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ACCESS TO SPACE: ROUTINE, RESPONSIVE AND FLEXIBLE

IMPLICATIONS FOR AN EXPEDITIONARY AIR FORCE

by

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Preface

This is an exciting and challenging time for the United States Air Force. Technological advancements and the blurring of lines between the military and the commercial world create new dangers as well as opportunities. As the Air Force struggles to mold itself into an expeditionary force, issues concerning the integration of air and space become more critical. This research paper briefly discusses the larger issue of integration to set the context for discussing the specific issue of routine, responsive and flexible access to space and how it may impact the Expeditionary Air Force (EAF) construct. The Air Force must act quickly to develop doctrine and command relationships designed to maximize the combat capabilities engendered by routine space access. It is imperative to exploit these rapidly developing capabilities in order to not only remain the world's preeminent aerospace power, but to protect and defend the economic viability of our country and ensure the safety of our citizens.

Lt Col Marty France first posed this research topic. Maj Ed Greer served as the Research Advisor for this paper and provided important feedback. I gratefully acknowledge Maj Jim Wolf's assistance. He shared his impressive expertise and knowledge of Air Force topics and demonstrated an amazing ability to pose, frame and articulate issues of national importance. I learned an incredible amount during my association with this excellent officer and am grateful for his contributions to this paper.

Abstract

The United States Air Force is implementing the Expeditionary Air Force (EAF) construct. Concurrently, technological, political and economic forces are driving the rapid development of routine, responsive and flexible access to space.[1] This paper presents the argument that routine access to space will happen more quickly than is presently forecast and therefore the transition to an EAF should address the implications of routine space access. The research methodology included literature searches in the areas of air and space doctrine, Reusable Launch Vehicle (RLV) development, EAF constructs, and command and control relationships within the joint force. The congressional record was searched for relevant legislation and legislative proposals. Interviews with EAF and space experts were conducted. Exercises and games such as Expeditionary Forces Exercise (EFX) 98 and Global Engagement 98 were analyzed.

The Air Force must quickly develop doctrine and command relationships designed to maximize the contributions routine space access brings to the joint warfighter. Doctrinal constructs for the effective use of USAF expeditionary aerospace power will help ensure our nation maintains its lead as the preeminent aerospace power. This paper specifically uses the near-future advent of Reusable Launch Vehicles and their implications for an Expeditionary Air Force as an illustration of how future Joint Force Commanders may effectively bring aerospace power to bear in the battlespace as a combined, synergistic whole.

Notes

[1] William W. Bruner III, “National Security Implications of Inexpensive Space Access” (master’s thesis, Air University, 1996), 3.

Chapter 1

Introduction

> *We are now transitioning from an **air** force into an **air and space** force on an evolutionary path to a **space and air** force.*
>
> —Global Engagement:
> A Vision for the 21st Century Air Force

Aerospace power is beginning to replace *air and space* power in the lexicon of the United States Air Force. This may be primarily a symbolic move designed to placate those in favor of a separate space force. It may also be simply designed to posture the Air Force to retain current space roles, missions and funding. Hopefully it is truly a sign of service commitment to integrating air and space power into a seamless aerospace force. There is neither a national, nor a military consensus that the preponderance of space power should remain in the US Air Force. On 18 November 1998, before the Fletcher School for Foreign Policy Analysis Annual Conference, Senator Bob Smith (R-NH), Chairman of the Strategic Force Subcommittee of the Senate Armed Services Committee, said,

> …I do not see the Air Force building the material, cultural, and organizational foundations of a service dedicated to spacepower….
>
> The Air Force must truly step up to the spacepower mission, or give it to another organization.[1]

Following the publication of Senator Smith's remarks, retired General Howell M. Estes III, former commander of Air Force Space Command and U.S. Space Command, was quoted in the Defense Daily as saying, "…without a major restructuring of the service's budget and large

divestitures of some parts of the Air Force's structure, the service can 'kiss the space mission goodbye.'"[2]

Acting Secretary of the Air Force F. Whitten Peters and Chief of Staff of the Air Force Gen Michael E. Ryan are understandably opposed to a separate space force. They are lobbying for the continued integration of air and space power in a US Air Force designed to project aerospace power from "'…the vertical dimension,' [where] military operations are blended and interdependent."[3]

Maj Gen Don Cook, one of the lead officers developing the EAF concept, opined that the integration of air and space was "…not dissimilar to integration of naval aviation and carriers to the battleship navy of World War II."[4]

It is obvious that the discussion concerning the future of space power is far from over. Whichever side of this multifaceted and sometimes rancorous debate an individual falls on, one theme remains crystal clear. Space power will continue to grow in importance to both our nation as a whole and our military establishment in particular.

Given this context, significant (and perhaps obvious) questions include "how soon will this growth occur?" and "how will this importance manifest itself?" This research paper presents the argument that the answer to the first question is "immediately" and the answer to the second question involves the continued migration of substantial parts of our nation's economic and military wherewithal to space. It is becoming clear that the military will be expected to both protect and exploit the realm of space, just as we now protect and exploit the freedom of the seas and the freedom of the airways.[5]

This paper does not explicitly explore the theme of US Air Force integration of air and space power. Neither does it pursue in-depth the questions revolving around our current national

policies towards the militarization of space and how those policies may change in the near future. These questions are simply too large and complex and beyond the scope of this project. These larger issues must be kept in mind, however, since they provide the context for any discussion detailing future space capabilities and their possible impact on the evolving US Air Force.

This report specifically focuses on the issues facing the USAF as it struggles to remake itself into an Expeditionary Air Force and how routine, responsive and flexible access to space will impact this struggle. The argument revolves around the development of Reusable Launch Vehicles (RLVs) and how this technology and the speed of its maturation may change the nature of how we fight and win our nation's future conflicts.

The paper reviews current space support to the theater campaign and makes the argument that space operations will soon appear similar to aviation operations as far as cost and responsiveness are concerned. Finally, it raises questions concerning doctrinal constructs and command relationships which must be addressed from an expeditionary point of view.

These issues must be addressed sooner rather than later. The explosive growth of technology and commercial space ventures ensure we will eventually be called upon to defend our vital interests in space even as we continue to use our current and future space capabilities to defend our vital interests on Earth. The next chapter sets the stage for this argument by reviewing the current status of space support to the joint campaign.

Notes

[1] AFSPC Legislative Liaison, "Sen. Smith's Speech: The Challenge of Spacepower" *Legislative Update*, 20 November 1998, n.p., available from HQ AFSPC/XPPL.

[2] Quoted in David Atkinson, "Estes Says Air Force Budget Must Be Realigned For Space Ops" *Defense Daily*, 13 January 1999, n.p.

[3] Quoted in John T. Correll, "The Integration of Aerospace," *Air Force Magazine*, January 1999, 2.

[4] Maj Gen Don Cook, address to the Air Command and Staff College, Maxwell AFB, Ala., 12 January 1999.

Notes

[5] HQ USAF/XPX-AITF, “Beyond the Horizon: Integrating Air and Space” (draft white paper, 4 Dec 1998, version 5.3), 3-1-3-2.

Chapter 2

Space Power Characteristics and the Warfighter

> *Space is already inextricably linked to military operations on land, sea, and in the air.*
>
> —Joint Strategy Review, January 1997

Space power is currently limited by several characteristics. These include the space environment itself, the responsiveness or flexibility of current space systems, the cost of equipment and the cost of reaching orbit. These characteristics directly affect the way space forces contribute to warfighting efforts. They shape current doctrine and the command relationships surrounding that doctrine. These doctrinal and command relationships, in turn, directly affect the way space power contributes to the warfighter.

The Space Environment

The space environment is inherently dangerous and harsh, but more importantly, it is governed by physics which seem counterintuitive to what we observe on the surface of our friction-filled Earth.[1] A lengthy dissertation on orbital mechanics is not required to understand that the motion of orbiting objects, such as man-made satellites, is very different from the motion of objects on the Earth and in the air. A succinct summation of this difference was presented when "…the Air Force Scientific Advisory Board recently referred to air and space as two flight regimes, one of which ignores Bernoulli and the other Kepler."[2]

The resultant manifestation of this difference is the ease with which it is possible to predict the location of a non-maneuvering satellite constrained in its motion by Kepler's Laws. The most recent highlight of this characteristic as a weakness were the nuclear tests conducted by India and Pakistan in the summer of 1998 which "…surprised the spooks running the world's most sophisticated spy satellites."[3]

Orbital prediction programs have proliferated to the point that anyone can purchase them cheaply. It is then simply a matter of accessing a database (easily accomplished via the Internet) or acquiring tracking data for a given satellite of interest and then propagating that data forward in time to predict when the satellite will next be overhead.

If a nation wishes to conduct surprise surveillance or reconnaissance on an adversary, that nation's space assets must either be able to maneuver or be launched rapidly in response to a tasking. Maneuvering costs fuel, which is often in short supply on non-refueling, long-mission spacecraft placed in orbit by non-reusable launch vehicles. It is simply not economical from a launch cost perspective to increase the fraction of satellite weight represented by fuel. Unfortunately, rapidity and responsiveness are not characteristics of current US space launch systems.

Responsiveness of Current Launch Systems

The preparation time in 1999 for on-demand satellite deployments is years on the high side to months on the low side. Recoverable, rapid response transport to, though and from space is on the order of months and can only be accomplished by the Space Shuttle and then only to low Earth orbits. Additionally, such launches are limited to shuttle-compatible spacecraft designed in compliance with manned spaceflight safety standards.

The United States Space Command Long Range Plan calls for significant improvements to these capabilities by 2005, with a key launch platform in place by 2012.[4] These new launch systems would reduce the preparation time to weeks and eventually days with alert forces poised to launch within hours of notification. This kind of capability would obviously create an asymmetrical advantage for a battlespace commander facing a foe who lacks the ability to respond in kind. This topic is more explicitly explored in chapter 4, Military Implications of Routine Space Access.

USSPACECOM also predicts that "around 2004, commercial spacelift will largely supplant the DoD's spacelift fleet because it will be so dependable."[5] It is important to note that the commercial capabilities referenced above are *expendable* launch vehicles. In a later chapter, this paper presents the argument that an accelerated development of commercial *reusable* launch vehicles will follow roughly this same time-line.

The bottom line to this discussion is that space access is currently neither routine nor responsive. US Air Force and joint command relationships and doctrine are crafted reflecting this reality. Should this paradigm change, doctrine and command relationships must necessarily change as well.

If routine and responsive space access capabilities develop rapidly, they could create a dangerous situation. The joint force, led in this area by the space savvy Air Force, should have doctrine and command links in place and ready to exploit these new capabilities as they occur. This doctrine and these command links must fit within the Expeditionary Air Force construct.

Costs of Equipment and Access

Closely related to the responsiveness of launch systems are the costs associated with the assets themselves as well as the vehicles used to put them in orbit. Satellite costs are declining,

due in large part to the microelectronics revolution. Other factors such as new business practices and the availability of improved aerospace engineering design tools also serve to lower costs.

Despite these savings, spacecraft are still very expensive to build. Commercial companies are more willing than ever to absorb these costs, however, due to the "…seemingly insatiable demand by consumers for mobile communications, Direct-To-Home satellite TV, and Internet access."[6] Spacecraft design will continue evolving to provide "…vital services to telecommunications operators and consumers."[7] There are obvious economies of scale, which further reduce the cost of fielding 70 to 300 spacecraft of similar design such as the Iridium or Teledesic communications systems.

The combination of these factors led to spacecraft themselves comprising less and less of the total cost to field a given system. Launch costs have not seen a similar reduction. The late 1980s and early 1990s were an era of intense focus on the spacecraft portion of the cost equation. There was a move away from "BattleStar Galactica" satellites in favor of smaller, cheaper and in some ways less capable spacecraft designed to work together to form a synergistic whole.

The middle and late 1990s have seen a similar and growing emphasis on cost reductions to the launch portion of space access. "Perhaps the largest single obstacle to the progress of space exploration, and to the utilization of space for human benefit, is the cost of space transportation."[8]

Although the United States elected not to pursue development of an aerospace plane as a national priority, many enabling technologies for such a reusable launch vehicle have been developed.[9] These technologies and the economic boom in commercial space applications have ignited a commercial race in the reusable market, which may eclipse current government efforts in this area.[10]

Doctrine and Command Relationships

The Unified Command Plan (UCP) designates USCINCSPACE as "…the single point of contact for military space operational matters."[11] This is a recent update to the UCP and highlights changing US military beliefs regarding the proper organization and use of space power.

The current relationships between Joint Force Commanders (JFCs) and space resources are in many ways unacceptable. The majority of military space assets provide information in one form or another to the JFCs (including theater Commanders-in-Chief) and "the processes to request and task **space** resources are too complex, time consuming and cumbersome."[12]

The United States Space Command released a Long Range Plan (LRP) in March of 1998 detailing proposals to fix many of the doctrinal and organizational hindrances currently impeding the smooth integration of space capabilities into the joint force. This plan promulgates a construct known as Full Force Integration (FFI). "Full Force Integration is USSPACECOM's strategy to seamlessly weave space capabilities into all dimensions of warfare."[13] This concept treats space forces as a separate entity, in many ways co-equal to land, sea and air forces. It could be interpreted to some degree as an argument for a separate United States Space Force.

Conversely, Acting Air Force Secretary F. Whitten Peters and Air Force Chief of Staff Gen Michael E. Ryan present a completely different perspective encapsulated in a draft white paper describing the integration of air and space. This proposal would integrate space and air forces into a seamless aerospace force, equal to its land and sea counterparts.[14]

The fundamental differences between these two plans are intriguing, and may indicate a rift between Air Staff and US Space Command doctrine. The disparity between two documents generated at the highest levels of the Air Force is interesting, and indicative of a lack of

consensus within the Air Force as to its organizational end state. The issue of air and space integration and the evolution into an expeditionary force will no doubt continue to produce intense debates over the next few years.

For the purpose of this paper's analysis, it is irrelevant whether space power is fully integrated into the proposed aerospace force or becomes a completely separate service. In either case, the current timelines are too long for developing doctrine and command relationships designed to exploit routine space access.

The next chapter presents the notion that routine and responsive space access will happen more quickly than currently predicted, and that the Air Force must address the doctrinal and command issues now, concurrently with its development of the Expeditionary Air Force construct. Failure to do so may lead to missed opportunities and increased national security risks.

Notes

[1] Jerry Jon Sellers et al., *Understanding Space: An Introduction to Astronautics* (New York: McGraw-Hill, Inc., 1994), 65-75.

[2] HQ USAF/XPX-AITF, "Beyond the Horizon: Integrating Air and Space" (draft white paper, 4 Dec 1998, version 5.3), 2-2.

[3] Duncan Campbell, "Hiding from the Spies in the Sky," *The Guardian Online,* 4 June 1998, n.p.; on-line, Internet, 29 January 1995, available from http:/online.guardian.co.uk/pic.html.

[4] USSPACECOM Long Range Plan (LRP), *Implementing USSPACECOM Vision for 2020,* March 1998, 24.

[5] USPACECOM LRP, 25.

[6] Theresa Foley, "Commercial Spacefarers," *Air Force Magazine,* December 1998, 44.

[7] Foley, 44.

[8] Robert E. Lindberg and Robert T. Feconda, "X-34: A test bed for RLV technology," *Aerospace America,* August 1998, 30.

[9] Congress of the United States Office of Technology Assessment, *Access to Space: The Future of U.S. Space Transportation Systems* (Washington, D.C.: Government Printing Office, 1990) 74-76, 85-92.

[10] Ben Iannotta, "Small start-ups vie for big business," *Aerospace America,* August 1998: 34-37, 51.

[11] USSPACECOM LRP, 75.

Notes

[12] USSPACECOM LRP, 90. Emphasis in original.
[13] USSPACECOM LRP, 73.
[14] HQ USAF/XPX-AITF, i.

Chapter 3

Space Access and the Near Future

In the development of air power, one has to look ahead and not backward and figure out what is going to happen, not too much of what has happened.

—Brigadier General William "Billy" Mitchell

Brigadier General Billy Mitchell is often touted as a visionary with respect to the possibilities of airpower. Depending on one's point of view, he was either a man well ahead of his time, or a zealot who promised much more than airpower could realistically deliver. It is clear that he advocated a forward thinking approach to technological developments, lest advantages are lost and dangers created.

It is easy to make the case that on more than one occasion the nation, including the military, has been surprised by the speed at which a new technology developed and almost immediately changed the way we think, organize, operate and fight. The machine gun, personal computers and the Global Positioning System (GPS) are several pertinent examples. These developments rapidly and fundamentally changed not only the military, but also the world in general. They created opportunities for those perceiving the promise of the technology, and grave dangers for those unprepared to embrace and exploit that promise.

This chapter's thesis revolves around the idea that we are experiencing a similar development today in the form of Reusable Launch Vehicles (RLVs), which will provide routine, responsive and flexible access to space. It presents the argument that there are

economic, political and technological forces coinciding to rapidly develop this capability. There will be opportunities and dangers associated with this access.

Economic Forces

Although statistics vary, most sources agree that sometime between 1996 and 1997 commercial satellite launches surpassed government satellite launches for the first time since the space age began. At an Air Force Association National Symposium held 13 November 1998, General George T. Babbitt Jr., commander of Air Force Materiel Command, said, "Over the next five years, 80 percent of space launches will be commercial….the space industry itself estimates that its revenues will grow from $79 billion in 1997 to more than $117 billion by 2001."[1]

The preponderance of this growth will be in the communications sector and "the days when satellites were limited to a narrow role in the $600 billion-a-year telecom business have ended."[2] Predictions of activity in the out-years indicate an almost exponential growth in space communications. "It is…forecast that approximately 1,017 commercial communications satellites will be launched in 1999-2008….the total value of these satellites will be just under $50 billion."[3]

Lt Gen Lester Lyles, director of the Ballistic Missile Defense Organization, captured the change succinctly during a speech to the Air Force Association Symposium:

> …In the areas of navigation and surveillance, things had changed again and we were no longer the No. 1 power – we being the military….space dominance had changed in terms of its definition. We were no longer the dominant force. The dominant force was commercialization.[4]

This amazing growth in the commercial spacecraft-manufacturing sector is accompanied by a corresponding growth in the launch sector. The outgoing Pentagon space architect, Maj Gen Robert Dickman,

> …recently completed a study to determine how a quick-response launch capability would benefit the military and commercial sector. [In the study, Gen] Dickman concludes that market forces will drive rocket firms to field launch-on-demand capabilities that will bring both military and commercial benefits.
>
> Reusable as well as expendable rockets will contribute to the quick-response launch capability…[5]

General Dickman concludes, "eventually, reusable rockets will push expendable ones out of the market for all but the biggest payloads."[6]

International and US companies are currently "…racing to build the world's first commercial reusable launch vehicle to serve the booming telecommunications satellite market. The winner of this new space race could earn a lock on…lucrative contracts to launch up to 2,000 next-generation communications satellites over the next decade."[7] There are currently at least five US companies participating in the commercial race.

These companies have articulated some pretty heady goals and "…plan to slash launch costs to just a third or even a fifth of today's average launch price of $5000/lb."[8] Such a reduction in launch costs would continue fueling the boom in satellite operations.

It is important to note that the government does not fund these companies and "…unlike most history-making spaceplane projects, these efforts will be funded largely with private money from wealthy individuals and companies."[9] The government is funding a completely separate reusable launch vehicle effort in coordination with industry. The Government RLV Status section of this chapter details this combined effort.

The combination of these two programs may yield success much earlier than either program would produce in isolation. The rapid development of small and inexpensive Global Positioning System (GPS) receivers by the commercial sector in response to commercial economic forces is an apt analogy. These commercial receivers in turn greatly influenced the design and implementation of military receivers. The launch vehicle government and private industry effort

may well follow the same model. The most apparent characteristic of this government-industry fusion in the GPS receiver analogy was the *speed* at which developments occurred.

Technological Forces

Closely linked to the economic forces driving commercial space ventures are the technological enablers. Marco Cáceres discusses the convergence of demand and technology in a November 1998 *Aerospace America* article:

> It is difficult to determine exactly what is fueling the growth in demand for satellite services – consumer appetites or the existence of new technologies with affordable and useful applications. This is a kind of "chicken-and-egg" question – it is hard to say what came first. The answer is probably a little of both.[10]

The complex interactions between consumer forces and technological advances are difficult to analyze. The end result is apparent, however. There are technological forces operating in conjunction with economic forces to rapidly advance state-of-the-art launch vehicles designed to appease the demand for space services.

There are two distinct technological approaches with regard to reusable launch vehicle design. The government-funded "…program is investing in the demonstration of approaches and technology that could be used by commercial developers [by] flying new enabling RLV technologies in realistic environments at realistic operational rates…"[11] These efforts are termed revolutionary with the aggressive objective of developing a single-stage-to-orbit reusable launch vehicle.

The commercial efforts, on the other hand, "…say they will rely on either existing technologies or technologies tested as long ago as the 1960s but never put into action."[12] Commercial leveraging of government-funded research and development to produce cost-effective products has proven extremely effective in the past. Once again, GPS receiver

development is one of the more recent and successful illustrations of this economic and technological partnership.

A review of the current technological status of both government and private reusable launch vehicle programs will illustrate the robust and multifaceted approaches addressing the problem of routine space access.

Government RLV Status

The US government currently has two major RLV programs in development. The first of these is known as the X-34 and is an outgrowth of an earlier NASA and industry partnership:

> Today's X-34 is designed to operate in a broad hypersonic flight envelope of speeds up to Mach 8 and altitudes up to 250,000 ft.
>
> The X-34 has been designed to incorporate several advanced technologies that, once flight-proven, will be candidates for use in future operational RLVs.
>
> The flight test plan calls for 25 flights of X-34 over the next year.
>
> [The X-34] will pave the way for decisions by the U.S. launch industry to proceed with new commercial reusable systems…[13]

The second major government program is the X-33 project, which is envisioned as a precursor to a Lockheed Martin concept known as VentureStar:

> This lifting body design is expected to loft 50,000 pounds to Low Earth Orbit – compared to the shuttle's 51,000 pound maximum – at only about $1,000 a pound…
>
> …a half-scale demonstrator called the X-33 is being built and will fly next year on suborbital flights of up to Mach 15.
>
> About 15 test flights of the X-33 are planned from Edwards AFB, Calif.
>
> The Air Force is interested in both VentureStar and the X-33 as possible launch vehicles…[14]

A related project is under development by Boeing. The X-40A is not a launch vehicle *per se*, but is reusable and designed to "…ride to space either on an X-33 derivative, VentureStar, or

an Expendable Launch Vehicle."[15] The X-40A *is* designed to return from orbit after completing a mission, and has orbital maneuvering capabilities. "[A] 90-percent-scale version….has been air-dropped and recently demonstrated an autonomous landing in a crosswind."[16]

Commercial RLV Status

As noted before, the commercial RLVs under development are not as technologically challenging as the government programs. This is not to say that they are any less creative and innovative in their design approaches. The five US companies currently designing and testing launch vehicles run the gamut from fairly traditional approaches to the slightly bizarre.

Kelly Space & Technology envisions,

> …a winged spaceplane that would be slightly larger than the Space Shuttle Orbiters.
>
> A Boeing 747 jet will tow the Astroliner via tether to an altitude of 20,000 ft, where it will be released. Rocket engines will boost the plane to 40,000 ft, where its nose cone will open to release an expendable second stage. As the Astroliner glides home, the expendable second stage will deliver its payload to LEO [Low Earth Orbit].
>
> The towing approach was demonstrated successfully last February through six flights at NASA-Dryden in California.[17]

Kistler Aerospace wants to enter the market with

> …a fleet of five "space trucks." The first test flight is tentatively scheduled for late this year…
>
> The K-1 resembles a standard expendable rocket except that its two stages will be reusable. They will float back to Earth beneath huge parachutes, which are deployed at an altitude of 100,000 ft. Touchdown will be cushioned by airbags.
>
> The first test flight is still tentatively scheduled for the end of this year from Woomera, Australia.[18]

The third US company positing a design for the reusable market is Pioneer Rocketplane:

> Pathfinder will take off from a runway powered by two Pratt and Whitney F100 jet engines. At an altitude of about 30,000 ft, it will take on liquid oxygen from a KC-135 tanker plane. The pilot will then fire kerosene-fueled RD120 rocket

> engines to boost the plane to an altitude of about 80 mi. There, on the fringes of space, an upper stage will launch the satellite.
>
> …the beauty of the Pathfinder vehicle will be its range and its ability to land or take off from conventional airports without fear of an oxidizer mishap.[19]

Rotary Rocket has produced the most unusual entry and leverages off an earlier McDonnell Douglas single-stage-to-orbit test bed program called DC-X.

> Like DC-X, the Roton will take off vertically. But the DC-X fired thrusters to slow down for landing; the Roton will turn on helicopter-like rotor blades for a soft touchdown. On the way to space, the rocket will be propelled by an unusual rotating engine that uses centrifugal force to pump propellants to its 96 combustion chambers.
>
> It…calls for a flight crew. "The crew will be able to override any automation. It will be just like an airliner," says Geoffrey Hughes, the company's director of business development.[20]

Space Access LLC rounds out the current US commercial competition with

> The "SA-1 satellite launch and deployment system" [which] will take off from a runway using an airbreathing ramjet engine….By using the ramjet to reach high into the atmosphere, the vehicle will not have to carry as much rocket fuel and oxidizer. The ramjet powerplant will boost the vehicle to a speed of Mach 6. Once the ramjet does its job, an "alligator mouth" will open and two rocket-powered stages will emerge to boost the payload into orbit.
>
> The upper stages will glide back to an unpowered landing on a runway, like the Shuttle.
>
> The plane will begin test flights in 2001 and will be operational by 2002…[21]

High financial risk and aggressive timelines characterize all of these commercial ventures. They reduce technical risk by leveraging existing technologies and combining them into innovative solutions. They are driven by profit motives, which is a key element of their design approach.

Clearly, some (perhaps most) of these companies will fail. It will only take one successful design to rapidly turn the current launch vehicle market on its head, however, and change the desire of routine and flexible space access into a reality.

Political Forces

"Government and industry officials…convene[d] in Washington DC on 1-2 December 1998 for a special conference on space….At the conference, key players from the commercial, civil and military sectors of the space industry…join[ed] senior Air Force leaders to share visions and assess areas for cooperation..."[22]

As the above report attests, it is clear that political forces are combining with economic and political pressures to encourage rapid development of both commercial and military US space capabilities.

Another indicator of renewed political interest in space launch is contained in a recently passed House bill:

> According to the *Associated Press,* 6 Oct 98, the House passed a bill on 5 Oct 98 that for the first time would allow private companies to send reusable launch vehicles into space. The Commercial Space Act (HR1702), crafted with White House support, would authorize the Department of Transportation to license U.S. companies to launch vehicles similar to the NASA space shuttles. It advanced by voice vote and was sent to the Senate. U.S. companies are not permitted to hold such licenses now. They can send objects into space, such as satellites, but are prohibited from returning vehicles to Earth. Lawmakers said enactment of the bill would be a boon to the American space industry.[23]

This is particularly pertinent and timely legislation considering the number of commercial reusable launch vehicles currently under development. Congress is not only clearing the way for commercial RLVs, they are also providing some help in their development:

> The Space Launch Cost Reduction Act of 1998 (S.2121), introduced in the Senate May 22 by John Breaux (R-LA), would set up a $400 million loan guarantee fund that would help secure private financing for commercial launch vehicle development.
>
> "Private sector companies across the United States are already attempting to develop a variety of lower-cost space launch vehicles, but lack of sufficient private financing has proven a major obstacle," Breaux said when he introduced the bill.

> [National Space Society executive director Pat] Dasch called on hearings about S.2121 before any legislative action is taken. "Let there be a full evaluation of the alternatives for implementing its fundamental concept -- which is enabling private sector development of reusable launch vehicles," she said.[24]

Not to be outdone, the Senate is also exploring the area of launch incentives designed to encourage private development of reusable launch vehicles:

> Both the administrator of NASA and leading members of the launch industry encouraged the development of government incentives, ranging from tax credits to guaranteed loans, to promote the development of new, low cost, reusable launch vehicles.
>
> Speaking at a hearing of the U.S. Senate's Science, Technology, and Space subcommittee Wednesday, September 23 [1998], NASA administrator Dan Goldin said current high launch costs is inhibiting not only the commercial development of space, but future uses by NASA.
>
> "The potential for the future seems almost limitless," Goldin said, but noting that NASA spends more than $4 billion a year on launch costs, "without affordable and reliable access to space, this potential will remain unrealized."
>
> Goldin said a NASA analysis of the launch industry indicated that if private industry developed a large reusable launch vehicle on its own, it could lower the price per pound to orbit to around $2,500. Government incentives, though, could lower that per pound cost to as little as $1,000. "The contrast is stark, and could make all the difference in opening up space."[25]

A final area of interest in the political arena is the notion of developing partnerships between the commercial and government sectors. "'Partnering' is a key concept that has emerged from the Do-Able Space effort, said [Acting Air Force Secretary F. Whitten] Peters….the challenge now is to expand the links between…the military, civil, and private sectors."[26]

Gen George T. Babbitt Jr., commander of Air Force Materiel Command, highlights some cultural changes which must occur as private industry and government, particularly the military, team up to attack the routine space access issue. "If we in the military are to be good partners with an industry driven by the pressure of business, then we must become better businessmen."[27]

If some of these cultural changes can occur, it seems reasonable to expect great synergism from a government-industry-military team. In some ways, the analogy of the Manhattan Project fits the current effort to reduce launch costs and increase routine access. That particular collection of private, government and military members accomplished what seemed an impossible task in an improbably quick manner. Perhaps the development of reusable launch vehicles will follow the same model.

The Case for Rapid RLV Development

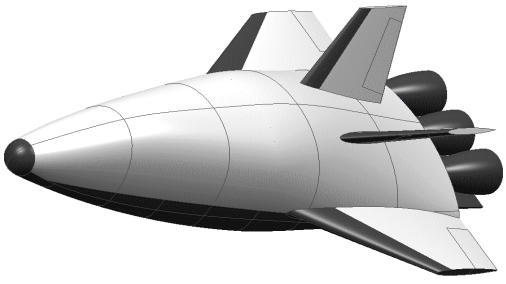
After reviewing the economic, technological and political forces converging to encourage RLV development, it seems reasonable to conclude that the possibility exists for routine and flexible space access to occur in the near future, arbitrarily defined as the next 3-5 years.

The US Space Command Long Range Plan was published in March of 1998 and predicted a reusable launch vehicle capability in approximately 2012. This vehicle, named the Space Operations Vehicle (SOV) in Air Force parlance, would require only fuel and normal maintenance and would reduce turn times to less than a week, effectively creating a capability almost as responsive as today's military aviation.

The plan also details a reusable and flexible on-orbit capability in the form of a Space Maneuver Vehicle (SMV). This vehicle could loiter for up to a year awaiting a tasking order to change its orbital position in response to ground commands. The SMV calls for a capability using expendable launch vehicles in the 2005 time frame. Figure 1 illustrates a notional SOV deploying a SMV. Figure 2 illustrates two notional SMV designs.

Source: HQ AFSPC/DOMN, Concept of Operations for the Space Maneuver Vehicle System

Figure 1. Space Operations Vehicle Deploying Space Maneuver Vehicle



Source: HQ AFSPC/DOMN, Concept of Operations for the Space Maneuver Vehicle System

Figure 2. Notional Space Maneuver Vehicles

Portions of the Air Force are beginning to revise their estimates of the advent of RLV capabilities, as evidenced by remarks from Gen Howell M. Estes III just prior to his retirement as US Space Command chief. "This is going to come along quicker than we think it is….we tend to think this stuff is way out there in the future, but it's right around the corner."[28]

The United States Air Force must be ready to exploit these revolutionary changes and defend against them. The next chapter explicitly discusses the military utility of rapid and flexible space access and how it may change current space force operations and how they fit into the joint campaign.

Notes

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[3] Marco Cáceres, "Commercial Satellites Surge Ahead," *Aerospace America,* November 1998, 25.
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[5] Quoted in Warren Ferster, "Quick-launch access could be near," *Air Force Times,* 6 July 1998, 36.
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[17] Iannotta, 34-35.
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[19] Iannotta, 36-37.
[20] Iannotta, 37.
[21] Iannotta, 37, 51.
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[27] Quoted in Grier, 30.

[28] Quoted in Tirpak, 41.

Chapter 4

Military Implications of Routine Space Access

In addition to supporting terrestrial operations, many military functions previously performed by terrestrial forces may be accomplished by space forces.

—Space Operations
Air Force Doctrine Document 2-2, 23 August 1998

"The current fleet of SLVs [Space Launch Vehicles] and the space launch infrastructure are not designed to be tactically responsive….inexpensive and responsive lift and on-orbit propulsion are required to employ space combat power."[1] The advent of responsive and flexible access to space has important military implications. These implications cover the gamut of current space operations and may open new possibilities for the warfighter to exploit.

The 23 August 1995 version of Air Force Doctrine Document 2-2 (AFDD 2-2), Space Operations, identifies four space force operations areas. These areas are space control, application of force, enhancing operations and supporting space forces. Each of these operational areas can significantly benefit from routine and flexible access to space.

"Space control is the means by which space superiority is gained and maintained to assure friendly forces can use the space environment while denying its use to the enemy."[2] Offensive and defensive counterspace operations comprise the missions required to successfully accomplish space control objectives. Just as offensive and defensive counterair missions rely heavily on the flexibility and versatility of airpower, so will offensive and defensive counterspace missions benefit from the flexibility and versatility routine space access brings to

space power. A draft Air Force Space Command Space Operations Vehicle (SOV) Concept of Operations details a scenario in which SOVs "…launch Space Maneuver Vehicles and place sensors and decoys into orbit to protect key space assets."[3] This capability significantly improves a Joint Force Commander's ability to conduct space control missions in response to a rapidly developing crisis.

"The application of force would consist of attacks against terrestrial-based targets carried out by military weapon systems operated in space."[4] As previously noted, current US national policy prohibits this mission. Despite policy limitations on force application, routine and flexible space access will nevertheless technically enable force application missions. Rapid response to a developing crisis situation such as an invasion would theoretically allow a commander to call for delivery of a weapon or weapons within hours of the crisis trigger. These weapons could deliver firepower to support national objectives in a time frame that even airpower assets cannot match.

"Force enhancement operations consist of those operations conducted from space with the objective of enabling or supporting terrestrial-based forces."[5] The enhancements envisioned in current Air Force doctrine consist primarily of "…data, data relay, analysis, or other enhancing capabilities."[6] Force enhancement is the largest area of contribution from current space forces. It has become critical in that "…much of the sensing needs to be from space so that we can have timely information access to any area of the globe. This is not possible with aircraft platforms. They often cannot get there fast enough and much airspace is denied to overflight by aircraft."[7]

Routine and flexible space access will enable a Joint Force Commander to rapidly detect and react to enemy forces. The SOV CONOPS describes a scenario in which an adversary denies the US knowledge of critical personnel and weapon movement information by accurately forecasting

the overflight of surveillance satellites. The US responds by rapidly launching several reconnaissance and surveillance packages designed to catch the enemy off-guard. These packages provide the Joint Force Commander with critical intelligence data regarding the personnel and weapon movements.[8] Responsive force enhancement operations will add a new dimension to the ability of military forces to operate inside an enemy's decision-making cycle.

"Space force support is carried out by terrestrial-based elements of military space forces to sustain, surge, and reconstitute elements of a military space system or capability."[9] The ability to rapidly reconstitute space assets after an attack is a crucial military mission. "Reconstitution through space launch offers promise…'reconstituting essential space assets after hostilities begin may be the only method of ensuring that critical systems survive.'"[10] Space force support is broken down into the areas of spacelift and satellite operations.

Spacelift is composed of three strategies. These strategies are launch to deploy, launch to sustain and launch to augment. Routine access to space will enhance all three of these strategies and significantly improve the support and flexibility military forces provide to achieve national security objectives. An example of space support would be the rapid reconstitution of the Global Positioning System (GPS) constellation after an enemy attack rendered several GPS satellites inoperable.

Routine and flexible space access will positively impact all four areas of space force operations. It will increase the options available to Joint Force Commanders and will provide theater campaign planners additional branches and sequels as they craft deliberate and crisis action plans. The next chapter provides details on the evolution of the US Air Force towards an expeditionary force, which will shape the relationship between air and space forces of the future.

Notes

[1] Lt Col Michael R. Mantz, *The New Sword. A Theory of Space Combat Power,* Research Report no. AU-ARI-94-6 (Maxwell AFB, Ala.: Air University Press, May 1995), 11.

[2] Air Force Doctrine Document 2-2, *Space Operations,* 23 August 1998, 8.

[3] HQ AFSPC/DOMN, "Concept of Operations for the Space Operations Vehicle System" (draft CONOPS, 6 February 1998), 16.

[4] AFDD 2-2, 11.

[5] AFDD 2-2, 11.

[6] AFDD 2-2, 11.

[7] William P. Delaney, "Winning Future Conflicts (Tactical Surveillance, Identification and Targeting on a Global Scale)" (paper presented to MIT Lincoln Laboratory, 15 October 1992), 6.

[8] AFSPC SOV CONOPS, 15.

[9] AFDD 2-2, 12.

[10] Maj Jeffrey L. Caton, "Joint Warfare and Military Dependence on Space," *Joint Force Quarterly,* Winter 1995-96, 53.

Chapter 5

An Expeditionary Air Force

> *The expeditionary aerospace force concept will allow us to continue to provide exceptional aerospace forces to accomplish our global mission and to better care for our folks as we do so.*
>
> —Gen Michael E. Ryan, US Air Force chief of staff

There is some confusion surrounding the terminology associated with the US Air Force move toward a more mobile or expeditionary organization. The term Expeditionary Air Force (EAF) describes the overall concept, and indeed, the goal of the reorganization. "Light," "lean" and "lethal" are the descriptors of choice. Lt Gen Gregory Martin, the Air Force chief acquisition executive, put it succinctly when he said, "we have always been deployable before in units, but we haven't always been expeditionary in our mind-set."[1]

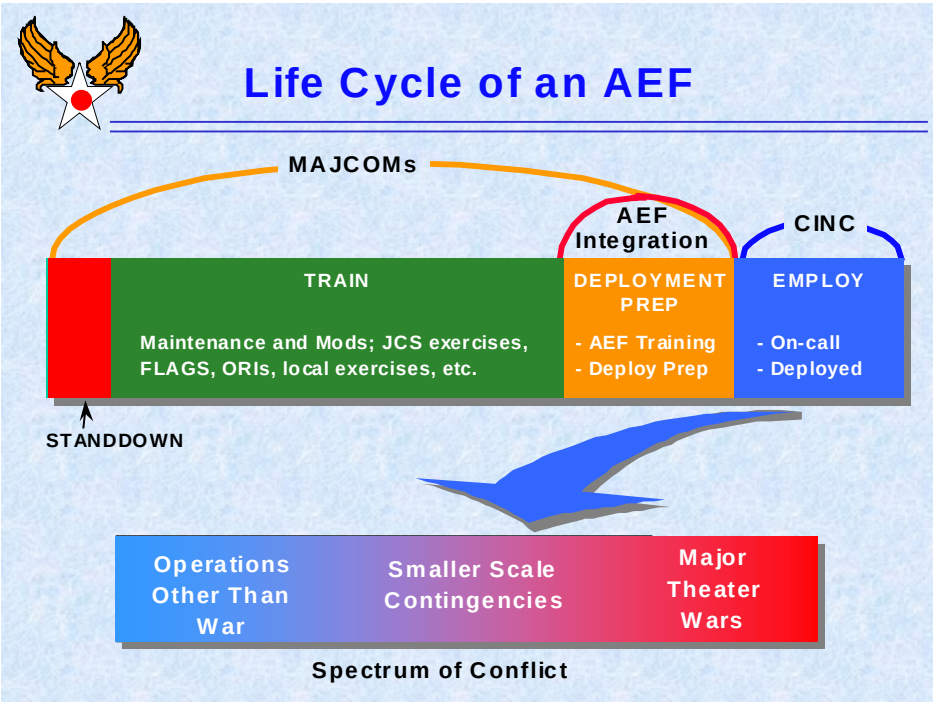
An Air Expeditionary Force (AEF) in comparison is an organizational structure supporting the overall EAF construct. It is a physical unit, and the current plan calls for "…the creation of the [ten] standing AEFs. The idea is to divide all the service's operational and support resources into 10 big organizations, each of which would be made available for deployments."[2]

Air Force Doctrine Document 2 was developed in parallel with early AEF concepts and lays the groundwork for AEF command relationships and the beginnings of doctrinal information for their proper employment.

The EAF is work in progress, however, the notional concept seems fairly clear and "senior Air Force officials announced…that they had adopted the plan and will have it in place by Jan 1, 2000."[3]

The motivation for the move toward an expeditionary force is in many ways a response to the increase in regional threats since the end of the Cold War. Lt Gen Lawrence P. Farrell Jr., former deputy chief of staff for plans and programs, explains, "…since about 1990, we found ourselves continuing to rotate forces….we got involved in Northern Watch and Bosnia and, without really realizing it, we found ourselves in a series of ongoing, expeditionary operations."[4]

Lieutenant General Farrell was the original architect of the EAF concept and describes the EAF as "…a virtual organization….it's an attempt to solve the optempo problem."[5] The idea is to rotate the 10 AEFs through approximately a 15-month cycle of training, deployment preparation, employment and stand down. This cycle is illustrated in figure 3.



Source: Gen Michael E. Ryan, Expeditionary Aerospace Force

Figure 3. Life Cycle of an AEF

The 10 AEFs are organized to be flexible and robust. They are "…large organizations with a lot of firepower, a lot of support, and a mixture of assets….you would have shooter units and support units and intelligence, surveillance, and reconnaissance capabilities."[6]

A notional AEF would forward deploy approximately 75 aircraft, although this would vary depending upon the tasking. Should more force be required an additional 100 aircraft would be on call to beef up the forward-deployed elements. These aircraft and support elements are spread among the total force and make better use of the Guard and Reserve.[7]

As a force management construct, the EAF is designed to bring more stability to air force members. "The theory is that, by structuring the forces into standing units, in peacetime they would train together….when their turn came to go on deployment, they would know a year ahead so they could plan for it."[8] The similarity to naval organizations designed with the same goals in mind is obvious.

Exercise and Game Results

Expeditionary Forces (EFX) 98 and Global Engagement (GE) 98 were two exercises which attempted to validate different segments of the EAF construct. EFX 98 "…include[d] live-fly missions, simulations, and insertions of advanced technologies in a specified and controlled war environment. The overarching goal is to integrate emerging capabilities with existing ones in an Air Expeditionary Force concept."[9] EFX 98 involved many players and actual missions, but the focus was on command and control. Specifically, command and control from a small forward-based Air Operations Center which was supported by a larger rear area (CONUS) operations center using the concept of "reachback" and advanced information processing and transfer.

Global Engagement 98, in comparison, was a war game held at Maxwell AFB, Alabama during November 1998. The game "…explored the capability of the Aerospace Expeditionary

Force (AEF) concept in a no-plan scenario."[10] Senior officers and senior executive civilians comprised the red and blue team panels.

During EFX 98, "…only 115 command-and-control personnel deployed forward….supporting them were about 300 people at a rear AOC."[11] The light, lean and lethal characteristics of the AEF were tested and seemed to work well for the most part during the exercise. General Ryan, USAF chief of staff said, "'a lot of these things…pushed the envelope'…however, EFX 'gives us a jump start on the next iteration of capabilities' necessary for AOCs and AEFS."[12]

Global Engagement 98 was specifically designed to "stress" the AEF concept and "…included a remote, austere deployment region with various levels of host nation support and infrastructure, limited prepositioning; and very compressed time schedules for political and military decision-making."[13] Despite these problems, initial reports from GE 98 also termed the AEF a success, albeit with some reservations; "…a quick review of game play suggested that despite the stresses imposed by the scenario and [intelligent] Red play, the AEF appeared to work."[14]

It is interesting to note that despite the goal to "shape Air Force thinking about Joint Vision 2010 emerging operational concepts regarding Space and Information Operations," the game "…was unable to explore the required command and operational relationships."[15]

The good news for space command and control integration into the AEF construct is coming soon, however. "In EFX 99…the service wants to take a closer look at space operations. One of the goals of next year's experiment…will be a 'more thorough integration of space-based capabilities and space-derived information…"[16] It is important to note that Air Force Space Command is the host major command for EFX 99.

These games and exercises shed light on weak areas of the emerging concepts concerning aerospace doctrine and command relationships. The next chapter presents the case that there are indeed problems in aerospace doctrine and command areas and space power integration into service and joint warfighting is currently less than desirable. The near-future advent of routine access to space and all that it implies to the battlespace commander may exacerbate these problems.

Notes

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[2] Bruce D. Callander, "The New Expeditionary Force," *Air Force Magazine,* September 1998, 54.
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[8] Callander, 55.
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[12] Quoted in Tirpak, 26.
[13] Ordress.
[14] Ordress.
[15] Ordress.
[16] Quoted in Wall, 66.

Chapter 6

Doctrine and Command Relationships

> *Air and space doctrine is a statement of officially sanctioned beliefs and warfighting principles that describe and guide the proper use of air and space forces in military operations.*
>
> —Air Force Basic Doctrine
> Air Force Doctrine Document 1, September 1997

"The Air Force places air and space doctrine at different levels and depths of detail in the forms of basic, operational, and tactical doctrine."[1] Air Force Doctrine Document 1 (AFDD 1) defines the various levels of air and space doctrine and identifies the publications associated with them. This chapter evaluates doctrine primarily at the basic and operational levels. It assesses how well USAF doctrine addresses issues related to the transition to an EAF and how routine and flexible space access may impact those issues and that transition. It also evaluates current and proposed command relationships.

Basic Doctrine and Command Relationships

A perusal of US Air Force doctrine and the assumptions behind the doctrine reveals an interesting fact. The Department of Defense assigns functions to the services in Department of Defense Directive 5100.1. "This directive states that the Air Force is the only US Service specifically directed to 'organize, train, equip, and provide forces for' both the 'conduct of prompt and sustained combat operations in the air' and 'for strategic air and missile warfare.'"[2]

The US Air Force isn't specifically designated as the single service ordered to organize, train, equip and provide forces for space operations at all!

This has, of course, influenced the development of space doctrine and led to disagreement about service roles in space. AFDD 1 nevertheless claims that "the Air Force is America's only full-service air and space force [and] only the Air Force is charged with preparing air and space forces that are organized, trained, and equipped to fully exploit air and space power's capability to accomplish assigned missions across all theaters of operation."[3] Some may view this as too great a leap from the duties outlined in Directive 5100.1. At the very least, this highlights a possible weakness regarding Air Force assumptions supporting aerospace doctrine.

AFDD 1 presents a new idea for warfare in which the traditional culminating point associated with combat power build up and decisive counteroffensive is replaced with a culminating point associated with the halt phase of conflict.[4] This view of conflict relies heavily on air and space power to force an adversary to early culmination. It is an interesting notion and is designed to create options for the Joint Force Commander. Routine space access will support these options by bolstering air and space power contributions to the "decisive halt."

Basic Air Force doctrine is the precursor to basic Air Force functions. AFDD 1 lists these basic functions and they include areas which are plainly related to space power such as counterspace, strategic attack, counterinformation, spacelift, etc.[5] At this doctrinal level, Air Force doctrine allows for and integrates space power effectively into basic Air Force beliefs about warfighting principles and Service competencies and functions.

AFDD 1 also identifies organizational principles. One of these is "…'the principle' and tenet of centralized control and decentralized execution."[6] Current non-routine and inflexible launch systems are organized more along the lines of centralized control and centralized

execution. This area becomes confusing, however, since the present organization is the result of the Cold War, classified programs and inflexible launch systems. Routine access will actually bring space power more in line with the preferred Air Force construct of centralized control and decentralized execution "…to ensure that air and space forces remain responsive, survivable, and sustainable."[7]

AFDD 1 also details a construct called the Air and Space Expeditionary Task Force (ASETF) and defines some basic command relationships within this entity. Despite the unwieldy name, it bears a striking similarity to the current proposals describing the named AEFs. The next version of AFDD 1 may replace the term ASETF with AEF and clear this confusion up. In any event, it is essential that space power be addressed in the composition of this structure, whether it is a named AEF or an ASETF.

At the basic doctrine level, most space forces would normally remain assigned to USSPACECOM, just as most air mobility assets remain assigned to USTRANSCOM. The analogy is apt, since both commands contain national assets, which are always in short supply and are global, not geographic in nature. The EAF construct, however, relies on command relationships, which span across units, numbered air forces and major commands to create AEFs. As routine space access becomes a reality, combatant commanders must efficiently generate taskings and receive support from space power assets. This conundrum will be further addressed at the operational level.

Operational Doctrine and Command Relationships

Air Force Doctrine Document 2 (AFDD 2) states "…planning at **the operational level of war** determines **WHAT we will attack, in WHAT order, and for WHAT duration**."[8] It

focuses on the use of operational art to effectively employ military power to obtain national objectives.

AFDD 2 recognizes that "operating from the third dimension, **air and space forces can strike directly at an adversary's centers of gravity and vital centers**."[9] At this level, space power, including capabilities resulting from routine access, is accorded its place as a flexible instrument used to gain an advantage in the battlespace.

As the document develops, however, there are major space power concerns missing from the guidance. The description of the planning process specifically addresses airpower and how to plan for its use. It clearly defines relationships between supported and supporting commanders and USTRANSCOM integration. It does not address the integration of current space power in the planning process and certainly is not constructed to address the opportunities and capabilities routine space access brings to the Joint Force Commander. This is a glaring omission.

AFDD 2 details a typical Commander of Air Force Forces (COMAFFOR) staff organization. It is possible for the COMAFFOR to integrate space representation onto the special staff, but as capabilities such as routine space access bring space power flexibility to the Joint Force Commander, the COMAFFOR (or Joint Force Air Component Commander, JFACC) must have the ability to offer courses of action across the spectrum of aerospace power. A knowledgeable space staff function is vital in the same way that airlift knowledge is vital to the staff.

Currently, a combatant commander must coordinate the employment of space assets through the 14th AF Space Operations Center. In many ways, this system is analogous to the coordination required with the Tanker Airlift Control Center (TACC) when requesting strategic mobility support. AF Space Support Teams assigned to the geographic CINCs and joint force

commanders provide additional space expertise and coordination. Reachback allows these teams to function, much as they did in EFX 98, but as routine and flexible space access becomes a reality, the current system will require greater and greater responsiveness and speed. If space experts were folded into the Strategy, Combat Plans and Combat Operations Divisions of the CINC's staff, space power could be integrated at all levels of planning.

The USSPACECOM Long Range Plan (LRP) calls for "…building a clear chain of command for tasking between USCINCSPACE and Component Commanders, and constructing a single point of contact for warfighters."[10] This is an excellent idea and would greatly improve the current system in which multiple points of contact result in a lack of responsiveness to theater commanders. As the Air Force transitions to an expeditionary organization, streamlined relationships will be even more important to a light and lean force projecting aerospace power. A Space Operations Center which produces space tasking orders and information much like an Air Operations Center would provide planning and execution functions for USSPACECOM.

The LRP further suggests that:

> …the normal relationship between USSPACECOM's Components and Components of other CINCs is direct liaison authority, which allows 'reachback' for education, information, and initial planning. Whenever necessary, however, USCINCSPACE may expand this relationship to (1) support; (2) transfer tactical control; or (3) after consulting with the supported CINC, ask the Secretary of Defense (SECDEF) to approve transferring operational control of a specific unit.[11]

Transfer of control would mean that the supported CINC must ensure he has the capability to command and control the assigned unit and its assets.

A useful example demonstrating how such command relationships would work is detailed in the draft Concept of Operations (CONOP) for the proposed Air Force Space Maneuver Vehicle (SMV):

> USCINCSPACE will retain COCOM [Combatant Command] of the SMV system at all times and will delegate operational control (OPCON) to COMAFSPACE….and may allow Theater CINCs to exercise Tactical Control (TACON) of SMV sensor and data flow in support of assigned missions.
>
> Timely and responsive support to Theater Forces is a top priority of USCINCSPACE. The DIRLAUTH [Direct Liaison Authority] relationship between CINCSPACE's components and the theater components will facilitate this as the conduit for reachback to identify operational requirements….Depending upon the situation, CINCSPACE may authorize a more direct tasking relationship to COMAFSPACE, including recommending transferring the force (TACON or OPCON) to the Joint Task Force (JTF) Commander. The JTF commander may delegate the integration of SMV into theater operations to the JFACC. Hence, the JFACC should be prepared to prioritize and integrate SMV theater operations.[12]

The draft CONOP further calls for a tasking system based on validated requirements prioritized at the appropriate level. These priorities would be set just as airlift priorities are set today to ensure these assets are used in a way designed to maximize their ability to bring power to bear in the battlespace.

Notes

[1] Air Force Doctrine Document 1, *Air Force Basic Doctrine,* September 1997, 2.
[2] AFDD 1, 45-46.
[3] AFDD 1, 61.
[4] AFDD 1, 41-42.
[5] AFDD 1, 45-60.
[6] AFDD 1, 61.
[7] AFDD 1, 61.
[8] Air Force Doctrine Document 2, *Organization and Employment of Aerospace Power*, 28 September 1998, 3. Emphasis in original.
[9] AFDD 2, 5. Emphasis in original.
[10] USSPACECOM Long Range Plan (LRP), *Implementing USSPACECOM Vision for 2020,* March 1998, 92.
[11] USSPACECOM LRP, 93.
[12] HQ AFSPC/DOMN, "Concept of Operations for the Space Maneuver Vehicle System" (draft CONOPS, 10 July 1998), 8-9.

Chapter 7

Conclusions

> *…the rapid evolution of technology in the postindustrial era…has altered warfare…Overhead, space-based capabilities affect all terrestrial forces, with a potential we have only begun to grasp.*
>
> —Joint Pub 1
> Joint Warfare of the Armed Forces of the United States, 10 January 1995

Routine, responsive and flexible access to space in the form of Reusable Launch Vehicles will alter the way military forces project power into the battlespace. Political, economic and technological forces are converging to rapidly bring about this routine access.

As the US Air Force evolves into an expeditionary force, it must develop doctrine and organize itself in such a manner as to reap the greatest advantage from these new capabilities. It must also protect against vulnerabilities such routine access may expose to our nation's economy and vital interests.

The recent Air Force emphasis on the integration of air and space power into aerospace power is encouraging. The alternative of forming a separate Space Force would be painful from many aspects, although it is another viable option for controlling and exploiting the realm of space.

High-level Air Force doctrine and command relationships support integration of routine space access capabilities into aerospace power in an expeditious and wise manner. Routine access, in fact, is an argument for breaking the current space paradigm of centralized control and

centralized execution and aligning space operations with the more familiar centralized control and decentralized execution, which serves airpower so well.

The overall move toward joint operations since the Goldwater-Nichols Department of Defense Reorganization Act of 1986 is providing an impetus for air and space integration from a doctrinal standpoint. The integration of air and space into the Aerospace Expeditionary Force is similar to the integration of land, sea and air forces into a joint team.

US Air Force operational level doctrine and command relationships are currently in a state of flux due to this integration as well as the change to a more expeditionary organization. The next AFDD 2 rewrite should specifically address the issues created by routine and responsive access to space. As the EAF construct is reflected in Air Force doctrine and command relationships, the Air Force should ensure that command and control of responsive space forces fit into the construct and the doctrine and command relationships underpinning the construct.

US Space Command is taking the lead in developing both doctrine and command relationships designed to integrate routine access to space and the capabilities it brings to the joint warfighter in the battlespace. Their ideas should be evaluated and developed for the next round of joint and service doctrine publications. Air Force and US Space Command doctrine should not continue to diverge.

The Air Force must act quickly to develop doctrine and command relationships designed to maximize the combat capabilities engendered by routine space access. It is imperative to exploit these rapidly developing capabilities in order to not only remain the world's preeminent aerospace power, but to protect and defend the economic viability of our country and ensure the safety of our citizens.

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