SPACE SECURITY: SOME ISSUES OF MILITARISATION AND WEAPONISATION

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INTRODUCTION

For 50 years, outer space has been used for scientific endeavours, civil and commercial applications as well as for military support functions but with careful restraint of not putting weapons in space so as to not disturb the international consensus on preserving outer space as the common heritage of mankind. Recent technological advances like the placement of a laser weapon onboard a Boeing 747 by the US and increasing integration of outer space capabilities in security and war-fighting doctrines have changed the nature of warfare as well as security perceptions, signalling the dawn of a new era of leveraging space superiority. The far-reaching military, economic and political ramifications of this impending transformation in the use of space are yet to be fully appreciated and factored into the future political strategies and security and defence doctrines of individual nations. The withdrawal of the US from the Anti-Ballistic Missile (ABM) Treaty in June 2002, the US Space Vision 2020, the US attempts for a space-based interceptor test-bed as part of its national missile defence, the US space policy of October 2006 and the Chinese anti-satellite (ASAT) test in January 2007, have generated fresh debate on the need for preserving outer space as the common heritage of mankind and not allowing any deployment of weapon systems in space. It is in the above context that a brief attempt is made to examine the issue of weaponisation vis-à-vis

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militarisation, the difficulties in defining a space weapon, and the concept of weaponisation of space.

SPACE AS A HIGH GROUND

Acquisition of the high ground for military advantage has been a perennial feature of military campaigns. For thousands of years, military tacticians have exploited the concept of 'capturing' or 'keeping' the high ground in military campaigns. Fortifications were built on high points, with walls that enabled archers to rain down deadly volleys. Hot air balloons were lofted by Napoleon and during the American Civil War to observe troop movements.[1] The initial utility of aircraft was perceived to be for high-level reconnaissance, followed by measures to deny the same. Thus, battles for control of the environment were the next logical progression. Aircraft revolutionalised warfare during the 20th century, leading to "command of the air" as a key strategic concept. By extension, following the shooting down of high altitude aircraft like the U-2, the quest for safer observation went further up into space. The same principal of denial led to initial struggles for control of the environment of space and both the US and USSR conducted exercises for controlling the realm of space with nuclear and conventional devices such as ASATs. Thus, the militarisation of space took place during the 1960s with almost all the space-based military missions having been exercised during the first decade of the space age, i.e. space support (the launching of satellites and day-to-day managing of on-orbit satellites), space force enhancement (a broader mission category that includes all space operations aimed at enhancing the terrestrial military operations), space control (ensuring friendly access and denying enemy access to the medium of space and space force application (delivery of ordinance from space, the USSR's co-orbital bombardment system). It is now evolving into weaponisation of space with actual placement of weapons planned by the US for decisive military advantage. Thus, weaponisation of space seems to be the next logical step in this endless struggle for mastering the ultimate high ground. Though the idea of placing

1. The hot air balloon is the oldest successful human carrying flying technology, dating back to its invention by Montgolfier Brothers in Annonay, France, in 1783, in Paris by Jean-Francois Pilatre de Rozier and Francis Laurent d'Arlandes.

weapons in space or using weapons through space can be found first in the 20th century fiction stories, it was not until the Cold War that this concept became a reality.

MILITARISATION VS WEAPONISATION OF SPACE

Militarisation of space in simple terms would mean use of space in support of ground/sea and air operations of the armed forces and refers to developing assets to be based in space with supporting ground infrastructure for military uses such as early warning, communications, command and control, position navigation and timing (PNT) and monitoring [remote sensing, and national technical means (NTM) that can be used for verification purposes and for surveillance and intelligence purposes]. It helps improve military command, control and communications, strategic and battlefield surveillance, and weapons targeting. (The legitimacy for use of satellites for military purposes has come in the aftermath of the Cuban missile crisis in 1962 where both the then superpowers agreed on the use of observation satellites for promoting international security and reducing the risk of accidental war and preemptive strikes).[2] Further, unlike the 1959 Antarctic Treaty which requires activities on that continent to be "exclusively for peaceful purposes," the Outer Space Treaty (OST) 1967, under a combination of Article I and Article IV permits that "space is free for exploration and use by all States, except for placement of weapons in space." Hence 'peaceful purposes' as the term has evolved over the years has come to be understood as non-aggressive means or permitting space to be used for military support functions.

The states party to the OST accept that 'peaceful purposes' include military use, even that which is not particularly peaceful [as in the case of using JDAMs (joint direct attack munitions) for targeting, guided by a feed from global positioning system (GPS) satellites], and space is considered a sanctuary only in so far that no weapons are deployed there. The US now feels that the time has come to act under the provisions of Article 51 of the UN Charter, which implies,

2. Pat Norris, *Spies in the Sky, Surveillance Satellites in War and Peace* (Chichester, UK: Praxis Publishing Ltd, 2008), ch.3, p.49.

Although currently there may be no weapon as such stationed in space, there are numerous components of weapon systems each of which forms a vital element in modern war-fighting.

"*A state could also use military force to defend itself against hostile actions*." This, when coupled with Article III of the OST which states, "*International law and the UN Charter extends to the exploration and use of Outer Space*" ensures that a state can undertake space control and space force application missions to protect its assets in space.

The use of satellites for force enhancement of military operations has been unquestionably demonstrated in the last decade and a half in various operations like Operation Desert Storm (Kuwait, Iraq 1991), Operation Allied Force (Kosovo, 1999), Operation Enduring Freedom (Afghanistan, 2002) and Operation Iraqi Freedom in 2003. With increasing dependence on satellites for conduct of military terrestrial operations, the US concern for their safety has been echoed in its Vision 2020[3] and the US space policy[4]. Not surprisingly, therefore, Washington is keen to progress from space force enhancement to space control and ultimately to space force application which envisions weaponisation of space.

Although currently there may be no weapon as such stationed in space, there are numerous components of weapon systems each of which forms a vital element in modern war-fighting. For example, in a typical battle situation, the US military now relies on space-based weather prediction systems (the Defence Meteorological Support Programme), military communications satellites (MILSTAR - to communicate from command centres and between troops), espionage and surveillance satellites (to intercept communications by an adversary and collect images of troop movements and weapon placements), early warning satellites (to provide information on missile launches) and military GPS satellites to allow troops and vehicles to navigate quickly and

3. US Space Command Vision 2020,p.10 < http://www.fas.org/spp/military/docops/usspac/visbook.pdf > Accessed on September 22, 2007.
4. US Space Policy 2006 p1< http://www.au.af.mil/au/awc/awcgate/whitehouse/ostp_space_policy06.pdf> Accessed on September 22, 2007.

accurately identify targets and guide 'smart' bombs and unmanned aerial vehicles (UAVs).

During Operation Iraqi Freedom, the US deployed 6,600 GPS guided munitions and over 100,000 precision lightweight GPS receivers in Iraq and used 10 times the satellite capacity employed in the Gulf War of 1991. Nine days before the start of the war, a new defence satellite communications system was installed to interconnect US military forces on land, sea and air with the Pentagon, the White House, the State Department and the US Space Command. Over 100 military satellites supported the US and UK war effort; 27 GPS satellites were available to help determine the exact location of special operations teams and of targets; and around 24 communications satellites for command and control and to give warning of a missile attack. There were also weather forecasting, TV and other systems in operation.[5] A February 2000 flight of the space shuttle *Endeavor* was used to produce a 3-D radar map of targets in Iraq. The human resources available were also extensive—Director of Space Operations Maj. Gen. Judd Blaisdel estimated that at that time 33,600 people at 36 sites around the world were involved in space-war activities.[6]

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From the above, it can be seen that the military use of space is rapidly increasing. Of the 870-odd active satellites in space today, the US has more than half of them. Russia and China have 89 and 35 satellites respectively.[7] India has 19 imaging, communication and other satellites suitable for military use (but underutilised by the armed forces) and Israel has military satellites and has plans for new communications, imaging and radar satellites and is considering a system that would allow launch on demand

5. David Webb, "On the Definition of a Space Weapon (When is a Space Weapon Not a Space Weapon?)," Praxis Centre, Leeds Metropolitan University < http://praxis.leedsmet.ac.uk/praxis/documents/space_weapons.pdf>
6. Ibid.
7. Union of Concerned Scientists Satellite Database 09/0108 version, http://www.ucsusa.org/satellite_database. Accessed on January 15, 2008.

of small satellites from fighter aircraft. Other countries such as Brazil, Japan, and Ukraine have military space capability or potential, Australia has a dual use military-commercial communications satellite. Iran launched its first satellite with Russian help in October 2005 and recently inaugurated its space centre by launching a sounding rocket on February 4, 2008, and plans the launch of its first indigenously made satellite (Omid) from within Iran by June 2008. In Europe, the UK, France and Italy make extensive use of military satellites for imaging and communications.

Many of these programmes are dual use ones - i.e. a mixture of commercial and military projects. This has obvious cost advantages to both parties and can also help to mask or deflect interest away from some covert military activities and this increasing grey area can make it more difficult to identify the extent and purpose of military space activity. However, the military reliance on space for command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) is well established. While it provides enormous benefits, it also has the serious disadvantage that satellite systems are extremely vulnerable to attack from ASAT weapons. Thus, it can be seen that space has been militarised since the last five decades except for placing of weapons in space.

ROAD TO WEAPONISATION

In the past half-century, no weapons have been used against space objects in a deep crisis (Cuba 1962) or even in warfare, even though the means and the reasons for doing so were available. One reason for the restraint on the part of the then superpowers could be attributed to their reliance on satellites for keeping a check on each other's ballistic missile arsenal. However, now with increasing proliferation of satellites into the military doctrines of the US, Russia and China, to cite a few examples, a prospective opponent will understandably view any space capability contributing to the opposing military as part of the forces arrayed against it in a theatre. When the space capabilities represent an easier target than the other critical nodes, one can expect interference with them and, hence, greater protection for them. The natural consequence of space integration into military activity is a more hostile environment for space.

However, the shift in US military thinking is evident from the planning and policy documents released in recent years that envision the development and deployment of anti-satellite weapons and space-based weapons. These new systems are meant to fulfill four general missions:

— Defending US satellites and ensuring US freedom of action to operate in space.
— Denying adversaries the ability to use space assets.
— Intercepting ballistic missiles using space-based interceptors.
— Attacking targets on the ground or in the air using space-based weapons.

The same have been laid down in the US space policy document released on October 6, 2006, which states, "The United States considers space capabilities — including the ground and space segments and supporting links — vital to its national interests. Consistent with this policy, the United States will: preserve its *rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to US national interests.*"[8]

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8. US Space Policy 2006 < http://www.au.af.mil/au/awc/awcgate/whitehouse/ostp_space_policy06.pdf> Accessed on September 22, 2007.

WEAPONISATION OF SPACE

For many in India, militarisation and weaponisation are synonymous and, hence, one can attribute the present state of Indian militarisation of space to this fact. Reacting to the need of the Indian Air Force (IAF) for an Aerospace Command likely to be set up at Akkulam, in Tiruvanathapuram, the then External Affairs Minister, Pranab Mukherjee, stated at the inauguration of the international seminar hosted by the IAF as part of its Platinum Jubilee celebrations on February 5, 2007, "There is merit in asking for the creation of separate institutions to oversee the assets that take warfare into space... it does not mean that India will go back on international commitments and weaponise space-based assets. Recent developments have shown that we are treading a thin line between current defence related uses of space and its actual weaponisation."[9] While the reaction of the former defence minister underscores the fine line separating the issue of militarisation and weaponisation, the same cannot be said of the Chairman of the Indian Space Research Organisation (ISRO) Madhavan Nair. Reacting to the Chinese ASAT test of January 11, 2007, and on the possibility of India doing an encore, he said the country was "against militarising space." These statements only underline the fact that there is still a lot of ground to be covered in India on dispelling the myth about militarisation and weaponisation being synonymous. However, for the world at large, the common understanding has been that weaponisation is a sub-set of militarisation and there is but a subtle difference between the two. If one envisions a continuum running from space systems being used for civil purposes to satellites providing services to support terrestrial military operations to satellites being integral parts of terrestrial weapon systems, to weapons themselves being deployed in space, weaponisation occurs when the upper range of the spectrum is reached. At its most extreme, space weaponisation would include the deployment in quantity of a full range of space weapons, including satellite-based systems for ballistic missile defence (BMD), space-based anti-satellite weapons (ASATs), and a variety of space-to-earth weapons

9. Sujan Datta, "Air Force Guns for Space Power-No Laughing Matter," *The Telegraph* (Internet Version-WWW), Monday, February 05, 2007.

(STEW), and these would play a central role in any type of military operation. These would be required to carry out the remaining two missions from space, namely, space control and space force application.

Space Control/Denial

Space control (or space dominance) mission involves protecting on-orbit assets of own and friendly countries, attacking enemy assets, and denying enemy access to space. The primary means of achieving these tasks are either launch suppression, or destroying or degrading the performance of enemy satellites. These actions can either be defensive (protecting friendly assets) or offensive (denying the enemy the benefits of space-based assets). It is more or less analogous to sea and air control/denial, both of which likewise involve ensuring friendly access and denying the same to an adversary. Viewed purely from a technical perspective, there is no difference in principle between defensive and offensive space control operations conducted in any other medium of warfare.[10] It is simply a matter of technical feasibility, desirability in principle, and cost-effectiveness for the pay-off being sought. The reason for the hiatus in moving forward on the desirability of space control in the aftermath of the initial surge in the early Sixties by the US appears to be the lack of political and public consensus at home, as to whether the actual combat, as opposed to passive surveillance and other terrestrial enabling functions, should be allowed to migrate to space and, thus, violate the status of space as a weapons free sanctuary, quite apart from the more practical question of whether preparing for space combat was even needed then at that still embryonic stage of space weapons development.[11] This could have been partly due to the fear

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10. Benjamin S.Lambeth, *Mastering the Ulimate High Ground: Next Steps in the Military Uses of Space* (Santa Monica: RAND, 2003), p. 105.
11. Lambeth, Ibid.

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that the other superpower (USSR) may also embark on such a mission and deny any advantage to the US. However, today, the US, being an unrivalled military space power, views space control as an essential precondition to maintain information dominance. It aims to deny any advantage to a likely adversary in the near future by dominating the medium of space.

Space Force Application

Space force application envisages attacking terrestrial targets from space-based weapons which would greatly reduce the reaction time, cost of human attrition and the other associated problems of attacking strategic targets deep inside enemy territory. The idea of having satellites/space planes orbiting overhead, awaiting a signal to rain down weapons on any nation at the pleasure of the US has alarmed many nations. The "Rods from God" being developed by the US[12] is an example of force application from space. Sceptics of weaponisation, more notably China, have argued that all these missions are possible from ground/sea and air-based operations and view the US drive as a move to assert its hegemony on the emerging players in the medium of space.

WHAT IS A SPACE WEAPON?

There is no clear definition of a space weapon in the current legal regimes nor has there been a consensus on what should constitute a space weapon. The debate over the definition encompasses the problems of whether or not the international community should define the weapon based on its position i.e. on land, sea, air or in space, or based on its intended target. Hence, there is a possibility for space to space, space to earth, earth to space, and earth to earth

12. Michael Goldfarb, "The Rods from God: Are Kinetic-Energy Weapons the Future of Space Warfare?" *The Weekly Standard* ttp://www.weeklystandard.com/Content/Public/Articles/000/000/005/700oklkt.asp http://www.weeklystandard.com/Content/Public/Articles/000/000/005/700oklkt.asp?pg=> Accessed on October 10, 2007.

(through space) weapon. Different technologies could be employed to destroy, disrupt or damage the intended targets. These could be kinetic kill vehicles that destroy by impact (the Chinese ASAT) or "Rods from God"— a proposal to fire tungsten rods from space to ground-based targets, missiles with conventional warheads, killer satellites, directed energy weapons, etc.

The advantages and disadvantages of various weapon systems which could be classified as space weapons are tabulated below:

	Principle	**Advantage**	**Disadvantage/Problems**	**Warning Time**
DEW	Laser	Direct effects	Energy; Line of sight, atmosphere; Counter-measures	Seconds to minutes
	Microwaves	Invisible	Low resolution; Counter-measures	Seconds to minutes
	Particle beams; X-Rays	Invisible, fast	Propagation; Energy production	Seconds to minutes
KEW	Homing missiles/ kill vehicles	High closing speed	Acceleration of the collision -mass; homing	Minutes/ hours/days
	Collision devices	Hard to identify	Space debris multiplication,	Minutes/ hours
	EM guns	High closing speed	Energy; Technical problems	Minutes
Nuclear	Nuclear weapons	Lethality, destruction radii	Destroys own satellites	Seconds

Further, the micro/nano/pico satellites being designed in a defensive role as bodyguard satellites or for close proximity operations with the host satellites also have a dual role, in that they can be used as space weapons: to destroy adversaries' satellites through kinetic kill or disrupt the use of satellite by spraying paint on the solar panels, view finders, etc. Before attempting to define space weapons, it would be pertinent to peep into history and learn about the key area of anti-satellite weapons, as the symbol and substance of militarisation and weaponisation which has existed almost since the advent of the space age.

The first operational non-nuclear ASAT system was developed in the late 1960s and early 1970s.

RUSSIAN ASATS

The USSR developed a wide range of ASAT capabilities, including direct-ascent launchers armed with both nuclear and conventional warheads, co-orbital anti-satellite systems, and laser systems. The current status of these systems is uncertain. Many of them involved facilities in the Central Asian states (especially Kazakhstan and Tajikistan). The crudest system involved the long-range Galosh anti-missile missile, first deployed around Moscow in the late 1960s and upgraded through the 1970s and 1980s as the exo-atmospheric intercept component of the ABM system built to protect the national command authority. It carried a 3.5 megaton nuclear warhead, which would have indiscriminately destroyed all low earth orbit (LEO) satellites passing over the Moscow region .The deployment of Gorgon (SH-11 or ABM-4) exo-atmospheric missiles began in 1983-84 to replace the Galosh system. Thirty-six of them remain operational around Moscow, carrying one megaton warheads. With a range of 350 km, they are capable of intercepting very low altitude satellites passing over the Moscow region. Other Gorgon interceptor missiles may be operational at the Sary Shagan ABM test range in Kazakhstan[13].

The first operational non-nuclear ASAT system was developed in the late 1960s and early 1970s. It involved a co-orbital ASAT system, using an SL-11 launch vehicle carrying a radar sensor and a pellet-type warhead; the missile was launched when the target satellite passed over the launch site and within one or two orbits (90-200 minutes) was manoeuvred to within a kilometre of the target satellite and the warhead detonated. It was able to reach satellites at altitudes between 230 km to 1,000 km. It was tested about 20 times from 1963 to 1972, including seven interceptions with target satellites and five detonations.[14]

Testing of a new co-orbital system began in 1976. It used optical and infrared sensor systems instead of onboard radar, and had a target envelope extending

13. Laura Greg, *A History of Anti-Satellite Weapons Programs* (Union of Concerned Scientists) < http://www.ucsusa.org/global_security/space_weapons/a-history-of-asat-programs.html> Accessed on September 21, 2007.
14. Detailed information about the testing programme for the Soviet/Russian Co-Orbital ASAT programme can be found in the article by Anatoly Zach "Anti-Satellite System" on < http://www.russianspaceweb.com/ > Accessed on September 21,2007.

from 160 km to 1,600 km, enabling the interceptor to usually manoeuvre to its target in a single orbit. It was tested about once a year from 1978 to 1982.[15] The system was declared operational in 1979. The launch site was at the Tyuratam (Baikonur) space complex in Kazakhstan, which had two launch pads and storage space for many interceptors; the system was reportedly modernised in 1991, but there have been no flight tests since 1982, and the system is probably no longer functional.

High-power laser systems became operational at Sary Shagan, near Lake Balkhash, in the mid-1970s. On five occasions in October-November 1975, a defence support (DSP) missile launch detection/early warning satellite of the US (controlled from Nurrungar in south Australia) was blinded by intense illumination from within the Soviet Union. In 1976, a new KH-11 imaging satellite was 'painted' and 'permanently damaged' by a Soviet laser. The Sary Shagan facility illuminated the Challenger shuttle on October 10, 1984, causing malfunction of onboard equipment and discomfort and temporary blindness of the crew. Two high-power lasers systems (using a ruby laser and a pulsed carbon-dioxide laser) were operational at Sary Shagan in 1987. By the time the Soviet Union collapsed, eight laser facilities had been constructed or were under construction for ASAT purposes, including a free-electron laser (FEL) prototype ASAT facility at Storozhevaya in the North Caucasus and the Sary Shagan complex. Three of them were situated in Tajikistan — at Nurek, Dushanbe and an unidentified site between these two places. The Soviet Union also experimented with a space-based laser for ASAT use. In 1987, it launched a Skif-DM satellite intended for perfecting the design and onboard systems of a future military space complex with laser weapons, but the satellite failed to reach orbit, and no further launches were attempted. [16]

US ASATS

In the case of the United States, the first operational anti-satellite system also involved a direct-ascent vehicle with a nuclear warhead. It consisted of a single

15. Greg, n.13.
16. Greg, Ibid.

The lead programme involved the ASM-135 ASAT missile, a 3-stage air-launched miniature vehicle (ALMV). It was successfully tested on September 13, 1985.

Nike Zeus ABM missile, with a 400 kiloton warhead, code-named Mudflap, based on Kwajalein Atoll in the Western Pacific, which was operational from 1962 to 1966. It was replaced by a small number of Thor missiles based on Johnston Island, two of which were maintained on 24-hour alert, from 1966 to 1972. In July 1982, President Ronald Reagan announced a "National Space Policy'', a "key element'' of which was to develop "an anti-satellite (ASAT) capability, with operational deployment as soon as possible.'' The lead programme involved the ASM-135 ASAT missile, a 3-stage air-launched miniature vehicle (ALMV). It was successfully tested on September 13, 1985 against an old US scientific satellite (P78-1 Sol Wind), using a modified F-15 Eagle as the launch platform. In December 1985, however, Congress imposed a ban on further testing of the ALMV in space.[17]

During the Reagan Administration, the US also used lasers based in Maui and Oahu in Hawaii and San Juan Capistrano in California to blind Soviet reconnaissance satellites orbiting over US ABM test facilities. The facility in California, later moved to Cloud Croft in New Mexico, reportedly "possessed a full anti-satellite capability.''

The US Army's megawatt-class MIRACL (mid-infrared advanced chemical laser) facility at the White Sands missile range in New Mexico was tested in an ASAT capacity in October 1997. A low powered laser (30 watts) was fired at an air force MTSI-3 satellite orbiting 300 miles above the earth, and the satellite was temporarily blinded.[18]

During the 1990s, the US Army also developed a ground-based kinetic-energy kill vehicle. Three vehicles were produced, and officials said in December 2002 that, with two test flights, the system could be deployed operationally within three years. However, no tests were funded, and two of the three kill

17. Dwayne Day, "Blunt Arrows: Limited Utility of ASATs," *Space Review*, June 6, 2006, <http://www.thespacereview.com/article/388/1> Accessed on October 1, 2007.
18. Lambeth, n.10, ch.5, p.102.

vehicles that had been built have been dismantled for use in other projects.[19]

OST AND ASATS

The Outer Space Treaty (OST) with respect to treating outer space as a common heritage of mankind is akin to a barbed wire fence. It attempts to protect the property (space) without obstructing the view (exploitation by the superpowers for militarising and weaponising space). It is pertinent to note that even after the ratification of the OST in 1967, and the ABM Treaty in 1972, both the superpowers continued to undertake the testing and development of ASAT weapons in their many variants. While OST and ABM Treaty prohibited the stationing of weapons of mass destruction (WMD) in space, along with the development, testing and deployment of space-based ABM systems and components in space, there are no limits on non-nuclear tests in space or tests against space targets from ground, sea or air. The OST was also silent on the definition of space weapons. Hence, in strict definitional terms, none of the existing ASATs could be called space weapons. The ASATs were permitted, if one were to analyse Paragraph 1 of Article IV of the OST which implies that objects carrying nuclear weapons or any other kinds of WMD can freely *transit* outer space, as long as they do not orbit the earth. Likewise, WMD that escape the earth orbit are permitted except that *they may not be installed on celestial bodies or otherwise stationed* in outer space. Other non-nuclear/non-WMD weapons may be placed in orbit (but not on the moon or other celestial bodies) and used to attack targets in space or on the earth. The foregoing implies that whilst the rules developed by the OST are fairly comprehensive, it does not apply to the present generation of space weapons being considered. Theoretically, then, the new generation of space weapons could be developed and deployed without violating the letter of the OST.

DEFINITION OF SPACE WEAPONS

In 1991, a study carried out by the United Nations Institute for Disarmament Research (UNIDIR) proposed the following definition:[20]

19. Greg, n. 13.
20. Webb, n. 5.

A RAND study in 2002 has defined space weapons as "things intended to cause harm that are based in space or that have an essential element based in space," with a degree of sought after harm ranging from temporary disruption to permanent neutralisation or disruption.

"A space weapon is a device stationed in outer space (including the moon and other celestial bodies) or in earth environment to destroy, damage or otherwise interfere with the normal functioning of an object or being in outer space, or a device stationed in outer space designed to destroy, damage or otherwise interfere with the normal functioning of an object in the earth environment. *Any other device with inherent capability to be used as defined above will be considered as a space weapon.*"

The final sentence of this definition implies that even earth-based systems or even dual capability satellites be treated as space weapons. The definition was not accepted by the international community precisely for these reasons. A RAND study in 2002 has defined space weapons as "things intended to cause harm that are based in space or that have an essential element based in space," with a degree of sought after harm ranging from temporary disruption to permanent neutralisation or disruption.[21] However, a tentative thinking on the definition of a space weapon was attempted by the Chinese and Russians in a paper presented to the Conference on Disarmament (CD) on May 22, 2006 (CD/1779) which defines a space weapon as "any device, based on any physical principle, specially produced or converted to eliminate, damage or disrupt normal function of objects in outer space, on the earth surface or in its air, as well as to eliminate population, components of biosphere critical to human existence or inflict damage to them except those devices needed by cosmonauts for self-defence."[22]

While the RAND study restricts itself to weapons based in space, the Chinese

21. Bob Preston, Dana J.Johnson, Sean J.A. Edwards, Michael Miller, and Calvin Shipbaugh, *Space Weapons, Earth Wars* (Santa Monica,California.:RAND, MR-1209-AF, 2002) p.23.
22. < http://www.reachingcriticalwill.org/political/cd/papers06/22mayChinaRussia2.pdf>Accessed on October 10, 2007

and Russian definitions include weapons like earth-based ASATs or lasers just as the definition of the UNIDIR mentioned earlier suggested. The stalemate continues on defining a space weapon. Experts like Michael Krepon from the Henry L. Stimson Centre have suggested that in order to make further progress, "a code of conduct for responsible space-faring nations" may be adopted rather than getting embroiled in definitions or creating new legal regimes for preventing an arms race in outer space. However like in many international issues affecting the world like the nuclear Non-Proliferation Treaty (NPT), Fissile Material Cut-off Treaty (FMCT) or the cut on greenhouse gas emissions, the major obstacle in the path is the US which does not support any definition or new legal framework towards preventing weaponisation of space.

VULNERABILITY OF SPACE ASSETS

The most compelling reason for moving forward towards acquiring the essential elements of a space control capability by the US is that it is now unprecedentedly invested in on-orbit capabilities, both military and commercial. In other words, while American military power derives its disproportionate efficacy from its ability to leverage critical space assets, the same assets present 'the US military's soft ribs' to an adversary. At present, of the 870-odd active satellites in orbit[23], more than 400 are of the US, and with billions of dollars invested in space by more than 50 countries, space has undisputedly become an economic centre of gravity. Space capabilities would in the years to come represent an easier target than other conventional critical nodes; hence, we should expect interference with them. While space power is crucial to the unprecedented military capability the US now enjoys, the space-based infrastructure is its nervous system. The muscle is in its air, land and sea forces

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23. n.14.

and will remain there for many years to come. Supporting these forces is the first mission of the US military space programme.

It is with this logic that concern for US space-based assets was expressed in the Space Commission's finding that the US is an attractive candidate for a virtual "Space Pearl Harbour"[24]. At its extreme, the greatest threat in the near term would be a large number of US and allied satellites being debilitated/destroyed by a major electro-magnetic pulse (EMP) or nuclear detonation in space by hostile forces. However, the theory of such an attack by nation states can be debunked if one goes by the experiences of the US on the effects of such experiments on satellites. In July 1962, as part of Project Starfish Prime,the US detonated a 1.4 megaton thermonuclear weapon over Johnston Island in the Pacific Ocean at an altitude of 250 miles to test the effects of EMP on radio communications and radar.[25] That event set off burglar alarms and burned out street lights in Oahu and further generated high energy electrons that were trapped by the earth's magnetic field, producing an artificial radiation belt that damaged weather and observation satellites and destroyed seven satellites in seven months. However, the same cannot be said of the non-state actors like Osama bin Laden who might be lured towards this exotic toy called the "EMP gun from space" and not think twice about using it on his avowed enemy, with scant regard for the international ramifications that might occur, much in the similar fashion in which he orchestrated the 9/11 attacks.

At the lower end of the spectrum, a notional Space Pearl Harbour might come in the form of interference with the US satellites by, for example, a ground-based laser attack that would either blind or dazzle US assets in space and affect the conduct of an ongoing US or allied military operation. Blinding or dazzling of satellites has also been experienced by the US in 1975 when three of their DSP satellites were intentionally illuminated by ground-based laser by the Soviets causing severe degradation in their performance. More recently, the Chinese illuminated an American satellite in August 2006[26] when it passed over the Chinese mainland, causing temporary blinding of the satellite.

24 Charles V. Pena and Edward l.Hudgins, *Should the United States "Weaponise" Space? Military and Commercial Implications*, Policy Analysis No.427, March 18, 2002.

25. Lambeth, n. 10, ch.5, p.102.

26. Vago Muradian, "China Attempted to Blind US Satellite With Laser," *Defence News*, September 28,2006< http://www.defencenews.com/story.php?F=2121111> accessed on September 10, 2007.

The US is more worried over such prospects from non-state actors or from states it views to be developing clandestine nuclear weapons like Iran and North Korea as a ground-based laser ASAT provides a cheap and flexible option to either degrade, damage or destroy an adversary's satellites temporarily or permanently and, in most cases, an adversary might not be able to detect and pinpoint the cause of the damage. It is, in fact, not only the case of the US being worried over the vulnerability of its satellites—the same is applicable to all space-faring nations, including China, which conducted an ASAT test in January 2007. The vulnerability to ground stations and uplinks/downlinks can be guarded with more conventional methods akin to guarding of other important installations but the nature of threat to satellites is unique as it can come from any of the existing four mediums i.e. land, sea, air or space or even from other outer space particles/objects like man-made debris or asteroids/meteors. A recent example of the threat to US satellites emerged when the US had to manoeuvre its terra earth-observing satellite to avoid a possible collision with the debris created from the Chinese ASAT test. In another instance, the US had to move its Cloud Sat out of the way of an Iranian satellite, Sinah-1 (a 160 kg remote sensing satellite of Iran launched by Russia in October 2005), to avoid a close encounter at an average altitude of 705 km.[27]

POTENTIAL THREAT TO SPACE ASSETS.

A 'space-based' system actually includes three parts: a ground segment [including telemetry, tracking and control (TT&C) facilities, communications earth station and/or data reception and archival facilities]; the space segment itself (artificial satellites consisting of payloads and platforms) and the radio links (uplinks/downlinks that carry commands, communication traffic, signals, telemetry and data). Launch vehicles and their associated infrastructure necessary to place artificial satellites and their upper stages into orbits for subsequent operational service are also pre-requisites for space-based systems.

Each element is vulnerable to a variety of distinct threats. The ground

27. NASA Report, "Cloud Sat was Moved to Avoid Iranian Satellite", *Space News International* ,Vol. 18, issue 43, November 5, 2007, p.9.

The United States has by far the largest investment in military space assets and best exploits the military advantages satellites can provide for missions such as reconnaissance, targeting, communications and surveillance.

segments and launch infrastructures are vulnerable to conventional attacks from opposing military forces. Radio links can be jammed, spoofed or otherwise hacked based on electronic transmissions from terrestrial, trans-atmospheric or orbital sources. The space segment is vulnerable to a range of attacks, including those from terrestrially-based trans-atmospheric vehicles (military space planes) or missile interceptors with nuclear, conventional explosive or kinetic energy warheads; for terrestrial-based directed-energy weapons such as lasers; and for space-based weapons such as space mines, missile interceptors, directed energy weapons (including neutral particle beams or lasers) and devices designed to alter the trajectory of the target, to create highly damaging debris clouds or to generate EMP.

ARGUMENTS FOR AND AGAINST WEAPONISATION

The advocates of space weaponisation, mainly in the US, rely on three assumptions:[28]

control—that controlling space offers unrivalled military and commercial advantage on earth;

vulnerability—that reliance on space assets presents particular vulnerabilities; and

inevitability—that weapons in space follow from land, sea and air developments, and that it would be to the US advantage to be the first.

Each of these assumptions has its pros and cons which are discussed below.

Control of Space Offers Unrivalled Military and Commercial Advantage.

The politico-military establishment or the more hawkish in the present Bush

28. Acronym Report, *Space Without Weapons: Ballistic Missile Defence and the Weaponisation of Space,* The Acronym Institute < http://www.acronym.org.uk/space/rejintro.htm> Accessed on September 20, 2007.

Administration feels that space control and space force application are the next logical steps in the race to master the ultimate high ground as space, in the years to come, would represent a critical battleground. They believe that space will necessarily be an important arena of future conflict due to the great military benefits that space weapons will provide to states that operate them. The United States has by far the largest investment in military space assets and best exploits the military advantages satellites can provide for missions such as reconnaissance, targeting, communications and surveillance. This military utility of satellites has naturally led to a desire on the part of the US military to preserve for itself these satellite-based capabilities and to deny them to potential adversaries. Some military missions such as boost-phase missile interceptions against large adversaries, can feasibly be conducted only from space, while the ever increasing importance of satellites for communications, targeting, and other essential military functions will make both attacking enemy satellites and defending one's own satellites a matter of leading strategic priority. In addition, as relevant technologies improve, space-to-earth weapons will become a potent military instrument.

The **opponents** to this proposition point out that space-based defences are enormously expensive and inherently ineffective. As an example, they cite that the space-based boost-phase missile defence system is intended for intercepting attacking missiles while the missile's engines are still burning. To reach attacking missiles very quickly, space-based interceptors (SBIs) must be stationed in low-altitude orbits. However, in these orbits, SBIs move rapidly with respect to the ground and cannot stay over any one location. To keep at least one interceptor within reach of a given missile launch site at all times requires many SBIs in orbit. A 2003 American Physical Society[29] study showed that many hundreds or thousands of SBIs would be required to provide limited global coverage against ballistic missiles and given the technology expected for the next decade, each SBI would weigh a ton or more. As a result, deploying such a system would be enormously expensive.

29. "The Missile Defence Space Test-Bed," May, 2007, <http://www.ucsusa.org/global_security/space_weapons/space-test-bed.html >Accessed on October 20, 2007.

A 2003 American Physical Society study showed that many hundreds or thousands of SBIs would be required to provide limited global coverage against ballistic missiles.

And yet even if such a system were built, it would not provide reliable defence. Even with this large system, only one or two SBIs would be able to reach a given launching missile in time to destroy it. The orbit of these SBIs would be low altitude and predictable, leaving them vulnerable to attack by inexpensive, short-range missiles. By eliminating only those few relevant interceptors, an attacker could create a hole in the missile defence system, which could also be defeated by simultaneously launching multiple missiles from one location, overwhelming the system. In short, a defence based on deploying hundreds or thousands of space-based interceptors, at enormous cost, would be defeated by a handful of enemy missiles.

Vulnerability of Space-Based Assets

The **proponents** of weaponisation who argue on this basis insist that apart from military advantage, today the US as well as other nations are increasingly dependent on space-based assets in their day-to-day life. Space has come to represent an economic centre of gravity and, hence, must be defended by basing weapons in space as that will decrease the sensor to shooter time and protect these critical assets from attack from all mediums. Their idea of weapons systems include the defensive satellites, often called bodyguard satellites, as a means of protecting high-value satellites by acting as a weapon themselves to destroy or disable the attacking ASAT weapon, space mines, etc.

The **opponents** of the theory argue that an adversary willing to cause harm to the US need not go to the extent of developing such a vast infrastructure so as to launch an ASAT weapon into space but can attack its ground infrastructure for which the existing conventional defences would suffice. Further, satellites are intrinsically vulnerable, and defending them from a determined adversary is difficult. Satellites are readily observable and travel on predictable paths, so their future position can be readily calculated. Most satellites pass over much of the

earth repeatedly, giving an adversary multiple opportunities to attack and no amount of counter-measures can guarantee 100 per cent protection.[30] Instead, they propose that more peaceful and non-debris causing methods like temporary or reversible methods like jamming or laser attack of the adversary's satellites can be resorted to rather than the more aggressive and debris causing methods in the form of bodyguard satellites.

The Inevitability Syndicate

The proponents of this theory draw their inspiration from history; for them, weaponisation of space is inevitable and this belief comes from the analogies drawn from the advent of sea power and air power.[31] The initial use of the media of water and air has been to aid mankind in economic progress and shrinking of the time distance horizon. However, the economic progress made through trade brought in the spectre of piracy on the high seas, which led to armed escorts for merchant ships, leading to weaponisation of ships at sea. In the case of aircraft, they were initially used for surveillance and reconnaissance and progressed to bombing from the air in World War I. Since history repeats itself, the same is going to have to be true of space. If space were to be weaponised, they feel that US should be the first one to deploy as the state to deploy space weapons will have a great, and perhaps insurmountable, advantage over its rivals.[32]

The opposition to this stems from the following facts of history:

— In spite of the intuitive similarities between sea-faring and space-faring, there is one fundamental difference between them which makes the sea-space analogy very weak: ships primarily transport goods and people, while spacecraft (with only minor exceptions) are built to collect, relay, or transmit information. This means that space piracy is not a problem, so space navies are not required to suppress it, while 'commerce raiding' threats to space systems can be ameliorated by building redundant, distributed systems of

30. "Weaponising Space: Is Current US Policy Protecting Our Security?" Testimony by Laura Greg, UCS staff scientist, before the Subcommittee on National Security and Foreign Affairs of the Committee on Oversight and Government Reform, May 23, 2007< http://www.ucsusa.org/global_security/space_weapons/testimony-on-space-security.html> Accessed on September 20, 2007.
31. Karl P. Muellar, *Totem and Taboo: Depolarising the Space Weaponisation Debate* (RAND, May 8, 2002).
32. Muellar, Ibid.

satellites; for merchant shipping, this is obviously not an option.

— The evolution of air and space power has not been as similar as space weapons advocates' analogies often suggest. For example, less than a decade elapsed between the Wright Brothers' first flight and the first aerial combat missions, while in the fifth decade after Sputnik, space remains un-weaponised. Naturally, it would be foolish to conclude from the history of the last 50 years that space will definitely not be weaponised during the next 50, but it would also be reckless to deduce the opposite from the history of flight between 1903 and 1915.

— As regards the race to be the first to weaponise, history is replete with incidents of how the military or technological advantage enjoyed by the first country is quickly eroded by an adversary acquiring a similar weapon or finding a defence to it. The history of nuclear weapons, ASATs and ballistic missiles are some of the examples which caused an offence-defence spiral between the then superpowers and a lot of legal regimes had to be put in place to ensure that the world would be a safer place to live in for the coming generations.

The opponents to the inevitability theory also bring out the case of nuclear weapons. Nuclear weapons were deployed in each of these environments by all the major nuclear powers more or less as soon as each was capable of doing so. Yet, not only has this failed to happen in space, but those who make the analogical argument for the inevitability of space weaponisation routinely fail to insist that the nuclearisation of space will occur in the future, raising doubts about the extent to which even its supporters truly believe in this argument.[33]

THE ROAD AHEAD

Of the comity of nations that are considered to have credible space assets, only the United States possesses the wherewithal (economic and scientific) to start the weaponisation of space. Though Russia has tested co-orbital weapons in the past, its present economic state precludes it from entering the weaponisation race. Russia feels that against the US, its arsenal of nuclear and ballistic missiles

33. Ibid.

will act as a deterrent. With the ASAT test in January 2007, China has demonstrated its limited ability to take war into space if required but its space programme to put weapons into space is still nascent. Further, the US space policy put out by the Bush Administration in October 2006[34] implies a hidden threat to any adversary if provoked weaponisation of space becomes inevitable. The approach of the US has been on developing technologies that would enable it to carry out its Vision 2020. These include:

—The development of advanced space architecture through various DARPA (Defence Advanced Research Projects Agency) projects like:

- The orbital express automated refuelling programme;[35]
- The front end robotics enabling near-term demonstration (FREND).[36]

— The near field infrared experiment satellite (N-FIRE) whose primary mission is to collect high and low resolution images of a boosting rocket to improve understanding of missile exhaust 'plume' observations and plume-to-rocket body discrimination during three plume signature types: targets of opportunity, dedicated missile fly-bys and ground observations.

— The future, fast, flexible, fractionated, free-flying space craft (F-6) space programme, and the tiny, independent, coordinating, spacecraft (TICS) programme.

More dual purpose systems under development which can be used for defensive as well as offensive use are listed below: [37]

— The space-based infrared system (to provide early warning for ballistic missile launches and overall missile detection capabilities).

— The space-based test-bed for testing ballistic missile interceptors in space.

— The likely revival of "Rods from Gods" weapon which envisages a space plane to be used as a co-orbital weapon loaded with tungsten rods which can be delivered onto a ground target and destroy it with kinetic effect.

— The airborne laser being developed to destroy ballistic missiles in flight can

34. n.15.
35. Rick Smith. "Look Ma, No Hands, No Humans," *Space Daily*, March 6, 2007 < http://www.spacedaily.com/reports/Look_Ma_No_Hands_No_Humans_999.html> Accessed on October 25, 2007.
36. Tactical Technology Office of DARPA< http://www.darpa.mil/tto/programs/frend.htm>Accessed on October 25, 2007.
37. Space Security Update#10, November 1, 2007 "Washington Moves Toward's Revamping Space Architecture," < http://www.cdi.org/friendlyversion/printversion.cfm?documentID=4132 > Accessed on November 10, 2007.

These programmes have only enhanced the speculation that though the US claims that it is not for weaponising space, the R&D towards space-based architecture is proving otherwise. A lot depends on the post-Bush mindset of the powers that are going to be at the helm of affairs in the US.

also be used against LEO satellites.

These programmes have only enhanced the speculation that though the US claims that it is not for weaponising space, the research and development (R&D) towards space-based architecture is proving otherwise. However, a lot depends on the post-Bush mindset of the powers that are going to be at the helm of affairs in the US. Irrespective of who gets elected to the White House in 2008, the US as a nation faces one possible policy dilemma. As the world's leading democratic country, its leadership is bound by an understandable obligation to do everything reasonable to maintain the moral high ground. Yet the leadership cannot afford to remain so passive as to allow itself to be caught by a "Space Pearl Harbour" surprise. An important question thus entails whether proceeding to lay down at least the essential wherewithal for moving, as need be, to weaponise space would risk incurring fewer downside consequences than waiting until later[38].

The US has been very categorical in its space policy that "the United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit US access to, or use of, space. Proposed arms control agreements or restrictions must not impair the rights of the United States to conduct research, development, testing, and operations or other activities in space for US national interests."[39] Its reluctance to discuss or enable a discussion on the Prevention of Arms Race in Outer Space (PAROS) is evident in the fact that it has abstained every year from voting on a consensus on preventing an arms race in outer space and in 2005 voted against it, for the first time reasoning that there is no need to address a "non-existent threat"[40]. In fact, it feels that there are more pressing issues to be

38. Lambeth, n.10, p.105.
39. n.8.
40. Prevention of Arms Race in Outer Space(PAROS) at the United Nations, January 21, 2007 <http://www.reachingcriticalwill.org/legal/paros/parosindex.html. Accessed on October 10,2007.

addressed like the FMCT and NPT than PAROS and has linked any discussion on PAROS with that of the FMCT and NPT, creating a deadlock in making any headway on preventing an arms race in outer space.

Analysts feel that any US space weaponisation that occurs, whether reactive or preemptive, will mostly be threat driven rather than as a result of prior unprovoked choice. However, most would agree that space weaponisation is not inevitable in the near term. Indeed, there is no observable evidence to suggest that military use of outer space will be substantially different in 2020-25 than it is today, at least regarding the development and fielding of new technologies and systems that would broaden the use of our on-orbit assets from force enhancement to force application—unless some unforeseen trigger event occurred to provoke it. The Chinese ASAT test of January 2007 can be considered one such event to provide fodder for the hawks in the Bush regime to 'step on the gas' in this regard.

Indeed, there is no observable evidence to suggest that military use of outer space will be substantially different in 2020-25 than it is today.

Yet, to say that space weaponisation is not round the corner is scarcely to say that it is out of the question altogether. As senior Col. Yao Yunzhu, one of the Chinese military's most thoughtful officers on nuclear and strategic issues, recently stated at a World Economy Forum dinner, "My wish is we really want to keep space as a peaceful place for human beings...But personally I am pessimistic about it... My prediction: outer space is going to be weaponised in our lifetime."[41] In a reflection of what might be called space weaponisation fatalism, Gen. Estes observed that "some day in the not so distant future, space will have evolved to the point where the movement of terrestrial forces will be accomplished only at the pleasure of space forces, much in the same way that the movement of land and sea forces today can only be at the pleasure of air forces. By this logic, the eventual weaponisation of space is only a matter of time—albeit a span of time that, at least to a degree, is within the power of the US to control by its near term conduct and by the

41. Ashley J.Tellis "China's Military Space Strategy," *Survival*, vol. 49, issue 3, pp.41-72, September 2007.

character and pacing of its eventual actions." [42]

CONCLUSION

US plans of a space-based interceptor test-bed; its space policy and the Chinese ASAT test have started an action- reaction process in the race to weaponisation of space. With this, the future of space is nearing a crossroads: will the 50-year tradition of international cooperation and space sanctuary prevail; or, will the fear of military and/or economic domination drive nations to compete aggressively for primacy in the ultimate high ground is the question that needs to be debated in the near future. Further, with the dual use capability of most intelligence, surveillance, reconnaissance (ISR) satellites and the rapid commercialisation of space, it would be more prudent for nations to migrate more of the dedicated military missions onto the commercial satellites in order to decrease dependence on a handful of dedicated military satellites and thus obviate the need for space-based weapons to protect key satellites.

A non-state actor would at best be able to destroy one or two satellites in LEO, and an adversary state having established launch facilities may be able to destroy double the number (provided it knows with certainty which satellites it wants to knock out) before retaliatory action is initiated. The states attempting to destroy an adversary's space assets are also fully aware of the debris effect on their space assets and this in itself would act as a deterrent for weaponising space, or attacking other nations' space-based assets.

The need of the hour for the international community is to find ways to prevent weaponisation of space by engaging in meaningful dialogue and assuring each other that there is no threat to each other's space-based assets. The states can aim to enhance collective security of their space-based assets from a non-state actor by increasing their space situational awareness and sharing of information. Further, each individual state can undertake passive defence of its satellites in the form of:

—Hardening of all future satellites against limited kinetic kill and EMP. Though this may increase the cost of launching the satellite into space, nations

42. Lambeth, n.10, p.120.

that are yet to master the technology of micro/nano/pico satellites will have to bear the burden of increased cost/launch rather than forgo an important satellite to an EMP or to a kinetic hit.

— Building system redundancy by ensuring that there are back-up systems for the majority of the tasks or having some reserve capacity on commercial satellites so that the military tasks can be transferred onto them if the need arises,

—Manoeuvring satellites from accidental collision with debris or other satellites.

These measures would mitigate the threat of an arms race in outer space and as against the international norms of treaties being inked after the weapon systems have been deployed, would ensure that a treaty is put in place to prevent the heavens being armed.

Note: The views expressed here are solely those of the author and do not represent the policies of any organisation.