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THE THIRD BATTLE: IS THE U.S. READY TO WAGE THE NEXT CONFLICT IN SPACE?

by

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Preface

Space has become as important today as the land, sea, and air domains have traditionally been in the art of warfighting. Much of the current debate revolves around whether or not the United States should move beyond the traditional space sanctuary mindset and take the first steps to weaponize space. Many in the U.S. government clearly believe in the need to protect friendly space systems and deny enemies use of space. Critics claim the newest military space doctrine and ever more aggressive military space visions are leading to an inevitable arms race in space. Although it is hard to argue the vulnerability posed by heavy reliance on space systems, it is also hard to see a way ahead that solves the dilemma. The military must contemplate the development of a completely new offensive and defensive space arsenal while at the same time recapitalizing its entire stable of traditional force enhancement space systems, most of which are facing block obsolescence in the next five years. Concurrently space, which has traditionally been a low priority in the military service's funding strategies, must compete against urgent needs such as the war on terror, recapitalizing the fighter aircraft force, and adding 30,000 troops to the Army while equipping them to fight with future combat systems. Domestic issues such as the growing budget deficit and social security debate have taken the public mind off the vulnerability in space. Add the fact that the vulnerability is not supported by a serious threat in the form of a formidable adversary in space, and the move to more expansive space doctrine becomes a tough sell. It is in this difficult context that the debate rages over space--it is my purpose to add some small piece of knowledge to the deliberations.

I would like to thank the faculty of the Security Studies Program at the Massachusetts Institute of Technology for the guidance and expertise they shared with me during my year as a National Defense Fellow. In particular, Dr Owen Cote was the inspiration for the way this thesis was organized as I used his wonderful book on anti-submarine warfare, *The Third Battle: Innovation in the U.S. Navy's Silent Cold War Struggle with Soviet Submarines* as the springboard to develop a construct to review the evolution of space since the early 1950's. Professor Harvey Sapolsky drove home the point that all things big in the military are political. Also, Cindy Williams was the force behind my realization of how powerful the budget is in developing and sustaining new doctrine and warfighting capabilities.

Abstract

The United States is now entering the third battle in space—a battle to go beyond space as simply a force enhancer to a position of space supremacy. National grand strategy has shifted from strategic engagement to primacy, where the U.S. must preserve supremacy by outdistancing any global challenger. Military doctrine is emerging to support that ideal in space. Is the United States really ready to embark on such a grand vision? The United States is the world leader in space because it won the first two "battles" in space. The first battle was won with the launch of the first photo reconnaissance systems and the deployment of a robust Intercontinental Ballistic Missile (ICBM) capability. The second battle was waged during the Cold War and saw the United States win the fight to integrate space into joint warfighting systems and doctrine. Today, there are serious questions about whether the U.S. can field a space force sufficiently powerful enough to dominate space. To pursue such an aggressive goal could actually erode the command of the space commons we maintain today.

This paper analyzes the political and organizational issues the U.S. faces in space. The politics of U.S. grand strategy and national space doctrine are driving a discordant national security space doctrine. Existing space organizations are not equipped to lead the shift toward new and dynamic space missions. Political and organizational issues are forcing the U.S. to make difficult decisions in national security space that will affect the drive to win the "third battle."

Chapter 1

The Third Battle in Space

> *Controlling the high ground of space is not limited simply to protection of our own capabilities. It will also require us to think about denying the high ground to our adversaries. We are paving the road of 21st century warfare now. Space is the ultimate high ground. Our military advantage there must remain ahead of our adversaries' capabilities. And our own doctrine and capabilities must keep pace to meet that challenge.*

The Honorable Peter B. Teets Undersecretary of the Air Force AFA symposium
15 November 2002

> *The progression in space systems has not been as dramatic as it has been in air systems. You'll find in many ways, we are doing business [in space] the same way we as we did 50 years ago.*

James Roche, the Secretary of the Air Force, commenting on space capabilities at the commemorating the 50th anniversary of Air Force involvement in military space and missile activities, 2004

Introduction

There are two major influences acting on U.S space policy: The United States' grand strategy of primacy and the organizational and technical capabilities of the nation's national security space architecture.[1] Grand strategy is the application of a nation's powers to the achievement of larger purposes. Current national grand strategy is leading the military to pursue a hard line space supremacy doctrine which seems well suited to the aggressive policies of the Bush administration aimed at the war on terror.

However, in actuality, primacy and the war on terror have created strategic imperatives to eschew space control in favor of upgrading the space force enhancement mission. Primacy—with its emphasis on outdistancing any global challenger—has created a domestic budget situation where there is little money for space. Stressing new targets, mobile and fleeting in nature, make innovation in force enhancement all the more important. In the meantime, organizationally the national security space program is unprepared to make the shift to space control doctrine and is failing the challenge it faces to update its legacy space weapons systems.

The Build-up to the Third Battle

In answering the questions surrounding U.S. readiness to enter the upcoming third battle in space, it is helpful to review those actions that led to the outcomes seen in the previous "battles" for space. The first battle was to gain access to space primarily for its deterrent value and reconnaissance capability. The first battle, driven by the space race with the Soviet Union, precipitated the development of strategic space capabilities including the ICBM, the reconnaissance satellite, space-based warning and variations of anti-satellite (ASAT) systems and was personified in the Cold War space race with the Soviet Union, beginning in the early 1950s and lasting nearly 30 years.

The second battle was to militarize space by integrating space utility into American warfighting. The second battle followed the end of the Cold War and was more tactical in nature, embodied by the militarization of space through the development of operational space capabilities such as satellite communications and navigation with ground, naval, and air forces. The second battle began as U.S. grand strategy shifted away from containment and toward selective engagement while national space policy slowly shifted from sanctuary thinking toward control of space.

The third battle is a fight to develop means that will enable space control operations to "ensure freedom of action in space for the United States and its allies and, when directed, deny an adversary freedom of action in space."[2] These requirements will entail the capability to apply force, and thus the third battle will be over weaponization of space.

As the United States begins to wage the third battle, it must overcome an inherent tension—while military strategy and doctrine become more aggressive, U.S. space systems have not kept pace and are under serious strain to support evolving doctrine. The Air Force and National Reconnaissance Office face block obsolescence of many on-orbit systems now in service. Author Benjamin Lambeth points out the severe challenge facing the Air Force to keep just its current capability alive as "every major U.S. military space system is due for an upgrade or replacement in the coming decade at an estimated cost of $60 billion."[3]

Meanwhile, military space leaders tout the need to move well beyond current thinking toward the goal of total U.S. superiority in space. In a speech in 2001, then Air Force Chief of Staff General Michael Ryan put it succinctly when he stated "the United States must eventually have the capability to shoot down orbiting satellites from space or from the ground to protect increasingly vital military and commercial links in space."[4] General Lance W. Lord, the Commander of Air Force Space Command, warns "the concept of space superiority needs to roll off the tongue…like air superiority."[5]

It is a fact that, with the collapse of the Soviet Union following the Cold War, the United States operates in space without peer. U.S. grand strategy since the Cold War has evolved from a bi-polar strategy of containment to a uni-polar strategy of "primacy" oriented around the U.S. advantage in military power. Experts make the case that "command of the commons", the global command of sea, air, and space, forms the foundation of the current U.S. position of hegemony.[6] Command of space does not mean that other states cannot use the commons of space—it means that the United States gets vastly more military use out of space and that adversaries would "lose a military contest for the commons if they attempted to deny them to the United States."[7] This has led to a more aggressive policy focused on counterspace systems designed to defeat those who deny the use of space to the U.S. military.

While it is tough to argue that counterspace is not important, a sole focus on counterspace and the ensuing spending required to develop offensive and defensive space capabilities will take away our most important space task—actually delivering new systems which provide utility from space to support national and military objectives. Under the constraints present in today's environment, the U.S. must choose between investing to recapitalize aging space force enhancement capabilities such as missile warning, weather, communications, and navigation *or* pursuing an aggressive and risky strategy to field an offensive space force sufficiently powerful enough to dominate space. If we pursue the more aggressive goal of space superiority, it will likely come at the expense of critical space force enhancement capability. The will and resources to do both do not currently exist.

In order to support this claim, this paper engages in political, organizational, and technical analysis. Space has always been political. Politics are influenced by perceived space threats, aggressive U.S. grand strategy, and a forceful space control doctrine. In addition, technology and budgets hold large sway over the political debate entering the third battle for space. On the political front, U.S. military hegemony has heated up the national pursuit of a more aggressive space policy.

There are important questions about whether the nation, in an environment where every aspect of U.S. power is competing for primacy in the world, can afford a military space doctrine calling for new and expensive space control systems. Many feel that the threat to our space capabilities is simply not mature enough today to demand anything beyond preliminary research and development efforts aimed at a space control capability.

On top of this, domestic issues have taken center stage in the competition for scarce resources. In an environment of large national deficits and growing unease with the war in Iraq, military investments intended for anything other than a clear and present danger will be a tough sell.

Organizationally, our national security space infrastructure is not prepared to tackle these issues. While there are certainly many acknowledged space experts, the basic building blocks of the national security space organization--the planners that develop doctrine, the acquisition corps that buys our space systems, and the military operators that fly the satellites—have not matured sufficiently to embark on a dual path of wholesale modernization of existing capabilities *and* the development of an entirely new mission area aimed at securing space supremacy.

The rationale used to distinguish the third battle in space is the impending move from *militarization* of space to *weaponization* of space. In order to respond to this significant shift, the national security space infrastructure must be able to balance politics, technology, and organizational change. If the United States is too aggressive in its pursuit of space supremacy, the cost could very likely be seen in the demise of current and planned upgrades to force enhancement systems. If we ramp up in space to achieve dominance, we risk losing capability in the force enhancement role that is integral to military forces today and into the future. .

This paper explores a series of political, technical, and organizational issues in national security space. These issues have forced the United States to trade space capability, such as satellite reconnaissance and navigation, for insurance, in the form of space control systems to protect vulnerable space assets and deny enemy use of space. Chapter two offers a brief assessment of the current state of play in military and intelligence space systems. Next, chapter three focuses on political implications affecting the national security space debate. Chapter four analyzes the readiness of today's space organization to tackle crucial challenges it will face if the United States is to move toward weaponizing space. Finally, chapter five offers conclusions and recommendations for those engaged in the ongoing national security space debate.

Notes

[1]The term "national security space" is most commonly used to describe the U.S. space infrastructure associated with national security needs. It includes space organizations and systems from the military, intelligence, and civil arenas that are considered important contributors to U.S. national interests.

Notes

[2] Adolfo J. Fernandez, "Military Role in Space Control: A Primer." CRS Report for Congress, (Washington D.C.: Library of Congress), 2.

[3] Benjamin S. Lambeth, "Footing the Bill for Military Space," *Air Force Magazine*, August 2003, Vol 86, No 8.

[4]Speech by General Michael Ryan, Chief of the US Air Force, August 1, 2001

[5]Adam Hebert, "Toward Supremacy in Space," *Air Force Magazine*, January 2005, 22.

[6]Barry Posen, "Command of the Commons,: The Military Foundation of U.S. Hegemony," *International Security* 28, No 1 (Summer 2003), 6.

[7] Posen, 8.

Chapter 2

Space Systems of the Third Battle

National Security Space Missions

As a prelude to analyzing the political and organizational issues influencing the national security space debate, it is useful to understand the current state-of-play in U.S space systems. U.S. "national security space" is made up of organizations and space systems that support national security objectives. National security space systems include force enhancement missions commanded primarily by the Air Force. These missions include satellite communications, missile warning, space-based weather, and navigation. Also included are intelligence missions, primarily imaging and signals intelligence space systems, typically run by the National Reconnaissance Office (NRO).

Today, five years into the third battle, the space systems the United States is flying are based on similar systems fielded in the 1960s and 1970s. As alluded to earlier, the entire national security space infrastructure is scheduled to be upgraded during the next decade. A review of today's force enhancement missions--satellite communications, missile warning, weather, navigation, and satellite intelligence--highlights the importance of current national security space systems.

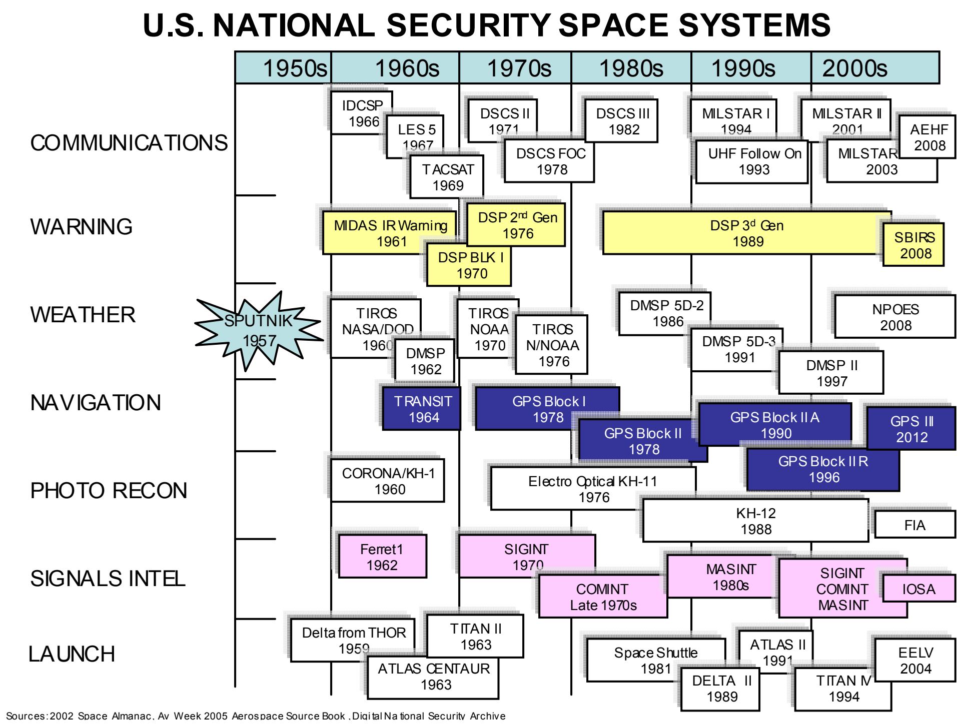

Figure 1--Historical Space System Development

Military Satellite Communications Systems (MILSATCOM): Today's U.S. order of battle in MILSATCOM consists primarily of three major satellite communications systems, the Defense Satellite Communications System (DSCS), the UHF Follow-On (UFO) system, and the Milstar system. Each of these systems operates in a different part of the electronic spectrum and offers different advantages and disadvantages to military users.

Military satellite communications systems are typically categorized as wideband, protected, or narrowband. Wideband systems such as DSCS offer high capacity. The Protected systems like Milstar carry anti-jam features, low probability of intercept, and nuclear survivability. Narrowband systems such as the UFO satellites are aimed at users who require voice and data communications in a mobile environment where small antennas are the order of the day. In addition, a large majority of the military's satellite communications (MILSATCOM) needs are met by commercial systems operated by international consortia such as the International Telecommunications Satellite Organization (INTELSAT) and the International Maritime Satellite Organization (INMARSAT).[1]

In the communications realm, it is easy to see why Air Force Secretary Roche commented we are operating with space systems that are much the same as those fielded in the 1960s. The backbone of U.S. military communications, DSCS was first launched in 1971 with an upgrade in 1982 via a service life extension. Milstar was developed as a Cold War system designed to operate through a nuclear war. Because of the extreme challenges of operating in this difficult environment, communication is limited to voice-grade data rates of 2400 bits per second in the survivable mode and 1.544 megabits (on 32 channels) in its highest data rate mode. As a comparison, the typical home computer network operates at about 50-100 megabits per second. The DoD began using commercial SATCOM in the late 1960s and remains one of its largest users. During Operation IRAQI FREEDOM, the invasion of Iraq in 2003, the United States military was forced to lease nearly 80% of its satellite communications throughput from commercial vendors.[2]

According to the Aerospace Corporation, a major player in the U.S. national security space development infrastructure, "the current military satellite communications network represents decades-old technology."[3] The military too recognizes that assured, high capacity communications will be absolutely essential to future combat operations that rely heavily on integrated and networked systems. As a result, there are major upgrades planned across the MILSATCOM spectrum to include replacements for DSCS and Milstar with the Wideband Gapfiller System and Advanced EHF systems respectively.

Each Wideband Gapfiller spacecraft will be capable of delivering 2.4 gigabits per second, exceeding the capacity of today's entire DSCS constellation.[4] The Advanced EHF system, now slated for launch in 2008, will have 12 times the throughput of Milstar and support twice as many tactical networks. However, both the Wideband Gapfiller and Advanced EHF systems are struggling to synchronize the space segment with the all important ground segment which includes satellite command and control as well as user terminals and radios. The Advanced EHF program is now said to be experiencing a cost growth of nearly $2.5 billion.[5] Full deployment of operational wideband terminals is not scheduled until 2010 with protected terminal synchronization following in 2012. To add to the challenge, launches of both systems have slipped as a result of technical challenges and budget instability.

A significant leap-ahead in MILSTACOM is planned for the 2012 timeframe with the Transformational Communications Architecture, a system of satellites and networks aimed at providing the communications backbone for all future military operations. The Transformational Satellite Communications spacecraft are being designed to capitalize on high capacity laser communication links to serve as an "internet in the sky" to connect deployed mobile forces on land, sea and air with the Global Information Grid.[6] The budget for TSAT, $774M for 2005, has been cut by $200M in both FY06 and 07, likely delaying the program significantly.[7]

Space-Based Missile Warning: The U.S. continues to perform the missile warning mission using the Defense Support Program (DSP) first launched in 1970. DSP satellites trace their legacy to the first infrared missile warning spacecraft, the MIDAS system orbited in 1963. The Defense Support Program is a system of geosynchronous satellites that form the backbone of North America's Early Warning System.[8] The system was designed to detect and track hot burning long range ICBMs such as the Soviet SS-18.

The major improvement in DSP's military utility since its inception came not in space but on the ground. Since the sensors on orbit have not changed substantially since the 1960s, and due to the growing need to see smaller theater class ballistic missiles, an innovative ground processing system was developed that provides highly accurate tactical threat data through the use of stereo processing of the DSP satellite data. This "Theater Event System" proved its effectiveness during the Persian Gulf conflict by detecting the launch of tactical threats such as Iraqi Scud missiles.[9]

The last Defense Support Program satellite, a fifth generation upgrade and the latest in a series of 18 spacecraft launched over the last 29 years, was launched in 2004.[10] The DSP system is scheduled to be replaced by a new series of geosynchronous satellites called the Space Based Infrared System or SBIRS, an infrared surveillance system designed for missile warning, missile defense, battlespace characterization, and technical intelligence.

By providing improved sensor flexibility and sensitivity through faster scan rates and expanded infrared sensor bands, SBIRS is slated to perform a much broader set of missions than DSP.[11] The improved satellite and ground processing capabilities will enable detection of much more stressing threats such as very short range missiles. The SBIRS program has faced a series of delays and cost overruns which have caused the first launch to slip from 2002 to 2007 and the budget to increase by over $2 billion in the past few years. The project is now estimated to cost a total of $9.9 billion.[12] The five year delay and the nearly 200 percent cost increase brings into question the military's ability to field basic space force enhancement capabilities necessary to support our current doctrine let alone a more aggressive doctrine that in the next 10 years would include offensive and defensive space control capabilities

Weather: The Defense Meteorological Satellite Program (DMSP) was designed to provide the military with a dedicated weather observation system. The Defense Department can also draw on civil weather satellites but the DMSP has specialized meteorological capabilities to meet specific military requirements. An upgraded Block 5D series (a $40 million spacecraft) was first launched on 20 December 1982, providing high accuracy pointing, improved redundancy, and a life extension of 3-4 years.[13] While an enhancement over previous models, the Block 5D is not a significant advancement in technology.

However, vast improvements have been made in integrating weather into the tactical battlefield via fielding of numerous theater receiver terminals. Transportable terminals were developed for use on large mobile platforms such as aircraft carriers while man portable small tactical terminals have been deployed which ingest, process, and display real time data from DMSP as well as high resolution data from the National Oceanic and Atmospheric Administration. [14] The proliferation of user terminals highlights the essence of the second battle, waged to assure full integration of space into terrestrial warfighting.

In 1994, the White House issued a Presidential Decision Directive (PDD) titled *Convergence of U.S. Polar-orbiting Operational Environmental Satellite Systems (NPOESS)*. The satellite system that will result from that directive will be designated

National Polar Orbiting Operational Environmental Satellite System (NPOESS) and will include civil and military space weather systems. The transition to the NPOESS is scheduled to begin by the year 2008. The plan was impacted significantly in September 2003 when a primary civil weather spacecraft, the National Oceanic and Atmospheric Administration (NOAA) N-Prime satellite, fell off its mounting stand in the factory and suffered significant damage.[15] The total loss of a $400 million satellite slated for launch in 2008 has impacted the already challenged space weather architecture. Again, the challenge of simply replenishing existing space capability has proven difficult.

Navigation: The Global Positioning System was declared fully operational on 27 April, 1995. Following the first launch of a Block II satellite in 1989, GPS was unexpectedly able to validate its worth following the Iraqi invasion of Kuwait in 1990 when the system was used to provide navigational information to airborne, ground, and naval units of allied forces. It was the media's coverage of GPS during and after the Gulf War that helped generate a surge of civilian interest that has since made GPS a worldwide utility.

In describing the primary upgrades to GPS during the second battle, author Steven Lazar notes enhancements to GPS have historically been driven both by technological advances and by user demand. Specifically, Block IIA spacecraft included an improved atomic frequency standard in the navigation payload, "yielding a nearly threefold increase in ranging accuracy over original specifications" as well as hardware and software upgrades to the operational control segment on the ground that steadily reduced the positioning and timing errors attributable to satellite orbit determination."[16]

The most significant improvement to fielded forces was not due to satellite improvements, it was operational improvements and the integration of GPS receivers into all levels of combat that was the story--from 112,000 Precision Lightweight GPS Receivers (PLGR) used by infantry and Special Forces to integrated GPS avionics in every aircraft in the U.S. military inventory. Operating a system designed to deliver 16-meter accuracy with 50% probability, GPS developers and operators were able to use innovative tactics and procedures to significantly improve accuracy to less than 6-meters at 95% confidence by the end of the second battle.

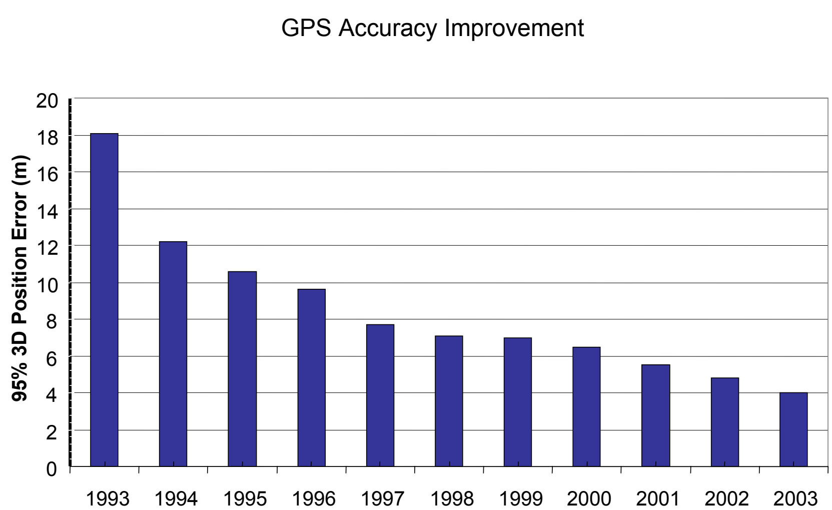

Figure 2--GPS Accuracy Improvement in the Second Battle

Since reaching operational capability in 1995, the Air Force has focused on two priorities with the Global Positioning System (GPS), sustaining the constellation and developing an upgrade to solve existing shortfalls. With the exception of a drought of nearly two years without a launch that was caused by a catastrophic booster failure and the ensuing investigation, there has been an average of three GPS launches per year aimed at sustaining the current constellation.

However, on-orbit GPS satellites have lasted well beyond their original design life creating a dilemma—continue to squeeze additional life out of the older GPS II and IIA spacecraft, or dispose of them and replace them with upgraded GPS IIR satellites? The mindset in space command has always been to fly spacecraft, even the relatively inexpensive GPS at $43 million a copy, for as long as possible due to their high cost and the uncertainty that the occasional launch failure adds to orbiting a replacement. As a result, GPS is old by industry standards with the satellites in the constellation averaging 8.5 years in age. This sustainment issue has caused a delay in putting new capabilities on orbit.

A primary shortfall of GPS is its low power signal—about 28 watts transmitting from 20,200 km in space. It is this low power that encouraged Iraqi forces to attempt to jam the GPS signal during Operation IRAQI FREEDOM. Upgrades to GPS include new signal structures and increased power levels aimed at assuring a high integrity GPS signal is available to both military and civilian users. However, the three upgrades currently in work (GPS IIR-Modernized, GPS IIF, and GPS III) to tackle these shortfalls have each run into schedule and budget delays. For example the GPS III program, being developed to counter the evolving jamming threat, was zeroed out in the fiscal year 2004 budget and its first launch delayed a year to 2013.[17]

Imagery and Signals Intelligence: National Reconnaissance Office programs have traditionally been kept highly secret. In 1998, the Defense Science Board authored a report describing how the NRO was creating a Future Imagery Architecture (FIA), for acquiring imaging satellites and their associated ground control and processing systems. The DSB noted that the current stable of reconnaissance satellites had a "finite life and the next generation is needed to assure continued availability of essential products."[18] FIA is intended to replace the existing satellite imagery baseline and improve the integration of space-based imagery data with other types of intelligence.

According to the Los Angeles Times, "The supersecret project for the National Reconnaissance Office is estimated to be worth up to $25 billion over two decades, equipped with powerful telescopes and radar, the nation's newest eye in space is expected to form the backbone of U.S. intelligence...able to fly over and take pictures of military compounds anywhere in the world, in darkness or through cloud cover, with far more frequency."[19] Indicative of the challenges associated with complex space programs, the Washington Post cited a follow-on report by the Defense Science Board that said FIA had been "significantly underfunded and has suffered from technical shortcomings" and was "not executable."[20]

Not all is lost however as the ground processing element of the FIA system, an element called the Mission Integration and Development program, or MIND, was placed into operations in December 2004 and came in on budget. According to defense consultant Lauren Thompson, MIND uses internet-style protocols to create a user-friendly intelligence system where "imagery can be quickly fused with other types of intelligence to create a composite picture of the battlespace."[21] It is important to note that FIA was not intended to offer large gains in "granularity" but is intended instead to offer better flexibility and responsiveness.[22] The integration of data using new and powerful ground processing, not the development of new apertures, is likely to offer the highest return on investment in the near- to mid-term.

The other major arm of overhead satellite reconnaissance is signals intelligence (SIGINT). In 1998, the Director of the National Reconnaissance Office, Keith Hall, announced the NRO was introducing an Integrated Overhead SIGINT Architecture (IOSA) to "improve SIGINT performance and avoid costs by consolidating systems, utilizing medium lift launch vehicles wherever possible, and using new satellite and data processing technologies."[23] In 2002, space observers noted problems with the existing SIGINT system caused by the loss of one on launch and the extended ground repair of another.

The proliferation of fiber in the global telecommunications infrastructure has also made it much more difficult to intercept communications via space-based platforms.[24] All this has led to turmoil in the signals intelligence world that still must be worked out. In the war on terror, signals intelligence can often be the tip-off that starts the time critical targeting sequence. Leaving U.S. intelligence agencies and warfighters without such vital information will certainly affect the ability to prosecute fleeting targets such as terrorists and insurgents. In searching for the best way to invest precious space resources, this should be a top priority.

In summary, the U.S. national security space architecture is hurting. The entire set of legacy missions is awaiting upgrades that have been terminally plagued by cost, schedule, and technical issues. The current state of play in space highlights the compelling need to upgrade legacy space force enhancement missions first, before tackling the tough policy issues, heavy investment, and significant technical challenges associated with space supremacy.

Notes

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Chapter 3

Politics in the Third Battle

> *The political, economic and military value of space systems makes them attractive targets for state and non-state actors hostile to the United States and its interests. In order to extend its deterrence concepts and defense capabilities to space, the U.S. will require development of new military capabilities for operation to, from, in and through space.*
>
> Report of the Commission to Assess United States National Security Space Management and Organization, 2001

The Space Threat in the Third Battle

Politics is driving the evolution of U.S. national security space. Concerns about possible asymmetric threats to American space systems are well documented. An aggressive grand strategy of primacy has emboldened space leaders to pursue a high end space supremacy doctrine based on controlling space. Budget constraints are acting to hold back space system development and slow technology growth. Finally, the issue of weapons in space is ever present in the background as the U.S. studies how to proceed in the third battle. This section will address each of these political drivers.

Does a Vulnerability Equate to a Threat?

Despite its monopoly in space, the United States continues to struggle to define a space architecture to meet future national security needs in an evolving international environment. The Space Commission raised fears of a "space Pearl Harbor" noting that the "political, economic, and military value of space systems makes them attractive targets for state and non-state actors hostile to the United States and its interests."[1] Numerous military threat assessments have pointed out the potential vulnerabilities of our space systems. To highlight the issue, approximately half of the roughly 700 operational satellites in orbit are U.S. commercial, civilian, or military satellites, according to U.S. military space authorities.[2]

This world leadership role in space and the potential vulnerability it presents has led the United States to aggressively pursue a doctrine of supremacy in space built around the concept of space control. The Space Commission report highlighted the need to develop a "deterrence strategy for space" which requires a broad range of improved capabilities that include "defense in space" and "power projection in, from, and through space."[3] The military space control mission, consisting of space situational awareness, defensive counter-space, and offensive counter-space, has assumed center stage in the national security space dialogue.[4]

Secretary of Defense Donald Rumsfeld laid out the potential for threats to U.S. space systems in a speech to military leaders at the National Defense University where he noted that the U.S. has unparalleled land, sea and air power, leading potential adversaries to "challenge us asymmetrically, by looking at our vulnerabilities and building capabilities with which they can, or at least hope, to exploit them."[5] The military points to current examples such as the 2003 disruption of a U.S.-built commercial satellite communications transponder carrying a broadcast (Voice of America) to the Middle East by Iranians operating in Cuba and the attempted jamming of GPS signals by Iraqi forces in Operation Iraqi Freedom.[6] As early as 2000, the Xinhua news agency reported that

China had begun developing strategies for defeating the U.S. military through a future war to be waged in space. It noted, "For countries that could never win a war by using the method of tanks and planes, attacking the U.S. space system may be an irresistible and most tempting choice..."[7] U.S. Space Command noted in its Long Range Plan for 2020 that, since space is crucial to both military and economic instruments of power and "the way a nation makes its wealth is the way it makes its war," space has become a vital national interest.[8]

Underscoring both the importance and vulnerability of this interest, Tom Wilson, a Space Commission Staff Member documented potential offensive counterspace threats that included a host of Anti-Satellite (ASAT) weapons to jam or destroy U.S. satellites (via laser, radio frequency, particle beam, and direct ascent weapons) in a paper titled *Threats to United States Space Capabilities*.[9] Further threats include the possibility of micro-satellites in space designed to rendezvous and destroy a target satellite, or even nuclear detonations in space aimed at increasing radiation to satellite-damaging levels. Wilson goes on to describe decidedly more low-tech methods such as electronic attack on command and data links and denial and deception techniques for enemies on the ground to use in avoiding U.S overhead space assets.

Long considered the easiest means to attack U.S. space capability is the attack or sabotage of supporting ground sites. Most of these facilities are relatively easy to get in close physical proximity to and can be attacked by a variety of means from physical destruction to computer network intrusion.[10] To make matters worse, due to the prohibitive cost and weight of protecting systems in space against a vaguely defined threat, most national security and commercial space systems are left unprotected and vulnerable to attack.[11]

An additional threat to the U.S. asymmetric advantage in space is the commercialization of the medium. A wide array of commercial communications, remote sensing, weather, and reconnaissance satellites make space available to U.S. adversaries on the open marketplace.[12] This civilian character drastically increases the difficulty for the U.S. in deciding how to cut off an enemy's space pipeline. Politically, destruction of a commercial satellite serving a host of international customers, including U.S. allies, may be untenable. Furthermore, commercial space systems create a natural redundancy through proliferation. If one communications satellite is damaged, it is relatively easy for a user to switch services making it nearly impossible to totally deny access to space products.

Conversely, many experts argue that the United States is so far ahead in space that to pursue such strategies as offensive counterspace and weapons in space would only increase the potential threat in space. Barry Posen argues in his cogent piece on military strategy that the U.S. enjoys "command of the commons—command of the sea, space, and air" and sees it as implausible the U.S. could see this command challenged in the near to medium term.[13] A vigorous pursuit of an offensive doctrine in space may drive nations to band together to balance against perceived U.S. hegemony. As foreign policy analyst Stephen Walt points out, vulnerable states tend to align against the most threatening power with threat measured as a function of variables such as net strength, offensive capability, and aggressiveness.[14]

A look at competitors in any upcoming space race produces a field that consists of Russia, Europe, Japan, China, India, and potentially South Korea. Russia's program is cash starved to the point that President Putin declared his country "had nothing to be proud of in space."[15] According to the Chairman of Europe's National Space Research Centre, Russia's investment in space has bottomed out at only 2% of worldwide expenditure, with the United States and Europe making up 90% of the world's space spending.[16] According to data gathered by *World Prospects for Government Space Markets,* (see figure 1), U.S. space spending dwarfs that of the next two closest competitors, Europe and Japan who spend on the order of $1 billion and $2 billion on military space respectively.

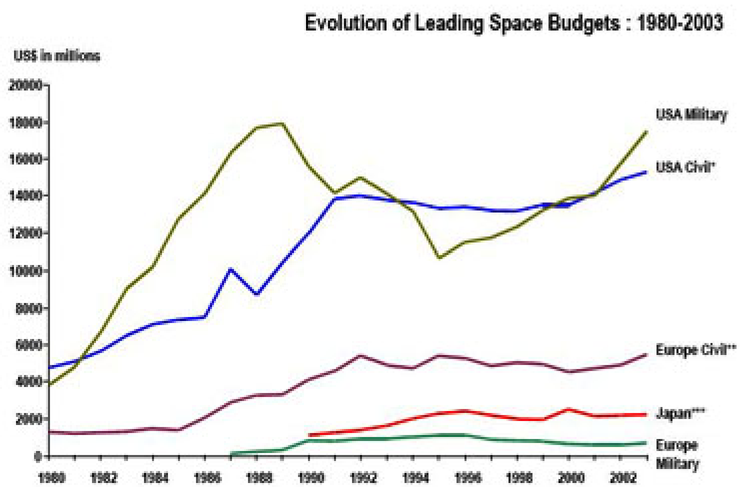

Figure 3--Leading World Space Budgets[17]

Europe is represented by the European Space Agency (ESA), a consortium of fifteen states. ESA is one of the leading space agencies in the world but has been hamstrung by the need to get agreement and funding passed through all member states.[18] Japan, crippled by a string of failed launches that caused the loss of a multi-billion yen astronomy satellite and resulted in cancellations of numerous launch contracts, is facing major questions on whether it should continue to pursue space. [19] Japanese defense spending is capped at 1% of GDP leaving little flexibility for the Japanese to use military means to solve the space dilemma.

Chinese and Indian space progress has historically been linked to missile development efforts. As for the Chinese, they have "long aspired to be a space power" says Dean Cheng, an Asian specialist at the Center for Naval Analysis, yet he estimates the Chinese space budget to be only $1.5 billion to $2 billion annually.[20] The recent launch of the *Shenzhou*, a manned mission to orbit the earth, has energized the Chinese space program. It is arguable whether or not the *Shenzhou,* very closely resembling a *Soyuz* capsule, was a significant Chinese scientific achievement as it drew immensely upon Russian design assistance but it can be said that manned space flight is definitely a sign of priorities in the Chinese government. However, the Monterey Institute of International Studies notes "the investment is clearly a significant drain on resources in a country still struggling to meet basic living standards for its population."[21]

India recently developed a launch capability designed to put spacecraft in 24-hour geostationary orbits. Impressive yes, but according to *The Economist*, the effort has taken nearly a decade and is represented by an investment of $300 million.[22] Compare that to the $9 billion the U.S. is spending on its latest missile warning satellite upgrade, the Space-Based Infrared System. Lastly, South Korea is planning for an indigenous launch capability that would be operational by 2005.

It is important to note that the risk of any of these potential competitors will combine to balance against the United States in space is low. The Chinese have leveraged Russian capabilities but Russia does not appear interested in continuing that trend. The European Union has moved to develop Galileo, a navigation system similar to the U.S. GPS system, yet the Europeans realize it is in their best interest to make systems like Galileo compatible with U.S. capability.[23]

Of these potential threats in space, it is competition from the Chinese that worries U.S. military planners the most. Arms control experts argue that if the U.S. continues to move more aggressively in space and China feels compelled to respond, it may be inevitable that China becomes the "third man on the fourth battlefield." [24] The United States clearly holds a dominating command of the commons with the nearest competitors spending a fraction of the U.S. investment in space. Today, no country is competitive with the U.S. in space. One is left to wonder if we are indeed only racing ourselves in the pursuit of space dominance.

Target Evolution is Stressing Space Reconnaissance Capabilities

While the United States maintains the strongest military around, it faces extreme challenges around the world ranging from cantankerous state actors to borderless/non state opponents. Henry Kissinger recently noted "Never before has it been necessary to conduct a war with neither front lines nor geographic definition and, at the same time, to rebuild fundamental principles of world order."[25] In space, the threats that our satellites were designed to see and sense, ICBM fields, electronic emissions, and infrared signatures, are evolving and becoming tougher to capture. No longer is the target an enemy armored Division or a fixed weapons site. Instead, the new target sets are what the military calls time critical or fleeting targets. Unlike traditional targets, these fleeting targets--terrorists, insurgents, weapons traffickers—are not suited to detection from space.

Dr. Loren Thompson of the Lexington Institute points out that U.S. intelligence has characterized the signatures for traditional fleeting targets such as mobile Surface to Air Missiles or SCUD short range missile launchers. But, the new breed of fleeting targets seldom exhibit predictable patterns, are extremely deceptive in nature, and do not use equipment that emits a significant trackable signature.[26] The technical challenge of collecting these signatures from space is made extremely difficult by the simple laws of proximity. Since radio frequency emissions fade as a square of distance from the source, collection of very low power signatures from orbital distances of 120 miles to 22,000 miles becomes nearly impossible. [27]

Add to the fact that increasingly, adversaries today elect not to face U.S. forces in the open but instead prefer to fight in what security studies experts have called "the contested zones"—arenas of conventional combat where "weak adversaries have the best chance of doing real damage to U.S. forces."[28] In these contested zones, where the enemy knows the terrain and high-tech weaponry is often non-existant, command of the commons becomes irrelevant.

As a growing number of targets are classified as fleeting, intelligence data takes on a more significant role in the targeting chain. Conventional kinetic weapons could be delivered from space or via converted ICBMs in less than an hour, yet without targeting quality intelligence, this strike capability buys little over what the U.S. has today with airpower or cruise missile attack capabilities. Ironically, these elusive threats are driving the military to look at systems that operate much closer to the battlefield as opposed to traditional space systems.

In *The Transformation of American Airpower*, Benjamin Lambeth points out that "just because a mission *can* be done from space does not mean that it *should* be."[29] General Lance Lord, the Commander of Air Force Space Command, talks about platforms such as lighter than air craft to attack the problem.[30] Operating at an altitude of 65,000 to 80,000 feet, platforms much like weather balloons would carry sensors to track fleeting targets form altitudes that enable engineers to solve the problems associated with capturing these targets from space. Recasting the debate in these terms challenges the traditional drive of space visionaries to migrate to space any mission that is possible to perform in space.

One wonders if this notion of pulling back from space supports the doctrine of space supremacy and what it will do to an already confusing cultural debate between traditional pilots and an emerging space cadre. National security space leaders are now faced with a difficult decision—enable the U.S. to maximize the gains from the space commons by developing systems to find and track new target sets in the contested zones; or develop space control systems to assure command of the space commons by protecting satellites and ground architectures from a threat in space. It is unlikely that U.S. defense budgets will support both.

Grand Strategy and Space Doctrine in the Third Battle

Ideally, it is national grand strategy that defines how a nation connects military ends and means. In turn, national space policy defines the nation's agenda in space. Military doctrine and strategy set the vision and influence which military systems are developed and fielded. These factors have played a role in stunting the evolution of U.S. military space capability as compared to the robust growth in space during the first and second battles.

Grand Strategy in the Third Battle: Today, the United States is in the enviable position of the sole superpower and is practicing a grand strategy of primacy. Primacy is built on the premise that U.S. power drives peace and views the rise of a peer competitor as the greatest threat to international order. As a result, primacy advocates are convinced the United States must preserve supremacy "by politically, economically, and militarily outdistancing any global challenger."[31] It is not enough to win the race, the competition must be crushed. In support of primacy, William Wohlforth claims the current strategic environment is "unambiguously unipolar" and the United States is "the first leading state in modern international history with decisive preponderance in *all* the underlying components of power: economic, military, technological, and geopolitical."[32]

The G.W. Bush National Security Strategy (NSS) of 2002 coupled with military and diplomatic actions following September 11, 2001 point squarely toward a hegemonic strategy more aggressive than the Clinton administration strategy of engagement and enlargement.[33] The Bush strategy has proven controversial due primarily to three themes that support primacy.[34] First, the strategy calls for preemptive military action against hostile states and terror groups seeking to build weapons of mass destruction—"our best defense is a good offense."[35] Second, is the stated objective to "reaffirm the essential role of American military strength" by building our defenses "beyond challenge."[36] Third, the NSS speaks of a renewed interest in working with others to diffuse conflict, but makes it clear the United States "will not hesitate to act alone, if necessary."[37] It has also left our military and in concert our national security space system wondering how to support this emerging grand strategy. It is quite possible this strategy of primacy is driving the U.S. into pursuing dominance in all areas—even those where we face no compelling threat. As it relates to U.S. space power, are we pursuing similarly aggressive actions in space? To answer these questions, it is helpful to review American space policies and doctrine in the third battle.

Space Doctrine and Policy in the Third Battle: The current National Space Policy, published in 1996, charges the Department of Defense to maintain the capability to execute the mission area of space control. The policy expressly specifies "consistent with treaty obligations, the United States will develop, operate, and maintain space control capabilities to ensure freedom of action in space and, if directed, deny such freedom of action to adversaries." [38] The administration has not issued a new comprehensive space policy but has delivered a number of space policy statements that indicate a strong move to shift U.S. space policy toward a more aggressive posture.

Since entering office, President Bush has issued two significant space policy addendums; a policy on U.S. commercial remote sensing; and a policy on U.S. Space-based Position, Navigation, and Timing. The commercial remote sensing policy is distinctly aimed at assuring that U.S. industry can compete as a provider of remote sensing capabilities, but ensures appropriate measures, such as "shutter control," are implemented to protect U.S. national security interests.[39] The *U.S. Space-based Position, Navigation, and Timing Policy* goes to great lengths to provide guidance on sustainment and modernization of the Global Positioning System (GPS) as well as development of capabilities to "protect U.S. and allied access to and use of GPS for national, homeland,

and economic security, and to deny adversaries access to any space-based positioning, navigation, and timing services."[40] The Associated Press characterized this guidance as President Bush ordering the U.S. to plan to disable the network of global positioning satellites during a national crisis to "prevent terrorists from using the navigational knowledge."[41] Both policies are clear gestures toward solidifying the nation's space control doctrine.

An argument can be made that historic U.S. space policy has weakened the U.S. position in space. Through most of the Cold War, allies did not emphasize investment in space—the United States made it unnecessary by shouldering the investment load. It may be time to push change. While the U.S. spends $13 billion per year on space, our allies spend a tiny fraction of that—why are we giving them free use of space services such as GPS? A cost sharing arrangement could help bolster current systems as well as fund future space protection schemes.

The nation's military space policy, last updated in 1999, hedges in fully directing a space control philosophy as it calls for the U.S. military to "provide space control capabilities consistent with Presidential policy as well as U.S. and applicable international law" and to "explore force application concepts, doctrine, and technologies."[42] Air Force Doctrine covering Space Control discusses both defensive and offensive counterspace operations. According to Air Force Doctrine Document 2-2.1, *Space Control*, defensive counterspace operations "provide the means to deter and defend against attacks and to continue operations by limiting the effectiveness of hostile action against U.S. space assets and forces."[43] Offensive counterspace operations "preclude an adversary from exploiting space to their advantage" by targeting an adversary's space capabilities to include space systems, information links or third party space capability. This offensive capability hinges on space forces to effect necessary targets ranging from electronic warfare weapons to exotic capabilities such as anti-satellite systems and directed energy weapons.

The move toward offensive space capabilities coupled with President Bush's strong support of a National Missile Defense system has edged the U.S. toward an even more aggressive thinking in space that can be characterized by a "high ground" doctrine. Advocates of the high-ground school argue that "the global-presence characteristic of space forces combined with either directed-energy or high-velocity-impact space weapons provide opportunities for radical new national strategies."[44] The idea that space forces can dominate forces on earth is prevalent in the high-ground doctrine which makes it controversial and much maligned by arms control advocates. Yet, when compared to the national grand strategy of primacy, both space control and high ground doctrines are found to be a close match with the philosophy spelled out in the U.S. National Security Strategy.

Can the U.S. Fund Primacy, The War On Terror, Military Transformation, Missile Defense…..And Space?

Of all the issues conspiring to make the decisions in space so difficult, none is more crucial than how to fund future prospects in space and at what opportunity cost to the nation.[45] National defense spending in the Bush II era is higher than at any point since the Reagan administration at nearly $400 Billion with over 50% of that going toward military personnel and operations and maintenance of the force (excluding supplemental appropriations for Operations in Iraq).[46] This defense budget is aimed at major themes including the global war on terrorism, expanding mission capabilities of the armed forces to include a national ballistic missile defense system, and transforming military capabilities. The FY05 defense budget request includes $68.9 billion in research and development funding, 57% more than in the 2001 defense budget.[47]

However, observers point out that much of this R&D funding is aimed at system development and demonstration of established programs such as the F-22, Joint Strike Fighter, DD(X)—a next-generation Navy destroyer, and the Army's Future Combat System, leaving little funding for transformational systems that will be required down the road. Space systems to tackle the space control mission fall in this category.

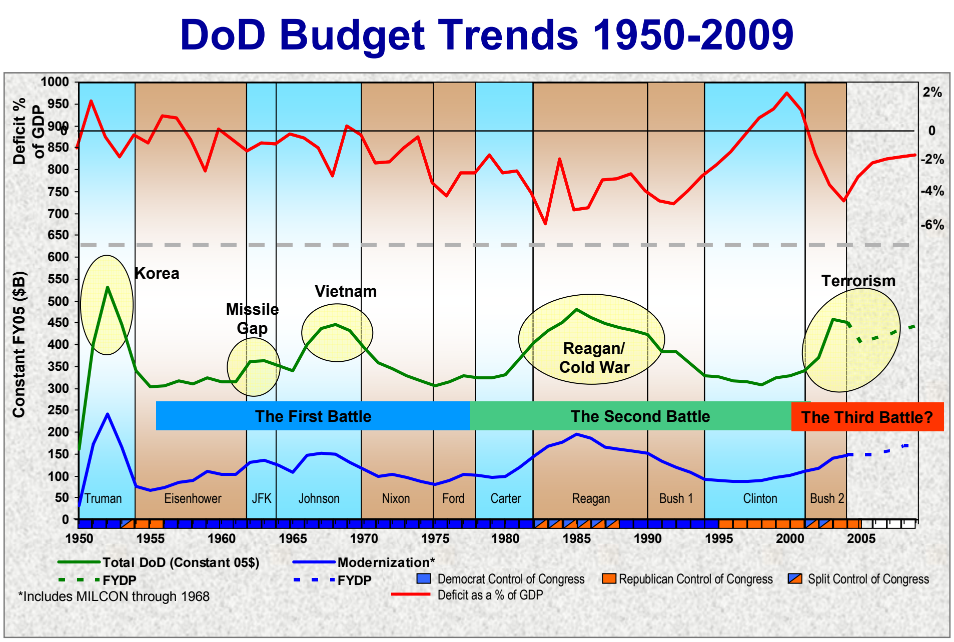

Figure 4--DoD Budgets thru the First, Second, and Third Battles

As a measure of economic strength in the national security space arena, the Department of Defense spent over $12 billion on space programs in 2004 and is predicted to increase that to $13.6 billion in 2005. According to the Commander of Air Force Space Command, "that $13.6 billion would be the highest percentage of U.S. Gross National Product that we've allocated toward space since 1992."[48] Compare this to the budget context in the first two battles in space.

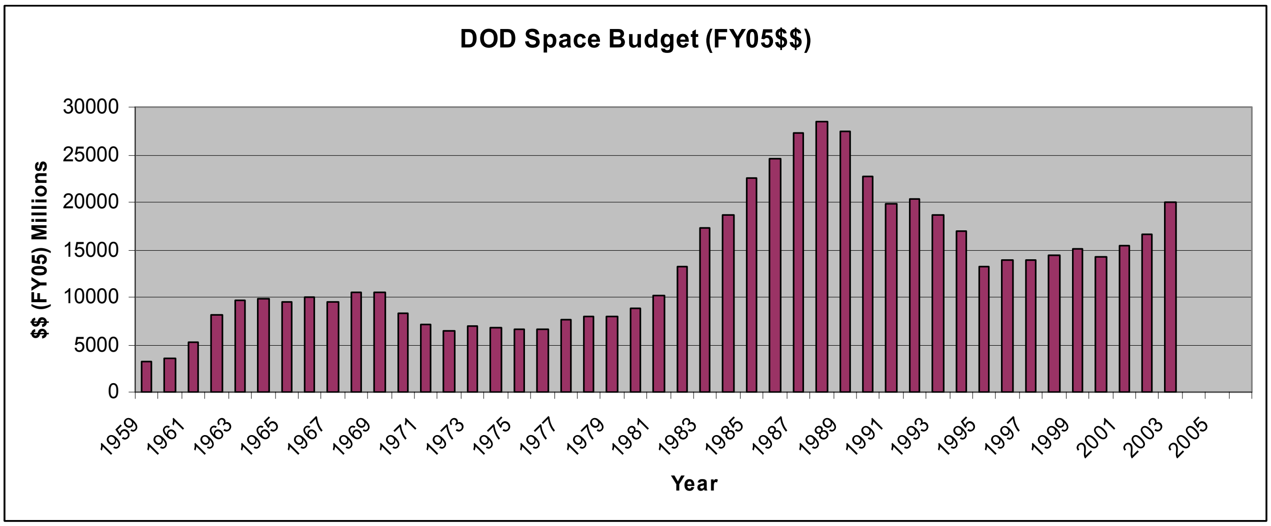

Figure 5 Historic Space Budgets

In the space control arena, the President's Budget Submission by the Air Force includes $727 million for the years 2004-2012.[49] This includes activities in the various programs to perform the missions of space situational awareness; defensive counterspace to protect U.S. and friendly space assets; and offensive counterspace to disrupt, deny, degrade, or destroy space systems hostile to the United States. Over $100 million is budgeted for two ground-based offensive counter space systems labeled the "Counter Surveillance & Recon System" and the "Counter Satellite Communications System." with another $25 million dedicated to a space control test and training range.[50] To put it in perspective, the $727 million currently budgeted for space control from FY 2004-2012 (9 years worth of spending) compares to the $10.1 billion budgeted for Missile Defense

(NMD) in 2005 alone.[51] The good news is that missile defense investments can have direct applicability to the challenge of negating an enemy satellite in the space control mode. However, to think that space control systems will be any less challenging or expensive than current space programs such as the Space-Based Infrared System or National Missile Defense would be overly optimistic.

Not only have international issues effected U.S. space actions, but competing interests are holding space back. Space systems are expensive. The U.S. is currently developing a number of systems expected to reach $5-10 billion each not including the $11,000 per pound it will take to launch them. The economics here on earth have a large impact on operations in space. National economic and budget woes have conspired to slow the rigorous growth once projected in U.S. space, particularly on the commercial satellite side of the house. Defense budgets, on the rise since 1996, have begun to retract. The U.S. national budget has gone from a surplus of nearly 2% of GDP in 1996 to a projected deficit of 5% of GDP in 2005 (see figure 2). The cost of current operations in Iraq, estimated at over $200 billion has dug into military modernization budgets.[52] U.S. investment in space systems has decreased dramatically since its peak in 1988-89 (figure 3). Additionally, a compelling need to modernize major combat systems in all military services has pushed space to the fringes in the battle for precious procurement dollars. The Air Force shoulders 87 percent of the DoD's space funding burden yet in the 2005 AF budget that equates to only 11 percent of Air Force military procurement dollars allocated to space systems.[53]

In the end, the United States must use great care in deciding where to push radical innovation. Michael O'Hanlon points out in *Technological Change and the Style of*

Warfare that "the status quo in defense circles does not mean standing still; it means taking a balanced approach to modernization that has served the country remarkably well for decades."[54] As a nation, defending against threats ranging from box-cutters in the hands of hijackers to enemy satellites in space has stressed the national security establishment. In space, we are left to wonder if the revolutionary vision of space supremacy is viable or achievable in the near future. By being overly aggressive in its space policies, the United States is achieving the unintended effect of making space control and supremacy too ambitious and expensive for the U.S. government and in turn the Department of Defense to accept. The result has been foot dragging when it comes to truly pursuing space supremacy concepts and systems. The nation should be skeptical of any space hypothesis that is too revolutionary if, as O'Hanlon argues "many of its technical underpinnings have not been well established and may not be valid."[55] A more modest objective of researching key space control technologies and operations concepts while completing the overhaul of legacy military space systems is a more prudent approach.

As the next section describes, major technology breakthroughs in space have been elusive when compared to innovations in aircraft systems.

The Space Technology Paradox

During the past decade, technology has grown exponentially in key areas that would seem custom suited to the design of more capable space systems. One example is computing power, commonly measured by "Moore's Law", which has seen the number of transistors on an integrated circuit rise from 2,250 in 1971 to 410,000,000 in 2004 while processor performance has improved by six orders of magnitude (from .01 to 1000 million instructions per second or MIPS) in the same period.[56] Another example is miniaturization. In building space systems, the limiting factor is almost always weight due to the excessive costs of lifting a spacecraft to orbit. Technologies such as micro electro mechanical systems (MEMS) and nanotechnology offer great promise for reducing weight on spacecraft.

Launch costs continue to be the largest drag on space systems. The U.S. launch business has seen not only a reduced launch demand, but the drive toward economic launch costs has been largely unproductive. According to Benjamin Lambeth in his article *Footing the Bill for Military Space*, the constant-dollar price of getting a satellite to orbit has not changed much over the past two decades. Putting a satellite in low earth orbit continues to cost between $3,600 and $4,900 per pound, while getting to geostationary Earth orbit runs $9,200 to $11,200 per pound.[57] Through micro-technology advances in industry, materials have become lighter. Power, a definite limiting factor in space, has become more efficient with smaller more capable devices requiring less electrical power.

However, trends in military satellite development have not kept up with those in industry. Mass and power on defense spacecraft have leveled out. The average weight of a commercial geostationary communications satellite over the past 10 years has slowly come down, stabilizing at about 3750 pounds.[58] Military communication satellites on the other hand have tended to be heavier with Milstar weighing in at 10,000 pounds and the new Wideband Gapfiller Satellite at 6,615 pounds.[59] This weight differential is partly due to military unique components required to assure survivability or add jam resistance. Despite significant breakthroughs in electronics and miniaturization, we have yet to see corresponding improvements in our national security space systems. Like the advent of stealth technology and precision weapons transformed airpower, the U.S. must seize on the chance to develop leap-ahead technologies in space.

A large reason behind the lag in DoD space technology is driven by the way it does space acquisition. Because space systems are typically complex in nature, acquisition leaders commit to technology decisions early in a program in order to stabilize the future production cost and schedule. This creates what Douglas Lee calls a "technology paradox" in that any technical advantage a program gains is lost before launch of the first satellite.[60] In the end, long development cycles and risk averse practices couple to make technology obsolescent before it reaches orbit.

Combined with typically long satellite development and production schedules (often 10 years from start to first launch), this paradox makes it especially difficult to respond with agility to a changing threat. Art Cebrowski, Director of the Office of Force Transformation pushes for tactically responsive space systems, claiming "What we want…are space capabilities in weeks and months and not decades."[61] To date, the space acquisition system has not adjusted to this new timeline. Revolutionary transformation will require revolutionary new acquisition processes—and a solution to the technology paradox. Based on recent space system acquisition results, the U.S. space acquisition system is not moving in that direction. Failures in developing replacements for legacy systems raise serious questions about whether the U.S. national security space system can support more complex acquisition programs such as space tracking and targeting systems and space weapons.

Weapons in Space

Peter Hays spells out in his treatise *Current and Future Military Uses of Space*, that virtually all issues of space strategy are shaped by the broad spectrum of views on weapons in space.[62] For 40 years since the U.S. put a man in space, the world's space powers refrained from putting weapons in space. Even during the height of the Cold War, the two superpowers refrained from actively deploying weapons capable of shooting down satellites and signed the 1972 Anti-Ballistic Missile (ABM) treaty forbidding either side from tampering with satellites including "prohibiting a state-party from interfering with another state-party's national technical means of verification" or spy satellites.[63]

The Space Commission report of 2001 documented how important space has become to our national well being. It also defined the role of space in the civil, defense, and intelligence sectors while assessing vulnerabilities and threats. Normally, this type of report would have fostered an intense debate on the future role of space in support of national grand strategy. Unfortunately, the events following the January 2001 release of the Space Commission report including September 11, the invasion of Afghanistan, and the ensuing war in Iraq have tempered the debate. The limited discourse has focused on two opposing positions: the need to maintain space as a sanctuary versus the need for space weapons.[64]

The majority of world space interests have striven to keep space free of weapons, partly because the cost of fighting in space is beyond their means, but also because of deep rooted beliefs that space is indeed a sanctuary that should be free of conflict. Some argue that space warfare would be devastating to global commerce, especially those commercial transactions and telecommunications services (think pagers, cell phones, cable TV) that use satellites.[65] Military leadership on the other hand is thoroughly convinced the US must move away from the sanctuary doctrine. Advocates of an aggressive military space policy argue that the US is more reliant than any other nation on space assets and is vulnerable to an asymmetric attack in space.[66]

The Space Commission Report lays out three objectives for space: 1) promote peaceful use; 2) use the nation's potential in space to support US domestic, economic, diplomatic and national security; and 3) develop means to deter and defend against hostile acts directed at US space assets. The report then proceeds to spend only six of the remaining 92 pages on anything associated with peaceful use, economics, or diplomacy.[67] It clearly advocates protection of U.S. space assets as its primary conclusion.

In testimony before a Senate sub-committee in March of 2000, General Ralph Eberhardt, then the Commander of U.S. Space Command, captured the importance of space control when he said:

> "Some may consider space a peaceful medium or even an international sanctuary for generating revenue. However, the dependence of our national security on orbiting satellites makes space a tempting target for terrorism and adversarial military operations. As these threats continue to evolve, the mission area of space control becomes even more important."[68]

From a US national security space point of view, the rhetoric points toward the dawn of a national space strategy focused on dominance in space. The Air Force Space Command vision focuses on "space warfighting forces …that operate and employ space power in, from, and through space."[69] A RAND analysis performed in 2002 pointed out that prospective opponents will understand when space capabilities represent an easier target than other critical nodes and will interfere with them. The natural consequence of space integration into military activity is a more hostile environment for space."[70] Evidence of a more hostile environment is documented in Air Force Space Command's *Almanac 2004-2005* which describes the command's future as transforming to provide "full spectrum kinetic and non-kinetic combat capabilities…and increase our focus on producing warfighting effects with space superiority and strike capabilities."[71] All of this points toward weapons in space.

Before moving full speed to weaponize space, the U.S. must consider the broadest possible set of consequences. Economics play a part in the discussion. Between 1996 and 2002, world revenue for space systems totaled $517 Billion with a growth rate of about 15% per year during that time.[72] In *Emerging Options for National Power*, the authors point out that force application missions have the least relation to U.S. economic interests.[73] They do not generate revenue and in turn may discourage free market forces from moving to space. On the political side of the debate, the U.S. must tread lightly as it ponders a move toward weapons in space. Because space weapons are expensive and technically demanding, they are unlikely to be built for a low level conflict. This implies space weapons are only good for peer or superpower wars. If, as argued earlier, the U.S. maintains command of the commons and is facing no peer in space, to what end would we be the first to develop space weapons? If the U.S. does press down this road, it should develop only a "silver bullet" capability aimed at providing flexibility should a peer threat unexpectedly break out in the future.[74]

In sum, politics have played a major role in shaping U.S. readiness for the third battle in space. The current grand strategy of primacy has led to an aggressive space control doctrine that may be overriding the need to upgrade existing force enhancement capabilities in space. Competition for space funding is further limiting the viable options in space while a technology paradox often makes systems obsolete before they are launched. Finally, the undercurrent of space Weaponization is ever present in the debate over how to proceed in the third battle.

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Chapter 4

Space Organizations of the Third Battle

> *Space is unforgiving; thousands of good decisions can be undone by a single engineering flaw or workmanship error, and these flaws and errors can result in catastrophe*
>
> Defense Science Board

Historic Rise of Space Organizations in the First and Second Battles

Both the first and second battles in space were driven by an organizational renaissance within the national security space realm. By the turn of the century, much of that organizational momentum had stalled. Space has become increasingly more important to U.S. national and economic security yet the national security space infrastructure has not kept pace.

Organizationally, the first battle, in the form of efforts such as the Atlas project and the Navy's development of the technologically ambitious Sea Launched Ballistic Missile, went on to change the complexion of both the Cold War and the aerospace industry as the Atlas project alone eventually involved "over 18,000 scientists, engineers, and technical experts in universities and industry…and 500 military officers with technical backgrounds."[1]

During the second battle, the U.S. military actively expanded its space capabilities concurrent with pursuit of a U.S. grand strategy of strategic engagement and a national doctrine of space control. Ronald Reagan's Strategic Defense Initiative, a concept based on a strong space-based component including satellite sensors, space-borne missile defense, and anti-satellite weapons, fostered the idea that a legitimate theater of conflict in space needed a command to lead such an effort.[2] The 1980s saw a flurry of organizational space activity as Air Force Space Command was established in the fall of 1982 followed a year later by Naval Space Command and ultimately by the formation of a joint space headquarters, United States Space Command, in 1984. The Army followed with its own space command in 1988.

United States Space Command was the first organization to truly tackle the tough issues associated with space doctrine and necessary military means in a major capstone document published in April 1998. The *U.S. Space Command Long Range Plan* held that three compelling circumstances had come together to set the stage for a bold new vision. First, the U.S. had entered a strategic pause in which it would face no global military peer within the next two decades; second, the nation had become vitally dependent on space capabilities; and third, space had true potential to lead to a "Revolution in Military Affairs."

U.S. Space Command left no doubt it was engaged when it claimed "*USSPACECOM Has The Lead*: As the single focal point for military space, the responsibility falls to USSPACECOM to ensure access to and protection of US interests and investments in space."[3] This was the first in a series of bold moves to put military space organizations in the forefront of the debate over space capabilities and its role in the national agenda.

Within the joint structure, Air Force Space Command was the largest component under U.S. Space Command and represented the largest percentage of DoD space capability providing 90 percent of the space personnel and 85 percent of the space budget by the 1990s.[4] Ultimately, a myriad of developments such as a dedicated Space Technology Center, the stand-up of a Consolidated Space Operations Center in Colorado to control DoD spacecraft, and the advent of the Space Warfare Center (SWC) to "support warfighters with space solutions…through innovation, testing, tactics development and training" embodied organizational space growth.[5]

Meanwhile, the Naval Space Command developed a rigorous capability to exploit national reconnaissance capabilities to benefit the fleet and took responsibility for training Navy and Marine Corps personnel concerning the potential contributions of satellite systems to their missions.[6] In addition, they continue to maintain space expertise in the Center for Naval Analysis, Navy TENCAP, the Naval Post Graduate School, and the NRO.[7]

During this same period, the Army took action to begin a space demonstration program and stand up its own Space Command tasked with the mission of operational space planning and support to the Army. The Chief of Staff of the Army, General Gordon Sullivan, summed up the Army Space Policy when he stated the Army would exploit space systems to ensure "space applications will be embedded in Army doctrine, training scenarios, wargames, exercises, and plans."[8]

The organizational awakening to space as a contributor to warfighting was personified in the Technical Exploitation of National Capabilities (TENCAP) programs adopted by each service space component. A parallel push was made to teach space--the

Air Force Institute of Technology and the Naval Post Graduate School each added masters degree level courses in space and the service's mid-level professional staff colleges began to include blocks of space instruction.

Ultimately, the build-up of a solid cadre of space experts defined one of the key elements that led to the U.S. winning the first two battles. It was not enough to simply have a threat that drove a grand strategy toward space—it took an organizational push from inside the military and industry to see the necessary technology and doctrine come to fruition. Entering the third battle, U.S. space organizations show signs of atrophy and must overcome significant challenges if they are to meet the goal of achieving space supremacy. Major issues to be addressed include consolidation in the space divisions of the military and industry, a brain drain of space expertise, and a changing operations environment. In addition, there have been numerous problems with acquiring systems to replace aging legacy space capability which raises tough questions about the ability of today's space organizations to develop tomorrow's space control systems.

Industry Consolidation Is Affecting the Third Battle

Organizational uncertainty has kept the U.S. national security space community from advancing a cogent naional strategy in space. In October 2002, the nation's single unified military command chartered with operational leadership of U.S. space forces, the United States Space Command, was disbanded and that mission was folded into the portfolio of United States Strategic Command (USSTRATCOM). Long charged with the command and control of the US nuclear deterrent force, USSTRATCOM is in its infancy as it relates to space power and the contributions of space to U.S. national security. In an article covering the merger, William Scott noted in Aviation Week that the new command is faced with "leveraging legacy orbital platforms while sorting out what warfighters absolutely must have in a new military and intelligence space architecture."[9] While on the surface this appears straight forward, USSTRATCOM is burdened with an unwieldy mission set of which space is one small piece. Consider the command's five distinct missions:

- Global Strike: STRATCOM is responsible for the conduct of precision strikes anywhere in the world using bombers, ICBMs, or computer network attack tools
- Missile Defense: STRATCOM is responsible for planning and integrating global missile defense operations
- Intelligence, Surveillance, and Reconnaissance (ISR) Management: STRATCOM is responsible for coordinating ISR to apply the right asset at the right time in support of military and intelligence missions
- Information Operations: STRATCOM is responsible for DoD's emerging cyberwarfare capabilities to include computer network defense
- Space: STRATCOM is responsible for aggregating combatant commander's space requirements and performing key trade decisions over what systems to pursue

Some, such as retired General Thomas Moorman see the establishment of US Strategic Command with its expanded missions as "one of the most significant events in military organization since the National Security Act of 1947 established the Department of Defense and the CIA." [10]

However, in terms of space, the unintended consequence was to deemphasize the space mission within the joint military arena. Much of this is due to the sheer size of the new mission USSTRATCOM inherited. No matter the dedication of the people involved, a single joint headquarters will most certainly have a hard time balancing priorities across such a wide mission set. As a result, the emphasis on the space mission can hardly help but suffer.

Perhaps a bigger issue is the loss of military officers with shared experiences in space that often drive doctrinal evolution. Stephen Peter Rosen, in his book *Winning the Next War*, argues that doctrine is often about distributing power and resources within an organization.[11] If this is the case, space is receiving short shrift in the larger joint warfighting construct of the U.S. military. If space can't even reign supreme in its own unified command, it will be extremely difficult to gain priority in the military writ large. The de-emphasis of space in the primary warfighting organization that owns the mission does not bode well for continued organizational advancement.

While consolidation has impacted the military's ability to tackle the tough issues associated with space, the nation's aerospace industry has an even larger consolidation problem. The combination of major space producing aerospace contractors has significantly cut the number of viable space system developers the U.S government can turn to for complex space systems. Over the course of less than ten years, the number of top tier Aerospace and Defense firms has dropped from 107 to just five in 2004.[12] Although for the most part, a small stable of strong prime contractors can likely respond to U.S. defense needs, the consolidation has severely impacted second- and third-tier subcontractors who make many of the critical components necessary to build advanced space systems.

Much of the contraction in space was driven by the failure of a viable commercial space market to transpire. The vast potential once promised by commercial space business in the mid 1990's has all but dried up. In 1998, expectations were that the US and the world's other space faring nations, would pump $500 billion into space, launching at least 1,000, and possibly 1,500, new satellites."[13] That same year 150 commercial satellites were launched around the world. Yet only three years later, in 2001, that total had dropped to 75 satellites--the lowest number launched in the past 10 years.[14] The U.S. launch industry saw a decline of nearly 50 percent from an average of over 30 civil and military launches per year (from 1995-2000) to only 17 in 2002. [15]

Worldwide, technical issues with launch vehicles and payloads kept the number of launch attempts to 54 in 2004, the lowest since 1961.[16] Evidence of the ramifications of these impacts can be seen in the fact that the U.S. defense department has been forced to support two launch vehicle manufacturers in order to maintain a viable industrial base. Critics note that consolidation following the Cold War was inevitable, but see the growing lack of indigenous U.S. space transportation manufacturing as a "national disgrace."[17]

The Space Brain Drain

Failures in our national space agenda have affected the U.S. military's space work force. U.S. military space is a unique blend of military operators and acquisition managers working closely with the U.S. defense industry and government civilians to build, operate, and maintain complex space systems. To develop future space weapons, taskable sensors, and dynamic fire control systems will require a space cadre with extensive technical skills and firm grounding in space systems.

Knowledge loss is often an unintended consequence of downsizing and has been a significant problem in the aerospace industry.[18] Rollbacks and consolidations following the Cold War as well as the 'dot.com' boom of the late 90's led to a significant reduction in aerospace technicians and engineers in industry. The ensuing brain drain was coupled with an aging workforce that has been increasingly difficult to replace.

This loss of technical skills in the space arena was not constrained to industry. The Deputy Assistant Secretary of Defense for civilian personnel policy noted that downsizing and increasingly complex missions have left the DoD facing real challenges in retaining adequate technical skills in the civilian workforce.[19] The Air Force predicts 45 percent of the civilian science and engineering workforce is eligible to retire in the next five years.

On the military side, accession and retention of skilled engineers and space operators has suffered as well. Air Force officers make up the largest majority of the military's space professionals in both the DoD and the NRO. A year-long review of the Air Force science and engineering community showed that the science and engineering career field in 2000 was "the most stressed career field in the Air Force.[20] Among military engineers with seven to 13 years of experience, under manning is a particularly serious problem. At the critical mid-level officer level, Air Force Captains in the scientist and engineer career fields are manned at 40% and 50% respectively.[21]

Technical expertise has also become a major issue in the Air Force's "Space Operations" career field, which contains nearly the entire military space operations workforce. In the early days of military space, satellites were flown by engineers in the Air Force's Systems Command which had the mission of acquiring and operating space systems. The introduction of an operational Space Command ultimately led to the merger of space operations with the traditional missile operations career field. Officers educated as engineers and scientists (who had traditionally operated the complex one-of-a-kind satellites in the inventory) slowly began to be replaced by a new breed of space operators. This new space and missile operations specialty did not require science or engineering degrees and drew much of its numbers from the ICBM crew force. Over time, the service began to operationalize many military space systems, eliminating the need for specialty engineers to solve rare on-orbit anomalies.

In parallel, there was a move to convert many space jobs to enlisted positions. Ultimately this led to a severe reduction in the number of officers, particularly those with science and engineering backgrounds, in the space and missile career field. As of 2005, only 9.6% of the 3,400 officers in the career field carried college degrees in hard science or engineering disciplines.[22] Overall, the brain drain in industry, civil service, and military space leaves one to wonder who will be left to develop the complex operations concepts and systems for the coming third battle.

Satellite Operations Are Changing—Is The Military Keeping Up?

The dilution of the technical base is not the only issue effecting organizational transformation in national security space. The Space Commission noted that the Air Force and the National Reconnaissance Office dominate satellite acquisition and operations in national security space. Due to basic differences in the force enhancement missions performed by the Air Force (i.e. navigation and satellite communications), and intelligence missions performed by the NRO (imagery and signals collection) these organizations run their organizations differently.[23]

On the Air Force side, operators typically monitor health and status of spacecraft and only intervene in the case of an anomaly. In contrast, NRO operators are faced with a dynamic collection environment which requires rapid reconfiguration of spacecraft to meet evolving collection requirements. The advent of future taskable DoD systems such as the Space-Based Infrared System and the Space-Based Radar or any type of space-based weapons or tracking function will require an operational philosophy that is much closer to that of the NRO.

At issue here is whether the Air Force is grooming space expertise to tackle the challenges associated with much more complex and dynamic space systems or the command and control capabilities required to fly them. As discussed earlier, technical space skills in the Air Force are at a premium. Air Force Space Command's *Strategic Master Plan for 2006 and Beyond* calls for having "the world's experts in all assigned systems and in the application of space power during peacetime, crisis and war."[24] Despite recent efforts to establish a "space cadre," the command is lagging in meeting this goal. Not only does the nation's lead space service lack officers formally schooled in science and engineering, but it is not growing a space cadre that will be suited to respond to the major issues associated with taking space to the next level.

In 1998, then Senator Bob Smith gave a speech he called "The Challenge of Space Power." In that speech, Smith noted that "Air Force Space Command includes 11 general officers. None are career space officers…a further breakout shows that five of the 11 are command pilots, five are command missileers, and one has a command and control background. To put this in context, consider how many general officers at Air Combat Command are not command pilots."[25] Peter Grier, in an article titled *The Space Cadre*, notes that pilots, nuclear submariners, and others in specialized military fields typically spend about 90 percent of their careers within their specified field. In 2001, however, less than 20 percent of all of the flag officers serving in key operational space leadership positions had come from career space backgrounds.[26] Since then the situation has improved, but there are indications at the lower levels in Space Command that the root of the issue has not been solved. In order to grow future space generals, we must start with space Lieutenants and Captains.

In response to the demands of the Space Commission, Air Force Space Command has tried to develop a cadre of "space professionals" who have the requisite education and experience to develop U.S. space power and apply it to combat, intelligence, and other national security missions. As of 1 Dec, 2004, Air Force Space Command it had 7,449 "credentialed" space professionals—5,982 officers and 1,467 enlisted members with "cadre" level experience.[27]

What fails to show up in the statistics is the level of experience in particular weapon systems. The military services would never expect an F-16 pilot to be an expert in B-2 stealth strategic bombing or a Naval surface warfare officer to understand the nuances of submarine operations. In space, the "space professional" is expected to be able to coherently speak on all space-related topics from navigation satellites to missile warning to ICBM targeting.

This paradigm has kept the space services, primarily the Air Force, from growing true space weapon systems experts. That F-16 pilot can be expected to fly the same aircraft for 12 out of his first 15 years, becoming an expert in its employment. Conversely, a typical path for a young space officer starts with an assignment as an ICBM crew member, followed three years later by a job as a satellite officer doing command and control of the Global Positioning System, followed by a broadening tour teaching ROTC at a university. While this type of rotation develops a certain amount of depth, it fails to develop weapons systems experts. The ramifications of this manifest themselves at the tactical and operational levels.

As an example, the 2nd Space Operations Squadron is charged with commanding the 28-satellite GPS constellation. In 2002, the average experience of an officer line crew member (typically a Lieutenant or Captain) was 3.6 months in the GPS weapon system, much less than necessary to be an expert in a system as complex as GPS.[28] A large reason behind the low levels of experience was the cultural impetus in the space career field to continually move space operators to new and varied jobs (often away from line space operations) in order to keep them eligible for promotion.

In addition to the struggle to develop young space operators, it is also difficult to train older military leaders in the employment, capabilities, and limitations of space systems. It is very difficult to run military exercises that show the full impact of losing space capabilities--after all, you cannot shut off GPS to the world for a week to see how U.S. forces would be impacted. Thus, military commanders (who have limited space expertise in the first place) have had relatively little experience in learning to "cope with the loss or temporary interruption of key space capabilities, such as GPS, satellite communications, remote sensing or missile warning information."[29]

United States Struggling To Upgrade Legacy Systems

A major issue that must be faced by the U.S. national security space system is how to modernize and replace nearly its entire space infrastructure due to "block obsolescence of many on-orbit systems now in service."[30] U.S. legacy space systems are aging and in need of replenishment while the ability to develop new and innovative space systems withers on the vine. Satellites are typically designed with an expected life of 6-8 years. The average age of U.S. military satellites on orbit is nearly 10 years and the satellite control network used to fly them is over 40 years old. The durability of US satellites is a boom and bust problem--because they are lasting so long, we are failing to replace them with new technology and new capabilities to solve long standing shortfalls. General Richard Meyers, current Chairman of the Joint Chiefs noted in 2000 "this is bad news because we have capabilities on orbit designed for a previous era and not responsive to our current needs."[31]

In framing the debate on where the U.S. should focus its national security space investments, a review of military space systems in operation today tells the story. The U.S. continues to perform the missile warning mission using the Defense Support Program first launched in 1970 as an incremental improvement of the MIDAS system orbited in 1963. The satellite communications backbone remains the Defense Satellite Communications System designed in the 1960s with a first launch in 1971. The military weather satellite flying today, the Defense Meteorological Satellite Program or DMSP, was first launched in 1962. The superstar of the US space portfolio, the Global Positioning System (GPS), is in essence flying the same design as the spacecraft first launched in 1978 and has an average satellite age of 9.2 years--nearly two years longer than the satellite's design life of 7.5 years.[32] The oldest GPS satellite in use today has been on orbit for over 15 years.

It is true that a number of systems are currently in development that aim to upgrade existing satellite constellations and ground control architectures. However, these space systems are all competing for a share of the DoD budget as the nation's military looks to modernize and recapitalize systems ranging from fighter aircraft to armored vehicles. Secretary of the Air Force Roche rightly recognizes that we cannot afford to backslide in terms of space support capabilities for they have become “like oxygen…if you have it you take it for granted, if you don’t have it, it’s the only thing you want.”[33]

The 2001 Quadrennial Defense Review described six foundational operational goals, each relying in some respect on space capabilities.[34] The space acquisition results since then cannot give space leaders confidence that the U.S. will be able to fully meet those operational goals. At issue here is whether the space acquisition system can support the DoD’s transformation goals or even today’s modest goal of maintaining existing capability in space. As a gauge of how severe the problem is, the SBIRS and AEHF programs are a combined $8 billion over budget. [35] The NRO’s new satellite imagery system (FIA) has been delayed by more than a year, scaled back the capabilities it planned to deliver, and its cost has increased from $6 billion to $10 billion.[36]

In 2003 alone, the Defense Science Board, Air Force Scientific Advisory Board, and the Government Accountability Office (GAO) published reports critical of the space acquisition process.[37] Of the major space systems currently in development including missile warning (SBIRS), military satellite communications (AEHF) and Transformational Satellite Communications or TSAT) and the intelligence systems (Future Imagery Architecture (FIA) and Integrated Overhead Signals Architecture), all are over budget and behind their original deployment schedule. According to the Government Accountability Office, in a report published in March 2004, the procurement costs associated with the Space-Based Infrared System increased 143 percent between 1998 and 2003.[38] The same report noted that the cost of the Transformational Communications Satellite system had seen program costs increase 148 percent in just two years since program inception.

Another issue with modernizing the U.S. space arsenal is how the burden should be shared amongst the services. According to the Government Accountability Office (GAO), the total programmed space budget for fiscal years 2002 through 2007 is about $165 billion. Of this, the Air Force is expected to spend 86 percent while the Navy spends 8 percent and the Army 3 percent (the remaining 3 percent is spent by other DoD agencies).[39] While space is widely considered a "joint enabler," the lion's share of the burden for funding expensive space systems continues to fall on the Air Force. This debate is raging at the same time Air Force is facing tough modernization decisions on major weapon systems including the tanker fleet which averages over 40 yrs old and the fighter force which is flying F-15s developed in the 1970s.[40] Until this problem is remedied, the challenge (for the Air Force anyway) will continue to be prioritizing space against other important Air Force missions and systems.

The bottom line is that U.S. national security space organizations are not equipped to handle the challenges of the third battle. Consolidation in military space and the supporting aerospace industry along with a brain drain of hard core space science and technology skills has impacted the ability to deliver new operations concepts and systems. The nature of space operations is changing with no evidence that space operators are keeping pace. Finally, the space acquisition system is not delivering the necessary systems. An organizational renaissance similar to those that powered the first and second battles in space is necessary.

Notes

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[6] Federici, 13.

[7] Federici, 13.

[8] Army Reference Text, "Army Space Policy," July 1994, n.p., on-line, Internet, 10 March 2005, available from http://www-tradoc.army.mil/dcscd/spaceweb/appa.htm.

[9] William B. Scott, "Strategic Space," *Aviation Week*, Oct 25, 2004, 83.

[10] Scott, 83.

[11] Stephen Peter Rosen, *Winning the Next War; Innovation and the Modern Military*, (Ithaca :Cornell University Press,1991),1-14.

[12] Briefing by Pierre A. Chao, Senior Fellow and Director Defense-Industrial Initiatives, Center for Strategic International Studies, to MIT Security Studies Program, 2 Mar 2005

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[20] Tamar A. Mehuron, "So Far, So Good," *Air Force Magazine*, October 2004, Vol. 87, No. 10, n.p., on-line, Internet 2 March 2005, available from http://www.afa.org/magazine

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[21] Major Robb Owens, Air Force Space Command Personnel Division, briefing 15 March 2005, "6X Entitlements—Summer Cycle '05."

[22] Demographic data sorted by Academic Discipline form Air Force Personnel Center's Retrieval Applications Website, https://www.afpc.randolph.af.mil/raw/. The key Air Force Specialty code reviewed was 13S (space operations). Most Air Force scientists and engineers are now classified as 61S (scientist) or 62E (engineer). As an example of how an operational squadron is organized, as the commander of the 2nd Space Operations Squadron, controlling the GPS constellation, I had 80 officers assigned; 69 space operators, eight engineers (designated as 62E), and 3 communications officers.

[23] Report of the Commission to Assess United States National Security Space Management and Organization, 67-68.

[24]Air Force Space Command, *Strategic Master Plan for 2006 and Beyond*, 1 Oct 2003,3.

[25] Bob Smith (R-NH), "The Challenge of Space Power," *Aerospace Power Journal*, Spring, 1999, n.p., on-line, Internet, 3 February 2005, available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj99/spr99/smith.html

[26] Peter Grier, "The Space Cadre," *Air Force Magazine*, June 2004, Vol. 87, No. 6, n.p., on-line, Internet, 21 March 2005, available from http://www.afa.org/magazine/june2004/0604cadre.asp.

[27] Tamar A. Mehuron, "Building a Space Cadre," *Air Force Magazine*, March 2005, 23. The Air Force admits this number is high since the system double counts—a person with space control and launch experience is actually tallied in both expertise categories.

[28] Personal experience as commander of the subject unit. A study of crew experience levels in 2003 revealed that between the six crew positions (3 officer, 3 enlisted), GPS experience averaged 3.6 months at the officer positions and up to 8 months at the enlisted positions.

[29] *Report of the Commission to Assess United States National Security Space Management and Organization*, 77.

[30] Benjamin S. Lambeth, "Footing the Bill for Military Space," *Air Force Magazine* 86, No 8 (August 2003), 22.

[31] Peter Grier, "The Investment in Space," *Air Force Magazine*, February 2000, Vol 83, No 2.

[32] Captain Patrick Long, briefing on "GPS Constellation Health," Vandenberg Air Force Base, CA, December 2004. GPS average age based on the 30 spacecraft on orbit as of Dec 2004 based on data from DoD GPS Support Center at Schriever Air Force Base.

[33] Peter Grier, "Space—The Next 50 Years," *Air Force Magazine*, Feb 2005,70

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[36] Lee, 8.

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[37] Lee, 4.

[38] United States General Accounting Office, "Defense Acquisitions; Assessments of Major Weapon Programs," 97, March 31, 2004 , n.p., on-line, Internet, 10 march 2005, available from http://www.gao.gov/new.items/d03476.pdf

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Chapter 5

Conclusions

The United States is entering the third battle in space—one that will require tough decisions on how the nation should proceed in space to support U.S. national objectives. Inevitably, the third battle will see the debate over whether or not to weaponize space reach its conclusion. Just as decisions made in the first and second battles yielded the space capabilities we now take for granted, decisions made today will affect the future of space power in the third battle to gain and maintain space supremacy.

The third battle is not like the first and second battles. In those early battles for space, the politics of the day supported robust growth in space. A visible threat drove a grand strategy and supporting space doctrine, all leading to development of space means to achieve national goals. Robust space organizations, such as General Schriever's Western Development Division in the first battle and United States Space Command in the second battle, arose to tackle the challenges of national security space.

The Bush strategy of primacy meshes with the evolving doctrinal debates advocating space supremacy. However, three primary elements that led to success in the first two space battles are absent as we enter the third battle. First, the politics of primacy are working to cloud the space debate. In order to attain the necessary military supremacy to support a grand strategy of primacy, the nation is expected to be first in all things—

including space. This is raising the distinct possibility that the U.S. will embark on an aggressive march toward space dominance while allowing the traditional force enhancement missions from space to wither on the vine.

Despite the legitimate concern over vulnerabilities of space systems, vulnerability does not equate to a true threat. The United States enjoys complete command of space. It spends eighteen times its nearest military space competitor. The technologies required to attack satellites are expensive and technologically challenging. The ramifications of attacks to ground nodes or communications links could be tactically significant, but it is extremely difficult to affect U.S. space systems at the strategic level.

Additionally, budgets are acting to severely constrain growth in space as satellite and ground system modernization competes with necessary military upgrades on the ground, sea, and in the air. The U.S. simply cannot afford to modernize all arms of its military and *at the same time* develop the complex space systems required to totally control the space regime.

A technology paradox exists today in space. Technology development in space systems has not kept pace with other military advances. Inserting state-of-the-art technology into new satellites is nearly impossible due to lengthy satellite development timelines and processes that incentivize low risk technology in order to stabilize costs. Often, spacecraft are launched with subsystems that are already obsolete. Many of the sensors and systems on orbit today are based on technologies developed in the first battle and the entire fleet of U.S. space systems is in need of modernization within the next decade. The tremendous difficulty the U.S. is having in re-capitalizing its space fleet leaves great doubt that the U.S. could make good on the technology and budget advances necessary to take the leap into third battle space systems such as space-based weapons.

Finally, traditionally strong space organizations are facing difficult challenges in keeping qualified space experts with the training and skills needed to develop offensive and defensivespace doctrine. The space community, hampered by a brain drain of skilled scientists and engineers and a massive consolidation in the aerospace industry, has struggled mightily to deliver relatively straightforward upgrades to existing space systems. The nature of space operations must change to support concepts such as weapons in space yet no sound concepts of operations have been developed. Present day space operators are not being equipped to succeed in the future world of dynamic, taskable space systems requiring real-time weapons engagement decisions. For the United States to overcome these obstacles and be successful in the third battle will require solutions to the problems identified above.

Recommendations

The organizations and systems of the third battle will be required to operate in a complex environment. Threats to space systems may be difficult to identify and targeting them in a situation where commercial, civil, and military spacecraft operate together will be challenging. United States grand strategy and space doctrine have evolved together and contain the language required to support movement toward a force that can gain and maintain space supremacy. National security space organizations must keep up by finding a way to develop new and innovative systems in what promises to be a challenging atmosphere of scarce resources and competing interests. The following recommendations are aimed at addressing the key political and organizational problems the United States faces as it enters the third battle.

Recommendation 1: Upgrade Critical Force Enhancement Space Systems. Politically, the standing space doctrine of space control supports the national grand strategy of primacy. However, it is critical that the United States commit to a first priority of recapitalizing the ailing force enhancement missions in space. The most urgent need is an upgraded satellite communications network. Programs such as Advanced EHF, the Multiple User Objective System, and the Transformational Communications System should be the top priority in space. The next priority should be the completion of the Space-Based infrared System to improve missile warning of small, short burning missiles. Finally, weather systems and GPS should stay on track for modernization.

Recommendation 2: Focus on Ground Control and Processing. The spotlight in space has traditionally been on "apertures" such as new electro-optical or infrared sensors. Advances in computing and network technology now make ground control system improvements a much more significant target for improved utility. Algorithms that lower the noise threshold are now possible, enabling the use of data previously ignored. The fusion of data from different sensors can now yield faster response or new insights. For example computer networks now exist that can use signals intelligence to tip-off infrared sensors of upcoming events, yielding collection opportunities that would have been missed in the past. Ground systems based on rapid software development offer infinitely faster options to upgrade ground processing compared to the slower timelines associated with launching new sensors. As an alternative, distributed constellations of small satellites that can be rapidly "upgraded" through launch of new components offer some promise in this arena.

Recommendation 3: Field Ground-Based Space Control Systems Now. Rapidly fielding ground-based space control systems such as the planned counter-communications and counter-intelligence systems that are designed to jam or degrade enemy space capabilities offers the greatest military utility and cost efficiency. The U.S. should limit development of space-based space control weapons to research and development of a "silver bullet" capability only, possibly as an offshoot from missile defense research. From a resource standpoint, this allows precious funding to go toward the recapitalization of the current national security space infrastructure. Politically, it mitigates (but does not avoid) the tendency of potential adversaries to balance against the United States in developing space weapons of their own.

Recommendation 4: Add Space Expertise to U.S. Strategic Command. To counter the de-emphasis on space driven by the large and diverse mission set now resident at STRATCOM, the headquarters should be populated with a select group of skilled space professionals and a senior staff with space expertise. These officers should stay in place long enough to formulate and implement third battle operations concepts and doctrine.

Recommendation 5: Develop Space Control CONOPS. National security space must act now to develop concepts of operation for the space control mission. These should include detailed concepts on how to positively identify enemy space actions such as jamming, spoofing, or destruction. In addition, the U.S. must develop a command and control architecture to guide our space control response. Once identification of adversary action is verified, rules must be established to develop response options and direct the course of action.

Recommendation 6: Stem the Technical Brain Drain. Actions must be taken quickly to stop the rapid exit of technical expertise occurring in the military, civil service, and aerospace industry. Special engineering and science pay bonuses have been effective in the past but implemented haphazardly. The Air Force should treat its space cadre similar to its pilot force when it comes to retention tools. On the industry side, contracts should be written with incentive clauses that encourage critical skill retention and developing young technical space expertise.

Also, the military should build a team of technically trained officers with space depth to act as the cadre to start up the space control mission area. Just as early space systems were operated by military officers (primarily engineers) before migrating to non-tech and enlisted operators, space control systems should initially be operated by technical experts who can develop tactics, techniques, and operational procedures.

Recommendation 7: Overhaul the Air Force Space Operations Field. The military should revamp its space operations career path. A focus should be placed on developing technical and weapon system expertise through longer assignments in a space system. The space operations crew force should be shaped now to be prepared to handle dynamic, taskable space missions requiring real time decision making. A move toward the NRO model of an operations crew consisting of a few experienced military operators supported by contractor experts who grew up developing the system may be warranted.

Recommendation 8: Modify The Space Acquisition System. Rules should be initiated to encourage technology insertion throughout the acquisition timeline in order to solve the technology paradox. Continuing research and development efforts in space technology must be a Department of Defense priority, not simply something relegated to compete in the Air Force budget process. Parallel technology development efforts and inta-service competition to design and build space systems (similar to that seen in fighter aircraft between the Air Force, Navy, and Marine Corps) may address this problem.

In the end, United States security in space relies on solving the political dilemma associated with primacy and the space organizational issues that have developed over the past decade. Victory in the "third battle" will depend on it.

Glossary

ABM	Anti-Ballistic Missile
AFDD	Air Force Doctrine Document
ASAT	Anti-Satellite System
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
FIA	Future Imagery Architecture
FY	Fiscal Year
GDP	Gross Domestic Product
GIG	Global Information Grid
GPS	Global Positioning System
ICBM	Intercontinental Ballistic Missile
IMINT	Imagery Intelligence
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
IOSA	Integrated Overhead Signals Architecture
MBPS	Mega Bits per Second
MILSATCOM	Military Satellite Communications
Milstar	Military Strategic and Tactical Relay
MUOS	Mobile Oser Objective System
NOAA	National Oceanic and Atmospheric Administration
NRO	National Reconnaissance Office
NSS	National Security Strategy
PDD	Presidential Decision Directive
PLGR	Precision Light Weight GPS Receiver
RAND	Air Force Think Tank
SBIRS	Space-Based Infrared System
SIGINT	Signals Intelligence
TENCAP	Technical Exploitation of National Capabilities
TSAT	Transformational Communications Satellite
USAF	United States Air Force
WGS	Wideband Gapfiller System

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