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on

Weaponizing Space:
Is Current U.S. Policy Protecting Our Security?

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Mr. Chairman, Distinguished Representatives:

Thank you for allowing me the opportunity to testify before you today. I would like to address the question of what approach the United States should take to develop an effective and sustainable policy toward space security that benefits both U.S. and international security.

I am a physicist by training, and currently apply my technical background to analysis of space security issues. An important part of understanding technical issues is understanding both the possibilities—and the limits—of technical approaches to security.

The main points I would like to make today are these:

- In recent years the United States has taken a largely unilateral approach to space security based on pursuing technical measures and capabilities.

- While there are useful technical measures the United States can and should take to improve security, because of the increasing technical capabilities of other countries, and the dual-use nature of microsatellites and other space technologies, the unilateral, technical approach is ultimately going to be neither effective nor sustainable.

- As a result, there is a need for diplomatic efforts to pursue "rules of the road" and operational constraints on space operations, as well as verifiable legal constraints on systems intended to damage or destroy satellites.

- As a first step toward controlling anti-satellite systems, an international ban on debris-producing anti-satellite weapons, similar to the weapon tested by China in January, would be a way of starting an international process and taking an important step toward preserving the use of space for the future.

So that we may start with a common understanding, I will be clear about what specific security issue I am addressing. The term "space weapons" encompasses space-based missile defense interceptors, ground attack weapons based in space, and anti-satellite weapons—both ground-based and space-based. While both space-based missile defense and ground-attack weapons have serious security implications, any sort of implementation of them is some years off. Instead, I will focus on what I believe is the major issue facing the United States in the near-term: the development of anti-satellite weapons.

Outer space has enormous potential as an agent of stability and prosperity. This potential is being realized, for example, via the unique capacity of satellites to observe and transmit to wide swaths of earth at once, permitting efficient communications to remote regions, simultaneous broadcast to large audiences, and comprehensive observation of the earth's atmosphere and surface. However, as satellites serve a number of important military missions and also have significant potential physical vulnerabilities, they have long been considered possible attractive military targets. And some argue that warfare in (and from) space follows naturally from war on earth.

How do we manage these strategic issues to preserve the beneficial agency of space into the future? How do we ensure that involving space does not escalate conflicts? How do we transition gracefully from the present to a future where many more states have interests and assets in space?

Currently, the state of affairs in space is as favorable to the United States as it is ever likely to be. The United States is the uncontested dominant user of space, owning over half of the nearly 850 satellites operating today.[1] Satellites have become integral to commercial endeavor, scientific inquiry, and military function. No state has deployed dedicated weapons stationed in space or weapons that could destroy satellites.

However, U.S. discussions of its military goals for space, along with futuristic visions of space-based ground strike weapons such as "rods from God" presented in semi-official U.S. military planning documents inflame apprehension domestically and abroad. These, coupled with the refusal of the United States to consider space security initiatives in international fora,[2] generate mistrust and strain strategic relationships that are necessary for progress on other crucial issues, such as nonproliferation and terrorism.

The choices made now about which space programs to pursue and how to formulate rules and engage in agreements about conduct in space will set the tone for space operations and strategic relationships for years to come. The United States, in particular, as the most influential user of space, has a great opportunity to shape the future. These issues have been visited before, most notably during the Cold War. But context is important, and a number of changes in political, strategic, and technical context have occurred in the last twenty years—changes that may lead to new policies regarding space weapons. This revisit finds the world with the United States as the single dominant space power, without the peer competitor relationship of previous years. At the

[1] Union of Concerned Scientists Satellite Database 4/09/07 version, http://www.ucsusa.org/satellite_database, accessed May 21, 2007

[2] The Russian Federation and China have submitted draft text for a treaty on space weapons to the United Nations Conference on Disarmament and have been trying to get it on the agenda for a number of years. The United Nations General Assembly has voted nearly unanimously for many years on resolutions on Preventing an Arms Race in Outer Space; only the United States and occasionally Israel or Micronesia has not voted positively. The United States has abstained every year until 2005, when it voted "no." Following the Chinese test, in the 2007 session of the Conference on Disarmament the United States agreed to take part in talks on space, if a plan of work is adopted.

same time, satellites and services from them, the use of which is not at all exclusive to space-faring nations, are much more deeply ingrained in the international economy than in the past. And the number of states with the ability to build and launch satellites,[3] or the aspirations to do so, has grown steadily.

In addition to the strategic roles they played in the past, satellites gained new roles over the last decade. Space systems playing tactical roles are now critical to the conduct of conventional military missions by the United States, and have been recognized as "an integral part of the deterrent posture of the U.S. armed forces."[4]

The new unclassified version of the National Space Policy[5] (NSP), released in 2006, recognized this ascendancy of military uses for space. In the 1996 NSP, the first space policy goal listed was civil ("Enhance knowledge of the Earth, the solar system and the universe through human and robotic exploration") and the second was military ("Strengthen and maintain the national security of the United States"). In the 2006 NSP, the top two goals listed are national security related: "Strengthen the nation's space leadership and ensure that space capabilities are available in time to further U.S. national security, homeland security, and foreign policy objectives" and "Enable unhindered U.S. operations in and through space to defend our interests there."

Of all nations, the United States has by far the largest investment in military space assets and best exploits the military advantages satellites can provide for missions such as reconnaissance, targeting, communications and surveillance. The military utility of satellites has naturally lead to a desire on the part of the U.S. military to preserve for itself these satellite-based capabilities and to deny them to potential adversaries.

However, satellites are intrinsically vulnerable, and defending them from a determined adversary is difficult. Satellites are readily observable and travel on predictable paths, so their future

[3] Over forty states own satellites as of June, 2006, not counting the states of the European Space Agency individually. Many more countries beyond this group buy satellite services.
[4] Department of Defense directive on Department of Defense Space Policy, July 9, 1999 http://www.dtic.mil/whs/directives/corres/pdf/d310010_070999/d310010p.pdf, accessed August 29, 2006.
[5] The new U.S. National Space Policy was released on October 6, 2006, four years after the Bush administration called for its review. The new directive replaces the Clinton National Space Policy of 1996, the previous operating document.

position can be readily calculated. Most satellites pass over much of the earth repeatedly, giving an adversary multiple opportunities to attack. By design, satellites are light and largely unarmored, as space launch is extremely expensive and mass at a premium.

As a result, these assets are not only valuable but vulnerable; this may provide other countries strong incentives to attack or disrupt them.

The 2006 National Space Policy emphasizes that space assets must be protected and afforded the unhindered ability to operate in space: "The United States … rejects any limitations on the fundamental right *of the United States to operate in* and acquire data from space" [emphasis added]. It also recognizes that in some situations, the United States may want to deny the use of these types of valuable space capabilities to its adversaries: "Maintain the capabilities to execute the space support, force enhancement, space control, and force application missions. …Develop capabilities, plans, and options to ensure freedom of action in space, and, if directed, deny such freedom of action to adversaries."

In addition, the new NSP dismisses arms control and diplomatic approaches as largely irrelevant.

In this regard, the 2006 NSP is strikingly different from the 1996 version. The 1996 NSP states that "Consistent with treaty obligations, the United States will develop, operate and maintain space control capabilities to ensure freedom of action in space and, if directed, deny such freedom of action to adversaries. These capabilities may also be enhanced by diplomatic, legal or military measures to preclude an adversary's hostile use of space systems and services." In addition, the Arms Control section of the 1996 NSP states that "The United States will consider and, as appropriate, formulate policy positions on arms control and related measures governing activities in space, and will conclude agreements on such measures only if they are equitable, effectively verifiable, and enhance the security of the United States and our allies."

In contrast, the 2006 NSP states that "The United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space. Proposed arms control agreements or restrictions must not impair the rights of the United States

to conduct research, development, testing, and operations or other activities in space for U.S. national interests…"

This shift is consistent with the U.S. diplomatic position in the United Nations, both in the First Committee and the Conference on Disarmament. As noted above, the United States has in recent years consistently opposed discussions of diplomatic approaches governing activities in space.

The approach instead has been to focus on developing a set of technologies, many of which have anti-satellite (ASAT) capability. While the United States has available for use nonpermanent means of interfering with the operation of satellites, such as "jamming" systems, more lethal options have been considered. In the 1980's, the Air Force performed a series of tests of the "Air-Launched Miniature Vehicle," a homing interceptor launched from an airplane, which could ascend directly to a satellite and destroy it with the force of impact; in a 1985 test, the system destroyed an orbiting satellite. About ten years later, the United States tested a system based on a high-powered laser that was coupled to a mirror that could track satellites. Research continues on technologies useful for laser ASAT systems. Additionally, systems such as the ground-based midcourse missile defense system and highly maneuverable microsatellites have intrinsic ASAT capability and create an implicit and unaddressed threat to satellites. And no clear directive has been issued taking destructive ASAT weapons off the table.

Because of the intrinsic vulnerability of satellites to various types of interference, one must assume that the United States will not have a monopoly on ASAT capabilities, and that other countries will be able to develop effective ASAT capabilities of some type if they have the incentive.

Defensive satellites, often called bodyguard satellites, are sometimes discussed as a means of protecting high-value satellites by acting as a weapon themselves to destroy or disable the attacking ASAT weapon. For various technical reasons, this is a very difficult task, and deploying such satellites would not provide confidence in the survivability of the satellite they were intended to protect. Additionally, defensive weapons of this type may be useful as ASAT weapons themselves, and because of their limited defensive use, may be viewed by others primarily as offensive.

With no legal restrictions on ASAT weapons, and with the evident strong interest in ASAT-capable technologies by the leading space power, other states may decide ASAT weapons are the answer to their perceived security needs. The Chinese rationale for developing and testing its ASAT weapon is unknown to us. However, its repeated calls along with the Russian Federation for diplomatic discussions about space security were rejected by the United States. Although it is impossible to say where such discussions could have led, that there *were* no discussions guaranteed that there was no law banning the Chinese destruction of an orbiting satellite. Additionally, although there were two tests of the ASAT system that were observed by the United States prior to the January test, there was reportedly no effort to dissuade China from testing it against a satellite.[6] It remains to be seen whether China sees this ASAT capability as important to its military posture. Performing another test of the system may indicate this is so; however, if China does not pursue additional tests, which would be required for the system to be considered operational, it may indicate that China is not committed to developing this capability and remains open to diplomacy.

The result of the series of tests of the Chinese ASAT weapon was the destruction of the Fengyun 1C satellite on January 11, 2007. FY-1C had a mass of just under one ton and was orbiting at roughly 850 km altitude when the collision occurred, and the energy of the collision completely fragmented the satellite into orbital debris. This test approximately doubled the density of debris larger than 1 cm in that region for at least five years, doubling the risk of a catastrophic collision at that altitude. By late May, the U.S. Space Surveillance Network had already cataloged some 1,600 pieces of debris (presumably larger than 5 to 10 cm) from the Chinese test. Because this breakup took place at a high altitude where the atmospheric density is very low, a large fraction of this debris will remain in orbit for decades, and the earth's gravity will spread the debris out into a shell around the earth.

Although it was a single destruction of a satellite, it demonstrated the very serious consequences of unrestrained ASAT weapon development. The breakup of satellites larger than FY-1C will

[6] M. Gordon and D. Cloud, "U.S. Knew of China's Missile Test, But Kept Silent," *New York Times*, 23 April 2007, p.1.

produce significantly more debris. Satellites that are considered likely targets of ASAT weapons, such as spy satellites, have masses ten times that of the FY-1C satellite. The breakup of a single large satellite with a mass of 10 tons would double the amount of debris with size larger than 1 cm in all low earth orbits, and could increase the density of debris, and therefore the risk of collision, in altitudes near the breakup altitude by several hundred percent. Satellites cannot be shielded effectively against collisions at orbital speeds with debris larger than about 1 cm. Moreover, debris smaller than about 10 cm cannot be reliably tracked from the ground to give warning of a possible collision. All satellites, not just the intended targets, would experience a resulting higher risk of collision.

Pursuing anti-satellite technologies in the absence of any restrictions on them will likely increase the threats that U.S. satellites face, both by ASAT weapons developed by other countries and the possible debris that testing and use of destructive ASAT weapons would cause. Clearly the approach in the NSP of using only a few of the tools in the toolbox—technical tools for space control, but not diplomatic tools—is misguided. The United States has available other approaches that are likely to garner more security.

Some of these approaches are technical. Fortunately, there are many things the United States can do to protect capabilities that rely on satellites, including designing satellites with redundancy, so that damage to one part of the satellite need not cause the satellite to be useless, and using a number of smaller satellites to perform the same function as a single or few big expensive ones. Moreover, ground and air-based components can provide a backup to satellites on a regional rather than global level. Keeping satellites from being an Achilles heel will also diminish their attractiveness as military targets.

The United States should implement these satellite safeguards, and should also take the lead on developing “rules of the road” for space operations, and increasing transparency on space security issues. Rules of the road could include rules that establish a keep-out zone around satellites, and a method for notifying the owner of a satellite should another satellite need to violate this zone. In a similar manner as the Law of the Sea, such rules can defuse unnecessary

tensions, and are especially useful during times of crisis. Diplomacy may not be perfect or solve all of the outstanding security requirements or tensions, but neither are military options perfect.

The United States emphasizes exploring a range of technologies, with the goal of seeing what works and may be useful. Similar effort ought to be devoted to exploring what is possible diplomatically. Exploring and understanding these possibilities does not imply the United States would necessarily see these efforts as successful and useful, and does not commit the United States to them. But neglecting this avenue altogether, as it does now, is irresponsible.

Space-faring countries have the most capability to mount effective ASAT attacks, and are the only ones who can place weapons in orbit. The technology required to build effective ground- and space-based ASAT weapons is within the capability of any space-faring nation, and they could deploy ASAT weapons relatively quickly in response to the deployment of ASAT weapons by another country. But these are also the countries with the most to gain by negotiating and observing limits on such weapons. This fact suggests that developing an effective international regime on controlling ASAT weapons should be possible.

There are some issues that military efforts cannot address, such as problems arising from dual-use technology, and that require diplomatic efforts to develop rules of the road that govern how systems are operated. A reasonable goal for diplomacy is to generate a mix of restrictions on the most dangerous technology and operational rules of behavior for dual-use technology.

A first step toward a comprehensive space security regime may be a multi-lateral ban on the testing and use of destructive anti-satellite weapons, particularly those intended to destroy satellites through impact, which therefore generate huge amounts of debris. If this agreement could be negotiated and respected, the single biggest threat to the sustainable space environment could be mitigated. This protection of the space environment would be the primary benefit, and a meaningful one.

Currently, missile defense tests consist of low-altitude intercepts of a ballistic missile warhead, which is sub-orbital. A ban on destructive ASAT weapon tests would prohibit the missile

defense interceptors from being tested explicitly against satellites, and the ban could set an upper altitude limit to missile defense tests.

Such a ban should be verifiable from the ground, perhaps with the already existing observational assets, perhaps with additional assets and coordination between observers. Countries that consider this idea may convene a panel of experts who could assess existing national technical means and their suitability for the purpose.

For example, U.S. early warning sensors could detect the launch of the booster carrying a ground-based hit-to-kill weapon; China's destructive anti-satellite test as well as the tests leading up to it (that did not destroy a satellite) were observed in this way by the United States. Additionally, preferably with—but perhaps initially without—launch detection, all possible satellite targets for tests of a destructive ASAT test could be monitored and verified that they have not been destroyed in an ASAT test. The US Space Surveillance Network (SSN) regularly tracks thousands of objects of size greater than around 10 cm; its tracking of active satellites and inactive satellites and large pieces of debris is considered to be complete.

Countries could verify the ban independently using a surveillance system that is much simpler than the U.S. Space Surveillance Network. Developing an independent capability to track all possible targets is a much simpler and focused task than trying to replicate the U.S. SSN catalog, as the number and type of targets and the mission is tightly circumscribed.

A test ban would prevent the production of the large amount of debris that would be generated in testing programs, and would reduce the military utility of the ASAT weapon due to the decreased confidence in an untested or incompletely tested system.

Limits on debris-creating ASAT weapons would be particularly powerful if it came in the context of other efforts to deter the use of destructive ASAT weapons in a conflict. These steps could include the measures discussed above to reduce the attractiveness of satellites as targets, and the declaration of a set of consequences that would follow the destruction of a satellite.

A destructive ASAT weapon ban will derive still greater relevance and usefulness as part of a comprehensive regime of arms control measures, rules of the road, and confidence-building measures. It is a logical place to start approaching a comprehensive space security regime, one that can not only preserve our ability to use space's benefits for many generations to come, but can help keep space from being a locus or catalyst for conflict here on earth.