THE WRIGHT FLYER PAPERS

Rapid Dominance

Integrating Space into Today's Air Operations Center

Mark E. Harter
Major, USAF

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Wright Flyer Paper No. 11

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY

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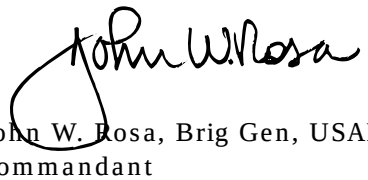
Foreword

It is my great pleasure to present another of the *Wright Flyer Papers* series. In this series, Air Command and Staff College (ACSC) recognizes and publishes the "best of the best" student research projects from the prior academic year. The ACSC research program encourages our students to move beyond the school's core curriculum in their own professional development and in "advancing aerospace power." The series title reflects our desire to perpetuate the pioneering spirit embodied in earlier generations of airmen. Projects selected for publication combine solid research, innovative thought, and lucid presentation in exploring war at the operational level. With this broad perspective, the *Wright Flyer Papers* engage an eclectic range of doctrinal, technological, organizational, and operational questions. Some of these studies provide new solutions to familiar problems. Others encourage us to leave the familiar behind in pursuing new possibilities. By making these research studies available in the *Wright Flyer Papers*, ACSC hopes to encourage critical examination of the findings and to stimulate further research in these areas.



John W. Rosa, Brig Gen, USAF
Commandant

Preface

Control of the vertical dimension—air and space—is essential to preserving healthy commerce and situational awareness during peacetime and sustaining military operations during conflict. Air and space forces must be integrated in order to achieve rapid dominance of the battle space when necessary. While airpower has existed for almost a century, military space operations are yet in their infancy. Military leaders, planners, and operators are just beginning to recognize the importance and legitimacy of space as a center of gravity and war-fighting medium.

This paper is based upon research in current aerospace operations, exercises, doctrine, and command and control (C^2) warfare. It also draws on personal experience as the first space warfare officer (1996–98) at the Thirteenth Air Force, Andersen Air Force Base (AFB), Guam. That experience included numerous Pacific Air Forces and Pacific Command major joint/combined exercises and several real-world military operations including noncombatant evacuation operations, humanitarian assistance, peacetime cooperative engagement, and military operations other than war. Many still believe and treat space merely as just an extension of the air medium, expecting little and receiving less from space operations. Accordingly, the Department of Defense needs to address significant issues in the areas of space training, doctrine, equipment, personnel, and C^2 in order to integrate space into military operations. It is important for the United States Air Force to make great gains in these areas in preparation for the Expeditionary Aerospace Force.

I appreciate the assistance of my faculty research advisor, Maj Daniel Blaettler, at Air Command and Staff College and the space personnel at the Air Force Doctrine Center, Maxwell AFB, Alabama. I also thank Col William J. “Chip” Beck, Air University (AU) space chair; Col Victor P. Budura Jr. (former AU space chair and current Air War College [AWC] faculty); Col Edward Groeninger, 613 AOS/CC; and Maj Gen Lance L. Smith, AWC commandant, Maxwell AFB, Alabama.

I extend gratitude to my wife, Kimberly, and our children Joanna, Noah, and Kristina for their patience and support.

Abstract

Rapid dominance—the ability of forces to exploit information and quickly destroy critical targets—is the key in controlling the battle space of future warfare. The ability to rapidly gain information, analyze it, and use it to make sound military decisions is key to military domination and victory. Huge volumes of critical war-fighter information speed through the space medium to reach their destinations at the strategic, operational, and tactical levels. Information provided via space systems is crucial to military planning and executing aerospace operations through the entire spectrum of conflict and therefore a key to any future military operation. Unfortunately, potentially greater space power contributions are often limited due to a lack of "space mindedness" by military leaders, planners, and operations during theater campaigns.

This paper identifies the importance and legitimacy of space as a center of gravity and military war-fighting medium, focusing on the realm of the joint air operations center (JAOC). It defines five key areas (with practical suggestions) that the Department of Defense needs to address in order to integrate space into military operations: space training, doctrine, equipment, personnel, and command and control. The research first documents current deficiencies of space awareness in the typical JAOC and then identifies and suggests methods to improve joint war fighting through space integration in the JAOC and the Expeditionary Aerospace Force (EAF) of the near future. The research presented here is particularly important for the United States Air Force to consider in preparation for the EAF—it provides a framework to educate JAOC and EAF personnel to more effectively employ joint aerospace power throughout the spectrum of military operations.

Rapid Dominance

Future warfare depends on the rapidity of collecting information and making decisions.

—Gen Charles "Chuck" Horner

Rapid dominance—the ability to exploit information and quickly destroy critical targets—is the key to warfare. The military that most effectively collects, fuses, and delivers information from sensors to shooters will be victorious. In this realm, aerospace forces form the critical link in rapid dominance. Today, aerospace forces are capable of delivering lethal military power anywhere on earth within hours (aircraft, ballistic missiles, and space systems). Aerospace power controls the vertical dimension with unparalleled speed, range, precision, and flexibility. Space systems provide the crucial links and nodes in warfare by rapidly collecting information and delivering it to war fighters for timely, accurate decisions.

Unfortunately, there is a lack of space mindedness in the planning and execution of joint air operations, which significantly reduces battle space rapid dominance. This research paper identifies the importance and legitimacy of space as a center of gravity (COG) and military war-fighting medium. It offers practical, near-term solutions to a space-minded aerospace force by focusing on improved joint space training, space resources (personnel and equipment), joint doctrine, and theater command and control (C^2) of space forces.

Space: Important Yesterday, Necessary Today, and Critical Tomorrow

Operation Desert Storm (1991), hailed by some as the "first space war,"[1] clearly employed significant force enhancement contributions for the first time in combat. Today, almost a decade later, all United States (US) services depend upon and use force multiplying space systems to achieve strategic, operational, and tactical military objectives. Tomorrow's twenty-first century space-enhanced

warfare will dwarf current space war-fighter operations due to improvements in joint space doctrine, training, equipment, personnel, and C^2. Additionally, three simultaneous factors make space power even more essential in achieving rapid dominance in current and future warfare: the Department of Defense (DOD) drawdown of the 1990s, the significant increase in DOD operations tempo, and the emergence of the information age.

Department of Defense Drawdown

The daunting defense force structure drawdown of the last decade (table 1) places a greater demand on space systems to deliver focused, accurate, timely information to leaders, planners, and war fighters. The near 40 percent decrease across the board of military personnel and 50 percent decrease in defense spending since fiscal year (FY) 1987 can be balanced by more effective real-time information systems, which depend on space operations.[2] Space forces provide indispensable contributions to US forces in the absence of personnel through automated collection—C^2 systems delivering information at the speed of light to war fighters.

Table 1

United States Drawdown

Force Component	FY 87 Strength	FY 97 Strength	Difference
USAF Personnel	607,035	371,577	-39%
USAF Aircraft	1,764	912	-38%
USAF Wings	34	21	-38%
Army Personnel	781,000	495,000	-40%
Navy Fleet (ships)	538	339	-37%
Federal Budget ($FY99)	417.7B	$267.0B	-36%
Defense Percent Gross Defense Product	6.1%	3.1%	-49%

Sources: Air Force Magazine, May 1998, 36–44; *Strategic Assessment 1997,* Fiscal Year 1987–97, 3–10; and data for FY 87–89 from Congressional Budget Office, January 1998, "The Economic and Budget Outlook: Fiscal Years 1999–2008," constant FY dollars.

Increasing Operations Tempo

The current strategic environment is one in which the US military will engage increasingly in small-scale contingencies (SSC) and military operations other than war (MOOTW) to protect our national interests.[3] The formidable monolithic threat of the cold war has transitioned to multiple, often unpredictable, international security threats. The strategic environment remains complex, and in addition to regional dangers, presents asymmetric challenges—terrorism, information warfare (IW), weapons of mass destruction; transnational threats—organized crime, drug trafficking, ethnic disputes, refugee flows; and "wild cards."[4] The surge in operations tempo magnifies the reliance on space systems due to their global presence, precision, and reliability (fig. 1). DOD total force is deployed in support of 10 joint/combined operations and participates in 11 exercises in more than 70 countries.[5] Once US military forces are deployed to these operations, there is a propensity for "mission creep" to occur; the conflict escalates, extending US military involvement beyond the original intent (e.g., Bosnia, Somalia, etc.). This volume of deployed personnel, exercises, and real-world operations demands global space assets to provide communications, navigation, weather, intelligence/surveillance/reconnaissance (ISR),

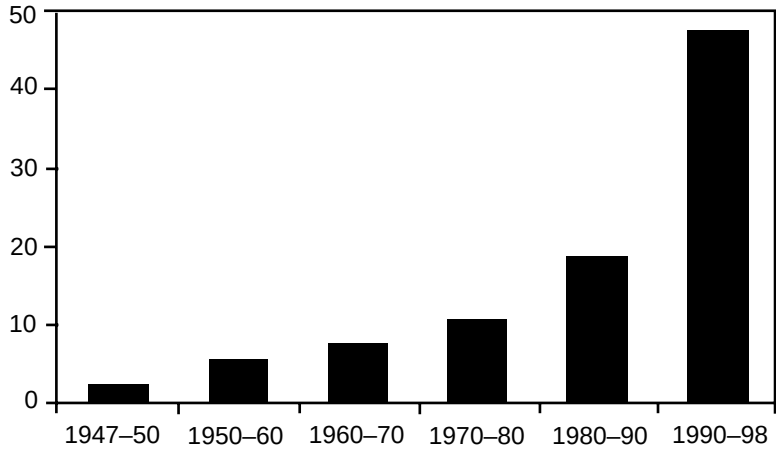


Figure 1. USAF Operations 1947–98

warning, targeting, and airlift/logistics support. Due to their global nature, space systems are usually the first in-theater, on-the-scene assets collecting valuable information for commanders and leadership to gain situational awareness for planning and executing military operations.

Twenty–First Century: The Information Age

Military campaigns live and die according to accurate, timely information or lack thereof. Warfare in the twenty-first century—the information age—depends on real-time, global information collection and dissemination to military leadership, often only capable by space systems. Information that is provided by an ounce of silicon in a computer chip might have more effect than a ton of uranium.[6] Information-based precision weapons are replacing weapons of shear firepower and mass destruction at a rapidly increasing rate, as evident in recent military operations using exclusively precision-guided munitions (PGM).[7] MOOTW and SSC, usually constrained by politically sensitive environments and complex cultural and population factors, necessitate the need for accurate, timely space-based information.[8] To illustrate the inextricable relationship between space and information, US Space Command now has the responsibility for DOD information operations.[9] For the United States to maintain global leadership and military power, US forces must exploit the space medium to create fully integrated aerospace campaigns and achieve rapid dominance, especially in the era of the Expeditionary Aerospace Force (EAF).

The Challenge: Space Mindedness

Rapid dominance is achieved when war fighters at all levels grasp and apply what space brings to the fight. To fully exploit the space medium in war fighting requires military leaders, planners, and operators to understand how to effectively integrate space power with air operations to control the entire vertical dimension while supporting land and sea forces. The rapid growth of military space operations, however, is depreciated and often perceived as trivial due to inadequate space awareness and training of

today's war fighters. Unfortunately, a lack of space mindedness exists in today's joint air operations center (JAOC) where the aerospace campaign is planned, controlled, and executed.[10] The JAOC is pivotal—it is the nerve center and senior C^2 node for theater aerospace combat power. Air Force Space Command's (AFSPC) Fourteenth Air Force recent initiatives to place qualified space experts (W-13SX) and space support teams (SST) in-theater are a good start in improving space awareness during JAOC campaign planning and execution, but there is still a long way to go. Compounding the problem, numbered air forces (NAF) do not have complete JAOC staffs—JAOCs are usually augmented by other NAFs and joint/combined war-fighting units for exercises and real-world operations. The result—a high percentage of JAOC personnel do not understand or appreciate the role of space in military operations and do not know how space combat power is employed in their specific JAOC function. This lack of space mindedness prevents the application of space power in joint operations and reduces force enhancement in every medium—air, land, sea, and space.

To better gauge this deficiency, the author gathered data from interviews, personal JAOC experiences, and a survey of JAOC augmentees—the 1998–99 Air Command and Staff College (ACSC) Prairie Warrior (PW) exercise team—to determine their initial space mindedness as they began their exercise in November 1998.[11] The PW exercise team demographics closely paralleled the composition of an actual JAOC (personnel from all services). Despite the PW team members being among the most planning and operations-minded people at their grade level (O-4), the survey results indicate a lack of space mindedness at the operational level. Table 2 summarizes basic trends from the survey. These results indicate that the majority of today's JAOC personnel do not understand the entire spectrum of what space offers; and, therefore, they are not prepared to adequately integrate space into joint theater air operations. The problem is that most JAOC personnel have not been educated on how space supports specific JAOC planning and operations, and "they don't know what they don't know." The end result—rapid dominance is neither as

rapid nor as dominant as it could be due to lost space integration potential.

Table 2

Air Command and Staff College
Prairie Warrior Space Survey Trends

—All services had similar knowledge levels of space support, with the Army officers slightly higher than the other services in actual military application.

—Aircrew members had less knowledge of what space brings to the fight/ JAOC.

—Fifty-nine percent of the exercise team had no JAOC experience at all (typical JAOC augmentees).

—Of the 41 percent that did have some JAOC experience, only 43 percent were ever briefed or educated on JAOC space support products and services related to their function.

—The majority had a reasonable understanding of basic space support but didn't know who in-theater was responsible for space or how to get specific space support.

—There was a general lack of understanding how space supports logistics.

—Thirty-six percent didn't know where/how to request space imagery requirements (J2 collections manager).

—There was a general lack of understanding that the US military received space support from non-US space systems.

—About one-third did not understand basic space threats and limitations.

—Only 11 percent felt that today's military space operations were "good"; the remaining 89 percent felt there was too much technical detail and not enough war-fighter integration.

The Solution: Putting the Aerospace Puzzle Together

Rapid dominance requires effective air and space integration, yet this is limited by the lack of space mindedness among war planners and war fighters. Space operations must be more than an afterthought in campaign planning and combat operations. This paper addresses the trends identified in current aerospace operations and recommends methods to improve aerospace integration in five major areas to facilitate the understanding, application, and integration of space combat power in the JAOC. These

five interrelated elements—training, personnel, equipment, doctrine, and C^2—are all necessary to establish an integrated aerospace force capable of battle space dominance (fig. 2).

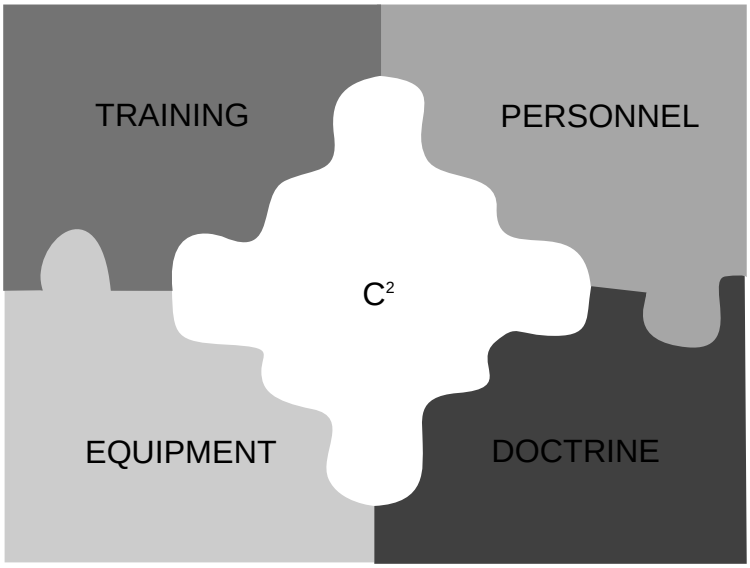


Figure 2. Aerospace Integration Recommendations

Training. JAOC personnel need to receive better space support training and education to capitalize on space force enhancement capabilities and space limitations.

Doctrine. Individual service components have their own space doctrine, but there is no joint doctrine on military space operations. This must be corrected, and the first step is a solid Joint Publication (JP) 3-14, *Tactics, Techniques, and Procedures for Space Operations*.

Personnel. Joint aerospace combat power requires permanent, qualified, and competent space operations personnel at JAOCs, NAFs, wings, and Aerospace Expeditionary Force (AEF) units, augmented by flexible SSTs and expertise reach back to space operations centers (SOC).

Command and control. Theater space forces C^2 must be clear, rapid, and structured to support theater campaign objectives. Space forces require centralized control and decentralized execution. The JAOC must effectively coordinate and integrate military, civilian, commercial, and foreign space capabilities.

Equipment. JAOCs and Expeditionary Operations Centers (EOC) need resident standardized space support equipment, as well as deployable space support hardware to effectively inform leaders and planners during en route operations.

This paper identifies methods to improve aerospace integration. It does not analyze space war-fighter applications that are already documented in Air Force Tactics, Techniques, and Procedures (AFTTP) 3-1, *Tactical Employment of Space*, the *Aircrew Combat Information Guide (ACIG)*, and at the Air Force Weapons School, Space Division, Nellis Air Force Base (AFB), Nevada.[12] The first element of space mindedness is for aerospace planners and operators to understand the importance and legitimacy of space as a war-fighting medium. This paper provides recommendations in training, doctrine, personnel, space C^2, and equipment. The paper concludes with a discussion of integrated aerospace power in the EAF, providing a military that works better and costs less through smart use of aerospace application, resulting in rapid battle space dominance.

Space—Dominating the High Ground

Take the high ground, and hold it!

—Sun Tzu, circa 500 B.C.

Great military leaders realize the strategic, operational, and tactical advantages of controlling the high ground. Ancient warriors in Sun Tzu's period understood the advantages of security and situational awareness in securing the high ground—a hill or a mountain. Armies of the US Civil War took the high ground to the next level with manned balloons to gather battlefield intelligence. Great aeroplane pioneers of World War I courageously took to

new heights with crude flying machines, demonstrating the ability to weaponize the skies; and by World War II airpower proved the value of multidimensional warfare (land, sea, and air). During the Persian Gulf War, coalition forces' superb air power achieved unparalleled domination of the battle space and witnessed the emergence of military operations in the ultimate high ground—space. Establishing control over the entire vertical dimension is critical, as stated by Gen Charles "Chuck" Horner—"Everything is possible if you have it; little is possible if you lose it."[13]

Importance of the Space Domain

The first element of space mindedness for aerospace planners and operators is to understand the importance and legitimacy of space as a COG and as a war-fighting medium. The rapid growth of commercial, civil, and military activities in space suggests that space will soon be an economic COG and perhaps already has achieved that.[14] Approximately 600 functional satellites are in orbit, 220 of which represent a US investment of more than $100 billion.[15] Estimates indicate that during the 1998–2003 time frame, the United States and other space-faring nations will invest $500 billion into space systems and launch between 1,000 and 1,500 satellites.[16] The estimated annual revenues for the global space industry in 1998 exceeded $88 billion and are expected to increase at a staggering 50 percent per year through 2001.[17] Communications, navigation, environmental resources, weather, education, telemedicine, entertainment, and science are just a few of the many applications migrating to space and driving this space "gold rush." The 1998 national security strategy (NSS) equates space to an emerging vital national interest, recognizing that US dependence on space could grow into vulnerability and a target. "Space has emerged in this decade as a new global information utility with extensive political, diplomatic, military, and economic implications for the United States. Unimpeded access to and use of space is essential for protecting U.S. national security and promoting our prosperity. Our policy is to promote development of the full range of space-based capabilities in a manner that protects our vital security interests. We will

deter threats to our interests, and if deterrence fails, defeat hostile efforts against U.S. access to and use of space."[18]

Space Power: What Does It Bring to the Fight?

When you think about protecting this nation's global interests, you have to remember it starts with space . . . it is the fourth medium of warfare.

—Gen Ronald R. Fogleman, USAF

Force Multiplier: With Space Forces, 1 + 1 = 3

Space forces provide military leaders, operators, and planners with enormous force enhancement products and services that are essential in achieving rapid dominance of the battle space. Today's space systems provide key information via global communications, navigation, weather, warning, and ISR to achieve full spectrum dominance across the range of military operations (table 3).[19] These same space forces allow the USAF to execute the core competencies of *Global Engagement*.[20] Military space applications are growing at an increasing rate delivering products and services to military leaders, planners, and operators better, faster, and cheaper than many conventional terrestrial systems.

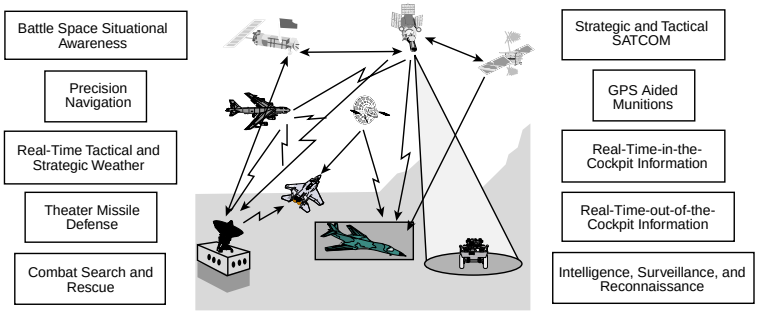
Table 3

Aerospace Power for the Twenty-First Century

Joint Vision 2010	*Global Engagement*
Full Spectrum Dominance	Air and Space Superiority
—Dominant Maneuver	Global Attack
—Precision Engagement	Precision Engagement
—Focused Logistics	Agile Combat Support
—Full Dimensional Protection	Rapid Global Mobility
Information Superiority	Information Superiority

Bullets Win Battles; Information Wins Wars

Today, the primary military contribution from space is information. With it a campaign is successful; without it failure is almost certain, and JAOC planners must understand this. Joint force commanders (JFC) strive to achieve information superiority—"the ability to collect, control, exploit, and defend information while denying the enemy the same."[21] Information operations (IO) is integral to the joint force air component commander (JFACC) aerospace planning process, consisting of information in warfare and IW. The JFC must quickly gain and exploit information in warfare (ISR, communications, precision navigation missile warning, etc.) for battle space situational awareness and rapid, solid decision making. Timely, accurate information is equally as important (arguably, even more important) as firepower; and combining information and firepower is lethal (e.g., PGMs). Some go so far to say that the ultimate precision-guided weapon is the electron, delivering or denying critical military information.[22] Warfare in the information age is highly dependent on global space forces, which allow forces to achieve dominant battle space awareness and decrease the "fog of war," providing the war fighter a clearer picture of the battle space. Space-based information is key for US forces to exploit battle space information for sensor-to-shooter operations (fig. 3). Real-time-in-the-cockpit (RTIC) and



GPS - Global Positioning System
SATCOM - Satellite Communications

Figure 3. Rapid Dominance: Space/Information Operations Provide Battle Management

real-time-out-of-the-cockpit (RTOC) information is emerging in exercises and deployments.[23] Theater commanders employ elements of IW to defend friendly IO and attack enemy IO, both relying on space systems.

Aerospace Campaign Planning

Space forces play an integral part in deliberate, crisis action and adaptive planning by linking and leveraging joint terrestrial operations to achieve JFC objectives. There is one theater campaign—and four major pieces to it: land, sea, air, and space. Space mindedness means consciously making space as much a part of the campaign plan as land, sea, and air. During campaign planning, space forces provide critical information for intelligence updates and real-time global communications to facilitate rapid campaign planning. The JFACC must know what space forces are in the fight (friendly and enemy) and effectively integrate them into the overall campaign plan. As with air, land, and sea power, space power requires careful thought and planning to make it lethal and successful. Aerospace campaign planning starts with the Joint Strategic Capabilities Plan (JSCP),[24] which provides guidance to the commander in chief, US Space Command (USCINCSPACE), apportions space forces, and assigns space tasks to combatant commanders and service chiefs. USCINCSPACE initiates space campaign planning in the operations plan's (OPLAN) Annex N (space operations). Space must migrate and be expanded throughout the entire OPLAN.

The JFC normally designates a JFACC, who is responsible for exploiting air and space operations to support JFC theater campaign objectives and accomplishes this through the *Joint Air and Space Operations Plan (JASOP)*—the aerospace part of the campaign that must effectively integrate air and space theater operations and forces.[25] Every *JASOP* section should reflect the space medium by identifying friendly/enemy capabilities, space objectives, enemy/friendly space COGs, space courses of action, and strategy development. The JFACC executes the *JASOP* through the JAOC, the JFC's theater air and SOC.[26]

Space Warfare: What Is the Threat?

Know the enemy and know yourself; in a hundred battles you will never be in peril.

—Sun Tzu
The Art of War

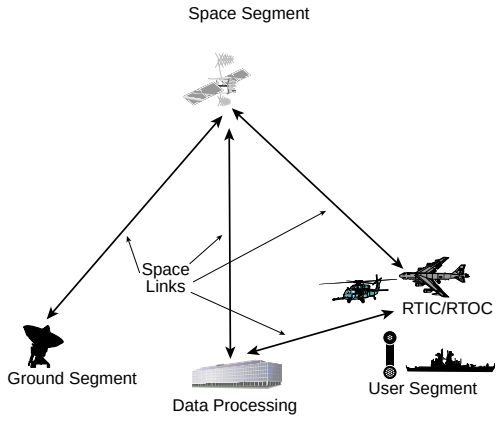
Space mindedness includes the realization that the United States is not the only nation that recognizes the strategic use of space—there are more than 40 space-faring countries that have varied levels of space programs to reap the contributions from space. There are 14 active space launch sites worldwide, and 26 nations have astronauts/cosmonauts.[27] More than 70 percent of the world's nations use satellite communications (SATCOM).[28] There are now more than 20 foreign and commercial imagery systems (expected to be more than 30 in 2001) providing imagery from 30 meters down to a one-meter resolution to anyone who can pay for it. Global Positioning System (GPS) navigation signals—standard precision service (SPS) < 100 meters accuracy—are available to any user who has a GPS receiver. Potential adversaries already exploit space-based communications, imagery, and navigation to further their own interests.

As the United States increases its reliance on space assets, potential adversaries will realize US dependence on space systems and eventually use space in threatening ways. Already nations have jammed regional SATCOM because of turf wars over geosynchronous slots over the equator.[29] This friction intensifies as telecommunications increase and satellites crowd the geosynchronous belt. JAOC personnel must also understand that GPS, with an inherently weak signal, has already experienced interference in signal saturated environments and is susceptible to jamming.[30] The DOD initiated the navigation warfare (NAVWAR) program in 1996 to ensure US military access to GPS signals in the face of enemy jamming while denying enemy access to GPS signals. Solutions to the NAVWAR challenge involve user equipment changes (near term) and GPS satellite signal modifications (long term).[31] Obviously, any interference with GPS or SATCOM weakens the ability to plan and execute joint aerospace operations.

Space Control

> Whoever has the capability to control space will likewise possess the capability to control the surface of the earth.
>
> —Gen Thomas D. White

Today, space is a friendly COG, but it could easily be an enemy COG in future conflicts. The United States must be prepared to seize the initiative and control space, just as we do in the land, sea, and air mediums. This is merely an old problem in a new medium—as the sixteenth-century blue water navy was created to protect sea commerce—the twenty-first century requires protection of space assets to secure space and information commerce. Space control is a controversial, hotly debated topic due to internationally and politically charged issues of national sovereignty, privacy, and weaponizing space.[32] JAOC planners—especially in the guidance, apportionment, and targeting (GAT) and master air attack plan (MAAP) cells—need to recognize that negating enemy space forces can be accomplished by controlling the adversary's space links (electromagnetic signals) and nodes (ground stations, satellites, and user equipment). These links and nodes represent space choke points and lines of communication (LOC), lucrative targets for any combat medium. Figure 4 illustrates links and nodes that are vulnerable to attack.



RTIC - Real-Time-in-the-Cockpit Information
RTOC - Real-Time-out-of-the-Cockpit Information

Figure 4. Space Control Links (Signals) and Nodes (Segments)

Primary nodes include ground control stations, the satellites themselves, data-processing nodes, and user equipment, which can be neutralized through physical operations—bombs on target or antisatellite (ASAT) weapons. Primary links (e.g., LOCs) include ground C^2-satellite links, satellite-user signal links, and satellite-data-processing-user links. Neutralizing the LOCs requires signal disruption. The JAOC space and information operations personnel bring this expertise to the GAT and MAAP cells to neutralize and/or negate the enemy space and IO threat. The level of warfare depends on the desired outcome—temporary or permanent soft kills to deny, degrade, disrupt, and deceive enemy space systems, or a hard kill destruction. The point is that JAOC planners and leaders must think with space in mind, understand what the enemy space systems bring to the fight, and then determine the space control objective.

Space Forces Limitations

Space mindedness requires military planners, leaders, and operators to understand the basic limitations of space systems (force application, timeliness and availability, and the space environment) and how to optimize what is available. The first limitation is that the United States currently possesses neither weapons in space nor an operational ASAT capability.[33] Therefore, force application and space control is limited to the above discussion. A second limitation is asset availability. On-orbit space forces are not continuously in-theater; and space-based ISR are near-real-time information systems, not continuous, real-time global systems. ISR systems are tasked via a complex priority driven process. JAOC personnel must understand when space assets are available to support military operations. The JAOC space operations officer (SOO), JAOC space cell (now a “specialty team”), and JAOC J2 collection manager provide this information. A third limitation is the harsh space environment itself. Space systems can be negatively affected by solar activity (flares, electromagnetic storms, etc.), and satellite signals can be distorted as they traverse the earth’s atmosphere (scintillation, natural and inten-

tional interference, etc.). The JAOC weather cell and SOO advise the JFACC when this risk is likely.

This section addressed the necessity for aerospace planners and operators to become space minded warriors—they must recognize the importance and legitimacy of space as a COG and as a war-fighting medium. With this foundation, the remainder of this paper will provide recommendations on how to build space mindedness and achieve rapid dominance.

Joint Space Training: Education and Exercises

The unresting progress of mankind causes continual change in weapons; and with that change must come a continual change in the manner of fighting.

—Rear Adm Alfred Thayer Mahan

Rapid dominance requires military leaders, planners, and operators to have space mindedness—a basic understanding of the importance and legitimacy of space as a COG and military medium. In order to achieve this, JAOC warriors must be educated and exercised on space warfare capabilities, threats, and limitations.

Today's JAOC personnel know very little about space force enhancement that could directly improve their functional JAOC duties.[34] There is no formal JAOC or NAF space training and education program for JAOC personnel. The JAOC space officer and SST champion space education; but this is a very slow, piecemeal process in the absence of structured, mandatory space awareness education. Effective space education captures four critical elements: (1) strong senior leadership who demand JAOC staffs understand and integrate space operations, (2) space in professional military education (PME), (3) structured JAOC space education training, and (4) seriously integrating space in joint and combined exercises.

Space: Leadership by Example

The first priority in building space-minded warfighting is the commitment of senior leaders to recognize and

communicate that space is an important medium of warfare that must be exploited. Space superiority can no longer be taken for granted and therefore needs to be as much of a concern to the JFACC as achieving air superiority. The JFC, component commanders (air, land, sea, and special operations), JAOC director, and senior JAOC supervisors must adopt a space-minded attitude and seek to make it a part of the joint force team. The *Joint Doctrine Capstone and Keystone Primer* states that the JFC is responsible to "exploit all forms of combat power (land, sea, air, space)."[35] This commitment must be sincere so that the chain of command will respond positively to space training and integration in exercises and real-world operations.

Space Education: Not Just an Afterthought

The second step is solid education at all officer levels of products and services space brings to the fight (not just space systems themselves) and basic space threats, to ensure that officers understand the basic space warfighting medium. This step starts with commissioning sources and continues through the Aerospace Basic Course, Squadron Officer School, ACSC, and Air War College. Although progress is being made, space is too often an afterthought rather than a core objective. Perhaps even more importantly, space education must be integrated into the backbone of JAOC/JFACC courses at the C^2 Warrior School, Command and Control Training and Innovation Center (C^2TIC).[36] The C^2 Warrior School treats the JAOC as a C^2 weapon system, provides JAOC initial qualification training, and certifies personnel before they are assigned to a JAOC. The C^2 Warrior School is a key target of opportunity in educating JFACC and JAOC personnel on the importance and legitimacy of space as a war-fighting medium and specifically what space brings to the JFACC/JOAC fight. These C^2TIC courses as well as the Joint Doctrine Air Campaign Course need space embedded throughout, particularly in the end-of-course exercises, where a true appreciation of space is revealed by application.

Third, each JAOC/NAF needs to provide space education during their mission qualification training (MQT) to new personnel and augmentees prior to major exercises and deployments so that they understand how space supports their specific function and how to take advantage of space force enhancement. Most NAFs and JAOCs already have tailored MQT (indoctrination briefings, documentation, and qualification tests)—space needs to be integrated into this process.[37] (See table 4.)

Table 4

Building a Space-Minded JAOC

Training/Exercise	Audience	Purpose
I. USAF Core Space Education		
Commissioning Source	Officer Trainees	Basic Space Forces, Employment
Air and Space Basic Course	O-1	Space Warfighter Products/ Services
Squadron Officer School	O-3	Operational Level Space Focus
USAF Weapons School	O-3	Tactics and Operational Space Employment
ISS/ACSC	O-4	Space Doctrine, Joint Operations
SSS/Air War College	O-5/6	Space Strategy, Policy, Interagency
II. JFACC/JAOC Space Training		
Joint Aerospace C^2 Course	NAF/JAOC (E-7/O-4)	Aerospace Theater C^2
JAOC Jumpstart Course	NAF/JAOC	ATO, MAAP/GAT, JTCB, Weapons
Joint Aerospace Ops Sen Course	NAF/JAOC (O-6)	Joint JAOC Ops Training
JFACC Training Course/Plan Tool	JFACCs	Train JFACCs on space planning, execution
JDACC (CADRE)	NAF/JAOC (O-3/6)	Air Campaign Planning
JAOC/NAF MQT	NAF/JAOC (ALL)	Unit MQT/Space Operations
III. Joint/Combined Exercises		
Concept Development Conf	NAF/JAOC/JTF	Advocate/Prioritize Space MSELs
Initial Planning Conf	NAF/JAOC/JTF	Develop Joint Exercise Space Objectives
Mid Planning Conf	NAF/JAOC/JTF	Space Forces,TPFDD/equip/ manning
Final Planning Conf	NAF/JAOC/JTF	Finalize Space Injects, Issues
Lessons Learned	NAF/JAOC/JTF	Document Lessons Learned

Fight Like You Train, Train Like You Fight!

Space must be injected into major DOD joint and combined exercises much more intensively than in today's space deficient exercises. One of the leading inhibitors to

aerospace integration is the exclusion of space participation in service, joint, and combined exercises.[38] When it comes to integrating space into major exercises, the DOD is simply guilty—we do not fight like we train or train like we fight. Actual combat is not the time to develop space procedures, C^2, and force enhancement techniques. The investment of a few key space exercise objectives will return huge joint war-fighting benefits and develop space as a powerful arrow in the JFC's quiver.

Solutions to integrating space into exercises are many, but three stand out. First, the senior leaders responsible for the specific exercise (the host command CINC, JFC, JFACC, and their staffs) must recognize and articulate the need to include space. In this respect, stronger USSPACECOM pressure on the other CINCs is necessary to include space objectives and training in major exercises. Second, it is essential for JAOC/NAF space planners to be proactive, persistent, start planning early, and continue throughout the exercise planning cycle.[39] The early adoption of space exercise objectives and requirements (personnel, equipment, and work space) cannot be overemphasized, with follow through to inclusion on the exercise time phased force deployment data (TPFDD). Realistic space exercise scenarios train both space personnel and the entire JAOC/JFC. Exercises would do well to integrate the AFSPC space aggressor teams (Space Warfare Center/DOTW) that emulate adversary space capabilities, a parallel to the traditional adversary tactics flight in a flying squadron. The final step is to ensure that space exercise experience is documented in joint universal lessons learned (JULL) so that resources (time, personnel, and money) are used wisely and we don't reinvent the wheel with each exercise.[40]

Structured space education and exercise integration provides visibility to JAOC warriors of the necessity to integrate space operations, but it is not recognized as such in joint doctrine. Joint doctrine must be created that recognizes the space medium as equal to land, sea, and air mediums and provides guidance on fundamental space employment.

Space Doctrine

At the very heart of war lies doctrine. It represents the central beliefs for waging war in order to achieve victory . . . it is fundamental to sound judgement.

—Gen Curtis E. LeMay

There is a complete void of joint space doctrine in the US military. There is no joint doctrinal guidance on the employment of space forces in joint capstone, keystone, or tactics, techniques, and procedures doctrine documents. The US Army and USAF each has only one service level space doctrine document—Field Manual (FM) 100-18, *Space Support to Army Operations*, and Air Force Doctrine Document (AFDD) 2-2, *Space Operations;* the US Navy has none.[41] Doctrine forms the backbone of unity of effort in employing military forces—without it, space power will never reach its force multiplying potential in battle space rapid dominance.

Space Doctrine and Policy

Space employment is driven by two closely linked elements: space policy and space doctrine (fig. 5). Stated simply, doctrine is the set of fundamental beliefs and principles that guide the employment of military forces and operations.[42] Doctrine applies theory and past experiences, describing "how" to employ forces effectively; policy takes precedence over doctrine and is "what" needs to be done, concerning it with implementing political decisions, cost, rules, and programs based on the current environment. Ideally, policy and doctrine balance each other and allow military forces to be employed consistently with both doctrine and current policy. Although joint space doctrine is nonexistent, national space policy exists and provides guidance for military, civil, and commercial space sectors and articulates strategic objectives for military space forces.[43] To date, however, space policy has been improperly substituted in the absence of space doctrine, stunting space war-fighting potential and effective aerospace employment in joint operations.[44] The result is an unstable, politically driven military space capability, rather than a solid doctrine driven space force. Military space employ-

ment effectiveness will remain weak, fragmented, and disorganized until proper joint space doctrine is approved and implemented.

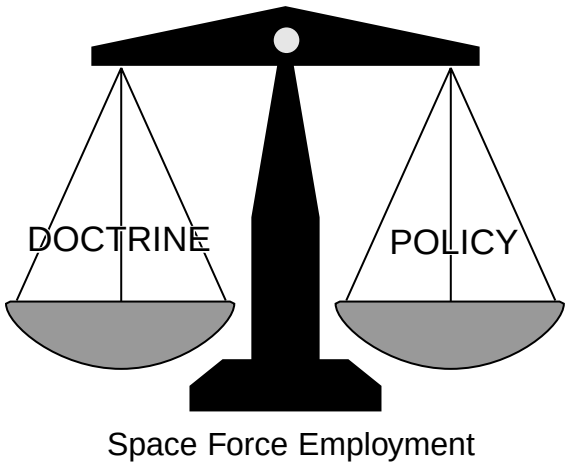


Figure 5. The Balance of Space Doctrine and Policy

Starting at the Top: Joint Space Doctrine

The closest joint doctrine for space today is the draft JP 3-14 in various draft forms since 1992 and never released for coordination.[45] Part of the reason for the long delay in getting this joint doctrine approved has been due to the rapid changing of the guard at USSPACECOM—every two years a new CINC arrives, usually with a different vision for space power. The draft JP 3-14 is revised to reflect each CINC's new vision—creating delays, and starting the joint coordination process all over. There are other avenues to reflect the CINCs vision, however. Joint doctrine is not necessarily the place to express vision; it is the place for guidance on how to employ space forces to support military operations. Instead, USSPACECOM (the OPR for JP 3-14 via the Joint Warfighting Center, Atlantic Command) needs to focus on *Joint Vision 2010* for doctrinal foundation, which will outlast the two-year CINCSPACE rotation cycle and allow JP 3-14 to be developed regardless of rotating CINCs. Joint space doctrine should focus on the operational

level to include C^2, space support to joint war-fighting operations (space missions: space control, force enhancement, force application, space support), space training and exercise coordination, and campaign planning. JP 3-14 needs to make it clear who is responsible for space forces in-theater—for example, JFC, JFACC, CINCSPACE, or a separate joint force space component commander (JFSCC)—to reduce confusion and provide unity of effort in-theater. From this starting point, additional detailed joint space doctrine needs to flow in the form of JP 3-14.1, 3-14.2, 3-14.3, 3-14.4, etc. (space control, force enhancement, force application, space support, etc.).

Service Component Doctrine

While joint space doctrine is in perpetual draft, service component space doctrine isn't much further ahead. USAF space doctrine (AFDD 2-2, March 1998) outlines the fundamental principles and basic doctrine for space operations—train, equip, organize, and operate space forces—but does not address space tenets, C^2 of space forces, and space support to the war fighter. On the USAF side, there are glaring inconsistencies between service doctrine (AFDD 2, *Organization and Employment of Aerospace Power),* the draft JP 3-14, and the JP 3 series (specifically JP 3-56.1, *Command and Control for Joint Air Operations).* These differences revolve around the JFACC as extending to "air and space" or "aerospace" component commander. AFDD 2 treats space as an extension of the air medium and states that the JFACC is responsible for air and space planning, employment, and exploitation through the JASOP in the JAOC.[46] AFDD 2-2 is silent on who is responsible for in-theater space employment. JP 3-14 counters with several "options" to theater space C^2 but avoids recommending one. JP 3-56.1 is overdue to be rewritten and does not connect space at all with JFACC responsibilities. The three documents are not congruent. Additionally, the USAF's AFDD 2-1 series (counter air, counter land, counter sea) omits a counter space doctrine document, neglecting a role that is becoming increasingly important.

Until DOD develops solid, coordinated space doctrine that is consistent with service doctrine, space employment will be

convoluted and fragmented, not achieving unified action with air, land, and sea forces that the JFC is responsible to provide. The solution is to develop and approve a solid JP 3-14, focused on *Joint Vision 2010,* as quickly as possible.

Space Personnel: Warriors In-Theater

Space power will be as decisive in future combat as airpower is today.

—The Honorable E. C. Aldridge Jr.

The Right People, at the Right Place, at the Right Time

Rapid dominance requires the smart, timely application of aerospace power throughout the theater campaign. This application demands trained, competent space personnel actively involved in JFC/JFACC staffs, planning the campaign, and executing space force employment. Fortunately, it is possible via three separate but essential elements of space support to theater operations. First, the USAF Weapons School now graduates tactically and operationally capable space operations officers, intended specifically for JAOC, NAF, and major command (MAJCOM) duty. These officers, referred to as W-13SX officers, are rigorously trained in space war-fighter applications. Second, the SSTs deploy personnel, equipment, and expertise to theater during exercises and real-world operations. Third, continental United States (CONUS) SOCs parallel an air operations center (AOC) by providing detailed space information, tasking, and C^2 of space forces. Together, the permanency of the W-13SX, the flexibility of the SSTs, and the expertise of the SOCs form the triad of space warriors necessary to bridge air and space integration in theater operations, providing the JFC/JFACC tremendous in-theater space expertise and capability (fig. 6).

The Permanent Fix: W-13SX Space Officers

War-fighting units need permanent, well-qualified space personnel on their staff in order to adequately plan and

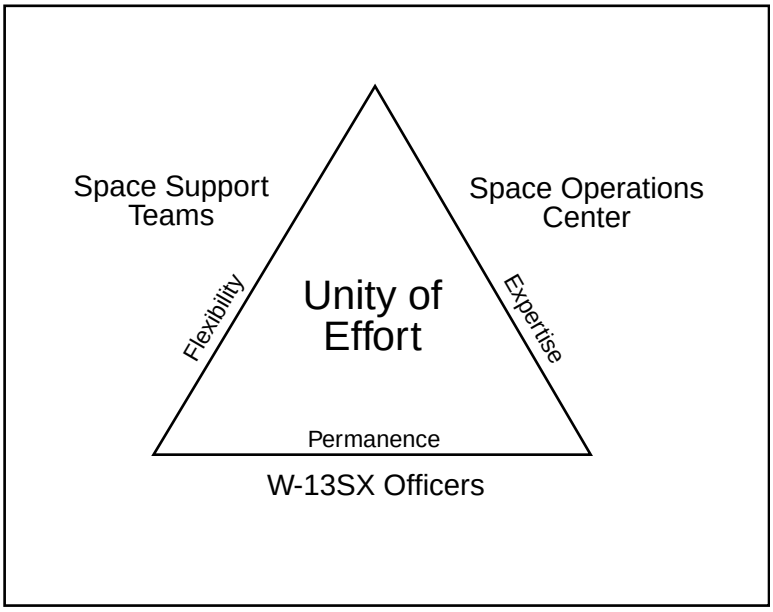


Figure 6. Space Warrior Triad

execute unit war-fighting missions—the W-13SX officer. The USAF Weapons School produces 24 W-13SX space officers per year who become embedded in every USAF NAF, MAJCOM, and many wings and operational support squadron (OSS) units.[47] Their objectives are to (1) educate their unit on space warfare, (2) perform exercise planning, (3) coordinate real-world space support operations, and (4) advocate space power. C^2TIC plans for six space personnel in each NAF to integrate space operations in the Strategy Division, Combat Plans, and Combat Operations. Headquarters AFSPC/DOTW is responsible for tracking and recommending assignments to AFSPC for these critical and limited W-13SX assets.[48]

The advent of the AEF increases the demand for W-13SX officers. To prosecute an aerospace campaign and exploit the aerospace medium, AEFs need space support—both permanent (W-13SX) and temporary surge (SSTs). Just as all NAFs and JAOCs now have permanent embedded space officers, so must each AEF C^2 structure. This need is particularly magnified due to the AEFs inherent need for rapid

en route mission planning, which is made possible by key space systems onboard the airborne EOC. The AEF requires experienced W-13SX officers in key AEF areas. First, the two AEF management staffs (AMS)—the silver and blue AEF planning teams that will assist the AEF lead wings planning and deployment—each need at least two W-13SX officers who will integrate space forces to leverage the AEF's aerospace combat power. Second, the two aerospace expeditionary wings (AEW), responsible for "pop-up" contingencies, need permanent W-13SX officers to integrate space operations into AEWs. Third, space officers are necessary during AEF preparation, exercises, en route AEF operations (mission planning), and deployment to theater. Ideally, W-13SX officers should be permanently embedded in each of the 10 AEF combat lead wings and the five AEF mobility lead wings to ensure this integration occurs before deployment. AFSPC/DOTW now needs to shift the highest priority for embedded resident W-13SX officers to the EAF C^2 (AMS, AEWs, AEF lead wings).

Flexible Surge Capability: Space Support Teams

War fighters need the capability to temporarily bolster their space support capability during exercises or real-world operations. This temporary surge is possible through the joint space support teams (JSST) and service focused space support teams: Air Force space support team (AFSST, Fourteenth Air Force); Navy space support team (NSST); Army space support team (ASST); and the National Reconnaissance Office (NRO) Operational Support Office (OSO) National Intelligence Support Teams (NIST). Due to the rapid increase of new space war-fighting applications, SSTs provide the knowledge and depth to augment any service component or theater commander in any theater of operation. SSTs are trained to provide space products and services to deployed military forces worldwide, with SST OPCON given to the theater commander they support (e.g., JFC, JFACC, etc.). In particular, the AFSST must not be phased out (currently planned for 2002), but continue space support in major exercises, MOOTW, and all AEF deployments. Each additional AEF deployment heralds the efforts and abilities of the AFSST in providing near-real-

time en route mission planning and communications capability, including real-world threat data, weather updates, and air tasking order (ATO) changes.[49] It is imperative that the AFSST be provided adequate personnel and equipment to support AEF units as the USAF progresses on its conquest of an EAF. Until each AEF C^2 structure has resident space officers with all the necessary space support equipment, the EAF/AEF concept demands AFSST participation and availability in order to achieve responsive precision aerospace combat power.

Space Force Reach Back: Space Operations Centers

The trend in current warfare is to move more information and fewer people and things. Rapid dominance in MOOTW and SSCs demands light, flexible forces with agile combat support and precision war fighting—exactly what the AEF is designed for. Reach back is critical—the ability to forward deploy with the bare minimum necessary while receiving support from fixed CONUS forces. As a form of reach back for detailed space information and tasking, several unified and service component SOCs provide invaluable information to theater operations. USSPACECOM operates the SOC (SPOC, Peterson AFB, Colorado), providing real-time, detailed joint space force information via voice or secure/insecure web sites. This information is key in preparing space orders of battle, courses of action, and campaign planning (GAT and MAAP cells) for joint operations.[50] Similarly, the NRO's OSO provides valuable, focused theater expertise on national systems collection and dissemination. Likewise each service component has an SOC that supports USAF, Army, and Navy operations. The AFSPACE SOC (Vandenberg AFB, California) provides information on all USAF space systems, as well as the dissemination of the space tasking order (STO), a parallel process to the ATO, which orchestrates and tasks USAF space force employment in synchronization with the theater campaign battle rhythm.[51] The AFSPACE STO is a good start, but it is not joint and therefore does not capture the entire space war-fighting picture. To achieve true jointedness, USSPACECOM should assume STO planning and execution to include all services, plus coordinated space support from the NRO, civil sector

(National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, etc.), and commercial/foreign space systems (INTELSAT, INMARSAT, IRIDIUM, SPOT, etc.). Synchronizing the ATO and STO provide the JFC the ability to plan, control, and rapidly dominate the vertical battle space.

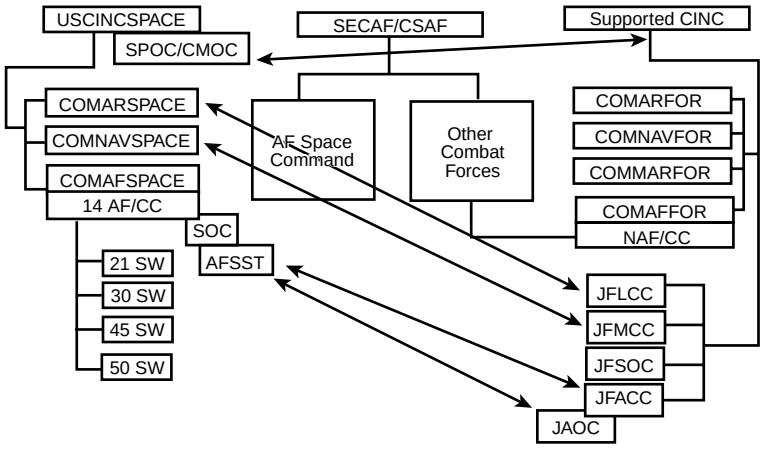
This triad—embedded W-13SX space officers providing permanent space capability; the SSTs flexibility and deployable space support equipment; and the SOCs critical reach back from the CONUS to theater—is the foundation for a space-minded NAF/JAOC/AEF. The AEF concept is not and should not be considered complete without space personnel and space support equipment. The right people at the right time and the right place make all the difference in planning and executing aerospace power, the key to rapid dominance of the battle space.

Aerospace Command and Control

Space is already inextricably linked to military operations on land, sea, and in the air.

—*Joint Strategy Review*
January 1997

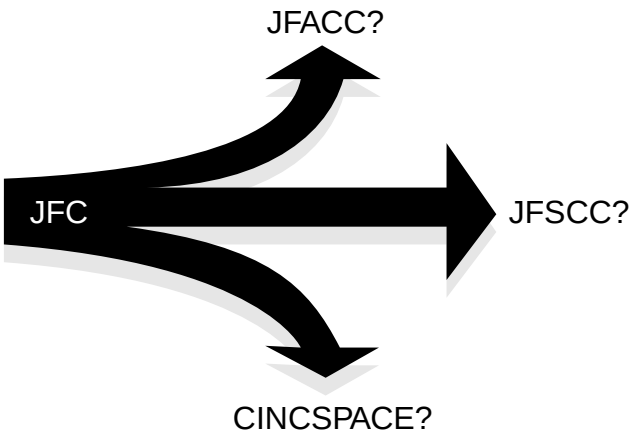
Imagine an air campaign without a JFACC, JAOC, or unified action among the other services' air forces. The result would be chaos, analogous to the fragmented, disjointed, and largely ineffective air operations of the Vietnam War. With the stunning success of Operation Desert Storm's air campaign, primarily through the JFACC C^2 via the JAOC, it is unthinkable today to consider an air campaign without JFACC/JAOC C^2 to plan and execute joint air operations. Space forces C^2 shares many of the same characteristics as joint airpower C^2—most importantly—unity of effort, centralized planning, and decentralized execution. By comparison, however, today's space forces are without clear theater C^2, there is no clearly defined "space component commander" to coordinate space operations, and the SOC—the space equivalent to the JAOC—is still in its embryonic stage (fig. 7). Today, confusion exists among JAOC and JFC staffs regarding who is responsible for space requirements and C^2 in planning and executing a theater campaign.[52]



AF - Air Force
AFSST - Air Force space support team
CC - Commander
CINC - Commander in chief
CMOC - Civil military operations center
COMAFFOR - Commander, Air Force Forces
COMAFSPACE - Commander, Air Force Space Command
COMARFOR - Commander, Army Forces
COMARSPACE - Commander, Army Space Command
COMMARFOR - Commander, Marine Forces
COMNAVFOR - Commander, Naval Forces
COMNAVSPACE - Commander, Navy Space Command
CSAF - Chief of Staff, United States Air Force
JAOC - Joint air operations center
JFACC - Joint force air component commander
JFLCC - Joint force land component commander
JFMCC - Joint force marine component commander
JFSOCC - Joint force special operations component commander
NAF - numbered air forces
SECAF - Secretary of the Air Force
SOC - Special operations command
SPOC - Space operations center
SW - Space Wing
USCINCSPACE - Commander in chief, US Space Command

Figure 7. Space Command and Control—The Big Picture

In order to prosecute legitimate and meaningful force enhancement and space warfare, space forces C^2 must be clarified and agreed to in joint doctrine. Unfortunately, the lack of joint space doctrine clouds the C^2 issue even more due to independent service views. Joint doctrine states that the JFC is ultimately responsible for space warfare. The JFC "synchronizes the actions of air, land, sea, and space forces . . . through joint campaigns." Unified action—"JFCs should ensure that their joint operations are synchronized in time, space, and purpose." And synergy—"JFCs employ air, land,



CINCSPACE - commander in chief space command
JFACC - joint force air component commander
JFC - joint force commander
JFSCC - joint force space component commander

Figure 8. Theater Space Command and Control Options

sea, and space forces."[53] However, just as the JFC delegates and designates joint forces land, maritime, and air component commanders (JFLCC, JFMCC, and JFACC), the JFC needs to designate and delegate the responsibility for space forces C^2.[54] This commander should normally have the preponderance of theater space assets with the ability for space forces C^2. It must be a truly joint space structure to integrate all service space capabilities and requirements, as well as plan, coordinate, and synchronize all available space forces—military, commercial, civil, and national (NRO) systems—to provide unified action and full spectrum dominance within the campaign plan. Figure 8 depicts three options for the C^2 of space forces in a theater campaign: JFACC, JFSCC, or CINCSPACE.[55]

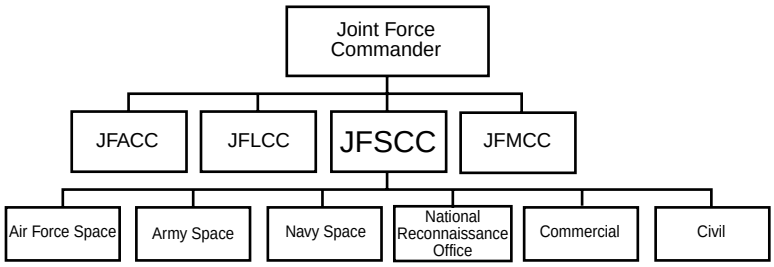
The Leading Contender: JFACC

The leading contender (and the logical choice today) is that the JFACC is responsible for exploiting joint air and space operations, including planning, coordination, allocation, tasking, execution, and assessments to accomplish campaign objectives. USAF doctrine, Air Force Instructions (AFI), and draft JP 3-14 already state the

JFACC is responsible for theater aerospace operations conducted through the JAOC.[56] Several strong arguments exist for the JFACC to lead theater space forces C^2. First, the JFACC now has W-13SX space personnel, a space cell (now called a "space specialty team"), and SSTs embedded in the JAOC to integrate aerospace operations. Second, the JFACC space cell currently coordinates space support with the JFC JSST, the AFSPACE SOC, and the USSPACECOM SPOC, enabling joint space forces to support the campaign directly. Additionally, in many minds, space power is the natural extension of air power and at least for the present most appropriately belongs to the JFACC. A limitation of this approach is that the JFACC is already triple hatted and busy with daily JFACC, area air defense commander (AADC), and airspace control authority (ACA) responsibilities. If necessary, this could be countered by creating a deputy JFACC specifically for theater space forces. With the JFACC option, terminology needs to indicate the JFACC/JAOC conducts theater space C^2 and campaign operations, so the term *JFACC* should be renamed to joint forces aerospace component commander and the term *JAOC* to joint aerospace operations center.

The Future: Joint Force Space Component Commander

The second option is to create and designate a JFSCC to orchestrate all allied space forces in unified action against the enemy.[57] This approach establishes a separate joint component commander, directly responsible to the JFC to plan, synchronize, and execute space operations in support of the theater campaign (fig. 9). The JFSCC would integrate a myriad of space capabilities including military space components, NRO, civil, and commercial/foreign space systems and focuses them on the theater campaign.[58] The JFSCC may be the wave of the future in twenty-first century warfare, but it has drawbacks and may be premature for current use. First, it necessitates a complete J-staff and a complex military-civilian organization in an already personnel-limited environment, which is difficult to staff. Second, in the absence of space force



JFACC - joint force air component commander
JFLCC - joint force land component commander
JFMCC - joint force maritime component commander
JFSCC - joint force space component commander

Figure 9. Theater Joint Force Space Component Commander

application weapons, the JFSCC concept lacks true combat power and may not be able to provide much more than today's current JFACC space C^2 approach.

CINCSPACE: Centralized Command, Decentralized Execution

The third option is based upon the JSCP and Unified Command Plan (UCP), which directs CINCSPACE to conduct space operations.[59] As a unified commander, CINCSPACE always maintains combatant command (COCOM) of space systems, so there would be little C^2 process change at the strategic level. However, this approach presents a problem at the theater and operational level—CINCSPACE resides at Peterson AFB, distant to the theater, and even with near-real-time state-of-the-art communications, is not able to rapidly and fully appreciate the theater campaign battle rhythm. Typically, the more distant C^2 is from the theater, the less effective and responsive C^2 is due to lack of situational awareness, battle rhythm, and delayed intelligence. While CINCSPACE will always maintain centralized space systems C^2 (COCOM), space forces OPCON should be delegated to the theater (either JFC, JFACC, or JFSCC) for decentralized planning and execution in support of specific theater campaign objectives.

Today, the JFACC represents the best theater space C^2 option today, which will no doubt evolve into a JFSCC

structure as space force application emerges and provides the JFC with true space warfare capability and theater space C^2 equipment that will shape the battle space.

Space Forces C^2 Equipment

Theater forces must acquire the equipment and develop the operational expertise necessary to receive, process, act on, and disseminate space data.

—Gen Charles "Chuck" Horner

Regardless of who is responsible for theater space C^2, the effectiveness of theater space C^2 depends directly on space-based information systems embedded in a well-orchestrated C^2 architecture. The JFC and JFACC need space systems that provide high quality, near-real-time situational awareness, space order of battle information, GPS navigation accuracy predictions, strategic and tactical weather information, ISR information, and secure, reliable communications. Today, many of these are stand-alone systems requiring dedicated equipment and complex, often unsupported hardware and software (table 5). Space support C^2 equipment is not standardized among war-fighting units and is often hastily assembled on an availability basis by the in-theater space operations officer. This is dangerous because it fosters stand alone, stove-piped space tools in the JAOC and EOC, which contradict joint war-fighting integration.[60]

The DOD space community needs to develop and field standardized space support hardware and software, a "tool kit" to bring to the theater, consisting of both fixed systems (for JAOC use) and deployable space support equipment (for AEF employment). Table 5 identifies current and near future space-based information systems that more effectively provide the right information to the war fighter at the right time—namely, the theater battle management core system (TBMCS) and a deployable suite of space-based systems for en route AEF operations.[61] Space support C^2 equipment completes the fifth and last part of the space-minded puzzle.

Table 5

Space Tool Kit: Today versus Tomorrow

Capability	Today's Systems	Future Systems
Fixed		
Situational Awareness	TSOC, SMAT, TSTT, MSTS SSTS, Talon Vision, ADSI, SCENE	SBMCS/TBMCS V2.0+
SATRAN	SMAT, TSOC, SIPRNET	SBMCS/TBMCS V2.0+
GPS Accuracy	OMEGA, SNAPM, GPS, SEM	SBMCS/TBMCS V2.0+
Space Tasking Order	SIPRNET, GCCS, Intelink	SBMCS/TBMCS V2.0+
TMD Support	ADSI, GALE, WOTS	SBMCS/TBMCS V2.0+
Space Databases	SIPRNET, GCCS, Intelink	SBMCS/TBMCS V2.0+
Space Based Weather	Weatherfront—TSOC	SBMCS/TBMCS V2.0+
ATO/SPINs Access	CTAPS	SBMCS/TBMCS V2.0+
Deployable (en route)		
Situational Awareness	MSTS (via TRAP/TIBS)	TBD
Secure en route C^2	COMBAT TRACK	COMBAT TRACK II
ISR, Threat Data, Secure	JDISS/INMARSAT	TBD

The Future Is Now: The Expeditionary Aerospace Force

The major objective of AEF deployments—rapid, accurate combat power—is simply not possible without space contributions in communications, navigation, weather, and ISR.

—Maj Gen Lance L. Smith

Rapid Dominance is the essence of the USAF's emerging EAF! Lean and lethal, the USAF will respond to future conflicts with rapid CONUS-based deployments of specially tailored AEFs.[62] Space forces clearly play a key role in AEF preparation, en route mission planning, and theater aerospace combat employment. The success of the AEF concept is linked directly to space-minded AEF war fighters, which is based upon solid space education, doctrine, personnel, C^2, and fielded space support equipment.

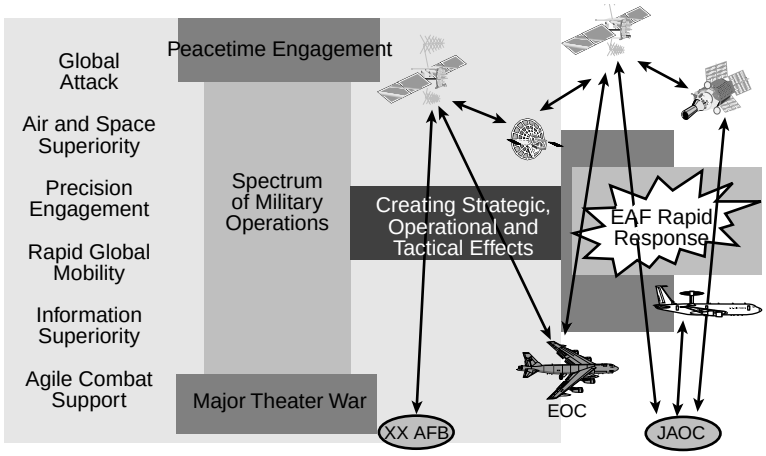
EAF: Lean, Light, Lethal Aerospace Combat Power

The EAF provides theater CINCs with tailored, rapid, responsive aerospace power across the spectrum of opera-

tions (humanitarian relief to combat operations). AEFs leverage the inherent strengths of air and space power—speed, range, and flexibility—giving the JFC a variety of aerospace power capabilities, including bombs on target any where in the world within 48 hours of deployment order. While ballistic missiles and long-range bombers have long been capable of limited alert combat operations, the AEF will provide a rapidly deployed, sustained, composite aerospace force. The USAF Scientific Advisory Board, a strong proponent of the EAF, stated that "the AEF can respond in less than half the time, with half the airlift and one-third the people forward, to unprepared locations throughout the world. The AEF can operate eight times more effectively, is consistent with other CINC requirements, is of relatively small cost, and is achievable in the near future (by 1 Jan 2000)."[63]

En route Mission Planning: The Hub of AEF Deployment

Two key concepts of the EAF are the ability to rapidly deploy forces and moving information rather than people and things. Space forces are uniquely positioned because forward deployment and information flow are inherent in space power. On-orbit space assets and many theater space support systems are already globally deployed to provide huge amounts of information, key to the AEF's en route mission planning. En route planning is critical to rapid AEF deployments because it allows aircrews to plan during deployment, saving precious pre-deployment time and enabling combat operations to commence immediately upon arrival in theater. Space forces are key in the AEF's ability to conduct en route mission planning via the AEF expeditionary operations center (fig. 10) planned for specially equipped C-141/135 aircraft.[64] SATCOM, the lifeline of EAF operations, links the planning and control functions of the airborne en route EOC with NAF headquarters, JFACC/JAOC forward/rear (C^2) elements, and deployed aerospace forces. Overhead space systems provide the airborne EOC with near-real-time ISR (threat order of battle, targeting information, warnings, and indications), and allow en route mission planning (build mission packages),



EAF - expeditionary aerospace force
EOC - expeditionary operations center
JAOC - joint air operations center

Figure 10. EAF Global Engagement Via the EOC and Space Forces

retargeting, ATO changes, imagery transfer, and secure E-mail communication. Recent AEF deployments prove the war-fighting value of onboard deployable space systems in receiving near-real-time information for mission planning.[65] Already en route, AEF planning staffs depend on space-based communications systems to receive huge amounts of mission data, as demonstrated during several recent AEF trial deployments to the Middle East.[66] These systems have reversed the norm in which JFACCs have had only "dead time" during deployments but are now able to do substantive planning and decision making due to near-real-time data.[67]

Effectively Integrating Space Power in the AEF

In today's environment, you can't waste 15 hours in the air—you must use that time to prepare (mission planning) for combat operations so that when the AEF arrives in theater it can immediately begin an air campaign. Space systems are key to enroute planning and define the essence of rapid AEF deployments.

—Maj Gen Lance L. Smith

To accomplish these time-critical tasks, the USAF must be able to draw upon the indispensable capabilities of space forces that focus on the five interrelated elements discussed in this research paper. Several trial AEF deployments to the Middle East proved the value of (and necessary improvements in) these space elements—training, personnel, doctrine, equipment, and theater space forces C^2.

First, the AEF needs space education and training among AEF personnel. AEF leaders, planners, and operators who understand the legitimacy and importance of space as a center of gravity and as a war-fighting medium achieve far greater results due to the synergistic relationship of air and space forces. Now is the time for the USAF to establishing a structured AEF space education and training program where space is more than just an afterthought. Because AEF personnel are from all ranks and career fields, space education must be embedded beginning at the commissioning sources, continuing through all levels of PME, and integrated into JFACC, JAOC, and AEF courses. Second, development of the USAF's service doctrine forms the foundation from which the AEF construct is framed, organized, and employed. USAF service doctrine and joint doctrine must be congruent regarding aerospace employment. Therefore, DOD must develop and approve solid joint doctrine, specifically JP 3-14, which is based on *Joint Vision 2010* (not the revolving two-year USCINCSPACE's vision) and forms the framework for space force employment.

Third, the EAF demands and the USAF must provide integration of qualified space personnel to leverage aerospace combat power. Permanent space personnel (W-13SX) need to be embedded in the AEF Management System teams, AEWs, 10 AEF lead combat wings, and five mobility AEF lead wings to begin the process of integrating AEF aerospace forces. The AEF concept demands the AFSST's flexible surge capability and deployable space support equipment for en route mission planning, at least until each en route EOC acquires deployable space support equipment and knowledgeable personnel to operate it. Once deployed, AEFs already draw on the expertise of the Fourteenth Air Force Space Operations Center (SOC); this

reach back will grow increasingly important as new space threats and capabilities emerge. Fourth, the USAF/DOD needs to identify, fund, and field standardized space support equipment so that AEFs, NAFs, and JAOCs have the ability to receive and process space-based information. Without deployable/en route and fixed (TBMCS-based) space support equipment, theater space force C^2 will suffer. Fifth, DOD needs to clearly define space C^2, and identify who in-theater is responsible for planning and executing space force employment. The JFACC is the logical choice for current and near-future theater space C^2 due to the close relationship of aerospace roles and functions, as well as C^2 capability. A space-smart JFACC more effectively employs AEF forces to achieve aerospace theater campaign objectives and operations. As enemy space threats increase and friendly space warfare capabilities emerge, theater space C^2 will migrate to a JFSCC responsibility.

Conclusion: Rapid Dominance Depends upon Aerospace Power

No one can predict with certainty what the ultimate meaning will be in the mastery of space.

—President John F. Kennedy

The strategic environment at the dawn of the twenty-first century demands an EAF ability to rapidly dominate the battle space anywhere in the world within hours of notification. This rapid dominance is based upon global space forces providing time-critical precise information to prosecute a theater campaign. Space forces provide critical support throughout the entire spectrum of conflict, fostering an expeditionary aerospace force capable of short-notice, rapid worldwide AEF deployments to engage in MOOTW and SSC operations. But the aerospace community is not there yet. Today's JAOCs, NAFs, and AEFs require space-minded warriors who appreciate the legitimacy and importance of space as a center of gravity and as a war-fighting medium. The USAF and DOD must concentrate on making straightforward changes in the five key areas of education/training, doctrine, personnel, support

equipment, and theater space C^2, which can reverse current deficiencies in this area.

Notes

1. Gen Merrill McPeak, Air Force chief of staff, address to the National War College on DESERT SHIELD/DESERT STORM, 6 March 1991. Quoted in "The Synergy of Air and Space," *Airpower Journal,* Summer 1998, 7.

2. *Air Force Magazine,* May 1998, 36, 43–44. Defense drawdown facts during FY 1987–1999: Air Force personnel strength dropped 39 percent from 1987 to 1998.

3. Joint Publication (JP) 3-07, *Joint Doctrine for Military Operations Other Than War,* 16 June 1995. General reference document.

4. Chairman of the Joint Chiefs of Staff, *National Military Strategy of the United States,* 1997, 1.

5. Ibid., 13.

6. Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century,* chap. 12—Space Wars, 69. Quote from Col Alan D. Campen, USAF, Retired, former US C^2 DOD policy director.

7. For example, Bosnia (Deliberate Force, 1995), antiterrorism retaliation in Afghanistan (August 1998), and United Nations (UN) resolution enforcement in Iraq (Desert Strike, Fall 1996, and Desert Fox, December 1998).

8. Gen Michael E. Ryan, August 1995, Operation Deliberate Force, *Final Report of the Air University Balkans Air Campaign Study*. General Ryan's statement, "every bomb is a political bomb," was in reference to the politically charged environment and civilian populace during Operation Deliberate Force in Bosnia, 1995. Quoted in Air Command and Staff College (ACSC) Conflict Resolution Coursebook, Col Robert C. Owen, January 1999, 199.

9. USSPACECOM is now responsible for planning, coordinating, and executing the DOD's computer network defense (1999) and computer network offense (2000).

10. Author's personal experience, Thirteenth Air Force joint air operations center (JAOC), 1996–1998, space warfare officer, numerous joint and combined exercises: Cobra Gold 1997, 1998; Tandem Thrust 1997; Ulchi Focus Lens 1997; Cope Thunder 97-4.

11. ACSC Research Survey 99-06.

12. Air Force Tactics, Techniques, and Procedures (AFTTP) 3-1, *Tactical Employment of Space,* OPR: Headquarters AFSPC/DOTW, SWC/DOTW, February 1998; *Aircrew Combat Information Guide (ACIG),* Space Warfare Center (SWC/DO), 1996 USAF Weapons School, 57th Wing, Air Combat Command (USAF-WS/WSS) Nellis Air Force Base (AFB), Nevada. Numerous weapons school research papers on space warfare, tactics applications, space doctrine/theory. Web site: www.mil.nellis.af.mil/usafws/Spacediv.htm.

13. Gen Charles Horner, 1997 *Air Force Issues Book,* 24, 1997.

14. Headquarters USAF/XPX-AITF, *Beyond the Horizon —Integrating Air and Space,* December 1998, 4-3. As an example of the United States's growing dependence on space commerce, reference the disruption of a single communications satellite, Galaxy IV, in May 1998. In North America, 40 million pagers malfunctioned, self-service fuel pumps stopped processing credit cards, hundreds of radio and television stations lost their programming, airline flights were delayed due to lack of weather information, and doctors on-call were delayed in emergency notifications. Imagine the chaos if multiple communications satellites were temporarily or permanently disabled!

15. *Beyond the Horizon,* 6-2.

16. Robert S. Dudney, "The New Space Plan," *Air Force Magazine,* July 1998, 22.

17. Frank G. Klotz, *Space, Commerce, and National Security* (New York: Council on Foreign Relations Press, 1998), 6.

18. *A National Security Strategy For a New Century,* October 1998, 25–26.

19. *Joint Vision 2010,* 26.

20. *Global Engagement: A Vision for the 21st Century Air Force, 7.*

21. *Joint Vision 2010,* 14.

22. John T. Correll, "Warfare in the Information Age," *Air Force Magazine,* December 1996, 3.

23. Maj Steve Lucky, 353d Combat Training Squadron, interviewed by author during Exercise Cope Thunder 97-4, July 1997, Eielson AFB, Alaska. RTIC demonstrated and fielded in the following aircraft: F-16CJ Block 50 Wild Weasel Vipers, EA-6B, AWACS, ABCCC, RC-135, U-2, F-15E, F-22 Joint Strike Fighter, Air Materiel Command airlifters (C-130, C-141, C-5, C-17), unmanned aerial vehicles (Predator, Global Hawk, Dark-Star), B-52, B-1B, and B-2.

24. Issued biennially from chairman of the Joint Chiefs of Staff (CJCS).

25. Air Force Doctrine Document (AFDD) 2, *Organization and Employment of Aerospace Power,* 28 September 1998, 47.

26. There is a movement among the Air Force Doctrine Center (Maxwell AFB, Ala.) and Command and Control Training and Innovation Center (C^2TIC) at Hurlburt Field, Fla., to rename the JFACC to joint force aerospace component commander, the JAOC to joint aerospace operations center, and the JASOP to joint aerospace operations plan. These changes will be reflected in future USAF doctrine and classes at C^2TIC.

27. BETAC, *International Space Operations,* ACSC briefing, November 1998.

28. Klotz, 11. Also located at the web site for the International Satellite Organization (INTELSAT), http://www.intelsat.int/cmc/info. As an example of worldwide SATCOM use, the INTELSAT consortium has grown from 10 original members in 1965 to over 140 in 1998.

29. Klotz, 42; Robert Wall, "Intelligence Lacking on Satellite Threats," *Aviation Week & Space Technology,* 1 March 1999, 54. Reference the 1997 incident where Indonesia deliberately interfered (jammed) Apstar1A, a national communications Tongasat satellite launched for Tonga by China into geosynchronous orbit over Indonesia. The International Telecommu-

nications Union had assigned the slot to Tonga. Indonesia demanded one of their own satellites occupy the slot. The issue is not yet settled. The demand for geosynchronous slots and frequency allocations will intensify and has already seen additional disputes in Asia, the Philippines, and INTELSAT. Gen Richard B. Myers, USCINCSPACE, recently indicated that Iran and Turkey have attempted to degrade satellite operations using primitive radio-frequency transmitter jamming.

30. David Foxwell and Mark Hewish, "GPS: Is It Lulling the Military Into A False Sense of Security?" *Jane's International Defense Review*,1 September 1998, vol. 31, Issue 009, 32–40; and *Aviation Weekly & Space Technology*, 23 November 1998, 57. There is speculation that GPS signals have been distorted and interfered with in areas saturated with electromagnetic signals, such as parts of Europe. Numerous articles are available to the general public (magazines, Internet) on how to build crude GPS jammers using common electronic components at local radio and appliance stores.

31. Headquarters AFSPC/DRN, 12 February 1999.

32. Klotz, 18–19. International treaty and law do not prohibit weaponizing space but there are some limitations. The 1963 UN Limited Test Ban Treaty bans nuclear weapon tests in outer space. The 1967 UN Outer Space Treaty (OST) provides the framework for international space law by stating "the use of space is for peaceful purposes . . . in the common interest of all mankind." It declares that outer space and all celestial bodies are free for exploration by all states and are to remain free of military bases. No nation can claim sovereignty or impose restrictions on space above any other nation. The OST bans earth-orbiting WMD weapons and states must provide public and UN notification of space launches. The 1972 US–USSR Anti-Ballistic Missile (ABM) Treaty prohibits the development, testing, or deployment of space-based ABM systems. International space law does not prohibit conventional force application weapons in space, antisatellite weapons, and protection of space assets.

33. The United States successfully demonstrated a direct ascent F-15 ASAT launch in 1985, but it has never been operationally fielded due to military policy and US political agreements.

34. The author conducted a survey of typical JAOC augmentees. The database was the ACSC academic year 1999 exercise Prairie Warrior.

35. *Joint Doctrine Capstone and Keystone Primer*, 87.

36. C^2TIC is located at Hurlburt Field, Fla., and is a field unit of the Aerospace C^2ISR Center (AC^2ISRC).

37. JAOC/NAF space education ideally should consist of introductory space briefings during MQT, hard copy material describing military space war-fighting applications, regular space updates, and detailed information on how space supports NAF/JAOC planning and execution in exercises and real-world operations.

38. Author's personal experience at Thirteenth Air Force in Exercises Cobra Gold 1997 and 1998 and Tandem Thrust 1997.

39. Author's personal experience at Thirteenth Air Force, Andersen AFB, Guam, during joint and combined exercises Cobra Gold 1997 and 1998, Tandem Thrust 1997, Tempest Express 1997, Ulchi Focus Lens 97,

and Northern Edge 1997. Space participation in joint and combined exercises must begin with the Concept Development Conference (CDC), sometimes as far as a year in advance of the actual exercise. The CDC is crucial because it is where space and missile play are be advocated for inclusion in the exercise. Once the CDC approves space/missile objectives, then Joint Mission Essential Task List (JMETL) and the master scenario events list (MSEL) are prepared. The space warfare officer, space support teams, USSPACECOM, and space service components (AFSPACE, NAVSPACE, ARSPACE) coordinate the JMETLs and prepare the MSEL script of exercise events which will be injected by the controllers during the exercise. Space representation by unit space officers, space support teams, and the theater's USCINCSPACE limited nuclear options need to continue throughout the remaining exercise planning conferences (initial, mid, and final).

40. Air Combat Command (ACC) Center for Lessons Learned—"Don't Reinvent the Wheel." Web site for all service Joint Universal Lessons Learned (JULL). Collected information regarding space support strengths and weaknesses in major US joint and combined exercises including Blue Flag, Cobra Gold (Thailand), Tandem Thrust (PACOM), and Ulchi Focus Lens (Korea). Web site location is http://www.mil.acc.af.mil/accll/. Headquarters AFSPC/DOTW is implementing a database method for rapid access to space-related JULLs.

41. The US Army's FM 100-18, *Space Support to Army Operations*, 20 July 1995, provides a solid discussion of Army space doctrine and policy, application of space systems, organization, operations, and training. Notable is a much more detailed description of space force enhancement with specific Army weapon systems compared to AFDD 2-2, *Space Operations*. The US Army also produced the Training and Doctrine Command Pamphlet 525-60: *Military Operations—Concept For Space Support To Land Force Operations*, 1 November 1994, which provides the basis for Army doctrine, training, organizations, and materiel changes through the use of space operations. Army doctrine (and personnel) reveal a better basic understanding of space forces but are weaker on the big picture of space warfare. The US Navy, although totally reliant on space-based navigation, communications, and ISR, has no service space doctrine at all.

42. *Joint Doctrine Capstone and Keystone Primer*, 2.

43. Robert D. Newberry, *Space Doctrine for the Twenty-first Century* (Maxwell AFB, Ala.: Air University Press, 1998), 7–9. National space policy provided to DOD: (1) execute mission areas (force enhancement, space control, force application, space support); (2) protect critical space-related technologies and missions; (3) act as launch agent for defense and intelligence sectors; (4) integrate and enhance satellite control robustness; (5) establish requirements for military and national-level intelligence information; (6) develop, operate, and maintain space control capabilities; and (7) pursue a ballistic missile defense program.

44. Newberry, ix, 1–6.

45. USSPACECOM/J5, "Joint Doctrine: Tactics, Techniques, and Procedures for Space Operations," draft V 1.3, November 1998.

46. AFDD 2, 47–48, 63–70.

47. Headquarters PACAF/DOQ, 23 February 1999. For example, PACAF has positions for 11 W-13SX officers, two 13SX, and one 1C6 spread throughout key PACAF units such as every NAF, several wings, and numerous operational support squadrons. USAFE and the other USAF major commands are following suit by populating their units with space-smart people.

48. Richard Boltz, Headquarters AFSPC/DOTW, personal interview, 12 February 1999. Based on a three-year assignment, up to 72 W-13SX officer billets are available to JAOCs, NAFs, and MAJCOMs.

49. Air Force Space Support Team, 76th SOPS, Fourteenth Air Force, Schriever AFB, Colo., www.swc.schriever.af.mil/76sops/index.html.

50. Author's personal experience during Exercises Cobra Gold 1997 and 1998 (Thailand), Tandem Thrust 97 (Australia), and Ulchi Focus Lens 97 (Korea). The USSPACECOM SPOC was the critical link in providing the enemy and friendly space order of battle, space systems operational capabilities, and information feeding into courses of action and campaign planning. SPOC unclassified web site: http://www.spacecom.af.mil/usspace/.

51. Headquarters Fourteenth Air Force /DOX, "Command and Control of AFSPACE Forces, A White Paper to Articulate COMAFSPACE's Vision," draft version 2.0, September 1998, 6, 27–30.

52. ACSC Research Survey 99-06, Prairie Warrior Space Survey, November 1998, ACSC, Maxwell AFB, Ala. The survey indicated that 47 percent believed the JFC was responsible for space in theater campaigns; USCINCSPACE, 6 percent; the JFACC, 6 percent, and 41 percent did not know.

53. JP 3-0, *Doctrine for Joint Operations,* 1 February 1995, ix, II-3, III-9–10; and *Joint Doctrine Capstone and Keystone Primer,* 15 July 1997, 32.

54. JP 3-56.1, *Command and Control for Joint Air Operations,* 14 November 1994, xiii, I-1 to I-3.

55. Dewey Miller, *JFACC in Space,* Air War College (AWC) research, October 1998. Miller addresses options for theater space forces C^2, including the JFACC and creation of a JFSCC.

56. AFDD 2, 47, 63–69; Air Force Instruction (AFI) 13-1, vol. 3, *Operational Procedures—Air Operations Center,* April 1998; AFI 13-1 SOC, vol. 3, "Operational Procedures—Space Operations Center," draft, October 1998.

57. USSPACECOM/J5, *Long Range Plan: Implementing USSPACECOM Vision for 2020,* March 1998, 94. The JFSCC is cited as an option in USSPACECOM's *Long Range Plan.*

58. The coordination of space forces is daunting, consisting of multiple (and growing) space organizations, including military (USAF, Army, Navy, NRO, DISA, DARPA), civil (NASA, NOAA, DOT/DOS, etc.), commercial (INTELSAT, INMARSAT, Iridium, etc.), and even friendly foreign systems (SPOT, RADARSAT, JERS, GOMS, GMS, etc.). This alone may conceivably justify a single JFSCC to coordinate effective space support to the theater campaign.

59. USSPACECOM/J5, JP 3-14, "Joint Doctrine: Tactics, Techniques, and Procedures (TTP) for Space Operations," November 1998, draft V1.3, I-4.

60. This makes space support unique and nonstandard in each theater, while requiring significantly more equipment with associated cables, power systems, manuals, and supplies to operate the various systems. Nonstandard equipment also creates interoperability problems, sometimes produces questionable information and data, and increases airlift requirements for an already constrained and saturated airlift system.

61. TBMCS Version 1.1 is to be fielded by the USAF in mid-1999. Unfortunately, there is no space support in TBMCS V1.1, but there is significant space integration in TBMCS V2.0, due for release in FY 2000.

62. Gen Michael E. Ryan, USAF chief of staff, "Expeditionary Aerospace Force—A Better Use of Aerospace Power for the 21st Century," address to ACSC on 18 August 1998. EAF driven by NSS, QDR, NMS, DPG, AFDD 2, *Joint Vision 2010*.

63. USAF Scientific Advisory Board, *Study on USAF Expeditionary Forces*, 25 November 1997.

64. 366th Wing, AEF Battlelab, Mountain Home AFB, Idaho. The en route EOC is a modified KC-135, complete with up to four SATCOM antennas, consisting of two UHF SATCOM (Combat Track II, voice/data), one Iridium SATCOM (voice), one INMARSAT (voice), and SIPRNET reach back.

65. Maj Gen Lance L. Smith, commandant, AWC, interviewed by author, 6 January 1999. According to General Smith, commander for AEF-3 (real-world AEF deployment to Qatar, August 1996) and AEF-4 (short-notice AEF deployment to Qatar, February 1997), space forces were absolutely superb in providing time-critical, in-flight information for en route planning and making changes to the air tasking order. General Smith recalls that the space systems on board the C-141 were often the only information systems providing war-fighting information which enabled his staff to make real-time changes to the ATO.

66. During the March–June 1998 AEF deployment to theater (Bahrain), en route AFSST space support equipment provided updates to two ATOs (received and printed in flight), 18 weather images and text reports, 12 point-to-point text reports, 19 imagery/graphics files, and four INTSUMS, DISUMS, and SPINS. During AEF V (November 1997, 366th Wing) the AFSST's MSTS provided the only comprehensive air picture via TADIL-A receive capability. (76th SOPS, Schriever AFB; 366th Wing/XP, "AEF V Lessons Learned," ACC Lessons Learned web site, http://www.mil.acc.af.mil/acccll/).

67. John A. Tirpak, "The Long Reach of On-Call Power," *Air Force Magazine*, December 1998, 22–24. Tirpak describes basic EAF operations and the importance of the EOC as demonstrated during EFX 98 in which the EOC was palletized and rolled on board Speckled Trout, a specially equipped KC-135R. The EOC received and provided intelligence and weather analysis, mission planning, air defense integration, aircraft status monitoring, and command post functions.

Glossary

AADC	area air defense commander
ACA	airspace control authority
ACSC	Air Command and Staff College
AEF	Aerospace Expeditionary Force
AEW	Aerospace Expeditionary Wing
AFB	Air Force Base
AFDD	Air Force Doctrine Document
AFI	Air Force Instruction
AFSPC	Air Force Space Command
AFSST	Air Force space support team
AFTTP	Air Force Tactics, Techniques, and Procedures
AOC	air operations center
ASAT	antisatellite
ASST	Army space support team
ATO	air tasking order
AU	Air University
AWC	Air War College
C^2	command and control
C^2TIC	Command and Control Training and Innovation Center (Hurlburt Field, Florida)
CADRE	College of Aerospace Doctrine, Research and Education
CINC	commander in chief
COG	center of gravity
COCOM	combatant command

CONUS	continental United States
DOD	Department of Defense
EAF	Expeditionary Aerospace Force
EOC	Expeditionary Operations Center
FM	Field Manual
FY	fiscal year
GAT	guidance, apportionment, and targeting
GPS	Global Positioning System
IO	information operations
ISR	intelligence/surveillance/ reconnaissance
IW	information warfare
JAOC	joint air operations center
JASOP	*Joint Air and Space Operations Plan*
JDACC	Joint Doctrine Air Campaign Course
JFACC	joint force air component commander
JFC	joint force commander
JFLCC	joint force land component commander
JFMCC	joint force maritime component commander
JFSCC	joint force space component commander
JP	Joint Publication
JSCP	Joint Strategic Capabilities Plan
JSST	joint space support team

JTF	joint task force
JULL	joint universal lessons learned
LOCs	lines of communication
MAAP	master air attack plan
MAJCOM	major command
MOOTW	military operations other than war
MQT	mission qualification training
MSTS	multi-source tactical system
NAF	numbered air force
NAVWAR	navigation warfare
NIST	National Intelligence Support Team
NRO	National Reconnaissance Office
NSS	national security strategy
NSST	Navy space support team
OPLAN	operations plan
OPR	office of primary responsibility
OSO	Operational Support Office
OSS	operational support squadron
PGM	precision-guided munitions
PME	professional military education
PW	Prairie Warrior
RTIC	real-time-in-the-cockpit information
RTOC	real-time-out-of-the-cockpit information
SATCOM	satellite communications
SOC	space operations center

SPS	standard precision service
SOO	space operations officer
SSC	small-scale contingencies
SST	space support team
STO	space tasking order
TBMCS	theater battle management core system
TPFDD	time phased force deployment data
UCP	Unified Command Plan
US	United States
USAF	United States Air Force
USCINCSPACE	commander in chief, United States Space Command
USSPACECOM	United States Space Command