No Harmful Interference with Space Objects: The Key to Confidence-Building

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Stimson Center Report No. 69

July 2008

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PREFACE

Dear Reader,

I am pleased to present this new report on international space policy, proposing a new way to build confidence among space-faring nations. International arrangements have not kept pace with the sharp increases in the number of countries using space and the value of the services provided by satellites. With further expansions of space activities being planned by nations around the world, space will pose a significant security challenge in the 21st Century unless space-faring nations agree to rules of the road that protect satellites.

Our new report, written by Sam Black, Research Associate in the Space Security and South Asia programs at the Stimson Center, examines the notion of "no harmful interference" as a concept that can advance the goal of building international consensus on managing the challenges of space utilization for peaceful purposes, and avoiding the weaponization of space.

This report is a noteworthy contribution to a body of work on space led by Stimson's Founding President, Michael Krepon, who advocates a code of conduct for space-faring nations. Sam Black's report develops the concept of "no harmful interference" as a key element for a code of conduct. The "no harmful interference" proposal takes into account the interests of a wide range of space-faring nations, including those who maintain hedging strategies against potential non-compliance. A code of conduct for responsible space-faring nations that includes a no harmful interference provision can help promote the peaceful uses of outer space while addressing the security concerns of major powers.

To look at more of Stimson's work on space, please see http://www.stimson.org/space/. We hope that you will find this report, and our earlier work on a code of conduct for space, useful. We welcome your comments.

Sincerely,

Ellen Laipson
President and CEO

I. INTRODUCTION

There is a consensus that the use of space is essential to preserving the economic, commercial, and military interests of advanced industrial nations, and that any harmful interference with satellites poses a threat to these interests. Opinions diverge on the means with which to secure the use of space over the long term. The advancement of an international norm against harmful interference with space objects, supported by a hedging strategy in the event of noncompliance by other nations, offers the best likelihood that satellites can continue to support the needs of citizens and their governments. Furthermore, a provision banning harmful interference with satellites might best be imbedded in a code of conduct for responsible space-faring nations. Indeed, a code of conduct that includes other essential provisions, such as those establishing debris mitigation and space traffic management protocols, could be vitiated if nations test and use mechanisms that result in harmful interference with space objects. One alternative to a code of conduct is including a provision banning harmful interference with space objects in a more formal legal instrument. Throughout this report the terms “ban,” “prohibit,” and others refer to the no harmful interference provision. In all cases this should be taken to mean, unless specified otherwise, a pledge not to interfere in a harmful manner with space objects. Whether this pledge takes the form of a politically- or legally-binding agreement would be a decision left to interested nations.

The report proceeds as follows. The next two sections will lay out a description of harmful interference and examine the precedent for embedding such a provision in an international agreement. This is followed by a discussion of the need for a ban on harmful interference with space objects in a code of conduct for responsible space-faring nations, including how the lack of a ban could threaten the success of the code as a whole. The fifth section explains why advanced space-faring nations will still retain the means to respond effectively if another state breaks its pledge not to engage in harmful interference. The sixth compares the relative merits of legally- and politically-binding instruments as tools for building a norm against harmful interference with space objects. The seventh rebuts some arguments that are commonly made against an international agreement regarding a code of conduct for activities in space. The final section concludes.

II. HARMFUL INTERFERENCE

There has long been disagreement about what course of action might best protect national interests in space. Interested parties have coalesced into two opposing groups. One believes that the best way to enhance space security is through international cooperation, most likely in the form of legal instruments or political agreements. The other is skeptical of the efficacy of such arrangements and emphasizes freedom of military action as the most likely path to securing national interests in space. At the core of this debate are the following questions: Is space weaponized? If not, can a treaty or code of conduct prevent it from becoming weaponized? Can space security be enhanced by a strategy that relies on military capabilities while largely rejecting diplomatic initiatives that impinge on freedom of military action?

It is not difficult to guess how the two sides answer these questions. Treaty skeptics generally argue that since anti-satellite weapons (ASATs) and ballistic missiles travel in and through space,

the medium is weaponized. They further argue that because space assets are required to use terrestrial weapons such as GPS-guided munitions, space assets "are a part of [these terrestrial] weapons system[s], and not an insignificant part at that."[1] Therefore, skeptics conclude that space is already weaponized and that in such an environment, treaties or codes of conduct would not provide adequate security to space assets. Ergo, military initiatives are the foundation on which these skeptics' proposals are based, and diplomatic initiatives that foreclose military programs are anathema to them. Naturally, proponents of treaties and codes of conduct believe that space is not yet weaponized, as no weapons are deployed in space. Moreover, a strategy that rejects any diplomatic measures which restrict military operations in space invariably fails to acknowledge the limitations and down-side risks of the use of military force in space. Between solar radiation, the Van Allen belts, and other complicating aspects of the space environment, space operations are already rather hazardous. The persistence of debris resulting from harmful interference with space objects (or through routine space operations) means that each interference event increases the severity of this operational hazard. The use of force in space is unlikely to be an isolated event, and the consequences could be detrimental to all space-faring nations, since it is far easier to harm satellites than to protect them. Thus, the more nations resort to military options to secure their perceived interests in space, the more satellites will be placed at risk. A national security strategy that relies heavily upon freedom of military action while discounting diplomatic initiatives that seek to strengthen an international norm against harmful interference would do much to undermine space security. Much of the remainder of this report will describe the merits of a strategy which relies upon diplomacy.

Military and diplomatic initiatives have an interlocking role in securing countries' interests.

That absolute freedom of action is not a guarantor of security has been recognized by policy makers for some time. The specific precedents will be discussed in the following section, but all have been driven by the same theoretical argument. Military and diplomatic initiatives have an interlocking role in securing countries' interests. Diplomacy facilitates the regular, ordinary operations of militaries by establishing and strengthening norms which govern the operation of these military organizations in peacetime. Without diplomacy, it is not always easy to differentiate normal operations or training exercises from precursors to war. Militaries provide an option of last resort when diplomatic measures fail to provide for normal, peaceful international relations. Their primary use is to violently censure a violator of diplomatic agreements and norms, especially when the violator initiates an incursion into the territory of another nation. A preponderant reliance upon either diplomacy or military power leaves much to be desired in terms of protecting a nation's interests. A related point is that the presence or absence weapons alone, whether they are earthbound or in orbit, doesn't necessarily impair the national interest of any country and doesn't necessarily impede efforts to secure national interests. It is the actual use of these weapons that evidences a breakdown of international order. However, the absence of any

[1] Jeff Kueter, "Testimony Before the Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, U.S. House of Representatives," May 23, 2007, http://www.marshall.org/pdf/materials/528.pdf, 2.

diplomatic efforts that might prohibit certain provocative actions could presage such a breakdown.

As this may seem to be a counterintuitive argument, an analogy may be helpful to convey it more clearly. The agreement most directly comparable to a ban on harmful interference with space objects is the 1975 Incidents at Sea Agreement between the United States and U.S.S.R. The agreement provided for the implementation of a wide variety of specific procedures so as to avoid dangerous close-quarters incidents at sea. That both navies retained the ability to respond forcefully when attacked actually enhanced the strength of the agreement. It also ensured that both had incentives to ensure strict adherence to the procedures by stressing the consequences of a failure to abide by the terms laid out by the agreement. This diplomatic agreement enhanced international security by limiting freedom of military action in a way that reduced the chances of unintentional escalation to a general nuclear war. In the years before the agreement was negotiated there were a number of incidents which posed a risk of unintentional escalation.[2] They forced the realization that without some diplomatic limitations on military operations, the risk of escalation was dangerously high. A ban on harmful interference with space objects would be perfectly analogous to avoiding incidents at sea if, in addition to creating political crises, incidents at sea made the oceans themselves more dangerous to traverse.

Though there is no perfect analogy to be made between a ban on harmful interference with space objects and other threat reduction agreements, the precursors of an international norm against harmful interference with space objects can be identified, as this provision is embedded in international treaties and agreements as well as, by extension, customary international law. These precedents include specific provisions that ban harmful interference with space objects, provide for notification or consultations in the event of harmful interference, and list some of the specific actions that might constitute harmful interference. The Anti-Ballistic Missile Treaty, SALT I, SALT II, Intermediate-Range Nuclear Forces Treaty, Threshold Test Ban Treaty, Peaceful Nuclear Explosions Treaty, START I, Conventional Forces in Europe Treaty, and START II treaties all contained measures which ban interference with "national technical means of verification," a euphemism that was commonly understood to refer to the satellites essential to monitoring treaty compliance. Similarly, the Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War contained a provision requiring that the United States and U.S.S.R. notify each other "in the event of signs of interference with these systems or with related communications facilities."[3] Similar consultation mechanisms were included in the Agreement Between the Department of Defense of the United States of America and the Ministry of National Defense of the People's Republic of China on Establishing a Consultation Mechanism to Strengthen Military Maritime Safety. The Incidents at Sea agreement lays out a number of specific actions that might be construed as harmful interference, including "maneuvering in a

[2] United States Bureau of Verification, Compliance, and Implementation, "Narrative: The Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas," http://www.state.gov/t/ac/trt/4791.htm.
[3] Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War Between the United States of America and the Union of Soviet Socialist Republics, Article 3, Signed September 30, 1971, http://www.yale.edu/lawweb/avalon/diplomacy/soviet/sov001.htm.

manner which would hinder the evolutions of the formation" or maneuvers of ships. Ships belonging to the Parties also:

> …shall not simulate attacks by aiming guns, missile launchers, torpedo tubes, and other weapons in the direction of a passing ship of the other Party, not launch any object in the direction of passing ships of the other Party, and not use searchlights or other powerful illumination devices to illuminate the navigation bridges of passing ships of the other Party.[4]

The Constitution of the International Telecommunication Union (ITU) created another powerful precedent for non-interference with space objects. Article 45 of the ITU Constitution states that, "All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States…"[5] Importantly, the next item in the constitution states that member countries are required to ensure that non-governmental providers and users of radio services or communications adhere to the non-interference clause as well. This document is particularly important because it established what might be the only legal precedent that specifically addresses harmful interference with satellites mounted by non-military and extra-governmental organizations. The ITU Constitution also presages the emergence of non-destructive, temporary means of interference. These will be discussed more completely in the following section.

The cornerstone of the existing international legal regime which governs activities in space, the Outer Space Treaty, also lays the basis for a ban on harmful interference with satellites. Article IX of the treaty links harmful interference with consultation measures:

> If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.[6]

[4] Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas, Articles 3.2, 3.6, and 3.8, Signed May 25, 1972, http://www.state.gov/t/ac/trt/4791.htm.
[5] Constitution of the International Telecommunication Union, Article 45, Adopted 1992, http://www.itu.int/aboutitu/basic-texts/constitution/chapter7/chapter07_45.html.
[6] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Article IX, Signed January 27, 1967, http://www.state.gov/t/ac/trt/5181.htm.

Finally, it is important to note that the provisions banning interference with satellites have existed for almost as long as satellites themselves. The earliest references to "national technical means" in international law are found in the Anti-Ballistic Missile Treaty and SALT I interim agreement of 1972, while the reference to harmful interference in the Outer Space Treaty was enshrined into international law five years earlier. A mere ten years after the space age began, states were already beginning to insist that others not interfere with satellites and other objects traversing space. This sentiment has only grown stronger over time.

III. METHODS OF INTERFERENCE

In order to capitalize on the strong and lengthy precedents of noninterference with space objects, an agreed-upon definition of what constitutes harmful interference is likely to be necessary. It should be made clear that while most attention has been paid to interference with satellites, interference with other space objects could be equally harmful. For example, the use of a large piece of debris as the target for an ASAT test could create as much debris as the destruction of an operational satellite. Furthermore, harmful interference with one's own satellites would also be banned by a successful no-interference agreement, as no country should be able to gain a retaliatory advantage by perfecting methods of interference with tests on its own space systems. Interference could take the form of one or more of the following actions: damaging or destroying a satellite, temporarily interfering with the normal operation of satellites in a way that does not cause permanent damage, or mimicking an authorized user for the purpose of controlling a satellite, also known as "spoofing." Within each of these broad categories, there are a number of specific tactics that could be used.

Physical damage or destruction is perhaps the most obvious result of interference with satellites. There are several methods available to physically interfere with satellites. Projectile weapons have had the most prominent place in recent ASAT history. They can be used to damage or destroy satellites in one of several ways. They can either employ a small warhead that detonates near the target satellite or use the kinetic energy of a warhead or missile to destroy a target by colliding with it.[7] Orbiting space mines with nuclear or conventional warheads might also be used to destroy satellites, though it should be noted that nuclear explosions in space were banned by the 1963 Partial Test Ban Treaty.[8] Finally, a space-faring nation could manipulate the orbital path of one of its own satellites in such a way that it collides with a satellite of an adversary, damaging or destroying the target satellite. The use of this method to interfere with another satellite might be difficult to characterize definitively as intentional harmful interference. However, given the relatively comprehensive network of satellite tracking sites, whether they consist of dedicated systems operated by governments or simple optical telescopes operated by amateurs, it should be possible to determine

A mere ten years after the space age began, states were already beginning to insist that others not interfere with satellites and other objects traversing space.

[7] Dean A. Wilkening, "Space-Based Weapons," in *National Interests and the Military Use of Space*, William J. Durch, ed. (Cambridge, Massachusetts: Ballinger Press, 1984.), 140.
[8] Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, Article I.1, Signed August 5, 1963, http://www.state.gov/t/ac/trt/4797.htm.

when and in which aspects a satellite's orbit has been changed. Accurately characterizing the nature of an interference event will become increasingly possible as global space situational awareness capabilities improve over the next few years. The evidence provided by such observations should be able to prove with relative certainty whether a collision was accidental or intentional. It is also important to note that damaging or destroying the target satellite would imply the forfeiture by the attacking nation of the weaponized satellite; given their expense and utility, the use of space systems as crude wrecking balls would not be an efficient method of interfering.

Directed energy weapons are a second option for those interested in physically damaging or destroying satellites. Such weapons might employ one of several different technologies, including lasers, particle beams, and microwaves. Laser weapons could be used to damage or disable a satellite by overheating or puncturing its outer surface or by blinding its mission or control sensors. A microwave weapon, on the other hand, could be used to damage a subsystem within the satellite. In a paper published in 1993, Maj. James Lee of the U.S. Air Force estimated that ground-based lasers could disable satellites orbiting at altitudes up to 1200 km, while ground-based microwave weapons could be effective against satellites traveling up to 500 km above the planet.[9] Alternatively, such weapons might be mounted on orbiting satellites. A directed energy weapon located on a satellite could use solar energy as a power source.[10]

Some of the technologies that could be employed by directed energy weapons, most notably lasers, are also commonly used to perform benign tasks. Lasers are an integral part of modern satellite operations, and are used for any number of purposes, including satellite tracking, range-finding, communications, and national technical means. On the other hand, as made clear above, they can also be used for malicious purposes. That this technology is dual-use is commonly cited (along with the existence of other dual-use technologies and capabilities) as a barrier to diplomatic efforts to enhance space security, but this is not necessarily true. A provision banning the act of interference rather than the system that is used to interfere would not require negotiators to formally differentiate between malicious and benign power levels or define and prohibit any other technological characteristic that might be unique to a weapon. Thus, the use of lasers in the course of non-harmful space operations would be protected.

There are also methods of interfering with satellites that may not result in permanent damage but still prevent the satellite from performing its desired function. The normal operation of a satellite might be interrupted by creating an electromagnetic pulse in space, causing the electronic components of the satellite to fail. Another method of non-damaging interference is jamming. Technically, this refers to "transmitting a high-power electronic signal that causes the bit error in a satellite's uplink or downlink signals to increase, resulting in the satellite or ground station losing lock."[11] Jamming could thus occur intentionally without directly interfering with the

[9] Maj. James G. Lee, "Counterspace Operations for Information Dominance," (Maxwell Air Force Base, Ala.: Air University Press, 1995), 32.
[10] Robert H. Zielinski, Robert M. Worley II, Douglas S. Black, Scott A. Henderson, David C. Johnson. "Star Tek—Exploiting the Final Frontier: Counterspace Operations in 2025," in *Air Force 2025*. (Air University, November 1996.), 38.
[11] Zielinski et. al., 25.

satellite in question. A study prepared for the Chief of Staff of the U.S. Air Force noted that proposals had been made to artificially alter conditions in the ionosphere using "chemical vapor injection and heating or charging via electromagnetic or particle beams" to produce a jamming effect "indistinguishable from naturally occurring space weather."[12] This method would probably be more difficult to detect and attribute to a particular country than some other methods of interference and is unlikely to become operational. If jamming does not cause harm to satellites, it would not be foreclosed by the no harmful interference provision of a proposed code of conduct. This does not, however, constitute an endorsement of jamming, particularly during crises.

Another type of interference is spoofing, or "taking over a space system by appearing as an authorized user."[13] Spoofing might be considered a more robust version of jamming because in addition to an attempt to prevent the original users of the satellite from accessing their system, it involves the deliberate misuse of the satellite, resulting in a degradation of its capabilities. Unauthorized usage of a vacant satellite transponder could also be considered harmful interference, though it would not necessarily involve the degradation or interruption of the satellite's other activities. Such interference was witnessed in April 2007 when a Sri Lankan Tamil rebel organization hijacked a transponder on a commercial satellite and used it to broadcast pro-rebel propaganda.[14]

There are a number of other methods that could be used to damage, destroy, jam, or spoof satellites. Some of these have yet to exist in a non-theoretical form, while others are more immediate possibilities. Microsatellites or "Robo-Bugs" might be used to surreptitiously approach other satellites and spoof, jam, or destroy them using any the means discussed above.[15] There are a number of theoretical variations on this theme, including the possibility of a microsatellite network masquerading as a satellite bodyguard – a satellite designed to defend other orbiting objects. A final possibility that has not yet been discussed is using a craft like the Space Shuttle to physically remove an adversary's satellite from orbit or transfer it to an orbit from which it could not perform its mission.[16]

Clearly, there is no shortage of options available to those who wish to interfere with satellites.

Clearly, there is no shortage of options available to those who wish to interfere with satellites. The damage caused by harmful interference with satellites ranges across a fairly large spectrum, presented here in order of increasing severity. The minimal cases of interference, spoofing, hijacking, or jamming a transponder, are associated with relatively minor costs. For commercial satellites, the costs would be equal to the revenue lost due to the interruption of service. Long term costs could include an erosion of the company's reputation as a reliable service provider, perhaps resulting in a loss of customers. Governments would lose whatever utility their satellite would have provided during the period it was being interfered with. This utility could be

[12] Zielinski et. al., 18.
[13] Ibid, 25.
[14] Peter B. de Selding, "Intelsat Vows to Stop Piracy by Sri Lanka Separatist Group," *Space News*, April 18, 2007, http://www.space.com/spacenews/archive07/tamiljam_0416.html.
[15] Zielinski et. al., 22 and 34.
[16] Ibid, 34.

significant in times of crisis when jamming or spoofing might be more likely. In the maximal case of interference, that which results in the permanent disabling or destruction of the satellite, the owner loses his entire investment, less the value of the services already performed by the satellite. Given that satellite research, development, and construction costs can amount to a billion dollars or more, and that deployment costs are commonly approximated at $10,000 per kilogram, the value of the investment in a satellite can be considerable. Furthermore, in the case of the violent destruction of a satellite, the orbital debris that is left behind can pose a threat to any satellites in similar orbits. This threat can be realized when nearby satellites' orbits have to be altered to give debris fields a wide berth, or, in the extreme case, when debris causes a second satellite to fail.

This discussion is not meant to serve as an all-inclusive list of all activities that might constitute harmful interference. Any agreement that prohibits harmful interference with satellites will need to be negotiated and agreed to by the parties pledging to refrain from harmful interference. However, one of the main advantages of this provision is that attempting to define interference rather than objects that interfere (space weapons) is likely to be far easier. It is essential that any definition of interference view harmful interference holistically. The negotiated definition will need to account for all of the methods of interference discussed above, as well as those that might be invented in the future. This will not be an easy task, but is the path most likely to yield the fruits of success.

The large number of possible methods of interfering with satellites illustrates the variety of options available to actors with malicious intentions. As many of these are available to state and non-state actors at a relatively low cost and level of technical competence, the threat posed to the continued use of space should be quite apparent. This underscores the need for an agreement that deals with harmful interference in a comprehensive manner.

IV. THE INDISPENSABILITY OF THE NO HARMFUL INTERFERENCE PROVISION

The crux of the policy dilemma is that the same technological revolution that has allowed satellites to become so indispensable has also fostered the development of a growing stable of satellite-interference methods. Recognizing that the United States' use of space is crucial to its national and economic security, domestic commentators have proposed policies that seek to resolve this tension satisfactorily. Most American commentators gravitate towards one of the two options discussed in the second section, military dominance or legal restraint. There is also a third option which doesn't constrain the ability to interfere or seek a treaty banning space weapons. It relies on a code of conduct built around the principle of non-interference with space objects. In fact, this principle would be an indispensable component of any of the three options: protection through freedom of military action, a space weapons treaty, or a code of conduct.

Attempts to dominate space by any country, and certainly by the United States, will inevitably run afoul of the security dilemma. Some argue that this is a plausible explanation of China's pursuit of an ASAT weapon. Regardless of the veracity of this claim, the security dilemma is a real concern. At its core, the security dilemma is the paradox often used to explain the

motivations behind arms races. A country may decide to build up its military with the goal of improving its capabilities relative to those of its neighbors. Its leaders may see such a buildup as being a viable way of improving the state's security. However, when its neighbors see the state upgrading its military, they realize that their own capabilities are growing relatively less capable. Thus, when one state builds up its forces, it implicitly threatens its neighbors, which can prompt them to build up their own militaries. This is a fear for space-based as well as terrestrial capabilities. Any attempt by a country to dominate space militarily would by definition make other countries that operate in space feel less secure. As a result of a state's pursuit of dominance, other actors face the spectre of a first strike attack on their satellites. These actors would then be spurred to pursue parity, or, more likely, asymmetric capabilities aimed at negating the competitor's advantage. The pursuit of ASATs or other systems with the latent ability to interfere with space objects would be characteristic of an asymmetric strategy. That this very possibility may have motivated the pursuit of dominance in the first place is the essence of the security dilemma.

The international community has already seen evidence of the security dilemma as it pertains to space. In the political firestorm in Washington that followed China's ASAT test, one did not have to look hard to find a "space hawk" calling for a muscular response. The response advocated with the most frequency was an increase in the level of funding devoted to offensive counterspace programs. China's reaction to America's destruction of its failed satellite (USA-193), though it was ostensibly for the purpose of enhancing safety and was conducted with advance warning to the international community, will be one indicator of how sensitive other countries are to the implications of the security dilemma as it pertains to space. Empirically, China's lack of transparency may make gauging this reaction difficult.

A provision banning harmful interference with satellites wouldn't resolve, but would help address, the security dilemma. By ensuring that any country that initiated harmful interference against satellites would be violating an established norm of international behavior, the no harmful interference provision would be the foundation of the victim's effort to rally international support for whatever the appropriate response might be. In effect, pledges by space-faring nations not to interfere harmfully with space objects would serve a purpose similar to that of the articles of the U.N. Charter that prohibit and allow for responses to acts of aggression. The nations with the technical knowledge and resources necessary to operate in space also generally have the means to respond to harmful interference with their space assets. International law and the U.N. Charter permit nations to defend themselves and their interests if attacked. The violation of an international norm against harmful interference against space objects would also make such a response more politically defensible, if a nation were to deem it necessary.

Pledges not to interfere with space objects may be broken, just as treaties may be broken. Major space-faring nations have the means to respond in space or on the ground if international norms or treaty commitments are disregarded. Thus, it is unreasonable to expect countries making a no harmful interference pledge to refrain from hedging against the possibility of a violation of the norm. Indeed, hedging strategies can serve as a deterrent, reducing the likelihood of interference directed against space objects. But such a pledge would preclude space-faring nations from

carrying out tests of harmful interference with satellites, ultimately serving to reduce the likelihood of any interference. Of course, this state of affairs – tit-for-tat strikes against satellites – would not be ideal. Surely, no nation desires (or should desire) a race to acquire anti-satellite weapons of any variety. Given the nature of the security dilemma and the existence of technologies with the latent capability to harm satellites, the world will be better off if there is a strengthened norm against interfering with satellites.

An early push towards a norm against harmful interference would also do a great deal to hasten a more complete code of conduct geared toward other aspects of space security. When building a norm against interfering with satellites, why not deal with other elements of space security as well? A holistic path towards securing space is much more likely to succeed than one that leaves issues other than harmful interference unaddressed. For example, efforts to establish space traffic management protocols would reduce the probability of an accidental collision. However, an accidental collision could be just as harmful as intentional interference. Though its effects could be indistinguishable from those caused by a harmful interference event, an accidental collision could not be considered a violation of an agreement not to interfere with satellites. It is unclear why countries would endeavor to prevent the consequences of one type of interference, but not the other. Given the precedents against interfering with satellites, a norm against harmful interference is a very attractive foundation for a more comprehensive agreement. It is also absolutely necessary for the other elements of a code of conduct to operate effectively or be meaningful at all.

The Henry L. Stimson Center, in collaboration with non-governmental organizations from other space-faring nations, has developed a code of conduct governing the actions of responsible space-faring nations.[17] Its key elements are as follows: non-interference with satellites, the prevention of activities resulting in persistent orbital debris, information exchanges and consultations concerning space activities in general, information exchanges and consultations regarding activities that might be construed as either interfering or debris-creating, the coordination of spectrum use (e.g. radio frequencies) and orbital slot allocation, and space traffic management. None of these are sustainable in the long term without a ban on harmful interference with satellites. The prevention of activities which create orbital debris is an obvious case, particularly when considering that debris-creating direct-ascent kinetic energy ASATs are currently experiencing an unfortunate renaissance and pose a serious threat to the existence and use of satellites. Some methods of physically interfering with satellites create debris, yet without a code against harmful interference, this debris would be treated the same as debris created by normal space operations – as unfortunate but largely unavoidable. The coordination of spectrum use and orbital slot allocation might likewise fall by the wayside without a ban on harmful interference. An incident that occurred late in 2006 serves to illustrate this point. The roots of the incident reach back to 1988, when the Pacific island nation of Tonga registered a large number of slots in geostationary orbit. It lacked the capacity to use the slots itself, but leased them out to corporations to bring in revenue.[18] However, several of these slots became subject to international

[17] For a copy of the draft code of conduct, see http://www.stimson.org/pub.cfm?ID=575. For more information about the Stimson Center's Space Security program, see http://www.stimson.org/space/programhome.cfm.

[18] Tonga initially registered the last 16 available slots in 1988 and then reduced its claim to 7 slots following the receipt of numerous protests.

dispute. Indonesia, in an effort either to put pressure on Tonga to acquiesce to its claim over a particular slot or to deny Tonga the use of this slot, proceeded to jam the satellite in the slot.[19] Thus, jamming occurred because of a disagreement about the use of an orbital slot. Thankfully, ad hoc diplomatic intervention prevented further escalation. With an agreement banning harmful interference, a mechanism to resolve the dispute would already be in place. Without removing the option of escalating such a dispute by physically interfering with the satellite in question, belligerent states have no incentives to resolve these disputes peacefully. With no clear international stance on harmful interference with satellites not necessarily involved in treaty verification (and therefore considered to be national technical means), it will doubtless continue to occur.

Space traffic management, another major element of a code of conduct for operating in space, is also vulnerable to the instability inherent in the present state of affairs. Since it entails debris mitigation as well as collision avoidance, it seems clear that space traffic management can be vitiated without a non-interference provision, lest debris created innocently be subject to the mandates of the system while debris created willfully remains perversely outside of it. Space traffic management also requires consultations, which would be difficult to maintain without a harmful interference ban. In fact, the possibility of instituting virtually any consultative measure seems very low without a ban on harmful interference. If there are no definite and pre-determined objectionable activities, what is there to consult about?

Establishing a space traffic management system, debris mitigation protocol, or consultative mechanism without a strengthened international norm against harmful interference with satellites is analogous to having a nuclear hotline that is automatically turned off during crises. Times of international tension, particularly those caused by an incident in space, are times when a code of conduct would be subjected to its most difficult test. Without first banning harmful interference, a code of conduct for operating in space would be less reliable during crises, when nations rely on their satellites to a particularly great extent. A ban on harmful interference with satellites is vital to international security, even if there is no code of conduct governing space operations. Conversely, if the international community opts to pursue a code of conduct for space, it cannot hope to succeed without also considering a provision that deals with harmful interference.

V. LIMITING INTERFERENCE PRECLUDES ASAT TESTS BUT NOT LATENT CAPABILITIES

One of the most common arguments against a treaty or code of conduct governing activities in space is that an expansive approach to protect satellites would capture military capabilities with other purposes. On the other hand, a narrow approach that focuses solely on "dedicated" ASAT capabilities would not be sufficiently protective of satellites, since many technologies can be used to perform both benign and hostile missions in space. Furthermore, critics argue, unscrupulous states will likely ignore the prohibition against developing and deploying the weapons that are

[19] Shiga, David, "Mysterious Source Jams Satellite Communications," *NewScientist.com*, January 26, 2007, http://space.newscientist.com/article/dn11033-mysterious-source-jams-satellite-communications.html.

banned, leaving the states that abide by the provisions of the agreement at a disadvantage. These arguments do not apply very persuasively to a ban on harmful interference. Critics are right to recall that a key barrier to concluding space arms control agreements has been the difficulty in defining space weapons. As noted by former U.S. Under Secretary of State for Arms Control Robert Joseph, "…negotiations [during the Carter administration] were stymied by questions of which so-called "space weapons" capabilities should be limited – co-orbital interceptors, direct-ascent interceptors, ground-based, or just space-based directed-energy systems."[20] However, space weapons don't have to be defined in order to maintain a provision banning harmful interference. The prohibition of harmful interference with satellites is specifically designed to take into account the multi-purpose nature of many space technologies. Missile defense systems, satellites capable of shifting their orbits, and even the Space Shuttle could be used to interfere with satellites. Some of these systems are considered more threatening than others. The fact remains that when negotiators seek to define space weapons, their definitions will always be too encompassing or too narrow, depending on the perspectives of their respective countries. Banning the act of interference rather than the existence of "space weapons" bypasses this difficulty altogether. Doing so is not without precedent – weapons of mass destruction (WMDs) have been stockpiled for decades without being used. Though WMDs obviously have more horrific effects, and thus weren't used for somewhat different reasons, the analogy holds because the first use of a space weapon in military conflict, like the use of a WMD, is unlikely to be a singular event. The existence of weapons doesn't imply their eventual or inevitable use if the consequences of such use can be devastative for both combatants.

Space weapons don't have to be defined in order to maintain a provision banning harmful interference.

An additional benefit of seeking to define harmful interference rather than seeking to ban space weapons is that it eases the dilemmas associated with verification. As noted by numerous critics of space weapons treaties, it would be extremely difficult to verify the absence of space weapons from the arsenal of a potential adversary. This problem would be exacerbated by the existence of numerous dual-use technologies and weapons systems. However, parties to a code of conduct do not need to concern themselves with what constitutes a space weapon or engage in the seemingly hopeless task of agreeing on a common definition of one. Instead, they need only focus upon one application of multi-purpose technologies – their use to interfere harmfully with satellites and other space objects. Monitoring and verification of this singular application would be left to national technical means, as would the choice of a response in the event that purposeful, harmful interference occurs. Clarifying harmful interference and ensuring verification would take hard work by national authorities; attributing harmful interference could be difficult in some cases. None of these tasks would be anywhere near as difficult as deciding on and verifying a common definition of space weapons or dominating space militarily.

20 Robert G Joseph, "Remarks on the President's National Space Policy – Assuring America's Vital Interests," Center for Space and Defense Forum, January, 11, 2007, http://www.state.gov/t/us/rm/78679.htm.

Nonetheless, states cannot be assured that others will honor their pledges. A hedging strategy, in which states actively research and field systems with dual-use capabilities, will surely continue during the negotiation and implementation of a code of conduct. Indeed, there is no feasible way of stopping this from happening. Space-faring nations will therefore reserve the right and probably have the capability to pursue whichever avenues of research seem appealing – as long as in this pursuit they do not test these technologies in ways that interfere with space objects. Hedging strategies that respect the norm against harmful interference can serve as a deterrent against subsequent ASAT tests.

VI. AGREEMENT FORMAT

To this point, a provision banning harmful interference with satellites has been discussed as if it would operate virtually identically as part of any code of conduct. Such a code could take the form of a legally-binding treaty, an executive agreement (an instrument often used in the United States that, under international law, has the standing of a treaty), or a politically binding agreement.

Political compacts between states, such as the Proliferation Security Initiative, do not have the standing under international law of treaties or, in the United States, of executive agreements. The countries involved commit to abide by certain rules, refrain from taking certain actions, and/or adhere to a set of best practices. These commitments are not legally binding. This may be a rather severe disadvantage for those countries that seek the security that may be provided by legally binding instruments. There may be ways to reassure such countries that other signatories take their political commitment seriously. In the U.S., for example, the President could issue an executive order (not to be confused with the executive agreements discussed above) which is binding on the conduct of Federal agencies. Such signaling devices would not be binding on the U.S. vis-à-vis other signatories. As noted by the Congressional Research Service, "…[political] agreements may be considered morally binding by the parties, and the President may be making a type of national commitment when he enters one."[21] This notwithstanding, legally binding agreements are preferred to other agreements by many nations.

Treaties usually take considerable time to negotiate, especially if many parties are involved and if consensus is required for their completion. While many countries favor a treaty to deal with the problems posed by ASAT tests and space weapons, it is difficult to envision how a consensus might be reached in this regard, or how a treaty can be negotiated in a timely manner. There is far more flexibility available if a code of conduct for responsible space-faring nations is negotiated in the form of an executive agreement. It could be negotiated in any one of several possible multilateral forums. It could be negotiated by a large number of countries, or it could initially be drafted by a core group of space-faring nations. It could be negotiated under consensus rules, or if a small number of states oppose consensus, an agreement could be reached among like-minded states that could seek broader support later.

[21] Ibid, p. 23.

U.S. law makes a peculiar distinction between treaties and executive agreements. Both are legally binding, and thus from the perspective of the international community, should be treated as substitutes.[22] A treaty in the United States requires the advice and consent of two-thirds of the Senate. When approved, it becomes law. Executive agreements do not require the consent of 67 Senators, a very high hurdle for any agreement, regardless of its content. In rare instances, executive agreements are brought before both Houses of Congress for their consent by a simple majority vote. The best known of these congressional-executive agreements is the SALT I Interim Agreement on the Limitation of Strategic Offensive Arms. It was submitted to Congress by President Nixon, where it won the support of all but two Senators and two members of the House of Representatives.[23] Thus, there is an avenue for executive agreements to gain legislative consent if doing so is deemed important, which it may be for reasons related to American domestic politics. Other executive agreements do not, however, require legislative voting or approval. A code of conduct for responsible space-faring nations may well fall into this category. Since it would not obligate any country to reduce its armaments, it might not be subject to treaty ratification as per the conditions of the Arms Control and Disarmament Act of 1961.[24] Using the vehicle of an executive agreement would allow a code of conduct to avoid the peril of legislative purgatory, in which a treaty has been fully negotiated but languishes in the Senate, un-ratified, for years. Entry into force of the Comprehensive Test Ban Treaty (CTBT) has fallen victim to this pitfall – the treaty was submitted to the U.S. Senate during the Clinton administration and has yet to be ratified. Indeed, in 1999 the Senate voted to deny its advice and consent to the ratification of the treaty.[25]

A code of conduct accompanied by a ban on harmful interference with satellites would significantly enhance space security.

There is no treaty banning space weapons that is likely to be verifiable and have reassuring enforcement provisions. It is also likely that any treaty that is not verifiable and enforceable will be unattractive to several of the major space-faring nations, including the United States. A code of conduct sets aside issues that are likely to bedevil treaty negotiators for a decade or more. In a code of conduct, verification and determination of compliance would be left to national authorities. One substantive task of negotiators would be to define precisely what constitutes "harmful interference." This task is far simpler than trying to reach agreed definitions of what a treaty regarding space weapons would seek to ban. Regardless of the precise definition of harmful interference, participating states could request consultations when they witness ambiguous events or events they perceive as interference. A refusal to comply with such requests would be a show of bad faith and would reinforce negative assessments. The dilemmas associated with enforcement will continue to exist regardless of the form in which a space security agreement appears. All viable agreements would require consultation measures, and at times these consultations might prove to be unsatisfactory. If signatories to a space security agreement violate

[22] Congressional Research Service, "Treaties and other International Agreements: The Role of the United States Senate," January 2001, http://www.au.af.mil/au/awc/awcgate/congress/treaties_senate_role.pdf.
[23] Christopher B. Stone, "Signaling Behavior, Congressional-Executive Agreements, and the SALT I Interim Agreement," *The George Washington International Law Review* 34:2 (2002).
[24] Congressional Research Service, 2001, p. 251. The relevant section of U.S. law is 22 U.S.C. Section 2573.
[25] Ibid, p. 254.

their pledges, states that feel disadvantaged have the sovereign right to respond, including the right to withdraw from the agreement.

In the wake of the destructive ASAT tests carried out by the Chinese and American governments, near-term actions are required to strengthen norms against harmful interference with space objects. One option is to employ a hybrid formulation consisting of a political agreement during the initial norm-building period, to be reinforced subsequently by an agreement with the force of international law. For example, the process could be jump-started by a summit meeting between the leaders of interested countries. The result of the summit could be a pledge not to interfere with satellites until such time as a legally-binding agreement could be negotiated. Using politically binding agreements, regardless of their form, to signal nations' commitment to negotiate a legally binding instrument could be a useful way of bridging the gap between the near-term and the medium-to-long term.

An instrument negotiated in a forum which does not require consensus and that is considered by the American government to be an executive agreement would be quite attractive. Agreement on a code of conduct that includes a no harmful interference provision would reinforce the norm-building process created by the network of other treaties that relate to space. Besides those setting the precedent for non-interference with satellites, there are also the Liability Convention, the Rescue Agreement, the Registration Convention, and the Moon Agreement, all of which have been adopted by the U.N. General Assembly.[26] The existence of this body of existing law indicates that the norm against satellite interference is present, but in need of reinforcement.

VII. COUNTERARGUMENTS

The Bush administration offers several arguments to support its opposition to diplomatic initiatives that limit U.S. military freedom of action in space. These arguments have been summarized in a speech made by Ambassador Donald Mahley, former Acting Deputy Assistant Secretary of State for Threat Reduction and Export Controls before the Space Policy Institute at the George Washington University in Washington, D.C. on January 24, 2008.[27] It is appropriate to address the specific case of the United States because of the widely-held perception that it is the most prominent opponent of multilateral agreements that limit U.S. military operations in space. A code of conduct which prohibits harmful interference with satellites mitigates many of the objections to space treaties raised by the Bush administration.

Space is and always has been important to the U.S. national interest. The United States has asserted that countries have a right to defend themselves and their space assets. An oft-articulated concern of the Bush administration is that China's counterspace programs pose a challenge to U.S. military options in space. However, U.S. counterspace capabilities potentially limit Chinese (and Russian) military options in space. The application of a double standard is not helpful in improving space security, though it does illustrate the security dilemma as described in section

[26] United Nations Office for Outer Space Affairs, "United Nations Treaties and Principles on Space Law," (United Nations: 2006), http://www.unoosa.org/oosa/en/SpaceLaw/treaties.html.
[27] Ambassador Donald Mahley, "The State of Space Security," January 24, 2008, http://www.state.gov/t/isn/rm/2008/99746.htm.

four. Some commentators interpreted China's 2007 ASAT test as the logical result of China's perception that the United States was intent on dominating space.[28] A more prevalent view was that China was intent on denying the United States space superiority in the event of a clash of interests. As Ashley Tellis put it:

> China's pursuit of counterspace capabilities is not driven fundamentally by a desire to protest American space policies…but is part of a considered strategy to counter the overall military capability of the United States, grounded in Beijing's military weakness at a time when China considers war with the United States to be possible.[29]

China's counterspace programs have, as Amb. Mahley stated, "prompted the U.S. to consider initiatives based on our long-standing support for voluntary transparency and confidence-building measures, commonly referred to as TCBMs."[30] The measures promoted by the Bush administration are voluntary, and do not limit U.S. freedom of military action in space. Thus, a no harmful interference measure is conspicuously absent from the Bush administration's proposed TCBMs.

The Bush administration has harshly criticized the draft treaty regarding space weapons put forth by Russia and China, the "Prevention of Placement of Weapons in Outer Space" or PPWT.[31] The draft treaty seeks to prohibit space-based missile defenses as well as other "space weapons" that are ill-defined. The treaty also contains a provision which would prohibit interference with satellites. The administration has noted the seeming contradiction between the China's professed commitment to the peaceful use of outer space and advocacy of the PPWT on the one hand and its test of an anti-satellite weapon on the other. The U.S. position continues to be that the existing legal regime is "sufficient to guarantee the right of all nations for access to, and operations in, space."[32]

In general, Bush administration officials stress three challenges which they consider to be significant enough to make arms control efforts in space untenable. The three issues are defining the weapons to be banned, verifying compliance, and the risk of breakout. The latter is defined as the covert development of systems with a dedicated or latent ASAT ability which could be used at any time for a first strike. The first and second of these are certainly valid concerns. However, a code of conduct with a no harmful interference provision acknowledges difficulties in defining the scope of coverage and the verification challenges of a treaty. By focusing on harmful interference, the scope of this element of a code of conduct lends itself to monitoring by national technical means. The United States' verification capacity will grow as it improves its space situational awareness (SSA) capabilities, which are even now the world's best.

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[28] Eric Hagt, "China's ASAT Test: Strategic Response," *China Security* 3:1 (2007).
[29] Ashley J. Tellis, "China's Military Space Strategy," *Survival* 49:3, p. 44-45.
[30] Mahley, 2008.
[31] People's Republic of China and Russian Federation, "Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects," February 12, 2008. http://www.reachingcriticalwill.org/political/cd/papers08/1session/Feb12%20Draft%20PPWT.pdf.
[32] Mahley, 2008.

The Bush administration's complaint the threat of breakout capabilities would exist with or without a treaty or a code of conduct calling for no harmful interference with space objects. The burden of the administration's argument rests on the assumption that treaties or "rules of the road" that constrain military action in space diminish U.S. security. If the United States were the only country to develop, test, and deploy offensive counterspace capabilities, this argument would hold weight. But clearly, the United States will not be the only space-faring nation to engage in such practices. The burden of this argument is that U.S. and global space security would best be served by establishing rules of the road that constrain observable actions that could harmfully interfere with satellites.

VIII. CONCLUSION

As the effect of satellites in the economy and national security of the United States continues to grow, the drive to protect these vital assets can be expected to increase correspondingly. A measured approach can avoid the controversies associated with offensive counterspace systems and treaties that seek to define and ban space weapons. A code of conduct accompanied by a ban on harmful interference with satellites would significantly enhance space security. Even in the absence of any significant movement forward from the status quo, a measure preventing harmful interference would have significant benefits. This proposal bypasses many of the common objections to formal arms control measures in space. Hedging strategies to accompany a code of conduct are already operational. Improved space situational awareness will increase the likelihood of determining when harmful interference occurs and will help with devising appropriate responses. A code of conduct incorporating a no harmful interference provision deserves to be seriously considered and advanced in the coming years.

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About the Space Security Program

The Space Security program seeks to promote the peaceful uses of outer space and to avoid the flight-testing and development of space weapons. The program also seeks to promote a Code of Conduct for responsible space-faring nations. Support for the program is provided by the John D. Catherine T. MacArthur Foundation, the Ploughshares Fund, the Secure World Foundation, and the New-Land Foundation.