The Advent of Space Weapons

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The issue of space weaponization is an increasing concern. Current debates become convoluted over differing definitions of 'weapon', 'space', and 'space weapon', as well as differing perceptions of current international laws, policies and capabilities. This article attempts to lay a clear foundation for the debate. An unambiguous definition of space weaponization illuminates the fact that space is currently militarized but not weaponized, and so clarifies the fundamental issue: can we reasonably expect to form a secure international environment on the frontiers of space without weapons available to those who would seek to secure that environment? The work proceeds to delineate the poles of this debate. The conclusion is ambivalent, favoring the theoretical position of banning space weapons but questioning the practicality of accomplishing it.

SPACE POSES a unique challenge to policy makers, a realm in which spacefaring states face conflicting and contradictory interests both at home and abroad. Many defense planners have viewed space as a military area of operations to be mastered and dominated. On the other hand, those involved with space-based applications such as intelligence, surveillance and reconnaissance (ISR) and mapping, charting and geodesy (MC&G) perceive important benefits from a multilateral, non-weaponized approach.

Space weaponization is most often the centerpiece of discussions involving national and international space posture. The current debate on space weaponization encompasses several broadly defined positions, from establishing a space sanctuary to a policy of 'get-there-first'. The latter is based on the belief that because weaponization is inevitable, responsible and capable states should take the initiative to control and dominate space. Those supporting space sanctuary policies reject the inevitable weaponization argument, and insist that establishing unilateral hegemony in space would ultimately *undermine* national security by destabilizing the international environment.

Polarizing the issue as proponents of weapons and war, versus those who favor international peace, incites an emotional response and misdirects attention away from the real issue: that is, what is the best approach toward international security in space? More specifically, *can we – as a community of responsible states – reasonably expect to form a secure international environment on the frontiers of space, without weapons available to those who would seek to secure that environment?*

Astropolitics, Vol.1, No.1, Spring 2003, pp.29–53
PUBLISHED BY FRANK CASS, LONDON

The purpose of this essay is to objectively articulate the best arguments on both sides of this issue, and to formulate a way forward that is perhaps sub-optimal from the perspective of either camp, but a better alternative in the aggregate.

Defining 'Space Weaponization' and 'Space Militarization'

To date, space has been militarized but not weaponized. The distinction is more than semantic. For the purposes of this discussion, a *space weapon* is that which is built with destructive intent to be used in a terrestrial-to-space, space-to-space or space-to-terrestrial capacity. Logical sub-divisions still apply: (1) weapons of mass destruction (WMD) including chemical, biological and nuclear weapons, and (2) conventional weapons including kinetic energy weapons (KEW), chemical explosive weapons (CEW), and directed energy weapons (DEW). The transition from space militarization to space weaponization is not an 'all-or-nothing' affair. As depicted in Figure 1, a continuum is defined on which to judge the likely impact of possible military activities in space. Points along this continuum loosely relate the level of weapons' deployment in space to the level of threat any foreign perspective might recognize from such a deployment. A few themes are apparent in this depiction.

First, ISR, MC&G and space communications have played an ever-growing military force enhancement role, but we have lived with this for arguably 40 years, and there is a sense that everyone watching everyone from an open skies world view is stabilizing and non-threatening. Hence the ISR, MC&G and communications force enhancement elements are seen as a less provocative

FIGURE 1
DISTINGUISHING BETWEEN SPACE MILITARIZAITON AND SPACE WEAPONIZATION

Space Posture	Perceived level of threat to foreign countries due to space posture	Threat Level	Type of Activity	
	HIGH	10	Permanently orbiting Space-to-Terrestrial Weapons (Unilateral)	**Space Weaponization**
		9	Temporary, or "pop-up" Space-to-Terrestrial Weapons (Unilateral)	
High-Ground		8	Space-to- Terrestrial Weapons (Multilateral)	
		7	Permanently orbiting Space-to-Space Weapons (Unilateral)	
Control		6	Temporary, or "pop-up" Space-to-Space Weapons (Unilateral)	
	MODERATE	5	Space-to-Space Weapons (Multilateral)	
Survivability		4	Terrestrial-to-Space weapons* (Unilateral)	
Today....		3	Terrestrial-to-Space weapons (Multilateral)	
	LOW	2	Space-to-Terrestrial ISR, MCG, Communications	**Space Militarization**
Sanctuary		1	Space-to-Space ISR, MCG, Communications	
	NONE	0	Terrestrial-to-Space ISR, MCG, Communications	

*** While some terrestrial-to-Space weapons have and do exist today, they are not pervasive and play a minimal role on the existing global space posture.**

militarization of space but not as the more threatening weaponization of space. Second, unilateral approaches to space weaponization are significantly more threatening than approaches that openly invite multilateral involvement. Third, terrestrial basing is less provocative than the continuous threat posed by the omnipresence afforded by space basing.

The current state of affairs reflects that *space is currently militarized – but not weaponized*. The definitions here allow a concise and unambiguous summary of the current state of affairs and the issue at hand, without being sidetracked with semantics. Globally, we are postured with communications and intelligence gathering capabilities that offer the possibility of everyone watching everyone – nurturing global stability (level 2 in Figure 1). These capabilities are used in military force enhancement roles and are accurately referred to as space militarization, but few would argue that these force enhancement capabilities constitute space weapons. Few, if any, multi-lateral attempts at advanced terrestrial-to-space weapons development (level 3) have occurred, and there may be latent terrestrial-to-space capable systems (level 4) such as airborne lasers, but they are not dedicated ASAT systems, nor has their use as space weapons been exercised to any great extent. In fact, both Russia and the United States have opted in favor of restraint on ASAT deployment. So in these terms, the issue becomes clear: *given that space is currently militarized – but not weaponized – should we allow space weaponization (either explicitly by collaborative and coordinated action, or implicitly by inaction) to occur?*

The only issue to be taken with these definitions might be the presumption of an existing low threat environment. It is based primarily on *system deployment*,

FIGURE 2
THE THREAT OF SPACE WEAPONIZATION AS A FUNCTION OF SPACE POSTURE AND SPACE POLICY

Perceived level of threat to foreign countries due to space posture	Type of "Weapons" Activity
10	Permanently orbiting Space-to-Terrestrial Weapons (Unilateral)
9	Temporary, or "pop-up" Space-to-Terrestrial Weapons (Unilateral)
8	Space-to- Terrestrial Weapons (Multilateral)
7	Permanently orbiting Space-to-Space Weapons (Unilateral)
6	Temporary, or "pop-up" Space-to-Space Weapons (Unilateral)
5	Space-to-Space Weapons (Multilateral)
4	Terrestrial-to-Space weapons (Unilateral)
3	Terrestrial-to-Space weapons (Multilateral)
2	Space-to-Terrestrial ISR, MCG, Communications
1	Space-to-Space ISR, MCG, Communications
0	Terrestrial-to-Space ISR, MCG, Communications

Today....

Perceived level of threat to foreign countries due to space policy	Type of International Coordination
10	Unilateral pursuit w/o limits
9	Unilateral pursuit limited by domestic debate
8	UN resolutions on non-interference w/ space systems of peaceful purpose
7	Non-Weapon "Rules of the Road" (e.g. Multilateral on Space Debris)
6	Bilateral (Allies) collaboration on STEW for BMD
5	Bilateral (Powers) collaboration on STEW for BMD
4	Expand CFE or OST (ban STEW & STSW; unilateral ETSW)
3	
2	Expand CFE or OST (ban STEW & STSW: multilateral ETSW)
1	
0	Comprehensive Weapons Ban via Treaty w/ means of verification

and overlooks *policy intent*. A more comprehensive delineation of space weaponization would include both (Figure 2). This more robust definition of weaponization based upon both weapons deployment (low threat) and policy intent (high threat) clarifies the current international attention being paid to the issue. In short, what is internationally unsettling and even threatening is not the existing space weapons *posture*, but the space weapons *policy* (or lack thereof).

While it is unpopular to be pro-war or pro-weapons, human history has shown many cases where war and weapons are unavoidably necessary. Before delving into the potential and more obvious drawbacks of weaponizing space, it is well worth understanding those critical factors that are leading the call for weapons in space. The propositions that follow will be offset by four subsequent counter-propositions.

Four Propositions on the Advent of Space Weapons

Proposition 1: Social and Economic Interest

> *Civil and commercial interests in space are rapidly outpacing military concerns and are becoming a central focus for many national economies. As a service to the state, the military role is typically to organize, train, equip and posture forces – complete with weapons – to defend those interests. Space weapons will necessarily follow space commerce – that is, they will 'follow the money'.*

A growing number of states have enormous commercial and social interests in space. The United States estimates that by 2003, the Global Positioning System (GPS) will generate $16 billion per year in revenue in addition to having crucial national security applications. Space policy experts estimate that by 2010, the cumulative US investment in space will exceed $500 billion – equal to the value of all US investments in Europe.[1] Hundreds of billions of dollars of US commerce rely on these space resources.[2] And while the United States may be a leader in space, it is only one of many countries pursuing similar goals.[3]

Scientific and technological advances have a long history of being predominant facilitators of commercial growth. Space could well be the poster child for this claim. Space-based scientific systems provide crucial information to scientific and other communities. Disciplines dependent on space-based resources include astrophysics and cosmology, microgravity biology, earth science, weather forecasting and climatology, microgravity physics, aerospace transportation, and manned space flight. There are also constellations of geostationary and polar-orbiting satellites that support weather services and certain search and rescue missions.[4]

Projections for worldwide civil and commercial operations and assets in space are debatable, but some call for up to 15 per cent annual growth. The actual 2001 worldwide satellite revenues were approximately $85.1 billion, but it should be emphasized that $46.5 billion of this was services, of which $39.2 billion was satellite subscription services, reflecting an expanding but tenuous market currently dependent upon satellites, but not critically so.[5] Should satellite availability wane, the demand for services would simply shift to terrestrial

alternatives (e.g. direct TV). Nonetheless, the existing space-reliant markets are not the remote space environment of old, they hit home for every member of our modern information society: space-based broadband data relay (Internet), narrowband data relay (pagers/messaging), satellite communications (mobile phones), satellite TV, GPS-based car navigation systems, and perhaps even commercial imagery applications (agricultural support, city-mapping, etc.).

Hundreds of billions of dollars in resources are invested in globally exposed assets orbiting the earth that directly support national economies and militaries, and in general, the twenty-first century civilized way of life. The total economic impact resulting from the destruction of space-based resources would be far greater than the loss of revenues from these assets, as many other sectors rely critically on satellite-related services. As such, any exposed and valuable asset is a target for adversaries – a target warranting protection.[6] The threat includes well-funded terrorists or the possibility of space collateral damage from rogue actors perceiving a military threat from an adversary in space, and responding against it (i.e., the impact to commercial and civil activities is simply a by-product of an assault on military activities). The emergence of microsatellites and possibilities for space mines must not be overlooked. While space-based weapons might not be the most obvious means of defending on-orbit assets, concepts of on-orbit weapons co-located with at-risk assets, with automated kinetic or directed energy intercept capability, must be considered. In a future of thousands of critically important and valuable national and international space assets some will, if left unchecked, inevitably support self-defense mechanisms that by any definition would constitute weapons in space.

Proposition 2: Technological & Doctrinal Inertia

> *Seizing the high ground is a military doctrinal precept as old as warfare itself. As technology opens the new high ground of space and offers the means to exploit it, sound military doctrinal development would be grossly remiss to overlook it. Simply put, the coupling of advanced technologies with well-intended and effective military doctrine development will inevitably lead to the acquisition of space weapons, particularly in the absence of countervailing policy direction.*

Several technical concepts are emerging that could – once the limitations are addressed – offer a significant means to achieve national objectives through space weaponization.[7] Under the category of *advancing technology*, for example, space-based directed energy (SPDE) is rapidly becoming a viable weapon system. The fact that it offers a force application response at the speed of light (if on orbit and integrated with space-based intelligence-gathering counterparts) is incredibly appealing from a military application perspective. Among many other possibilities, it offers the ability to prosecute time-critical targets. Similarly, lower-energy SPDE concepts offer a jamming capability to space-, air-, sea- and land-based communications and adversarial intelligence-gathering systems.

Space-based kinetic energy (SBKE) weapons have also been designed against both exo-atmospheric and terrestrial targets. Exo-atmospheric targets at

altitudes of greater than 60 km are perhaps too hardened for high-energy SPDE weapons, but may be susceptible to intercept by space-based SBKE weapons. Again, the move toward national missile defense systems makes these space-based defensive weapons a viable option from the boost phase all the way to re-entry of aggressor ballistic missiles. Terrestrial targets offer a different profile, but are still susceptible to attack by a different kind of SBKE weapon. Heavily defended slow-moving targets requiring vertical penetration, such as ships or silos, would make excellent targets for a long and slender KE weapon.

Finally, space-based conventional weapons (SBCW) of low mass that are re-entry hardened offer the advantage that they can maneuver around defenses and correct for terminal guidance. The utility of these systems is enhanced once the options of multiple dispensable sub-munitions are considered.

In recognition of the threatening posture of orbital weapons, and in an attempt to avoid pre-emption, creative advances in military concepts of operation (CONOPs) have accompanied the new space weapon technologies. Of note, pop-up maneuvers employing space weapons, whereby space superiority can be temporarily gained to meet a threat – and *withdrawn* as the threat subsides – are appealing.[8] These CONOPs very much avoid the perceived threat of continuously orbiting weapons, and appeal to a traditional employment of military power: air power. Coalition forces achieving air superiority over Iraq did not threaten the world, because that superiority was gained for a purpose, and withdrawn as the threat subsided. Likewise, CONOPs that deploy and achieve space superiority for a limited period in the presence of an immediate threat, and are withdrawn when appropriate, are likely to be received in the global community better than their continuously orbiting alternatives.

While all three of the space-based weapon technologies and associated CONOPs bring technical and operational challenges, they also bring the promise of space control and defense, and rapid-response, global-reach force application. Such ubiquitous military capabilities are not easily dismissed, and require an *advancing doctrine* to be properly incorporated.

One of the most important responsibilities of any military organization is to be as strong and effective as possible. To that end, militaries employ short- and long-term planning to predict future needs and implement policies to meet those needs. Technology and associated CONOPs have historically played a crucial role in the development of military strength, with successes depending on the ability of military planners to push the limits of scientific progress, analyze technologies before they are fully mature, construct viable CONOPs and make decisions about whether or not to integrate new technologies into future plans.

The interaction between technology and policy has not always yielded the best or most sensible result.[9] Prior to the Second World War, for example, France relied on traditional static, ground-based defenses and built the Maginot line to defend against an invader from the east. They did so despite apparent rapid technological advances in terrestrial and aerial mobility that would later render those defenses virtually impotent in the face of German blitzkrieg.

German doctrinal development during the same era, though, was not without similar oversights. Prior to 1945, German military policy made great use of the V2 rocket while simultaneously failing to recognize parallel atomic developments that could have turned the tide of the Second World War.[10]

Seizing the high ground is a military doctrinal precept as old as warfare itself. As technology opens the new high ground of space and offers the means to exploit it, sound doctrinal development would be grossly remiss to overlook it. Simply put, the coupling of advanced technologies with well-intended and effective military doctrine development will inevitably lead to the acquisition of space weapons.

In addition to the power of top-down policy leadership, forces outside the control of high-level policy makers will also drive the acquisition of space weapons. In some circumstances, the institutions involved in the planning processes – including scientific laboratories, administrative divisions and military consumers – apply significant pressure outside their formal areas of expertise or responsibility. In explaining one motivation for countries to acquire nuclear weapons, Scott Sagan explains: 'bureaucratic actors are not … passive recipients of top-down political decisions; instead, they create the conditions that favor weapons acquisition'.[11]

Today we find ourselves in a situation with an absence of clear top-down policy guidance on space weapons, and in such a case, military doctrine can build an inertia of its own, and impact – or even become – the default policy.

Proposition 3: Diplomatic Leverage

> *The confluence of prestige, prowess and leverage offered by space presence – a witness to the perceived superiority of a particular ideology – will compel a space race, to include the pursuit of military dominance by way of space weapons.*

During the Cold War, the United States and the Soviet Union used scientific and technological progress as evidence of ideological superiority. The space race of the 1950s and 1960s offers a relevant case study. The successful launch of *Sputnik* on 4 October 1957 came as a major shock to the United States, whose policy makers viewed Soviet technological success as a direct threat to US interests worldwide. Many in the United States feared that unaligned states, struggling to decide between capitalism and communism, would be swayed by the prestige conferred to the Soviet Union by its highly visible technological breakthrough. In response, the United States undertook intensive efforts to surpass the Soviet achievement, resulting in the successful launch of the *Explorer* satellite, the establishment of NASA, and, more than ten years later, the successful *Apollo 11* mission to the moon.

Although many of the forces that started the space race in the late 1950s disappeared with the end of the Cold War, some remain motivating factors for policy makers today. Most importantly, scientific and technological strength provide a strong bargaining chip in international diplomacy, commerce and politics. Other countries value their economic, political, scientific and diplomatic relationships with spacefaring nations in part because they recognize

that these countries constitute the world's leading high-tech innovators. Interaction with these high-tech innovators can raise other countries to a new level of technological expertise through education, experience and trade. Space-based technological prowess is highly visible and especially important, as evidenced by the number of countries undertaking their own independent satellite launch programs.

Throughout modern history, states have effectively used gunboat diplomacy to influence political events in other countries. Space-based weapons would be uniquely attractive for this purpose, providing the ability to exercise gunboat-style diplomatic pressure anywhere *on the globe*, *continuously and instantly.* Currently grossly underappreciated, but no doubt soon to be realized, is the fact that space weapons will afford countries an omnipresent ability to influence the politics of other states by the mere possibility of force application.

Proposition 4: Military Superiority

> *Two types of superiority are critical* – military information superiority *and* military operational superiority. *As for the first, the exercise of twenty-first century military power is critically dependent upon communications and intelligence, much of which is collected from and/or passed through space systems. The world witnessed the incredible advantage this supplied in the first 'space war', Desert Storm. Future adversaries will not allow such an advantage to go unchallenged.*

In the words of then US Assistant Secretary for Space Martin Faga, as he reflected on the Gulf War: 'We could see, hear, and talk all through the war. After a few hours, he (Saddam Hussein) could not.'[12] The military resources that made this success possible, including imaging, signals intelligence (SIGINT), navigation and communications, are critically dependent upon space-based assets.

Space-based imaging capabilities, with their origins in Cold War satellite photography, are now a crucial element of defense complexes. For example, although details are confidential, it is well known that imagery and its computational processing and communications chain is 'one of the most technologically advanced sectors of the US arsenal and represents a significant slice of the $18 billion (US) DOD annual space budget'.[13] Digital remote imaging, with near-real-time intelligence capabilities, allows for the prosecution of time-critical targets. During the Gulf War, more than thirty satellites provided surveillance data to the allied forces. By simultaneously denying less capable space resources to Iraq, allied forces had the huge advantage of being able to see all parts of the battlefield while maintaining the element of surprise against Saddam Hussein's forces.

Signals intelligence is a similarly crucial space-dependent asset. Robust SIGINT constellations are capable of intercepting and locating radio and cellular communications as well as microwave and radar emissions.[14] This affords enormous military advantage by providing the ability to locate and destroy enemy radar assets during the first stages of conflict. Without ground-to-air anti-aircraft systems, adversaries are less capable of defending themselves

against airpower. During the Gulf War, these capabilities were so unnerving for the adversary that by the third day, Iraqi forces refused to use cellular communications for fear of their transmissions prompting a barrage of allied fire from above.

Space-based military communications assets provide a third pillar of military superiority, complementing imagery and signals intelligence, by coordinating the application of military force. A constellation of ten geostationary satellites broadcasting six super-high-frequency channels and providing secure voice and data communications, supported by the US fleet satellite communications and Air Force satellite communications, coupled with a host of allied and commercial satellite communications, allowed the allied forces to increase their communications capabilities by a factor of ten within a month of Saddam Hussein's invasion of Kuwait.[15] This readily scalable space-based capability became a crucial factor in the coordination of allied forces that won the Gulf War.

Militaries also possess powerful space-based navigation tools. Using encrypted precise codes of the global positioning system (GPS), militaries can know exactly where their constituent components are at all times. This system was used extensively during the Gulf War, both by ground soldiers to locate positions and targets and by aircraft to direct their bombs more precisely.[16] After the Gulf War, additional military tools were developed based on satellite navigation; most notable among these for its success in Operation Enduring Freedom is the joint direct attack munition (JDAM), a space-guided air-launched weapon.

All modern states must assume that potential adversaries have studied the allied use of space-based resources in the Gulf War and the war on terrorism, and will seek to counter these military information resources by any means necessary. The allies could – and, some would argue, already do – face a symmetric threat to space resources from the global proliferation of space-based ISR, communications and navigation systems. The allies might also face a range of asymmetric attacks on space-related resources: physical and electronic attacks on space resources, lines of communication or ground segments; denial of services through electronic jamming; or deception by camouflage, spoofing or decoys. The space-based segments of military information assets are particularly vulnerable to attack by a range of weapons, including space-to-space and earth-to-space anti-satellite weapons. For example, a nuclear detonation in space and the subsequent ionization of Earth's Van Allen belts would devastate space-based military and civil resources, and greatly diminish the value of their replenishment for months or years thereafter.[17]

Modern militaries must defend against these explicit and implicit threats to their pursued positions of information superiority. Defensive military alternatives include space-based kinetic or direct energy weapons with the capability to intercept an incoming projectile, and electronic counter-countermeasures (ECCM) to defend against electronic jamming and spoofing. Voluntarily limiting defensive options by excluding space-based weapons jeopardizes the superiority of military information resources. Weapons must be

allowed to migrate to space for these defensive purposes, else the epitaph of the next war might be: 'we could see, hear, and talk all through the first few hours of the war. After that, they decided that we should not'.

Military Operational Superiority is the second critical element of Proposition 4. The prospects of a secure homeland afforded by space-based defense, combined with the overwhelming offensive potential afforded by the pervasive and immediate application of force from space, represents the ultimate high ground. Any country that achieves space weaponization will readily become a preeminent military power.

Over the long term, space weapons may be the best – and in some cases, only – means to meet important national security needs.[18] The military applications and national security needs best fulfilled from space include defense of the homeland against foreign ballistic missile threats, defense of national space assets, and future terrestrial offensives – specifically in pursuit of time-critical targets.

In a world of emerging terrorist and rogue nation threats coupled with proliferating WMD technologies, a strong case can be made for the pressing demand for national missile defense systems to protect responsible nations and their territories against land-, air- or sea-launched ballistic and cruise missiles. One attractive model for a layered missile defense calls for interception during the boost phase. In the absence of local terrestrial interceptors, boost-phase intercept would require the capability to apply sufficient destructive force as soon as missile launch was detected. This capability is almost inconceivable without a space-based weapon system.

Additionally, space-based weapons offer the ultimate military offensive high ground. Capabilities that space weapons could confer include:

- strategic attack of slow-moving or fixed targets requiring vertical penetration, such as ships, buildings or missile silos;
- strategic attack of targets requiring horizontal effects such as runways and bridges;
- strategic attack of fast-moving surface targets, such as Scud and mobile missiles, using space-based ISR to probe denied areas;
- elimination of an adversary's airpower by attacking aircraft on the ground and in flight, and;
- attack of an adversary's air defenses by attacking ground-based anti-aircraft assets.

The prospect of a secure homeland and space-based defense, combined with overwhelming offensive capabilities, represents the ultimate military high ground. The first country to achieve full space weaponization could easily become the preeminent military power in the world. To not seize this is to concede it to another.

Summary Proposition: Historical Precedent

Where goes man, goes the clash of opposing wills, goes the instruments to effect that

> *clash: weapons. It was true of the territorial frontiers throughout history, true of the high seas in the Middle Ages, and true of the air realm in the twentieth century. The same is destined to be true in space.*

The causes of human conflict and the inevitability of warfare have been a central concern of human philosophy throughout the centuries. As Immanuel Kant argued, 'the state of peace among men living side by side is not the natural state; the natural state is one of war. This does not always mean open hostilities, but at least an unceasing threat of war.'[19] From the *c.* 2000 BC outpouring of Indo-European tribes across the Mediterranean and southwest Asia, through the European expansion across the Atlantic in the fifteenth and sixteenth centuries, to the massive air armadas of the two world wars, the history of human civilization has demonstrated this predisposition towards war.

As humans have mastered new realms of their physical environment, often through technological innovation, they have found new venues and opportunities for armed conflict.[20] Although human mastery of the seas and skies followed two distinctly different patterns, each sheds valuable light on likely motivations and reasons why armed conflict will spread to outer space.

The history of human involvement with the seas demonstrates the relationship between commerce and armed conflict. For early civilizations, oceans and rivers served three crucial purposes: travel, trade and communication. For thousands of years of human history, water was the fastest, cheapest and easiest means to transport people and goods. Control of maritime resources has historically generated great power and wealth; between 2000 and 1200 BC, Crete benefited from its strategic position on Mediterranean trade routes and, nearly three thousand years later, Holland built a powerful empire based on rich sea commerce.[21]

Competition over the immense value of maritime resources led to armed conflict on the seas. From the earliest days of sea trade, the vulnerability of seafaring ships and the value of the goods they carried led to piracy. Countries built navies to defend trading ships and the ports upon which they depended, both at home and abroad. Greed also played a role in bringing conflict to the seas, as countries tried to maximize their share of commerce by barring others from sea trade, often through violent means. The use of naval force to defend commercial resources developed naturally into a tool for military offensives, first applied in the Greco-Persian war in the fifth century BC.[22]

In the human conquest of the skies, military utility equaled or surpassed commercial and civil applications. Long before man could dream of the vast commercial value flight would hold in the twentieth century, he understood its potent military advantages. The Chinese are reported to have used kites for military reconnaissance, signaling and scattering propaganda leaflets over hostile forces as early as 550 AD.[23] Poets and philosophers in the seventeenth and eighteenth centuries described the peril that would result if enemies were to possess the power to attack from the sky.[24]

With the outbreak of the First World War, the immense military potential of airpower was developed in a matter of years. The Wright brothers sold their

Flyer to the United States War Department in 1908 and, a year later, the British government undertook its own programs in heavier-than-air flight.[25] During the First World War, Allied aircraft were first used for reconnaissance of enemy troops and artillery targets, communication via colored lights and wireless telegraphy, and aerial photography. As each side in the conflict sought to defend its own aircraft and to destroy its opponent's, aerial warfare was born.[26] By the spring of 1915 airplanes were used for bombing, and a year later both sides had outfitted their aircraft with machine-guns for air-to-air combat.[27]

The air-to-space analogy is perhaps stronger than that for sea-to-space, and one can almost hear future historians recount our access to the space realm in the same terms that today's historians recount our access to the air realm almost 100 years ago:

> Craft in the new realm were first used for reconnaissance of enemy strategic positioning, enemy troops and potential targets. The new craft provided intelligence and means of communication that were initially unchallengeable. As the new realm afforded more of these new capabilities, and as these new capabilities emerged as determinants of conflict, offensive capabilities reaching *to* the realm were born in order to deny those capabilities. As each sought to defend its own craft in the new realm, and to destroy its opponent's, warfare *in* the new realm was born. Shortly thereafter, as any reluctance to exploit the new realm waned, capabilities *from* the new realm were used for force applications on the ground and seas.

Any weaknesses in the air-to-space analogy are attributable to access: where access to the skies blossomed shortly after first flight, access to space has proven to be much more of a technological challenge. But, once full and ready access to space is realized, the analogy will become undeniable.

The two historical cases of man gaining access to the new sea and air realms offer several valuable themes with which to consider the human struggle to master outer space: national interests in commerce, transportation and communication, perceived military utility, and the catalyst of international crisis. Space combines some of these themes. On one hand, space holds enormous commercial and economic value by facilitating communication and the flow of information. Information is probably the twenty-first century's most valuable commodity, the equivalent of manufactured goods and raw materials in the eighteenth and nineteenth centuries.[28] On the other hand, space has conferred unparalleled military advantages upon the countries that have mastered it. Space-based assets have ushered in an outright revolution in the conduct of warfare, equal to or greater than any such change in the history of humankind.

Propositions 1 through 4 contribute to this historical basis. That is, social and economic leverage, inertia of technological and military doctrinal advance, the lure of prestige and prowess afforded on the international stage, as well as military information and operations superiority provided by weapons' accession

to the frontiers are the determining reasons for the historical precedent. *Where goes man, goes the clash of opposing wills, goes the instruments to effect that clash – weapons.*

It is important to note that these propositions *are not* assumptions about the future. They are simply a consolidation of thought on those positions leading some to conclude that space weapons are a viable possibility for responsible states preparing to deal with threats wherever they might appear. These propositions are, of course, only half of the story.

Four Counter-Propositions to the Advent of Space Weapons

Counter-Proposition 1: Appropriateness

> *Whatever the space posture, it must enhance unity, enable justice, secure tranquility, provide defense, promote general welfare and secure liberty. These constitutional precepts apply uniformly to individuals and states. Quite apart from any perceived immediate benefit, a strong case can be made that space weapons negate unity, inhibit justice, disrupt tranquility, undermine defense, demote general welfare and constrain liberty. A future of space weapons is inconsistent with basic human and international values.*

In many open forums, it has been implied that issues on space weaponization are clouded by such philosophical perspectives. While one may expect to enter this debate on rational grounds with an intent toward logical deduction, ultimately a states' policy position will come down to judgement. And judgement requires a basis of values. Thus, assessments of appropriateness are necessarily dependent upon national character. In the American case, national goals in space should not conflict with fundamental US objectives that further the global spread of constitutional values. The following excerpts from the Preamble to the US Constitution and the US Declaration of Independence have far-reaching implications.

> We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defence, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America.[29]

> We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.–That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed.[30]

Generalizing to a global context, many states have equally altruistic national values. As the community of responsible states proceeds to discuss international policies regarding man's role in space, they must be careful to sift through a host of currently competing interests and pressures, ranging from domestic

opinion to media influence and from corporate to political pressures, and remember that what is done now will necessarily echo for generations.

The American perspective would at least suggest criteria from which to measure space policy options (listed in Figure 3). The period 1949–1989 was a time when people lived in a world that they knew could be vanquished at any moment by nuclear war – a prospect that would most certainly have destroyed tranquility, ruined general welfare and eradicated liberty. The issue at hand is clear. Does the international community, currently living in relative peace, want to re-instate a world again dominated by the continuous and immediate threat of destruction (through space weaponization) – even if not total destruction?

The case can be made that the United States has a window of opportunity.

FIGURE 3
CRITERIA FOR MEASURING 'APPROPRIATE' SPACE POSTURE

POSITIVE	vs. NEGATIVE	
Unity-enhancing	Unity-negating	i.e., actions taken unilaterally
Justice-enabling	Justice-denying	e.g. actions which promote lawlessness, plausible deniability, or a frontier mentality
Tranquility-ensuring	Tranquility-disrupting	i.e. actions which incite conflict
Defense-providing	Defense-inhibiting	i.e. providing offense
General Welfare-Promoting	General Welfare-Demoting	i.e. promoting actions which benefit the few at the expense of the many
Liberty-securing	Liberty-constraining	

As a relatively benign sole superpower, it could posture itself as a space police force and ensure the use of space 'for the benefit of all mankind'. But by design, the US Constitution was written to ward off such unchecked power – regardless of who would wield that power. Applying the same wisdom George Washington demonstrated when he declined the offer to become the first American king, the United States, bound by constitutional intent, must resist the lure of becoming the first space hegemon, and pursue this unique leadership opportunity to create the international environment that will lead to the assured use of space for the benefit of all humankind.

While military and economic dominance via space hegemony are means to national security, which in turn is of prime importance in assuring a secure base from which to advance a state's values, dominance should not be an end in itself. The goal that should not be lost is the legacy to future generations – grounded in core values and achieved with means *appropriate* to them.

While the issue of appropriateness naturally leads one away from policies proposing space weaponization, it is certainly not the only issue that does so. As one considers a concrete rationale for the posturing of weapons in space to

achieve national and international goals, a host of unintended consequences warrant consideration.

Counter-Proposition 2: Military Non-sense

> *The migration of weapons to space is likely to create more military problems for the host country than it will solve. From a military perspective, the price of localized and global instability coupled with incentives for pre-emption and escalation may well be a* weakened *military posture.*

Global instability is the core issue in an international context. One country's pursuit and deployment of space weapons is destabilizing from the perspective of both foe and friend. Weaponization could prompt adversaries to develop ASAT or space-based weapons. In the extreme case, a peer competitor might engage in an escalatory arms race. Probably a greater threat, however, is dispersed, low-level proliferation. A number of countries are capable of building limited ASAT or rudimentary space weapons, and might choose to do so. The wide proliferation of micro-satellites or other ASAT weapons would threaten all space assets, due to the varying (and perhaps unpredictable) motivations of countries that could obtain them. Those countries capable of posturing space weapons are generally those that have the most assets to lose in a space war. The acquisition of such weapons might well present an irresistible first-strike opportunity for a country unlikely to win in a conventional conflict. Other adversarial states, especially those incapable of building space weapons or achieving parity in conventional forces, might increase their efforts to acquire nuclear, biological or chemical weapons, or pursue other asymmetric activities (e.g. terrorism).

Beyond adversarial responses, allies and partners abroad might also react unfavorably. Any unilateral decision to weaponize space might have negative consequences for diplomatic relationships worldwide. The European Union has been a consistent and vocal critic and, as validated by multiple resolutions in the UN regarding the prevention of an arms race in outer space (PAROS), reflects the opinions of the larger international community. In response to proposed US tests of its mid-infrared advanced chemical laser (MIRACL), an official from the European Space Agency commented: 'The world space community is confused as to the need for the US to develop space weaponry now, and is dismayed that the US is planning to test a high-powered laser against a satellite target'.[31]

Although it is unlikely that weapons in space would threaten or sever strong existing diplomatic ties, simple unpopularity might prompt a shift in the international center of gravity. Countries opposing or alienated by one states' space policy might gravitate to other alignments, possibly creating an international coalition to oppose the space-weaponizing country on these and other issues within international organizations such as the UN or the World Trade Organization (WTO).

A decision to posture weapons in space might also diminish the ability of the space-weaponizing country to assemble international coalitions. In the case of the United States, such international political clout has been crucially

important to the military, political, judicial and economic conduct of the war on terrorism. These forms of diplomatic influence might be more important than hard power in the maintenance of global stability in the twenty-first century.[32]

The simple unilateral posturing of space weapons creates global instability in the form of encouraging adversaries to respond symmetrically or asymmetrically, heightening tensions, while at the same time crippling alliances. In this less stable global environment, there is also the prospect of space weapons causing less stable regional environments.

Integrating space weapons into military operations could have unexpected consequences for the progression of conflict situations, prompting significant *regional instability*. In most war games that include space assets, commanders discover that preemptively destroying or denying an opponent's space-based assets with space weapons is appealing, yet often leads to rapid escalation into full-scale war, even triggering nuclear weapons use. One commander commented: '[If] I don't know what's going on, I have no choice but to hit everything, using everything I have'.[33] That this conclusion surprised strategists suggests that the full implications of space weapons have not yet been fully explored. What is common knowledge, derived from years of experience in futuristic war games, is that permanently based space weapons invite preemption and escalation. Local to a specific situation of heightened tensions, the existence of space weapons on one side, the other, or both could be the determining catalyst for escalatory war.

In this view, a space-weaponizing country creates both the powder keg of global instability (where it has weakened its own international posture) as well as the spark of regional instability (where it has made itself a target of preemption and escalation). Coupled with this very unstable environment, it can also be argued that the same country that weaponizes space *may actually damage its own military power*.

Much of the impetus behind space weaponization stems from perceived military utility, to include national missile defense applications for boost-phase intercept, time-critical targeting, and defense mechanisms for critical space systems. Ironically, the posturing of more military assets in space could actually *weaken the military posture* of those that seek further military advantage in that domain. Space assets are already a center of gravity (CoG), or at least a critical concentration of military force enhancement assets. To deploy more systems in space in an attempt to protect this CoG only complicates the problem. In spite of the added defenses, the preponderance of threats will remain: denial and deception, electronic warfare (e.g. uplink and downlink jamming), ground facilities disruption, micro-satellites (e.g. space mines), direct ascent interceptors or even a nuclear detonation in space.[34] In addition to limited utility to defeat these threats, the new space-based weapon systems would also be vulnerable to those same threats. There are more logical alternatives, many of which de-emphasize reliance on centralized space assets (e.g. alternatives offering redundancy in space or with terrestrial systems). In a briefing to the George Washington University's Space Policy Institute Workshop, Dr Karl Mueller of RAND summarized a comprehensive set of responses to foreign space threats that do not require space-based weapons (Figure 4).[35]

FIGURE 4
NON-SPACE WEAPON ALTERNATIVES TO COUNTERING SPACE THREATS

Eliminate Operable Enemy Space / Counterspace Systems
Destroy, damage, or disable hostile satellites (could include 3rd party systems) before or during launch
Prevent launch of satellites by attacking or suppressing enemy launch facilities
Destroy or damage terrestrial ASAT systems
Eliminate terrestrial military threats to friendly space support facilities and ASATs
Eliminate enemy ability to procure or produce space systems or ASATs
Prevent Enemy Use of Space / Counterspace Systems
Destroy or disable space/ASAT command and control facilities
Jam or override command and control of satellites
Destroy or disable satellite downlinks
Jam or modify/corrupt transmission of data from satellites
Covert access to third-party space systems or data
Make use of enemy counterspace systems prohibitively costly to them
Retaliatory and/or punitive threats, including threats of escalation
Raise the opportunity costs of expending limited space/ASAT resources
Make Use of Enemy Space/Counterspace Systems Ineffective
Shield friendly forces from view by hostile space or counterspace sensors
▪ Obstruct view of sensors, Camouflage, Concealment, Deception (prevent detection of targets)
▪ Mobility, evasion (prevent tracking of targets)
Make attacks against friendly targets in or from space impractical
▪ Dispersal/Redundancy (eliminate lucrative targets)
▪ Locate forces where enemy cannot or will not attack them
Foil attacks against friendly targets in or from space
▪ Active defenses (interception, jamming, etc…)
▪ Hardening and other passive defenses
Reduce significance of enemy reconnaissance or attack by or against space systems
▪ Redundancy (within or across systems)
▪ Repair and replacement of losses (rapid reconstitution)
▪ Substitution (reducing reliance on vulnberable systems, either preemptively or following attack)
Shutter controls on commercial imaging (requires good international relations)

In short, for the countries that could weaponize space, doing so would only amplify an extant and vulnerable CoG, and they would do so in the midst of many better and less costly alternatives. Perhaps more significant than extending the space CoG (i.e. making it more vulnerable) is *exposing it* (i.e. revealing it). A move toward space weapons is likely to prompt competitors to build ASAT systems, systems that will also threaten robust communications intelligence gathering systems that, to date, have been protected by an open-skies environment. Additionally, it could be strongly argued that the countries currently able to posture space weapons are those that currently hold military advantages in many other realms, and this begs the question: why would powers that currently hold military advantage in the air, land and sea realms open a new realm in space that could conceivably level the playing field for others?

The posturing of weapons in space by a country capable of doing so will extend and expose a military CoG: space-based military force enhancement.[36] As a result, the militarily weakened and more vulnerable space-weaponizing state would simultaneously posture space forces that invite pre-emption and escalation in a globally unstable environment it created. From the military effectiveness perspective alone, 'non-sense' may be too weak a term; more to the point, for a state to posture weapons in space is 'counter-sense'.

Counter-Proposition 3: Exorbitant Costs

> *$1 trillion for an effective space weapons system – and that is on the low side, assuming the world is not compelled into a space race. Additionally, opportunity costs go well beyond mere dollars. In the zero-sum game of government expenditures, costs must be measured in foregone investments in other necessary military and defense acquisitions; domestic investments in education, pensions and health; and international investments in humanitarian relief efforts.*

Although the precise cost of any space weapon system is impossible to predict, we can consider some rough approximations. The space-based laser, for example, has undergone considerable cost study. A rudimentary 24-satellite constellation is estimated to cost between $80 and $100 billion.[37] A more robust system, requiring 120 or more satellites, could cost as much as $500 billion or several trillion dollars. Furthermore, space systems – such as the Space Shuttle and International Space Station – have often grossly overrun their budgets, due to underestimation during the budgeting process and unforeseen technical hurdles encountered during development and construction. For the sake of argument, $1 trillion for a significant space weapons capability is a reasonable estimate.

All of this presages adverse impacts on other national security programs. As an accountant for any national treasury might put it, the books simply do not balance. The United States far out-spends any other state in the area of national security, and its annual defense budget of ~$350 billion is mostly committed upon arrival. Given salaries, pensions, benefits, facilities, operations and maintenance, only ~$125 billion is left for procurement and R&D. Within that, major acquisitions of the F-22, joint strike fighter, bombers, carrier battle groups, UAVs, etc., all vie for this limited funding. Every other national defense establishment operates under similar or more severe funding constraints. In the context of military spending alone, space-based weapons are simply unaffordable. Beyond this, one country's pursuit of space weapons could well catalyze the next major arms race.

One state's decision to weaponize space could prompt other countries to acquire space weapons or ASAT capabilities and might result in uncontrolled proliferation or an outright arms race in space. Although most experts agree that some degree of space weapons proliferation would probably result from weaponization, they are divided over the likelihood of a space arms race. Many suggest that high cost, the technological sophistication required, and viable asymmetric alternatives would drive all but a few states away from following another in a race to weaponize space. There are potentially four powers that could pursue parallel paths in a race to develop and deploy space weapons: the United States, Russia, the European Union and China. Other countries could also respond without an aim for parity and include those with access to space (or which may soon have access); among these are Australia, Brazil, China, France, India, Israel, Japan, North Korea, Pakistan, Russia, Taiwan and Ukraine. Countries with the ability to fabricate satellite technology include France,

Germany, India, Israel, Italy, Japan, Russia and the United Kingdom.[38] Technology transfer has been rapid, especially for micro-satellites, and many other countries may soon be capable of building their own satellites. For instance, the United Kingdom's Surrey Satellite Technology Ltd has undertaken joint technology transfer programs with Pakistan, South Africa, South Korea, Portugal, Chile, Thailand, Singapore, Malaysia and China.[39] All said, a multitude of countries, at some level, could enter a costly race to space weaponization, or align with major powers that do so. Moreover, the first country to do so might actually provide the gateway to space exploitation. At huge expense, it will have broken the technological frontier only to realize that once the heavens are opened to weapons, everyone else goes much more cheaply.[40]

In addition to posing insurmountable military opportunity costs and the potential of another costly arms race, space weapons directly threaten the fiscal health of the space sector itself. Use of destructive weapons in space would obviously promote an orbital debris problem that is on the threshold of becoming a major inhibitor to space commerce. Currently, the US Space Surveillance Network uses ground-based radar and optical/infrared sensors to track roughly 7,500 objects across orbital space. That constitutes objects greater than 10 cm in diameter in low Earth orbit to objects greater than 1 m diameter in geostationary orbit. Only approximately five per cent of those objects are operating satellites; the rest are effectively debris, 40 per cent of which are fragments of disintegrated satellites and upper stages of rockets.[41] Unfortunately, there are between 30,000 and 100,000 *untracked* objects between 1 cm and 10 cm diameter (large enough to cause serious damage to spacefaring vehicles), and an unknown but enormous number of particles smaller than 1 cm (many of which could damage sensitive systems on impact). While the space environment is extremely large and the probability of an impact is still small, that probability is growing. For some space missions active protection through shielding is already a requirement (e.g. the International Space Station). Getting this shielding to orbit is an added expense to an already low-profit-margin industry. Any weapon use in space, but particularly proliferating weapons use in space, could readily make space a no-go area of dangerous debris, in the process pre-empting commercial and civil development.

Beyond the use of weapons in space, the satellite insurance business is extremely volatile. In the last four years, satellite insurance rates have risen by 129 per cent, driven by increasing complexity and anomalies of satellite systems.[42] The mere presence of weapons poses a risk, and insurance companies structure their rates on risk estimates. The resolution approach for the insurers will be to strengthen their exclusion clauses for acts of war – and pass the risks to the financiers, who will have to decide to go to space without such insurance coverage, or not go at all.[43]

The combination of weapons posturing and/or use may well cause increasing debris, expensive hardening and increasing risk (perceived by insurers and/or assumed by financiers), all producing an inaccessible international commercial space environment. But there are adverse impacts on domestic programs as well. National domestic expenditures and international

relief expenditures pose a zero-sum game for national economies. To highlight the significance of domestic and international concerns, last year alone over six million people died of cancer worldwide, and the 2020 projection is 20 million deaths – yet our collective investment in research to combat this foe is less than one per cent of defense spending. The opportunity costs of space weapons in terms of other national security expenditures, impact to the international space market, other domestic expenditures, and international relief efforts are but a few of many international ramifications. This begs the question: what real wars are to be lost while we collectively expend billions on space weapons – weapons that in all probability will merely pacify paranoid insecurities?

Counter-Proposition 4: Bad Precedent

> *Should states seek to move away from the precedent-based interpretation of international law that implicitly prohibits weapons in space, in favor of the literal interpretation that allows conventional weapons in space, it could pose an international precedent that would have grave consequences on the spirit of international cooperation.*

Any decision to weaponize space could have negative implications for international law and the body of treaties that govern the use of outer space. The extent of these implications would depend both on the degree of weaponization and the school of interpretation applied to international law. One literal interpretation of international law, and perhaps the preponderant interpretation, is that whatever is not explicitly forbidden is implicitly (and perhaps deliberately) allowed. Conversely, there is the softer interpretation of intent and/or precedent; that is in this case, several decades of de facto policies that should not be lightly overturned.

Under a *literal interpretation* of current international law, and with the 1972 Anti-Ballistic Missile Treaty now defunct, posturing non-nuclear weapons in outer space would not breach the terms of any international agreement. Despite the considerable number of treaties governing outer space, the use of force and posturing of conventional weapons in space is not explicitly prohibited. The 1967 Outer Space Treaty (OST), for example, explicitly forbids the use of weapons of mass destruction in space, on the Moon or on other celestial bodies but says nothing about conventional weapons.[44]

Under a *precedent-based interpretation*, by contrast, a substantial body of de facto policy stands in opposition to any decision to posture weapons in space. Proponents offer the following evidence: the United States refrained from posturing weapons in space, despite the testing of a Soviet co-orbital ASAT weapon in the 1960s and 70s, and the Soviet Union subsequently chose not to pursue their ASAT program.[45] Both the US and Russian governments have consistently placed restrictions on the testing (and funding) of space weapons programs.[46] In conjunction with these historical facts, the 1996 US National Space Policy explicitly supported international cooperation and the peaceful use of outer space by all states and has been interpreted by some analysts as a de facto ban on space weapons.[47] All signatories continue to be firmly committed

to the Open Skies Treaty (2002), the driving principle of which is the concept that widespread, unhindered overhead surveillance will stabilize the international environment by enhancing mutual understanding and confidence.[48] Finally, many spacefaring states are parties to several international treaties, each of which carries explicit or implied restrictions on military activity in space. These include the Moon Treaty, the Space Registration Convention, the Liability Convention and the International Telecommunications Union.[49]

Should states seek to move away from the precedent-based interpretation in favor of literal interpretation, it could have grave consequences for the spirit of international collaboration recently built around suppressing aggression in the Gulf and combating terrorism. It could also jeopardize broad efforts to negotiate on WMD proliferation and arms control. Principally, most responsible states favor the expansion of the Outer Space Treaty of 1967 to address and explicitly prohibit weapons' migration to space. A combination of precedent-based interpretation and this strong international desire begs action.

Summary Counter-Proposition: A Logical Appeal

> *It is evident that states should simply choose to pursue avenues toward national and international objectives other than space weapons. Based upon the four preceding counter-propositions, unilaterally weaponizing space is: inappropriate by almost any value-base; military 'non-sense' in that it is ineffective in light of countermeasures (expands and exposes the space CoG), is destabilizing locally (escalatory), is destabilizing globally (inflammatory and threatening), is militarily ineffective at the expense of many better alternatives; is extremely costly – it would damage any national economy; and it is politically unviable in an increasingly interdependent world of responsible states.*

Balancing the Propositions and Counter-Propositions Regarding the Advent of Space Weapons

Should we set aside the damning assessments based upon appropriateness, unintended security consequences, better alternatives and fiscal and political opportunity costs, yet hold fast to the *assumption* that independent states will selfishly pursue national goals in the absence of an international adjudicator, the historically grounded logical consequence is that states will move into the new space environment with weapons in order to prosecute the exercise of their wills. Hence, as was true of the land, sea and air realms, the weaponization of the space realm is inevitable – unless the assumption is changed.

The summary proposition is one of historical precedent, the summary counter-proposition is one of collective rational choice. In continuing the quotation cited at the outset of the summary proposition on historical precedent, Immanuel Kant recognized that the human means of resolving the opposition of wills does not necessarily have to be left on the natural path: 'A state of peace, therefore, must be *established*, for in order to be secured against hostility it is not sufficient that hostilities simply be not committed; and, unless this security is pledged to each by his neighbor, each may treat his neighbor,

from whom he demands this security, as an enemy'.[50] As we look to the future, Kant's remedy could quite clearly be applied now as a demarcation point in human history. Kant's three definitive articles for perpetual peace entail that the laws of nations shall be founded upon a (1) federation of (2) free republics, and (3) the law of universal citizenship shall be limited to conditions of universal hospitality. The global community is migrating in that direction: it could be argued that political evolution is leading to the establishment of republics across the globe. That only leaves a choice to be made for a global federation and the design of its nature. For those that might read this as an abdication of national sovereignty, Kant's third article draws a clear limit on the extent of universal citizenship. The federation becomes the adjudicator – not a master, but a means by which cooperating free nations establish collective security. The unity of will, resolve to be vigilant, means of adjudication, and enforcement of decisions must be well established. It is important to remember that the goal is not the absence of conflicting wills, but a Solomon-like approach when resolving them.

That leads to international diplomacy. A very logical step would be to pursue such cooperation among nations now, in a world context ripe with emerging republics seeking collective security and technological advance on the doorstep of broad access to the new space environment. This would require a call to aggressive diplomatic action in the form of a robust multinational space compact.[51] Some inroads to such cooperation are already apparent. The Outer Space Treaty of 1967 has effectively banned nuclear weapons from space, and the use of chemical and biological weapons have been similarly banned by specific treaties. Unfortunately, these bans are not aimed at a far-reaching global peace, but more simply at the inhumane and indiscriminate nature of the weapon itself. As such, these minor bans do not set the necessary precedent that might lead to a weapons-free space environment, and ultimately, collective global security.

If a weapons-free space environment, as a first step toward a global environment largely free of warfare, is a future we would have, it will require global cooperation unprecedented to date; a global and collective exercise of that which distinguishes man from all else – an ability and determination to make decisions counter to his own natural inclination and the natural design. The leading countries of the world, and the only states currently capable of weaponizing space, would be the most credible advocates of a space compact to ban space weapons as a first step toward perpetual peace.

In the discussion of these propositions and counter-propositions, two alternative futures are apparent – one where a natural evolution to space weapons is allowed to occur, and the other where an aggressive multi-national posture is pursued to inhibit that natural or even inevitable weaponization. The latter is predicated upon establishing means of adjudicating space-related differences among nations. There is a third and lesser alternative to these worth mentioning, that is, the path that we are currently on: *indecision*. This constitutes the future of a half-hearted, mediocre attempt to prohibit space weaponization that ties the hands of responsible nations, but does not provide the international structure to prohibit belligerents from weaponizing space. If we are to pursue

the option to prohibit the weaponization of space, we must pursue it with fervor. If we find establishment of a strong and credible multinational adjudication arrangement not practical or unworkable, we ought to strongly consider a measured move to weaponize space to the advantage of states that have the self-restraint to not misuse it. In the absence of such adjudication, armed preparation and even armed conflict is not necessarily as bad as 'this kind of peace'.[52]

ACKNOWLEDGEMENTS

The author would like to recognize the very significant contributions of retired NASA director and Council on Competiveness consultant Dr Daniel S. Goldin, the Council on Foreign Relations' Philip D. Reed, Senior Fellow for Science and Technology, Dr Richard L. Garwin, and Council on Foreign Relations' Research Associates Jeremy Marwell and Scott Kemp.

NOTES

1. See Michael Krepon, 'Lost in Space: The Misguided Drive Towards Antisatellite Weapons', *Foreign Affairs* 80/3 (May/June 2001), p.7.
2. See The Office of Space Commercialization, *Trends in Space Commerce* (Washington, DC: US Department of Commerce, 2001).
3. There are a host of international collaborative activities in space, not least of which is the International Space Station. See the NASA homepage site <http://www.nasa.gov/nasaorgs/other_agencies.html> for references to more than 25 nations' activities in space.
4. See 'COSPAS–SARSAT Search and Rescue System – Taking the "Search" out of "Search and Rescue"', National Oceanic and Atmospheric Administration Magazine, 1 February 2002, <http://www.noaanews.noaa.gov/magazine/stories/mag16.htm>.
5. Satellite Industry Association (SIA), *2000–2001 Satellite Industries Indicators Survey*, prepared by the Futron Corporation (available at <http://www.sia.org/papers/Satellite%20Industry%20Indicators%20Survey-02.pdf> The remaining revenues are from launch, as well as satellite and ground infrastructure manufacturing.
6. Note that commercial interests and dollars in space are primarily in geosynchronous Earth orbit, well away from most current and credible threats.
7. Limitations include (1) somewhat vulnerable in its stable-observable-predictable orbit; (2) existing legal and policy restrictions – ramifications (e.g. allowed targets, nation/agency/organization notification; confusion with posturing of WMD that would be counter to the Outer Space Treaty of 1967); (3) large numbers of satellites required for persistent access to any point on the ground; (4) limited energy availability – cooling demands; (5) excessive launch costs and difficulties associated with any kind of maintenance; and (6) a reactive adversary employing effective countermeasures.
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13. Peter Anson, 'The First Space War: The Contribution of Satellites in the Gulf War', paper presented at the 12th AFCEA Europe Symposium, reprinted in Campen (note 12), p.128.
14. Summaries of five generations of US satellite capabilities, dating from the 1960s, can be reviewed online at <www.fas.org/spp/military/program/sigint>.
15. Jet Propulsion Laboratory 'Quick Look' paper on FLTSATCOM, Online Mission and Spacecraft Library, <http://eis.jpl.nasa.gov/mtp/missions/camex4/QuickLook/QuickLook.html>.
16. See Anson (note 13), p.127.
17. See Dennis Papadopoulos, 'Satellite Threat due to High Altitude Nuclear Detonation,' working paper, University of Maryland, 2002. See also Ian Steer, 'Blind, Deaf and Dumb', *Jane's Defence Weekly*, 23 October 2002, pp.20–23.
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22. See Potter (note 21), pp.2–3.
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25. See ibid., p.37.
26. See Scott E. Gilson, *A Study on Contrasts, Similarities, and Differences Between the Development of Airpower and Space Power* (Maxwell AFB, AL: Air University, Air Command and Staff College, April 1998), pp.5–7 (available at <http://www.fas.org/spp/eprint/98-100.htm>).
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41. See National Research Council, Commission on Engineering and Technical Systems, *Orbital*

Debris: A Technical Analysis (Washington, DC: National Academy Press, 1995), available at <http://books.nap.edu/books/0309051258/html/index.html>.

42. See Futron Corporation, Space and Telecommunications Division, *Satellite Insurance Rates on the Rise: Market Correction or Overreaction?* (Bethesda, MD: Futron Corporation, 2002), p.1, available at <http://www.futron.com/pdf/Futron-SatInsurance.pdf>.
43. As claimed in the research performed by the Insurance Information Institute: <http://www.iii.org>.
44. 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies', 27 January 1967, <http://www.oosa.unvienna.org/Reports/ostE.pdf>. See also 'Space Treaty', *Aviation Week & Space Technology*, 14 November 1988, p.23.
45. The Soviet Union unilaterally renounced its ASAT capabilities in 1983, a policy adopted by the Russian Federation.
46. There has been no dedicated US ASAT development program since 1975 and the last ASAT test (a miniature homing vehicle on a two-stage homing missile launched from an F-15 fighter aircraft) occurred in 1985. See Bruce M. DeBlois, 'Space Sanctuary: A Viable National Strategy', *Airpower Journal* 12/4 (Winter 1998), p.45; Richard Garwin, 'The Weaponization of Space', paper presented at CISAC session with CSGAC, Committee on International Security and Arms Control, 3–5 March 2001.
47. For example, Theresa Hitchens, 'Rushing to Weaponize the Final Frontier', *Arms Control Today* 31/7 (September 2001), available at <http://www.armscontrol.org/act/2001_09/hitchenssept01.asp>.
48. The Open Skies Treaty entered into force in January 2002 and formal observation flights began in August (Bureau of Arms Control Fact Sheet, 'Open Skies Treaty,' 14 August 2002, <http://www.state.gov/t/ac/rls/fs/12691pf.htm>).
49. While drafted by the US State Department, the Moon Treaty was never ratified by the Senate. Objections by the L5 Society (a space pressure group) were predominantly opposing the 'common heritage of all mankind' language, which, as they saw it, precluded exploitation of non-terrestrial resources by anyone. See also 'The Convention on Registration of Objects Launched into Outer Space', 14 January 1975, <http://www.oosa.unvienna.org/SORegister/registxt.htm>; 'The Convention on International Liability for Damage Caused by Space Objects', 29 March 1972, <http://www.oosa.unvienna.org/SpaceLaw/liabilitytxt.htm>; 'International Agreements and Other Available Legal Documents Relevant to Space-Related Activities', <http://www.oosa.unvienna.org/Reports/intlagree.pdf>.
50. Kant (note 19).
51. A 'treaty' connotes the end of a war – a 'compact' among states or 'league' of states connotes the stronger expectation of terminating all war.
52. Paul Seabury and Angelo Codevilla, *War: Ends and Means* (New York: Basic Books, 1989), p.7.