Space weapons: the urgent debate

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This article has been written by International Student/Young Pugwash (ISYP) in collaboration with the Space Generation Advisory Council in support of the UN Programme on Space Applications (SGAC). This follows on from our paper 'Militarization of space: a youth perspective' presented at the 52nd Pugwash Conference in La Jolla, 2002, which gave a summary of the reasons against space weapons. In that paper we included recommendations for ways forward, both for the international community at large, and Pugwash in particular. The current article aims to address one of our recommendations in that paper to 'encourage high-level debate' on this issue. To do this, we have been working together with a US Air Force General to develop a critical analysis of both the pros and cons of space weapons, for a nation considering deployment. By developing a balanced debate, we hope to set a framework for the discussion in which all sides can take part.

There is an urgent need for a discussion on the future military uses of space for several reasons. First, the technology for developing and deploying weapons systems in space is already available in major space faring nations. Second, conflicts are beginning to arise over space-based assets, both for economic and security reasons. Thirdly, there are few legal restrictions on the use of space weapons. Finally, a number of political and military leaders in some major powers have expressed their support for the deployment of space weapons. Deployment could therefore be imminent. Moreover, the stakes are high since once deployed, it may be impossible to eliminate space weapons, even if they prove unsuitable or destabilising. However, given that deployment has not yet taken place, we have a unique opportunity for thinking through these issues now.

The challenge is to find a way of managing space that avoids the 'tragedy of the commons', whereby the pursuit of individual rationality by every state leads to a collectively worse outcome for everyone. The costs and gains of space weapons must therefore be addressed in a comprehensive and balanced debate. In synopsis, short term advantages from

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acquiring offensive space weapons must be weighed against the medium and long term consequences of deployment, most importantly the risk of a destabilising arms race in space.

This article, the result of collaboration among a military officer, space professionals, and a political scientist, seeks to put the question of space weapons firmly on the security agenda of the 21st century. To that end, we offer a framework of analysis that places the issue of space weapons in appropriate technological, economic, political, and strategic contexts.

Diminishing constraints, growing incentives

A decision to deploy space weapons would not face many constraints, whether technological or legal. After years of development, the technology required for space weapons is now feasible, albeit still expensive. Both the US and Russia have the capability to deploy advanced space weapons in a matter of years. Several other nations have the capability to launch lower technology space weapons in a similar timeframe. The Reagan and Bush I administrations funded, on the order of ten billion dollars, a variety of initiatives which laid the groundwork for contemporary space weapons systems. As a result, the development and deployment of space weapons, is no longer a technological challenge, but a question of political will.

The legal framework governing space weapons is minimal. The only explicit rules regarding space weapons are those prohibiting conventional weapons on celestial bodies and weapons of mass destruction everywhere in space. Conventional space weapons are therefore legal as long as they are based on a satellite rather than the moon. The legal framework has been further weakened by the abolition of the Anti-Ballistic Missile Treaty. Law is therefore no obstacle to deployment.

At the same time as the technological and legal constraints on deployment are abating, the incentives are mounting. The critical role that space has become to play, in both civil and military activity, has created the potential for future conflict. The US military is now dependent on space assets to wage its preferred style of war. Perhaps even more important, the economic benefits of the Global Positioning System (GPS) and other space-based technologies gives the US and other countries a substantial interest in maintaining, protecting, and augmenting those assets. Discord between peer competitors, such as the one surrounding Galileo, the European satellite navigation system, are seen by some as early seeds of greater conflict. Other conflicts have arisen due to differences of opinion over the distribution of reconnaissance data and in controversies over the use of radio spectra. The effect of all these developments is that space policy is being increasingly securitised and framed as a core national interest.

Against the backdrop of waning constraints and rising incentives, it is no surprise that political will is emerging. There have recently been prominent voices within the US military (US Space Command Master Plan 2001 and Air Force 2025) and political (Commission to Assess United States National Security Space Management and Operations, Rumsfeld, 2000) leadership in favour of considering the acquisition of space weapons. In the US military document 'Vision 2020', for instance, it is argued that the United States should seek capacity to operate freely within all technological domains of land, sea, air, space, and information. A decision on deployment could therefore be impending.

Not business as usual

The decision on whether to acquire space weapons is not like any other strategic choice. One reason is the asymmetrical nature of the available options before and after deployment. Historically, the introduction of new weapons systems is generally an irreversible path-dependent process. Put another way, it is much easier not to deploy a new system than it is to withdraw it following deployment, even if they prove unsuitable or destabilising. Nations will indefinitely be able to choose to deploy space weapons, but once deployed it will be difficult ever to return to a situation of no such weapons. This irreversibility of deployment suggests that substantial consideration be put into debate.

The relative peace characterising the current international situation is a further reason why the decision on space weapons is different. Whereas the development of many new weapon systems, including weapons of mass destruction and many advances in aircraft and ships, have occurred during times of war, currently we have more breathing space to think before we act. This is a unique opportunity to consider the costs and benefits of space weapons, including those of the long term, prior to making a decision on their deployment. The long term consequences are far reaching and impinge fundamentally on humanity's prospects for a peaceful future.

All in all, given the nascent political will, a decision that could have irreversible and substantial long-term ramifications can happen within a few years timescale. In the meantime, effective regulation or prohibition of space weapons could be a rapidly disappearing opportunity. As such, the issue of space weapons deserves immediate and careful attention.

A brief history of space and defence

The military use of space is not new. Access and utilisation of space is of national interest. In addition to the economic potential of commercial exploitation of space and celestial bodies, space is the ultimate military high ground. Historically, space-based military assets have been largely passive, concentrating on activities such as reconnaissance, communications, and navigation. Indeed, expenditure on space by the military has consistently outweighed civil spending. Even some scientific exploration missions have arguably been dominated by military objectives, such as the pursuit of technological supremacy during the Cold War which led both to the first satellite (Sputnik, 1957) and human (Yuri Gagarin, 1961) in space and culminated in the manned lunar programme (Apollo, 1963-72).

To date, no offensive space-based weapon has been deployed. The closest it came was during the parallel anti-satellite (ASAT) programmes developed by the US and Soviet Union that were begun in the sixties. These programmes primarily developed a variety of 'kinetic kill' vehicles, though initiatives for ground-based laser systems were also begun. Specifically these included initiatives such as nuclear pumped X-ray lasers, space-based optical lasers, radiation-belt weapons, ground-based reflected laser systems, and space-based interceptors. While many of these initiatives were not carried through, the technology base they developed enable the near-term deployment of space weapons. In addition, many of the main components of space-weapon systems are already used in the civilian space sector. Telemetry, tracking, and control systems for a remote sensing communications satellite, for example, are very similar to analogous systems within a space weapon. Testing of such systems was periodically prohibited or

left unfunded by the US Congress during the eighties and nineties. The US military also expressed its disinclination to use kinetic kill ASATs that tend to create large clouds of space debris.

Meanwhile, the broader international community has repeatedly stated its support for space to be used for peaceful purposes only. This position was codified early in the space age by the 1967 Outer Space Treaty (OST), through which 96 states, including the US and former USSR, recognised the common interest of all humankind in the exploration and use of outer space for 'peaceful purposes'. The OST explicitly prohibits treaty states from placing weapons of mass destruction in space or weapons of any kind on celestial bodies. In 2001, the UN General Assembly approved by a 156-0 vote the basis for a treaty establishing a permanent prohibition on space-based weapons (Resolution 56/535). Recently, a joint working paper on preventing space weapons was introduced by China and Russia in the UN Conference on Disarmament (UNCD).

Against this background of inactivity and caution, new elements have in recent years begun advocating the consideration of new space weapons with strike capabilities. In April, 2003, for example, the US Congressman representing NASA's Florida base stated his support for weapons deployed in space: 'We must adopt a doctrine that states that we as a nation will vigorously pursue the ability to project power to, through and from space against any aggressor'. He also noted, 'It would be inappropriate to deny ourselves this advantage simply because of romantic notions of some that space is some type of sacred place'.

Perhaps more significantly, elements of the US military have advocated a strategy to include the deployment of space weapons within a matter of a few years. However, this position has not yet been adopted at the highest level. In fact, many military officers still regard space-based weapons with a dubious eye. The military focus on space, however, has been reaffirmed repeatedly in key documents such as Air Force Vision 2020 and other related strategic planning documents.

Definitions

There is no strict definition of a space weapon. Whether to include both weapons and targets located in space, direct and indirect applications of force, and temporary impairment as well as permanent destruction all shape the debate. In table 1, following the theme of this article, we characterise the generally agreed areas (black and white) as well as the grey areas. Military space activities are grouped into three categories. Activities in the white area are military applications of space that do not entail force application from assets stationed in space. The black area comprises technologies that fit the traditional definition of space weapons. The weapons in the interstitial grey area are more difficult to categorically classify because they span a range of technologies. These technologies may blur the line between space-based and space-transiting weapons; for example, one strategy that has been considered is the use of temporarily-emplaced weapons that orbit for days to weeks.

A representative example of this conception can be taken from a 1998 working group of the United Nations Institute for Disarmament Research (UNIDIR), which states: 'A space weapon is a device stationed in outer space (including the moon and other celestial bodies) or in the Earth's environment designed to destroy, damage or otherwise interfere with the normal functioning of an object or being in outer space, or being in the earth environment'.

Table 1: The spectrum of military space activity: what is a space weapon?

Space Weapons *(Generally or historically prohibited)*	**Intermediate Systems**	**Military activities not involving Space Weapons** (*Generally allowed*)
[Key Words: **Degrade, Destroy**] - WMD or radiological weapons - Space-based directed energy weapons - Space-based kinetic weapons - Anti-satellite satellites (ASAT) destruction or degrade other satellites	[Key words: **Deny, Disrupt**] - ASAT – Deny access to satellite or ground system, passive measures, encryption - ASAT – Temporarily interfere with satellite or ground system (cyber attacks etc.) operation - ASAT Disrupt operations of space or ground segments permanently - Ground-based directed (at space) weapons - Nuclear weapons for NEO defence - Ground based jamming - Suborbital intercept missiles for missile defence	- Communication - Navigation - Reconnaissance (space-based or high altitude platforms) - Space-monitoring networks - Early warning systems ICBM with suborbital trajectory - Suborbital delivery of troops or equipment

Not surprisingly, white activities are readily employed in today's world by many nations and some of the grey capabilities are maintained by a significant number of nations. Systems within the black area are not fully developed or deployed, but have been the subject of intense national and international discussion due to their potential to create instability in international affairs.

Though debatably outside the traditional definition of space weapons, it may be the technologies within the grey area that deserve the most immediate attention. They are the most likely to be deployed in the short term, and could certainly exert the effects of other traditional space-based weapons. A clear line needs to be agreed upon between states.

Space as a strategic domain

Space is a strategic domain, like the land, air, and sea. It can be viewed as the ultimate high ground, by analogy to traditionally successful land strategy, or as a vast unpopulated medium through which things travel, like the sea. Space is an observation platform, a communications hub, host to a highly accurate positioning system, a medium through which ICBMs pass, a pristine scientific environment, and a vast untapped commercial frontier.

The military significance of space is inextricably linked to its resource value and utility for both civilian and military purposes. Like it or not, military principles established over thousands of years of human conflict are extending into space, as they did for airspace in the last century. Overall military significance is particularly important in structuring a stable status quo. For example, Antarctica is a military-free zone by international treaty, and a large part of the

stability of this treaty is due to the low military value of Antarctica, which like space is unpopulated, hostile to life, and of unique scientific interest. If Antarctica was all temperate meadows, or had the strategic uses that space does, it is not clear that the same treaty alone would produce a stable peace.

Conflict in or through space could form one aspect of a ground-based war, arise from disputes over resources in space, or uses of space that interfere with others. In the present preferred style of warfare, military dominance on land relies on air dominance, and contributions from passive space-based systems in the form of battlefield intelligence, navigation, and communication are beneficial, but not a necessity for victory. In the future, space dominance could conceivably become a deciding factor as improvements in ground force capabilities stem from the use of space-related systems, leading to a tiered dominance with space at the top – 'the ultimate high ground' (see figure 1).

Space is unpopulated, and large-scale destruction in space does not imply the loss of life that might occur on land, though the way wars are fought may never make the two interchangeable. To achieve a military objective in any given conflict, the addition of air support to ground forces provides a 'sharper' tool with which to progress; by bombing selected targets ground forces encounter lower opposition, in effect sparing lives that would otherwise be lost by ground assault alone. Similarly, the evolution of air systems to employ space-based GPS guidance has further sharpened this approach. Combined with air and space-based imaging to identify weak points, this mode of combat more effectively than ever before combats an opponent by preventing them from fighting, rather than by attrition. An opponent seeking to win by pure numbers in a future conflict may wish to begin by disabling current passive space-based systems. The risk of militarising space to protect this capability therefore opposes the risk of fighting bloodier wars.

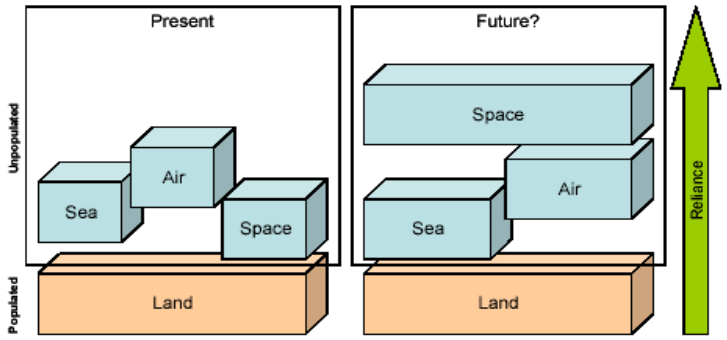

Figure 1. Present and possible future reliance on different military domains

Ultimately, the way space is used for defence, offence, and is itself defended is determined by the peculiarities of orbital mechanics and many other unique aspects of the Earth-Space boundary, which, unlike policy, force structure, and military technology, do not change. The timescale of space transit is minutes, in comparison with other more conventional arenas shown in table 2, in which transit timescales slow even the fastest conflict to a comparable crawl. An ascent to low earth orbit (LEO) takes 3-10 minutes, and the fastest LEO trajectory

Table 2. Fundamental characteristics of military domains

	Transit timescale	*Perceived defensibility*
Land	Days	High
Sea	Days	High
Air	Hours	High
Space	Minutes-hours	Low
Cyberspace	Seconds	High

could take as little as 45 minutes to reach the opposite side of the planet. This is the expected timescale for an exchange of space-transiting weapons, such as intercontinental ballistic missiles (ICBMs). Space-based weapons, for example lasers, may occupy a more distant medium earth orbit (MEO), increasing the intercept time to hours and allowing the possessor a near-instant strike from a weapon that has up to a third of the world's surface in its field of view at any one time. In contrast, the logistical build-up for major conventional military action takes months, and combat itself days to weeks – long enough for top-level international political and decision-making structures to operate, and the possibility of diplomacy to defer or diffuse the situation.

There are no bushes in space, no clouds, and no atmosphere to constrain viable ways to detect objects. The nearest naturally occurring obstacle is the moon, many hours away. Objects in space can in principle been seen by all, though the capabilities of individual nations vary, and limited stealth techniques can still be used in space. For this reason, an arms race of space-based weapons could occur in disguise or via 'dual use' technologies. It could occur on the ground in the form of space-transiting weapons that are stowed until used, similar to ICBMs of the cold war. Potentially, an outlawed and previously unknown space-transiting weapon need only be revealed by launching it, though one might reasonably expect to become aware of involved or widespread development efforts by means of intelligence gathering efforts or facility inspections.

The economic and security context

The issue of space weapons must be assessed in light of contemporary economic and security developments in space technology. Arguments over commercial and security, non-armament uses of space may have important effects on the issue of space weapons. Galileo, the European Union's embryonic satellite navigation system, to take one example, is in direct competition with the American GPS. GPS data is used worldwide for anything from cellular telephones to Automated Teller Machines (ATMs). With the United States suffering from trade (and now budget) deficits on the order of hundreds of billions annually, the tens of billions generated by GPS in US national income is a welcome contribution that the US Government would like to maintain in the future. Not only does the EU aim to capture a share of the GPS market, the Galileo system would also make the EU independent from US military data for modern warfare. The twin drivers of economics and security create a context of potential friction even between allies.

Table 3. Strategic analysis: deployment probabilities and outcomes

	Other states do not deploy space weapons	*Other states deploy state weapons*
Dominant state does not deploy space weapons	**Outcome 1**: Likely, Stable	**Outcome 2**: Less likely, Unstable
Dominant state deploys space weapons	**Outcome 3**: Less likely, Unstable	**Outcome 4**: Likely, Uncertain outcome: Arms race or Stable

Another important example of such friction comes in the area of remote sensing surveillance satellites, and the specific issue of shutter control. The continuing proliferation of high-resolution imaging capability has reduced the superpowers' exclusive hold on this strategic resource. In general, this development has been positive and has increased the stability of the global system. However, during conflict, these capabilities may become a source of tension. One early suggestion of this came during the 1991 Gulf War, when SPOT, the French satellite imagery company, began receiving increasingly stern warnings from the US military about its data products over the Middle East.

Multiple outcomes

It is important to understand the strategic dimensions of the decision on whether to deploy space weapons or not. The choice should not be reduced to a question of whether the required technological capacity, financial wealth, and political will is available, since outcomes emerge out of the strategic interaction between all the relevant actors. Whether a dominant state will enhance its comparative advantage or gain national security by acquiring a new weapons system therefore depends on how the other states are responding.

As illustrated in table 3, there are multiple possible outcomes in such a strategic situation. The worst-case scenario after the deployment of space weapons would be an arms race in space. Other possible outcomes include a competitive but stable system, or a unipolar stable system akin to the current US dominance of the high seas.

Regardless of its power, a dominant actor cannot determine the outcome unilaterally. On the contrary, without due regard to the likely responses of other states, the rational choice of a dominant actor to make a first move could result in a collective outcome that makes everybody worse off, including the dominant actor. Any potential dominant actor should therefore carefully consider the probable response of other states to the placement of its weapons in space, and the effect these responses will have on global security.

In addition to the risk of starting an arms race with space weapons, states should also consider the likelihood of spill-over effects into other strategic areas. The impact on nuclear strategy is particularly important to assess. Space weapons, along with information warfare, could eventually replace nuclear deterrence as a central strategic policy. This strategy could provide the post-nuclear deterrence paradigm for the United States and other nations. Such a shift could be positive or negative on overall security: On the one hand, it could reduce the overall reliance on nuclear weapons by the dominant state – a positive effect. On the other hand, due to an increased military gap between the dominant state and other nations, the move could also

lead to an increased likelihood of use of nuclear weapons by countries as a last resort and decrease the threshold for using a nuclear weapon in a conflict.

Many players

There is no shortage of potential actors that might respond to a first move by a state. While the US and Russia lead in capacity, the European Union, China and India all have the requisite technical capabilities for at least certain space weapons systems.

Given a first move by another state, the US is likely to act quickly to ensure dominance in this domain. The reaction of Russia, whose military strength still relies heavily on its nuclear weapons capability, to such a threat would also act to counter the initial deployment of space weapons with those of its own since any attempt to move from the nuclear deterrence paradigm would reduce its power.

The European Union may move to competitive behaviour as development of collective space defence infrastructure is initiated. Efforts to reduce reliance on the United States are considerable, as demonstrated by the effort in the Galileo navigation system. Explicitly addressing the connection between European Security and Space, European Research Commissioner Philippe Bus-quin has said that space-based observation, communication and navigation systems represent exceptional tools for the construction and reinforcement of the European Union, in particular with respect to European Security and Defence Policy.

China is also investing heavily in space and has publicly announced plans of lunar exploration. It is unlikely to want to be restricted and has proposed a treaty banning space weapons in the UN Conference on Disarmament.

Moreover, history suggests that if one strong player on the international arena gets too powerful, then the other smaller players may combine to produce a counterbalance. Such behaviour was in clear display by Germany, France, Russia and China, during the lead up to the war in Iraq. The dominant state should therefore not only consider the chance of single nations countering their actions, but the risk of many nations combining initiatives.

Short-term gains and costs

The judgment of whether to deploy space weapons should be based on a detailed analysis of their effects on stability and welfare in the short, medium and long term. Only by considering all of these time frames it is possible to make an informed cost-benefit analysis of space weapons and their impact on security. The following analysis is an attempt to outline some of the key issues that need to be taken into consideration. The main purpose is an impartial list of the potential pros and cons of such weapons. We will begin by assessing some of the most immediate aspects.

In a short-term perspective of less than a decade, several advantages of space weapons can be imagined:

1. *A superior weapon*: Space weapons are potentially a primary tool for information dominance, and thus may be a key to battlefield dominance in contemporary war. Space weapons enable an advantage in time and space over an adversary which enables a state to acquire and maintain the initiative. This would mean increased capability to

halt potential aggressors more effectively, with less collateral damage and probably earlier, compared to conventional arms. [Table 3, Outcome 3]

2. *First mover advantage*: If the readiness for deployment of space weapons is low among other countries, the first state to deploy will enjoy a short-term advantage.
3. *Protection of space assets*: Assets in space are a critical part of modern communications, navigation and information gathering, vital to the economy, vital to security and in demand in everyday life. Damage to these assets could seriously cripple a nation. Thus the ability to prevent hostile attack, whether from the ground or from space, is desirable.
4. *Image of technical supremacy*: By bolstering the image of technological supremacy, space weapons could act as a deterrent to hostile action.
5. *Other*: Military and commercial industry can be bolstered by gains from long-term (>5 years) research and development projects.

On the other hand, a range of short term disadvantages are possible:

1. *Ineffective and expensive*: Space weapons could become the analogue of the 19th century Dreadnaught ships; very expensive to produce and deploy, with little tactical advantage. Worse, they could provide a false sense of superiority that justifies unwise actions. Actual performance of weapons placed in space may be overstated and not cost-effective. Most critically, due to orbital dynamics, space weapons require an entire orbit to strike (typically 90 minutes) which may not have a fast enough response time to have any 'revolutionary' effect. In addition, their expense is highlighted by the fact that whilst the United States continues to explore space solutions for missile defence, the very high cost and low availability of such weapons as space-based lasers has led the nation to defer pursuing space-based lasers for the indefinite future.
2. *Vulnerability*: Space weapons aimed at Earth targets will need to be in low earth orbit (LEO) for a quicker response time and greater effectiveness. Hardware in LEO is relatively easy to monitor and is more susceptible to ground-based attack. In fact, most military officials acknowledge that, at least for the time being, leo-based weapons run the risk of being orbital sitting ducks.
3. *Provocation to diplomatic and arms-control efforts*: Unilateral deployment of space weapons could spark an international backlash which compromises the interests of many other diplomatic efforts of the nations initiating such a move. This could make it more difficult to achieve goals on other strategic interests. While the Outer Space Treaty only explicitly bans 'weapons of mass destruction' from outer space, global political opinion tends strongly to the view that any weapon in outer space violates the spirit of that Treaty.
4. *Public unrest*: The majority of the public worldwide appears to oppose space weapons. There is also a history of civil unrest concerning issues of military uses of space and the use of nuclear power in space. Similar movements might accompany the deployment of space weapons. These movements perceive an opportunity for humanity to make a psychological leap in the way matters are solved by halting the spread of destructive weapons to the space frontier.

Medium-term gains and costs

Second, also in a medium-term perspective, looking between ten and twenty years ahead in time, there are certain advantages of space weapons:

1. *Stable domination*: Cognisant of the arms-race arguments against unilateral moves in space (see below), some argue that restraint on the part of a nation such as the United States may not persuade other nations from moving ahead to their own advantage. Seizing the initiative, they argue, could enable the United States to stop an arms race before it starts by establishing a globally dominant, stabilising force in space.
2. *Global stabilising effect on earth*: The past half-decade has seen considerable instability and conflict throughout the world. The latest threat is global terrorism. Space offers not only the ability to detect threats globally on very short time scales, but some believe it may also offer the ability to counter those threats from space on similarly short time scales.
3. *Basis for new multilateral security-co-operation regime*: While military use of space is still largely dominated by the United States and to a lesser extent a handful of other major powers, its benefits for support of other military operations are manifest. Space-based weapons systems might enhance these benefits even more. While such situations could lay the seeds of an arms race (see below), they might also be the basis of new co-operative security regimes in outer space. If placed at the service of global coalitions and following agreed 'rules of the road', space arms might serve as a stabilising influence.

At the same time, there are potential disadvantages also in the medium term:

1. *Arms race in space*: The current global perception is that the United States has a technical lead in the military use of space. This strategic advantage may lead other nations to accelerate their space security efforts. This might trigger an arms race. For example, the deployment of an ASAT could instigate the development and deployment of a 'DSAT' to counter an ASAT. Such an arms race might also blur the distinction between conventional and mass destruction weapons in space. [Table 3, Outcome 4]
2. *Asymmetric defence* (Nitze criteria): If there is an economic or tactical asymmetry in the relationship between a weapons system and that system's countermeasure, it could easily lead to an arms race – or to a situation in which an expensive weapon is rendered useless by a cheap defence. This is an elaboration on the point above. For example, a ton of gravel launched in an appropriate orbit could act as deliberate 'space debris', destroying billions of dollars in both national security and commercial space assets.

Long-term gains and costs

Third, some advantages of space weapons might only emerge in a long term perspective of at least twenty years:

1. *Basis of outer space 'Naval' Paradigm*: The existence of weaponry in global 'common' areas can be a long-term positive and welcome influence. The standard analogy of outer space is to the world's oceans including the presence of global, weaponised navies dominated by a single power (in the 19th Century Great Britain and in the 20th the United States). This regime may be applicable to space and could result in security in space akin to the world's oceans, with all nations operating free from interference based on an internationally recognised 'Law of the Sea'.
2. *Economic impetus to large-scale space exploitation*: Today much of the developmental spending on space, perhaps the majority of it, is spent on security-related expenditures. Indeed, the US Apollo programme and associated 'space race' was arguably based mostly on security-related competition. Some argue that large-scale military space spending, particularly on weapons and even with (and maybe in light of) an arms race, will ignite rapid development of space technologies at a pace not seen since Apollo. As with the opening of the American West, military pathfinders and operations might presage finance and enable large-scale civil and economic development of space assets.

Notwithstanding, the long term disadvantages must also be taken into account:

1. *Threat to long-term peace*: Many believe that the choice for or against the deployment of space weapons is fundamentally linked to whether humans will have weapons in their long-term future. Humanity has a shared interest in a peaceful future in space. Deploying space weapons might threaten that future rather than enable it. New strategically important weapons quickly become embedded into national security strategies. Such weapons become so deeply embedded in the dominant political paradigm that they are largely impossible to remove from the strategic arena – and certainly impossible to remove from the global arsenal. Nuclear weapons represent a good example, and in this regard there is no reason to think that space weapons shall be any different. Once space weapons are deployed, it may be impossible to eliminate them even if they prove unsuitable and dangerous to humanity. Humanity appears to be on the verge of expansion into space and this expansion will set precedents for our future civilisation. Whether or not future human settlements on other planets have to deal with weapons will depend on today's decisions
2. *Proliferation of weapons*: Arguably the biggest threat to a dominant nation's security is based on the proliferation of weapons which it has played a large part in developing: Certainly the biggest threat to the US has been the potential use of nuclear weapons on the US home soil. By analogy, the first state to deploy space weapons may find itself faced all too soon with these same weapons as they proliferate. This is particularly true of space weapons which are considerably easier to produce than nuclear weapons. As the current global superpower, the US has a choice to try to use space weapons to its advantage, but add these to its proliferation concerns or attempt to manage them by spearheading a reliable legal and verification regime for preventing their deployment by any nation.
3. *The unique environment of space*: Some argue that is important to keep in mind that space has a unique identity beyond a traditional arena of classical balance of power politics.

> Space is different. Space is humanity's shared resource and common heritage. The question of whether weapons should be deployed in space is therefore an issue beyond the interests of any one country or generation.

The way ahead

There are positive and negative attributes of space weapons: On the one hand it is necessary to recognise that space is integral to virtually all security operations through its communications, surveillance and other support functions and that there are potential advantages, particularly in the short term, of deploying weapons in space. Conversely, not all weapons systems are a good idea, even for the best intentioned, since they are not vastly more effective than conventional weapons and moreover, they can have political and unintended security ramifications in the long term which far outweigh their benefits. Despite these seemingly conflicting issues, there may be areas for fruitful compromise on space weapons.

Faced with a decision on deployment that might come sooner rather than later, nations have to think about how the international community should respond to this extraordinary issue on the security agenda of the 21st century. Three main options are available:

1. *Fairly comprehensive prohibition*: A ban of space weapons would halt the potential for an arms race. The disadvantage is that it may constrain states if a situation arises and a state decides to abrogate a ban. A legal regime would ideally be negotiated in an international forum such as the United Nations Conference on Disarmament. However, if stalemate persists, a less encompassing agreement could be agreed at an ad-hoc gathering. One possible solution is for a country, which supports the prohibition of space weapons, to host a treaty conference for interested nations. This model was followed successfully in the so-called 'Ottawa Process', which led to the successful Ottawa Land Mines Treaty. Means of verification for monitoring compliance would be vital to the successful implementation of a prohibition. In this regard, much could be learned from the Chemical Weapons Convention. A great challenge, however, would be to establish effective sanctions against violations of the treaty. Without sanctions, it is difficult to achieve credible commitments to the legal regime, which jeopardises international co-operation.
2. *A mid-ranging legal regime*: An international agreement on space weapons analogous to the International Law of Sea could be created. This could lead to a stable situation that avoids the earlier pitfalls. It could require an international regime backed up by global, real-time monitoring. The downside is that it is not concrete and might be overtaken by events.
3. *No regime*: In this current state of uncertainty, the global security in the mid-term future is unclear. The major concern is the potential for an arms race in space. Without establishing the rules of the road, even the lead nations are subject to consequences, especially in a domain as potentially asymmetric as space.

In essence, the challenge is to manage space in a way that avoids the 'tragedy of the commons'. In order to avoid this self-destructive logic, we have to escape ending up in a 'prisoner's dilemma', where co-operation is impossible due to lack of communication and trust

among the actors. Because of the strategic nature of the situation, all states, and in particular those with ambitions and capabilities regarding space, should work together. A frank and open discussion should begin in the nations closest to the possibility of much larger military uses of outer space. One possibly fruitful area for opening international negotiations leading towards a legal regime could be in defining hostile and prohibited acts in space. These efforts can be directed towards building agreement amongst the space powers of the 'Rules of the Road' in order to regulate the use of space.

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