The United States Approach to Military Space During the Cold War

by

Matthew J. Mowthorpe

This paper examines the military uses of space during the Cold War period by the United States. The central thrust of the paper is that both the Soviet Union and the United States formed a consensus on the military uses of space which sought to prevent it from being weaponised. However, in the 1980s this consensus began to be weakened. In order to analyse this assertion this chapter will identify the theories of space power that emerged during the Cold War. The space policies announced by the United States will be examined, and then analysed using the theories of space power.

During the latter part of the Cold War the consensus on the non-weaponization of space began to show signs of apparent weakening. Indeed as the following quote demonstration, although there are no weapons in space this does not mean the issue was not considered during the Cold War.

> Since the space age began in earnest, dozens of space weapon system concepts have been seriously investigated and brought to varying degrees of development by both superpowers. From satellite interceptors to anti-ICBM networks to orbital bombardment systems, from conventional explosives to nuclear warheads to high energy beams and other exotic devices, these weapons vividly refute any notion of space as a sanctuary.

The Strategic Defence Initiative and its subsequent reorientation to the Global Protection Against Limited Strikes (GPALS) was the epitome of the straining of this consensus. The final section of this chapter addresses the reorientation of the SDI programme to GPALS and its effect on the consensus on the non-weaponization.

Military Space Power Theory

The following theories of space doctrine provide a useful analytical framework in which to view military applications from space during the Cold War. This section will outline the central tenets of the sanctuary school, the survivability school, the space control school and the high ground school of space power. Having done this the space policies will be explored with particular reference to the schools of thought from which it draws its theoretical underpinning.

The sanctuary view of space doctrine believes that the realm of space should not be used for military purposes. The intrinsic value space provides for national security is that satellites can be used to examine within the boundaries of states, since there is no prohibited over flight for satellites as there is for aircraft. This enables arms limitation treaties to be verified by satellites in space serving as a national technical means of treaty verification. Early warning satellites serve to strengthen strategic stability since they provide surveillance of missile launches which increases the survivability of retaliatory strategic forces. The sanctuary school sees the

importance with which space systems provides these functions that space must be kept free from weapons, and antisatellite weapons must be prohibited, since they would threaten the space systems providing these capabilities.

The survivability view of space doctrine believes that space forces are inherently less survivable than terrestrial forces. It represents a departure from the sanctuary doctrine in as much as that it recognises that space forces have the potential for increasing the military effectiveness of terrestrial forces. The survivability school argues that space forces must not be depended upon for providing various functions such as communications and surveillance in wartime because they will not survive. The reliance on military space systems has however become a fact of life with the enhanced capabilities that space provides. The United States during the 1980s pursued the goal of near-term military efficiency and committed herself to become dependent on space assets, in the knowledge that credible and effective threats would emerge.

The space control school considers space as any other military theater and the military objective should be to seek control over the space environment. This is seen as analogous to concepts of air superiority and sea control. Although the space control school states that both defensive and offensive operations are likely to be conducted in space, it provides less focus on what specific purposes are served through space control.

The high ground school of thought believes that space has the ability to be the critical factor in determining the outcome of a battle. The high ground school uses the analogy that the domination of the high ground ensures the domination of the lower areas. It then follows from this that in the future, space forces will dominate terrestrial forces. This school of thought has its origins in President Reagan's Strategic Defence Initiative speech in that it advocates space based ballistic missile defence. However, conceptually the high ground school envisions force application missions from space more than just for ballistic missile defence.

The Development of US Space Policy During the Cold War

There were several factors which accounted for the lack of U.S. interest in space during the aftermath of World War II. Firstly, the unknown potential of military space was unable to compete against the core missions of the military in the austere budget environment that followed the war. Secondly, many of the top scientific and military leaders believed that space-related technologies capable of making a contribution to national security, such as the ICBM would not mature for many years. Thirdly, prior to the recognition that the Soviet Union was putting substantial resources into developing ballistic missile programmes the U.S. was reluctant to give attention or funding to programmes with unclear military potential.

The primary goal of Eisenhower's space policy was to examine and exploit the potential of space to open up the closed Soviet state by using satellite reconnaissance. The second major goal was to design policies to create a new international legal regime which would legitimize satellite over flight for 'peaceful purposes' including reconnaissance. The third major goal was to investigate space for scientific purposes. One of the most important aspects at this time was the U. S. had to develop boosters capable of launching satellites or warheads over intercontinental range which underpinned all of these goals.

In 1957 none of the services had a comprehensive doctrine related to the potential military uses of space, with the development of space reconnaissance deemed the only acceptable aspect of space utilization. The creation of the National Aeronautics and Space Administration on 1 October 1958 saw added impetus for the civil route of the U.S.' entry into space. The Eisenhower administration's policy of establishing space as an environment for peaceful purposes determined the de-emphasis of any other potential military missions in space.

The reaction to the news on the 4 October 1957 that the Soviet Union had launched Sputnik I and had become the world's first spacefaring nation was to fundamentally shape U.S. space policy for several years. The administration renewed its calls for bringing other future developments in outer space under international control at the United Nations. For the services Sputnik I meant that space was no longer a strategic backwater but could now offer a pathway to increased power and prestige. The Sputniks shock provided a rationale for the U.S. military to explore the requirement of an ASAT capability. Each of the services proposed some form of ASAT proposal prior to November 1957.

The Air Force moved during the initial period of the Sputnik shock to claim responsibility of U.S. military operations in space. This claim consisted of two interrelated parts: the development of the aerospace concept, and a high ground approach which asserted that space could make a critical contribution to national security. This was later reinforced with the first Air Force space doctrine announced by General Thomas D. White on 29 November 1957 which included the ideas that spacepower would prove as dominant in combat as the Air Force believed that airpower already was; there is one operational medium of aerospace since there is no distinction between air and space; and the Air Force should have operational control over all forces within this medium. These assumptions held by the air force were in direct conflict with Eisenhower's space policy which followed the belief that space was a sanctuary for reconnaissance purposes.

President Eisenhower in 1958 established a special panelwhich was later to be know as the Purcell Report. This report reinforced Eisenhower's views on the militarization of space. Although, the report had a wider remit on the scientific benefits of the exploration of space it did endorse the military uses of space which were considered to be of specific utility. These included reconnaissance, communication, and weather forecasting. The reports support for these passive military benefits of space also included a rejection of the notion of space weapons. This report was to establish the basic guidelines for the US military exploitation of space.

The military and the Air Force in particular were encouraged by the rhetoric of the missile gap by the Kennedy administration and renewed their efforts to increase the U.S. military presence in space during the U.S.-U.S.S.R. tensions. However, by the end of the Kennedy administration the decisions to cancel the Air Force's X-20 manned space vehicle and the race to the moon, meant that the US was moving into space along a civil path.

In the early 1960s the Kennedy administration began to reassesses the sanctuary school of thought when Soviet statements and actions indicated that they were developing orbiting nuclear weapons. In order to counter the problem in May 1962, Secretary of Defence McNamara tasked the Army with the modification of the Nike Zeus ABM for a future ASAT role. The modified system, Program 505, was based at Kwajalein Atoll in the Marshall Islands. Each missile carried

a nuclear warhead capable of destroying satellite targets. As the Soviets continued to pursue efforts towards an orbital bomb pressure increased for a US ASAT capability. In 1963 Kennedy approved Program 437, a ground-launched ASAT based on the Thor IRBM.

One of the major initiatives in this period was the negotiation by the Kennedy administration of the United Nations General Assembly Resolution 1884 (XVIII) on the 17 October 1963. This resolution called for the prevention of placing nuclear weapons or weapons of mass destruction in outer space. This resolution laid the foundation for the Johnson administration to negotiate the Outer Space Treaty of 1967, which strongly influenced the development of subsequent military space doctrine. Some of the concerns regarding the OST was the possibility for verification. The prohibition of military installations on the moon and other celestial bodies coupled with the banning of weapons of mass destruction from space, placed enormous restraints on the belief that space could openly serve as the high ground for deterrence or actual warfare at the strategic level. The OST was one of the clearest signals that the U. S. civilian leadership did not believe that space held a great deal of military utility except as a sanctuary for reconnaissance satellites.

President Johnson continued the ASAT programs undertaken by the Kennedy administration, sharing the view that an ASAT was a hedge against Soviet orbital weapons. However, a report into ASAT weapons considered the use of ASATs against targets whether or not the orbital delivery weapons were introduced and advocated the US ASAT capability as being able to enforce the principle of non-interference in space. However, the Johnson administration did not share the view of the report's additional missions for the ASAT capability and instead reiterated the view that targeting Soviet satellites invited retaliation, and the United States was more dependent of satellites. The Johnson administration subsequently proved ambivalent to ASATs and did not seek to enhance the United States capabilities further than Program 437.

Shortly after entering office, Nixon established a Space Task Group and tasked it to conduct a comprehensive review of the future plans of the U.S. space programme. The tone of the report of the group which was published in September 1969, reflected the cost consciousness of the administration. It was announced that the Department of Defence would only be permitted to embark on new programmes when they could show it to be more cost effective to be done in space. The reports recommendations appeared to confirm what was already being undertaken in practice, such as the cancellation of the under funded Manned Orbital Laboratory in June 1969.

The SALT I agreements comprising of the Treaty on the Limitation of Antiballistic Missile Systems and the Interim Agreement on the Limitation of Strategic Offensive Arms in May 1972 had considerable implications for military space policy. The primary impact on space policy as a result of these negotiations was on the central role for reconnaissance satellites to serve as a means of verification, and unclear restrictions for ABM systems. These agreements signaled that the U.S. military had made a departure away from the space control doctrine toward the sanctuary school.

The Ford administration in 1975 convened the Slicther Panel to review the military applications of space. The panel observed that the United States dependence on satellites was growing and that these assets were largely defenseless and prone to countermeasures. This led to another panel to be initiated to analyse the vulnerabilities and to consider the need for an ASAT

programme. The panel known as the Buchsbaum panel considered that an ASAT capability would not enhance the survivability of US satellites and that deterrence would be ineffective given the heavy dependence on space. However, the blinding of US satellites in 1975 and the resumption of Soviet ASAT testing led President Ford in 1977 to release National Security Memorandum 345 ordering the department of defence to develop an operational ASAT.

The general lack of emphasis on military space issues can be seen from the fact that between the Kennedy and Carter administrations there were no major military space policy reviews undertaken at the NSC level. There were however, two major policy statements on space during the Carter administration. These statements reflected the improvements in military technology and the increasing importance of space to the military. President Carter announced during a press briefing in March 1977 that he had proposed to the Soviet Union arms control measures to provide restrictions on an ASAT capability. Carter's space policy can be seen as being dual tracked, on the one hand he sought to establish a verifiable ban on ASAT systems, and on the other he pursued the development of an air launched ASAT capability, with the Miniature Homing Vehicle contract awarded to the Vought corporation. However, the signing of the SALT II Treaty on June 18 1979 and subsequent invasion of Afghanistan by the Soviet Union, pushed the issue of an ASAT ban into the background.

On May 11 PD-37, National Space Policy was signed by President Carter. This set out the twin track approach to ASAT developments along with the initiation of a long-term programme to provide greater survivability for military space systems. It also stressed that the Secretary of Defense develop a plan to use civil and commercial space systems during declared national emergencies. The Carter administration's top priority of its space policy remained the exploitation of space reconnaissance, but the increasing vulnerability of these systems and the need for the protection of these assets gradually came to see the weakening of the sanctuary school of thought.

In 1981 President Reagan came to office. There had been little indication of the nature of the administration's military space policy during the election period and during the transition to office. The first space policy review was completed by the summer of 1982 and the National Security Decision Directive 42 set out the primary aims of U.S. space policy. These were not dissimilar to PD-37 in terms of improving satellite vulnerability but a subtle shift in emphasis on ASAT policy occurred. Whereas the Carter administration had maintained that an ASAT arms control agreement was desirable, the Reagan policy was merely to "continue to study space arms control options." There was also a shift in emphasis for the development of an ASAT capability to provide a means of deterring threats to U.S. space systems and denying any enhancement in the capabilities of the space-based forces of the potential enemies. A corollary to this was the requirement to develop a programme capable of detecting threats to U.S. space forces and to provide a contingency in the event of such an occurrence.

The announcement of the Strategic Defense Initiative in March 1983 set out a research and development programme into the feasibility of utilizing space for strategic defence. This coupled with the Challenger disaster of January 1986 led to a revised policy on U.S. space policy in January 1988. This set out four basic requirements for U.S. space policy and were specified as follows:

1) deterring, or if necessary, defending against enemy attack;

2) assuring that forces of hostile nations cannot prevent our own use of space;

3) negating, if necessary, hostile space systems; and

4) enhancing operations of United States and Allied forces.

This directive builds upon the foundations of military space doctrine which includes: space support, force enhancement, space control and force application. The space support mission mandated the Department of Defense to maintain launch capability on both coasts and to enhance the robustness of its satellite control capability. For force enhancement, the DoD was to develop space systems and plans to support operational forces at all levels of conflict. In the space control area, DoD was directed to develop an integrated combination of antisatellite survivability, and surveillance capabilities. And finally, under force application, the DoD was to conduct research, development and planning to be prepared to deploy space weapons systems for strategic defence should national security conditions dictate it.

The Evolution Of The Strategic Defense Initiative Program

The original task of the Strategic Defense Initiative (SDI) was to research the feasibility of a missile defense capable of breaking up a determined Soviet nuclear attack on the United States that could consist of thousands of nuclear weapons. This Phase I of the SDI program was to ensure that a large percentage of these nuclear weapons would be destroyed. Although the military requirements established for SDI in the Reagan Administration are classified, it has been reported that Phase I would have been able to shoot down 30 percent of all warheads fired in a first strike and 50 percent of the warheads carried on the SS-18 Satan missile, whose combination of accuracy and yield made it the most dangerous counterforce threat in the Soviet arsenal. This would mean that a Soviet war-planner could not successfully plan for a first strike, since he would be unsure of how effective his first strike could be. Phase I was to be only the start of a larger defense system, as necessary to meet possible changes in the Soviet threat.

The Department of Defense under President Reagan's direction began a study into the technological feasibility of missile defenses. This came to be more commonly known as the Fletcher Panel. The major recommendation of the Fletcher study was for a long-term research and development program on ballistic missile defense. No specific BMD systems were selected for ultimate deployment, but promising new technologies and systems were identified for research. Decisions about further research and development for deployment would be made after an initial five years of study.

The technologies study team placed its emphasis on a long-term program to research and develop a multi-tiered defense that would provide significant damage limitation. It believed that a credible defense would have to have a low leakage of warheads, but no actual number was defined. The study deemphasized short term narrowly defined program elements.

The Fletcher Panel estimated that the research and development programs could last ten to twenty years to enable critical technological problems to be solved and begin deployments. In essence the Fletcher Panel approach overly stressed performance standards to the detriment of deployment of limited but potentially effective defenses. A major flaw of the Fletcher Panel's report was that it called for research into BMD technology to continue until it was possible to make and deploy in its entirety a nearly flawless defensive system against very large scale and very sophisticated attacks. One critic commented,

> President Reagan's Fletcher Panel crafted gold-plated definitions of what is required for ballistic missile defense. Moreover, the Fletcher Panel stated plainly that even these definitions might be made more demanding to take account not of what intelligence learns the Soviets are doing but rather the American technician's own evolving notions. In bureaucratese, such changing of standard's is known as the 'responsive threat.' Thus was the SDI established as a program of research without logical end.

The Future Security Strategy Study, also known as the Hoffman Panel, established at the same time as the Fletcher Panel, was given the assignment to study the implications of strategic defenses vis-a-vis the relationship between the United States and the Soviet Union. The panel found that strategic defenses, even if not perfect, were not inconsistent with the goal of helping to stabilize the U.S.-Soviet military relationship. With this opinion, the Hoffman Report differed from the Fletcher Report. The Hoffman report advised early deployment of partial strategic defenses, even if they were not the highly capable multi-layered defenses envisioned by President Reagan and the Fletcher Panel. Even limited defenses, it said, could greatly enhance deterrence by denying the Soviet Union at least some of its military objectives. In short, the Hoffman Report called for a healthy mix of offense and defense to enhance the United States' deterrent. The Fletcher Report, on the other hand, advised waiting until a highly-capable system could be deployed all at once.

The SDI Mission

The SDI program from its conception in 1983 eventually changed its focus significantly. At first, it focused on the threat of a massive Soviet attack, but by 1991 it had switched to protection against much more limited strikes from anywhere on the globe. During each of these mission periods, there were significant changes to the program, based on policy reviews and decisions by the President, the Secretary of Defense, and the Congress. The first phase and change to the SDI program began with the development of the technology period up until late 1987. The next major step that followed this period was Phase I with the Space Based Interceptor, and the final step before the switch to GPALS, was Phase I with Brilliant Pebbles.

Phase I, the defense against a massive Soviet attack phase began with its creation in 1983 and lasted through till 1990. In accordance with directives from the President, the Secretary of Defense chartered the Strategic Defense Initiative Organization (SDIO) in 1984 to research and develop a set of technologies supporting concepts for Ballistic Missile Defense (BMD). SDIO was to support a decision to be made in the early 1990s on whether to begin developing BMD for deployment. Initial deployments were to contribute to strategic defense and move the United

States toward a goal of eliminating the strategic nuclear missile threat. SDI was also to protect options for near-term deployment in case of a Soviet deployment in violation of the Anti-ballistic Missile Treaty (ABM).

The SDI program was to be treated as a research program until the early 1990s, when a decision would be made to decide whether to develop and deploy an initial capability. The SDIO was developing a wide range of key technologies for sensors, kinetic kill weapons, and directed energy weapons. As President Reagan stated, "the SDI program was to provide to a future president and a future Congress the technical knowledge required to support a decision in whether to develop and later deploy advanced defensive systems." This research phase, which began in 1984, lasted through 1987, when the Phase I system became subject to the oversight of the Department of Defense's formal acquisition process.

In the fall of 1986 a phase I national missile defense design was developed. The concept of phased deployment was to "develop and deploy militarily useful increments of capability" that would also add to arms control negotiating leverage for reductions in offensive weapons. If the Soviets responded favorably to arms reduction proposals the phased deployment proposals could be modified. There were three phases. The first phase aimed at denying Soviet initial strike objectives, along with the ability to blunt follow-on strikes, which would complicate Soviet attack options and defeat limited attacks and accidental launches. The early follow-on phase included directed energy systems and active discrimination sensors. The final phase, the late follow-on phase, included advanced energy directed weapons and support technologies. The latter two phases would lead to highly effective, multi-layered defenses.

The general outlines of the Phase I and follow-on deployment concepts were approved by President Reagan in December 1986. Phase I emphasized the space based elements as being of critical importance to countering the Soviet proliferation of offensive missiles. The White House also called SDI "a main inducement for the Soviets to negotiate for deep cuts in offensive arsenals." President Reagan declined Soviet demands to confine SDI to laboratory research.

The Defense Acquisition Board's (DAB) review in September 1987 led to the recommendation of selected Phase I elements. The selected Phase I elements were

- Boost Surveillance and Tracking System;
- Ground-Based Surveillance and Tracking System;
- Space-Based Surveillance and Tracking System;
- Space-Based Interceptor;
- Exoatmospheric Re-entry Vehicle Interceptor System;
- Ground-Based Radar;
- Battle management/command, control, and communications;

• System engineering and integration; and launch

In September 1987, Secretary Weinberger approved the recommendation by the DAB that Phase I concepts and technologies, called the Phase I Strategic Defense System, enter the validation section of the acquisition process. The advanced technologies for follow-on phases were to enter demonstration and validation prior to full-scale development of Phase I. The need to lower costs and resolve effectiveness issues such as survivability, vulnerability, and sensor performance meant that Phase I underwent continual design and renewal. Success in this endeavor saw the cost estimates of a Phase I defense of the United States reduced from an original June 1987 DAB estimate of $145.7 billion, to $115.4 billion in June 1988, then $69.1 billion in September 1988 and to $55.3 billion by November 1989. These reductions came about by successive redesign of the system elements, reductions of support costs, and changing cost estimating models.

After Phase I was proposed, the SDIO began investigating a new, innovative space-based interceptor, known as "Brilliant Pebbles". These were to be a constellation of up to thousands of individual interceptors, each with its own surveillance capability and enough power to operate autonomously, within its own field of vision. Brilliant Pebbles was a competitor to the Space-Based Interceptor design concept, which was to house several interceptors together in a large "garage" or carrier vehicle. Brilliant Pebbles responded to the DAB concerns over the high cost of the Space Based Interceptor "garage" or carrier vehicle. Primarily , however it allayed concerns relating to the survivability of the Space-Based Interceptor garage. Brilliant Pebbles was subjected to several technical feasibility reviews in 1989.

President Bush upon entering office in 1989, directed a National Security Review which was headed by Ambassador Henry F. Cooper. This review, which was completed in spring 1990, endorsed the concept of Brilliant Pebbles and recommended its innovative approach be applied to the rest of the SDI Phase I architecture. In testimony before Congress in April 1990, the Director of the SDIO announced that Brilliant Pebbles had replaced both the Space-Based Interceptor and the Boost Surveillance and Tracking System in Phase I. In June 1990, the Under Secretary of Defense for acquisition endorsed the changes.

In November 1990 the SDIO recommended revisions, which included the replacement of the Space Surveillance and Tracking System satellites, with smaller, highly distributed Brilliant Eyes satellites. These satellites are drastically smaller than the previous missile tracking satellites which makes them easier to defend from attack. The Endo-Exoatmospheric Interceptor was introduced as a competitor to the exoatmospheric Ground-Based Interceptor and design changes were made to the Ground-Based Radar, redesignating it the Ground-Based Radar-Terminal.

During the Reagan administration, it was the White House which set the most ambitious plans for military space rather than the Pentagon, this ushered in a reversal of the formulation of military space policy that was witnessed under the Eisenhower and Kennedy administrations.

President Bush's Global Protection Against Limited Strikes System

The change in the U.S.-Soviet relationship and more influentially the break-up of the Soviet empire caused a re-evaluation of the purpose of the SDI program. This re-evaluation was to be

widespread throughout U.S. military strategy, as President Bush announced that U.S. military strategy was to be significantly altered from fighting a global war against the Soviet empire to fighting regional conflicts against a variety of potential aggressors. It is in this context that the SDI program was reoriented.

The SDI program was to be "refocused on providing protection from limited ballistic missile strikes, whatever their source." The smaller scale SDI would aim to provide high protection against a smaller number of missiles. It would not assume that the Soviet Union was the aggressor, or that the United States was the target. The system would be capable of protecting not just the United States, but military forces overseas and allies.

> GPALS pares back America's SDI plans to meet the fiscal and military requirements of the 1990s. Unlike Reagan's SDI program, designed to disrupt a massive Soviet surprise attack involving thousands of incoming missiles, GPALS will give America--and its allies--a near-perfect defense against limited or perhaps accidental attacks by up to 200 missile warheads. GPALS then cuts the proposed costs of SDI from $53 billion to $41 billion over ten years. This puts SDI well within the cost-range of other important defense programs--less than the Air Force's B-2 Stealth bomber and comparable to the mobile Midgetman missile system.

GPALS was designed to provide near-perfect protection against smaller strikes, potentially from a Third World foe or a fragmented Soviet Union. It was to be able to defend missile strikes of up to two hundred warheads aimed at the U.S. from anywhere in the world with near 100 percent confidence. This stands in contrast to the Phase I SDI mission which was developed under the Reagan Administration.

In 1991 General Colin Powell, Chairman of the Joint Chiefs of Staff, in a statement before the Committee on Armed Services, said that the Pentagon officially still retained the military requirements for a full Phase I SDI system as a long term goal for the U.S. ballistic missile defenses. If necessary, GPALS could have been expanded through the deployment of additional interceptors to meet Phase I requirements.

During the period 1989-1990 the Department of Defense and SDIO reacted to new forces affecting SDI. These new forces were the innovations in the Brilliant Pebbles concept and the changes in Soviet and third-world threats. The events in the world during this period led to a re-examination of the policy and technical goals of the SDI program. This led to an Office of the Secretary of Defense study of "the strategy and technical feasibility of global protection against limited strikes" in the spring and summer of 1990.

In January 1991, President Bush refocused the SDI program to deal with accidental or unauthorized launches of ballistic missiles and with deliberate attacks of limited scope. As President George Bush declared in his State of the Union Address,

> Looking forward, I have directed that the SDI program be refocused on providing protection from limited ballistic missile strikes, whatever their source. Let us pursue an

> SDI program that can deal with any future threat to the United States, to our forces overseas and to our friends and allies.

Whilst the threat for GPALS was less technically stressing, the mission of near-perfect protection put additional stresses on designs. As the report to the Chairman on Governmental Affairs in the Senate argued:

> High levels of protection require near perfect system performance in detecting, discriminating, and tracking targets; in battle management, command, control, and communications functions; and in intercepting and destroying targets.

The Missile Defense Act in 1991 changed the shape and priorities of the GPALS program. The act set goals for the early deployment of advanced theater missile defenses and the initial site for the defense of the United States against limited attack. Congress gave the Department of Defense 180 days to develop a plan to meet its mandate for early deployment. It also mandated that Brilliant Pebbles space-based interceptors would not be part of initial planned deployments, but be pursued in "robust" research and development.

In November 1991, the SDIO briefed the DAB's co-ordinating committee that the Theater High Altitude Area Defense program, including the Theater Missile Defense Ground-Based Radar, had high cost and schedule risks. SDIO was requested by the co-ordinating committee to develop acquisition strategy options to reduce risks. The Army and the SDIO subsequently modified the program, which consequently led to the DAB approving a milestone I entry into demonstration and validation. DOD reviewers identified concurrency risks in meeting the Congress' early fielding goals for an initial, single-site national missile defense system. After considering the DOD's assessment, the Congress amended the Missile Defense Act in 1992, delaying the proposed fielding date. The 1992 Act continued the restrictions on deployment of space-based interceptors.

One of the key elements of the refocused SDI program was the increased priority for the theater missile defense programs. The experience in the Persian Gulf with the Patriot missile focused more attention on this priority. One of the objectives of the program was to focus on near-term deployment of improved theater missile defense systems. This is an area where co-operation with allies could be expanded.

The Importance of Space-Based Assets

The issue of why space has to be utilized was a key issue in regard to the refocusing of the SDI program. The issue was not space versus ground; even with an emphasis on ground systems space elements were required. At a minimum, space-based sensors made ground systems more effective. The issue was not whether to utilize space; space based sensors are required. The real issue was whether or not to use space-based weapons. There are many advantages to using space-based systems, particularly as the threat matures and improves over time.

Space-based weapons would always be in position. They could defend and offer protection against threats to forces arriving in theater before theater commanders have had the opportunity

to establish their own theater defense capabilities. Space offers broad area coverage to protect "a wide array of assets from a system based in space rather than having to protect each of those assets with their own individual ground-based systems." Space-based weapons are a key hedge against a possible resurgent threat.

The need for highly effective defenses placed a premium on the ability to take multiple shots against ballistic missiles, including shots from space. A layered defense, combining surface- and space-based interceptors (SBI), provides the highest confidence in achieving protection for the United States against limited missile threats. Space-based interceptors would constitute the initial layer of a multilayered defense. They offer a defensive tier, with warning, command and control, and intercept technologies that are independent of those dedicated to the surface-based layer.

It was argued that space-based defense could provide multiple early engagements, well away from the defended targets. One of the lessons of the Gulf War was the importance of intercepting at distances and altitudes sufficient to prevent portions of a ballistic missile or its warheads from striking the intended target. Space-based interceptors could have mitigated one of the limitations associated with the Patriot missiles during Operation Desert Storm. Intercepts could have taken place above the atmosphere and debris from destroyed missiles could have been less harmful by the time of impact. The destruction of nuclear, chemical and biological weapons above the atmosphere would be important to prevent fallout over military or civilian target areas and dispersal of chemical and biological weapons.

Space-based interceptors would provide global defensive coverage could contribute to U.S. military strategy for regional conflicts. This would be particularly valuable for effective defense of U.S. forward-based and expeditionary forces because the location and timing of regional conflicts cannot be predicted, and may occur with little warning. Space-based interceptors would assist in protecting U.S. forces that must be deployed rapidly abroad. The forward-deployed forces would increasingly be operating within range of ballistic missile threats. As DeBiaso argues:

> In such a contingency, where an adversary might attempt to oppose the initial build-up of U.S. and allied forces, with ballistic missile strikes against ports, airfields, and early arriving troops, space-based interceptors could offer protection before surface-based interceptors were in place, thereby helping to maintain stability during a period of escalation and mobilization.

It was argued that basing defenses in space would also provide a cost-effective protection for U.S. forward-based and expeditionary forces, and reduce the overall requirement for surface-based interceptors and their associated level of manpower and logistic support. During Operation Desert Shield, more than 450 C-141 equivalent air sorties were flown to transport ground-based missile defenses into the theater. Space-basing in combination with new generation theater missile defenses, would reduce such logistical burdens and also ease the overseas basing issues associated with deploying large numbers of surface-based interceptors globally.

The global coverage offered by space-based interceptors would possibly provide a unique capability to defend multiple theaters simultaneously. This is particularly important to the

conduct of U.S. military operations as the threat of ballistic missiles extends beyond any single theater, especially in areas where ground-based defenses might not be deployed. For example, in the event of a crisis in the Middle East, space-based interceptors could provide protection to vulnerable U.S. and allied targets in adjacent theaters, such as cities, staging points or forces, necessary for operations in the primary theater.

In the same way U.S. forces deployed overseas would benefit from the combination of space- and surface-based defensive systems, so would U.S. allies. The deployment of space-based interceptors would provide an initial defense tier complementing the allies' own ground-based defenses, resulting in protection against the entire range of threats. As DeBiaso argued:

> U.S. space-based interceptors could ease the burden of allied costs for theater missile defenses, thereby increasing the incentives for allies' investment in their own ground-based defenses. These allied theater missile defense systems could, in turn, provide additional coverage for U.S. forward deployed and expeditionary forces, especially against short-range missile attack. More broadly, deploying defenses in space should help demonstrate U.S. support for its allies by providing a unique military capability, despite reductions in forward deployed nuclear and conventional forces.

The GPALS 1992 Architectural Design

The refocusing of the original SDI mission of destroying around half of a mass raid involving several thousand re-entry vehicles launched out of the Soviet Union to protection of limited strikes meant a new architectural design. A component of GPALS would be transportable defenses that could be moved into a theater or region, if and when a hot spot might develop. In places that are continuing hotspots, defenses could be deployed indigenously, such as the Arrow system developed jointly with the Israelis.

The ground-based element of GPALS was a defense against strategic ballistic missiles to be deployed in the United States. This ground-based system includes a satellite sensor, Brilliant Eyes. This sensor would improve the effectiveness of theater defenses as well as defenses against longer-range strategic ballistic missiles. The inclusion of Brilliant Eyes reiterates an important aspect about space versus ground-based defenses. Ground-based defenses require space-based sensors if they are to reach their potential.

The Ground-based Radar (GBR) was much smaller and more mobile than in the previous SDI architecture. Its development builds on the program of the smaller GBR employed in the theater missile defense system. Other elements of the ground-based system included two interceptors. The Exo-atmospheric Interceptor, (E_2I) performs its intercepts high in the earth's atmosphere, after the RVs are able to be distinguished from lighter decoys since the atmosphere causes distinct deceleration characteristics.

The final component of the GPALS system was the space-based interceptor called Brilliant Pebbles. Each Pebble was to be an autonomous interceptor which could act independently once it has been authorized. "It basically looks and sees the ballistic missiles when they rise from their silos, or, in the case of a Scud, from a mobile launcher. At the appropriate time, it drops its 'life-

jacket' and proceeds to maneuver into the oncoming path of the threat ballistic missile--or during the mid-course phase, of a re-entry vehicle transiting space."

It was a misconception that Brilliant Pebbles could not be employed effectively to counter theater ballistic missiles. If the range was greater than a few hundred miles, normal minimum energy trajectories would carry the RVs above the earth's atmosphere and there would be time to intercept them from space, using Brilliant Pebbles. Such a system could be employed to counter the Scuds launched out of Iraq into Tel Aviv and Riyadh. The debris from such intercepts would probably burn-up when re-entering the earth's atmosphere rather than fall on city streets.

GPALS would consist of anti-missile systems developed by the SDI program, but GPALS will need fewer of them. The number of space-based interceptor missiles was reduced from over 4,000 in the Phase I plan to 1,000 in the GPALS plan. The number of ground-based interceptors was halved from 1,600 to 800.

Brilliant Pebbles interceptors were tiny satellites designed to track and destroy an enemy missile as it rises through the atmosphere, in its late to mid-course phase. Each had its own on-board sensors to identify targets, a computer system for processing information and a propulsion system to speed it toward a target.

Brilliant Pebbles destroy their targets by "kinetic energy", that is, by smashing into them at high speed. If deployed in the proper orbit, Brilliant Pebbles could intercept ballistic missiles with ranges from about 300 miles to intercontinental distances. However missiles with ranges below 300 miles do not climb above 62 miles and thus do not reach altitudes high enough to become vulnerable to space-based Brilliant Pebbles interceptors. During the Persian Gulf War, Iraq's al-Hussein and al-Abbas missiles, with ranges of 375 and 550 miles would have been vulnerable to Brilliant Pebbles.

Space-based weapons remained essential since they would have far more effective than ground-based interceptors against missiles with multiple warheads. Ground-based interceptors must discriminate between warheads and decoys and then attack each of the warheads individually in space or as they re-enter the earth's atmosphere closing in on their targets. Brilliant Pebbles would not have needed not do this because it would destroy the one missile carrying the warheads and decoys.

Warheads that slip through the Brilliant Pebbles net in space would have been intercepted by ground-based interceptors. Two ground-based interceptors were under consideration. The Ground-Based Interceptor (GBI) and the Exoatmospheric/Endoatmospheric Interceptor or E^2I. The GBI was based on technology developed through the Exoatmospheric Re-entry vehicle Interceptor Subsystem (ERIS) test program. A test version of ERIS intercepted and destroyed a U.S. Minuteman I dummy warhead in space in January 28, 1991. The targeted Minuteman I was launched from Vandenberg Air Force Base, while the test version of ERIS was launched from Kwajalein Atoll in the Pacific Ocean. Ground-based interceptors, like ERIS would attack enemy missile warheads in space before they re-enter the atmosphere.

The E_2I is based on technology developed through the High Endoatmospheric Defense Interceptor (HEDI) program. E_2I was designed to intercept and destroy enemy warheads after they re-entered the atmosphere, it generally would attack only after the earth's atmosphere had stripped away the decoys. The challenge the E_2I faced was ensuring that its on-board sensor would find the target warhead and direct the interceptor against it. This is tougher to accomplish inside the atmosphere than above it, since the speed of the incoming missile created friction with the atmosphere that then creates extremely high heat. This heat distorts the view seen by the E_2I's sensor as it "looks" through its window.

GPALS depended on ground-based as well as space-based sensors to track ballistic missiles in flight. The ground-based sensors would relay essential targeting information to the interceptor missiles so that they could locate and destroy enemy warheads. Two ground-based sensor systems were included in the GPALS system.

The first of these systems was the Ground-Based Radar (GBR), which tracks missile warheads in the latter stage of their flight in space and inside the atmosphere as they close on their targets. The Ground-Based Radar is particularly useful in tracking missiles that have shorter times of flight, such as submarine-launched ballistic missiles (SLBMs) since it has the ability to process radar information quickly and provide it to commanders. The Ground-Based Radar system was designed to be mobile and was envisioned to be deployed on railcars to make it less vulnerable to enemy strikes.

The second of the GPALS ground-based sensor system was the Ground-based Surveillance and Tracking Systems (GSTS). This is a heat-sensitive sensor mounted on a rocket. Upon early warning of a missile strike, the sensor would be launched into space to scan for incoming warheads beyond the range of the ground-based radar. The GSTS system was to play an important role in distinguishing between real warheads and decoys.

The Theories of Space Power Underpinning U.S. Space Policy

Space policy during the Eisenhower administration followed the sanctuary view of space. The focus on utilising satellites for reconnaissance purposes combined with the reluctance to countenance the protection of these satellites by means other than international law, and a treaty based approach to establish legal overflight of these satellites fits into the sanctuary view as outlined previously. Although the Air Force aerospace doctrine advocated by General White departed from the sanctuary view, this met strong resistance from the Eisenhower administration.

During the Kennedy and the subsequent Johnson administration the sanctuary school view of space can be visibly highlighted with the culmination of the Outer Space Treaty which prohibited weapons of mass destruction being placed in orbit. This significantly curtailed the high ground view of space which sees space as a place from which Earth could be dominated, presumably with the placing of nuclear of weapons in space. Also, the policy of utilising satellites for reconnaissance purposes continued to follow the sanctuary school of space.

The Nixon administration's most significant space policy act was the signing of the Antiballistic Missile Treaty in 1972. This placed limits on ballistic missile defence and hence had

implications for the high ground of military space theory which sees ballistic missile defence in space as an integral part of the military utility of the 'high ground'. Also, the Salt I Treaty for the first time advocated a NTM (national technical means) code for reconnaissance satellites as a means of monitoring arms control agreements. This action followed a sanctuary view of space, as a means of using space for peaceful purposes, that is as a way of strengthening strategic stability since it was believed that no side would cheat if there was a reasonable chance that the other side had a means of verifying whether they were adhering strictly to the terms of the treaty.

The Carter administration pursued a policy on similar lines which followed the sanctuary school of space theory. However the feeling of satellite vulnerability gave some credence to the vulnerability school of space power. President Carter faced with possible satellite vulnerability led to a policy of research and development into a possible antisatellite capability. The research and development of such a capability would however lend itself towards a space control theory of space power. However, it can be assumed that the administration was developing an ASAT capability as a prelude to an ASAT ban, using an ASAT capability as a negotiating tool with which to bargain away. However, an ASAT ban was to prove a difficult treaty to negotiate and was never realized.

The Reagan administration's space policy was a dramatic departure from the sanctuary school of space power. The development of an ASAT whilst maintaining that an ASAT treaty was undesirable lends itself toward the space control view of space power but combined with the announcement of SDI, this gravitates its space policy toward the high ground. Indeed, the development of a space-based ballistic missile defence was one of the fundamental tenets of the high ground view of space power. Although the announcement of a military space doctrine which valued space support, force enhancement, space control and force application leans heavily towards the space control view of space power. However, to summarise the Reagan administration's space policy can be classified as following the space control view of space power, but with a view towards the future of a high ground view of space, with the research and development of space based ballistic missile defence capabilities.

The Eisenhower administration's space policy was highly secret and had a heavy focus on space being a sanctuary for spy satellites. The sanctuary school of thought continued throughout the Kennedy administration right up until the Ford administration. The Ford and Carter administrations saw the revival of interest in ASAT issues, but still the prevailing school of thought was the sanctuary school. The Reagan period saw a significant shift away from the sanctuary school of thought with the SDI speech, which can be characterized as the "high ground" school of space theory. Despite the rhetoric of the SDI speech, a more sober analysis of the Reagan administration would better be classified as a move toward the space control school of thought. This can be evidenced by the four basic tenets of U. S. space policy as set out in 1988 which covers space support, space enhancement, space control and force application. However, throughout most of the Cold War period the United States viewed space as a sanctuary free from the deployment of weapons.

The United States use of space during the Cold War period could be characterized as following the broad theory of the sanctuary school of space power. The successive administrations from Eisenhower up to the Carter envisioned military space best serving national security interests

through the adoption of a sanctuary view of space power. The Reagan administration saw the prevailing sanctuary view of space power to be questionable. The announcement of the Strategic Defence Initiative ushered in a more robust view of the realm of military space with the research and development of space borne platforms for ballistic missile interception. This had implications for the sanctuary view of space in that it was effectively replaced by a space control view of space power which whilst not necessarily advocating the weaponization of space, it nonetheless did not see space as a sanctuary from military operations and views space as another arena not too dissimilar to land, sea and air power.

The Bush administration facing an altered geostrategic environment, especially vis a vis the United States-Soviet relationship redirected the SDI mission to the GPALS mission. This redirection of the SDI mission clearly weakened the notion of space being free from weaponization, as the space architecture envisioned space components for the interception of ballistic missiles. The rationale for the use of space components for ballistic missile defence was that they provided a layered approach which could allow multiple early engagements away from the defended areas. However, not unlike the original SDI program the use of space for ballistic missile interception was left primarily a research and development programme.

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