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AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

VIRTUAL SPACE CONTROL:

A BROADER PERSPECTIVE

by

Shawn J. Barnes, Major, USAF

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Advisor: Major Carmen F. Perone

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Preface

During this academic year, the students at Air University have been frequently told about their "Air and Space Force," and how we will soon be moving toward a "Space and Air Force." If this is indeed the case, it's important for airmen to understand what the "Space" part of the future force will entail.

I've chosen the topic of space control for a number of reasons. First, I know something about it from personal professional experience and I find it an interesting subject. Second, the Air Force, as well as the rest of the military establishment, seems to have little grasp as what space control really entails or how to accomplish it. Third, I believe it's important to continue the professional dialogue among those airmen that will shape the future Air Force. I've written this paper for both the space and terrestrial Air Force operators. While I'm sure it provides no concrete solutions to the issues I've raised, I hope it will provoke further thought on the matter.

I would like to thank my research advisor, Major Carmen Perone, for his valuable insights and assistance. Additionally, I wish to commend the superb staff of the AU library and advise all future ASCS or AWC researchers to exploit their many talents. Finally, I need (literally as well as figuratively) to thank my wife Colleen. I deeply appreciate her emotional and practical support throughout this research process.

Abstract

Space control ensures friendly access to space-based capabilities while denying this same access to the enemy. Like air and sea control, it need not be executed during peacetime, but must be retained and implemented during conflict. Increasingly, U.S., allied, and adversary military forces depend on the capabilities space assets provide. This paper proposes that the U.S. has little ability to actually protect friendly space assets nor has it the ability to deny space support to its enemies. While there are both practical and political impediments to achieving space control over which the military may have little influence, there are significant doctrinal impediments to achieving space control that could and should be immediately addressed.

Traditional space control doctrine has focused on protecting and denying space *assets*. This paper proposes a doctrine which instead focuses on protecting and denying space *capabilities*. The difficulties in achieving traditional space control along with the growing commercial space sector make a capabilities focused space control doctrine an imperative.

Chapter 1

Introduction and Organization

> *Ground which both we and the enemy can traverse with equal ease is called accessible. In such ground, he who first takes high sunny positions…can fight advantageously.*
>
> —Sun Tzu
> *The Art of War*

Introduction

Man has understood the importance of owning the high ground in time of conflict since he first began to critically think and write about making war. *Space control* ensures command of the earth's highest ground. According to draft Air Force doctrine, space control ensures friendly forces gain and maintain space superiority to assure use of the space environment while denying its use to the enemy.[1] But what does this really mean? Can space control be achieved? If so, how? This paper will explore the meaning of space control and take a critical look at the concept. The primary argument forwarded in this paper is that space control, in the currently and commonly narrowly accepted definition, cannot be achieved. Today's concept of space control is focused on physical *assets*. Instead, the U.S. should redefine the term to include a broader perspective, one that focuses on *capabilities*. In this way, *virtual space control* might be accomplished.

Organization

In order to support this "broader perspective" hypothesis, this paper seeks to answer a series of questions. What is space control? Why is space control important? What are the origins of U.S. space control doctrine? What is the broader perspective and why is it important? What are the implications for this perspective? The paper devotes a short chapter to each of these questions and while the report is written to be read as a single document, each chapter should stand on its own. Finally, this paper will examine some alternative viewpoints and offer some recommendations and conclusions.

Research Methods

This paper draws upon a number of professional military and civilian sources. These include past research papers, professional military journals, academic writings, business reports, scholarly texts, and formal military doctrine. In addition to these texts, this paper calls upon the professional experience of the author.

Notes

[1] Air Force Doctrine Document (AFDD) 2-2 (Draft), *Space Operations*, February 1997, 11.

Chapter 2

Space Control—The Basics

Space Missions

This chapter will briefly review the primary military space organizations responsible for providing space support to the warfighter and the four space missions they perform. U.S. Space Command (SPACECOM) is the unified combatant command responsible for executing the nation's military space missions. It provides joint employment of military space forces and operational support to other unified, combatant commands. SPACECOM performs these functions through four primary missions: space support, force enhancement, force application, and space control.[1] U.S. Space Command has combatant command (COCOM) of the forces provided by its three service components, ARSPACE (Army Space Command), NAVSPACE (Navy Space Command) and AFSPACE (Fourteenth Air Force)[2]. Since the Air Force provides a significant majority of the space forces to the unified command, and since this author brings a distinctly USAF bias, this paper will discuss space control from both SPACECOM and Air Force perspectives. This is not to say that the Army and Navy perspectives are unimportant, only that they are outside the scope of this research.

Space support (or space force support) is carried out by the terrestrial (land, naval, and air) elements of the military space force to sustain, surge, and reconstitute elements

of a military space system or capability.[3] It is, quite simply, those activities that must be accomplished to ensure a space force can provide support (force enhancement and force application) to the terrestrial warfighter. In general, this includes space lift—launching satellites into orbit, and satellite operations—the everyday tasks required to monitor and maintain military satellites. Although a significant bulk of the space forces' day-to-day mission is focused on space support, these activities are typically transparent to the warfighter. In many respects, space support is analogous to the day-to-day transportation and logistics functions required of the terrestrial forces.

Force enhancement is one of the two *products* of a space force and is continuously used and exploited by the sea, land, air, and space forces each and every day. Force enhancement includes the intelligence, warning, weather, communications, and navigation support provided by the satellites and associated ground equipment and personnel. Force enhancement is the product of space systems that enables terrestrial and space forces to accomplish their functions. Although military space systems provide much of this product, civil, commercial, and national space systems contribute greatly to the force enhancement effort.[4]

The other product of a space force is *force application* and as the name implies, involves applying force either *from* or *through* space. No nation currently has the capability to accomplish space force application (outside of launching ICBMs), however it is not difficult to envision a variety of force application tasks. For example, the Missile Defense Act of 1991 directs research and development of capabilities to provide global protection against ballistic missile strikes.[5] In the not too distant future, SPACECOM will execute a surface and space-based system to intercept ballistic missiles as they fly

through the air and space. Military futurists envision more extreme examples of space force application. They foresee manned orbiting platforms which could launch kinetic or directed energy weapons at ground, sea, or air targets in support of terrestrial military operations.[6]

Space control provides the secure environment for space operations; it allows for force enhancement and force application. Figure 1 illustrates how the four space missions are related. Space control is a foundation mission for further space operations. If space control is achieved, space support can then be accomplished. Force application and force enhancement are not directly dependent upon one another, although both require space control and space support. As space control is the focus of this paper, it is necessary to explain the concept in greater detail.

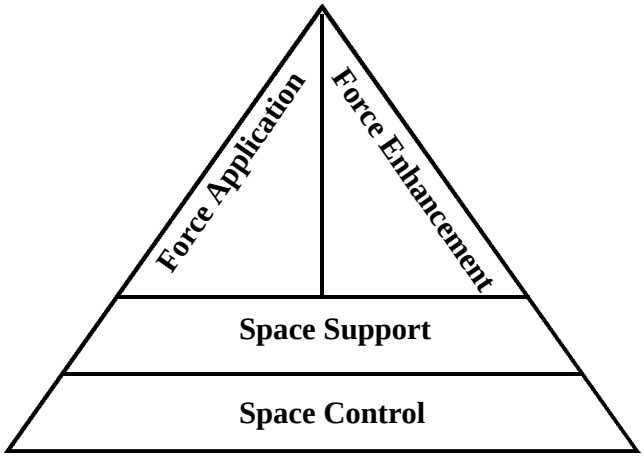

Figure 1. Space Missions

Space Control

As earlier indicated, space control is defined by the draft AFDD 2-2 as the means to gain and maintain space superiority to assure friendly forces can use the space environment while denying its use to the enemy. SPACECOM uses a slightly different definition. According to the unified command, "Space control is similar to sea control. It includes surveillance of objects in space, ensuring the conduct of space operations without interference, and the ability to deny an adversary the use of space-based support."[7] Although they use different language, both the Air Force and SPACECOM agree the space control mission is accomplished through three functions: space surveillance, defensive counterspace, and offensive counterspace.[8]

Space surveillance uses a worldwide system of ground-based radars and optical sensors to detect, track, identify, and catalogue the thousands of man-made objects orbiting the earth. According to SPACECOM, the Cheyenne Mountain Space Control Center tracks over 8000 objects daily.[9] These 8000 objects include debris from launches, non-operational satellites, and approximately 675 operational military, commercial, and civilian satellites.[10] By identifying the location (or predicted location) of operational satellites, space surveillance provides the foundation for defensive and offensive counterspace.

Defensive counterspace (or what SPACECOM calls "Operating Without Interference") ensures freedom of access for U.S. and allied space systems.[11] It involves monitoring foreign space activities – both terrestrial and space-borne – to ensure friendly space operations can be conducted without interference. SPACECOM is responsible for warning affected space system operators upon verification of a hostile act, which then

allows, at least in theory, the operator to execute a passive or active protection tactic. There are a number of hostile actions an adversary might take in an attempt to deny the U.S. its critical space support. These include attacks on the ground segment of a space system with special operations forces or conventional military actions, attacks on the space segment with some sort of an anti-satellite (ASAT) device, or attacks on the connecting communications segment by jamming either the satellite or the ground system.

Offensive counterspace, (or SPACECOM's "Denying the Enemy") is designed to deny the enemy freedom of access to and in space, thereby preventing them from exploiting U.S. or allied systems and negating their space system support. The focus of offensive counterspace has historically taken a three-prong approach. The first approach is executed through negation of the enemy's terrestrial space segment.[12] This would include targeting their launch infrastructure, satellite command and control systems, and satellite communication nodes. It could be conducted by air, naval, ground, or space forces and could include the permanent destruction of a system, the temporary denial of the support the system requires, or any other means within this continuum. Examples of this first approach might include a tactical air strike disabling critical space launch facilities or a special operations team cutting the electric power source to a critical satellite communications node. Clearly this approach is well within U.S. military capabilities.

The second approach targets the communications segment between the satellite and associated ground equipment.[13] Either or both the satellite or the ground equipment could be electronically jammed. Although our current electronic warfare capabilities

could easily jam the ground segment of a space system, the U.S. has no capability to interfere with the space segment.

The third approach focuses on the negation of the orbital segment of a space system.[14] This approach could be conducted by air, naval, ground, or space forces and could include the permanent destruction of a satellite, the temporary denial of the support a satellite requires or produces, or any other means within this continuum. Examples of this second approach might entail the use of a ground launched kinetic energy weapon to physically destroy an enemy intelligence satellite or a space-based laser targeting a key communication satellite. The United States does not have the capability to execute this third approach today, although the technology is well within the nation's ability and research into ASAT technology is continuing.[15] In fact, the United States has tested a variety of ASAT technologies. One of the latest included the successful intercept of a low earth orbiting satellite with a relatively small air-launched missile. This system was, however, quickly shelved. The program had apparently stirred controversy in Congress where it was viewed as the start of a space arms race.[16] The Russians, on the other hand, have long had a variety of weapons that were either specifically designed to negate U.S. satellites or could easily be adapted to do so. The Soviet Union developed a ground launched system designed to orbit a kinetic-kill vehicle, then attack the target satellite with a "shotgun" like burst of tiny projectiles. This "co-orbital" ASAT has been successfully tested several times and threatens essentially all U.S. high-value, low-earth orbiting satellites.[17]

This quick review of the four primary SPACECOM missions provides a basic foundation. Armed with this understanding of *what* space control is, it is now time to discuss *why* it is a critical mission.

Notes

[1] "U.S. Space Command Fact Sheet," n.p.; on-line, Internet, 10 February 1997, available from http://www.defenselink.mil/factfile/chapter1/spacecom.html.

[2] Fourteenth Air Force (AFSPACE) is headquartered at Vandenberg AFB, CA and is the Air Force's space *warfighting* component to U.S. Space Command. Air Force Space Command (AFSPC) is the Major Command responsible for the organize, train, and equip functions for the Air Force space and ICBM forces.

[3] Air Force Doctrine Document (AFDD) 2-2 (Draft), *Space Operations*, February 1997, 9.

[4] AFDD 2-2 (draft), 8.

[5] "U.S. Space Command Fact Sheet."

[6] George and Meredith Friedman *The Future of War* (New York: Crown Publishers, Inc., 1996), 374.

[7] "U.S. Space Command Fact Sheet."

[8] "U.S. Space Command Fact Sheet" and AFDD 2-2 (draft), 9.

[9] "U.S. Space Command Fact Sheet" and day crew of the Space Control Center, interviewed by author, 11 Mar 98.

[10] Day crew of the Space Control Center, interviewed by author, 11 Mar 98.

[11] "U.S. Space Command Fact Sheet."

[12] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 47-48.

[13] AFDD 1, 47-48.

[14] Michael R. Mantz, *The New Sword: A Theory of Space Combat Power*, (Maxwell AFB, AL: Air University Press, 1995), 22.

[15] AFDD 2-2 (draft), 6-7.

[16] Curtis Peebles, *The High Frontier—The U.S. Air Force and the Military Space Program*, (Washington, D.C.: Air Force History and Museums Program, 1997), 67.

[17] Robert L. Pfaltzgraff, Jr. and Richard H. Schultz, Jr. ed., *U.S. Defense Policy in an Era of Constrained Resources*, (Tufts University: The Fletcher School of Law and Diplomacy, 1990), 94.

Chapter 3

The Importance of Space Control

> *…aerospace control must be gained and maintained. Without it the theater campaign is unlikely to succeed.*
>
> —AFM 1-1

Space control provides the U.S. and her allies freedom of action in space and denies this same freedom of action to her adversaries. It has no inherent importance—in and of itself, it will win no wars. Its importance, rather, is indirect. Space control enables space operations. Space operations in turn, has evolved from a force enhancer to a critical force enabler. Space control's importance, therefore, lies in what it allows U.S. and allied terrestrial forces to accomplish and what critical support it can deny to the adversary. To appreciate the *importance* of space control, one must understand *what* it controls.

Currently, space operations are focused on data and information. Military, national, civil, and commercial satellites either *collect, relay,* or *distribute* data. In the future, satellite systems might very well leap beyond the realm of *data* to the direct application of *force*. Regardless of this possible evolution, space systems are key force enablers today. Since the offensive and defensive counterspace functions outlined in the previous chapter will not be exclusively executed by space forces, it is imperative that terrestrial forces understand the friendly space capabilities they may be tasked to protect and the enemy space capabilities they may be tasked to negate.

Data collection is accomplished primarily by intelligence, weather, warning, and imaging satellites. These assets provide some sort of "picture" to the warfighter, to those directly and indirectly supporting a military operation, and to the national decision makers that decide whether or not to invoke the military instrument of power. *Relay* systems facilitate inter- or intra-theater communications. This communications might be raw data, pictures, messages, warning, or simply voice conversations. Positioning, navigation and timing data is *distributed* by Global Positioning System (GPS) satellites. Like many other military weapons, space systems play a role at the strategic, operational, and tactical levels of war.

At the *strategic* level, early warning satellites provide the national command authorities the earliest possible indications of a ballistic missile attack against the nation. Intelligence and other imaging satellites provide key information about an adversary's capabilities and intent. The ability to collect and understand this information allows the U.S. to anticipate an adversary's actions and potentially preempt hostilities with the diplomatic, economic, information, or military instruments of power. The National Command Authorities (NCA) use strategic satellite communications to relay critical information and orders to theater commanders as well as to communicate to heads of state and other key decision makers worldwide.

Operationally, early warning satellites can be focused on a specific area of concern and provide the theater commander with near instantaneous warning in the event of a ballistic missile attack. Intelligence satellites provide near-real-time information concerning enemy order of battle information, battle damage assessment, force location and deployments, and assist in identifying key centers of gravity. Weather satellites

provide the theater commander insight into the environment that is then used to set the timing and tempo of major operations. Satellite communications systems provide the theater commander the ability to reach back to the CONUS or other supporting commanders for necessary support and allow him to communicate with his subordinate commanders within theater. The information distributed from the GPS satellites guides precision munitions to key centers of gravity with tremendous accuracy.

At the *tactical* level, early warning satellites identify from where a ballistic missile is launched and predict where within a theater the missile is likely to strike. In Desert Storm, these satellites were used to detect Iraqi SCUD launches and provided warning to battlefield and installation commanders. Intelligence satellites identify key targets, giving the military planner critical information prior to an offensive operation. These same assets can then be used to provide detailed battle damage assessment. Weather satellites provide detailed environmental information about the target, ingress, and egress routes—allowing for optimal target and weapon selection. Communication is relayed via satellite from anywhere in the world or from over the next hill directly to the warfighter on the battlefield. Distributed GPS information provides situational awareness to the pilot in the cockpit, the soldier laying mines on the battlefield, the marine landing on a desolate beach, as well as to the supply sergeant in search of a specific crate.[1]

These are but a few examples of how U.S. and allied forces exploit space systems. The nation's military, national, civil, and commercial space systems have become an integral and enabling part of almost all military operations. Loss of the capabilities listed above might very well prove decisive in future operations and the need for defensive counterspace is clear. What, however, do U.S. and allied terrestrial forces have to fear

from an adversary's use of space? Is it enough that we protect our own space systems, or must we deny the enemy the use of space? Space experts and general officers alike agree, this nation must be prepared to conduct offensive counterspace operations.[2]

A number of authors have used a "what if" scenario to illustrate this point and it makes for a convincing argument.[3] What if Saddam Hussein had exploited the space resources that were, in point of fact, available to him in 1991? The Iraqis could have vastly improved the accuracy of their SCUD missiles with modifications to incorporate a GPS navigation signal. This would have transformed the theater missile from a fairly useless weapon of terror to an extremely capable platform for delivering chemical, biological, or conventional munitions onto airfields, troop concentrations, or urban areas. Hussein might have easily obtained commercial or third-party source satellite imagery of key targets, perhaps the coalition's three major fuel dumps in theater. The allied build-up of troops in northwestern Saudi Arabia in preparation for the coalition's "left-hook" took significant time. Even imagery that was several days old might have tipped off the Iraqis to the operation. The element of surprise, key to this envelopment tactic, could have been lost and Hussein might have used his modified SCUDs to further disrupt the operation.

It would be unreasonable to suggest that an Iraqi use of space would have cost the coalition victory. The cost in dollars, time, and lives may, however, have proven unacceptable. The example serves to illustrate the importance of conducting offensive counterspace operations. As AFDD 1 appropriately states, "To ensure that our forces maintain the ability to operate without being seen, heard, or interfered with from space, it is essential to gain and maintain space superiority."[4]

This paper has so far reviewed some of the basic information about space missions and the need for space control. The next chapter looks at the origins of the nation's space control doctrine, for these origins have significant implications for its execution.

Notes

[1] Personal experience of the author as exercise and real-world operations planner for 14 AF.

[2] "Space Dependence: A Vulnerability Leaders Warn of Inadequacy in U.S. Control," *Washington Times*, 2 February 1998.

[3] Steven Lambakis, "Space Control in Desert Storm and Beyond," *Orbis* 39, no. 3, Summer 1995, 417.

[4] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 30.

Chapter 4

The Origins of Space Control Doctrine

Whereas those who have the capability to control the air, control the land and sea beneath it, so in the future it is likely that those who have the capability to control space will likewise control the earth's surface.

—Gen Thomas D. White
Chief of Staff, USAF, 1957

Command of the Sea, Air, and Space

The primary argument forwarded in this chapter is that current space control doctrine, if there is indeed such a thing, has its roots grounded in the air and sea control precepts, and this origin leads to certain implications about the way space control is understood. In an effort to make this connection clear, one must first understand some of the basics of sea and air control doctrines.

Two of the most important men to write about sea power were the American Alfred Thayer Mahan and the Englishman Sir Jullian Stafford Corbett. Although these contemporaries disagreed on many points, they both argued the goal of sea warfare was control of and over the sea. By controlling the sea lines of communication (SLOCs), a maritime nation could maintain itself and strangle an enemy in time of war.[1] Writing in 1889, Mahan argued that maritime dominance rested on a nation's ability to wage war on the seas, sea-borne commerce, and significant and worldwide colonies to support both the war making capability and the commerce itself. Mahan believed decisive victory at sea

would come with the destruction of the enemy's fleet and would directly lead to ultimate victory in war.[2]

Corbett, on the other hand, believed effective sea command could be won by blockade, deterrence, or diversion as well as by battle, and command of the sea was only a means to an end, not an end in and of itself. He believed sea command could be limited and that it was unlikely to be maintained over great time or distance. Sea command might entail control of a single critical line of communication, like the Strait of Gibraltar. [3] Corbett's concept of sea command separated the two tasks of securing friendly access and freedom of action and of denying access and freedom of action to the enemy. Additionally, he identified the fact that SLOCs were not mutually exclusive. The SLOCs of both belligerents, as well as neutral parties, might very well be the same.[4] The Straight of Hormuz, for example, is a key SLOC for all of the Persian Gulf nations as well as for the United States, as much of the world's oil transits this strategic location.

Although the role of today's Navy goes well beyond controlling the seas, this is a fairly recent development and the theories of Mahan and Corbett continue to play significantly in U.S. Naval operations.[5] Likewise, early writings of air power philosophers continue to have great relevance for today's Air Force.

Giulio Douhet wrote *The Command of the Air* in 1921. According to this early Italian air pioneer, "To have command of the air means to be in a position to prevent the enemy from flying while retaining the ability to fly oneself."[6] Along the lines of Mahan, Douhet believed that to have command of the air was to be in a position to win.[7] It would provide the freedom of action required to execute a merciless campaign of destruction upon the enemy's fielded forces, supporting infrastructure, and the population itself if

that was required. Command of the air would also protect oneself from this same devastating fate.

To a great extent, most critical thought concerning air power during the interwar years tended to forsake the requirement for command of the air. Theorists in England and at the Air Corps Tactical School in the U.S. instead focused on the potential destructiveness of air power. The allies paid a heavy toll for this lack of consideration in Europe, "[the air campaign of WW II] was characterized by a struggle to understand and master new instruments and methods of warfare, by large-scale battles of attrition, and by the critical importance of defensive techniques."[8] In the end, however, allied air power attention returned to command of the air and the allies wrested air superiority from the Luftwaffe. Command of the air turned out to be at least as important to the ground and naval forces as it was to the air force. Riding through Normandy after D-Day, General Eisenhower remarked, "If I didn't have air supremacy, I wouldn't be here."[9]

The lessons of WW II, however, fell largely upon dumb ears, and command of the air again played second fiddle to strategic attack. In the 1950s the U.S. Air Force focused primarily on developing strategic bombers and fighter-bombers with nuclear capabilities. Consequently, the USAF suffered significant combat losses as it began to commit substantial resources to the effort in Vietnam.[10] Since Vietnam, however, the USAF has made significant strides in gaining and maintaining command of the air. In 1974, the Air Force brought the world's most advanced air superiority fighter, the F-15, into operation, and has maintained this commitment to air superiority with development of the F-22.[11] According to Air Force Doctrine, air superiority is now considered a necessary condition for victory on land and at sea.[12]

There are certainly some obvious links between control of the sea or air and control of space. Like the sea and air, space is essentially ubiquitous; it is like the international waters or airspace. Friend and foe alike may share sea, air, and space lines of communication. Like control of the air and sea, control of space need not be exercised during peacetime. It is, rather, "…a peacetime capability serving as a deterrent because it can be employed during wartime."[13] And as in control of the air and sea, control of space sets up the conditions for victory so that the final decision may be reached on land.[14] The link between air control and space control was, however, consciously written into Air Force doctrine in 1992.

The Unfortunate "Aerospace" Connection

The U.S. Air Force has been appropriately criticized for not having much in the way of doctrine. General McPeak, the Air Force Chief of Staff, set out to change that in 1992 with the publication of Air Force Manual 1-1, "Basic Aerospace Doctrine of the United States Air Force." This significant milestone in air power doctrine inexorably tied together air and space with the term "aerospace." Although this document has since been superceded, it is worth comparing the aerospace connection made in AFM 1-1 and arguments to the contrary:

> The aerospace environment can be most fully exploited when considered as an indivisible whole…there is no absolute boundary between them…Its lower limit is the earth's surface and its upper limit reaches toward infinity.[15]

Some, however, argue there is no "aerospace" and the term unfortunately links two mediums that could hardly be more different. Operational space begins at approximately 100 miles above the surface of the earth. Conventional aircraft have a maximum ceiling

of about ten miles. The gap between the two mediums—the mesosphere—is an area of transit for non-air-breathing rockets, but not an area for real air or space operations. The air is simply too dense for orbital bodies and too thin for air breathing ones.[16]

> Elevation above the earth's surface provides relative advantages over surface-bound forces. Elevation provides broader perspective, greater potential speed and range, and three-dimensional movement… Aerospace's power, speed, range, flexibility, and versatility are its outstanding attributes.[17]

Air operations do indeed offer a number of unique advantages over ground or naval operations. The ability to quickly maneuver in all three dimensions provides tremendous freedom of action. While both air and space systems exploit the advantage of elevation, space systems suffer from a *lack* of flexibility. The weightlessness of space appears to give objects the power to roam at will, but this freedom is illusionary. In reality, gravity and the physical laws of motion trap satellites into a predetermined elliptical path. This path can be changed, but only with great care and energy. Aircraft enjoy the ability to maneuver because the physics of air flight—power from engines and lift from wings—offer the aircraft much greater energy than gravity. Spacecraft, however, can not practically be refueled so satellite engines produce small amounts of power to produce relatively minute changes in orbital velocity (speed and/or direction). A satellite's speed and range are predetermined by its orbit, in which it is inflexibly trapped.[18]

> In much the same way [as naval forces control movement at sea], aerospace forces attempt to control the aerospace environment to deny its use to the enemy and to assure friendly use of the environment without unacceptable interference.…Control of the atmosphere is achieved by counterair missions and control of space by counterspace missions. These missions thus have the same objective and are *only* differentiated because, generally, they require different kinds of technologies and platforms (emphasis added).[19]

Since it should now be apparent that space is a separate and distinct operating medium with a different set of physical rules, it follows that a separate and distinct theory for operating within this medium is required.[20] Contrary to AFM 1-1, counterspace should be differentiated from counterair because it is conducted in a completely different environment, not only because it requires "different kinds of technologies and platforms."

The Air Force apparently recognized some of these distinctions in 1997 with publication of Air Force Doctrine Document 1, Air Force Basic Doctrine, the successor to AFM 1-1. At the very least, the term "aerospace" disappeared. Unfortunately, it was all too often merely replaced with "air and space." Although the Air Force apparently understood there must be differences between air and space, this document did not necessarily recognize what these differences are. Excerpts from the 1997 document are revealing:

> Unlike surface power, air and space power's inherent exceptional speed and range allows its forces to visit and revisit wide ranges of targets nearly at will.[21]

> Air and space maneuver is uniquely able to achieve mass while moving with unmatched agility.[22]

Although some space systems can revisit a wide range of targets, it is only due to a pre-determined and highly inflexible orbit. Geosynchronous communications and warning satellites, for example, will remain over a single (although massive) target set unless maneuvered at great expense to remaining fuel and satellite life span.

In other ways, however, AFDD 1 has made some significant distinctions between air and space operations. Separate paragraphs are used to describe counterair and counterspace and each is defined with more meaningful descriptions than provided in AFM 1-1. Additionally, the 1997 document subtly but substantially altered the focus for

space control operations. In 1992, the focus of counterspace operations was on systems. In contrast, AFDD 1 reads:

> The main objectives of counterspace operations are to allow friendly forces to exploit space *capabilities*, while negating the enemy's abilities to do the same (emphasis added).[23]

This shift toward capabilities is central to the argument for a broader perspective. The following chapter discusses this argument in greater detail.

Notes

[1] Barry M. Gough, "Maritime Strategy: The Legacies of Mahan and Corbett as Philosophers of Sea Power," *RUSI Journal*, Winter 1988, 162.

[2] Gough. P. 164.

[3] William R. Hawkins, "The Man Who Invented Limited War," *MHQ: The Quarterly Journal of Military History* 14, 1997.

[4] Henry G. Franke III, "An Evolving Joint Space Campaign Concept and the Army's Role," (Ft Leavenworth, Kansas: Army Command and General Staff College, 1992), 22.

[5] Naval Doctrine Publication (NDP) 1, *Naval Warfare.* March 1994, 21, 31.

[6] Giulio Douhet, *The Command of the Air*, (New York: Coward-McCann, 1942), 24.

[7] Douhet, 23.

[8] Tami Davis Biddle, "British and American Approaches to Strategic Bombing: Their Origins and Implementation in the World War II Combined Bomber Offensive," as found in *ACSC War Theory Coursebook*, Academic Year 1998, 291.

[9] Benjamin Franklin Cooling, ed. *Case Studies in the Achievement of Air Superiority*, (Washington, D.C.: U.S. Government Printing Office, 1991), forward.

[10] Cooling, 623.

11 "Boeing Fact Sheet," n.p.; on-line, Internet, 15 March 1997, available from http//:www.boeing.com/companyoffices/history/mdc/militar8.htm and *United States Air Force Issues Book, 1997, Appendix B*, as found in *ACSC Operations Forces Course Book*, Academic Year 1998, 149.

[12] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 29.

[13] David E. Lupton, *On Space Warfare: A Space Power Doctrine*. (Maxwell AFB, AL: Air University Press, 1988), 111.

[14] Lupton, 114.

[15] Air Force Manual (AFM) 1-1, *Basic Aerospace Doctrine of the United States Air Force*, vol. I, March 1992, 5.

[16] George and Meredith Friedman *The Future of War* (New York: Crown Publishers, Inc., 1996), 344.

[17] AFM 1-1, vol. I, 5.

[18] Friedman, 342-343.

[19] AFM 1-1, vol. II, 103.

Notes

[20] Franke, 16.
[21] AFDD 1, 25.
[22] AFDD 1, 17.
[23] AFDD 1, 47.

Chapter 5

The Need for a Broader Perspective

The argument forwarded in this paper is that the historical space control perspective has focused primarily on space assets and their supporting systems rather than on the capability space assets provide. Truly effective space control will only come through a broader perspective, one which focuses on the products of space systems, the force enhancement and force application earlier described. The primary tenet of this broader perspective is that space control must not exclusively focus on the protection and negation of space systems, but rather on space capabilities. This concept of a capabilities driven space control doctrine does not, however, ignore the importance of protecting and destroying assets. Rather, it embraces and expands upon the concept.

The objective of air superiority is the denial of an adversary's air power *capability*. Air superiority is achieved through offensive and defensive counterair operations, which focus on the adversary's air power *assets* and supporting systems. Offensive and defensive counterair are primarily concerned with destruction of the adversary's aircraft, cruise and ballistic missiles, air defenses, and associated command and control structure.[1]

The objective of space superiority is the denial of an adversary's space power capability. Unfortunately, the focus of space superiority has traditionally been on the adversary's space assets. But until a space system provides force application, the sole

product of space power is some sort of data or information. The product of air power may be data or information, but it may also include pinpoint lethal destruction of key centers of gravity. This significant distinction between air and space power allows for the broader perspective. Since the product of space power is information, the target of space control should be the protection or denial of information. Although more specific implications are provided in the following chapter, the following example may provide some insight.

As part of space control, defensive counterspace "consists of active and passive actions to protect our space related capabilities from enemy attack or interference." [2] In this example, an *asset-focused* space control strategy might work to protect the two critical U.S. launch facilities the nation requires to place satellites into orbit. A *capability-focused* strategy would look at the entire range of potential access to space. In addition to protecting the only two U.S. launch facilities, a number of other possibilities emerge: development of more ground-based launch facilities, development of air and sea-based launch facilities, development of launch boosters that require little launch facility support, contractual agreements with other commercial or state sponsored launch facilities, etc. Defensive counterspace is more adequately executed by focusing on the *capability* of access to space rather than on the physical launch infrastructure.

A capabilities driven space control doctrine is not any radical departure from traditional military doctrine. U.S. Joint Doctrine dictates that commanders design campaigns that focus on defeating either enemy *forces* or *functions* or a combination of both.[3] A capabilities or functions focused space control doctrine then, is the maturation of space doctrine. In fact, air power doctrine matured in a similar fashion. Initially, air

power doctrine began with almost no consideration for air control. Even after WW II reinforced its importance, air control was largely ignored. By 1991, however, air control was considered a function that must be accomplished for successful prosecution of ground and sea operations. [4]

The lessons of Desert Storm speak volumes to the indirect approach for creating air superiority. Air superiority was achieved over Iraq not because Hussein had no aircraft. On the contrary, over half of the original 700 combat aircraft were still available to the Iraqis at the termination of hostilities.[5] Air superiority was achieved because the Iraqis could not muster air power *capability*. U.S. and Coalition forces targeted the Iraqi ground-based air defense system with attacks on the KARI command and control system, on the sector and interceptor operations centers, and on the numerous reporting and listening posts that provided early warning information.[6] These attacks allowed such freedom of action for Coalition air forces that the Iraqi aircraft fled to the "shelter" of their recent adversary, Iran.[7] Although Coalition forces continued to target Iraqi aircraft on the ground, air supremacy was declared by General Schwarzkopf on 27 January 1991, a short 11 days after the air operation began. Air control doctrine has matured from pre-WW II when it was essentially ignored to Desert Storm when air supremacy was quickly declared through indirect attacks on supporting capabilities.

One can expect the evolution of space control doctrine to take similar steps. The practical and political differences between and air and space power necessitate the capabilities or functions focused space control doctrine. The difficulty in protecting friendly space systems and the apparent unacceptability of destroying enemy satellites

makes the broader, capabilities-focused perspective an imperative. These facts are amplified by the rapid commercialization of space.

SPACECOM is charged with warning space operators about potential or documented threats to their systems. Warning, however, is only a first requirement for protection. Unfortunately, the space operator can take little recourse in response to SPACECOM's warning. U.S. satellites are not hardened against physical destruction from either kinetic or directed energy weapons and they cannot be easily maneuvered out of harms way. The time it takes to move a satellite is much greater than the time it takes to destroy one. Additionally, the critical ground segments of U.S. space systems are vulnerable to attack. Large satellite dishes make for obvious and excellent targets. U.S. inability to protect its space systems is matched by its unwillingness to operationalize an ASAT system.

Although the U.S. tested several ASAT systems, they've all since proven politically or practically unacceptable. In reaction to the Cuban Missile Crisis of 1962 and a perceived Soviet nuclear threat, a U.S. State Department plan in 1963 concluded:

> In anticipation of the contingency of a Soviet weapon in space and recognizing that it may be necessary to undertake physical countermeasures, we should develop as rapidly as possible anti-satellite capabilities.[8]

The Army's Nike Zeus anti-ballistic missile (ABM) and Thor intermediate range ballistic missile (IRBM) were both adapted for ASAT systems during the 1960s. As early as 1959 the Air Force has looked at fielding an air launched ASAT system, which culminated in a successful test of the F-15 launched ASAT in September 85.[9]

Despite this successful test and the continued call for an ASAT capability, none exists today, nor are any operational systems under development. Indeed, President

Clinton recently cut funding for the Army's design for a ground launched kinetic kill ASAT.[10]

The nation's failure to build adequate negation or protection systems is complicated by the significant and growing commercialization of space. An increasing number of commercial communications satellite systems, including INMARSAT, INTELSAT, and Iridium provide voice and data communications to users worldwide. In fact, the U.S. military has contracts with a number of commercial ventures and multinational consortiums to provide military communications.[11] Other nations are sure to follow America's lead.

New commercial ventures will soon produce high-resolution (one meter) quality imagery data. Economic competition will likely keep the price so low that even poorly funded terrorist organizations will be able to afford this military-quality product. Some business estimates indicate the market for space imaging may grow from $100 million today to $10 billion in the next few years.[12] This potential market will surely increase the number of commercial imaging satellites in the near future. EarthWatch Inc. and Space Imaging are two Colorado based companies that intend to launch high-resolution photo imagery satellites within the next two years.[13] And these companies know how to produce imagery and how to distribute it. The new president of Space Imaging is Jeffery Harris, who once headed the National Reconnaissance Office (NRO).[14]

Given this nation's recognition for the need to control space, its increasing reliance upon space assets, its reluctance to field an ASAT system, its failure to protect satellites from attack, and the growth of the commercial satellite sector, the warfighter must turn to a broader perspective to achieve *virtual* space control.

Notes

[1] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine,* September 1997, 46-47.

[2] AFDD 1, 48.

[3] Joint Pub 3-0, *Doctrine for Joint Operations,* February 95, III-7.

[4] AFDD 1, 29.

[5] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey – Summary Report,* (Washington, D.C.: U.S. Government Printing Office, 1993), 64.

[6] Keaney, 60.

[7] Keaney, 64.

[8] Curtis Peebles, *The High Frontier – The U.S. Air Force and the Military Space Program,* (Washington, D.C.: Air Force History and Museums Program, 1997), 61.

[9] Peebles, 67.

[10] "Space Dependence: A Vulnerability Leaders Warn of Inadequacy in U.S. Control," *Washington Times,* 2 February 1998.

[11] "Iridium Home Page," n.p.; on-line, Internet, 10 February 1998, available from http//:www.iridium.com.

[12] "Colorado's Space Race," *Colorado Business* 23, no. 3, March 1996, 37.

[13] "Colorado's Space Race," 37.

[14] "Spy Chief to Head Colorado Firm," *Denver Business Journal* 47, no. 46, 26 July 1996, 3.

Chapter 6

Implications of a Broader Perspective

This chapter answers the questions "What is the broader perspective?" and "What are the implications for the warfighter?" The perspective must be broader across the entire spectrum of space control and this chapter will discuss implications for all three functions—space surveillance, defensive counterspace, and offensive counterspace—in some detail.

Space surveillance is currently focused on identifying the location of satellites. A broader perspective calls for a more complete understanding of the space battlefield. This intelligence preparation of space must identify all the space capabilities an adversary depends upon, not just the location of satellites. For example, Iraq may not own or operate any satellites, yet might receive communications support from international consortiums, navigation support from commercial GPS receivers, and imagery from third-party nations. Space intelligence must include the location of supporting satellites as well as which transponders and frequencies, the type and number of GPS receivers, details on contractual obligations, and the source of third-party support.

Defensive counterspace operations are actions to protect friendly space related capabilities from enemy attack. The broader perspective opens the door to many protection strategies. It begins with the question "What capabilities do I need to

protect?" There are a number of obvious answers from preceding chapters: access to space (space launch), information collection (intelligence and other imagery, warning, weather, etc.), information relay (communications), and information distribution (precise timing, positioning, navigation, etc.). In the future, force application platforms will require defensive counterspace options as well. Armed with an understanding of what capabilities require protection, comprehensive defensive counterspace operations can be implemented.

As was discussed in the last chapter, access to space can be assured by developing more and varied launch operations—with flexible ground facilities and launch vehicles. The Air Force is developing the Evolved, Expendable Launch Vehicle (EELV) and appropriately looking toward a space plane as a reusable space launch vehicle to add this required flexibility.[1]

Information collection, relay, and distribution can be protected through a variety of means. From a traditional vantage point, protection of the *assets* themselves will remain important and increased satellite maneuverability will be central to asset protection. Satellite maneuverability will require smaller satellites, more on-board fuel, more efficient maneuver engines, and either a command and control system that can quickly react to an ASAT or on-board sensors and processors which implement maneuver actions independent of ground control. Any satellite maneuver however, tends to move a satellite outside its optimal mission orbit, which degrades the space capability. One defensive maneuver may require several more to reposition the satellite back to a useful orbit.

Besides maneuver, satellites might employ deceptive tactics to defeat an ASAT. These would include deployment of inflatable satellite decoys—the space equivalent of chaff and flares. Another tactic may be to harden satellites from directed or kinetic energy ASAT attacks. As the satellite payload itself becomes smaller and lighter, it may be possible to add some level of "armor" with no appreciable net weight gain.

Besides these asset-based protection techniques, other strategies are available. Redundancy of capabilities is among the most important. Due to their high cost, military space systems have suffered from a lack of significant on-orbit redundancy. In an environment where U.S. space systems come under hostile fire, some sort of redundant system must be able to provide the threatened capability. Redundancy can and should be accomplished in three fashions: on-orbit, with quick replenishment, and by terrestrial support.

On-orbit redundancy has traditionally meant the launch of expensive "spare" satellites. This has been prohibitively expensive, and few U.S. space systems have any significant on-orbit spares. An alternative is to develop multiple, inexpensive, lightweight systems that provide the same capability as the larger single satellite systems. This concept borrows from some of the more recent commercial ventures. The commercial Iridium system, for example, will use 66 very small satellites in low earth orbit to provide world wide communication.[2]

The ability to quickly launch replacement satellites on demand is a second method of providing redundancy. This requires a much more responsive launch infrastructure than currently exists. Development of the space plane and other inexpensive expendable launch vehicles will be a key to quick replenishment redundancy.

A third way of providing redundancy is to ensure the capability can be accomplished through non-space related means. Although space assets can provide some traditionally air, ground, and sea-based capabilities cheaper, faster, and more efficiently, the U.S. must retain the capability to accomplish these functions with terrestrial forces. For example, the space-based GPS satellites provide key navigation aids to air, sea, and ground forces. But this does not obviate the need for the compass or the LORAN system. If for some reason GPS capability was negated, U.S. military forces must retain the ability to navigate. Likewise, satellite communications should not replace point to point communications, and satellite intelligence collection should not replace other collection sources currently available.

A related redundancy strategy involves exploitation of the commercial sector. As earlier indicated, the U.S. military already uses commercial satellite communications, and to a lesser extent, commercial imagery. Market competition will continue to increase commercial capability and drive down costs. The U.S. military simply cannot afford to develop and exploit space capabilities on a separate and distinct track.

Redundancy provided by multiple on-orbit systems, a quick replenishment capability, terrestrial back-up systems, and exploitation of the commercial sector provides a significant deterrent against attacks on space systems. An adversary is unlikely to expend costly ASAT resources if the result does not appreciably decrease U.S. capability. Redundancy is more than an insurance policy, it is a protection strategy in its own right.

Just as defensive counterspace focused on capability protection, *offensive counterspace* must focus on capability denial. The question is not "What satellites do I deny the enemy?" rather "What capabilities do I need to deny the enemy?" Until the U.S.

faces an enemy with a space force application capability, it must focus its offensive counterspace efforts on the denial of information.

The key to an effective offensive counterspace strategy is knowing what information to deny. Offensive counterspace must deny the *specific* information the U.S. cannot afford to have in the hands of an adversary. But this does not mean the U.S. should target intelligence information, or communications information, or navigation information in broad terms. There may be great military value in allowing an adversary to communicate or collect information or navigate. But the military must have the capability of denying very specific information at specific times. In this way, offensive counterspace takes on new meaning. It is not the denial of an enemy's photo-imagery satellite, it is denial of specific photos. It is not the denial of an enemy's communications satellite, it is the denial of specific conversations.

Offensive counterspace should include the ability to physically destroy an enemy's satellites, but must also include the capability to jam or corrupt satellite signals, deny launches, terminate contracts, deny ground facility support, and deceive the enemy with ambiguous or erroneous information. Much of this offensive counterspace will be executed by the terrestrial forces in support of SPACECOM's overall space operation.

Ground, air and sea forces, for example, will be called upon to destroy enemy launch facilities and satellite command and control facilities. Terrestrial units will be directed to execute a coordinated plan to deceive enemy space imagery with false massing of troops, deceptive maneuvers, and deployment of artificial structures and equipment.

Denial of commercial space support will be a critical facet of offensive counterspace. An easy solution may be to contract options for exclusive U.S. support under certain

specified conditions. Another option may be to license commercial ventures to operate in the U.S. only if companies agree to terminate support to U.S. adversaries upon demand.

The broader perspective of space control calls for a synergistic effort of all the military forces as well as the support of diplomatic and economic instruments of power. The final chapter of this paper will provide some alternative thoughts on space control, offer some recommendations and summarize the ideas presented.

Notes

[1] *United States Air Force Issues Book, 1997, Appendix B,* as found in *ACSC Operations Forces Course Book,* Academic Year 1998, 163.

[2] "Iridium Home Page," n.p.; on-line, Internet, 10 February 1998, available from http//:www.iridium.com.

Chapter 7

Alternatives, Recommendations, and Conclusions

Alternative Ideas

The broader perspective of space control is but one of many and will hopefully stimulate further discussion on the subject. A few of the more common other thoughts on space control include accepting the *status quo*, working towards a diplomatic solution, and building a robust ASAT program.[1] Each has its value and its shortfalls.

The U.S. could continue to employ its space assets and increase its dependency on space support without worrying about space control. Few other nations currently have the ability to significantly deny our access to space nor do they exploit space to a great extent. All evidence, however, points to a reversal in this trend and the U.S. has recognized the need to do something. Indeed, the USAF considers "Space Superiority" an Air Force Core Competency. The growing dependence of the U.S. military and the world economy on space support make the *status quo* an unacceptable alternative.

A second school of thought looks to diplomacy to avoid any confrontation in space. This idea postulates that comprehensive treaties and arms agreements could be forged to protect all space assets from hostile target. This idea seems fatally flawed for at least three reasons. First, treaties and arms agreements apply to the peacetime environment. When hostilities break out, nations no longer feel obliged to honor prior agreements.[2]

Second, diplomacy applies only to state actors. Future military action is unlikely to be limited to *state* belligerents. Third, the U.S. has led the technological push for space support and should not cede the same support to its adversaries. The U.S. would never negotiate away air or sea superiority. It makes no more sense to allow an enemy unfettered access to space.

The concept of an ASAT-centered space control doctrine has more merit. The capability to physically destroy an enemy satellite will be a critical facet for controlling space. An ASAT system will be imperative if another nation ever develops the ability to apply force through space, and this is almost certainly an eventuality. The political and practical impediment to an ASAT system are significant, but can be overcome. But even the most robust ASAT program will not protect U.S. space capabilities. An ASAT may deter another rational state actor from employing a similar system, but it would not stop the terrorist or the nation on the losing side of war. Additionally, the ASAT is an impractical weapon against commercial systems. For one thing, many commercial systems are owned and operated by U.S. companies and are involved in the daily commerce of the world market. For another, the U.S. military is sharing some commercial space systems with potential adversaries.

Recommendations

If the U.S. is to actually control space, it must begin to take steps now. The technology to develop an ASAT system clearly exists, and it must be exploited. This however, will be only one step, and to be used under the most extreme circumstance. With a change in mindset, a broader perspective, the United States can begin to control space in a meaningful fashion. The U.S. has the ability to take many of the specific

measures outlined in this paper. What it requires is a maturation of space control doctrine. The technology of space support provides an *opportunity* for a true revolution in military affairs. The opportunity is unlikely to be realized unless space power doctrine matures along with technology. The U.S must learn to control the capabilities space provides – to protect this critical force enabler for friendly forces and to deny enemies the advantages space can provide. The U.S. should begin this process by pulling its head out of the sand and face the difficult challenges of space control. The answer to this political and practical puzzle may or may not involve the idea of virtual space control forwarded here. It does, however, lie in a concerted and immediate effort by the military establishment to address doctrinal issues.

Conclusion

Space control is a capability the U.S. military must achieve if it is to execute successful terrestrial military operations. The U.S had *de facto* space supremacy in its first "Space War"–Desert Storm—because no other nation rose to the challenge. Nations hostile to the U.S. almost certainly learned this lesson and are unlikely to allow the U.S. such freedom of action. When this happens, and it surely will, the U.S. will either be better prepared to conduct space control or it will suffer significantly. The U.S. military in general, and the Air Force specifically, have often learned their best lessons through substantial and tragic losses. Failure to conduct space control in future conflicts will almost certainly lead to greater and unnecessary tragedy.

Although traditional asset-focused space control has proven practically and politically difficult to achieve, a broader perspective focused on controlling space

capabilities may prove significantly more effective. By protecting and denying specific space *capabilities*, the U.S. can conduct virtual space control.

Notes

[1] David E. Lupton, *On Space Warfare—A Space Power Doctrine.* (Maxwell AFB, AL: Air University Press, 1988), 33-43.

[2] Henry G. Franke III, "An Evolving Joint Space Campaign Concept and the Army's Role," (Ft Leavenworth, Kansas: Army Command and General Staff College, 1992), 19.

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