consistently. That effort in and of itself would be a very useful. Equally important, administration leadership is crucial toward overcoming opposition and treading softly into space cooperation with China in the non-threatening area of space science, to allow both sides a better understanding of cultural and bureaucratic differences, and there will be many, relevant to working together. Ultimately, however, if the United States is serious about improving its strategic communication, there is no substitute for dialogue. Acknowledging that China and the United States seek different outcomes from dialogue, including China in the talks about the Bush Moon-Mars Initiative – for which there is already precedent – appears a good place to start, as those talks have been at the strategic level. The intent would be to build the trust necessary to work together on more prickly issues. Some people would likely say that it is impossible to build trust with China, as long as it is Communist. But not trying is not in the best interests of the United States.

The Pentagon's 2005 *Annual Report on the Military Power of the People's Republic of China* describes China as being at a strategic crossroads. The United States clearly will influence what road China takes into the future, generally and regarding space specifically. The good news for the United States is that it appears that China does not yet have a plan for fully integrating space capabilities into is military doctrine or organizations, or for trying to acquire an asymmetrical advantage in space. While Beijing may choose to develop one regardless of U.S. actions, if the United States continues to express a schizophrenic attitude toward

both China and space activities, particularly space weapons, almost certainly it will. The United States thus could give China the focus it has been lacking, and push it down a road the United States doesn't want it to go. Therefore, it is imperative that the United States decide what message it is trying to send about space, and stay on message.

Endnotes

1. The views expressed in this article are the authors' alone and do not represent the official position of the Department of the Navy, the Department of Defense or the U.S. government. The author would like to thank Dr. Tom Nichols and Dr. Andrew Stigler, both of the Naval War College; Theresa Hitchens, Center for Defense Information; and Dr. Gregory Kulacki, Union of Concerned Scientists, for their comments on earlier drafts. The responsibility for the content and views expressed rest solely with the author.
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6. It should be noted too that part of the problem is clearly political. Communication and information sharing issues are less common with businesses, even U.S. businesses, and among non-U.S. entities. European Union officials, for example, state that even on sensitive issues like nuclear affairs, communication and information sharing are far less an issue than their American counterparts claim they encounter.

~Book Release~

Johnson-Freese's next book, *Heavenly Ambitions: Will America Dominate Space?* is forthcoming from Columbia University Press. The book takes a comprehensive look at the future of the United States in space, including both its manned and military space programs, within the context of the space activities of other nations and with an eye toward mapping a future that maintains America's global leadership. The author argues that space is a strategic asset too important to leave its fate to inertia, apathy or a few individuals, as is currently the case, and encourages a broad public debate on the relevant issues.

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Shenzhou and Dreams of Space

Sun Dangen

The successful flight of Shenzhou VI has impressed the world with a profound and lasting image of China's capabilities in space. The mission showcased China's reliable manned spaceflight technologies and validated its ability to manage large-scale projects. Yet, while Shenzhou VI has been a major milestone in China's space program, it is only one step along China's long journey to becoming a great space-faring nation.

China's space program lags behind those of the United States and Russia, and will for many years to come. Facing a large gap in space technology and know-how, China fervently desires international cooperation on space issues, especially with the United States, and believes such cooperation will be beneficial for all parties. China embraces the idea of utilizing space peacefully and seeks to avoid a space arms race. Its space program is intended to advance China's economic and technological development and is neither oriented towards, nor optimized for, military purposes.

A number of recent gestures between the United States and China have set the stage for renewed Sino-American space cooperation. Now, both nations must seize the present opportunity to ameliorate existing tensions and build towards a better future.

A Latecomer but Moving Forward

Despite the increased confidence in its spaceflight project brought about by Shenzhou VI, large disparities still exist in experience and technology between China's manned space program and its Russian and American counterparts. Relative to these two programs, China's program remains in its infant stage.

In April 1961, the Soviet Union's Vostok 1 carried Yuri Gagarin on a 108 minute tour of space. Twenty-three days later, Alan Shepard became the first American to follow suit. It was more than 40 years later, in 2003, when China sent its first traveler, Yang Liwei, into space.

In the course of its Apollo program alone, between 1968 and 1972, the United States sent 29 explorers into space. To date, China has sent only three.

Though China's manned space program began at a comparatively later date it is progressing at a fast pace. The successful Shenzhou V and Shenzhou VI missions, which realized the objective of manned spaceflight, marked the conclusion of the first phase of China's manned spaceflight program, which began

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in 1992. In the context of China's priorities for manned space flight, the real significance of this first phase was in its demonstration of China's capability to perform human-operated scientific experiments in space.

The objective of the second phase will be the construction of an orbiting space laboratory. This laboratory will be manned and operated on an intermittent basis, and will orbit unmanned for an extended period. The challenges to be met during this phase will include: rendezvous and docking procedures between the space laboratory and a spacecraft, shuttling astronauts between the Earth and the laboratory, testing their living and working conditions in space, and accomplishing a spacewalk.

The third phase will involve the creation of a Chinese space station. Two to three astronauts will be stationed there for extended periods of time in order to conduct scientific experiments, again serviced by shuttles transporting supplies, materials and experiment products.

Four further Shenzhou missions have already been planned in order to advance this agenda. The next flight, Shenzhou VII, will feature a spacewalk; Shenzhou VIII will launch a target object with which Shenzhou IX will subsequently execute an unmanned docking exercise. Shenzhou X will then carry out a manned docking test. The intervals between the launches of Shenzhou VIII and Shenzhou X will be very short, with a schedule of approximately one launch per month.

In the longer term, China's space agenda, like that of the United States, includes plans for lunar exploration. China's lunar program will also be divided into three phases. The first phase, scheduled for 2007, will send an exploratory satellite into orbit around the moon. The second phase will send exploratory robotic landers to the moon by 2015. The third phase will see astronauts land by 2020, two years after the United States plans to launch its next generation of explorers.

Benefits of Manned Spaceflight

The economic benefits generated through manned spaceflight are evident, with great rewards on investment. According to the International Space Business Council's *State of the Space Industry*, a report published in August 2005, revenue from the space industry's global commercial services and government contracts totaled $103 billion in 2004. This figure is expected to surpass $158 billion by 2010. The ratio of financial input to output of the space industry is about 1:2, and the corresponding ratios of supporting industries range from 1:8 to 1:14. A manned space program, therefore, contributes to the goal of economic development that lies at the core of China's national development strategy.

For China, the direct economic benefits of the successful Shenzhou VI flight are the revitalization of the country's business in the international satellite launch market. The Long March (LM) rocket has a track record of almost 50

consecutive successful launches, which, coupled with its comparatively lower cost, will provide China with growing numbers of satellite launch orders. Economic returns from Chinese industries related to the space program have already reached 120 billion RMB ($14.9 billion).

Technologies developed for manned spaceflight have also filtered down through numerous Chinese industries into goods produced for daily civilian use. The civilian application of manned spaceflight technologies are found in many aspects of Chinese people's lives and work, including precision navigation, meteorological forecasting and disaster warning. As a vivid example, Chinese farmers living in remote areas gain significantly as seeds with drastically improved agricultural yields are tested in space. This has the potential of helping turn China's vast waste lands into arable fields, which will play an especially important role for a country like China with the majority of its population dependent on agriculture. Such benefits will have a far-reaching significance for improving China's social stability.

Butter, Not Guns

Numerous commentators in the international media have looked beyond these obvious economic rationales and suggested that China's manned space program will greatly enhance its military capabilities. These allegations do not stand up to scrutiny, however. The peaceful objective of China's space exploration program is undisputable.

In the history of human society, every major scientific and technological breakthrough has been closely intertwined with both war and peace. Whether such a breakthrough has aided the advancement of human society or destroyed the fruits of that society has depended on whether the country or organization mastering that technology intends to seek peace through development, or to win peace through wars and hegemony. To take a stark example, nuclear technology is one the greatest scientific innovations mankind has known in the 20th Century. When applied to military goals, nuclear weapons could destroy our civilizations several times over. However, when used for peaceful intent, nuclear technology can play a huge role in the area of energy, medicine and other scientific purposes.

In light of the importance placed on intent, China's space program faces critical choices: to serve military or civilian purposes. China's national development strategy focuses on economic development, with the goal of providing China's vast population a prosperous livelihood by building a harmonious society. Today, China's space program serves the nation's strategic goals: economic development, social improvement and scientific and technological advancement.

Alternatively, when the security of a rising China is threatened or violated, its space capabilities will no doubt be key to protecting the nation's national security interests. This is not unique to China's space program, but is true for the

programs of other major nations, including the United States.

Keeping in mind the important role that scientific and economic development play in China's space program, all the technologies used for China's manned space flights have been essential for sending humans into space and for its peaceful exploration and use. Anyone with rudimentary military knowledge will understand that any assertions to the contrary are inaccurate and incorrect.

One such claim regarding the "dual-use" nature of the Shenzhou program, involves the contention that the powerful Shenzhou launch vehicle, if fitted with a warhead, could serve as an advanced ballistic missile. The liquid-fueled Long March-2F carrier rocket used by China's manned space program requires approximately 20 hours to fuel, unlike the U.S. and Russian mobile, solid-fuel strategic missiles, which can be launched within minutes. Time is the essence for success in modern warfare; which therefore requires light and swift weapons and technologies.

A second line of thinking suggests that the orbital-maneuvering technology utilized by the Shenzhou capsule may allow Chinese missiles to evade a missile defense system. The United States and Russia long ago possessed spacecraft orbital-maneuvering technology, though China developed this technology only in the 1970s. The Shenzhou program has therefore not demonstrated any capabilities that China has not already had for several decades. The capabilities exhibited by the recently deployed U.S. missile defense system are a great deal more advanced than those developed almost half a century ago. Relying on decades-old technology would be 'throwing an egg against a rock,' and will never be a strategic option for the descendants of the military strategist Sun Tzu.

It has also been suggested that instruments aboard the Shenzhou craft may be used for military reconnaissance. In particular, questions have been raised about Shenzhou VI's orbital module, which remained in orbit after the reentry module brought the mission's crew back to Earth. Quite simply, it would be a waste of the

limited resources dedicated to China's manned space program to use the expensive and already-complex manned spacecraft to accomplish tasks that could be accomplished by unmanned satellites. Regardless, the capabilities necessary for any spacecraft do not nearly compare with the surveillance capabilities of major space-faring countries. For instance, the resolution of U.S. ground surveillance satellites is accurate to the centimeter and those satellites have been launched in numbers up to 100 per year, providing coverage of the Earth several times over. China simply cannot compare with the United States in terms of launch capability and Earth surveillance capability.

Other commentators have questioned China's use of military launch pads for its civilian manned space program and of military servicemen for its space crews. These practices are in accordance with the experience of space powers. Both the United States and the Soviet Union recruited their first astronauts from within the ranks of their military – Yuri Gagarin was an Air Force pilot and Alan Shepard a Naval aviator. Military pilots are superior in quality and enjoy a high level of training. Military personnel are highly disciplined and therefore are naturally suited for running a mission as huge and complex as manned space flight. Even today, many NASA employees previously served in the U.S. Armed Forces, and the head of Russia's Federal Space Agency was formerly the general commander of Russia's space forces. Yet, these military men are now engaged in the peaceful use of space. What country has not launched its manned space vehicle from a base operated and commanded by the military? Existing military launch sites are easily transformed and maintained for civilian use.

Certain individuals in the United States exaggerate a 'China threat' by emphasizing the ties between China's space program and its military. Such misguided views go so far as to suggest that China may launch a "21st Century war" against the United States aided by satellite ground stations and anti-satellite systems allegedly deployed in Latin America. Such sentiment is baffling as China has not dispatched a single soldier abroad, with the exception of fulfilling its peacekeeping responsibilities to the United Nations. Furthermore, China maintains no military bases abroad and has been active in promoting the prevention of space weaponization.

China's manned space program is still in an incipient stage, and the technologies, capabilities, quantity and quality of its spacecraft remain substantially behind those of the United States and Russia. China maintains a national policy of 'peaceful development,' and the core of its military strategy is 'active defense.' Objectively speaking, many technologies, including manned space technology, could be used for both civilian and military purposes. Which direction China's manned space program will go and for which purpose these technologies will be used will be determined by the country's political will. Although China's manned space technologies have the potential to be transformed for military use in the future, the world shouldn't assume that China's space program is created for

military purposes.

Peaceful and harmonious development is the existing strategic goal China has set for its future. When the success of the manned space program helps consolidate the country's strength, it will further lock China in the development path of protecting national security with advancement of science and technology and national comprehensive strength. The assumption that China will launch an offensive strike against other nations' satellites is hence implausible. China does not feel the necessity to, does not have the capability to, and will not fight a war against the United States.

Windows of Opportunity

One important purpose for China's manned space program is to enhance its own technology and capability in space. This will lay the groundwork for international cooperation in manned space exploration. Without sufficient capability and strength, China won't be qualified to partner with others and absent communication and exchange of technology beneficial to all parties, cooperation in space cannot be sustained.

China has made great strides in its manned spaceflight through self-reliance and hard work. Today, China has sufficient economic and technical potential to further develop its manned spaceflight program independently. However, a great technological gap remains between China and the original space-faring nations. China therefore realizes that in order to continue effectively down its chosen path of national development, it must join the international space community and adhere without reservation to its norms and common practices. China's manned spaceflight program must cooperate more with other space programs in the international community. Only when the collective wisdom, talent and resources of all nations are put to cooperative use can mankind truly make great strides in exploring space.

Since the 1980s, China's space flight industry has, in fact, had extensive ties with other countries, especially the United States. During the 1990s, China launched many U.S.-made satellites. Unfortunately, this cooperation was interrupted in 1999 when the U.S. House of Representatives released the Cox Commission Report, which groundlessly alleged that China had stolen U.S. missile technologies. This interruption was a great loss to both nations.

At present, the main obstacle to Sino-U.S. cooperation on manned spaceflight is that the United States believes China's space programs lack transparency and are controlled by the military. However, space cooperation and trust between these two nations are gradually being reestablished. Before the launch of Shenzhou VI, the United States volunteered information to the Chinese space program on space debris and U.S. spacecraft activities. China responded with details about Shenzhou VI. Both countries used U.S. Secretary of Defense Donald Rumsfeld's visit to China in October 2005 as an occasion to indicate their sincere interest in

transparency and reciprocity. China, in particular, demonstrated its openness and desire for a Chinese-U.S. military exchange.

A senior member of a U.S. delegation visiting Beijing in January 2006 said President George W. Bush had conveyed that he wanted to discuss space cooperation with China during the Sino-U.S. summit in April 2006. This signifies "a significant step in the right direction" for Sino-U.S. space cooperation. The leader of China's space program has also expressed a strong interest in upgrading the Shenzhou space vessel to be able to dock with any U.S. space vehicle or the International Space Station. This indicates U.S. recognition of China's rapid progress in space exploration, which will increase the potential for cooperation in space, but will also enhance the military ties between the two countries. This, in turn, will contribute greatly to improving mutual trust and world peace.

In the interest of peace and development of the world, China is very open-minded to cooperation in space. With a growing space program, China has every reason to desire cooperation with a space superpower like the United States. China sees great opportunity to enhance its capacities and the well being of its people through joint efforts to explore space and to utilize its resources peacefully. If the U.S. government wishes to demand concrete and reasonable concessions from the Chinese space program in exchange for such cooperation, it should consider those concessions carefully and present them for discussion. Such a position would be a welcome change from the current U.S. approach, which has been perceived by the Chinese as one of besieging, persecuting, blockading and intercepting Chinese institutions and ambitions.

In many ways, the contribution of China's space program to international efforts in manned spaceflight could mirror that of Russia, which now carries provisions to the International Space Station and has taken over astronaut transportation following the Columbia Shuttle accident.

Future space cooperation should build on the experiences described above, and be guided by principles of mutual respect and interest in the goals of economic, human and scientific development through peaceful use of space. In spite of the delicate relations between the United States and China, the two nations can still cooperate closely in exploring the unknown. Further cooperation can include fostering commercial satellite development, developing technology for manned spaceflight, performing scientific experiments in space and cultivating the skills and interest of talents in this area. All cooperation should be voluntary for both countries.

China looks forward to working together with the United States and the international community to explore and exploit space peacefully in the interest of all mankind.

Trends in China's Space Program And the Prevention of Outer Space Weaponization

Teng Jianqun

China's successful launch of the Shenzhou VI manned space vessel on Oct. 12, 2005, once again demonstrated to the world the country's achievements and strength in outer space. In light of this launch, foreign media sources have made a number of conjectures about the future of China's space program. Some have even suggested that it will make obsolete the U.S. missile defense program, and that there will be an outer space arms race between China and the United States. Within China, the state media provided comprehensive coverage of the launch, its activities in space and return of the spacecraft. While authorities have strictly controlled commentary on the launch, they maintained that the goals of China's space program are entirely peaceful, and denied any military application.

In fact, the Shenzhou VI mission had no military component. However, like other technical platforms, the spacecraft itself holds the potential for dual-use applications. Whether China will apply its space technology to weapons is a current issue that has raised many questions. For example, as the military and civilian use of such technology becomes more compatible, is China willing to commit its limited resources towards outer space weaponization? Will China's progress in space technology contribute to an arms race in outer space and pose a challenge to U.S. superiority? As the international community has become increasingly wary over the weaponization of outer space, it is necessary for China to clarify its position on this issue? The author will examine these issues in the following analysis.

Program Goals and Accomplishments

Weaponization is a policy choice rather than a result of having one or two platforms in place. In contrast to its approach in utilizing nuclear energy technology, China has from the outset charted a definitive course for its space industry: to pursue economic and technological development based on the domestic and international environment.[1]

China's space mission began in the mid-1950s though meaningful progress

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only started in the 1980s. Apart from the Shenzhou series, China has also seen encouraging achievements in the following fields: (1) It has formed a relatively complete program ranging from research and design, to experimentation and manufacturing; (2) It has established a network for measurement and control consisting of launch centers, domestic ground stations and remote tracking and measurement systems capable of launching various satellites and spacecraft; (3) It has established a range of satellite applications; (4) It has built a space research system that meet the highest professional standards; and (5) It has trained a large number of highly qualified space science and technology personnel.

China's development in space centers around five major components: (1) *Satellites*. On April 24, 1974, China successfully launched its first man-made Earth observation satellite, Dongfanghong-1. Currently, China's satellite series is divided into five categories: recoverable remote sensing; communications and broadcasting; weather; scientific exploration and technology experiments; and Earth resources; (2) *Launch Vehicles*. China's launch vehicles mainly consist of the Long March series, used to launch satellites into near-Earth, geostationary and solar synchronous orbits; (3) *Launch sites*. China's three launch sites in Jiuquan, Xichang and Taiyuan have completed rocket experiments and successfully launched various man-made satellites and spacecraft; (4) *Space measurement and control system*. This includes establishing land as well as ship-based marine measurement and control networks, a system that has already successfully fulfilled the space measurement and control tasks for near-Earth orbit satellites, geostationary satellites and spacecraft; (5) *Manned space missions*; (6) *A lunar exploration program*. The long-term aim of this program is to set up a base on the moon similar to what China accomplished at the North and South Pole.

China's space applications include: (1) *Satellite remote sensing.* Since the 1970s, remote sensing has seen extensive use in the fields of meteorology, geology and mining, surveying and mapping, agriculture, forestry, water conservation, oceanography, earthquake research and urban construction. China has established the National Remote Sensing Center, the National Satellite Meteorological Center, the National Resources Satellite Application Center, the Satellite Ocean Application Center and the National Remote Sensing Satellite Ground Receiving Station; (2) *Satellite communications*. China began developing its satellite communications technology in the mid-1980s. During this period, China has established dozens of medium- and large-sized satellite communication ground stations serving 27,000 international communications satellite phone lines with over 180 countries and regions as well as nearly 100,000 domestic communications phone lines; (3) *Satellite navigation and positioning*. In the 1980s, China began using foreign navigation satellites to develop satellite navigation and positioning application technologies, which are widely used for geodesy, shipping and flight navigation, earthquake monitoring, geological disaster monitoring, forest fire prevention and urban transport management.

In space sciences, a field that began in the 1980s, China used a recoverable remote sensing satellite to conduct various experiments, making progress in crystal and protein growth, cell culture and crop breeding.

China has set new development goals for its space mission in the 21st Century. These mainly include: (1) Establishing a long-term, stable satellite-to-Earth observation system. The weather, resources and ocean satellite series and the environmental and disaster monitoring small satellites will form a system enabling stereoscopic observation and dynamic monitoring of the land, atmosphere and oceans of China and its surrounding areas; (2) Establishing an independently operated satellite broadcasting and telecommunications system. China is actively supporting the development of commercial broadcasting and telecommunications satellites such as geostationary telecom satellites and TV direct broadcasting satellites with long operating life, high reliability and large capacity, so as to form China's satellite telecom industry; (3) Establishing an independent satellite navigation and positioning system. This includes incremental construction of a navigational and positioning satellite series and relevant application system; (4) Upgrading the overall standard and capacity of China's launch vehicles. This will be achieved by improving the performance and reliability of the existing Long March series and developing the next generation of non-toxic, pollution-free, high-performance and low-cost launch vehicles; (5) Preliminarily establishing a manned space engineering research, development and testing system; (6) Establishing a coordinated nationwide satellite remote sensing application system and a unified plan for building various satellite remote sensing and ground application systems.

Domestic and International Environment

Based on the above review of China's space program ambitions, we can, at the very least, draw the following conclusions. The primary effort is in meeting the challenges in civilian research and development. This contrasts with the early period of China's nuclear energy development, when the primary focus was on developing nuclear weapons. Under the different international security environment today however, China is striving to develop its economy and build a harmonious and prosperous society, for which space technology applied in the broader civilian sector will be a principal driver. In pursuit of its space aspirations, China is realizing the centuries-old dream of 'flying into space' to show itself as a world power and to bolster national spirit.

The international environment China faces presently has changed profoundly since the 1980s. 'Peace and development' have become the theme of the times. China no longer faces the nuclear threats and blackmail it once did in the 1950s and 1960s. According to statistics from Indian scholars, from its founding in 1949 to the 1980s, China has been threatened with use of nuclear weapons at least 40 times by certain powers, mainly the United States. However, in recent

decades, without pressure to use outer space technology for military applications, major space-faring nations including the United States and the Soviet Union (later Russia) have begun to cooperate extensively in space. Such collaboration, including satellite launches, is the inevitable outcome of easing Cold War tensions.

Over the past 20 years, the development of China's space program has coincided with the country's reform and opening-up. In the mid-1980s, with potential threats such as invasion and intervention by foreign military powers decreasing, China shifted its focus to economic development. This led to a fundamental change in China's military posture. Up to this point, China's military had been readying itself for imminent war. The state of alertness in "preparing for an early war, a big war, a nuclear war", as advocated by Mao Zedong, was abandoned.[2] Consequently, the People's Liberation Army (PLA) that had for decades been the country's top priority was downgraded to serving and yielding to the country's comprehensive economic construction. Thus began the period of development under which the guiding principle for the PLA would be restraint. This was reflected by full-scale disarmament. Between 1985 and 2005, the PLA was reduced in size by 1.7 million. At the same time, China has entered a stage of full economic liberalization and development. Standards of living have risen significantly and China's comprehensive national strength has noticeably improved. Such a domestic environment suggests that China will not develop its space program in the same way its nuclear program was developed under Mao and the first generation of leaders – through belt tightening and military application. It is neither realistic nor necessary to commit limited space resources to military purposes.

During this current period of transition, China's decision-makers are well aware that the economic structure and ideological framework on which the country has operated for decades are cracking. Both the national economy and individual ideology are rapidly transforming. To unite its people, China must initiate activities and programs that boost morale and lift the national spirit. One message is clear from the enthusiastic, though controlled media coverage of the Shenzhou spacecraft series, particularly Shenzhou V and VI: their significance far exceeds the launch of the spacecraft. The successful manned space program is not merely a technological feat, but an embodiment of national spirit. Along with achievements such as winning the bid to host the Olympic Games and accession to the World Trade Organization, the Shenzhou launches are considered by the Chinese people as symbols of the nation's strength.

Given the current circumstances, it would not be possible for China's space mission to principally focus on military application. Expanding the military applications of China's space program would demonstrate total disregard for the current international security environment and China's focus on economic development. China does not have such intention or plan. Conversely, China will accelerate scientific research in space, which will spearhead its advance in

comprehensive national strength to ensure its status as a major power and its place in the international development of outer space.

Evolution of War

The lessons of history show that absent any restrictions, where social and economic productivity develops, military innovation will not be far behind. The military has always been highly sensitive to changes in the level of social productivity. In fact, the expansion of battlefield and the development of new weaponry have been almost in direct sync with economic and technological development. Consequently, it is reasonable to assume that the development of human productivity will ineluctably bring war from land, sea and air into outer space if no constraints are placed on it.

One of the key reasons for this is the inherently neutral quality of innovation and technology. Virtually, any advancement in human productivity can be used for peaceful or non-peaceful purposes. The development of atomic energy is a telling example of the organic dual-use nature of technology. Nuclear reactors have not only provided mankind with a new energy source, but have also led to the production of highly destructive weapons. World powers eventually negotiated the Nuclear Non-Proliferation Treaty, but only after nuclear proliferation became a reality. Like nuclear power, mature space technologies also have an inherent dual-use application. Admitting only to the civilian use of space and not its military function would be to deny reality. Likewise, making the same mistake in controlling the use of space will prove both costly and disastrous.

The advance of modern human productivity and progress in technology have profoundly transformed the battlefield, weaponry and combatants, all of which are interdependent and often mutually reinforcing. The expansion of the battlefield constitutes an intangible developmental force and can give rise to new weapons. New weapons in turn can also enlarge the battlefield or create a new spatial dimension for warfare. Both affect the way in which the combatants operate. The relationship between them is reflected in the fact that the emergence

of every new weapon is the result of a need on the battlefield at the time. When a new weapon appears, the space occupied by the old naturally gives way to the new.

When man fought with his bare hands, the battlefield was limited. The advent of gunpowder and firearms created an entirely new reality for warfare, vastly extending the size of the battlefield and virtually eliminating the need for hand-to-hand fighting.

Today, combatants have also radically changed from the uniformed rank and file of soldiers to civilians. During the attack on the United States of Sept. 11, 2001, the terrorists responsible were not soldiers in uniform but common civilians. Their weapons of choice were neither fighter jet planes nor tanks, but civilian passenger planes. Such transformation of the battlefield and those fighting on it is unprecedented. The nature of war is undergoing profound and systematic changes. We must redefine the true meaning of security, war, military buildup and modes of battle. Traditional experience no longer applies.

In utilizing modern weapons soldiers can achieve maximum damage with relatively little effort. One such modern battlefield that has emerged in recent years is cyberspace. In this environment, information war can begin on one side of the world and strike a target on the other. It can destroy banking systems or paralyze the traffic control system of the target country. It has also given rise to 'digital troops' and intangible electromagnetic space and information weapons. While the battlefield may be virtual in nature, its power can nevertheless be equally destructive to dropping an atomic bomb over a city.

As battleships brought war to the seas, and airplanes brought war to the sky, mankind's efforts to conquer outer space has brought warfare there too. Furthermore, it is in the environment of space where the most drastic transformation of the battlefield and weaponry is taking place. Currently, developed countries have made information and space technology the platform and primary means of competition. The widespread application of military satellites, space vehicles and other armaments has appropriated the tranquility of space. Though people have not yet fully envisioned all the new weapons that can be brought about by the integration of information and space technology, we have nevertheless seen the beginning of such trends.

In 2000, Gen. Ralph E. Eberhart, commander of the U.S. North American Aerospace Defense Command, noted that outer space is increasingly indispensable to ground, sea and air combat. Thus, the United States must focus its attention on space dominance. On Jan. 11, 2001, the U.S. Commission to Assess United States National Security Space Management and Organization (Space Commission) recognized the need to prevent a "space Pearl Harbor" against the United States. It noted that like land, sea and air, the "mission" of outer space will, without exception, become a venue for military competition and the United States should make early preparations for this eventuality. In fact, when the United

States began its pursuit of space technology over a half century ago, American leaders, including John F. Kennedy, had already begun to understand the military significance of outer space. They realized that whoever controlled outer space would also control the Earth.

Today, the advancement of social productivity and technology brings man into outer space, and along with it, military influence will spread to every facet of space development. If the international community allows this trend to continue, the weaponization of outer space will become a reality. However, the international community has learned its lessons from previous arms races, and understands that it is not only imperative but also feasible to prevent one in outer space. With the advances of technology, increasing economic globalization and growing human aspirations for peace, controlling space weaponization is an urgent task for the greater international community.

The Time to Act is Now

The international community should draw lessons from history and should either halt the current drift toward space weaponization or, at the very least, slow its trend. Space-faring powers should recognize the dual-use applications of space technology and make the universal and peaceful use of space their first priority.

The international community has had prior success in preventing certain technologies that have the potential for the destruction of mankind from serving military purposes. The laws of war in the long history of international relations are the crystallization of such efforts. The signing and entry into force of the Chemical Weapons Convention (CWC), which banned an entire category of weapons of mass destruction, has fundamentally standardized the act of war. Of course, such efforts were only undertaken after countless casualties to soldiers and civilians.

On the other hand, it takes far greater effort to prohibit certain technologies from being applied to military purposes after a period without controls than at an early stage when such capabilities are monopolized by a minority of countries. It is far more difficult to set restrictions over the development and use of such technologies once they begin to proliferate. The Nuclear Nonproliferation Treaty took effect 30 years after the first use of nuclear weapons and its effectiveness has been severely weakened as a result.

If efforts to standardize nuclear proliferation had been made in the 1940s and 1950s, and if the international community had made consistent efforts to adhere to strict regulations, the nonproliferation situation today would be significantly different. Confronted with maturing space technologies, mankind must be both brave and wise enough to nip in the bud the natural tendency towards developing increasingly destructive weapons. This is all the more necessary, and difficult, in a closely integrated world where many different countries with their

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own goals, values and interests must work closely together to deal with new technologies that easily move across borders.

The broad application of modern technology to military affairs is bringing profound and comprehensive changes to the nature of warfare and the level of its destructiveness. Thus, any country's pursuit of outer space weaponry will inevitably draw negative attention and reaction from other countries. Space weaponization is a double-edged sword. Some big powers may gain advantages in outer space at a certain time but will not be able to monopolize it forever. Therefore, concerned countries will need to sit down and develop rules to standardize space conduct. Although actions that come late are better than never, the price of delay is often too high, a lesson the international community has already learned through international arms control and disarmament. Establishing effective rules of the road to prevent or delay space weaponization is the right and necessary choice.

Following the Cold War, it has been a principal national policy of most countries in the world is to use their limited social resources and wealth to raise standards of living of their citizens and increase comprehensive national strength. How to best use these limited resources and wealth is a crucial question facing every nation in the world. This is especially true following the end of the U.S.-Soviet standoff, when imminent large-scale conflict appears increasingly unlikely. Developing a stable economy has become a near universal priority of every nation. China is a great success story in this regard. Since the mid-1980s, China has shifted from a posture of war readiness to focusing on peaceful development, with remarkable achievements to show for it. A key reason for this success is China's sensible distribution and use of its domestic resources.

In the foreseeable future, China will concentrate on the development of space technology for civilian use as a driver for economic development. Meanwhile, China will undeniably pay close attention to the progress in space by other nations, particularly the United States, but China will by no means emulate the United States and develop a space weapons program. China has not formulated such policies and does not have sufficient resources to compete with the United States in outer space. Conversely, China is more than willing to cooperate with space powers such as the United States, Russia and the European Union in establishing rules to prevent the weaponization and preserve the tranquility of outer space in the 21st Century.

Endnotes

1. This section consists of updated excerpts from: "*White Paper: China's Space Activities*", The Information Office of the State Council of the People's Republic of China, November, 2000.

2. Huang Guozhu, Jia Yong, Cao Zhi, "Voyage in Peaceful Time: Deng Xiaoping and the China's Way of Streamlining and Strengthening the PLA", *Xinhua News Agency*, Aug. 16, 2004.

Blockade on China or the United States? U.S. Regulatory Policies on Space Technology Exports to China

Guo Xiaobing

There are two puzzles surrounding U.S. regulatory policies on space technology exports to China. First, among the major space faring nations, China is the only country that the United States has excluded from its space cooperation strategy. Europe and Japan have benefited greatly from their space cooperation with the United States. The former director of the Centre National d'Etudes Spatiales (CNES), even referred to CNES as a little baby of NASA. In the former Eastern Bloc, the United States has adopted an engagement policy and allowed for the establishment of a joint launcher with Russia and Ukraine to canvass business worldwide. This policy kills two birds with one stone. Not only does it reap the business benefits intrinsic in the advanced rockets of the former Soviet Union, but also highlights the security benefits of preventing space technology proliferation. The Iron Curtain is gone and the East and West have been cooperating, with the International Space Station (ISS) acting as an important symbol. However, there is no trace of Chinese participation in this international project.

The second puzzle is that despite this blockade by the United States, China's space capabilities have improved tremendously with regards to manned space missions and satellite exportation. Conversely, the United States, though it is the implementer of sanctions, finds its own share of the commercial satellite market falling continuously. The ISS, advocated by the United States, has been in dire straits, mainly due to the breakup of the Columbia Shuttle.

In the face of these conundrums, the Chinese people cannot help but inquire: Why is the United States isolating only China? And why has this policy of isolation produced precisely the opposite of its intended result? Is the United States blocking China or has it put shackles on itself? Should the current policy be continued? This paper will make a brief review of these issues.

The "Continental System" in an Era of Globalization

The United States began imposing restrictions on space exports to China during the Cold War era. At the time, satellite and other space materials fell under

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the Coordinating Committee for Multilateral Export Controls (COCOM)[1] industrial product list. To launch U.S.-made satellites or purchase relevant satellite materials made by COCOM members, China needed to secure COCOM approval. The legal basis for current U.S. regulations of satellite exports to China is the *Foreign Relations Authorization Act* of FY 1990 and 1991. This act forbids the use of Chinese rockets to launch U.S.-made commercial satellites. Consequently, an agreement was reached between the United States and China whereby an exemption must be obtained from the U.S. president for any U.S. commercial satellite to be launched by China. Moreover, the agreement stipulated that Chinese Customs cannot perform security inspections on U.S.-made satellites when they enter Chinese territory.[2] While the satellites are inside China, the United States should implement 24-hour monitoring on the security of such satellites. During the administrations of George H.W. Bush and Bill Clinton, the mainstream view held by the U.S. government was that utilizing China's low-cost space launch capacity would help strengthen U.S. business competitiveness and expand the market share of U.S. satellite markets. As a result, the United States adopted a fairly liberal approach to the issue of satellite exports to China. The dispensing power was exercised several times to allow the use of Chinese rockets to launch U.S.-made satellites.

In 1996, the Clinton administration transferred oversight of the export of satellites and other space materials from the State Department to the Department of Commerce. This decision further reduced obstacles to commercial satellite exports. Although it did not remove the ban of 1989, it did facilitate satellite export to China. Furthermore, it was a peak moment in the U.S. relaxation of its space export restrictions and promotion of free trade following the end of the Cold War.

The National Defense Authorization Act for Fiscal Year 1999 adopted by Congress in 1998 was a turning point in U.S. regulatory policies on space exports to China. Under this act, commercial satellites and other space materials were defined as munitions. Thus, oversight of such materials was returned from the Export Administration Bureau of the Department of Commerce to the Office of Defense Trade Controls of the State Department.

The cause of the above developments go back to the 1990s when a series of accidents occurred, especially the February 1996 explosion during a launch that resulted in the destruction of both the Chinese Long March 3B launch vehicle and its payload of U.S.-made Intelsat 708 satellites (produced by Space Systems/Loral). At the request of insurance companies, U.S. companies Hughes and Loral took measures to review the Chinese side's investigation results. However, during the process they made a procedural error by sending their review report to the Chinese side without first submitting an application to the relevant U.S. authorities. Afterwards, the companies concerned took the initiative to report the situation to the U.S. Department of Commerce. The matter was itself purely a

procedural error and the two companies transferred no technology of any kind to the Chinese side. However, some in Washington seized the opportunity to stir controversy, which evolved into a countercurrent against U.S.-Chinese commercial cooperation. Some congressmen exaggerated the significance of the incident, claiming that each time the United States exports satellites to China and makes payments to the Chinese government; it actually helps China, directly or indirectly, to improve its missile launch capabilities.

In March 1999, as noted above, the jurisdiction for licensing commercial satellite export was transferred to the State Department and commercial satellites were once again labeled as munitions, as they were prior to the 1996 reform. The legal basis for the State Department's oversight of commercial satellite export thus became the ITAR (International Traffic in Arms Regulations) regime. The export procedures under ITAR are much stricter and more complicated than the Department of Commerce's EAR (Export Administration Regulations) regime. Separate permits are required for the export of each article or technology falling under ITAR jurisdiction; several permits may therefore be required for the export of one satellite. Technical data require a permit, as does application and actual hardware export. A permit is further required when final shipment is executed. Satellite technology exports valued at $50 million or more, which includes nearly all satellite-related sales, require congressional approval prior to the State Department's issuing a license. When articles under ITAR regulations are to be transferred, exported or re-sold by the initial recipient country, approval must first be obtained from the State Department. In addition, any commodity made in a foreign country is seen as a U.S.-made commodity so long as it contains parts or subsystems under ITAR regulations, regardless of quantity. The sale and export of these commodities also require permits from the State Department. In other words, following the regulatory changes, in order for a U.S. company (or a non-U.S. company using U.S.-made parts) to sell commercial satellites to China, a license (or series of licenses) from the State Department is required. Otherwise, companies (and nations) face the threat of sanctions.

After the export license jurisdiction was transferred, the U.S. Department of Commerce maintained oversight over non-sensitive space articles, such as space-qualified tape recorders. Unfortunately, the Commerce Department is not friendly either, as Chinese space-related end-users are on the top of the department's black list.[3] The Department of Commerce recently listed a total of 57 foreign entities that may not receive U.S. exports. Of those, 19 were Chinese, putting China at the top of the list of nations with blacklisted entities. Further, 11 of the 19 end-users were engaged in space research; the list included institutions of higher learning such as Beijing University of Aeronautics and Astronautics and Northwestern Polytechnic University of China.

Since 2000, the United States has, time and again, failed to approve any export license for a satellite sale to China on the grounds of missile technology

proliferation. Despite their desire to cooperate, Chinese launch companies and U.S. satellite makers can do nothing about it.

In history, it is not uncommon for countries to use export control to weaken competitors. Generally, there are two means of regulation. The first is so-called target regulation. For instance, to prevent another nation from developing weapons of mass destruction, strict regulations on exports of specific nuclear, biological and chemical materials can be employed. To prevent another nation from developing its conventional forces, restriction of the sale of certain advanced weapons and military technology can be used. The second regulatory means is comprehensive regulation, which weakens another nation's economic foundation through blanket restrictions on all types of civilian and military trade, thus reducing resources for use in military development. France's "Continental System" policy serves as an apt example. Some 200 years ago, Napoleon strictly forbade countries on the European continent to trade with Britain in an effort to destroy the British economy. Those breaching the order would be executed, while those leaders instigating trade would be deposed. U.S. regulations on space exports to China belong to this category. Not only are military space items and technology regulated but so too are satellites used strictly for commercial purposes. Therefore, it is no exaggeration to refer to U.S. policy as a "Continental System" in the modern space field.

Both China and the United States Pay a Price

Has China paid a price for the U.S. policy of isolating China in space? The answer is partially affirmative. The U.S. regulations on space exports have indeed caused certain difficulties for the development of China's space industry.

China is at a low point in terms of commercial satellite launches. It has been excluded from this market for six years. During the 1990s, China's commercial satellite launch services flourished. Between 1990 and 1998, it sent 29 foreign satellites into space on behalf of more than 10 countries and regions. This accounted for seven-to-nine percent of the market and made China the third largest rocket supplier in the world. American satellite makers were the main partners of the China Great Wall Industry Corporation (CGWIC). After the U.S. government banned satellite exports to China, however, Chinese launch companies' supplies were cut off and CGWIC suddenly had no satellites to launch. From that point through 2005, CGWIC has not launched a single foreign satellite. Europe and Japan have largely stepped in to capture the market share made available after China's withdrawal.

The business activities of Chinese satellite operators were also affected. There are two important cases which illustrate the gravity of these losses. The first is that of China Satellite Communications Corporation (China Satcom), which signed a satellite purchase contract with Loral in 1997 for the ChinaSat 8 satellite. Under the contract, Loral was to build the satellite, while CGWIC was

to use its Long March rocket to put it into orbit. However, the U.S. government was unwilling to issue a launch permit, with the result that ChinaSat 8 has been in storage ever since. China Satcom has suffered heavy losses as a consequence. Apart from the $130 million spent to purchase the satellite, it has also lost service revenue of over $300 million.

A second example is the case of the Apstar 5 satellite, acquired by the Hong Kong-headquartered APT Satellite Holdings Limited (APT). For identical reasons, the launch date for Apstar 5 has been postponed time and again. The direct result of this has been a decline in orders and the loss of customers for APT. For example, SingTel, an important customer of APT, has reduced the number of leased transponders from 15 to six. Apstar-1A, which is to be replaced by Apstar 5, has also seen its lease rate fall. Furthermore, as supplementary facilities have long been left idle, operating costs have increased. APT has built a completely new 50,000-square-foot satellite testing and control center along with a 125,000-square-foot telecommunication port, but because Apstar 5 cannot be put into space, the time taken to return the investment on these infrastructure facilities has been greatly extended.

Finally, China has been excluded from international space cooperation projects, such as the ISS, in part because of the difficulties relating to ITAR. As a result, the cost of its space research is higher, as there are fewer opportunities for China to learn from scientific exchange and the advanced management experience of developed nations through multilateral cooperation.

For U.S. Industry, Numbers Speak Volumes

As a result of the above state of affairs, Chinese launch companies and satellite operators have been hit hard, but are their American counterparts faring better? In fact, their situation is equally adverse, which is reflected in reports issued within industry circles, the government and independent research institutions. Data from the Aerospace Industries Association, which represents U.S. aerospace firms, show that the value of U.S. civilian satellite and satellite component exports dropped to $410 million in 1999 from its peak of $670 million in 1998, representing a sharp decrease in revenues of 39 percent. In 2000, it fell further to $170 million, down by 59 percent. As for communications satellites, U.S. companies were winning 76 percent of the total orders for geosynchronous orbit communications satellites in 1997. In 1998, they still maintained a 73 percent stake in the global market. Following the introduction of the U.S. policy of isolating Chinese space endeavors in 1999, this figure plummeted to 52 percent.[4]

Figures released by the U.S. Department of Commerce support the industry analysis. William Reinsch, undersecretary of commerce under President Bill Clinton, noted in his testimony to Congress in 2000 that U.S. satellite exports had already fallen by 40 percent just nine months after satellite export licensing was transferred from the Department of Commerce to the State Department.[5]

U.S. think tanks have also expressed deep concern over this loss of market share. In its 2002 report, *Preserving America's Strength in Satellite Technology*, the Center for Strategic and International Studies (CSIS) noted that in 1995, U.S. satellite parts suppliers held 90 percent of the international market.[6] By the year 2000, this figure had fallen to 56 percent. By contrast, European suppliers saw their market share grow to 34 percent in 2000 from less than 10 percent in 1995. If this trend is not reversed, CSIS warned that small and medium-sized U.S. satellite component suppliers would disappear from the market.[7]

Root of the Problem

Industry circles, the government and the think tank community all believe that the root of the problem lies in the transfer of satellite export licensing to the State Department in 1999. In other words, the transfer has brought five distinctly negative effects upon U.S. commercial space activities:[8]

- Prolonged delivery time. The State Department's ITAR regulation procedure is complicated, requiring a fairly long examination and approval time. For international users, the length of satellite export permit examination and approval is a decisive factor. Intelsat and Eutelsat, both long-time customers of U.S. satellites, have all publicly stated their desire to procure European satellites rather than deal with the trouble of applying for U.S. export permits.
- Increased cost. The policy has made it impossible for U.S. satellite manufacturers to take advantage of China's cheap and reliable space launch services, thus depriving them of having a price advantage in the international market.
- Obstacles in space launch insurance. European companies have captured the majority of the international space insurance market. The restrictive U.S. regulatory policy on satellite export adds a cost burden and technological hurdles in completing their risk assessment and other relevant work.
- Transit trade obstacles. The overseas jurisdiction right as stipulated in ITAR weakens the attraction of U.S. satellite components. In order to avoid U.S. export restrictions, French-based Alcatel is now making satellites without U.S. parts. It has spent millions of dollars to build a supplier base outside the United States.
- Missed business opportunities in China. Satellite business has been growing rapidly in China. There is a very large market demand for communications, weather and navigation satellites. To avoid the risks posed by U.S. regulatory policies, Chinese satellite service vendors have begun shifting their sights to other countries. APT Satellite Holdings Limited once bought four satellites from the United States: Apstar-1, Apstar-1A, Apstar-2R and Apstar-5. Due to the negative influence of the Apstar-5 fiasco, it recently chose Alcatel for purchasing its Apstar-6 satellite. France promised to issue an export permit unconditionally and the satellite will be launched by China's Long March rocket. China Satellite Communication Corp. has bought no satellite from the United States since

ChinaSat 8. Sino Satellite Communications Company Ltd. also did not consider the United States in the purchase of its new Sinosat 2, choosing instead the China Academy of Space Technology.

- Damage to U.S. companies' reputation as reliable suppliers. This is the last aspect, but not the least in terms of significant long-term implications.

In the highly competitive space industry, any obstacles are sufficient to cause international customers to seek alternative means. Cooperating with China is an attractive option.

An International Club without ITAR

While the United States has distanced itself from China in space activities, other countries are growing closer, including Russia, several in Europe, Brazil, and a number in the Asia-Pacific region. There exists a wide range of cooperation in space between Russia and China. In the period of 2004 to 2006, 29 new cooperation projects have been initiated. China and Russia will launch a joint deep space exploration program in 2007 and join forces to explore the Sun and Mars.[9] Deep space exploration is not China's strength and cooperation with Russia will help China to speed the development of relevant technologies in this field.

With regard to the European Union, China was the first non-EU member state to take part in the Galileo project and has agreed to contribute 200 million euros. Throughout the first phase, it will invest 70 million euros in research. In addition, space cooperation projects between China and Europe include the "Double Star Program" and the "Dragon Program" between the European Space Agency and China's National Remote Sensing Center. The "Double Star Program"[10] has already achieved initial results, while the "Dragon Program"[11] has played an active role in flood control and relief work in China. Drawing upon the high definition pictures provided by the satellite, the Chinese government is capable of making rapid disaster evaluation and initiating quick response. Sino-European cooperation will continue to expand, on Nov. 28, 2005, the China National Space Administration and the European Space Agency signed a space cooperation agreement, covering areas such as space science, Earth observation, communications, navigation and microgravity research.

The Earth resources satellite cooperation between China and Brazil can be heralded as a model of mutually beneficial cooperation. It not only improves China's satellite R&D ability but also allows Brazil to acquire independent remote sensing imaging through launching CBERS-2.[12] Brazil no longer needs to rely on U.S. Earth resources satellites to provide ground pictures. China and Brazil have also explored the possibility of jointly researching and developing weather and communications satellites, signing a cooperative agreement in 2003.

China has had success in multinational cooperation in Asia as well. It has promoted the establishment of the Asia-Pacific Space Cooperation Organization.

Headquartered in Beijing, APSCO is an organization that aims to foster multilateral cooperation in the application of space technology amongst its members which include Bangladesh, China, Indonesia, Iran, Mongolia, Pakistan, Peru, Thailand, Argentina, Malaysia, Russia and Ukraine.

China is a strong partner as its reliable and low cost space hardware and services offer an attractive option for these countries. China has fairly mature space launch capabilities and a burgeoning satellite industry. Cooperating with China allows partner countries to reduce their burden and lower risks. At the same time, it allows them to skirt U.S. regulatory obstacles. With the exception of the United States, no country classifies commercial satellites as munitions. Furthermore, only the United States views foreign satellites that contain American made components as its own product and therefore subject to stringent U.S. export controls. Many of the countries partnering with China are fed up with the U.S. practice of imposing its own standards on others.

In March 2004, the British newspaper *The Observer* pointed out in a discussion on the reasons for developing the Galileo system that U.S. policies do not sufficiently consider others' interests.[13] It noted that (Europe) should not trust the United States in developing its satellite positioning system. Jacques Blamont, former CNES director, who acknowledged the close association between his center and NASA, said that an international network to avoid ITAR regulations has gradually formed due to the increasing frustration with U.S. regulatory policies. Countries including Russia, China, India, Japan and Europe, as well as other organizations, have collaborated to circumvent the use of U.S. satellite components. Though he says this trend is likely to increasingly define the international satellite export market, it does not mean these countries will formally organize against the United States. Rather, such moves will likely be decided based on the needs and interests of individual companies and nations.

China has gradually shrugged off its depressed position in the international commercial satellite market. On April 12, 2005, China successfully launched the Apstar-6 satellite for APT, signaling a formal return to the international commercial launch market. In the development of its space industry, China has also overcome the handicap of being 'strong in one leg and weak in the other;' that is, having strong launch capabilities but weak satellite manufacturing capacity. Now, its satellites have also begun to enter the world market. In 2004, China made a breakthrough with the export of a satellite to Nigeria and another one to Venezuela in 2005. Both these satellites were launched by Chinese rockets.

Getting Back on Track

Based on the above analysis, the following conclusions can be discerned regarding U.S. regulation of space exports to China:

- The U.S. restrictions on commercial satellite exports to China, in place since

1999, are an overreaction based on groundless suspicions. The purpose of these restrictions is to obstruct China's development of space and missile capability by denying China access to advanced American space technology and the international commercial satellite launch market.

- From the end of 1990s to 2003, the policy put China's commercial space activities in a difficult situation. However, with the rise of its overall economic strength, independent innovation, and the forging of wide-ranging space cooperation relationships with countries, China has made breakthroughs in crucial space technology development. As a result, the U.S. policy has lost its relevance in isolating China.
- U.S. satellite makers are the biggest victims of the U.S. policy. Since 1999, they have lost their advantageous position in the international market. U.S. space security interests will also be harmed.

It is in the long-term interests of the United States to correct the wrong decision made in 1999 and return to the policies of free trade pursued by the administrations of George H.W. Bush and Bill Clinton. Nurturing China's growing space activities through contact and cooperation will be beneficial for both China and the United States.

After Shenzhou V successfully carried China's first *taikonaut* into space, Sun Laiyan, director of the China National Space Administration, expressed China's sincere desire to cooperate with America during his U.S. visit. However, this idea was met with skepticism; the United States insists that since China lags behind by more than 20 years in terms of space capabilities, it is not in a position to cooperate with the United States.[14] The truth of the matter is that while China still has some weak points in space development, it also has many areas of strength and thus the two countries can, at the very least, engage in fruitful cooperation in two main respects.

First, the U.S.-led ISS has found itself in a difficult position following the U.S. space shuttle accidents. As a result, projects undertaken by the United States have been delayed from time to time. Currently, transportation of personnel between Earth and the station rely completely on Russian spacecraft. Much uncertainty has therefore been added to the construction of the space station and there have been instances of astronauts unable to return to the Earth on time. As China's manned space flight technology gradually matures, adopting Chinese spacecraft as a backup transport would provide for a more stable and secure operation of the space station. The cost of building the station will also decline significantly following China's participation. Presently, each launch of a shuttle costs the United States approximately $1 billion, while Russia spends even more per launch. China's manned space flight program has been proven to be safe and reliable. China has now used the Long March rocket series for 42 consecutive successful launches from 1996 to 2005 without incident, effectively ending the in-

cident-prone period in the mid-1990s. More importantly, China's participation in the building of the ISS could further highlight the symbolic meaning of Eastern and Western integration.

Second, the United States should take advantage of China's low-cost space launch capability and jointly develop the international commercial satellite market. Some industry experts believe that if the United States made full use of China's launch capacity in the next five years, it would be possible to bring $8 billion worth of benefits and 16,000 job opportunities to the U.S. space industry.[15]

The United States harbors two major concerns about using Chinese space firms. The first is that Chinese rockets will take business away from U.S. space launch companies. In fact, China's Long March (LM) rocket series is not yet in a position to compete on the international market with the U.S. Delta or Hercules rockets, Europe's Ariane or Russia's Proton. The LM series is only a competitor to Japan's H-2A and India's GSLV. Also, the orders that China can acquire have a thin profit margin and will not cause an impact on U.S. space launch companies' client base.

The second concern is that China will use trade in the space sector to obtain U.S. 'technology secrets.' However, several factors have made this increasingly irrelevant. A guiding principle of China's space program development is self-reliance and attaining independent intellectual property rights for space technology. China's achievements in manned space flight and satellite research and development have amply demonstrated its independent R&D prowess. China does not need to rely on U.S. technology to make progress. Furthermore, it would be difficult to integrate outside technology with China's own, as China has developed its own standards for rockets and satellites.

Finally, the satellite launch agreements signed by China and the United States during the late 1990s contained strict regulations regarding technology safeguards. If these regulations are adhered to, the chances of unsanctioned technology transfer can be minimized. Those companies that made a procedural error in 1996 have already learned their lessons and strengthened their internal compliance system. Thus, chances for repeat mistakes are very slim.

The overall Sino-U.S. relationship is improving. The two nations have been cooperating closely in the global war against terror, the nuclear issue in the Korean peninsula, and on global security. Bilateral economic ties are closer than ever. Currently, 80 percent of Wal-Mart's supplies come from China.[16] U.S. Deputy Secretary of State Robert Zoellick's characterization of China as a stakeholder instead of strategic competitor is accurate. U.S. insistence on isolating China in space is incongruous with the larger scheme of developing bilateral ties. Such a policy is an insult to the Chinese and has harmed the United States. It is high time the United States charts a new course and disposes of a policy that has not only failed in its goal of preventing China's development in space, but has alienated China and fueled an adversarial relationship between the two countries.

Endnotes

1.The Coordinating Committee for Multilateral Export Controls was a non-treaty organization that cooperatively restricted strategic exports to communist blocs during the Cold War.
2. China and United States signed *Memorandum of Agreement on Satellite Technology Security* on Feb. 11, 1993, in Beijing.
3. The official name for this is the "Entity List." It lists end-users to which the export of space-related, dual-use items is banned.
4. Lin Feng, "Telecommunication Satellites of Europe and the United States: A Brief Introduction of History and Current Market Competition," *The Journal of Aerospace China*, Issue 9, 2001.
5. William A. Reinsch, Testimony of the Under Secretary Before the Senate Foreign Relations Subcommittee on International Economic Policy, Export and Trade Promotion, June 7, 2000.
6. Center for Strategic and International Studies, "Preserving America's Strength in Satellite Technology: A Report of the CSIS Satellite Commission," CSIS Press, April 2002.
7. James Lewis, "Preserving America's Strength in Satellite Technology: A Report of the CSIS Satellite Commission," CSIS 2002.
8. "Five-Year Period of Tribulation in Sino-US Satellite Trade," *21st Century Business Herald,* Nov. 30, 2003.
9. "Russia and China will Cooperate on Moon Landing and Mars Project as Exploration Goal," *Global Times*, Nov. 4, 2005.
10. The mission of Double Star Project is to monitor the interaction between the solar wind and the Earth's magnetic field. See: http://www.cnsa.gov.cn/jdhg/show.asp?id=7735.
11. The Dragon Program features the satellite remote sensing for monitoring in the areas of agriculture, flooding, forestry mapping, forest fires, as well as oceanography research. See: http://www.cnsa.gov.cn/jdhg/show.asp?id=1851.
12. Sino-Brazilian Earth Resources Satellite 02 consists of Payload Bay and Service Platform, with a designed life span of two years. It can cover the entire surface of the Earth in 26 days. The box-shaped satellite, with a mass of 1,540 kilograms, is powered by a single-wing solar array.
13. Jacques Blamont, "International space exploration: Cooperative or competitive?" *Space Policy,* 21(2005) pp. 89-92.
14. Tariq Malik, "U.S. Snubbed China's Offer for Space Cooperation: 'Technology Not Mature'," *Space.com,* April 28, 2004.
15. "U.S. Government Erects Barriers: Five Years of Hardships in Sino-U.S. Satellite Trade," *Jinrongjie,* Dec. 2, 2003. See: http://www.p5w.net/p5w/home/domestic/200312022088.html.
16. "Chinese Workers Pay for Wal-Mart's Low Prices," *Washington Post,* Feb. 8, 2004.

Mutually Assured Vulnerabilities in Space

Eric Hagt

Introduction

China is pursuing space primarily as a market, not as a battleground. Imperative economic development priorities steer China's interests overwhelmingly toward peaceful exploitation of space. However, a number of factors threaten to alter that course. China is growing increasingly concerned that U.S. plans to develop a robust missile defense and space control capabilities are both inevitable and directed squarely at it. If the United States were successful in those pursuits, China fears its nuclear deterrent would be jeopardized, which in turn would force Beijing into a destabilizing arms race.

Less understood are the uncertainties emerging from China's rapidly-evolving space program. Driven by perceived strategic threats as well as commercial interests, an increased Chinese focus on developing capabilities and placing assets in space is creating a new environment that will influence the security of space. China's bold plans in commercial space, coupled with the inherent dual-use application of satellite technology, are bringing about vulnerabilities for China and arousing misgivings with its potential peer competitors, particularly the United States. China thus is even further compelled to hedge against perceived threats from U.S. missile defense systems, especially a future system based in space.

China's consideration of hedging strategies to counter the United States in space in turn further drives U.S. military space plans in the direction of a weaponization strategy – thus entrenching a security dilemma. This impasse can be ameliorated by greater transparency regarding both capabilities and intention. Transparency, however, is conceived differently by the Chinese and American sides, with the former focusing on underlying strategic objectives, and the latter, capabilities.

It is vital that both countries work to enhance communication regarding their programs, bilaterally and within international forums. However, as the nation with vastly superior capabilities in space, America must first confront the central issue upon which the possibility of transparency and greater cooperation with China rests: Does the United States intend to control space?

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Traditional Threat

The security environment in space is rapidly deteriorating as the United States continues to vigorously pursue missile defense, including space-based systems, and appears ready to develop attack weapons for space. The administration of President George W. Bush has declared the goal of being able to shoot down missiles of all ranges, in all phases of their flight (boost, midcourse and terminal) and to do this from land, sea, air and space.[1] Each of the components of this layered missile defense system will rely on space-based early warning systems, and the Missile Defense Agency now plans to include space-based interceptors having both defensive and offensive capabilities. Meanwhile, the U.S. Air Force is advocating an aggressive space strategy that would include the future development of anti-satellite (ASAT) weapons and perhaps even weapons based in space for striking terrestrial targets. Experts have noted the significant financial, political and technical barriers to most of these programs.[2] Yet, given the growing budgets for U.S. military space and missile defense activities in a highly politicized climate, the current administration is set to continue pursuing these systems.[3]

Although the U.S. government claims 'rogue states' such as North Korea and Iran as putative targets for such programs, China increasingly perceives itself as an intended loser – as a robust U.S. missile defense network and an arsenal of space-based weapons could effectively negate China's nuclear deterrent and thus trigger a destabilizing arms race.[4] The rationale for China's angst comes from a number of places. In terms of background, in 1998 the Pentagon reinstated China as a strategic nuclear target in the U.S. nuclear war plan, and Bush's 2001 *Nuclear Posture Review* identifies China for the first time in two decades as an "immediate or potential nuclear contingency."[5] Coupled with a U.S. national defense strategy that asserts a preference for preemptive strikes, even a modest missile defense capability would dramatically raise the risk for Beijing that the United States would be capable of disabling China's strategic nuclear force. Considering that China has always maintained a policy of minimal deterrence with its immobile, liquid-fuel strategic nuclear force, circumscribed by a declared No-First-Use policy, Beijing feels particularly vulnerable.

Other factors serve to aggravate China's fears. In 2001, before he became U.S. secretary of defense, Donald Rumsfeld called for the U.S. government to vigorously pursue "the option to deploy weapons in space" if national interest exigencies require it.[6] Additionally, a number of doctrinal papers by the Air Force reinforce a clear intent to develop such weapons, with the capability for war-fighting "in, from and through space."[7] The 2003 *Transformation Flight Plan* speaks of denying the high ground of space to adversaries while the most recent *Counterspace Operations Doctrine* calls on the United States to achieve space superiority, which will provide the "freedom to attack as well as freedom from attack." While none of these documents single out China as a threat, the fact that the 'Shriever' space war games conducted by the Air Force in 2001, 2003 and 2005 were thinly veiled

contests with China strongly suggests U.S. defense planners consider China a potential adversary in space.[8] The Pentagon's annual report on China's military power has also grown increasingly alarmist regarding China's military capabilities in space.[9]

Perhaps the most important of China's concerns is U.S. cooperation with India and Japan on missile defense.[10] As both are rising Asian powers neighboring China and potential military competitors, their participation in missile defense could deeply upset the region's strategic balance. Japan's involvement is particularly alarming to China considering the close U.S.-Japanese strategic alliance and tense Sino-Japanese relations. China is anxious about the possibility that co-development of missile defense systems will drive Japan's military build-up to new heights and lead to regional proliferation.[11] Moreover, China is fearful that its leverage over Taiwan would be adversely affected by U.S. and Japanese common interests there, which were recently highlighted in a joint defense statement released in early 2005.[12]

Thus, the apparent steady march toward missile defense and space warfare capabilities by the United States has raised deep concerns about the consequences for China's national security, and fears in Beijing about the potential for future conflict. However, a second development in space is creating a new security environment that will alter the strategic calculus of both China and the United States: China's deep and growing interest in space programs, especially the development of a satellite fleet.

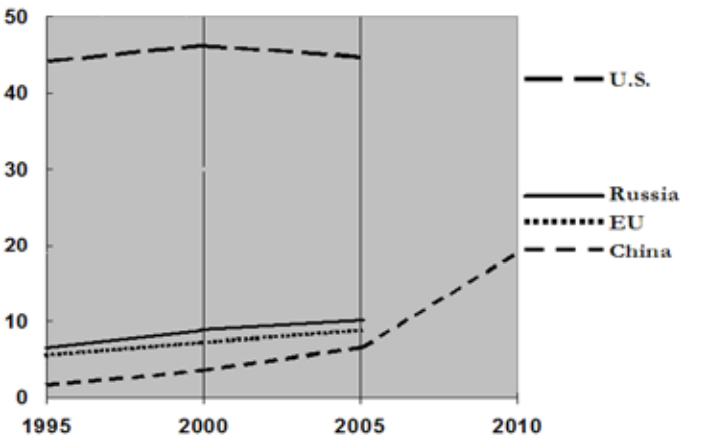
Space Ambitions

Bolstered by its successful manned space program, China has launched an impressive satellite program, with a clear determination to advance its capabilities in satellite technology and application, production and launch capacity and infrastructure.[13] This ambitious plan is primarily driven by the attraction of gaining a larger share of the current annual $100 billion global commercial satellite market, which is set to grow to $150 billion by 2010.[14] It also, however, has implications for China's future military capabilities and thus will rapidly alter the security architecture in space.

China's Shenzhou manned space missions have been powerful advertisements for its satellite launch industry, though the current growth in satellite capacity is also a culmination of strong national policies promoting China's satellite and satellite launch industry that date back to China's first White Paper on Space.[15] This document arrived in the wake of the 1999 Cox Commission Report mandated by the U.S. Congress, which accused China of illicitly acquiring sensitive technology through its commercial ties with U.S. satellite firms,[16] and the subsequent U.S. move to place satellite exports under the International Traffic in Arms Regulations (ITAR), which effectively shut down China's international trade in the space sector..[17]

These highly politicized actions by the U.S. Congress ended any co-operation between the United States and China in space, and set the latter on the determined path to develop an expansive and autonomous space program defined by a high level of industrial production capacity and commercialization. This process began in earnest with the deep institutional reforms to China's space industry beginning in 1999.[18] At that time, China Aerospace & Science Corporation (CASC) and China Aerospace Science & Industry Corporation, China's two space industry giants, were established as state-owned enterprises rather than government entities – with the Commission on Science, Technology and National Defense Industry no longer managing them in an administrative capacity. CASC, while still providing military products, was pressured to operate under market principles in the civilian and commercial space sectors. Such reform was pivotal, infusing the space industry with greater profit-driven vitality.[19]

In the past 10 years, China has launched a total of 39 satellites. At present, China has 27 satellites on orbit, with an estimated 18 owned and operated by the government, eight by the military, and one civilian satellite owned and operated by Beijing Landview Mapping Information Technology Co. Ltd. [20] Based on these numbers alone, China has the world's fourth largest satellite space program.[21] And given that 75 percent of those satellites have been launched since the year 2000, China has had the fastest growth in launch rate of any space-faring power in the past five years.



Satellite Launch Growth Rate (Sats/Year)

China's plans to develop its satellite industry reveal a dramatic rise in its interest in space. Judging by the increase in satellite assets during the past Five Year Plan (FYP), the number of Chinese satellites looks set to grow significantly. A high-end estimate by Ma Xingrui, deputy general manager of CASC, suggests that China will launch an average of 25-30 satellites per year for the next five years.[22] This may be a little ambitious, at least for this year, as it was recently announced at the National People's Congress that China will launch nine satel-

lites in 2006.[23] Nevertheless, the overall goals for satellite launch show a steep upward curve. Sun Laiyan, president of the China National Space Agency, stated that China's goal through 2010 is to triple the number of satellites China will launch.[24]

National policy statements also demonstrate the Chinese government's resolve in this regard. China's 10th FYP (2001-2005) was the first of such plans to place priority on the development of satellite applications.[25] The recently published 11th FYP (2006-2010) reinforces the importance of the space program in the next five years as a spearhead for China's drive to be a leader in science and technology, with specific mention of a number of satellite programs for development.[26] The recent rise in the number of government and industry-sponsored international and domestic conferences on space development also testifies to a salient shift in China's ambitions.[27]

China's plans are more than just rhetorical. An impressive array of infrastructure to support satellite research and development, manufacturing and application technology has been built or is under development. Beijing now boasts the world's largest micro-satellite industry park, which was established in December 2004. The park stretches over 16,000 square meters, and has an annual capacity to manufacture and test six to eight advanced small and micro-satellites as well as their application technologies.[28] Two other projects to research, design and produce micro- and nano-satellites are housed at the Shanghai Institute of Microsystems and Information Technology and the Haerbin Institute of Technology; a third is at Tsinghua University – a program in cooperation with the University of Surrey in the United Kingdom.[29] A number of other satellite design, production and launch projects are in progress jointly with Brazil, France, Germany, the European Space Agency (ESA) and a group of Asian countries.[30]

The significant expansion of infrastructure will soon give China considerably increased capacity for domestic satellite launch. China's new launch site in Hainan Island, which is to be functional by 2010, will more than double the payload launch capacity for satellites going into geosynchronous orbit, an ability that China has been critically lacking in the past.[31] A new generation of launch vehicles is also under development using the strategy "making the big, bigger, and the small, smaller."[32] At the one end, the Long March 5, planned to be tested and operational by 2008, will provide heavy lift for China's space exploration missions and larger communications satellites.[33] At the other end of the scale, several smaller rockets are being developed to satisfy the growing requirement for launching micro-satellites to Low Earth orbit. These include the liquid-fuel LM-1D, and the solid-propellant commercial satellite launch vehicle series known as Kaituozhe.[34] China has also achieved launch of multiple satellites on a single rocket.[35]

These comprehensive capabilities constitute an autonomous program that enable China to offer the full package of satellite services including development,

production, launch and applications. China's goal of building a complete and self-reliant space sector is designed to meet the demands of its domestic satellite industry market.[36] Also spurring indigenous growth of the commercial space sector are China's obligations under the World Trade Organization (WTO), which as of this year (2006) will require China to fully open its satellite application and launch market to foreign competition.[37]

Beyond the domestic sphere, China's current strategy for space is to dominate the Asia-Pacific market and become the market leader in the developing world.[38] As satellites and launch costs decrease, access to space will expand, including to countries with lesser economic means.[39] China is jointly engaged in developing a number of satellite programs, including an Earth observation constellation, with Bangladesh, Indonesia, Iran, Mongolia, Pakistan, Peru and Thailand. The burgeoning regional relationship in the area of space has been codified with the Asia-Pacific Space Cooperation Organization treaty, signed in October 2005 and the first treaty of its kind in Asia.[40] Further afield, contracts have also been concluded with Nigeria and Venezuela, in December 2004 and November 2005, respectively.[41] These latter two projects are particularly important because they are China's first so-called 'turnkey projects,' in which it will provide all segments of the project from design and production to launch and servicing the satellite on-orbit. China naturally has ambitions to become a real player in the lucrative international market, after having been excluded from it in 1999 and only recently reentering, as of April 2005, with the launch of Apstar 6, of APT Satellite Holdings Ltd.[42]

Building a strong domestic satellite and launch industry is a key to China's aims in space, which are centered on its overarching goal to become a technological and scientific powerhouse. This larger goal, in turn, is the foundation for China's long-term sustainable development. To achieve these goals, the government is nurturing a new generation of scientists and engineers. In the 10th FYP, China's space industry increased its workforce with newly graduating engineers by roughly 10 percent while paring down the total employed by an equal percentage. China's goal is to reproduce this feat during the 11th FYP by providing incentives in salaries and benefits for its space sector two to three times higher than the national average for comparable professions.[43] As a result, 70 percent of space sector employees are under the age of 35, far younger than NASA's aging workforce.

Vulnerabilities in Space

China's growing satellite and commercial interests will complicate space security. Drawing parallels with the American experience, the U.S. National Security Strategy in 2002 declared the goals of the military space program as: to defend the homeland, to ensure U.S. access to distant theaters and to *protect critical U.S. infrastructure and assets in outer space*.[44] As China's satellites increase in number,

whether they are civilian or military, its vulnerability in space will grow – forcing China to find methods to protect itself in space.

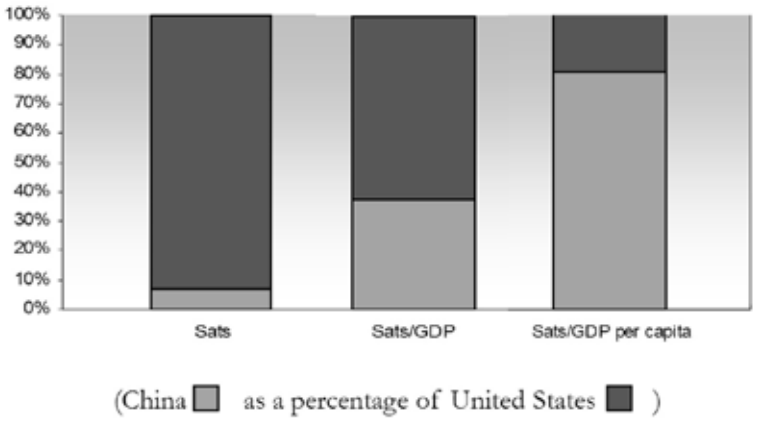
Satellites are intrinsically vulnerable to attack and interference.[45] Traveling in fixed, predictable orbits, they can be targeted by relatively cheap and technically easy methods such as ground-based ASATs or jammers. This is true for all satellites, although in general commercial assets are more vulnerable in that they are rarely protected with robust anti-jamming and electronic hardening technologies or extra fuel for maneuvering.

Thus, as the U.S. Department of Defense (DOD) has become heavily dependent on commercial satellites for communications and reconnaissance missions, the protection of all space assets has become a national security imperative.[46] DOD was slow to address the vulnerabilities of commercial satellites but this is now becoming a key element of American national space strategy, as was laid out by the White House in 2003.[47] This plan proposed a number of measures for resource allocation, information sharing, and interagency and international response in order to protect critical infrastructure assets in space that face imminent and long-term threats. As operational rules for protecting commercial assets with military force are still ill-defined both at national levels and internationally, an integrated strategy for commercial satellite protection is essential to any country's national security as well as global space security.

The structure of China's satellite industry falls along different lines than that of the United States: there are no exclusively privately-owned satellites, rather they are under operation of the government and civilian entities, with a number of them used for military purposes. However, the degree to which China's space program has become increasing dependent on civilian and commercial incentives is often underestimated.[48] The Chinese military is undoubtedly deeply involved in the country's space activities; however, a robust space program quickly grew too expensive for the military to develop independent of economically viable principles. China has historically had very limited resources (compared to the United States) to devote to space, compelling the military to substantially divest itself from development and production and become highly reliant on market-oriented activities to build a sustainable space program.[49]

It is reasonable to assume the military's need for space support and force enhancement will grow, and along with it the dependency on non-military space assets. As with the United States, all of China's space assets will become critical national infrastructure requiring protection.

Although presently China has less than one-tenth of America's approximately 413 satellites,the number of China's satellites holds a strategic importance greater than it implies.[50] If space assets are measured against a country's GDP, the significance of China's satellite base increases dramatically, and if compared with GDP per capita, it rises to a level on a par with the United States. This is to say, in the context of China's overall level of development, its current interests in



space are already substantial (and are rising dramatically) and should therefore be considered strategically important to China, even vis-à-vis the largest global space power.

China's relative strategic isolation in relation to the United States is a further complicating factor for Beijing in calculating the vulnerability of its space capabilities. It is worth considering that during operations in Iraq, up to 77 percent of the communications bandwidth used by U.S. deployed forces was provided by commercial suppliers, a significant percentage of which were foreign.[51] Thus, strategic allies will potentially be very important in the new global space environment. Not all commercial satellite operators are under the institutional control of the nations they are registered in.[52] However, the United States has become acutely aware of the need for cooperation amongst treaty allies for protection of satellite infrastructure and sharing of selected threat and vulnerability data.[53] Although China has a 'strategic partnership' with seven of the top 10 space powers,[54] five are in NATO and all but one (Russia) would arguably be considered to fall within a formal or informal alliance structure with the United States.[55]

China has no firm security alliance with any of the major space-faring nations. Cooperation with the European Space Agency on Galileo, providing China access to satellite navigation capabilities independent of the U.S. Global Position System, has posed real concern in the United States. However, though China has invested 200 million euro in the 3 billion euro program, its participation in development and production of the system will be limited.[56] In addition, under pressure from the United States, the European Union has taken precautions to ensure that China will not have access to sensitive technologies or functions.[57] Even Russia, which will work with China on a number of civilian space missions, has been highly ambiguous in its position on granting China access to Russia's space and other military technologies and capabilities during a time of conflict.[58] This makes China more dependent on its own space assets and thus more strategically vulnerable than any of the other major powers and/or space faring nations.

China's increasing vulnerability will create both an opportunity and a dilemma. Its significant commercial space assets coupled with a comparable strategic weakness vis-à-vis the United States could engender a powerful incentive for China to keep space non-weaponized, which may in turn be a strong motivator to reach accommodation with the United States and the international community on legal measures to maintain a peaceful environment in space. On the other hand, as China reaches a point of strategic vulnerability, the need to mitigate threats to its assets in space and thus to its national security will intensify. It is essential to come to grips with the parameters of this strategic shift and its implications for security as China pursues its ambitions in space.

China's Response

Already, the changing security environment in space has begun to raise deep concerns in China. The direction of U.S. military space strategy has led to increasingly vigorous diplomatic efforts by Beijing, along with intensified efforts by academia to analyze these developments and find prescriptions to address them.

China's official policy position on space weaponization has been unequivocal in its opposition to testing and deployment of weapons of any kind in outer space, whether nuclear or conventional.[59] "The deployment of weapons in outer space would result in a series of grave repercussions: breaking [global and regional] strategic balance and stability, undermining international and national security…damaging existing arms control treaties…and triggering an arms race." Furthermore, "…the deployment and use of weapons in outer space would seriously threaten the security of outer space assets."

However, going beyond China's diplomatic call for a weapons ban – which appears increasingly unrealistic considering the present security environment – there is no official policy addressing the real possibility that space does become weaponized. What if the United States (or other country) deploys ASATs or space weapons? What if China's diplomatic efforts fail? Does China have a Plan B? There is a growing body of academic discourse on this subject within China. There is also speculation within the United States about what direction China is taking, some of which assumes the worst.

A number of politicians and analysts in the United States have claimed that China is already developing anti-satellite weapons that pose a direct threat to the United States.[60] "China's offensive anti-satellite programs," it has been stated, indicate that "Beijing's strategy to confront the United States in this area is clear."[61] Such analysis takes the view that China's official promotion of a multilateral treaty to ban space weapons is merely the gambit of a country still playing catch-up, with the purpose of constraining U.S. political freedom to act in space while China continues to develop its own weapon systems to destroy American space assets. The Pentagon's 2005 report to Congress directly asserts that "China

is working on, and plans to field, ASAT systems."[62] However, China has not tested or deployed any ASAT weapon and there is no evidence that it intends to do so.

China's diplomatic response to space security has failed to convince the skeptics' about the direction of China's space program. Yet, the more pessimistic claims by U.S. analysts and the Pentagon remain unsubstantiated. Indeed, the writings of Chinese space strategists and experts inside China suggest a more nuanced path.

A recent proliferation of literature among military analysts in China indicates an urgent need to prepare for what is seen as the inexorable trend toward weaponization of space.[63] It is a general consensus amongst Chinese space experts that future war-fighting will not only extend into outer space, but also that space will be the key to integrating ground, sea, air and space forces, with such integration increasingly a dominant feature in warfare.[64] There is also agreement that the United States (and perhaps Russia) is on a course to seizing the advantage and preventing adversaries from using space to their own strategic benefit. As such, many Chinese experts are calling for a full range of capabilities to give China plausible means of safeguarding its nuclear deterrent and protecting its space assets. However, contrary to the more dire pronouncements in the United States regarding China's goals in space, offensive measures are largely dismissed as being strategically destabilizing and not within China's reach for the foreseeable future.

Most Chinese analysts take a decidedly defensive posture when considering preparation for confrontation in space. Furthermore, the concept of defense is often divided into 'passive defense' and 'active defense,' with a premium placed on the former.[65] The concept of passive defense for space assets emphasizes a preventative quality but also something that is inherent and inert in the satellite. It stresses

protection against attack, rather than deterrence against attack. Passive defense measures for satellites include hardening, encryption, camouflage, stealth, and redundancy and duplication in satellite network systems and subsystems.[66]

Secondarily, there are also active defense measures, which entail actions of avoidance such as orbital maneuvering; or countermeasures such as anti-interference and anti-jamming techniques. At the extreme would be the use of micro-satellites to actively 'guard' other satellites and act as decoys, or even counter-attack.[67] While these remain defensive measures, they take on a quality of dissuasion and even deterrence.

Greater situational awareness through enhanced monitoring and surveillance in space is also crucial to this idea of defense in space. One of the driving forces behind China's efforts to research space debris identification and tracking is to also improve China's ability to monitor military assets.[68] The ability to identify and discriminate objects in space is crucial to evaluating threats from non-threats in space.

The above constitute 'comprehensive defensive actions,' centered on capabilities to enhance survivability of China's satellite networks, and ensure China's access to space that is considered indispensable for future 'informationalized warfare.'[69] At the heart of this defensive strategy is the need to protect against an adversary's ability to prevent or restrict China from using space to its economic and national security advantage; that is, the ability to 'deny the denial.'

It is the dual-use nature of China's satellite program that will provide the means to achieve that comprehensive defense in space. For example, China's plan to increase indigenous development and production capacity of durable and miniaturized satellites for missions of data transmission and Earth remote sensing is aimed primarily at civilian and commercial purposes. However, such technologies offer lower cost access to space with greater maneuverability and thus would have a direct impact on military space capability. China also intends to increase its capacity to launch on demand and achieve launch redundancy,[70] which also could markedly enhance its military space potential. Chinese slogans such as 'applying military to civilian,' and 'integrating military and civilian' are used in official discussions to stress the integration and embedding of military with civilian technology development and production.[71] Since the early 1990s, the revolution in military affairs has been the central theme for China's military modernization program, of which space is an indispensable part.[72] Such notions indicate the importance of a dual-use strategy.

As for existent capabilities in space, although there is no official admission, China does have satellites for navigation, remote sensing, reconnaissance and communication that have military uses.[73] These are mainly for 'power enhancement and support' capabilities. However, as others have noted, they remain vastly insufficient for gaining any real advantage vis-à-vis U.S. dominance in space[74]. Nevertheless, it is reasonable to assume that the number of these assets would

grow substantially under the planned satellite development program and thus rapidly improve China's force enabling capacity.

In addition, a number of U.S.-based analysts of Chinese military affairs have noted that China is exploring some research areas relevant to ASAT technologies, such as the use of kinetic-energy vehicles, ground-based laser and radar capabilities, and high-powered microwaves.[75] However, this research remains at the theoretical level and there is no conclusive evidence of a concerted program to develop such capabilities.[76]

Security Dilemma

The inherent dual-use potential of China's space program combined with the analysis of the above literature on defensive capabilities in space indicates a hedging strategy. Yet, the extent and nature of such a hedging policy remains unclear as official and public discourse on the subject is entirely absent, thus leaving open a number of possibilities.

First, it is possible that China is indeed considering binding itself to a voluntary self-ban on the development, testing and deployment of space weapons of any kind, regardless of whether the United States proceeds with the weaponization of space. However, such a strategy seems implausible as it would be inordinately risky for China's national security. Furthermore, China has declined to declare a no-first deployment of space weapons – as the Russians have done and urged China to do. It seems logical that China would hesitate to declare a no-first deployment policy when it is ostensibly not even developing or testing space weapons. Although this rationale holds in isolation of other factors, it falls short of providing deeper assurances regarding China's commitment to non-weaponization.

Alternatively, China may be determined to develop, test and deploy a full range of defensive measures, both active and passive, but is attempting to keep it secret for fear of antagonizing the United States. An 'active defense,' as some analysts in the United States have concluded, may be merely an offensive strategy in sheep's clothing. This has been a suspicion regarding China's overall defense strategy, but it applies equally, if not more so, to the realm of space. A guardian or body-guard satellite, to take an example, would also have ASAT capabilities. Nevertheless, a dedicated yet secretive space weapons program, however defined, is unlikely as such an effort would be difficult, if not impossible, to keep concealed. More importantly, the political fallout for China if caught at this game makes this scenario highly implausible.

Another possible scenario is that China is continuing to study and research applicable space technology, but will wait to see whether the United States will deploy robust missile defenses and space-based weapons before it in turn responds. A final possibility may be that there is an ongoing and unresolved internal debate on the issue – with diplomats firmly opposed to any form of hedging measures

in space, but with the military dissenting. These latter two options better reflect the reality of China's strategic concerns and its goals in space. China is growing increasingly suspicious of U.S. military intentions in space, and likely is striving to find a strategy that at once protects itself against the risk of space weaponization and at the same time does not propel that risk further along.

Although a hedging strategy would seem to make sense for China at this time, nowhere does the PLA officially condone or admit to developing or testing anti-satellite or offensive space capabilities. That said, there are a number of factors that point in that direction. One key indicator is the mind-set expressed by senior-level officers convened for a task force on military space issues.[77] In concluding that the weaponization of space is inevitable, they argue that China must prepare itself and should not tie its hands through overly restrictive international legal treaties. In other words, while it is in China's interest to work diplomatically to the extent it can, it should not limit its options if the United States proceeds with missile defense and space weapons. In theory, this is fair, especially from military planners concerned with national security. Yet, to the degree the PLA holds sway over national policy, this engenders certain strategic uncertainties about China's intentions.

For one thing, the PLA's lack of enthusiasm for a weapons ban treaty exacerbates the concerns of many in the United States about what they see as inherent ambiguities in China's diplomacy. Since 1984, China, joined by Russia and most of the world, has taken an unequivocal stance at the Conference on Disarmament (CD) in opposition to space weapons.[78] Yet, the CD has been in a perpetual state of gridlock, without even a working agenda, since 1996.[79] Therefore, some analysts – particularly in the United States – view the various Chinese-proposed resolutions to begin treaty negotiations on a space weapons ban as a ploy on the part of the Chinese (and Russians); China's position provides international prestige that costs it little since there is a slim-to-none chance of its resolutions ever being accepted.[80] This may seem to be unfair when it is not China, but the United States, which is the principal country blocking the CD agenda – and the United States furthermore has the power to call such a bluff by engaging it. Still, even some U.S. analysts less hawkish than those accusing China of an offensive strategy believe Beijing is undertaking a classic two-track strategy – pursuing negotiations while also pursuing a military space program to eventually trade away – a suspicion that stems from America's own past behavior vis-a-vis arms control.[81] There is a strong perception in the United States that China's diplomatic assurances about its dedication to the peaceful use of space conflict with a military space program that is, for the U.S. security community, unquantifiable and unqualifiable. A clear hedging strategy would be entirely consistent with China's diplomacy. However, the possibility that China might have a clandestine or hidden agenda of trying to secretly achieve space weapons breakout is an unacceptable risk for U.S. military planners.

Thus, the lack of clarity of China's apparent hedging strategy feeds suspicion of China's capabilities and intentions in space. This helps drive the rationale for a more aggressive U.S. military space program, which predictably pushes China's military toward pursuit of the same. Such an environment, where each fears the other will be first to develop and deploy weapons and gain the military advantage in space, creates a vicious circle that threatens to undermine the security interests of both countries as well as the international community. Thus, the central question for space security at this juncture is how this negative cycle can be broken. In the broad sense, greater communication and understanding of capabilities and intention are fundamental to any solution.

Transparency

China's lack of transparency exacerbates suspicions regarding both its space capabilities and intentions – and thus undermines Beijing's own interests. Unfortunately, for a variety of historical, strategic and cultural reasons, China remains allergic to the Western approach to transparency.

China has in the past justified a degree of secrecy in operations and capabilities as essential to the security of weaker states who must exploit uncertainty as a deterrent. In this way, non-transparency of China's nuclear forces arguably played to its advantage. With a minimal deterrent strategic nuclear force structure based on a policy of No-First-Use and facing a threatening security environment, China had little choice but to maintain a high level of secrecy so that a strategic competitor would be forced assume the high end of China's nuclear capability. This would work for space as well only if China indeed felt it needed a clear deterrent in space. In an environment of opacity, China's strategic competitor naturally assumes the worst-case scenario: that China is developing military means to challenge it in space, either clandestinely or through its dual-use systems. But China does not have a (declared) space weapons program or an overt policy of deterrence in space. The alternative choice, and one China has repeatedly made clear, is a policy aimed at avoiding an arms race in space. Considering the far-reaching goals of its domestic space program coupled with its current weaker position vis-à-vis the United States, China's interests are indeed served by keeping space a peaceful frontier. This viability of this policy choice, however, is being undercut by China's lack of transparency.

A number of models to enhance the exchange of information, ideas and concerns amongst space-faring powers are available from non-governmental organizations that range from bi-lateral and multilateral data exchange on non-threatening topics such as space debris to military-to-military contacts.[82] However, any measures to improve transparency would invariably run up against the barrier of fundamentally diverging approaches between China and the United States.[83] The difference may be less a matter of culture than in perceived national interests.

The United States prefers a more operational orientation of transparency that sidesteps complex, intractable political issues. Instead, U.S. transparency efforts focus on moving incrementally using practical measures, such as technology exchanges, that build trust from the ground up and eventually contribute to confronting root political differences. What this boils down to is an emphasis on transparency with regard to capabilities. Despite declarations or national policy statements, the United States will suspect China's intentions without definitive knowledge of the capabilities and programs that have the potential to challenge U.S. military superiority.

Conversely, the Chinese place an emphasis on the transparency of intentions, such as official statements of a government's position on vital issues of security. Capabilities of even a vastly superior military power are less of a worry for China if they are set within larger security guarantees. China thus seeks strategic assurances on the Taiwan issue, China as a target of U.S. nuclear policy and the U.S. decision to pursue a robust missile defense.

CD and International Fora

Even if the disparate approaches of the United States and China regarding transparency can be bridged, an ongoing problem is the lack of international fora to help spur efforts at bridge-building. Unfortunately, as noted above, the forum for negotiating an international security architecture for space, the CD, is completely dysfunctional at the moment. This international body has the mandate to negotiate disarmament issues but requires a consensus to pass resolutions to the United Nations, thus allowing one country to single-handedly block progress[84]. The United States has been instrumental in vetoing all the major resolutions and papers introduced at the CD to limit and control space weaponization. A multinational effort was recently made to shift the CD dialogue on disarmament and nonproliferation to the UN First Committee in the General Assembly, where a resolution would be decided through majority vote, but this faced strong opposition by the five nuclear-weapon states, as well as India, Israel and Pakistan.[85]

The present U.S. position of antagonism to the CD is unlikely to change under the Bush administration, but pressure is growing in the international community to create "democratic and multilateral alternatives to a situation where the security interests of the many are being held hostage by the policies of the few."[86] While such a change would not solve the flaws inherent in an unwieldy UN body, it would at least remove the monopoly of decision-making on space weapons by any one country and move the discussion firmly into a forum better able to consider the interests of the entire international community.

This could be done by formulating measures to prevent the weaponization of space in fora outside, but parallel to, the CD. Such discussions could include 'Track 1.5' or 'Track 2' sessions as well as discussions amongst intergovernmental agencies.[87] Such an environment would have a number of potential advantages.

Rather than involving a large unwieldy group of nations, such as at the CD, alternate venues could include a smaller group of space-faring powers making it easier to reach consensus and find necessary common ground.

Also, rather than discussing long-term binding issues such as treaties to ban weapons, early, practical steps could be taken on space security issues where wide measures of consensus already exist. One such approach might be the pursuit of measures to limit and/or prohibit the creation of debris in space, including a treaty to restrict or prohibit debris-creating weapons and weapons tests.[88] Another might be an effort to pass a UN resolution on non-interference with non-military satellites.

In addition, such alternative fora could engage in preparatory work on a treaty while the current U.S. administration's political opposition remains, including unifying definitions of ASATs and space weapons, setting limits on permissible military assets in space, drafting verification measures and the allocation of space among various users.[89]

However, a sea change in the operations and functioning of international mechanisms may come too slowly to stem the emerging U.S.-China space security dynamic. U.S. missile defense programs continue apace, and nascent plans by the United States to test and develop ASATs and weapons remain on the books. Meanwhile, China's concern about its growing vulnerability in space also increases with each passing day. Thus, the United States and China, two of the defining powers in space in the 21st Century, must move in the near-term to interact together directly.

Opportunities for bilateral cooperation in space are beginning to open up with a number of exchanges among space sector officials and, most recently, Chinese space officials and members of the U.S. Congress.[90] But much deeper dialogue among political leaders and military officials is required to address underlying strategic issues in space. The two countries have already initiated a strategic dialogue between the U.S. State Department and China's Foreign Ministry.[91] Space, a crucial element of both countries' future security, should become a part of that discourse. Through such interaction, both the United States and China can express their legitimate security concerns as well as make clear the possible consequences if those concerns are not addressed. At present, bilateral communication on all such issues remains virtually non-existent.

Paramount Issue

Meanwhile, there is a fundamental question that the United States must ask itself regarding its overarching strategic goal in space. It is the same essential question that China and the international community are asking; indeed, it is the central question to international space security. What is the endgame for the United States in space? If the answer is to maintain a strategic advantage, even relative dominance, in space without necessarily weaponizing it, then there is

hope for averting an arms race in space. Within such a theoretical construct, there is a rationale and even a responsibility for China to apply itself to greater transparency with the United States to mitigate the security dilemma. However, if the U.S. endgame is to maintain absolute superiority in space, including control of space through unilateral weaponization, regardless of other countries' interests and actions, then there is no point in Beijing seeking accommodation and negotiation of arms control measures in space.

Assuming it is the former, the United States must engage China. It is true that if the United States sees China as a 'bad actor' or military peer competitor, the pressure not to engage is surely high. Yet, since the mid-1990s, China has shown itself increasingly receptive and even proactive in participating in arms control and nonproliferation regimes. Again, given China's growing stakes in space as a tool of economic development, there is no reason to doubt China would not undertake a correspondingly earnest attempt to reach agreement and accommodation on military space.

Unfortunately, the present policies and behavior of the United States point to the latter strategy as the answer to the above question. In the field of military space, the United States outspends the rest of the world, accounting for over 90 percent of global military space budgets.[92] Despite its overwhelming predominance in space, the United States sees space as a zero-sum game. Any gain by China or other potential competitors in space is seen as a strategic loss for the United States. And so, the United States – a vastly superior power in space and one which has the ability to shape the rules of the road for peace in space – has instead chosen to ignore China, and worse, ostracize it. Whether this is due to an adversarial intent toward China or a fear of China as a potential aggressor, such action only gives China reason to develop defensive measures in space.

Until now, China has been primarily concerned with the risk of space weaponization and the potential for U.S. missile defenses to undercut its strategic deterrence. But, as noted above, China's interests in space are growing rapidly, and along with that, its own vulnerabilities in space. As China advances towards its goals in space, there should be no doubt that it can, and will, develop the means to protect its interests there. If the United States denies this reality and proceeds with plans for unimpeded or unbounded space control, then it may indeed drive China to pursue space as a battleground rather than as a market. Forcing China down such a path would not only be detrimental to U.S. strategic interests, but also to those of China and the rest of the world.

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Development Goals of China's Space Program

Wu Chunsi

The successful Shenzhou VI manned space mission has demonstrated the substantial progress of China's space technology, and has inspired a patriotic fervor among the Chinese people and their leaders that bodes well for future support of the program. In October of 2005, unprecedented coverage and discussion of the Shenzhou VI launch and China's space program dominated the country's Internet chat rooms, newspapers and television programs. Less noticed, however, was the fact that the launch of Shenzhou VI, like its predecessor, Shenzhou V, was scheduled to coincide with the end of the Communist Party of China (CPC) Plenum – the meeting that introduced the 'Five Year Plan' blueprints for China's economic and social development. All members of the Political Bureau of the CPC publicly lauded the completed manned mission.

The international community has also viewed the Shenzhou VI mission and the progress of China's space program in a positive light. U.N. Secretary-General Kofi Annan, on Oct. 17, 2005, hailed the success of the mission declaring the flight a demonstration of how the exploration of space knows no national borders and that every peaceful mission accomplished is another step forward for all humankind. Among some observers, however, there has been conjecture about the possible military application of China's space program, including progress in missile defense system countermeasures development, as well as in reconnaissance and surveillance. Suspicions regarding the military background and intentions of China's space program have also been raised. While these arguments appear reasonable to a degree, they do not stand up to closer analysis. A balanced judgment of the Chinese space program's goals and intentions requires a broader understanding of China's national strategy and the role of space technology in national development.

Development: Science and Technology

China's present national strategy was formulated in the late 1970s, at the end of the Cultural Revolution when the country's economy was on the brink of collapse. With the introduction of 'reform and opening up' policies, China placed the highest priority on social and economic development and the improvement of people's living conditions. After more than two decades of recovery and re-

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construction, Chinese citizens, especially urban dwellers, are beginning to enjoy a stable life without worry about food and clothing. Economic development remains the chief goal of China's national strategy, as stability in China can only be fundamentally guaranteed with sustained and rapid growth. Therefore, China's domestic policies take precedence over external challenges, and as an integral part of its national strategy, China's space program must act as a driving force for economic development.

Through the lessons of history, the Chinese people understand that advancement in science and high technology are crucial to economic development and social prosperity. Failure to take advantage of the rise of modern science and technology that evolved in the wake of the Industrial Revolution contributed to China's perceived humiliation during the 19th and 20th Centuries. The late Deng Xiaoping viewed science and technology as the chief 'productive force' for growth and development, a belief that has taken root in the hearts of Chinese people and their leaders. In recent years, it has become increasingly apparent that science and technology will reduce the potential risks and obstructions to achieving sustained economic growth. Hu Jintao has also fully endorsed scientific development by promoting independent initiatives in various sectors of the economy to seek and develop new and advanced technologies.

Space inspires nations to pursue goals of advanced science and technology when they long to achieve prosperity and glory. The strongest countries in the world all possess, or are pursuing, advanced space programs and space technologies. As the only post-Cold War superpower, the United States has achieved a high level of development in space technologies. Russia, also a space power, has seen its capabilities in space as instrumental in maintaining the country's status as a world power. The European Union and Japan are also driving forward with their space programs. In addition, India and Brazil, two large developing countries, are active in space so as not to fall behind. Space is regarded as both a reflection of a country's technological prowess and as tied directly to economic development.

Similarly, China's space program primarily serves its national development strategy. Those who dwell on the military component of China's space program underestimate its greater strategic meaning. Military and security considerations are certainly important to any country, but they are not the first priority in the current Chinese grand strategy.

Going Commercial

China's space programs began in an unfavorable security environment. At that time, mainland China was isolated by the international community and faced military threats from both the United States and the former Soviet Union. Under those circumstances, as a country with very limited resources, China had no option but to entrust the mission of developing space-related technologies to the military. Thus, it is historical tradition, to some degree, that has brought about

the influence of the military in China's space program. Approximately 20 years ago, however, a reform program was put forward that called for transforming military sectors to promote economic development. This initiative had, and will continue to produce, a deep impact on the structure of China's space program.

Space was one of the 'unlucky' sectors to be selected for this reform program, as its annual budget from the government was drastically reduced.[1] The space industry was required to operate as an enterprise and survive in commercial markets. From this point, China's space industry gradually matured. It explored domestic and foreign markets, looking for foreign customers and investment, and consequently became familiar with international customs, regulations and import/export procedures. After two decades, many Chinese players in the space industry have become market-oriented enterprises, a phenomenon that will continue and expand in the future. This process has served to separate the civilian and commercial sectors of China's space program from the military sector, although that division has not yet been completed.

The military presence remaining in some civilian and commercial space activities does not necessarily signify that China has the intention of pursuing military capabilities in space through its civilian space programs. Chinese technicians for the Shenzhou VI project have pointed out that all the technologies utilized for the program are necessary for sending astronauts into space. They are all basic technologies for the peaceful exploration of space and not technology for military development. A number of the capabilities exhibited by China's manned missions are suspected by some in the Western media to have military applications, such as those related to rocket stability, reliability and accuracy. However, these capabilities were developed and mastered by the United States and the Soviet Union decades ago. Furthermore, the liquid-fueled launch vehicle with strap-on boosters that China uses for Shenzhou missions is nearly obsolete in terms of real military value. Modern militaries depend on high-speed and mobile missiles with solid-fuel propulsion systems.[2] A large portion of the civilian space program, in terms of the technologic sophistication, thus is not useful in modern military terms.

Furthermore, civilian and commercial uses of space facilities and technologies enjoy a broad market in China, rather than catering exclusively to the military. A simple illustration is the vigorous application of space technology to China's booming domestic automobile market. The in-car Global Positioning System (GPS) is an increasingly popular feature in developed countries; the availability of this technology in China remains low but is growing. In 2002, there were more than 20 million vehicles running on China's motorways. This rise in automobiles has unfortunately led to an increase in auto theft. GPS applications are useful not only in providing services such as navigation and road mapping and traffic management, but also in preventing theft.

With the continuous growth of China's economy and the improvement

in standards of living, it is forecasted that there will be increasing demand for space-related technologies by Chinese society. Thus, in the context of China's development strategy, more attention should be given to commercial and civilian space programs by Chinese society.

Engagement

The motivation of economic development and the increasing demands of domestic consumption suggest that the peaceful and commercial use of outer space is in accord with China's interests. This lays a foundation for cooperation between China, the United States and the larger international community. For example, U.S. space activities can be classified into four categories: civil, commercial, defense and intelligence.[3] This suggests that despite the dual-use characteristics of space technology, it is still likely, to some degree, for the United States to keep certain space activities in civilian and commercial areas and it is these projects that China potentially can join.

Encouraging China's integration with the international community will further separate the space industry and the military. By participating in the global economy, the commercial and civilian elements of China's space program will see their capabilities grow along with a sense of independence from the military. Interactions with foreign players also provide impetus for the civilian and commercial entities to behave in accordance with international norms and regulations, institutional arrangements and management practices. If China follows a path of isolation, exclusion will only deepen its suspicion and resentment, and the commercial and civilian sectors of China's space program would be forced to seek help from the government or even the military. In addition, the world will lose a vital channel into China's space market. Therefore, it is in the world's best interests that China's space industry be involved with international activities.

Involvement with the international community also shapes China's policies. A prime example is China's growing participation in the international regimes of nonproliferation of weapons of mass destruction. With the signing of the Nuclear Non-proliferation Treaty (NPT) on March 9, 1992, China has gradually changed its attitude and policy toward nonproliferation.[4] China not only actively participates in a number of international nonproliferation arrangements, but is gradually tightening its domestic legislative regulations and export control systems to this effect. China's track record in the area of nonproliferation indicates that international engagement can positively influence its behavior. As a newcomer, China needs time and international assistance to further improve the structure of its space industry, so the international community will cooperate with, rather than be suspicious of, its space program.

The presumed military intention of China's space programs using the connection between the military and civilian institutions is a premature judgment based on appearance. As suggested by the early history of China's space

program, the strong presence of military persons in a civilian institution is, to a large degree, the result of the specific environment in which the initial program was developed. It is narrow-minded to seize upon the flaws of a neophyte in space development. A more constructive method will be aiding China in further regulating and commercializing its space industry.

China's Space Program a Military Threat?

In comparing space capabilities, it is hard for the Chinese to understand why their comparatively smaller scale space program will pose a military threat to the United States. The technological gap between the United States and China in terms of missiles, satellites, command and control systems, or the ability to integrate these capabilities for military purposes, is at least several decades. Thus, the Chinese tend to believe that such scrutiny cannot be explained by China's space program itself. Rather, political and even ideological factors must be playing a significant role.

China is considered by some Americans as the largest geo-political threat to U.S. global dominance after the fall of the Soviet Union. Guided by a zero-sum strategic mentality, China-threat proponents are fearful of a Chinese space program emerging as a new driving force for the expansion of China's capabilities and political influence. Many Chinese perceive this as the real reason behind U.S. concern over China's space program.

During the flight of Shenzhou VI, there was Western discussion about the possible dual-use applications of Chinese manned space flight. Specifically, skeptics of China's peaceful development of space technologies worry about surveillance, reconnaissance, navigation and other functions that can be applied to military purposes.

It is surprising to this author that the surveillance and other functions were emphasized in the discussion of the Shenzhou VI. This reveals a fundamental lack of knowledge pertaining to China's satellite capability and, more generally, China's status as a space-faring nation. China has successfully launched multiple satellites, providing the country with communications, weather data, resource surveying capabilities, geo-positioning and other functions. With these and future planned satellite launches, it is illogical to assume that China would spend its limited resources on a space program that would mirror the purported military functions that satellites can already achieve.

Moreover, if the two-astronaut, five-day manned space flight of Shenzhou VI and China's dozens of satellites impose a so-called military threat, then how would one judge the military implications of the International Space Station? It is permanently in orbit, and receives frequent visits by U.S. shuttles. There are also vastly more U.S. satellites in orbit. According to the Union of Concerned Scientists, the United States has approximately 60 dedicated military satellites in operation, which include ocean reconnaissance, weather forecasting and ground

imaging satellites in Low Earth orbit (LEO), 29 GPS satellite in Medium Earth orbit (MEO), and communications, early-warning and signals-intelligence satellites in Geosynchronous orbit (GEO). Paralleling the large scale of its space activities, the United States also dominates military spending in space accounting for more than 90 percent of total expenditures by some measures.[5]

Regarding the application of U.S. military space assets, during the 1999 Kosovo conflict, hundreds of GPS-guided Joint Direct Attack Munitions were used, with an additional 5,000 employed in Afghanistan from 2001-02. A comparable number were utilized in Operation Iraqi Freedom in 2003.[6] In comparison to U.S. actions, other countries involved in military operations during the same decade did not demonstrate such space capabilities; including in conflicts involving the European Union and NATO in Yugoslavia and Russia in Chechnya. The United States is the only nation that possesses the means to exploit space-based assets for military force on the battle field. The maintenance of this status quo is the main aim of U.S. policy.

Anti-Missile-Defense

There have been concerns in the United States that certain technologies exhibited in the spaceflights of Shenzhou series, such as orbital maneuvers, indicate that China has developed technology to counter U.S. missile defenses.[7] The argument connects China's manned space program with military applications and could potentially antagonize other countries, especially the United States.

It is true that China is deeply concerned about the development and deployment of a U.S. missile defense system for several reasons. Primarily, China considers the willingness of the United States to invest so heavily on such a technologically immature program as suspicious. Furthermore, the unilateral pursuit of missile defense by the administration of President George W. Bush without consideration of the potential impacts on other countries may endanger China's interests in international stability and regional security. Nonetheless, China does not require a manned space program to strengthen its anti-missile-defense capabilities.

There are many measures that can reduce the effectiveness of U.S. missile defenses, including equipping ballistic missiles with decoys and countermeasures. According to experts studying countermeasures, any country capable of deploying a long-range missile would also be able to deploy countermeasures that would defeat the planned U.S. missile defense.[8] On April 24, 1970, China successfully demonstrated to the world its long-range missile capability by launching its first man-made satellite, the Dongfanghong-1. In addition, orbital maneuvering capabilities, which were mentioned in certain media outlets as proof of the connection between China's space program and anti-missile-defense (AMD) capability, are not new to China. Chinese space experts have claimed it is a technology that was routinely applied in the nation's recoverable satellite program. Therefore, to

stress the AMD function of China's manned space program is, at the very least, misleading.

After several years of observation, study and debate, Chinese officials, scientists and researchers have reached a clearer and more realistic understanding of U.S. missile defense. While the strategic intentions and the potential of the program is still a matter of concern, it is also generally acknowledged in China that U.S. missile defense will not be technically mature or practically effective in the near future. Accordingly, it is illogical for China to give AMD a central role in its space program. The AMD argument in relation to China's space program overestimates the importance of the U.S. missile defense system to China's strategic planning. The fundamental importance of China's space program stems from its potential contributions to the country's national development strategy and not for military application.

Conclusions

China's White Paper on China's space activities, published in November 2000, clearly states that the government has always regarded the space industry as an integral part of the state's comprehensive development strategy.[9] It further stresses that the exploration and utilization of outer space should be for peaceful purposes and the collective benefit of all mankind. As a developing country, China's fundamental tasks are to develop its economy and continuously press forward with its modernization drive. The peaceful use of outer space can best serve these national goals and, therefore, is in line with China's interests.

In June of 2002, China, together with the Russia Federation, submitted to the Conference of Disarmament in Geneva a working paper entitled "Possible Elements for a Future International Legal Agreement on the Prevention of the Deployment of Weapons in Outer Space, and the Threat or Use of Force against Outer Objects" (CD/1VI79).[10] The document requires countries "not to place in orbit around the Earth any objects carrying any kinds of weapons, not to install such weapons on celestial bodies, or not to station such weapons in outer space in any other manner." The document further states countries shall not "resort to the threat or use of force against outer space objects." However, the draft's sponsors recognize that some space assets have an implicit military use and that it would seem impossible for the U.S. to give up its missile defense under development. Therefore, the document does allow for certain space military activities, stating that it "shall not be construed as impeding the research and use of outer space for peaceful purposes or other military uses not prohibited by this Agreement."

These policy and legislative documents clearly indicate the Chinese government's recognition that its security interests lie in preventing the weaponization of space and taking precautions against the negative affects of military operations on commercial and civilian activities in space. China does not have the luxury of engaging in a military competition with superpowers in space, or in other

areas. Instead, exploring and developing space with other countries, sharing its economic potential and reducing conflict are unequivocally in China's interest.

In fact, the economic and commercial activities of people around the world are growing increasingly dependent on space. If the peace in space were disrupted by military operations or strategic competition, everyone would lose. For the same reason, both the Untied States and China must be concerned about the development of so-called anti-satellite (ASAT) weapons. Although the number, and the applied scope, of Chinese satellites is not as large as that of the United States, China utilizes its satellites to great advantage. The use of ASAT weapons could destroy China's satellites and greatly harm China's economic activities that depend on this technology.

Therefore, an urgent task for all countries currently employing space-based technologies is to establish a system of rules to manage and coordinate space activities. There are some existing laws and regulations, such as the 1967 Outer Space Treaty, the 1968 Astronaut Rescue Agreement, the 1972 Liability Convention, the 1976 Registration Convention and the 1984 Moon Agreement, but they are insufficient in a time when advanced technological proliferation is proceeding rapidly. We now stand at the threshold of space weaponization. The number of nations active in space is increasing, and thus the international community must act quickly while the present window of opportunity remains open to formulate regulations to guide activities while promoting international space cooperation.

It is true that space technologies can be applied to both civilian and military areas, yet China's space policy shows that it desires to cooperate with the international community to exploit economic and civilian benefits to the fullest extent possible. This must be pursued while simultaneously restricting the applications of space technologies for warfare to the bare minimum.

Endnotes

1. For the early history of the China program on transferring military sectors to serve for economic development, see: Joan Johnson-Freese, *The Chinese Space Program: A Mystery Within a Maze*, Malabar, Florida, Krieger Publishing Company, 1998, pp. 54-55.
2. "Shenzhou-VI Has No Military Threat," *Global Times (in Chinese)*, Oct. 24, 2005, p.1.
3. See the Report of the Commission to Assess United States National Security Space Management and Organization, Pursuant to Public Law 10VI-VI5, Jan. 11, 2001.
4. For a history review of the development of China's nonproliferation policy, see: Zhu Mingquan, "The Evolution of China's Nuclear Nonproliferation Policy," *The Nonproliferation Review*, Winter 1997, pp. 40-48.
5. Michael E. O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space*, Washington, D.C.: Brookings Institution Press, 2004, pp. 42-59, p.5. Recently, the Union of Concerned Scientists published a satellite database, which lists the details of the satellites different countries have. The website of the database is: http://www.ucsusa.org/global_security/space_weapons/satellite_database.html.

6. Ibid., p.3.
7. The argument was noted in "Shenzhou-VI Has No Military Threat," *Global Times (in Chinese)*, Oct. 24, 2005, p.1. Also see, Joseph Kahn, "Reaching for Moon, China Works to Put Astronauts in Orbit," *The New York Times*, March 14, 2003, p. 1.
8. "*Countermeasures: A Technical Evaluation of the Operational Effectiveness of the Planned US National Missile Defense System*," Union of Concerned Scientists and MIT Security Studies Program, 2000.
9. The Information Office of the State Council of P.R. China: "*White Paper: China's Space Activities,*" November 2000.
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Documentary Review *Shaking the Heavens*

Chen Yali and Eric Hagt

After 2 million yuan ($250,000) and two years of work, the Chinese Central Television Station released its 900-minute documentary on China's space program in September 2005. Like the exploration of space itself, *Shaking the Heavens* is a fascinating odyssey into the history of China's development in space. It weaves a gripping narrative of the triumphs and tribulations, the technological breakthroughs as well as launch failures throughout the evolution of China's space effort. The documentary features numerous interviews with rocket scientists, satellite designers, aeronautics engineers, and policy-makers key to China's space program, many of whom have never before appeared in the media.

Shaking the Heavens also disappoints, however, as it studiously avoids a number of issues critical to the shaping of China's space development such as the relationship of civilian and military actors, military space capabilities and intentions, institutional restructuring and the future ambitions of the program. It offers not a word on the Cox Commission Report and surrounding events, which arguably did the most to define Sino-U.S. relations in space in the past decade. As it focuses on China's launch capability development, it partly serves as an official booster for the China Academy for Launch Vehicle Technology (CALT), China's main rocket design and launch institute.

However, the documentary covers a number of important topics with a depth and comprehensiveness that go beyond propaganda. As the longest television series of its kind, it includes unprecedented coverage of debates within CALT, close-ups of early launch tests as well as launch failures, in which a number of scientists and workers lost their lives.

Spanning the history of China's space program from its inception in the mid-1950s until the latest Shenzhou manned space mission, a number of salient themes emerge throughout the series. The first of these reveals how China's space program, against considerable odds, was born. Tribute is duly paid to the pioneering space scientists, without their great self-sacrifice and deep patriotism – not to mention a little help from the Soviets – China's space program would never have gotten off the ground.

Once the journey was begun, however, the space program would be deeply impacted by the economic and political forces throughout the 1950s-1980s. From the necessity of secrecy amidst strategic tensions with the U.S.S.R. and the United States, to the chaos of the Cultural Revolution, to the upheaval caused by transforming to a market-driven industry; all influenced the direction and nature of China's space effort.

Another subject addressed in the series is the profound influence of China's entrance into the international space launch market and its difficult interaction with the dominant player in space, the United States.

Finally, *Shaking the Heavens* captures the unique process of how China developed independently a fully indigenous capability in space. In light of the damage caused by the Cox Commission Report and China's alleged attempts to steal sensitive technologies, this theme is particularly enlightening. It reveals the deserved reputation of Chinese aerospace scientists for achieving impressive technological breakthroughs through innovation and creativity with limited resources.

A Breed Apart

With the heady success of China's second manned space mission, Shenzhou VI, China has entered the elite circle of space-faring powers. China can launch indigenously produced satellites into any orbit just as the United States and Russia. Yet, this documentary draws the distinct conclusion that China's space program is indeed unique from its American and Russian counterparts, a fact that stems from its very different beginnings. Understanding how China's program started is crucial to appreciating that uniqueness.

Before the People's Republic of China entered the Korean War in the early 1950s, the country had been fighting for almost 20 years first against the Japanese and then in civil war, rendering China virtually devoid of industrial infrastructure. With only limited and short-lived assistance from the Soviet Union in the late 1950s, China embarked on an autonomous path to develop its national defense industry under dire political and economic circumstances.

In the mid-1950s, a number of events led to the birth of China's missile program. During this time the country's survival was teetering under the strain of a feeble economy compounded by the heavy cost of the recently concluded Korean War. It was the deep patriotic fervor for the newly established republic that was the germinating seed to starting a missile program in 1957. As Wang Xiji, chief satellite designer explains, "the difficulties China then faced were profound. At that time, it was a question of whether or not the Chinese race would be extinguished. If the Chinese didn't commit to making China strong, the country wouldn't survive."

Mao Tse-Tung's visit to the Soviet Union in 1957 gave further impetus to China's missile program. Mao was awed by Russian rocket technology, which he saw for the first time and that even moved him to quote from the classic, *Dream of the Red Chamber*, "either the East Wind (allusion to communism) will overwhelm the West Wind (capitalism), or the West Wind will overcome the East Wind." Thus, China's future missiles would take on the sobriquet that would hold significant meaning: 'Dongfeng' (East Wind) rocket series. At this time, Tsien Hsue-Shen fortuitously arrived in China to lead the fledgling program and would

eventually earn the title, 'Father of China's rocket program.' Tsien was a talented rocket scientist trained at CALTECH who had been deported from the United States in the maelstrom of the McCarthy witch hunts.

Humble Beginnings

The Fifth Institute of the Ministry of Defense took on the daunting task of building China's missile industry from scratch. A total of 156 engineering graduates were recruited, none of whom had ever seen a rocket before. "It was mysterious to us," says Liu Ximin, retired engineer of the Ministry of Aerospace Industry (MAI). "How could such a huge hunk of wingless steel fly?"

The U.S.S.R. provided assistance to China's nascent missile program by accepting Chinese students to study in Moscow and sending 102 scientists to China in 1957. The Soviets also sent along two P-1 short-range, ground-to-ground missiles, which were only slightly more advanced than Nazi Germany's V-1 rocket, the technical documentation for which China was made to pay weight-for-weight in gold. As Chen Zhenguan, a Chinese rocket engineer recounts, "We paid a kilo of gold for a kilo of documents. It was very expensive!" This first attempt at copying a missile, called Project 1059, came to naught as China's engineering and technical standards were not sufficiently developed.

The documentary portrays China's ideological mentors, the Soviets, as sincere in there desire to help China develop missiles. However, that assistance was limited to copying, and nothing more. "Russian experts would explain the design blueprints, but would never go into theoretical issues," explains Wang Zhiren, rocket engine expert who had studied in Moscow. Yet, even that ended with the Sino-Soviet split in 1960, when all Russian personnel in China were suddenly recalled, taking all documents with them. This sent China's missile program, and in fact its entire national defense industry, into a tailspin.

If the blow of the Sino-Soviet split was traumatic to China's incipient rocket program, the political and economic events beginning in the late 1950s would prove to be an existential crisis. Wang Xiji tells us that under the grandiose ideals of the Great Leap Forward Movement, the launch vehicle program set unrealistic targets in sending rockets to space. "The program was completely disconnected with China's industrial development stage at the time." These goals were eventually scaled down, and China's first sounding rocket, the TH-7, was launched to a height of eight kilometers. Nevertheless, hardships continued to define the program.

Many remarkable stories are revealed in this documentary testifying to the implausibly primitive conditions under which China's missile program evolved. In 1960, when launch experiments began in the suburbs of Shanghai, rockets were hoisted using a well winch onto a modified launch pad made of water piping. Without any communication equipment, or even a loud speaker, launch orders were

transmitted 100 meters away from the launch site to a command center by shouting or hand gestures through a line of people. Command and Control itself was merely bundles of dry hay, behind which the commanders would duck during launch to avoid being scorched by rocket heat and fire.

The success of the Soviet's first astronaut mission into space in 1961 inspired China's own space program. In 1964, China launched a rocket to a height of 70 kilometers carrying two lab mice and repeated the feat in 1966 by sending Xiaobao and Shanshan, two dogs, into space. With these initial successes, the Chinese dared to dream of its own manned space program.

Revolutionary Satellites

Since the 1950s, the capability to send satellites into space has symbolized the collective strength of a nation. Chinese scientists proposed a satellite development program in 1964. It was approved by the leadership in 1965 and formally established in 1966. Dubbed Project 651, it set the goal of producing a three-stage rocket to launch satellites into orbit by 1970. The three-stage rocket series would be named the 'Chang Zheng' (Long March) to commemorate the tortuous journey of the Chinese Red Army in 1938. But just as Project 651 got underway, China would soon descend into another ordeal of nationwide chaos in the form of the Cultural Revolution.

CALT, or the First Institute, was in charge of developing the Long March (LM) series of rockets.* However, progress was slow with project managers and engineers distracted by the mayhem of infighting between political factions in the Institute. Everyone was forced to attend endless political meetings. Zhou Enlai, then China's premier, ordered a list of key researchers to be spared from "participating in revolution" during working hours. But not even Zhou could safeguard the Project and its people from all the excesses of that period. The production of crucial materials was often disrupted, even forcing scientists to make some parts on their own. Once, several rocket scientists were discovered building an explosive device by themselves and filling it with explosives using their own soup spoons.

Such constraints were minor compared to the intense political pressure the Project's personnel felt. The nightmare for all scientists was the failure of a satellite launch. One story is told in the documentary of the great anxiety caused over how the first satellite to go up would transmit "The East is Red," a song to laud the greatness of Chairman Mao. What if the song went out of tune? It might even be a humorous anecdote if it weren't for the fact such a snafu would be politically dangerous for those involved. Chinese scientists even placed a self-destruct mechanism on-board the satellite in case anything went wrong. However, the launching of the first Long March rocket on Jan. 30, 1970 was a success.

More fundamental problems resulted in the turmoil of the Cultural Revolution, including a general inertia, lack of responsibility and quality

control of workers. In one incident, a quality and systems check on a rocket revealed more than 30 waste items inside the launch vehicle including screwdrivers, screws and scraps of metal. This so-called '108 Incident' led to a complete organizational overhaul to improve quality control under Gen. Zhang Aiping of the 7th Mechanic Division, which was responsible for most of the production of the launching vehicles.

Learning to Swim

China's satellite communication program proceeded slowly in the 1970s, forcing China to spend exorbitant sums in renting foreign satellite services. As a result, China commenced Project 331 in the mid-1970s with the goal of sending satellites to geosynchronous orbit. However, China quickly discovered that its ambitions exceeded its capabilities.

China needed a more powerful launch vehicle. In 1964, Ren Xinmin, another rocket engine scientist, began to develop a liquid hydrogen and oxygen engine that was a process of two steps forward and one step back. The technology was available in open source Western publications, but gaining the exact know-how for an indigenously produced rocket largely became a matter of trial and error. The documentary chronicles a number of expensive failures both in treasure and lives. Experiments for this engine type were extremely dangerous due to the highly combustible materials involved. During the first experiment in 1978, a massive explosion injured 10 researchers, and two months later, a huge fire broke out. In 1984, however, the Long-March III (LM-3) was finally completed.

In 1984, on the second attempt, the new LM-3 successfully launched China's first telecommunications satellite, the Dongfanghong-2 (East is Red) into geosynchronous orbit. For the first time China could send phone and TV signals to all places on its land and maritime territories, a capability the Americans had accomplished 20 years earlier. In the wake of these developments, China began construction of a more complete space infrastructure including the Xichang Satellite Launching Site, ground observation and control stations, sea-based observation ships, and large-scale observation and control centers.

Although the Chinese space program was making great strides, Deng Xiaoping clearly understood the existing technological gap with the world when, during his visit to the United States in 1976, he sat in an American lunar capsule. At the same time, the economic reform and opening-up of this period swept over every corner of China, including the space program. In the past, all budgets, all employee salaries, all infrastructure of the space sector came from government allocation. The space program would be increasingly weaned off its government funding in part because of financial limitations to support this increasingly bloated entity and in part to induce it to become self-sustaining.

The tide of market reform shifted the strategic goals of China's space

program from achievements based on symbolic political significance to practical economic results. Beginning in the 1980s, the space industry was forced to support itself and learn to survive in a market economy while the military industry was ordered to turn to civilian and commercial pursuits. It began a period of great upheaval for the space industry, creating both winners and losers. Hundreds of thousands of employees in China's space industry who had devoted decades to the space program were suddenly swept away by the current of economic reform. Many were laid off, some became unemployed while others got rich, becoming the so-called '10,000 yuan households.'

Liu Jiyuan, former general manager of the China Aerospace Corporation noted, "Managers had to make a great effort to develop civilian products for the market, as the free housing was abolished and salaries and bonuses depended on their own means."

These internal reforms and their attendant fiscal pressures on the space industry led to a new orientation toward the growing international space market. The transformation was inevitable but highly problematic for an entity reared in a closed and secretive environment. To be successful they would need to operate in a highly sophisticated global market. Several interviewees admitted that in the beginning they did not understand the laws and regulations governing the international launch business. They didn't have the right channels or contacts to market products and didn't even know how to write a bidding proposal. An agency to deal with foreign countries on space matters hadn't yet been set up.

In 1982, Chinese delegates made their first international trip to Geneva to attend a U.N. meeting on the peaceful use of the outer space, but the four participants were under instructions only to listen. Chinese delegates gave a brief report on the feasibility of providing space launch service to the world. The following year, the China Great Wall Industry Corporation (CGWIC) was established, to provide a platform to represent China's launch services in the international market. It fully committed to globally competing in space with a decision in 1986 by the Chinese leadership to begin opening up their space industry.

However, China's competitive position internationally remained precarious for some time. In 1989, China won just a single bid in commercial launch compared to three for the United States and nine for France. Huang Zuoyi, director of the CGWIC's North American office, recalls the desperation of those times:"They even considered shooting vessels with crematory remains into the outer space for Westerners." Struggling to gain a position in the international market China met many obstacles, not the least of which was an unreceptive American attitude.

Good American, Bad American

As the leading space power of the world, U.S. actions often influenced China's own ambitions in space. Such

motivators came in both negative and positive ways. When reminiscing about how they came to devote their careers to China's space program, many of the first-generation scientists cited the Korean War. The show of American air power with the bombing of the China-North Korean border instilled a sense of fear of what lay in store for China without air power. This prompted many to join China's nascent air force, out of which evolved an aeronautics and space program.

On a more positive note, when President Richard Nixon, on his 1972 trip to China, brought as a gift a mobile communications satellite station, it was the first of its kind the Chinese had seen and was deeply appreciated by China's scientists and leaders. It revealed to China for the first time the great potential of communications satellites both for China's own domestic needs and integrating with the modern world.

By and large, however, the relationship was a rocky one. Those in China's space industry recount many bitter memories about what they felt was American arrogance. "At that time, for a developing country such as China to sell high-tech products to a rich and developed country like the United States was an extremely difficult process," said He Kerang, former deputy director of CALT. At the beginning, when China tried to market its launch services, one American unabashedly asked for one million dollars for just talking to the Chinese, on the grounds that the meeting was more of training session than a consultation. One universal lesson of the Chinese space industry experts interviewed was that Americans admire authority. "If you are not at the same level of technological know-how, the Americans won't take interest in you."

Yet, as the European regulations only allowed launch services by EU states, that market was off limits and thus China understood that to achieve a legitimate position in international space arena, it had to engage the United States.

Practical challenges were often intertwined with politics. Huang Zuoyi describes the suspicion by Western companies regarding the origin of China's early rocket technology.

Also, according to the documentary, the American embassy in Beijing attempted to dissuade the Chinese space industry from entering the international launch business in 1985, for reasons concerning nonproliferation. Tang Jinan, former general manager of the CGWIC, said in an interview that after they had convinced Balapa Satellite Company of Indonesia to sign a launch contract and even got the blessing of the former president, Suharto, the deal was apparently axed because the United States threatened to subtract an amount of aid to Indonesia equal to the launch services provided by China.

Yet, in 1987, China signed the first launch contract with a small American satellite company. Others followed in 1988 with contracts between CGWIC's and the Hughes Corporation and a second to launch the AsiaSat I for Asia Satellite Telecommunications

Company.

Though the experience of dealing with Americans was often scarred by bitter memories, *Shaking the Heavens* pays due tribute to the overall positive influence of the United States on China's space development. One scientist notes the sometimes tough but necessary lessons learned. For instance, were it not for the Americans, China's launch facilities might still have no emergency escape system. At the launch of AsiaSat I, upon discovering the Chinese had no escape facility, the American technicians refused to climb up the launch structure.

Painful First Steps

On Feb. 12, 1990, the American satellite AsiaSat 1 arrived in Xichang with 18 U.S. guards providing 24-hour supervision. AsiaSat 1 would be China's first launch of a foreign satellite and the date was set for April 7 of the same year. It was also a first attempt at a joint project using a Chinese rocket and American satellite, one that proved to be hard-won, with a degree of acrimony between the two sides.

First, a hard and fast deadline was set to accommodate the many invited guests that would view the launch, and CALT was to pay $100,000 for each day the launch was delayed.

Also, U.S. demands that it retain exclusive access to the satellite during preparations led to much internal debate amongst the Chinese space leadership, recalls Liu Sunyun, a prominent rocket scientist. "Some believed that China was selling its sovereignty." A degree of tension pervaded the atmosphere throughout the project as both sides kept information on capabilities and technology to themselves, making cooperation difficult. The documentary explains that from the Chinese perspective, its rocket program was institutionally secretive as it was entirely developed indigenously and had been closed to outside observers since its inception. However, the Chinese rocket had to be refitted to launch an American-made satellite and so communication and exchange was necessary.

Meanwhile, the Chinese had great difficulty in acquiring the know-how for implementing international technical standards as the U.S. government put up many barriers to providing these to the Chinese.

Despite these obstacles, the LM-3 was prepared in time for launch on April 7. An engineer recounts the day as one filled with trepidation for all. It was the rainy season in Xichang, Sichuan Province, where the launch site was located. However, bad weather and a sharp drop in temperature produced a coating of frost around the rocket as it was being fueled. The rocket began to shake and Chinese engineers worried that the environment would degrade the strength of some metal parts and cause the rocket to fall apart. In a remarkable feat of ingenuity, the day was saved as dozens of cotton blankets were wrapped around the rocket by hand. AsiaSat 1 was launched successfully.

More problems lay ahead however with the unsuccessful launch

of Australia's Hughes 601 satellite in 1992. This satellite was to be launched on China's untested LM-2E rocket. Under the contract, the LM-2E would have to have a successful launch by 1990. As China's first launch vehicle with four strap-on boosters, numerous technical hurdles and multiple ground tests had to be overcome. But CALT didn't even have the financial means to test and manufacture this proposed missile. Liu Jiyuan recalls, "If we cannot get the funding [through allocation], we will get it through loans." CALT ended up borrowing several hundred million renminbi from the Chinese bank for the project.

CALT was faced with the monumental task of overcoming innumerable technical hurdles, producing hundreds of thousands of parts, and completing more than 300 ground tests in 18 months that would normally take more than six years. Liang Ziheng explains how CALT met the challenge by creating a new work method called "blooming all over" (遍地开花). "When a scientist came out with the preliminary conditions, the designers would draw the blueprint while the factory would already start preparations for production and the test site would begin readying for the test."

If this wasn't onerous enough, China also needed to construct a larger launch site to accommodate the new rocket. Thousands of people labored during the wintry days of 1989-1990 in the hinterland of Xichang to complete this project in time. After a mere 18 months, the 97-meter-high launch structure was erected and tested with the first strap-on rocket.

On March 22, 1992, after more than 300 ground tests, the real launch of the Australian Optus B1 Satellite was ready to go with live broadcast in China on CCTV. But hundreds of millions of Chinese would be stunned as the rocket caught fire and threatened to explode the launch vehicle, its payload and the launch pad. Catastrophe was narrowly averted as the emergency control system shut down the main engines and the satellite was safely removed. The cause of malfunction turned out to be a piece of aluminum scrap in the program distributor.

A new LM-2E was produced in 100 days and successfully launched the Australian satellite. Ironically, the satellite was sent into orbital position within four kilometers of its intended target, making it the most accurate launch of a Hughes satellite in history, according to the documentary.

China's LM-2E rocket continued to be plagued with problems between 1990 and 1995, with two of its seven launches resulting in explosions. Lack of integration between launch vehicle and payload and cooling were found to be the primary issues.

Secrecy and Hardship

In the summer of 1988, experts of Hughes and the Australian Satellite Communication Corporation were taken to a mysterious site at Mount Qinling in Shaanxi Province. To their utter disbelief, the Australian and American guests were informed by their Chinese hosts that this village, indistinguishable from others, was a

rocket engine production base. People who looked like farmers were introduced as China's top rocket engine designers.

Base 067, as the place was called, illustrates the secrecy of China's space program during that period and the effect it had on China's early space program. The difficulties of primitive living conditions for high-level personnel in the program and the remoteness of location posed significant obstacles in producing highly sophisticated technology.

Li Lin, propaganda officer at Base 067, notes the hardships that resulted from the level of secrecy. Located in several isolated valleys, the base was so secluded that rocket engineer scientists were forced to grow vegetables themselves and live in makeshift shacks made of mud and bamboo. Zhang Guitian, chief rocket engine designer, recalls in the documentary, "In the early days we cooked over fire using wood that we either bought from farmers or gathered ourselves in the mountains. We steamed bread ourselves and had little rice…the corn flour we ate always had a moldy smell."

Zhang Baokun, deputy chief rocket designer tells us, "Every time we went to Beijing for business, each of us would carry 30 bags of supplies. Because we didn't have rice, meat or even enough cooking oil. The biggest difficulty then was the inconvenience of communication and transportation. We couldn't make a direct phone call to Beijing. If one had to call, he had to register a number with the operator's office and then return hours later when the operator notified him it was ready."

Zhang Guitian also recalls the numerous floods in the area. "One major flood washed away our houses and base facilities. Space experts there, together with their families, became refugees taking shelters in the mountains and lived on the food dropped from helicopters."

Going it Alone on Little

A culture of secrecy, however, was one of the by-products of a program forced to develop without outside cooperation. As the Chinese invariably ran up against numerous technical difficulties, their appeals for outside assistance were often rebuffed. Xiao Yun, chief designer of the Long March 2F rocket, recalls that even after the collapse of the Soviet Union, Russia was willing to jointly work with China in technology, but when it came to core technology, the Russians refused to cooperate. In one instance, the Chinese requested an evaluation of their indigenously designed launch vehicle fault detection and escape system, for which Russia demanded a shockingly high price of $10 million.

A conclusion drawn by those interviewed in the documentary is that no country wants to cultivate a competitor. In order to survive, the Chinese space program had to depend almost entirely on its own technological ability and know-how.

Before 1983, China had no supercomputers, Ni Jiamin, a space technician, tells us. The machines then didn't even have the computing power of a

Microsoft 286. "Chinese rocket scientists had to do calculations using small machines to solve big problems." That is, they simplified computations by reducing them by orders of magnitude.

The limitations of China's resources drove many early debates over the space program. In early the 1990s, when economic development really kicked into full gear, a great internal discussion was initiated amongst key agencies over the critical question of whether and how China should invest in space. Many Chinese scientists were skeptical of manned space due to the lessons garnered from the competition between the United States and the Soviets in the 1970s. Qi Faren, chief designer of Shenzhou V, explains, "The two superpowers were racing against each other and were investing too much money in their manned space programs. At that time, Chinese scientists wondered whether we should also begin preparations in [manned space]." From of this debate, China's manned space program was born and named Project 714 to reflect the date the decision was made, April 1971. However, a lack of concrete results and limited economic resources conspired to put China's first manned space initiative on hold.

It wasn't until 1992 when China successfully launched the LM-2E, and when China's economic reform made significant progress, that China rethought its manned space ambition. Unfortunately, the documentary doesn't discuss the importance of the mood of uncertainty many were feeling in the early 1990s about the country's future and its relevance to the decision on pushing full speed ahead with manned space program. The project was a political opportunity to revive the pride and spirit of ordinary Chinese, in addition to other potential benefits. Coded Project 921, support for the program grew and the government even promised to use China's gold reserves to finance it if need be. Ambitious targets were set for the project to ensure major technical breakthroughs by the year 1998 and a manned flight into space by 1999.

Numerous difficulties slowed progress however. For instance, scientists recall how seemingly simply items such as the astronaut's seat took almost 10 years to design. A serious explosion occurred during testing of the rocket engine. By 1997, the spacecraft remained merely a prototype in the workshop and it was clear that the goal of sending China's first manned space craft by 1999 would not be realized. The shadow of failure hung over Project 714.

Qing Wenbo, deputy commander of space vehicle systems, recounts, "If such delays continued, our design and development team wouldn't be sustained and we would see our research funding would be reduced or even cut off. In order to keep the project going, we only had one choice: to conduct an unmanned flight test before the deadline, even though the engine system was untested." He worried that if they couldn't meet the goal, the whole project would be in jeopardy. It was clear at the time that as went the progress of Project 714, so went

the future funding for manned space. In order to make the deadline, the development team decided to take the unconventional step of doing testing and production simultaneously. Also, the prototype shuttle in the workshop was directly turned into the actual test spacecraft that would be launched into space. All electronic and mechanic parts that were originally used for ground testing were converted for use in the real space shuttle. On Nov. 21 1999, the first test was successfully launched, cementing the political confidence in China's young manned space program.

As China's manned space program is discussed in the final two episodes of the documentary, one is struck less by the content covered than by those telling the story. The majority of those interviewed are in their early- to mid-30s and speak in the idiom of technical jargon rather than high-minded patriotism and self-sacrifice. Liu Jiyuan, formerly the vice minister of the Aerospace Industry and the vice president of CAST, accurately sums up a core rationale for China's space program. "First, it is feasible from a technical point of view and second, such daunting challenge is requisite to developing talent."

The fact that this documentary was made attests to the successes of China's space effort. In that way, *Shaking the Heavens* has given an honest if less than comprehensive picture of the difficult political and economic circumstances out of which that program came to be. However, the vision of the new generation of technological sophisticates now leading China's space initiative points to an ambitious and promising future. Understanding what lies in store for China's space program will hopefully be the sequel to this fascinating documentary.

* The Eighth Institute which was dedicated to the development of Long March series was asked to transfer all research material to the First Institute or CALT.

China Book Shelf

Chen Yali and Eric Hagt

Military Astronautics by Chang Xianqi, Li Yunzhi, Luo Xiaoming, Xu Wei, Geng Yandong, Chen Haoguang, Lin Dong
National Defense Industry Publishing House; 2nd Edition, 2005
Introduction to Military Satellites and their Applications by Wang Yonggang and Liu Yuwen
Nation Defense Industry Publishing House, 2003
Military Secrets of the 20th Century: Missile Defense and Weapons of the 21st Century by Maj. Gen. Vladimir Belous (Rtd.), translated by Xu Jindong, Wei Xiaoming, Ji Hua, Wang Chuanhua, Wang Guoqiang, Li Chunmei, Xu Zhiling, Dou Xiaobing
Oriental Publishing House, 2004
Advancing into Space by Shu Xing
People's Liberation Army Publishing House, 2005
Space Armaments Application by Ling Yunxiang, Xiu Dishan and Xu Peide
National University of Defense Technology Publishing House, 2005

The most defining characteristic of the issue of space security in China has been the nearly complete lack of information about it in the public domain. Judging by the number of books on the subject now available in China's book stores, that situation may be changing. The year 2005 has seen a spate of new publications by Chinese authors offering a remarkable range of technical knowledge and perspectives on the strategy, politics and economics of space exploration and militarization. From the shelves of China's national book stores, this review has selected five of the more notable examples of this material that reveal not only what the general public is reading but also how this important topic is being brought out of the shadows and into the public eye.

One of the salient themes running throughout much of the literature is the importance of the revolution in military affairs (RMA) to the Chinese military. The People's Liberation Army (PLA) has been a keen student of the RMA since it was displayed on prime-time television during the first Gulf War in 1991. The quick and overwhelming U.S. victory forced Chinese military strategists to confront the reality that the RMA would be the key to victory on the battlefield for the next 20-50 years. Awed by the show of American high-tech power, the war provided a crucial lesson for the PLA. It understood not only the reality of modern warfare, but also how vulnerable and unprepared the PLA was – an

understanding that triggered a major shift in Chinese military thinking that continues to this day. The publication of *Unlimited Warfare*, a book widely read in the West and often quoted as representative of PLA thinking on how to respond to the revolutionary change in warfare, was in reality not accepted by the mainstream Chinese military apparatus. Rather, a more representative view of the PLA's reaction to the RMA, with the military use of space as a crucial element, can be found in the books reviewed below.

As the significance of the RMA grew in China's military strategic planning, the value of space capabilities grew in tandem – creating a strong motivating factor for development of China's aerospace program. Yet, commercial success and profitability are central concerns for China's space program, as they support the nation's primary goal of economic development. Thus, the military component is embedded in the development of space technology with an emphasis on civilian products and driven by the principle of economic viability. The dual-use nature of space technology endows China with a self-defense capability. This line of thought is consistent with that of the Chinese leadership since the era of Deng Xiaoping and the push for military reform.

The books reviewed here reveal in stark relief a realistic, yet pessimistic, view about the weaponization of space. The authors of *Military Astronautics* conclude that "the new military revolution demands that the U.S. and Russia speed up the building of their space power, which is inevitable over time." In this context, the authors closely reflect upon China's own national security interests in space. They conclude that space will become a central component of military deterrence in future wars because, in contrast to conventional and even nuclear deterrence, deterrence in space is unbound by national borders and could extend to areas of conflict anywhere around the globe. In addition, space potentially provides an increased capability to threaten strategic assets deep inside the enemy state. Space deterrence is therefore even more credible than nuclear deterrence because of the threat of highly destructive, precise, and rapid conventional strikes.

Another pervading theme among these authors (including one translated from Russian) is the categorical emphasis on a self-defense rationale in space over an offensive strategy. Based on their critiques of American and Russian space doctrines, we can reasonably conclude that the authors assume the Chinese military would seek to counter any attempt by others to deny China's access to space for its economic and military advantage. A prevailing sense that Chinese military planners see space as a place that holds grave military threats is unmistakable. According to *Military Astronautics*, the momentum of space militarization, and especially the weaponization of space, is gaining and will ineluctably bring war to outer space. And with this impending reality, countries will look to defend against threats from space, just as they have on land, sea and air.

In a somewhat futuristic tone, the importance of resources in space is a central leitmotif raised by several of the authors. Space is seen as "an indispensable reservoir of resources imperative for human survival and development." It is the future environment that will be tapped for energy, minerals, living space and as yet unknown assets. Its potential attracts nations to invest in space technology development to compete for better access. Once this competition for resources causes irreconcilable differences, it may lead to confrontation. *Advancing into Space* highlights the urgency of this problem and the author sees the issues regarding access to orbital slots as the opening gambit in the coming competition over space resources.

These Chinese authors are well aware of the interrelationship between space and economics. The development of space technologies and capabilities has a clear economic rationale. Economic strength, in turn, is seen as the basis for any development of space war-fighting capability. With China's economic development increasingly dependent on space, space infrastructure in addition will become a strategic target in wartime and thus warrants military protection. This fact leads directly to the need for war-fighting capability in space for defensive purposes.

These newly-published books on the facets of space security generally adhere to two approaches: they are either surveys of the science involved and thus are largely technical, avoiding the difficult analytical and policy issues; or they directly explore matters of national security and space. The latter are more useful for understanding policy and intention, but are often restricted to the discussion of American and Russian strategies. Insights into China's own military space policy and program are rare, and vague, when they surface. The silence on China's own program is deafening as the subject is eminently important to the authors, most of whom are experts on space and national security. The feeling of urgency among the authors about the future potential for conflict in space is palpable, yet they do not (or are unable of or unwilling to) provide prescriptions about how China could and should respond. While it is not hard to imagine certain chapters of these books may have been removed and classified for internal discussion, the reader is ultimately left wanting more.

In the course of reading these books, the reader is also reminded that in China – despite the phenomenon of round-the-clock, live broadcasting of the Shenzhou launches – space is still a very sensitive area and penetrating policy analysis remains outside the public domain. The system's instinctual secrecy, the gap between official policy and the unanswered challenges of space weaponization, and the tendency to keep outsiders guessing about its intention and military capability have all contributed to the lack of discussion on China's own space policy and development. Rather, such knowledge and discourse largely remains the monopoly of the military and has not yet been disseminated to

civilian analysts.

A second observation is that the majority of Chinese academic analyses on space (exemplified by this review though with the exception of *Military Astronautics*) use Chinese and Russian references almost exclusively. Beyond the suspicion that the authors may have limited knowledge of English materials, it begs the more important question of possible motive. The explanation may be relatively benign, as the writers possibly omitted U.S. sources for reasons of political sensitivity. Nevertheless, the use of Chinese and Russian sources, which tend to approach U.S. activity in space with a high level of criticism, may have a political, even nationalistic, impact by instilling a drive for competition and zero-sum thinking on space. This is the mirror image of what is often seen in the highly politicized discussions of China's space program in the United States. The risk of such methodology on either side, of course, is that it can deepen mistrust and misperception between the United States and China.

In light of these books, a more troubling problem exists in the policy debate on space weaponization in China. That is, American points of view are very rarely mentioned, let alone explained, save those U.S. voices that are most grating to Chinese ears. The lack of a sophisticated understanding of the diverse U.S. perspectives on security in space, no matter how unpalatable any one position may be, undermines the persuasiveness of the Chinese arguments in influencing American thinking and policy-making. One reason may be that, as noted above, the military is in control of the space debate in China, which is problematic not because China's military analysts are necessarily wrong, but because military officials generally hold one particular and unique viewpoint. Their perspective is focused more on capabilities than intentions, and often concentrates on worst case scenarios in the interest of national security. Militaries are not in the business of giving others the benefit of the doubt. The subtleties of politics and diplomacy often escape military analysts. Therefore, the debate on space security in China may be skewed.

A diversity of voices on this sensitive issue has yet to emerge in China. Nevertheless, the following books have come a long way in providing a richer body of information on the subject where little existed before.

Military Astronautics

By Chang Xianqi, Li Yunzhi, Luo Xiaoming, Xu Wei, Geng Yandong, Chen Haoguang, Lin Dong.
National Defense Industry Publishing House; 2nd Edition, January 2005; ISBN 7-118-03706-0
RMB 40

Military Astronautics is China's first published and, to date, most definitive study of military space. This book is also the first serious effort by scientists and strategists to build China's own theoretical framework on military astronautics. It is the product of the key task force on the Study of Space Forces and Space War-fighting under

the PLA's 10th Five-Year Plan on military science research, a joint effort by the PLA's General Armament Department and reviewed by a group of experts in the Academy of Military Sciences.

The book is divided into three sections on military space: technology; armaments and forces; strategy; and combat. Like other Chinese books on the subject, *Military Astronautics* deals extensively with American and Russian theories and operations, and is rich in case studies on the conduct of space warfare dating from the first Gulf War to the recent war in Iraq. It attempts to explore military strategies and theories of space warfare based on the thinking and operations of the authors' American and Russian counterparts.

However, it is highly unique in that it displays an independence of thought that cuts through the idiom of diplomacy and propaganda that has characterized much of the relevant literature in China to date. While the authors dwell on theories rather than actual situations, they do so from a realistic point of view that approaches the analytical standards of Western military publications. The book's brilliance lies in its candor and honesty, which, on a subject of great sensitivity in China, is a laudable accomplishment.

The authors also strive to systematically define much of the difficult language surrounding this subject. This includes terms like space forces, space deterrence and the space battlefield, as well as concepts such as ground force enhancement. They reach far and wide in explaining theoretical ideas and technical terminology. Interestingly, it is also the only book among those reviewed here that has English references.

The first five chapters are compiled by Senior Col. Li Yunzhi, professor in the PLA Armament Command & Technology Academy, who does not shy away from the possible military use of manned spacecraft. Although in her analysis there is no specific reference to China's own manned space program, she believes that manned space shuttles have potential in providing more effective human surveillance, experiments with new space weapons, and are more adept in maneuvering highly complex war-fighting operations in space. She views space planes – such as the National Aerospace Plane (NASP), which NASA and the U.S. Defense Department were once jointly designing – as potentially powerful strategic weapons. Li herself successfully designed the support system for the air- and ground- joint search command for China's manned space program, among other systems.

In the section authored by Maj. Gen. Chang Xianqi, former president of the PLA Armament Command & Technology Academy, the concept of space forces is explored. He defines the term as referring to "the forces a country possesses to enter, utilize and control space in order to realize national strategic goals." The ability to fight an information-based war through the utilization of space forces is crucial to national security and the national interest. He believes that space deterrence impacts and constrains the

enforcement of conventional and nuclear deterrence. Military surveillance satellites have reduced the possibility of war by greatly increasing military transparency and therefore preventing both sides from hastily launching a war. In this way, space technology of the 21st century reconciles with Chinese strategic thinking of 2,500 years ago that "the height of skill is to subdue the enemy without fighting."

Luo Xiaoming draws out the dangers of debris and space warfare. He sees "soft kill/injure" (interfering with and jamming satellite signals) as superior to "hard kill/injure" (destroying enemy satellites) in controlling space, as the latter would cause debris that could in turn damage other spacecraft. He also lays out the subtle distinctions of offensive versus defensive confrontation in space. Because satellites have fixed orbits, and are easy targets, they are inherently vulnerable to attack – factors that impact notions of offense as part of protection and defense. Three approaches to anti-satellite (ASAT) warfare are discussed: the use of satellites against other satellites, the use of missiles against satellites and the use of lasers against satellites. A number of ASAT tactics are explored as well, such as directed energy and kinetic energy weapons, jamming devices, ambush and interception in space, and even seizure of enemy satellites with mechanical arms on space shuttles. He points out, however, the survivability of satellites will improve by strengthening the capability for advanced orbital maneuvering, installing sensors and arming with defense weapons.

Xu Wei switches gears with a discussion on the legal instruments governing space, particularly the Outer Space Treaty (OST), which leads to some provocative conclusions. On the one hand, the author points out that the OST doesn't explicitly prohibit warfare in space or from space; nonetheless such military action could only be conducted under "sufficient reason" such as self-defense or protection of allies. Also, since the OST fails to mention non-WMD (weapons of mass destruction), deployment of kinetic energy and directed energy weapons would not technically contravene the treaty. At the same time, attack against any on-orbit spacecraft of any country would violate a nation's sovereignty. In this complex and potentially insecure situation, Xu is seeking a logical argument whereby a country would be justified in waging battle in space within the strictures of international law, an option that China should reserve. China must adhere to the fundamental principles of international laws, he says, but "neither should she tie her own hands and feet."

Introduction to Military Satellites and their Applications

By Wang Yonggang and Liu Yuwen
Nation Defense Industry Publishing House; May 2003; ISBN 7-118-03114-3
RMB 25

This book is a fairly dry, technical manual on military satellites and their applications. However, it is of particular interest as one of the 16

textbooks listed for the exam used in recruiting PhD candidates to the PLA Armament Command & Technology Academy on the subject of Military Command Theory.

With an impressive passion for detail, the authors cover a range of basics including the history of China's satellite development, the fundamental science of satellites, satellite components, launch systems, and recovery technology. It also includes a list, although incomplete, of the successes and failures of China's own satellite launches between 1970 and 2000. But, as with other books on the subject, this one also sticks to analyzing U.S. capabilities in space, with a particular focus on the Global Positioning System (GPS) satellite navigation network and its use in precision weapons guidance.

Introduction to Military Satellites and their Applications becomes interesting with the authors' enthusiasm about small satellites and micro-satellites for military purposes. Most of the discussion is generic, focusing on the capabilities of the largest space power, the United States, but including reviews of advances by smaller powers such as Sweden. The chapter dedicated to small satellites notes the important shift from large-sized satellites to small satellites by the U.S. military, with numerous contingency launches during the first Gulf War and the Kosovo War. Very little information on China's own military satellites is offered up. However, the authors do note that small satellites are becoming the new favorites of modern warfare because, compared to large satellites, they are far less costly, have a short lifespan, are easy to launch, and are especially suitable for mobile and agile applications on the battlefield. The book then covers China's research and development on small satellites, at Tsinghua University and Harbin Insitute of Technology (HIT) in particular, and notes a number of successful small satellite launches.

Chapter VII on "Comprehensive application of military satellites in modern warfare" studies the use of U.S. military satellites in recent wars, but also includes a section on ASATs, as developed by the Soviet Union and the United States. The authors cover the 21 ASAT tests by the former Soviet Union between 1968 and 1983 (including one over NATO territory), of which 60 percent were successful, "proving that their satellite interception technology had matured and could be applied in real battlefield situations." The authors even suggest that "such weapons have been improved since then in order to meet the challenge of U.S. missile defense." The authors also cite a number of U.S. ASAT technologies and past tests. However, the discussion of U.S. and Russian ASAT development is not complete or up-to-date, providing even less information than what can be found in the Chinese press – illustrating a sense of necessary restraint on this sensitive topic.

This book is notable as a PLA recruitment textbook for its focus in terms of the trends in military satellite application. The authors conclude by saying, "we must develop our own military satellite system to establish a

'network' against such space threats to protect our territorial land, seas and air…and fully exploit the role of military satellite systems in modern warfare."

Military Secrets of the 20th Century: Missile Defense and Weapons of the 21st Century

By Maj. Gen. Vladimir Belous (Rtd.)
Translated by Xu Jindong, Wei Xiaoming, Ji Hua, Wang Chuanhua, Wang Guoqiang, Li Chunmei, Xu Zhiling, Dou Xiaobing
Oriental Publishing House; September 2004; ISBN 7-5060-1850-0

At first blush, it may seem out of place to include a book penned by a Russian author in a review on space and security in China. But, if you are what you read, then *"Missile Defense and Weapons of the 21st Century"* by Maj. Gen. Vladimir Belous, the only foreign book (in translation) on space to be found in the book stores, gives a taste of what the Chinese are reading and therefore what may be shaping popular perspectives. Interestingly, the sober title provided by this professor at the Academy of Military Sciences in Russia was 'sexed up' for the Chinese version to become "*Military Secrets of the 20th Century.*" But more importantly, Belous holds a cynical view about the United States and its "militarist" plans for missile defense, believing that Russia has no alternative but to "counter U.S. missile defenses by various means."

The book begins with an overview of the history and future of arms control, nuclear weapons and a variety of new space weapons and technologies developed in the age of 'Star Wars.' The last two chapters concentrate on U.S. missile defense plans and Russia's response. Not unexpectedly, Belous believes some Western countries, including the United States, still implement policies to "weaken and divide" Russia. He therefore puts great emphasis on nuclear weapons, believing nuclear weapons will safeguard the territory and unity of Russia. By building a missile defense network, the United States is attempting to negate Russia's nuclear deterrent and build up an overwhelming military advantage. This will force Russia to look for allies and forge a united front against the United States, which will effectively dismantle current disarmament regimes and cast the shadow of a 'second Cold War' over the world. His conclusion stems from his hard-boiled realism, which sees a United States that has pursued its own interests at all costs, including the compromise of treaties, lies, deceit and abandonment of promises. Belous does not discuss Russia's perspective on China's capabilities or how China and Russia could cooperate to deter the United States. His conclusion for the need to develop and test highly effective missile penetration capabilities to counter U.S. missile defenses, however, might find an audience among Chinese strategists who feel militarily constrained by limitations similar to those of Russia.

Contrary to how the Chinese popularly see the Russian stand on U.S. withdrawal from the Anti-Ballistic

Missile (ABM) treaty, Belous' discussion here concludes, "The U.S. made a wrong decision, but it doesn't threaten Russia's security. Weapons to penetrate these defense capabilities are rapidly improving."

All in all, this book paints a dim picture of U.S. intentions, U.S.-Russia relations and the prospects for negotiations over issues of space security. Due to its strong point of view, it is therefore regrettable that a translated American rebuttal is not also available on the books shelves of the Xinhua Bookstore.

Advancing into Space

By Shu Xing
People's Liberation Army Publishing House; April 2005; ISBN7-5065-4604-3/G 282
RMB 26

'Shu Xing', the author of this book, means 'star of Sichuan.' It is doubtless a pen name and a thinly veiled reference to Sichuan province, where Xichang, one of China's launch sites, is located. The uncertainty of the author's identity thus leaves vague who in China is represented by this book's very candid recommendations for China to actively pursue military options in space. Yet, *Advancing into Space* contains some unusual quotations from a range of space experts, scientists and government officials that give some noteworthy insights into China's internal discussion on the subject.

In fact, the majority of the book covers an eclectic collection of concepts and technologies in a manner that comes across like a survey of space for enthusiasts. It sometimes takes a familiar tone in covering subjects such as launch vehicles and manned space, but also digresses to more farfetched topics such as popular space travel and space immigration. Much of the book seems to be for public consumption, but the author(s) is trying to make a serious attempt to impress upon the reader that space holds innumerable resources and opportunities that China must not miss.

In Chapter 10 the book switches gears and addresses the need for China to take action. Entitled "The Tragedy of Earth Must not be Repeated," Chapter 10 offers the pessimistic judgment that mankind is indeed condemned to repeat history and space will see confrontation, conflict and war just as Earth has. According to this author, space has become the new environment for man to carry out experiments and enhance scientific understanding, but also a new venue for weapons that give some nations great advantage over others. Thus, space is crucially important both for its resources and as a strategic arena. In space, nations will compete to express their strength, and thus struggles in international politics will increasingly be inseparable from space. Shu Xing argues that "space belongs to the world, so those who want to control space alone will see their dream dashed just as happened in the past with those who pursued the control of the land and the sea."

Predictably, blame for the author's

gloomy predictions falls on the United States. American unilateral efforts to develop missile defense capabilities and space weapons, as well as its withdrawal from the ABM treaty, are seen as having paved the way for global deployment of weapons in space. The United States ignores international rules and violates other nations' sovereignty. It extends such behavior from Earth to space, because it is too powerful and thus treats international law as "private" law – i.e., law that can be manipulated and law to which the United States is less subject than others. As a result, small and weaker countries, refusing to tie their fate to laws and treaties that no longer provide security guarantees, may choose to ultimately arm themselves with cheap but effective asymmetric capabilities such as ASATs.

By way of conclusion, the book offers a number of prescriptions for China's future development in space, all of which push China to play a more active role than it presently does. China, Shu Xing argues, must strive to attain a position of advantage in order to exploit space resources, for instance by accelerating the launch of satellites to occupy more orbital slots. China's satellite communications network presently serves mainly the government, military, big corporations and multinationals, but should concentrate more on the development of the military than on the commercial applications of space. Learning from the lessons of other major military space powers, China should focus on a few key areas to rapidly develop its combat capabilities in air and space, and should do so through independent development rather than follow others. The author believes China needs to build a 'Great Wall in space' to prevent slaughter and bloodshed on Earth from being repeated in space.

Space Armaments Application

By Ling Yunxiang, Xiu Dishan and Xu Peide

National University of Defense Technology Publishing House; May 2005; ISBN 7-81099-179-5/TJ 2

RMB 32

Wide-ranging theorizing about the present and future role of military assets in space forms the theme of this book, which is based on the authors' graduate course on the subject at the National University of Defense Technology. Although this book is somewhat disappointing in its complete lack of analysis of China's own military capabilities and plans in space, it does flesh out a number of intriguing ideas for the application of military satellites.

Although the military satellite systems designed by the Soviet Union and the United States in the 20th Century played an important role in the Cold War era, current Russian and U.S. capabilities do not meet the requirements of modern warfare, according to the authors. Both the first Gulf War and the Kosovo War illustrated a number of problems with the U.S. satellite architecture: it does not have contingency launch capacity; it does not provide comprehensive,

24/7 global coverage; it has difficulty tracking mobile targets; and it cannot reliably identify missile decoys

As information warfare utilizes space, countries will build tactical military satellites including contingency-based, maneuverable micro-satellites; increase the accuracy of surveillance satellites for target discrimination; and expand the number of communication satellites. At the current rate of technological development, the authors believe, the level of military satellite sophistication will take a big leap by 2010. As warfare in space emerges in the 21st Century, military satellites will not be limited to logistical and support functions alone; rather they will also take on combat roles in future space confrontations.

Military satellites will become both larger and more miniaturized, with reliable, launch-on-demand to respond quickly to military contingencies. They will also need robust self-protection and recovery systems to maintain a high degree of survivability under enemy attack. The authors further suggest military satellites will become far more integrated, with capabilities for on-orbit rather than ground-based control. By 2020, most major space powers will have built military satellite networks with major tactical capabilities that can directly undertake combat operations.

Literature Review

Su Dejin

Open source literature on a range of subjects germane to China's domestic and international security is rapidly becoming more widely available. Yet, this body of information remains largely inaccessible to people outside China, in part because the vast majority of it remains in Chinese, but also because many of the publications are not readily available on the Internet. To help remedy this situation, *China Security* reviews below a number of articles culled from more than 60 publications based on the criteria: that they come from established journals; and that they are well-written with a standard degree of fact-based analysis. This literature was primarily selected from journals, conference proceedings, doctoral dissertations and newspapers. Many are gathered from the China National Knowledge Infrastructure (CNKI), a pay-per-view, on-line document service.

The articles in this review cover various aspects of China's space industry, but primarily focus on reactions to the threat of space weaponization. The popularity of this topic amongst Chinese writers is evidence of China's growing concern over U.S. plans for missile defense and space-based weapons. They were also selected to compensate for the scarcity of English resources on China's views regarding this issue. However, *China Security* makes no claim that these articles represent in any degree the position or opinions of the Chinese government or the military. Neither does the collection of articles chosen reflect the views of editors of this journal.

"**The Status and Lessons of Russia's Manned Space Program**"

Li Ming (Deputy Director of the 8511th Institute, China Aerospace Science & Industry Corporation)

Journal of Aerospace Electronic Warfare, Issue 1, 2005 (Sponsored by the China Aerospace Science & Industry Corporation, or CASIC, a leading state-owned space corporation in China)

Li's article proposes how to negate U.S. space dominance by utilizing electronic warfare, due to its relatively low cost, efficiency and non-lethal nature. He believes that, in response to U.S. and Russian efforts to build a space arsenal, China should adopt a new military ideology, recognizing the strategic significance of a space presence. Moreover, the author suggests that, in the future, electronic warfare in space will become a decisive factor in potential conflicts.

As it is unrealistic and unnecessary for China to pursue conventional

military supremacy, Beijing should concentrate on areas where it enjoys a unique technological capability, such as electromagnetic technology. Given this comparative advantage, Li believes China could consider conducting electronic surveillance and electronic attacks. More specifically, with respect to space conflict, China could jam an enemy's space-based sensors, instead of physically destroying them using kinetic energy kill vehicles or space mines. Singling out the Global Position System (GPS) and satellite-borne synthetic aperture radar as the largest threats, Li concludes that China will have an edge in space warfare if it acquires the technology to both impede the function and reduce the effectiveness of enemy satellites.

"**China's Strategies to Develop International Market for Commercial Satellite Launch**"

Zhang Huiting (Deputy Editor of *Aerospace China*)
Aerospace China, Issue 2 & 4, 2005

"China's Satellite Application Industry: Today and Tomorrow"

Tong Huijie, Ge Bangjun,
Aerospace China, Issue 5, 2005

These articles offer fairly candid analyses of the prospects for China's commercial satellite launch industry. The obstacles faced by the industry are growing international competition and a dwindling market share. As global customers increasingly value service reliability over price, China has lost some of its competitive edge with its comparatively less reliable rockets. An inability to carry larger payloads, a lower capacity to launch multiple satellites on a single rocket, and inefficiency with regard to launch management systems all contribute to China's woes in the commercial launch business. However, China also holds certain advantages, such as a booming domestic satellite launch market, improve satellite-manufacturing technology, lower labor costs, and the success of its manned space program.

Zhang offers a number of proposals to improve China's performance in the international launch market. First, China should move ahead with construction of new launch sites, such as the one on Hainan Island in Southern China, which can offer reductions in transportation costs and improved launch site conditions. In addition, China must master the technology to design, research and manufacture its own commercial satellites. This will enable it to circumvent the handicap placed on it by U.S. policies that require an onerous application and licensing process in order to launch U.S.-manufactured satellites or satellites with U.S.-made parts. To better benefit from global technology and resources, China should also form joint ventures, and strengthen cooperation with Russia, Europe and developing nations. The author also asserts that China should seek financial help from domestic and overseas markets and offer loans to customers.

Tong and Ge provide a detailed

introduction to China's satellite application industry, its current status and potential areas of future growth. Satellites have become an indispensable tool for China with a broad array of applications. Nevertheless, China's satellite industry is still in its infancy. The satellite communications industry is facing fierce competition and steadily losing business to ground-based service providers. Navigation services are still relatively weak, as service providers are generally small contract companies unable to provide technical support to clients. Remote sensing satellites, particularly those made domestically, are playing an increasing role in Earth surveillance for civilian purposes including environmental monitoring, mineral resource surveying and urban development planning. Areas with the most growth potential include live broadcast, digital audio/video, broadband data transmission and Internet access, and satellite navigation services.

"**Space Policy Adjustments by the U.S.A, Japan, Europe and Russia Create both Opportunities and Challenges for China**"

Tong Qingxi (Academician, Institute of Remote Sensing Applications, Chinese Academy of Science) , Ma Jianwen (Research Scientist, Institute of Remote Sensing Applications, Chinese Academy of Science) , Cao Xuejun (Chief of Department of High and New Technology Development and Industrialization, Ministry of Science and Technology)

Journal of Remote Sensing, Vol. 9, No. 3, May 2005 (Sponsored by the Institute of Remote Sensing Applications, Chinese Academy of Sciences and the Geographic Society of China)

This article offers an analysis of China's policies on space. As China's policy-making mindset is principally reactive in nature, policies are largely made in response to the actions of other countries. While such an approach should be regarded as positive overall, the authors suggest it has a number of pitfalls. First, a country cannot stay ahead of the curve by simply countering other nations' initiatives. Second, there is the danger of misinterpreting and misperceiving others' actions and intentions. The article calls for a more proactive policy approach, particularly for space.

Following the Cold War, economic and scientific development has become the engine driving space exploration. Major space-faring nations have come to realize that their space policies have a huge bearing on their global competitiveness and overall national strength. Thus, China should develop satellites for a wide range of applications, including weather forecasting, resource surveying, environmental monitoring, communications, and global positioning. China should also focus on enhancing its heavy payload capacity rockets with clean fuel and dual-use application.

"**Thoughts on Establishing a Space-based Information System for China's Military**"

Qian Zongfeng (Graduate Student of School of Communication Engineering, PLA University of Science and Technology), Zhang Gengxin.

The Journal of Technology Foundation of National Defense, Issue 1, 2005 (A journal sponsored by China North Industries Group Corporation, China's leading weapons producer)

With remarkable clarity and detail, Qian and Zhang sketch a roadmap for China to develop its own space-based information system. In contrast to other articles dealing with similar subjects, the United States, in this case, is not regarded as the potential adversary. Rather, U.S. superiority in surveillance, communication and global positioning capabilities serve as inspiration to the authors, who see China's space-based information system useful in a regional conflict in the Taiwan Strait and South China Sea.

The authors propose a step-by-step approach in building China's space systems. The initial objective is an evaluation of what should be constructed, based on necessity and feasibility. It is imperative to develop communications and surveillance systems first, while simultaneously ensuring that such systems have navigation and global positioning capabilities. Other smaller systems and sub-systems should be integrated to form a large single network capable of facilitating information sharing and decision-making. To ensure the survivability of this system, China should strengthen both its defensive and offensive capabilities in order to deter attacks against its space assets.

The article also details how satellites can be constructed to better survive both hardware and software attacks. Such improvements include back-up satellites, orbital modification capabilities, shutters to protect high-resolution lenses, stealth technology and satellite-based early warning sensors. As it is easier to attack than to defend a satellite, the authors suggests China should also develop the technology to disable enemy satellites, such as utilizing high-powered lasers to damage surveillance satellites in Low- and Medium-Earth Orbit while they pass over China. Jamming the satellite or interfering with its remote control and surveillance system could cause its orbit to decay by disrupting the satellite's uplink systems.

"**Discussion of Anti-Satellite Weapon Equipment Development**"

Yuan Liwei (Ph.D. candidate of the Air Force Engineering University), Yang Jianjun (Professor of the Air Force Engineering University)

Winged Missiles Journal, Issue 12, 2004 (A Journal sponsored by the China Aerospace Science and Technology Corporation, the State-owned flagship enterprise in the space sector)

Yuan and Yang justify the development of anti-satellite (ASAT) weapons based on a calculus of necessity; namely, that the weaponization of

outer space has already severely threatened China's strategic security. The development of ASATs will greatly enhance China's prospects of winning a regional high-tech war while simultaneously stimulating growth in space technology industries. It is not only necessary, but also feasible to develop such weapons. China has the financial resources and technological means to further this goal, including precision-guidance systems, launch vehicles for ballistic missiles as well as satellite orbital maneuvering technology. Yet, if China is to develop ASAT weapons, it must also address a number of issues. Thus, space warfare theories and rules, the formation and structure of ASAT forces and key relevant technologies should be thoroughly researched.

As military action against satellites is a highly sensitive strategic issue, different methods of attack (physical destruction, damage to key systems or jamming communications) should be employed according to the particular situation. The authors conclude that, given the enhanced role satellites will play in future wars, ASAT weaponry is destined to be a key factor in ensuring space superiority and national security. To make certain the credibility of deterrence, and to safeguard its security and national interests in the 21st Century, China must apply an asymmetrical strategy in accordance with its particular condition, actively researching and developing ASATs.

"The Launch of Shenzhou VI Highlights the Many-fold Significance of China's Rise"

Ren Jiantao (Dean of Department of Public Administration, Sun Yat-sen University)

Nanfang Daily, Oct. 13, 2005

Published one day after the successful launch of China's second manned space flight, Ren's work bathes in a mood of patriotic triumph. He reflects on the cultural and national significance of the event for China. The launch symbolizes China's emergence as a world power, the author states. This new status does not necessarily guarantee economic or political dominance in international affairs, but imparts recognition of China's contribution to achieving man's destiny and its responsibility for playing a part in the international order. China should ensure that its development is conducive to the overall development of the global community.

The author asserts that the space launch can serve to broaden the political vision of China, which until recently has been preoccupied with more earthly matters such as political autonomy and economic development. The launch has also served to boost the country's confidence in its future, effectively ending the sense of backwardness that has plagued the nation for more than a century. Such a transformation of mindset may help to make the Chinese people more politically rational, as the success of Shenzhou VI highlights the significance of science and technology and China's mastery of it. This departs from a tradition of impulsive behav-

ior, the author tells us, as epitomized by the chaotic Cultural Revolution.

"**China Aerospace Science and Technology Corporation's Human Resource Management and Global Development Strategy**"

The Communist Party Committee of the China Aerospace Science and Technology Corporation (CASC)

Aerospace China, Issue 1, 2004

Although this article is collectively written by the Communist Party leadership of China's flagship space company, it transcends a façade of propaganda. The authors concentrate on CASC's strategy to fully tap its potential in a market economy through rational workforce management. The general aim is to ensure that the company operates efficiently, which entails a 10 percent annual layoff rate but also means attracting and retaining young talent. Currently, the ratio between management, experts and technicians is 1:4:6, and employees younger than 45 now hold 57 percent of the leadership positions in all areas of the company's research institutes and bases. Presently, within the manned space program, one-third of researchers are younger than 35. CASC has been attempting to create a level playing field for its employees regarding income and advanced training opportunities. Other measures to enhance the competency, creativity and commitment of individual workers include: transferring employees overseas and dispatching workers to manage domestic joint ventures for dual-use products.

Recognizing that the most advanced technology is virtually impossible to acquire through international cooperation, the company has committed enormous resources to establish new labs and to set up cooperative relationships with Chinese universities. CASC has also worked hard to create a more horizontal working environment, where its younger R&D staff can interact frequently with the company's top researchers and technicians – thus ensuring expertise is passed on to the younger generation. Of course, the article also emphasizes a corporate culture highlighting national interest, self-reliance and quality control.

"**America's Outer Space Policy and the Cold War: Misconceptions and an Excessively Defensive Mentality**"

Zhang Yang (Lecturer of the Northeast Normal University of China, Ph.D. candidate)

American Studies Quarterly, Issue 3, 2005 (Sponsored by the Institute of American Studies, Chinese Academy of Social Sciences)

Utilizing newly declassified information, Zhang examines the relationship between U.S. space policy and the Cold War, citing documents from the administrations of Presidents Dwight D. Eisenhower, John F. Kennedy, Lyndon Johnson, Ronald Reagan and

George W. Bush. The author argues that the United States, stung by the success of the Soviet satellite Sputnik, reacted excessively in formulating its space policy. This had a large and lasting impact on American actions in the Cold War. Wishing to avoid further surprises, the United States has been bracing for the eventuality of a "greater than expected threat." This defense-oriented mentality has abetted the misconception of Russian and Chinese space capabilities, which has negatively affected bilateral relations. In one extreme instance, the United States, fearful that purported Russian missile technology transfers to China would tip the balance between the two camps, chose to export missile technology to Japan. The author argues that even today, U.S. space policy is still, to a large extent, based on ill-conceived views. The irrational assessment of a rival's capabilities leads to an equally irrational response from the United States. Zhang fails to mention, however, the contributing factors to these misconceptions and what the United States or China should do to reduce the gap between perception and reality.

"**The Space Development Strategy of China's New Industrialization**"

Han Minqing (Vice President of Shandong Academy of Social Science, Director of New Industrialization Research Center)

Shandong Social Science, Issue. 6, 2004 (Sponsored by Shandong Academy of Social Science)

This article is representative of a large amount of writing urging China to fulfill ambitious goals in space. According to Han, the development of space will largely define the modern age of industrialization. Space development includes resource exploitation, which encompasses new energy sources, materials and the establishment of new settlements. The pursuit of knowledge of outer space and the scientific and technological means to conquer it will be a central driving force in exploring this new frontier. If China is to be a world power, it must be a space power, argues the author. He looks far into the future and urges China to pursue construction of lunar bases for deep space exploration and acquiring new energy sources and materials. Following this, China should establish bases on Mars. Accomplishing these feats will require major breakthroughs in launch vehicle capability, artificial intelligence, space networking technologies, chemistry and life sciences.

China should not be discouraged by the massive initial financial commitment demanded to fulfill its potential in space. Such investment serves a higher purpose than immediate economic return. It will ultimately benefit China and help all mankind to reach a brighter future. China must view space exploration as the inexorable trend of the new age of industrialization. The author approaches this subject with an almost religious zeal due to his belief that, in a time of space development,

material comfort is less important than the man's collective curiosity and creativity. To the author, even national interest pales in face of such pursuits. In short, this article is an attempt to lay the philosophical groundwork for Chinese space exploration.

"**Analysis of the Future War's Demands on China's Satellite System Security and Anti-Jamming Technology**"

Zhou Yuchang, Xi Qingling, Lei Shaomin, Xiong Zhifan (Fifth Research Institute of CASC)
Proceedings of the Satellite Telecommunications Conference, 2004 (collected by CNKI)

An information war in space, insist the authors, is all but inevitable. Control of outer space is key to ensuring national security, thus the weaponization of space is unavoidable. The United States has been preparing for this eventuality for some time. The authors urge China to also prepare for such inevitability now, with the first step increasing the survivability and anti-jamming capabilities of its satellites. The risks currently faced by China's satellites include data interception, signal jamming and damage by physical destruction. To defend against such threats, China should provide protection to satellites and ground stations. The authors maintain that such capabilities lag behind those of the United States by approximately 20-30 years. The current defense mechanisms of China's satellites are mainly designed to combat exposure to the elements, not hostile forces. Chinese space assets, whether for defensive or offensive purposes, should possess better active and passive defense mechanisms against both reversible and irreversible attacks.

Though China did engage in limited satellite anti-jamming research during the 9th and 10th Five-Year Plan periods (1996-2005), the authors suggest that China expand such efforts during the 11th Five-Year Plan period (2006-2010). Of particular importance are the applications of nanotechnology, artificial intelligence and signal processing.

Editorial Policy

China Security is an international and interdisciplinary quarterly policy journal dedicated to bringing diverse perspectives to bear on vital traditional and non-traditional security issues that impact China's strategic development and its relations with the United States and the region. The journal seeks to improve the understanding of China amongst American policy practitioners and the public by providing authoritative analysis on critical security issues.

China Security presents ideas from a wide range of intellectual traditions that cover both theoretical and policy-oriented research on political, social, economic and military issues relevant to China. As an independent journal, *China Security* provides a peer-reviewed forum for research publication that enhances the communication of concepts and promotes a creative dialogue within China and across national boundaries.

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Each issue also contains reviews of recently published books and other forms of literature (monographs and journal articles) on the topic area. These materials have been published in China, are written in Chinese and make an important contribution to the field.

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